IDS

Appendix N

2016 NZ Transport Agency Strategic Maintenance Investment Model

Graphical Outputs

July 2016

Graphical Output Chart Summary

This document is split into three (3) sections. Each sections contains three (3) subsections as detailed below.

Section 1: Recommended Options
This section looks at generated model outputs comparing the 6 investment options that are put forward in our final recommendation. Details of the options are provided on the section title pages.

Section 2: Unlimited Routine Maintenance Options
This section looks at generated model outputs comparing 7 varying levels of Renewal Investment with an unlimited Routine Investment. Details of the options are provided on the section title pages.

Section 3: Recommended Options
Identical to section 2, however the Routine Maintenance in this series of outputs has been fixed at $30M pa.

Subsection 1: Length of Treatment Forecast for each investment option

Subsection 2: Cost of Treatment Forecast for each investment option

Subsection 3: Key Condition Variable Forecast for each investment option

1.1 Length Charts – Recommended Options

This set of outputs includes Stacked Bar Charts showing predicted Treatment Length (Lane km) for each Treatment Type.

- Asphalt Surfacing - AC (light green)
- Chipseal Surfacing - CS (mid green)
- 2nd Coat (dark green)
- Pavement Rehabilitation - RHAB (yellow)
- Heavy Maintenance (orange)
- Safety (where applicable – red)

The first Chart/Table compares the six (6) 'Recommended Options' as a 20 Year National Average Annual Lane km Length

- **$100M_$130M_V3**
  - Renewal Investment: Fixed **$100M pa** through 2025, increasing to **$130M pa**
  - Routine Investment: Fixed **$30M pa,** Safety Investment: Safety not Included
- **$100M_$150M_V3**
  - Renewal Investment: Fixed **$100M** pa through 2025, increasing to **$150M pa**
  - Routine Investment: Fixed **$30M pa,** Safety Investment: Safety not Included
- **$100M_UNL_B**
  - Renewal Investment: Fixed **$100M pa**
  - Routine Investment: Fixed **$30M pa,** Safety Investment: **Unlimited**, Safety programme completed
- **$100M_V1**
  - Renewal Investment: Fixed **$100M pa**
  - Routine Investment: **Unlimited,** Safety Investment: Safety not Included
- **$100M_V2**
  - Renewal Investment: Fixed **$100M pa**
  - Routine Investment: Fixed **$30M pa,** Safety Investment: Safety not Included
- **FWP – Contractors 10 year Specimen Programmes adjusted by RAPT reviews**
  - Renewal Investment: **Unlimited**
  - Routine Investment: **Unlimited pa,** Safety Investment: Safety not Included

The second series compares the six (6) ONRC Classes as time series over 20 years for each 'Recommended Option'.

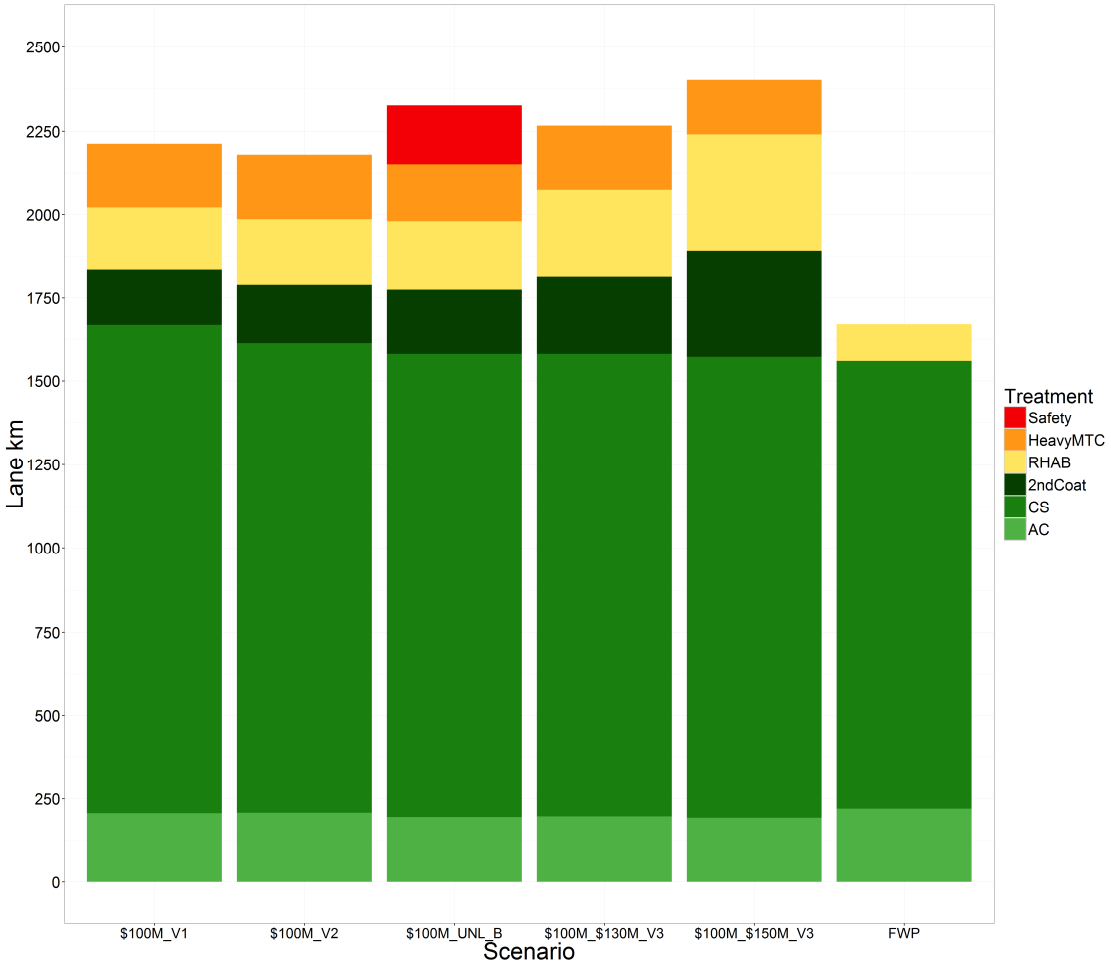
- Secondary Collector, Primary Collector
- Arterial, Regional
- National, National High Volume

The third series compares the 'Recommended Options' by ONRC Class as time series over 20 years

The fourth series compares the twenty three (23) Regions as time series over 20 years for each 'Recommended Option'.

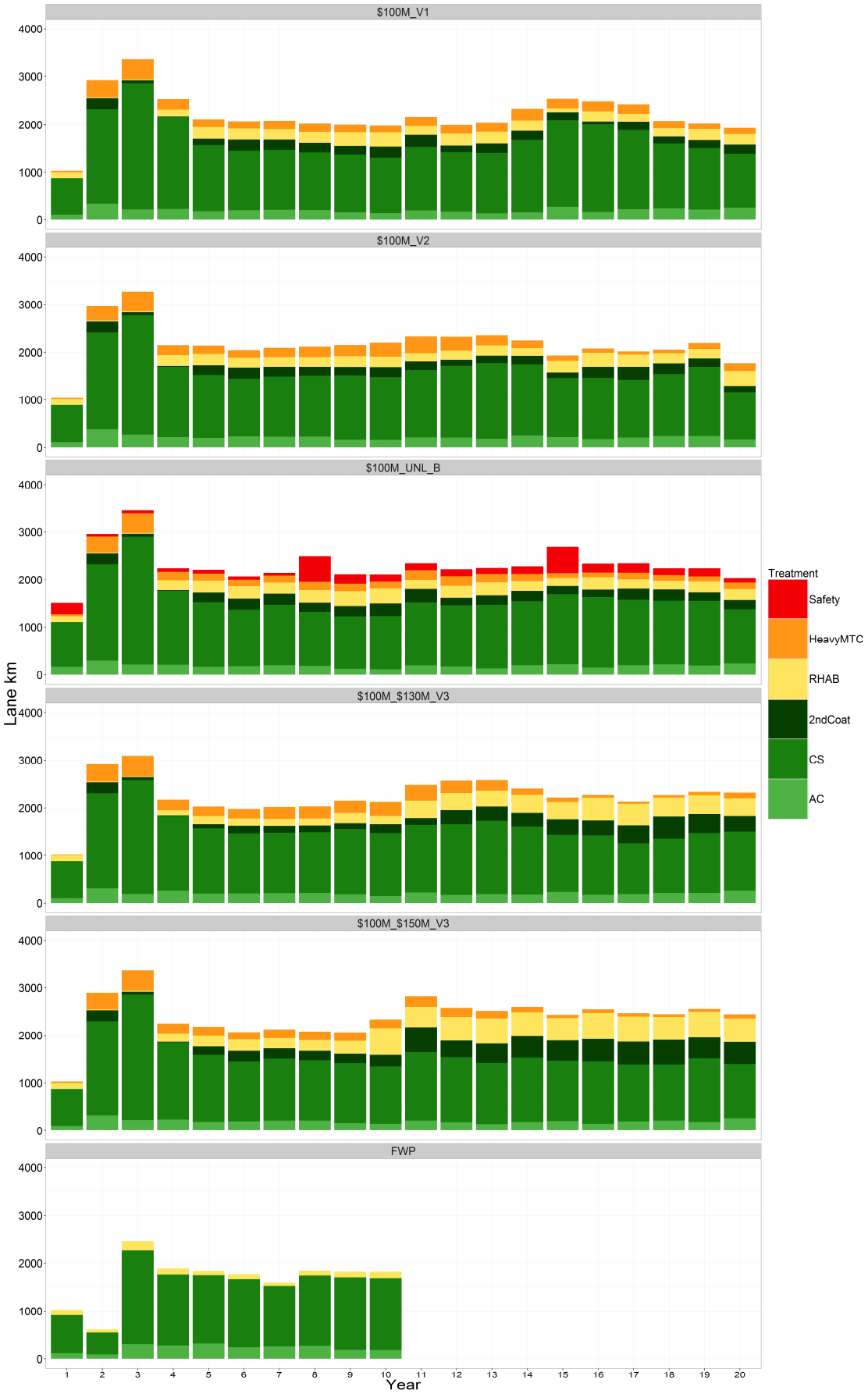
Length

National 20 Year Average Annual Length

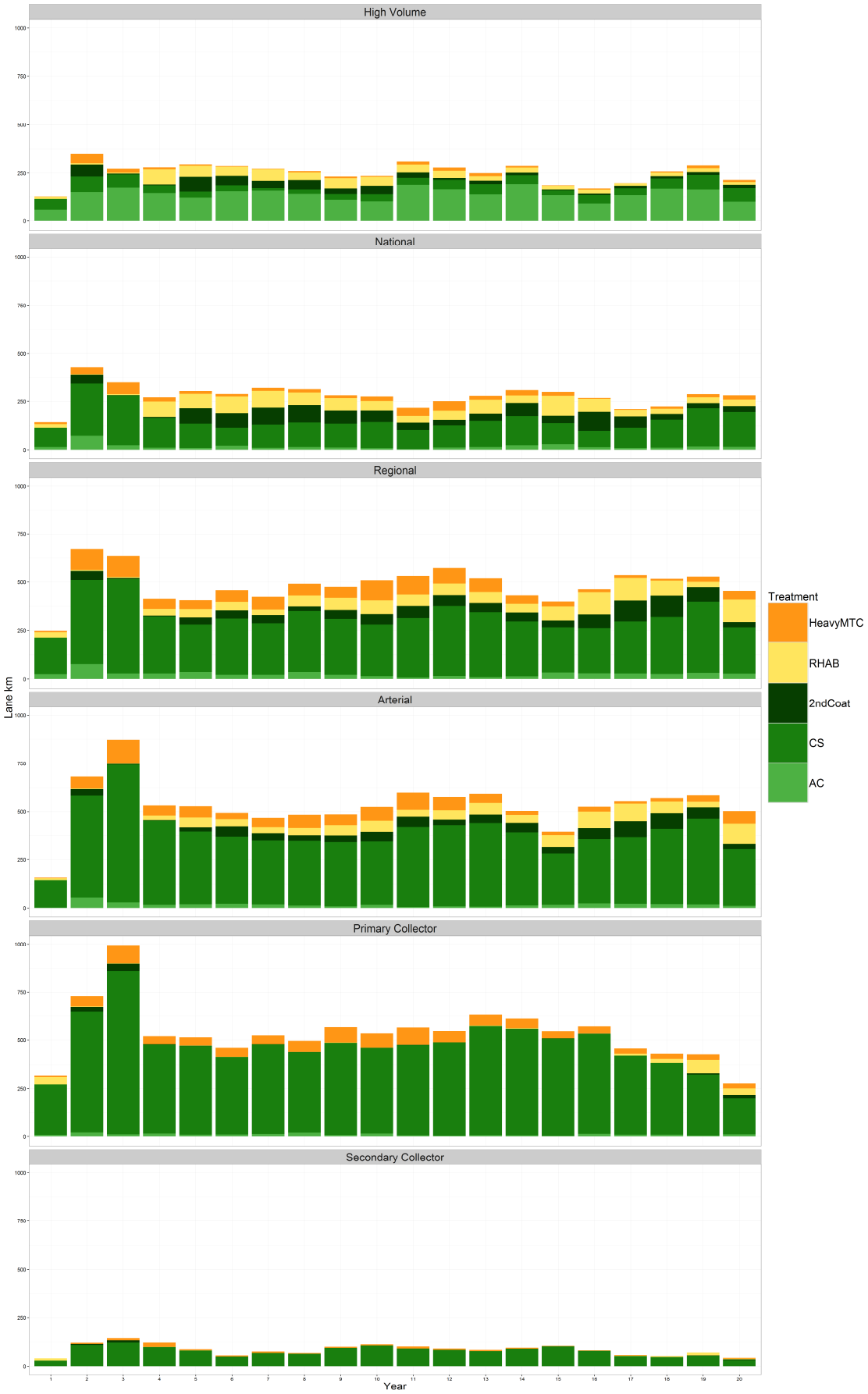


	$100M_V1	$100M_V2	$100M_UNL_B	$100M_$130M_V3	$100M_$150M_V3	FWP
AC	206.86	208.27	195.34	197.93	193.8	220.09
CS	1460.68	1405.11	1387.19	1384.25	1379.77	1341.22
2ndCoat	168.12	174.26	191.18	232.78	316.49	0
RHAB	185.37	198.44	206.51	257.41	350.9	108.1
HeavyMTC	189.44	192.63	169.99	194.08	160.59	0
Safety	0	0	174.13	0	0	0

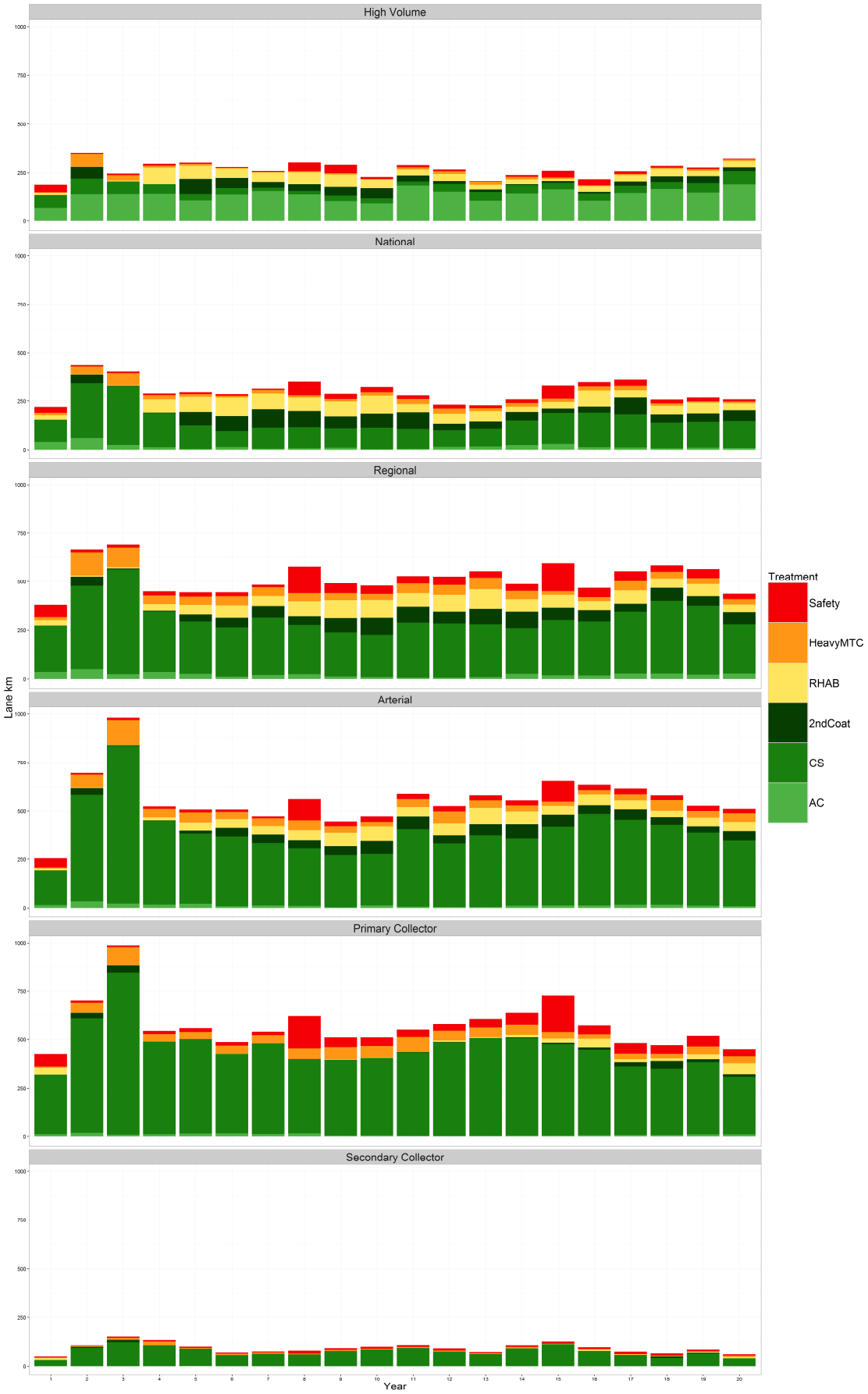
National - Total Network Lane km



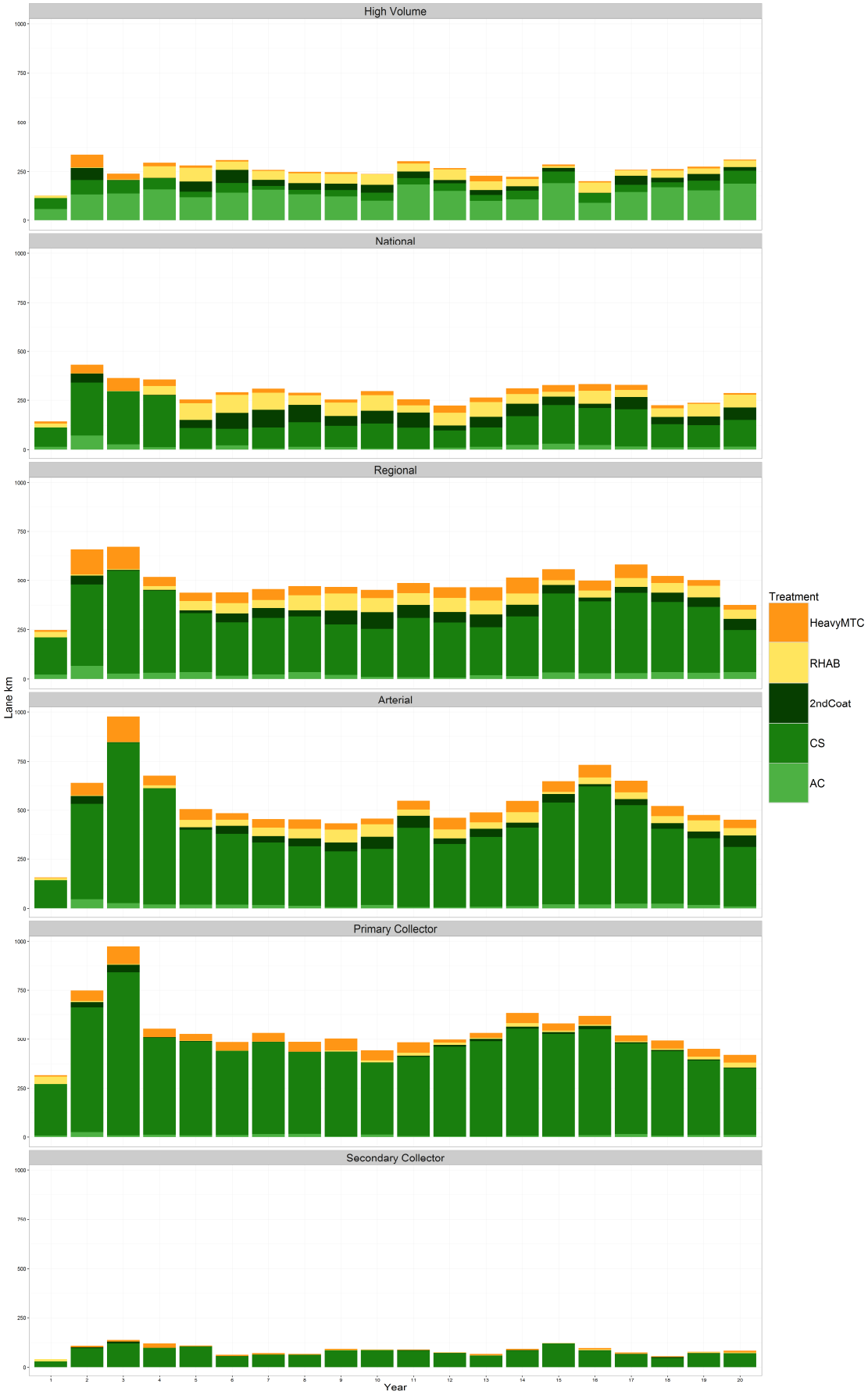
Lane km $100M_V2 by ONRC



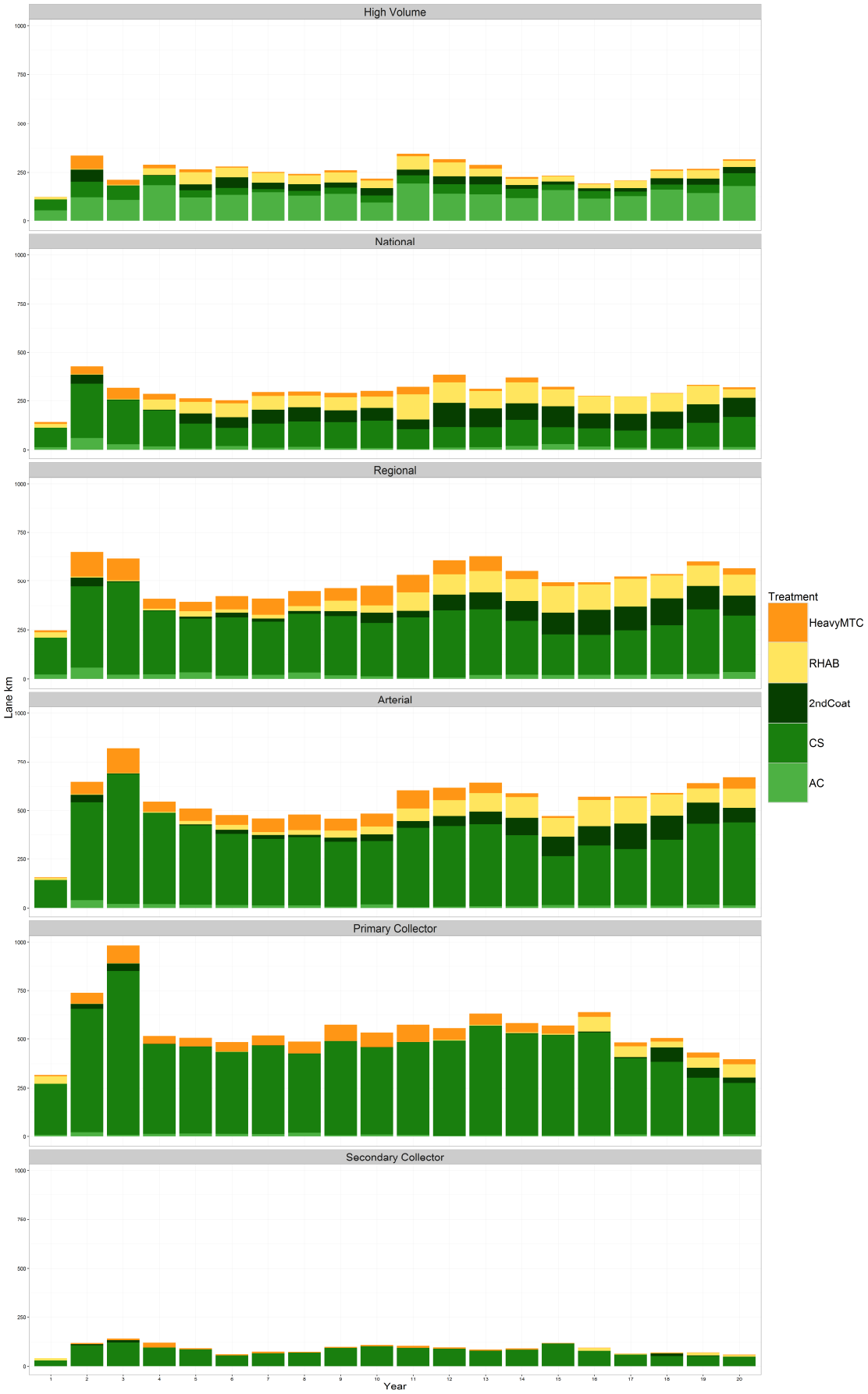
Lane km $100M_UNL_B by ONRC



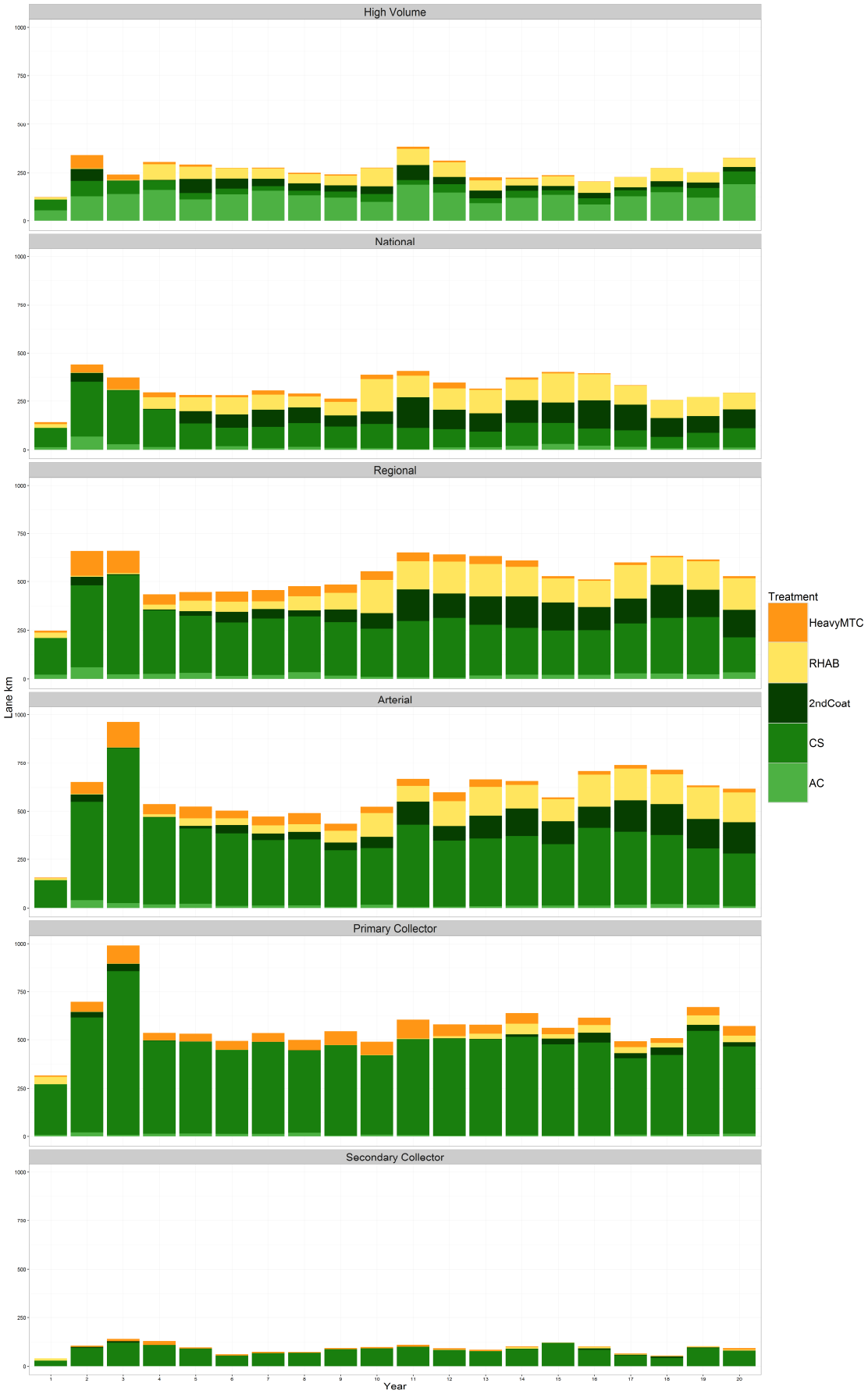
Lane km $100M_V1 by ONRC



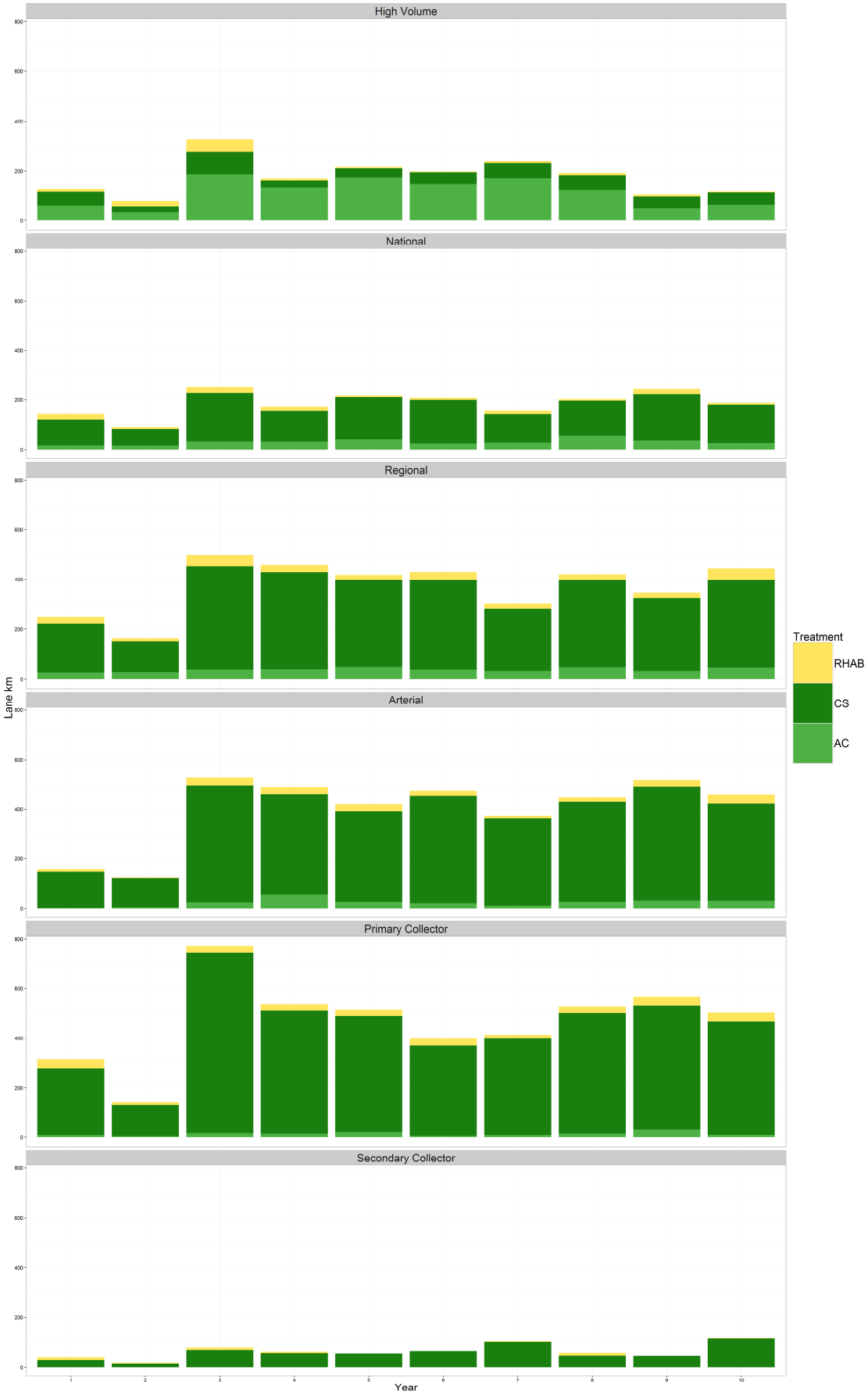
Lane km $100M_$130M_V3 by ONRC



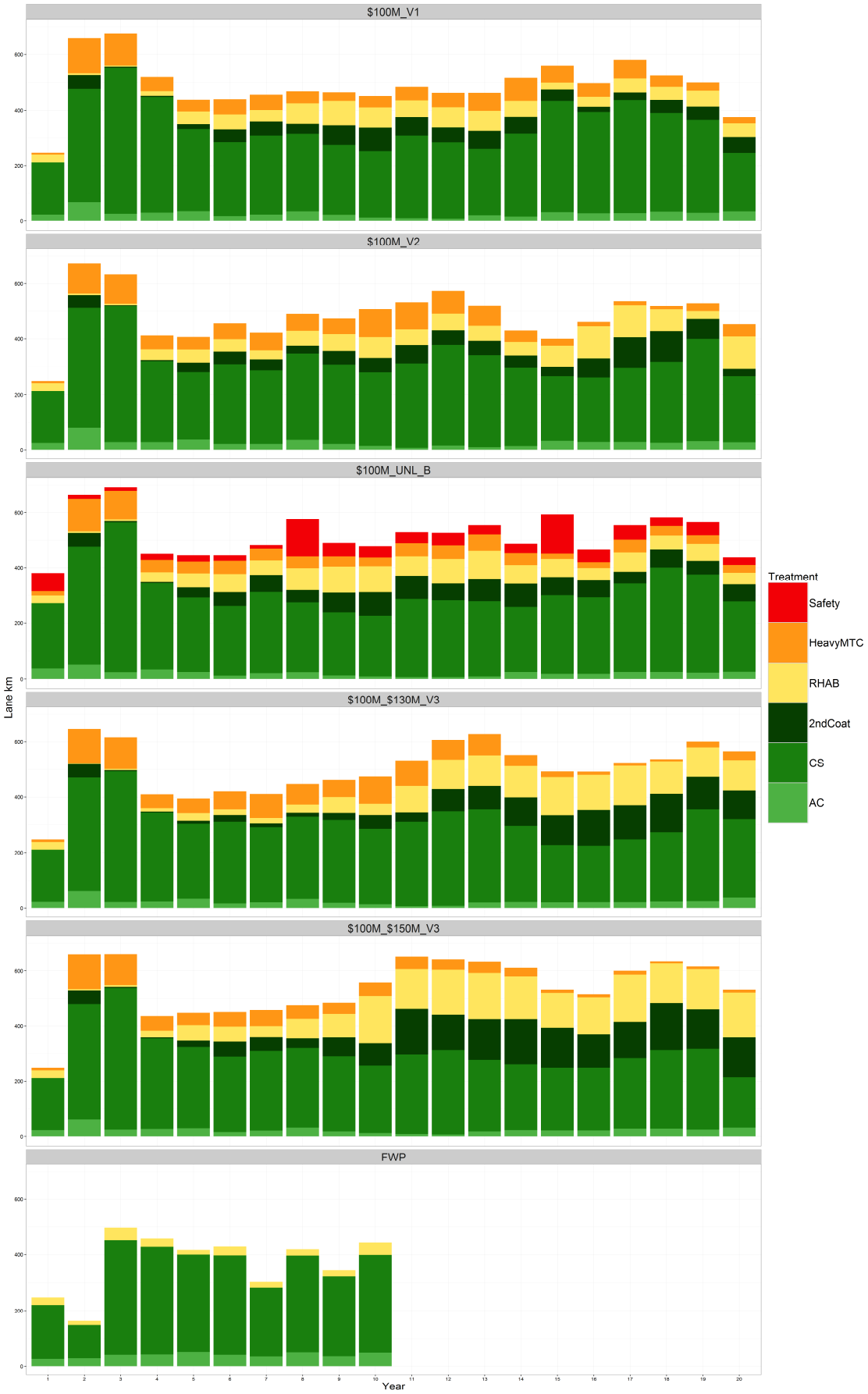
Lane km $100M_$150M_V3 by ONRC



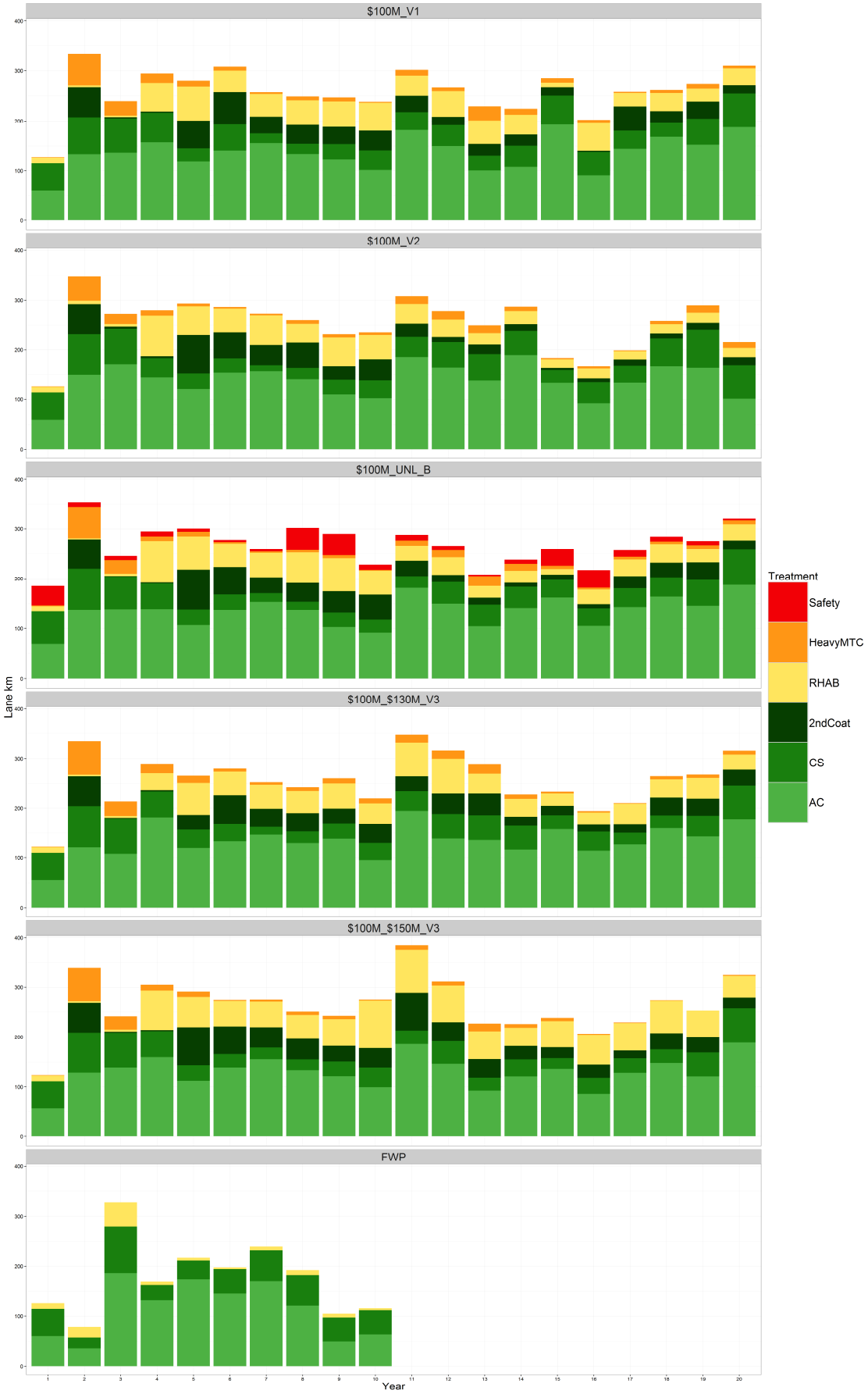
Lane km FWP by ONRC



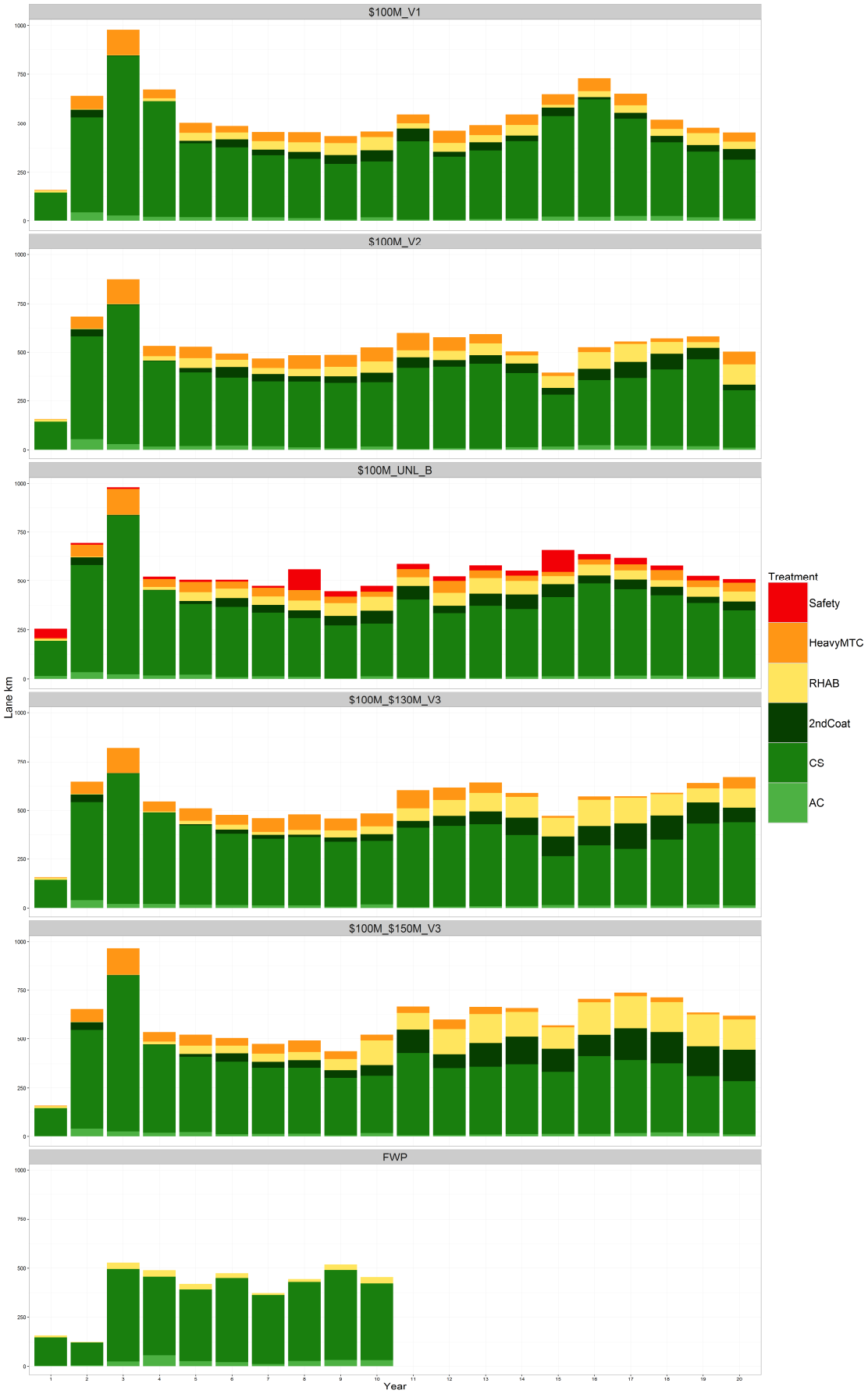
Lane km by ONRC - Regional



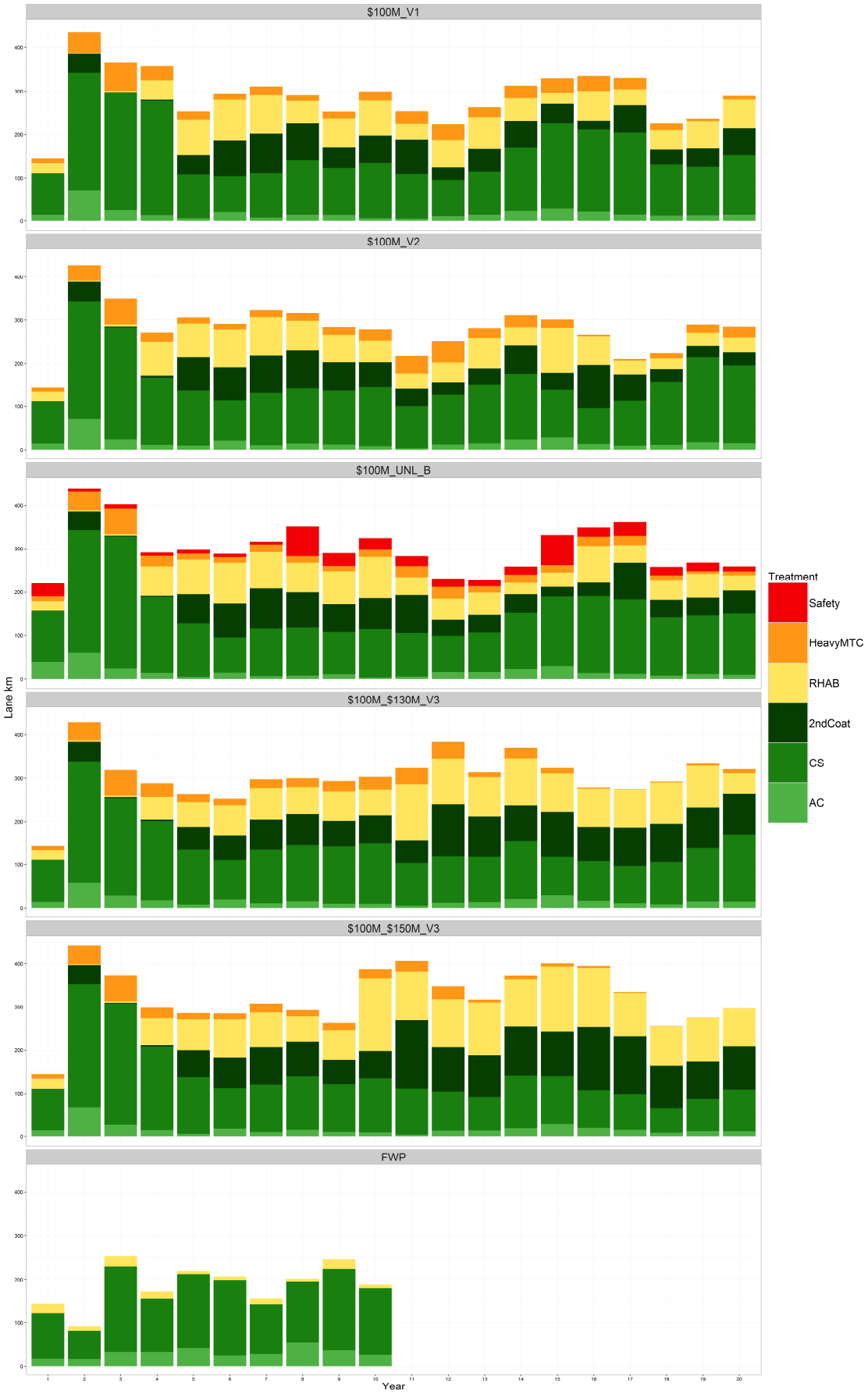
Lane km by ONRC - High Volume



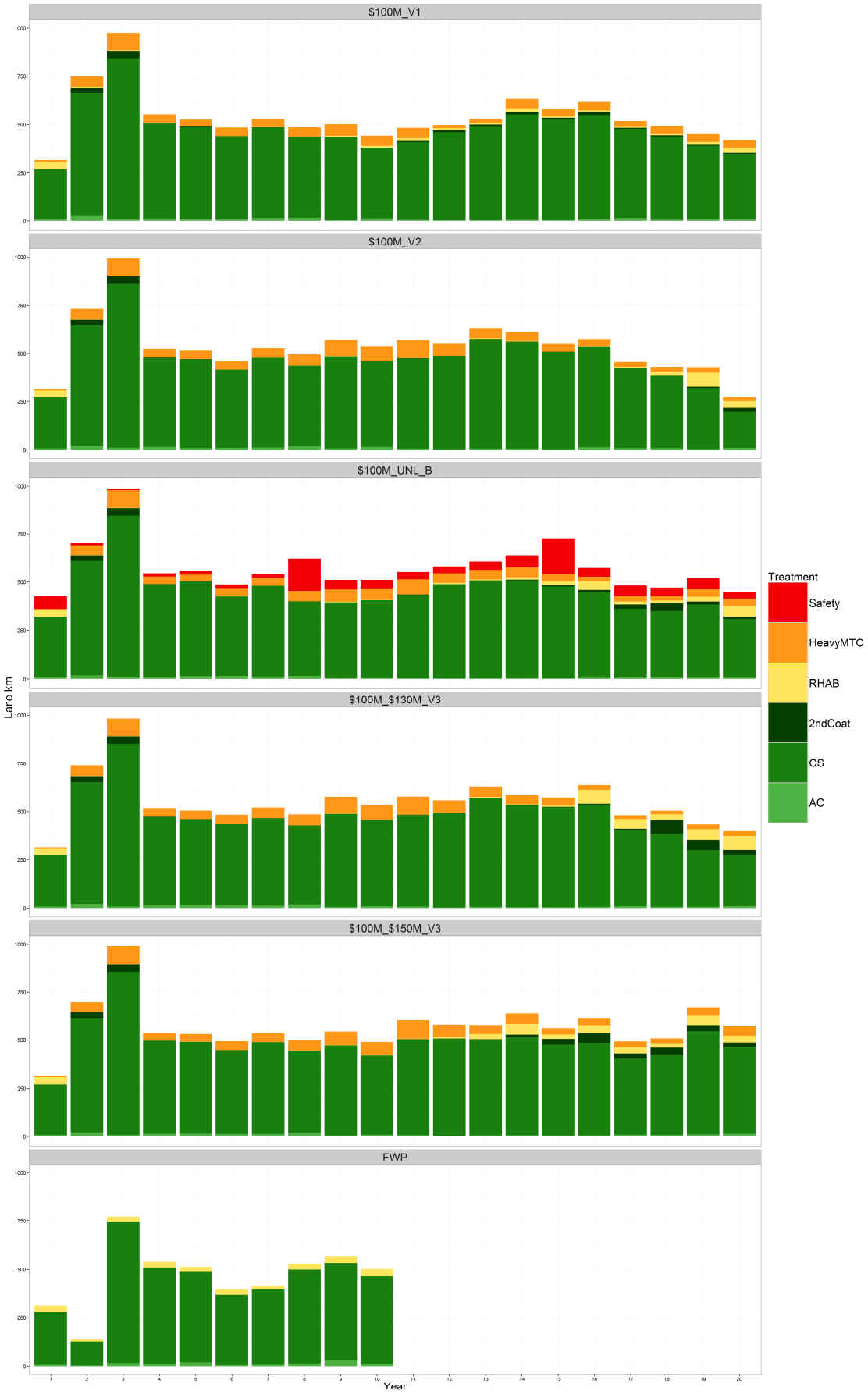
Lane km by ONRC - Arterial



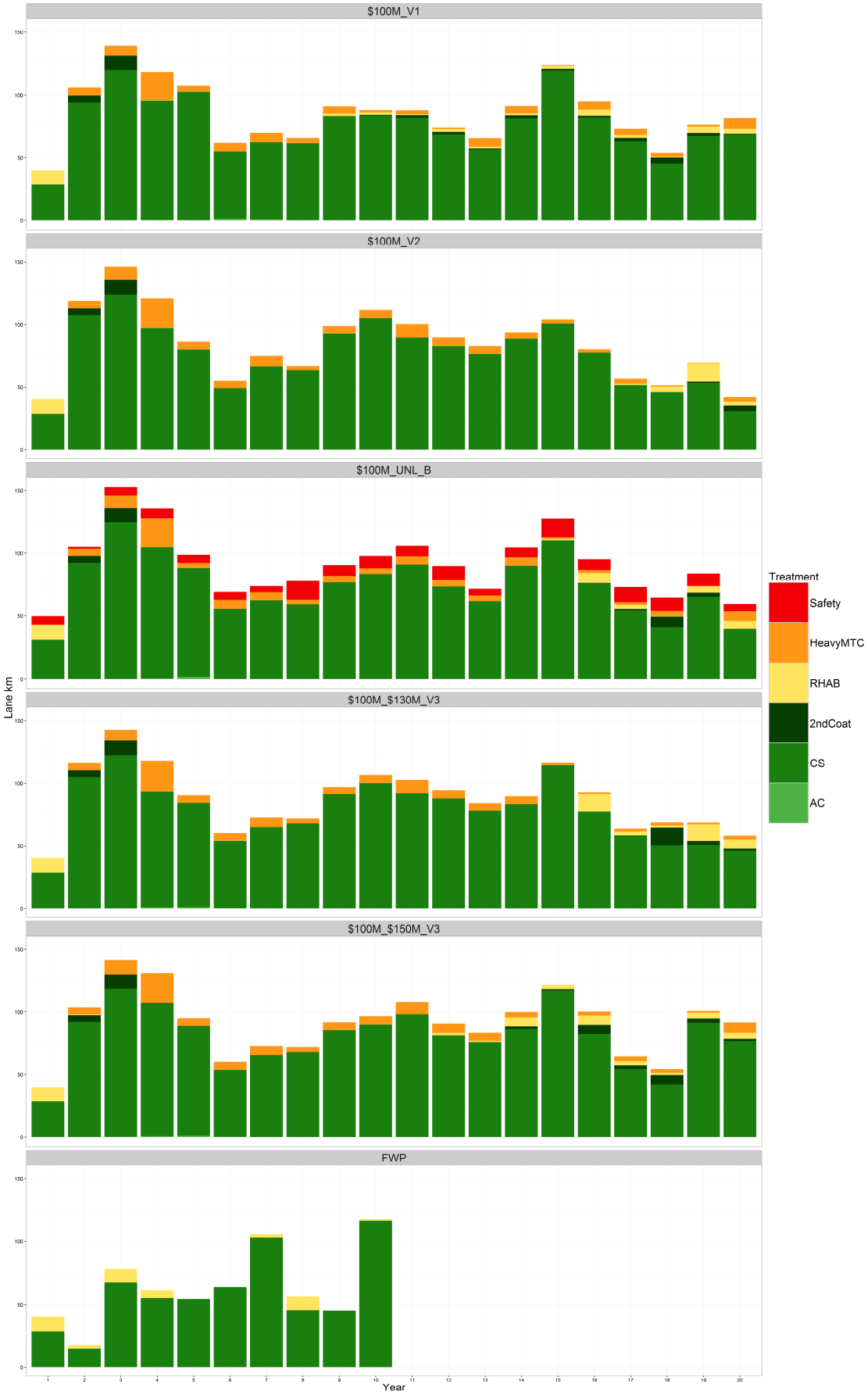
Lane km by ONRC - National



Lane km by ONRC - Primary Collector



Lane km by ONRC - Secondary Collector

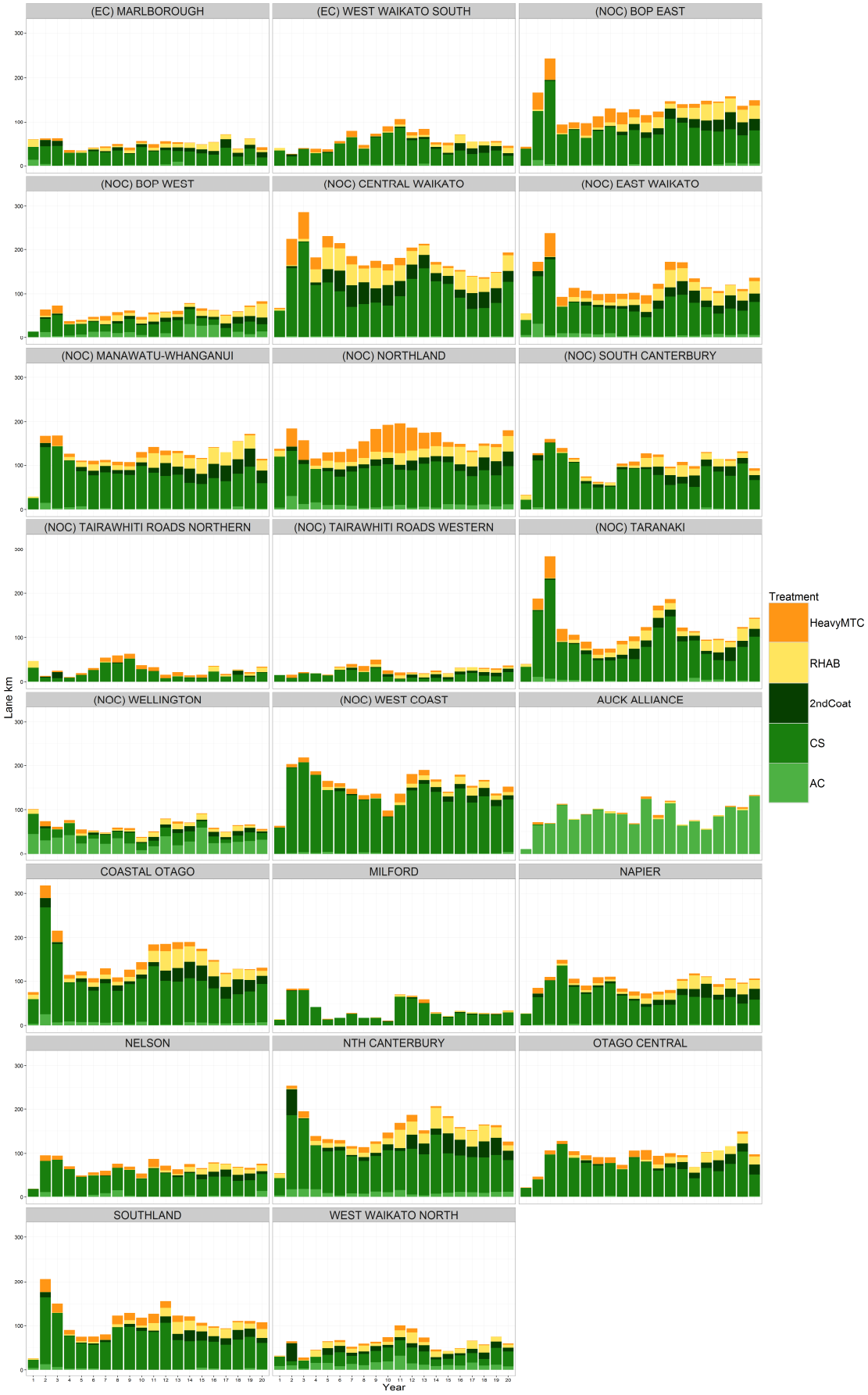


Lane km by NOC - $100M_V2

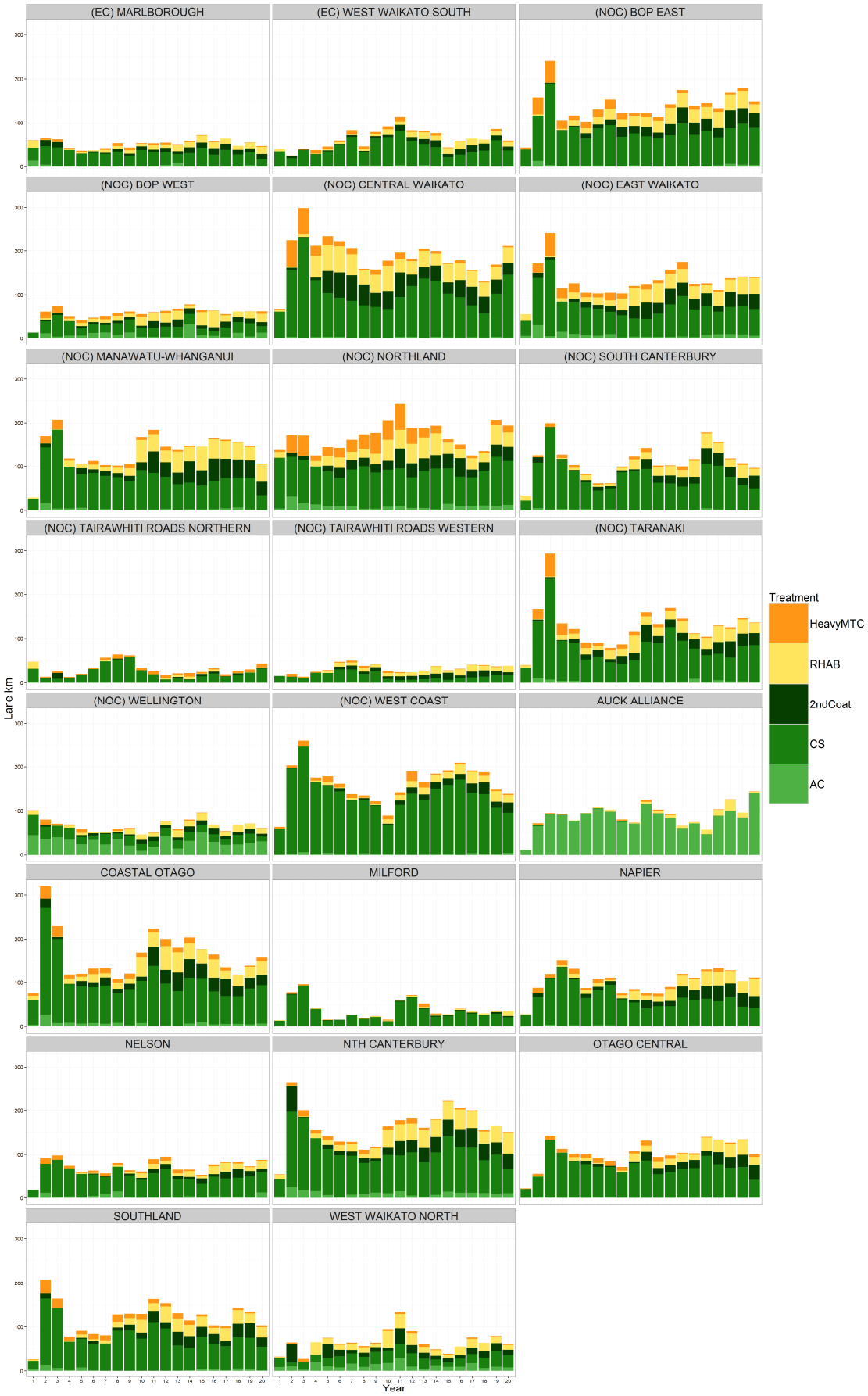
Lane km by NOC - $100M_UNL_B

Lane km by NOC - $100M_V1

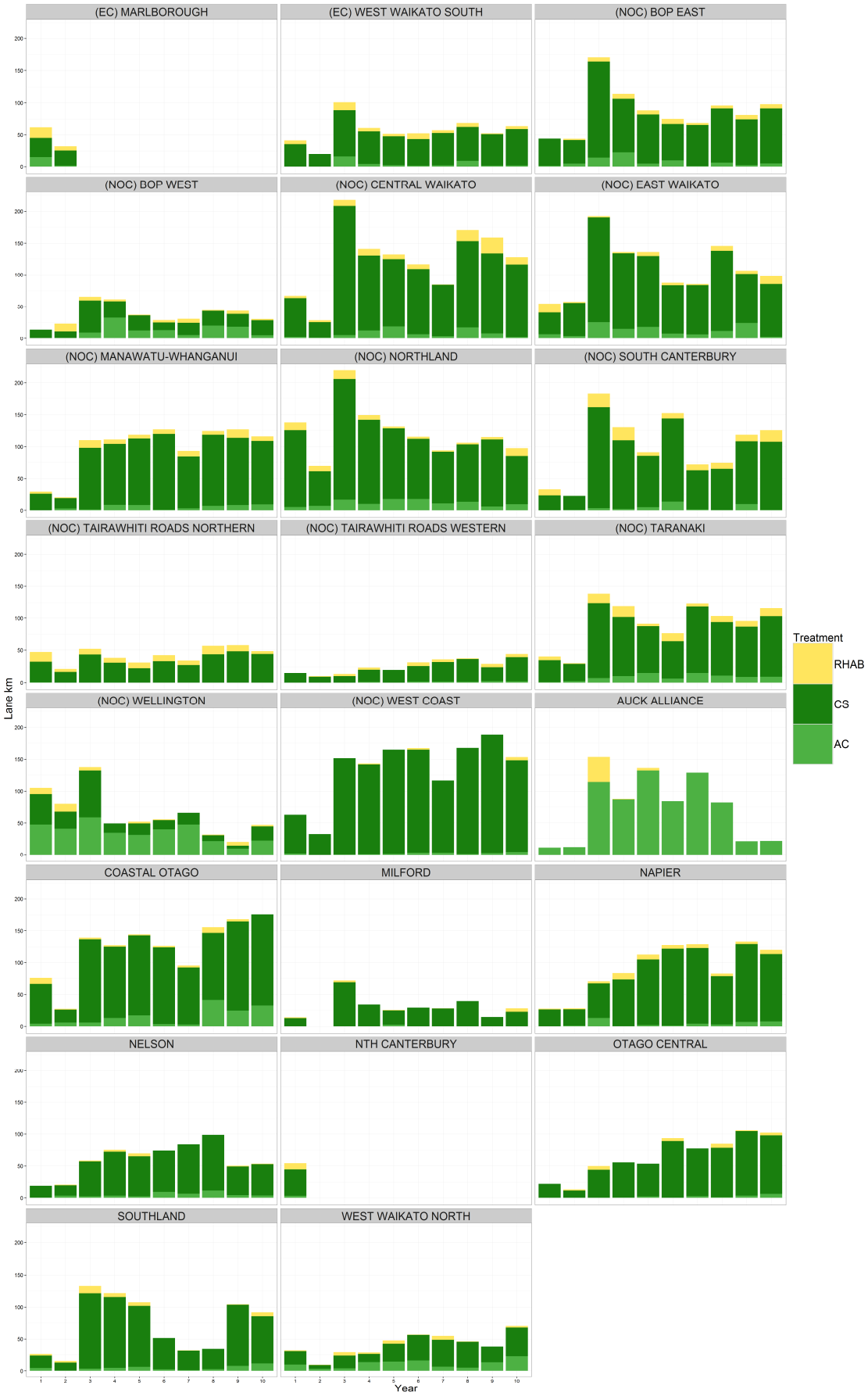
Lane km by NOC - $100M_$130M_V3



Lane km by NOC - $100M_$150M_V3



Lane km by NOC - FWP



1.2 Cost Charts – Recommended Options

This set of outputs includes Stacked Bar Charts showing predicted Treatment Cost ($ Million) for each Treatment Type.

- Asphalt Surfacing - AC (light green)
- Chipseal Surfacing - CS (mid green)
- 2nd Coat (dark green)
- Pavement Rehabilitation - RHAB (yellow)
- Heavy Maintenance (orange)
- Safety (where applicable – red)
- Routine Maintenance – RTNE (light blue)
- Pre Reseal Repairs – PSEAL (dark blue)

The first Chart/Table compares the six (6) 'Recommended Options' as a 20 Year National Average Annual Cost ($ Million)

- **$100M_$130M_V3**
  - Renewal Investment: Fixed **$100M pa** through 2025, increasing to **$130M pa**
  - Routine Investment: Fixed **$30M pa,** Safety Investment: Safety not Included
- **$100M_$150M_V3**
  - Renewal Investment: Fixed **$100M** pa through 2025, increasing to **$150M pa**
  - Routine Investment: Fixed **$30M pa,** Safety Investment: Safety not Included
- **$100M_UNL_B**
  - Renewal Investment: Fixed **$100M pa**
  - Routine Investment: Fixed **$30M pa,** Safety Investment: **Unlimited**, Safety programme completed
- **$100M_V1**
  - Renewal Investment: Fixed **$100M pa**
  - Routine Investment: **Unlimited,** Safety Investment: Safety not Included
- **$100M_V2**
  - Renewal Investment: Fixed **$100M pa**
  - Routine Investment: Fixed **$30M pa,** Safety Investment: Safety not Included
- **FWP – Contractors 10 year Specimen Programmes adjusted by RAPT reviews**
  - Renewal Investment: **Unlimited**
  - Routine Investment: **Unlimited pa,** Safety Investment: Safety not Included

The second series compares the six (6) ONRC Classes as time series over 20 years for each 'Recommended Option'.

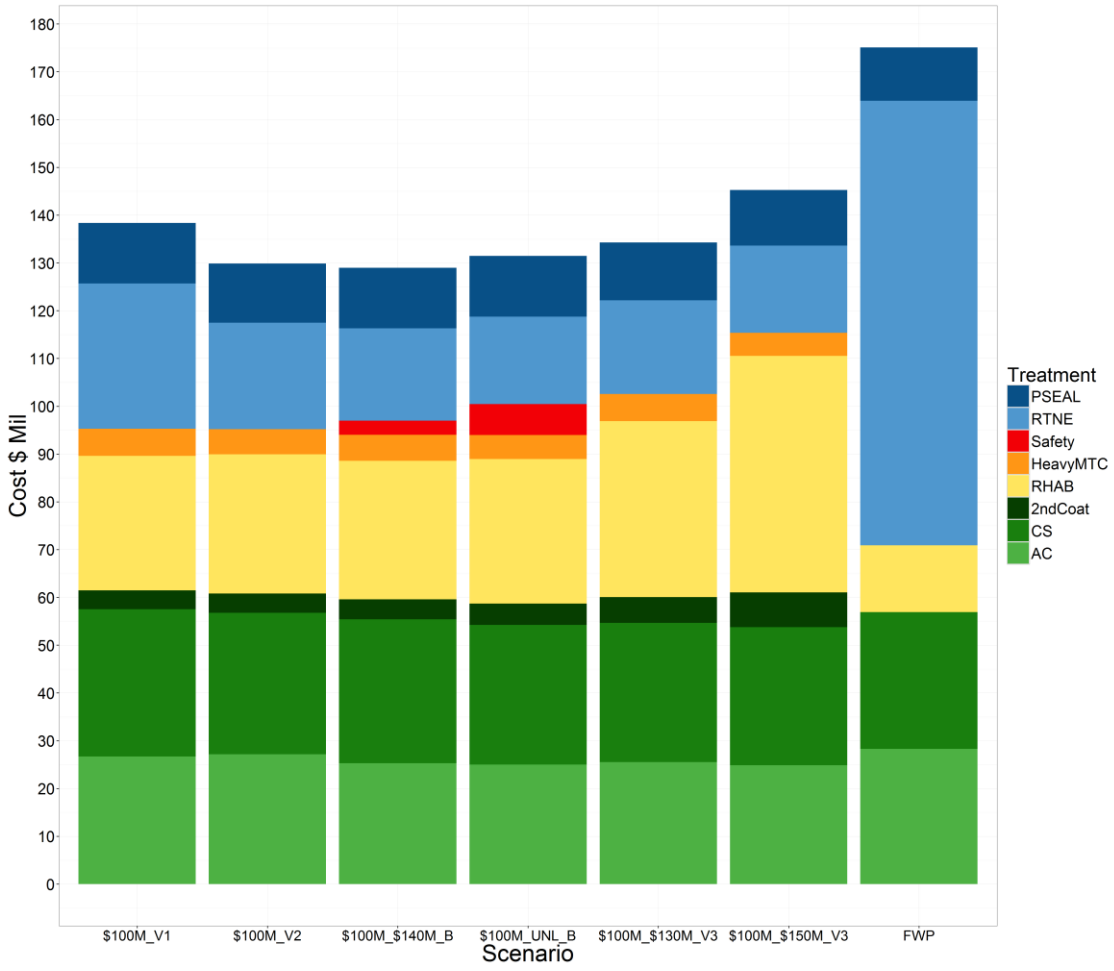
- Secondary Collector, Primary Collector
- Arterial, Regional
- National, National High Volume

The third series compares the 'Recommended Options' by ONRC Class as time series over 20 years

The fourth series compares the twenty three (23) Regions as time series over 20 years for each 'Recommended Option'.

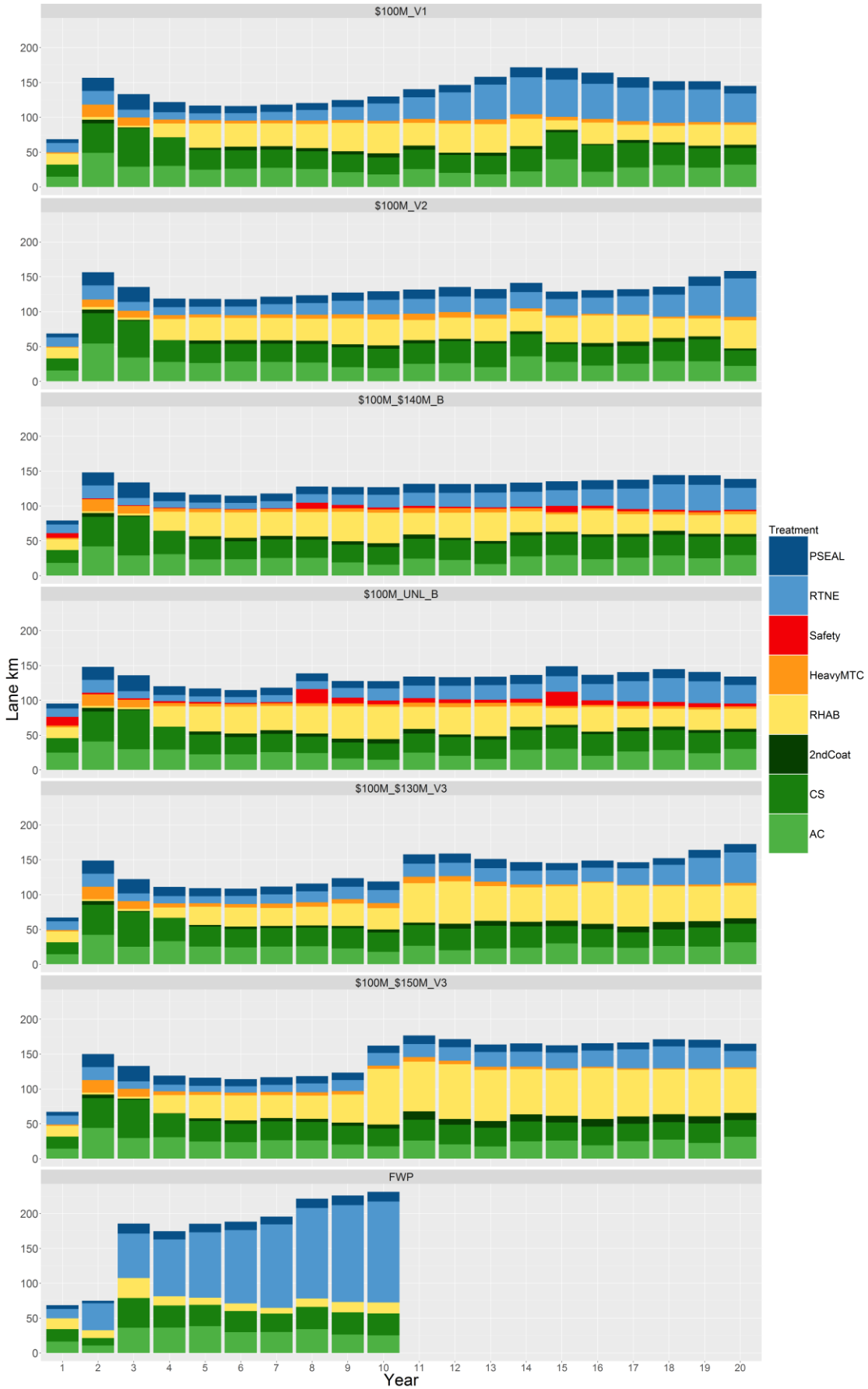
Costs

National 20 Year Average Annual Cost

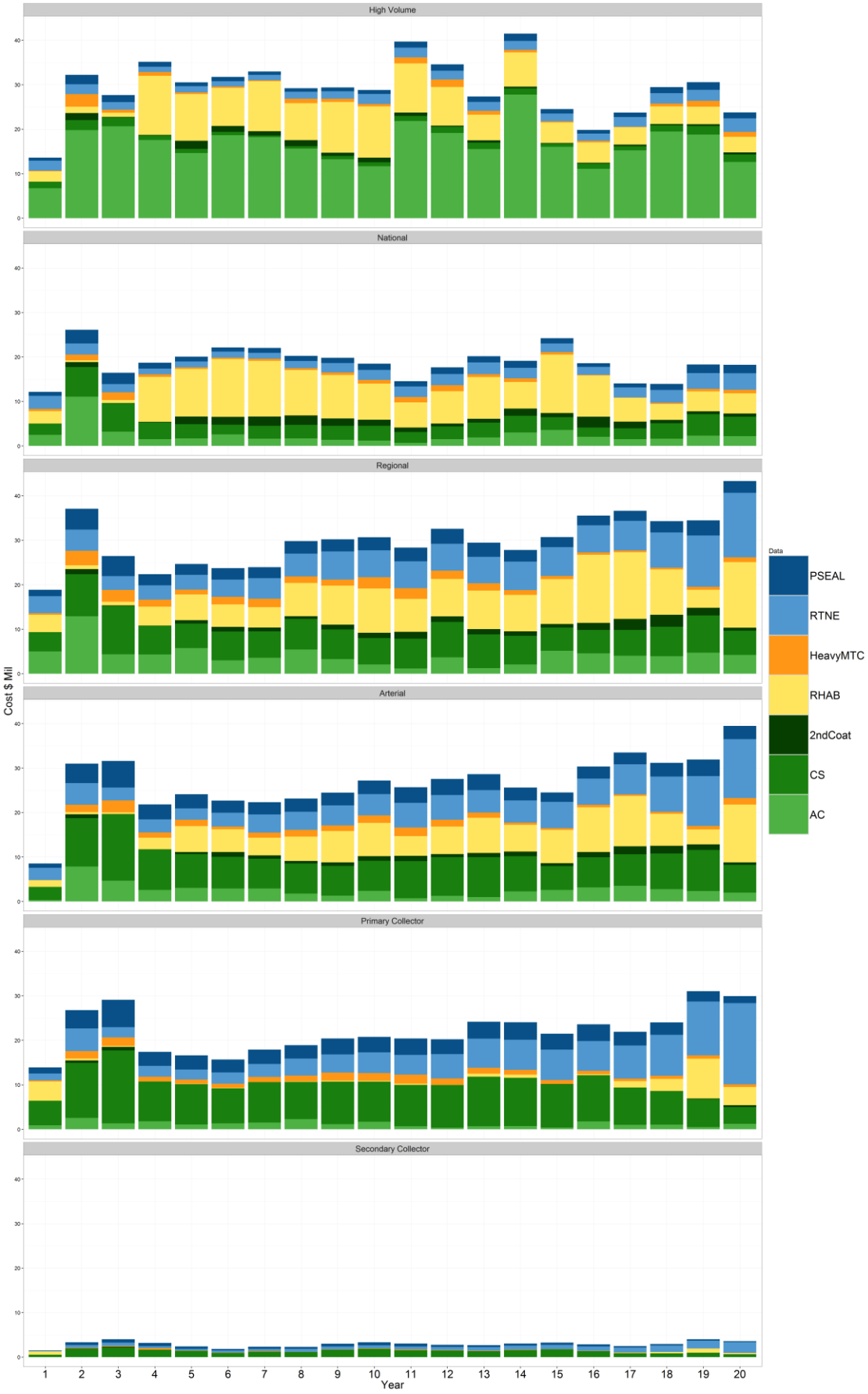


	$100M_V1	$100M_V2	$100M_$140M_B	$100M_UNL_B	$100M_$130M_V3	$100M_$150M_V3	FWP
AC	26.7	27.15	25.27	25.02	25.55	24.86	28.31
CS	30.81	29.64	30.13	29.21	29.13	28.93	28.59
2ndCoat	3.93	4.03	4.18	4.45	5.4	7.27	0
RHAB	28.17	29.1	28.98	30.29	36.79	49.5	14.01
HeavyMTC	5.7	5.27	5.44	5.03	5.7	4.81	0
Safety	0	0	2.99	6.49	0	0	0
RTNE	30.36	22.3	19.3	18.28	19.61	18.24	93
PSEAL	12.7	12.35	12.67	12.69	12.08	11.66	11.19

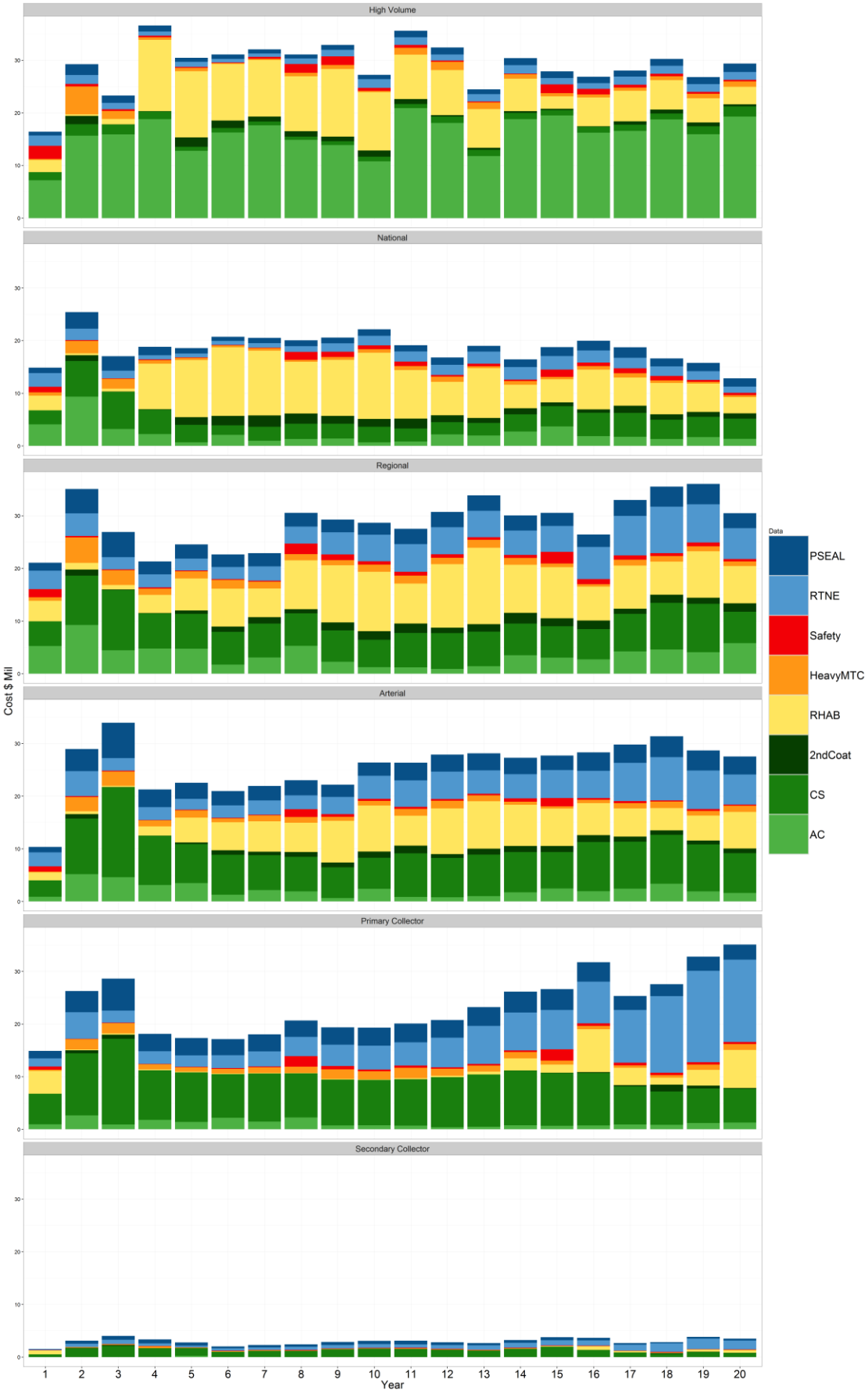
National Total Network Cost $ Mil



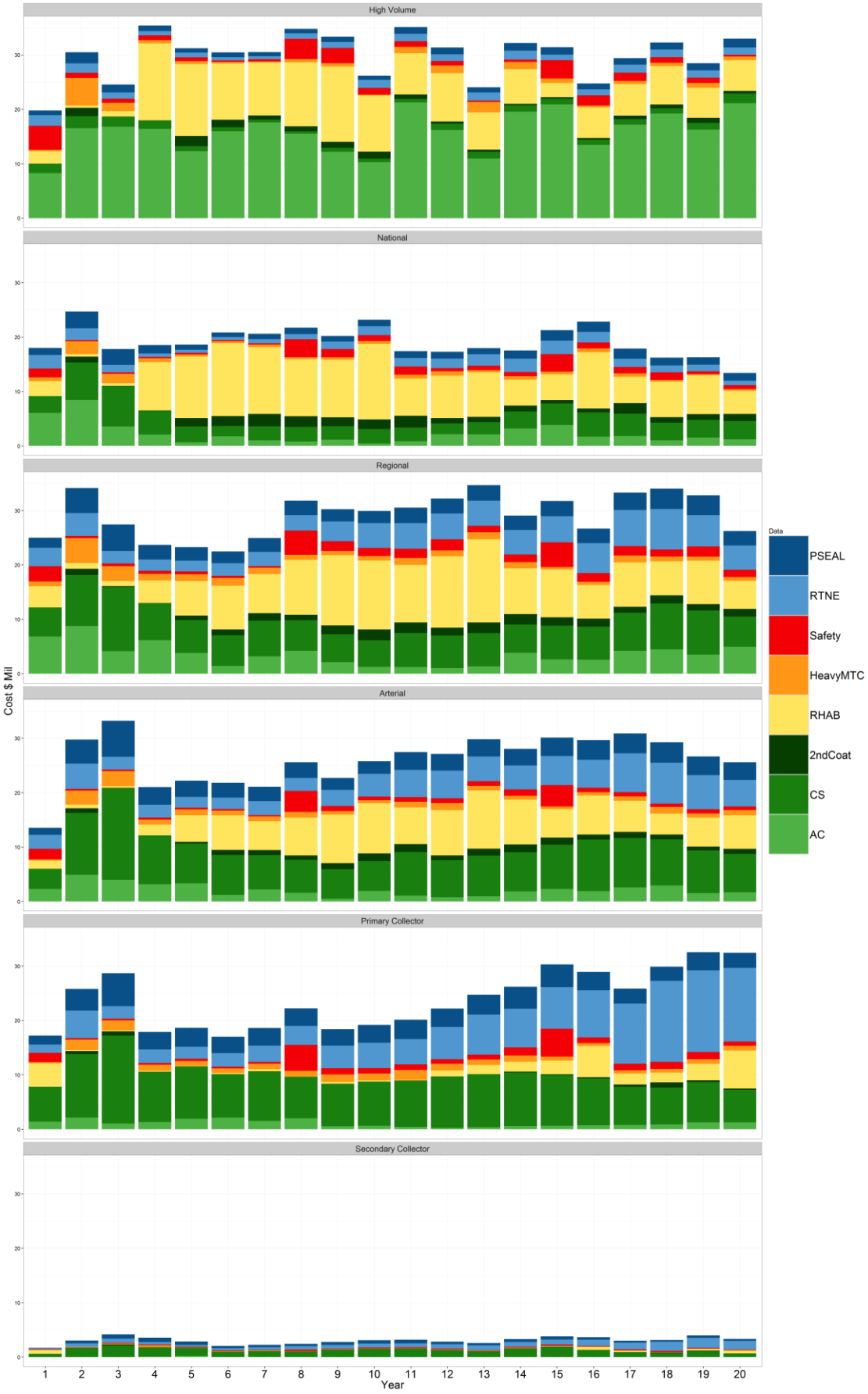
Cost $ Mil $100M_V2 by ONRC



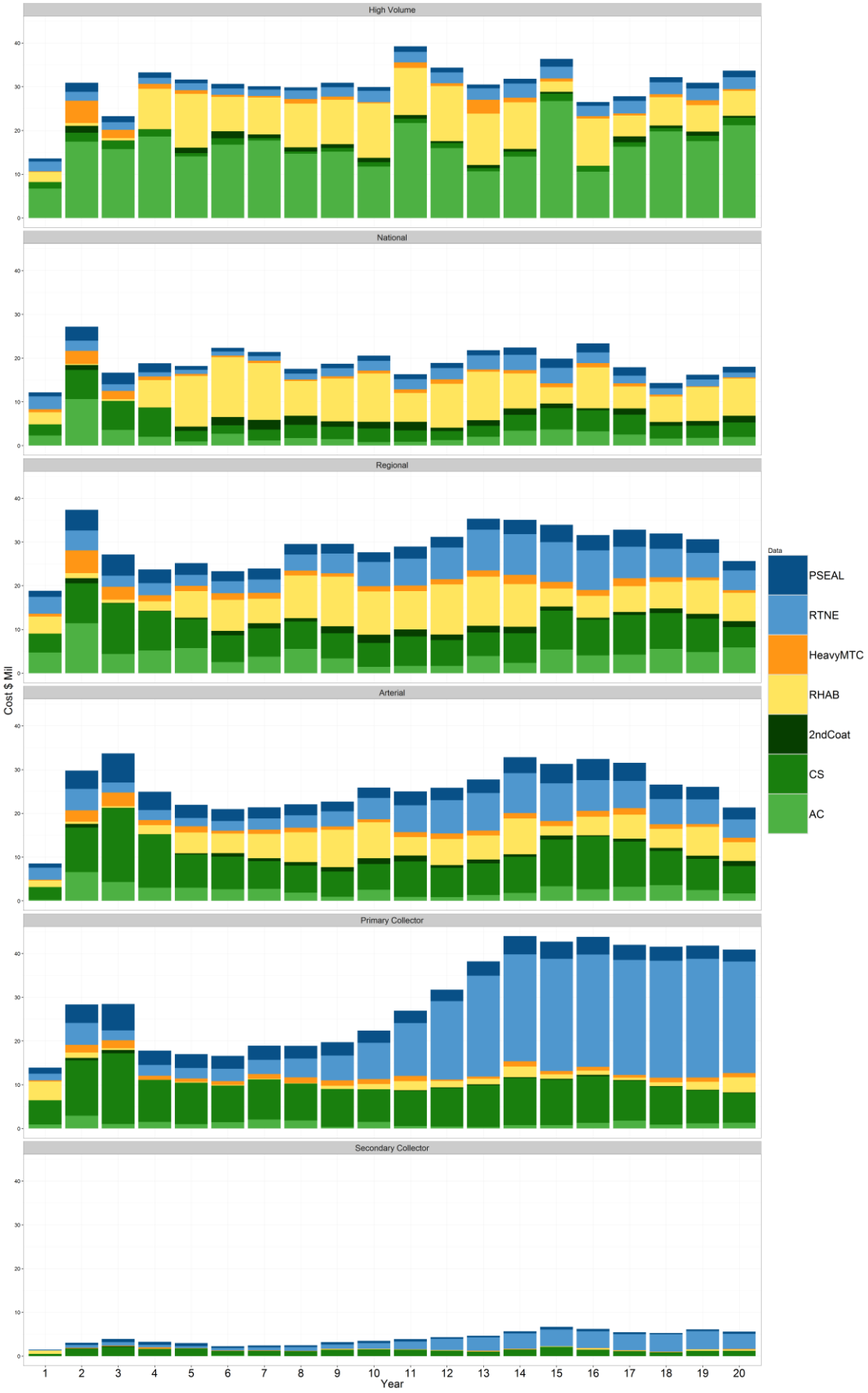
Cost $ Mil $100M_$140M_B by ONRC



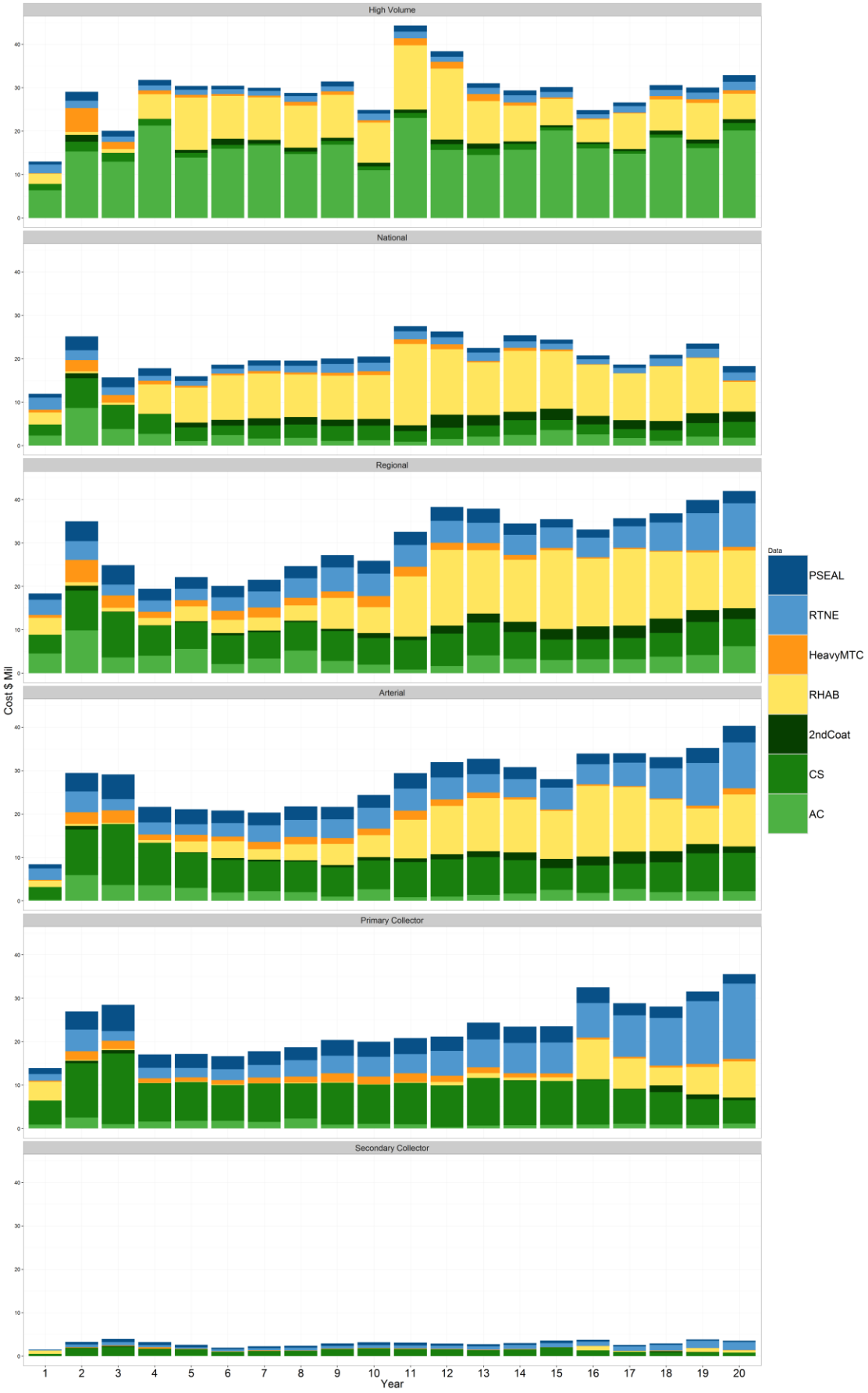
Cost $ Mil $100M_UNL_B by ONRC



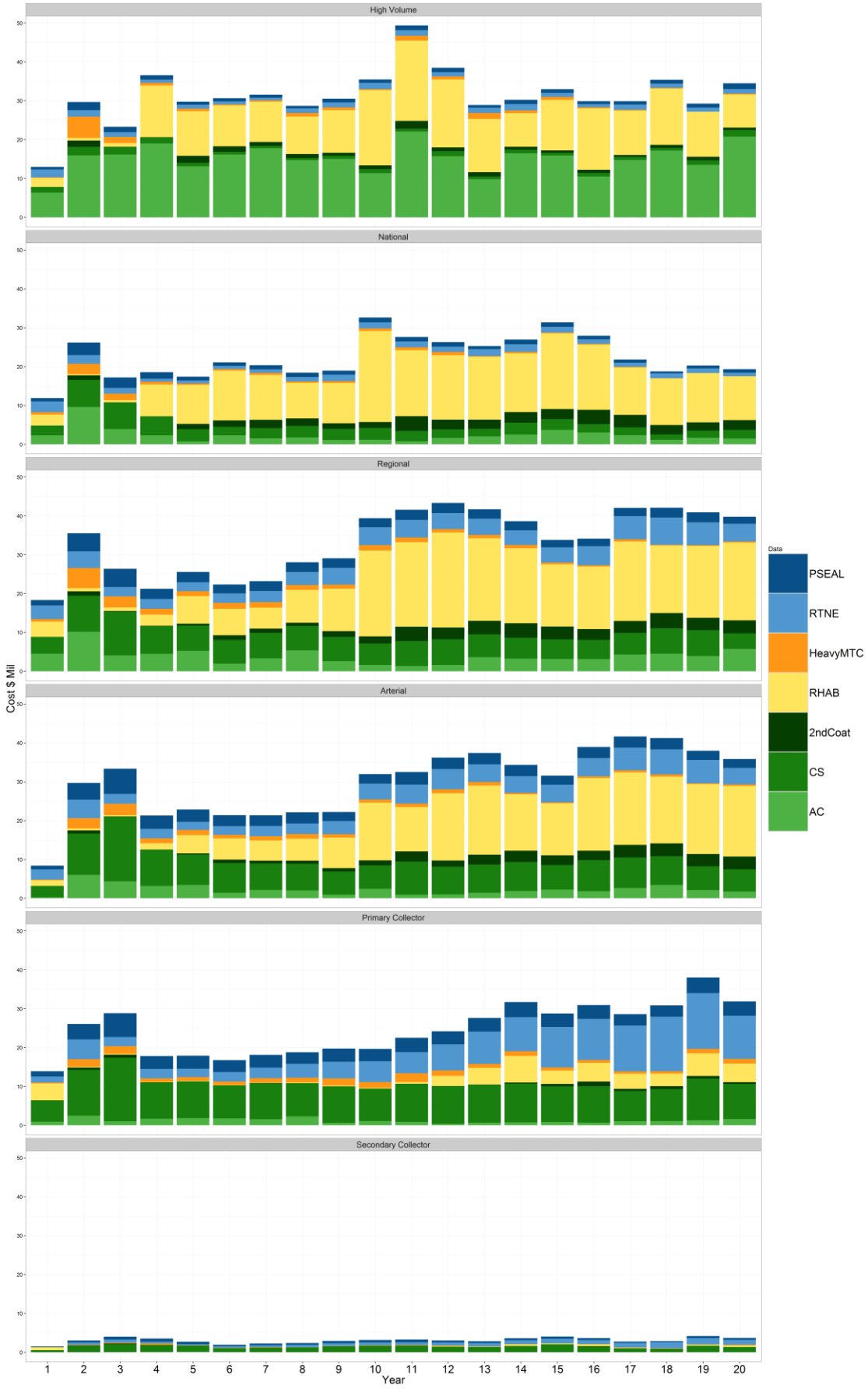
Cost $ Mil $100M_V1 by ONRC



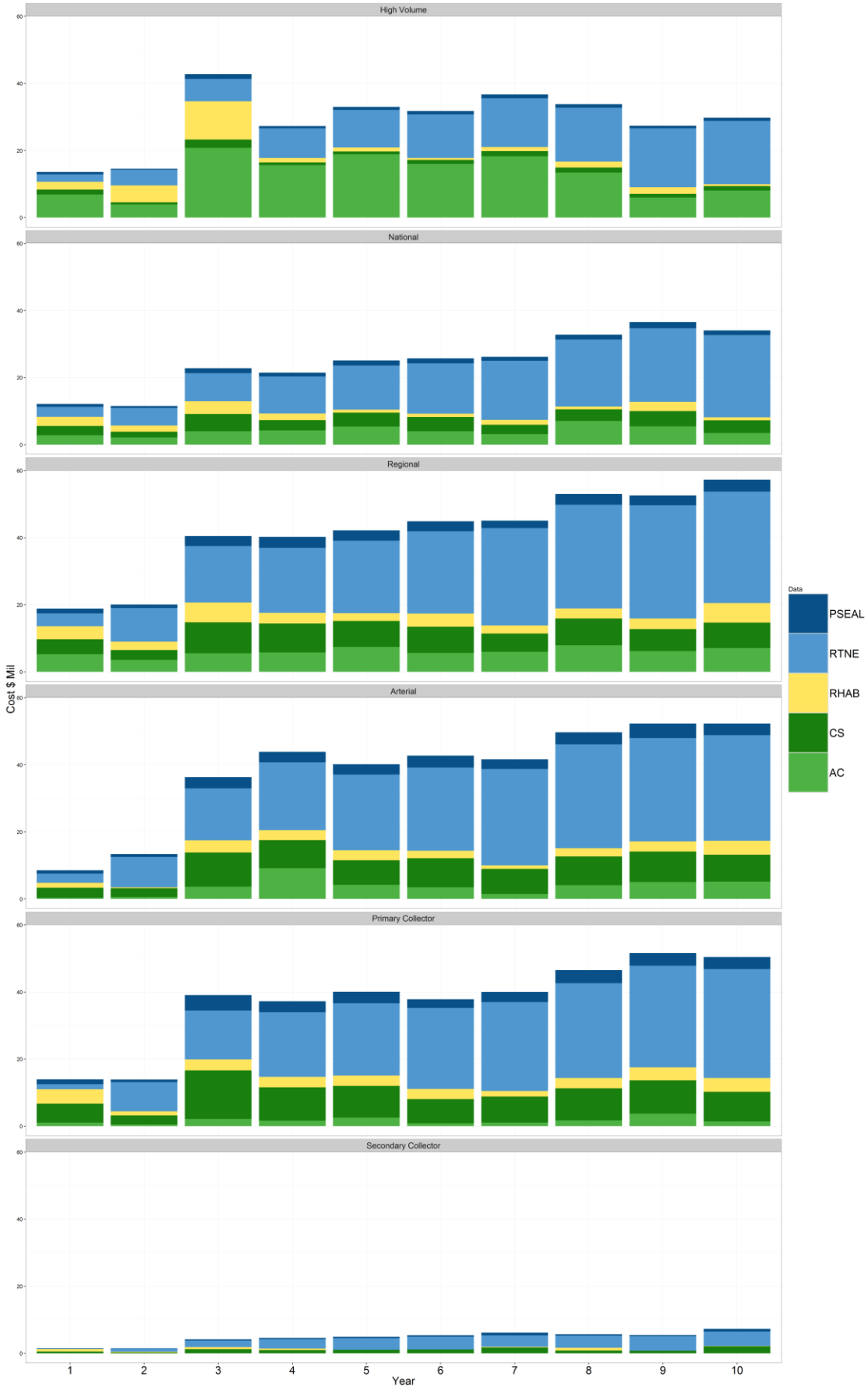
Cost $ Mil $100M_$130M_V3 by ONRC



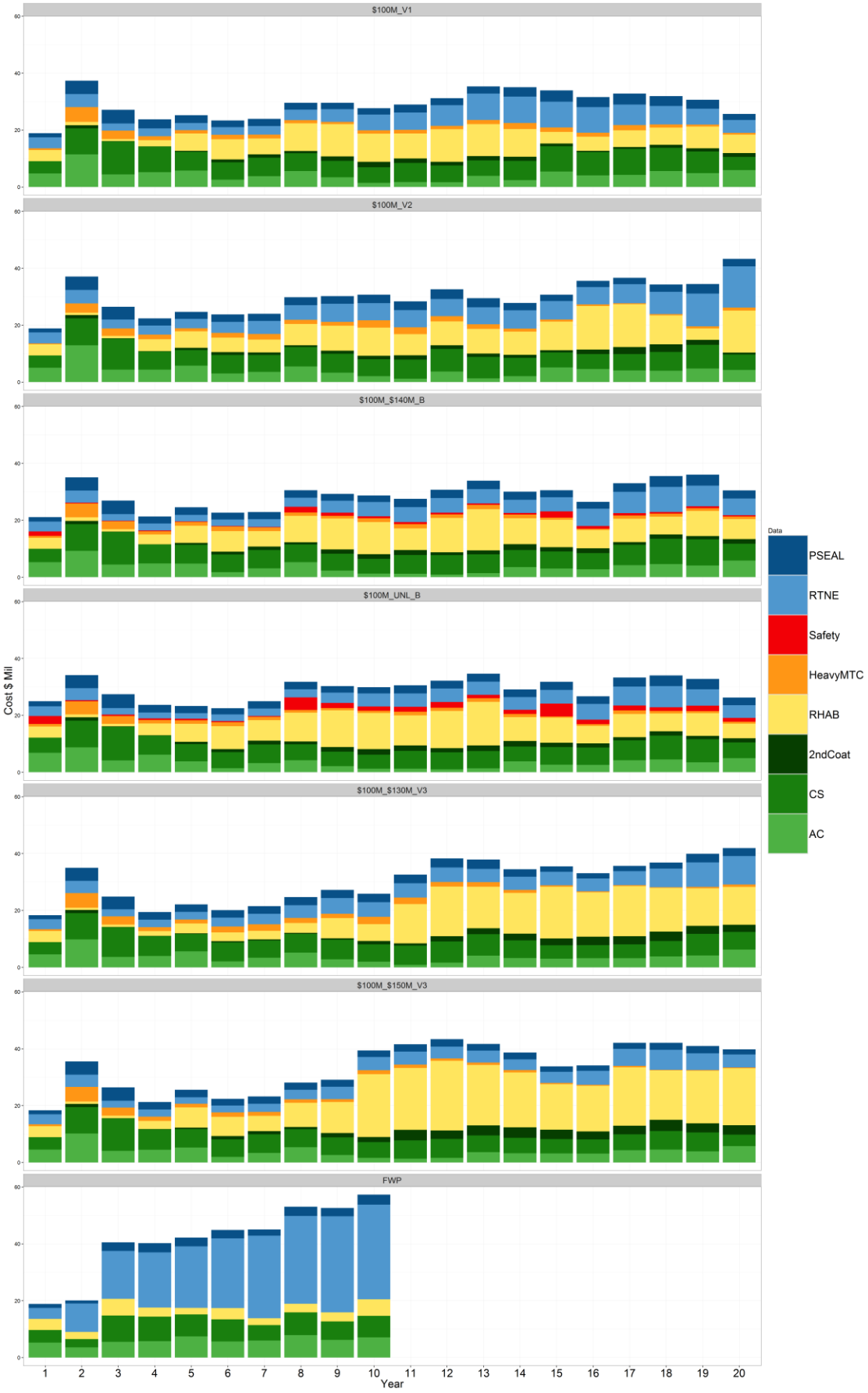
Cost $ Mil $100M_$150M_V3 by ONRC



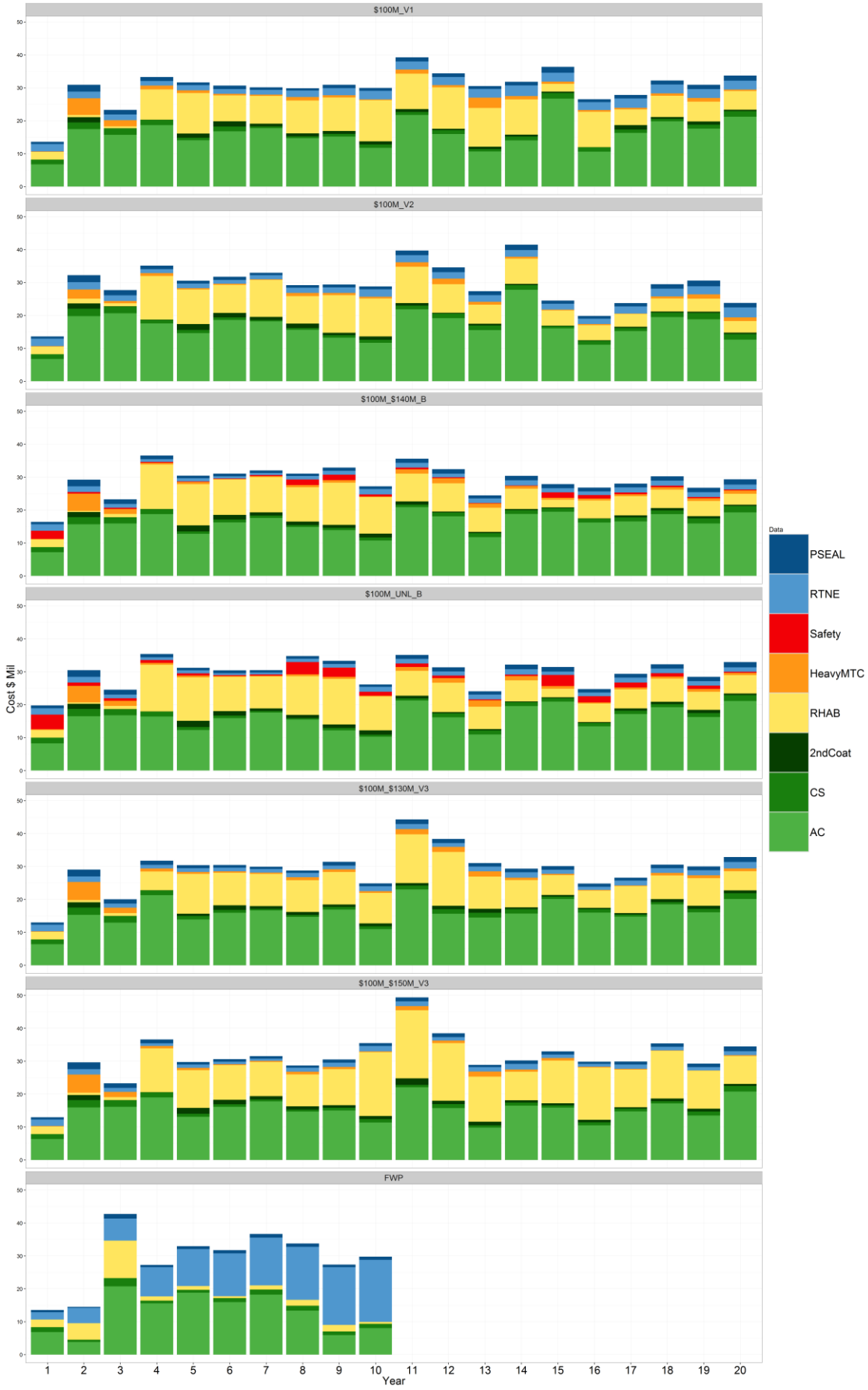
Cost $ Mil FWP by ONRC



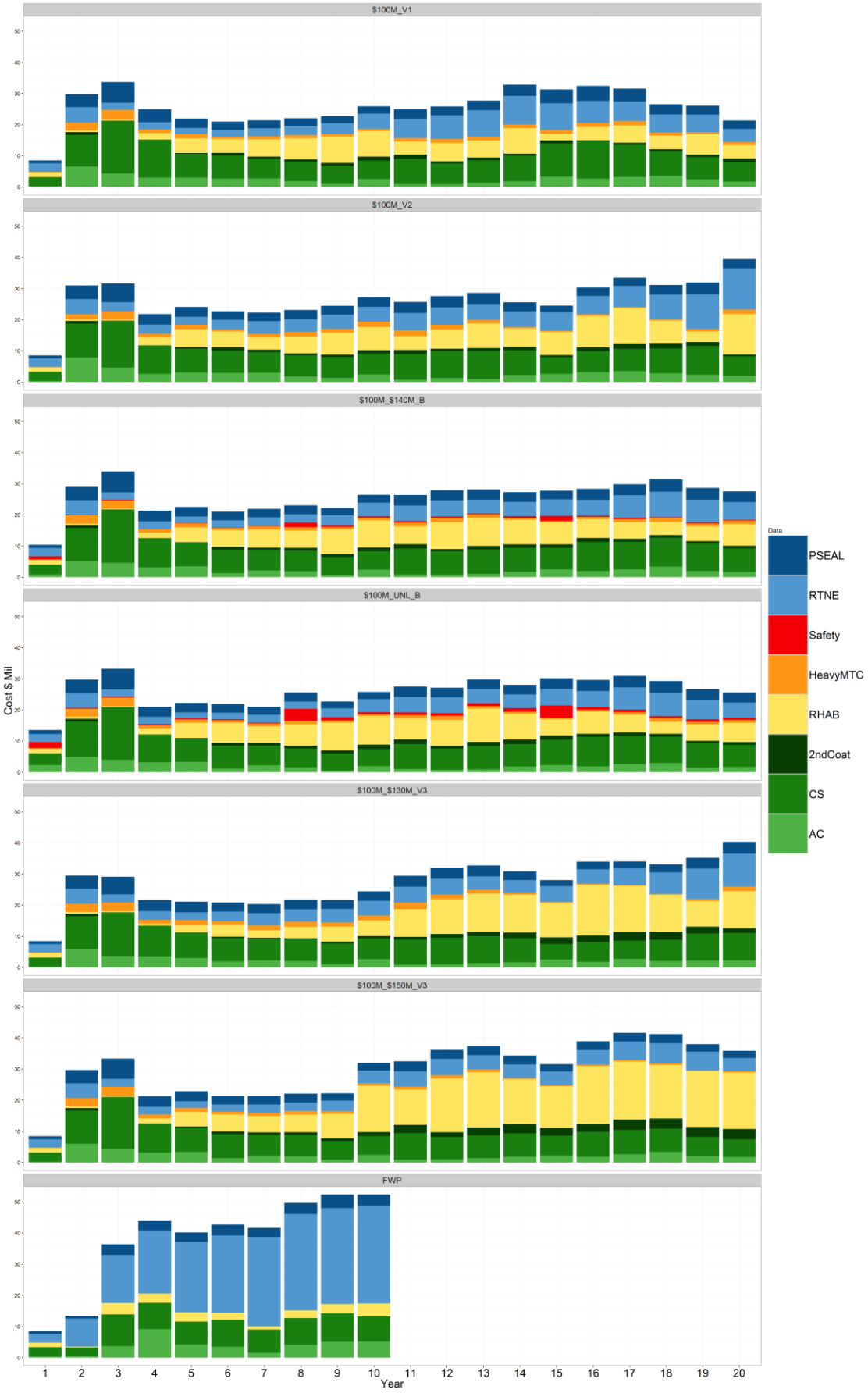
Cost $ Mil by ONRC - Regional



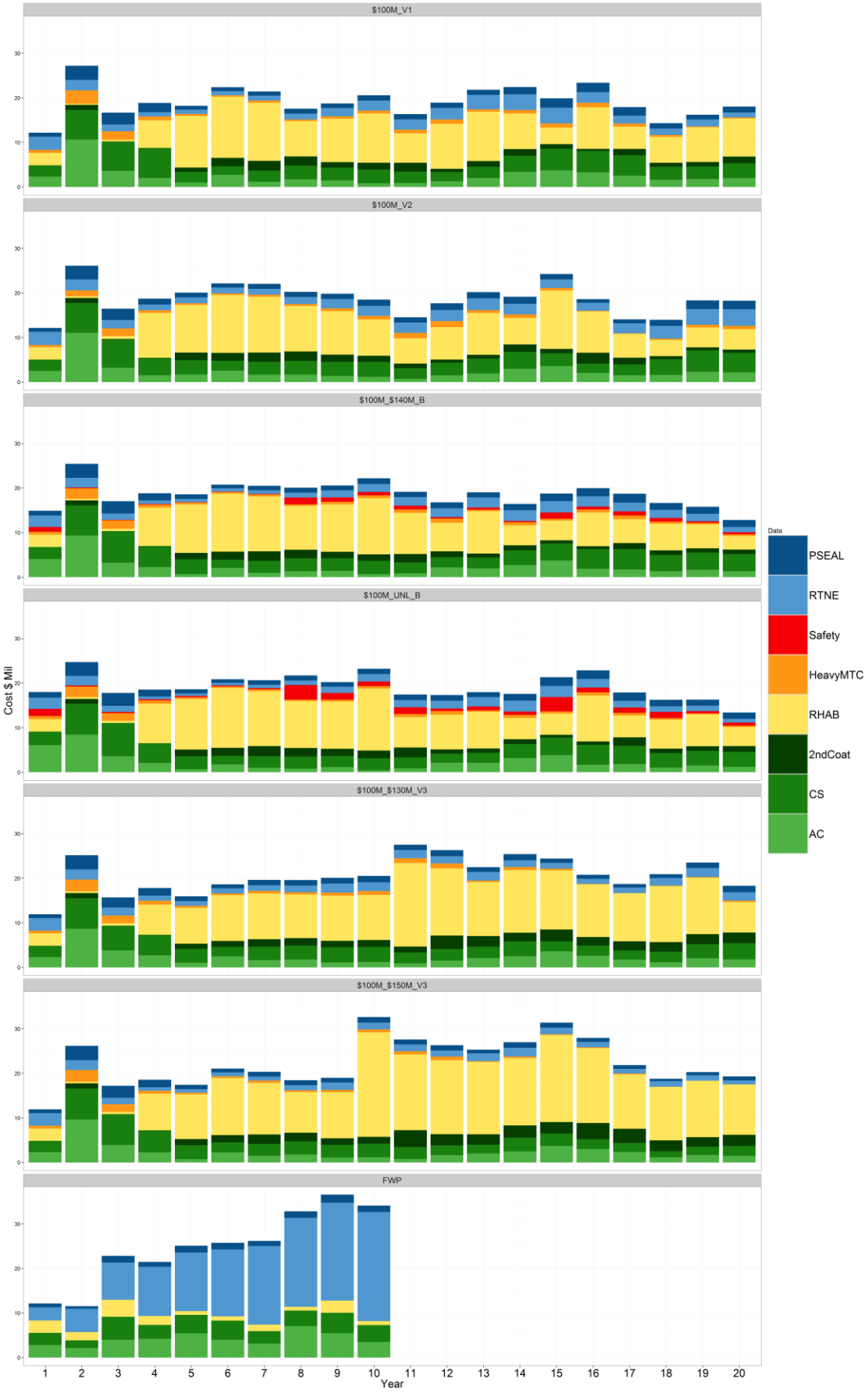
Cost $ Mil by ONRC - High Volume



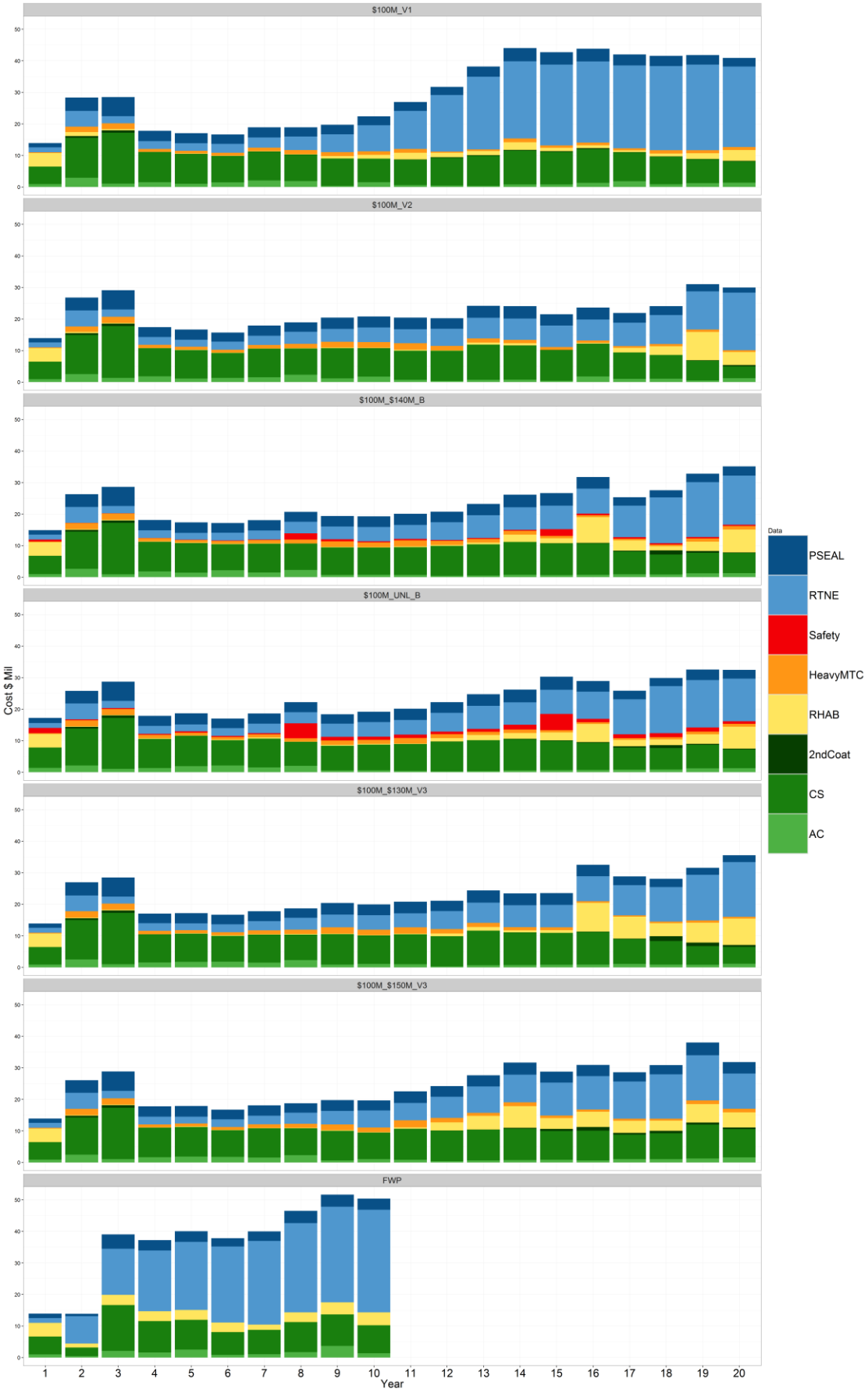
Cost $ Mil by ONRC - Arterial



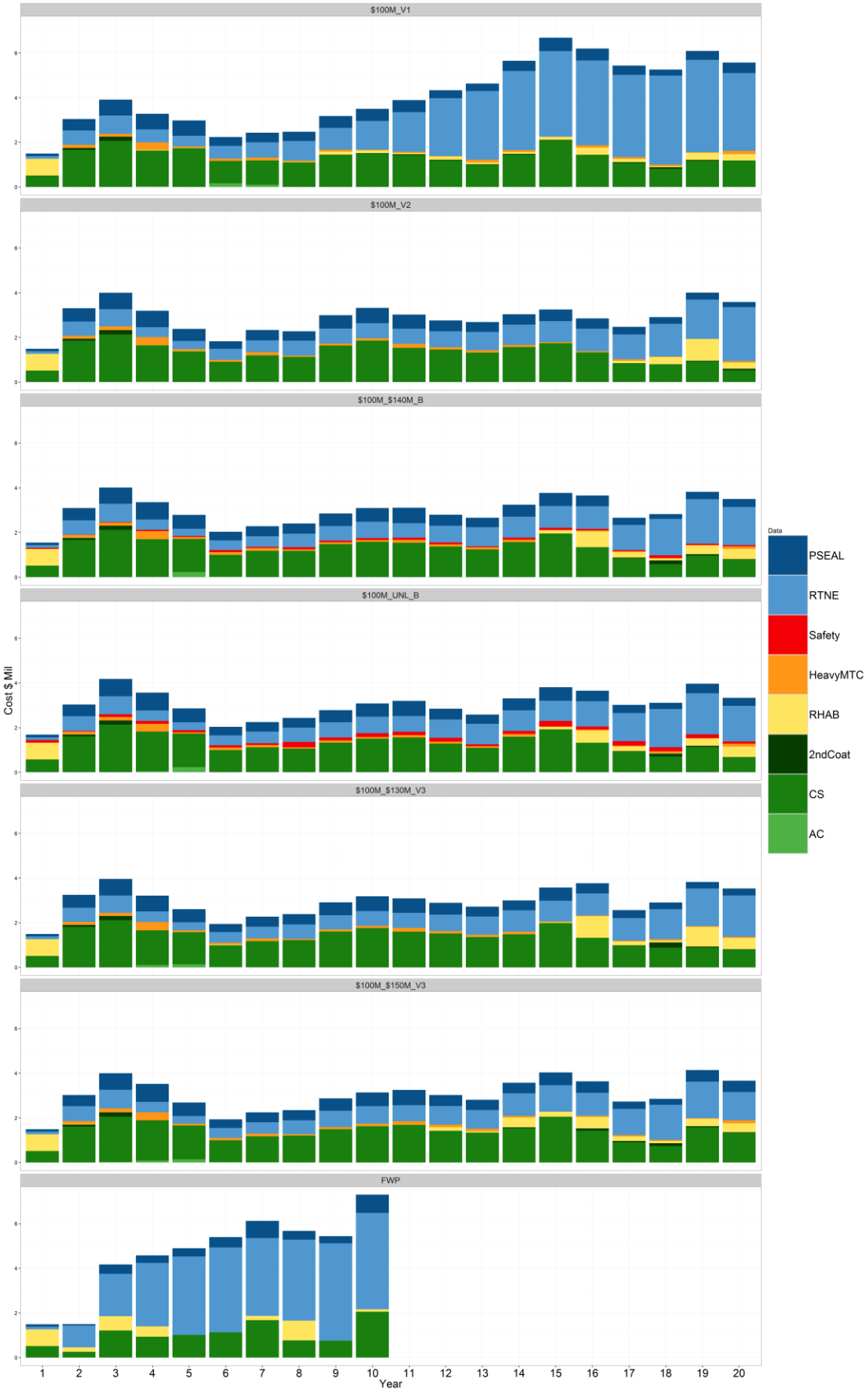
Cost $ Mil by ONRC - National



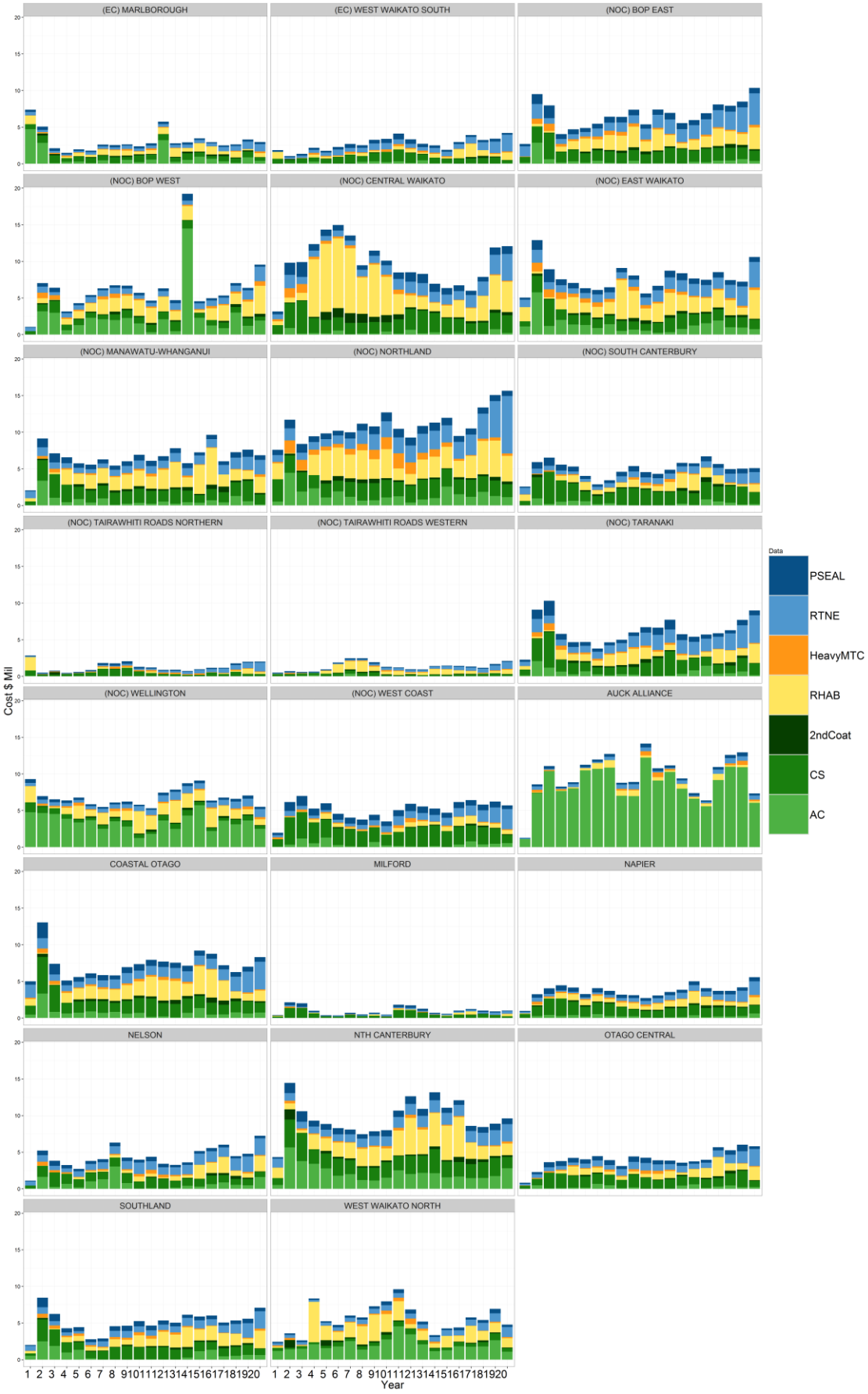
Cost $ Mil by ONRC - Primary Collector



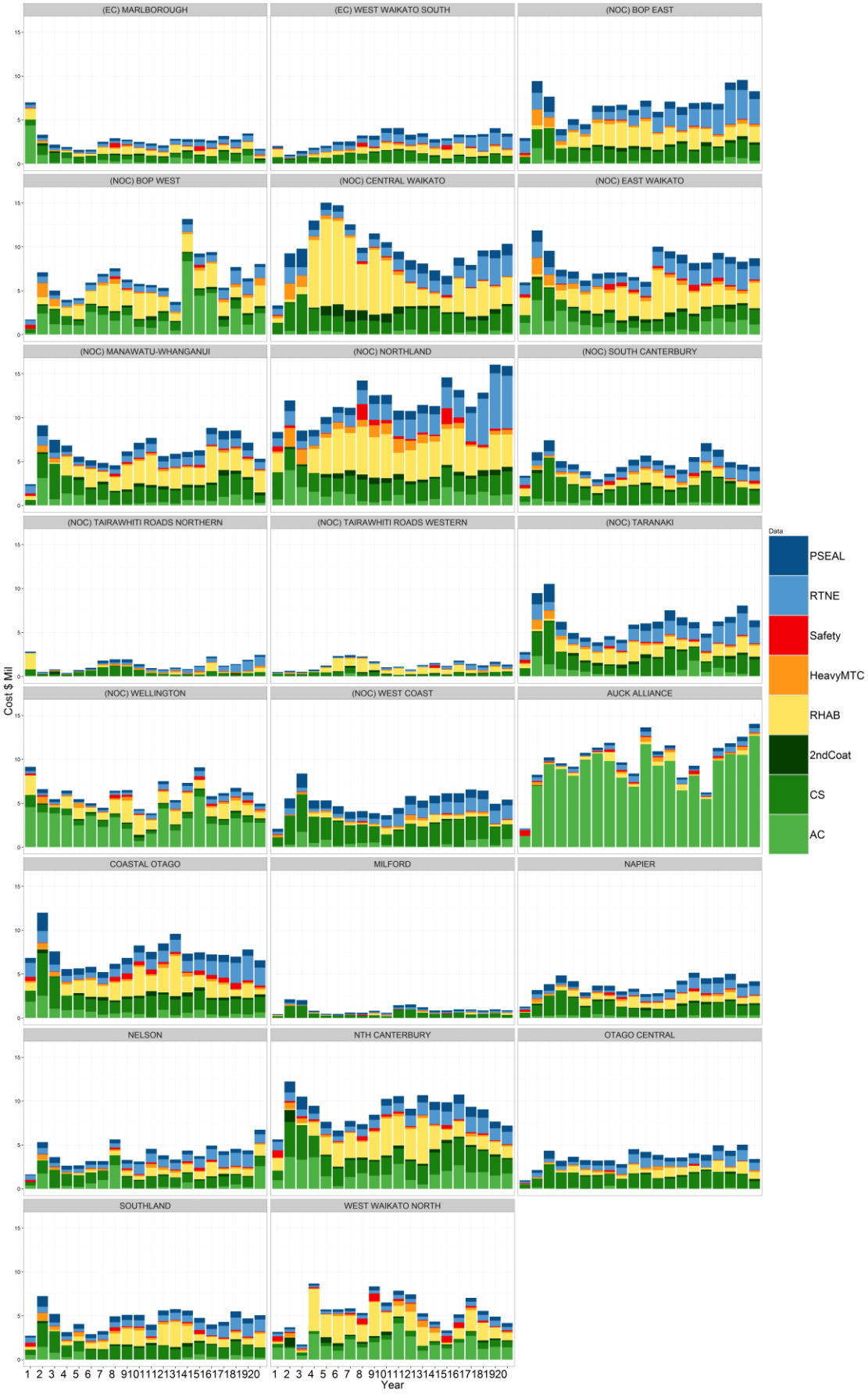
Cost $ Mil by ONRC - Secondary Collector



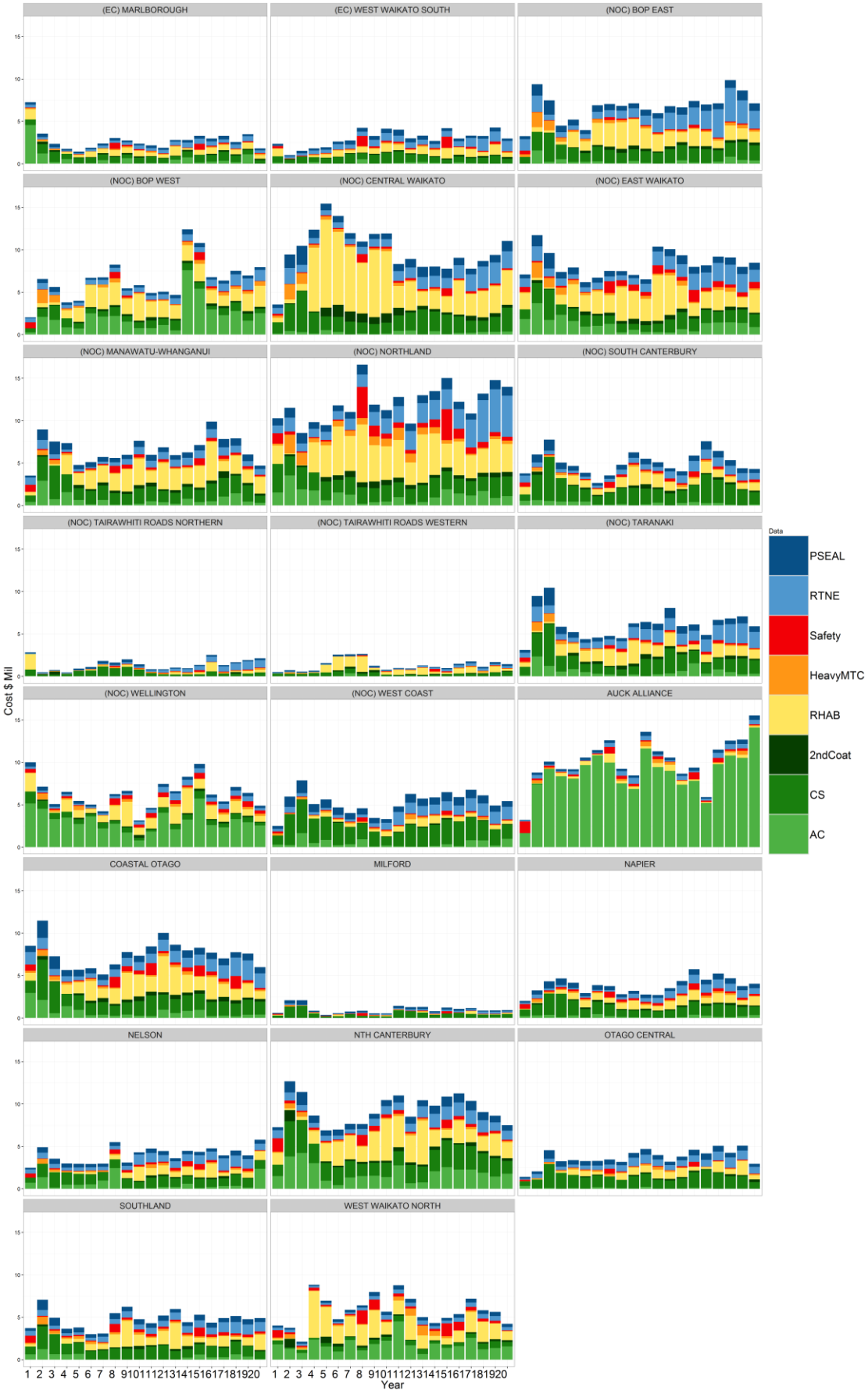
Cost $ Mil by NOC - $100M_V2



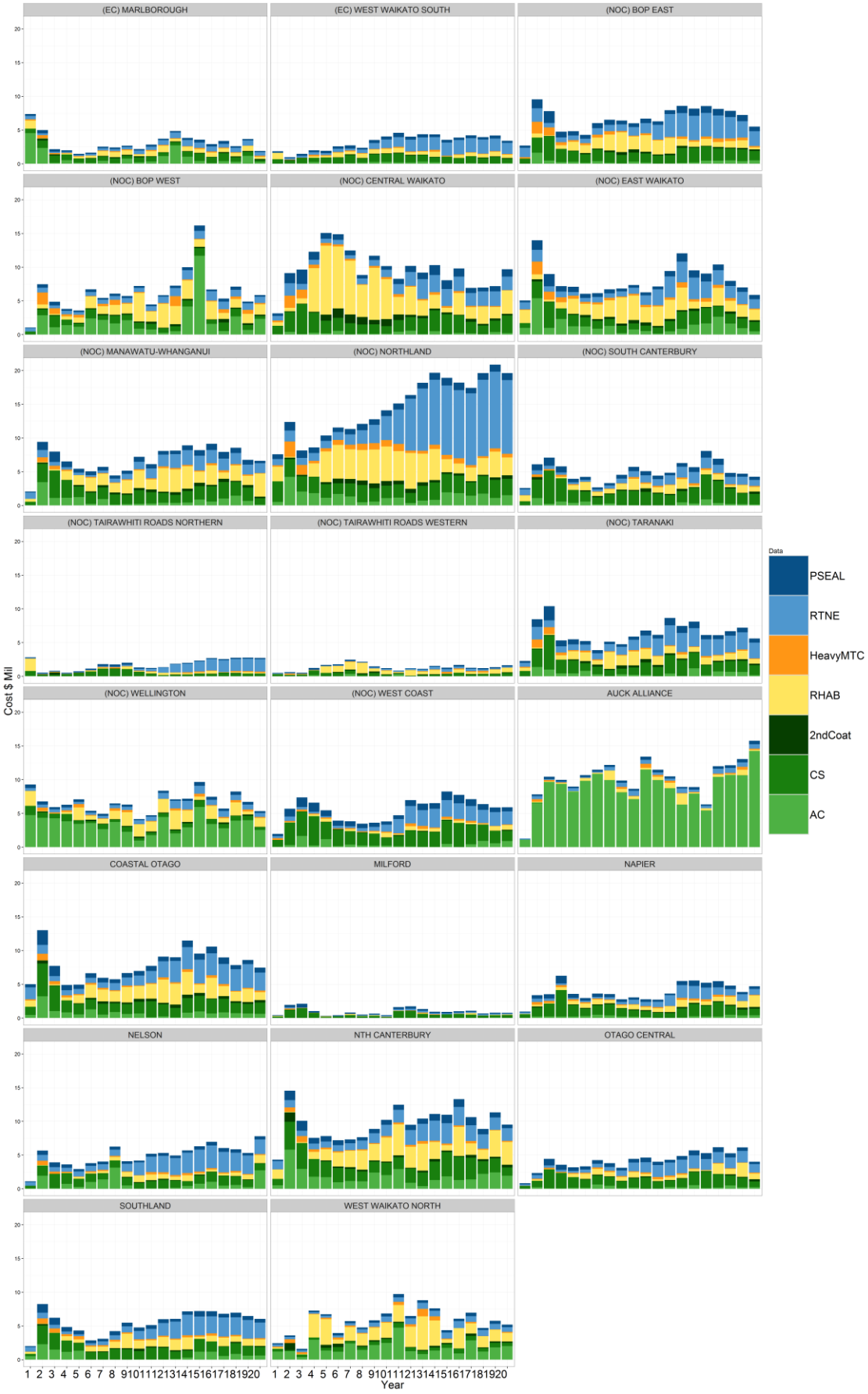
Cost $ Mil by NOC - $100M_$140M_B



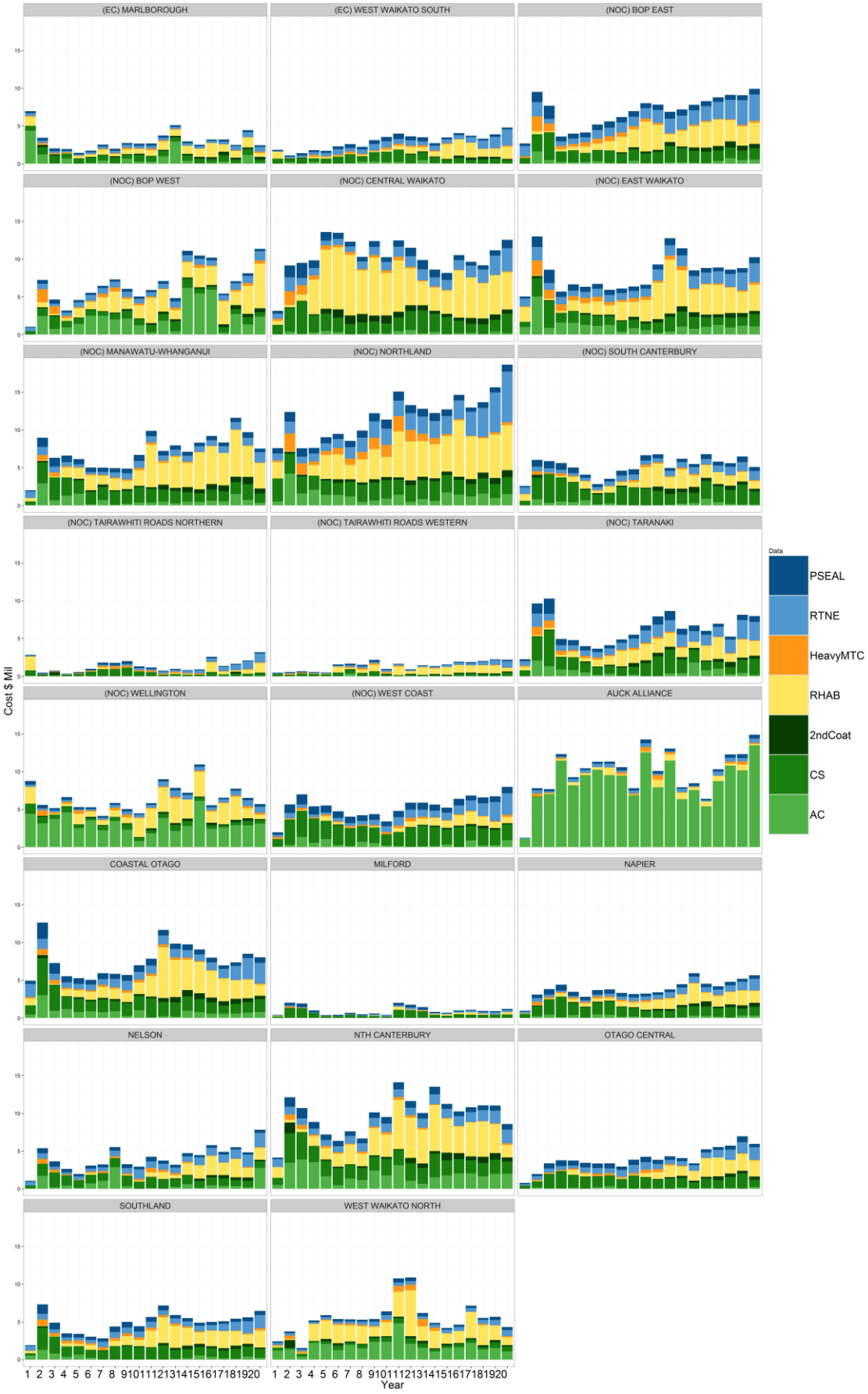
Cost $ Mil by NOC - $100M_UNL_B



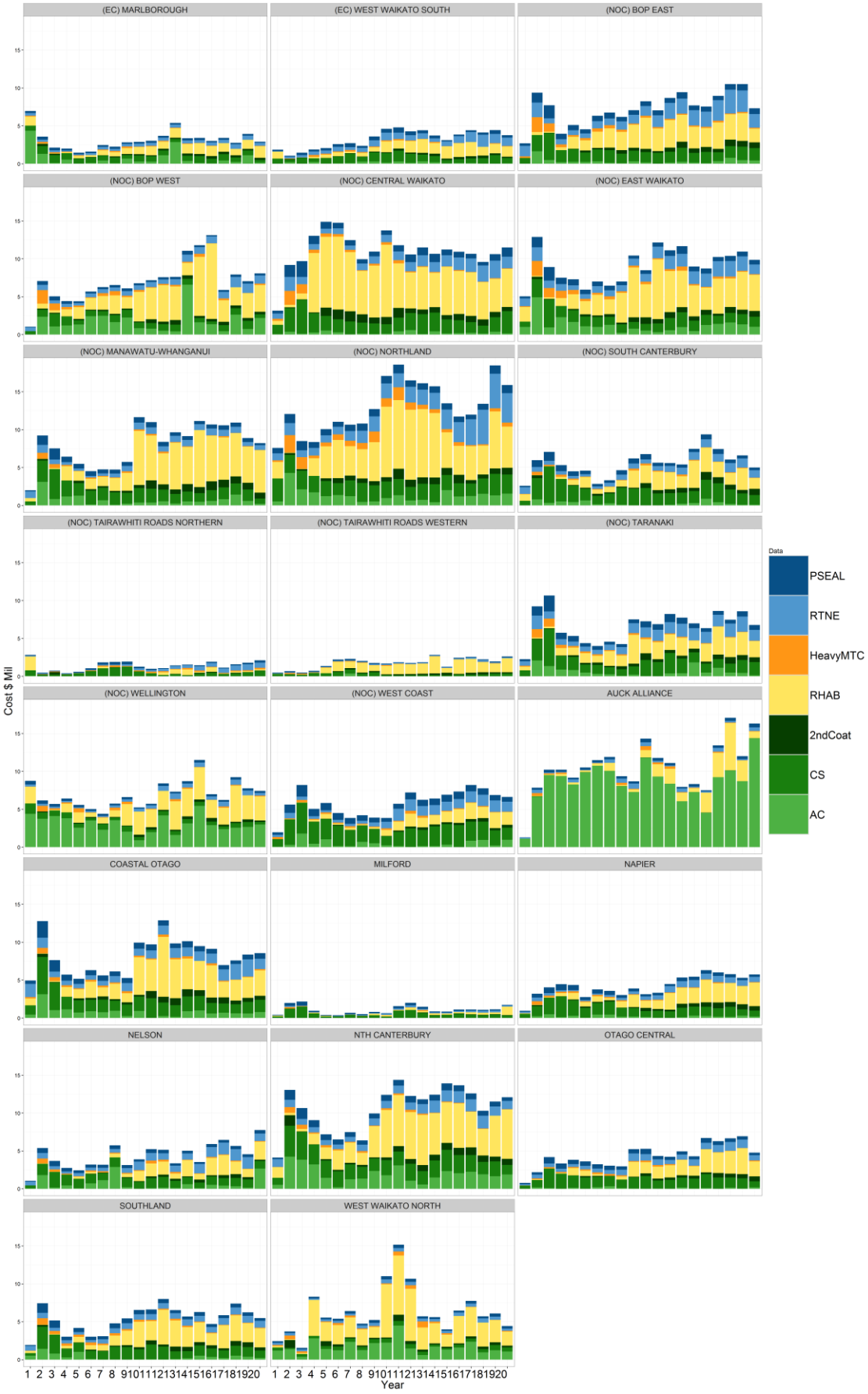
Cost $ Mil by NOC - $100M_V1



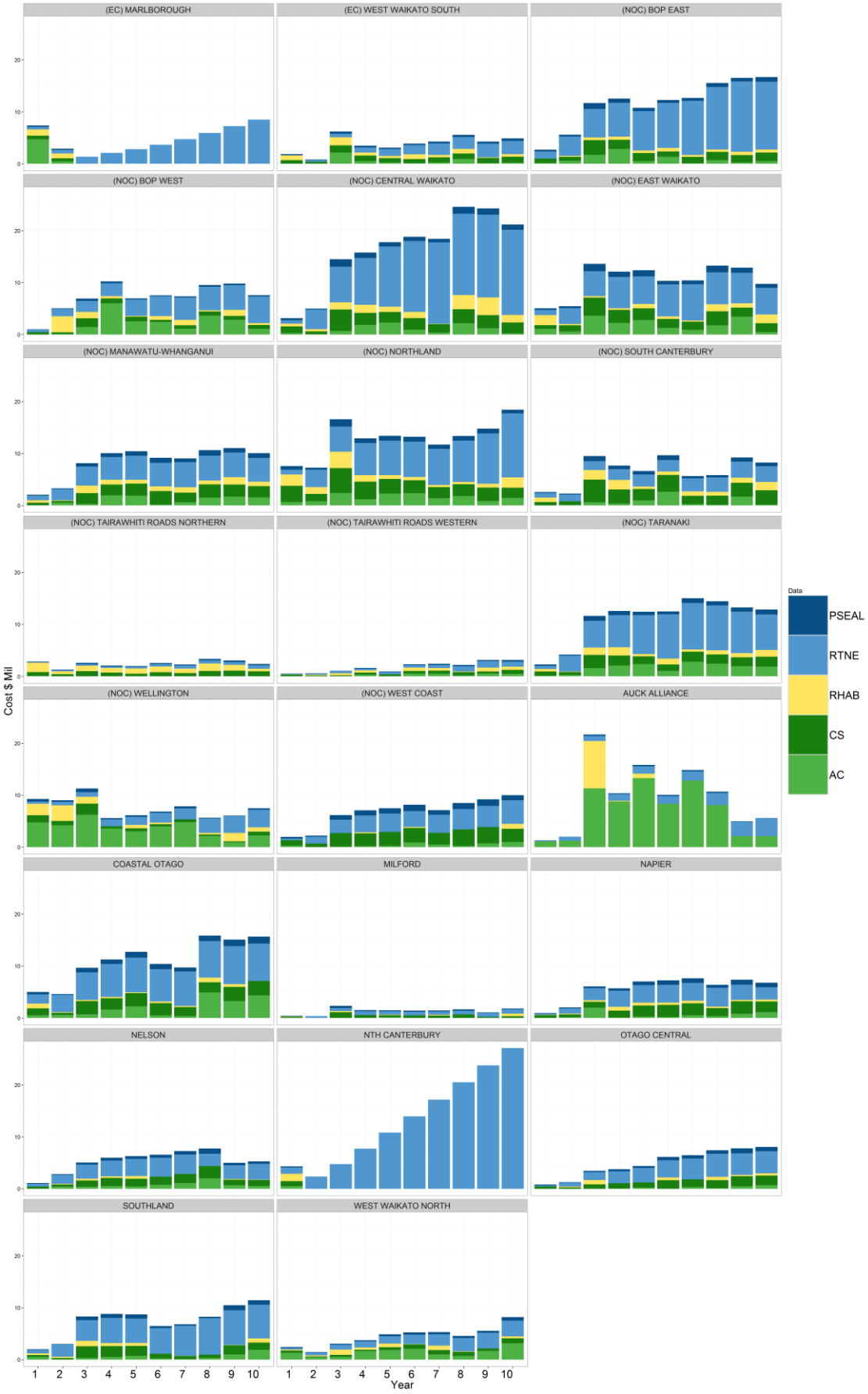
Cost $ Mil by NOC - $100M_$130M_V3



Cost $ Mil by NOC - $100M_$150M_V3



Cost $ Mil by NOC - FWP



1.3 Output Variable Charts – Recommended Options

This set of outputs includes Box & Whisker charts for each key variable.

- Roughness
- SII (Surfacing Integrity Index)
- Rutting
- PCI (Pavement Condition Index – overall condition)

The first series compares the six (6) 'Recommended Options' as time series over 20 years

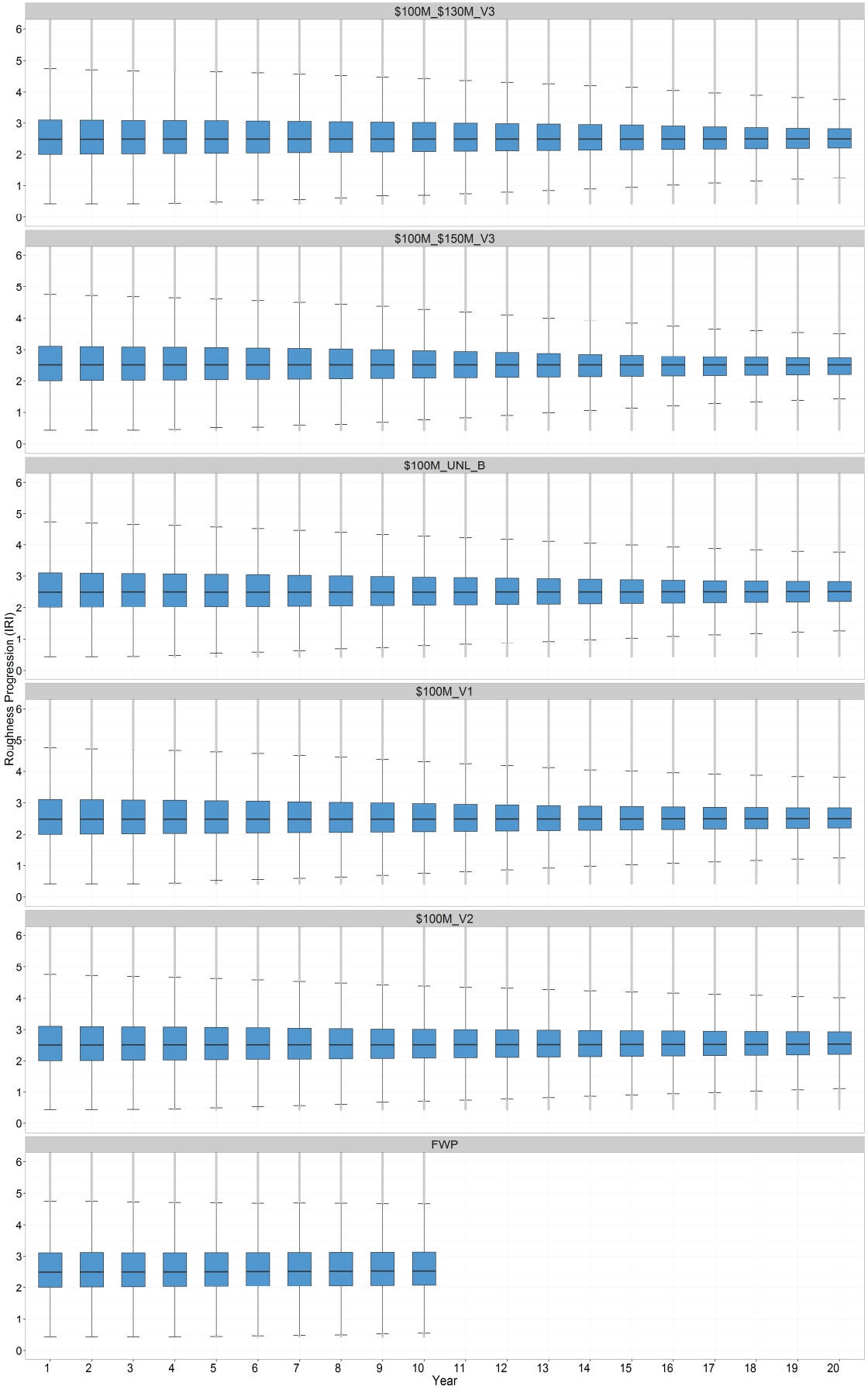
- **$100M_$130M_V3**
  - Renewal Investment: Fixed **$100M pa** through 2025, increasing to **$130M pa**
  - Routine Investment: Fixed **$30M pa**
  - Safety Investment: Safety not Included
- **$100M_$150M_V3**
  - Renewal Investment: Fixed **$100M** pa through 2025, increasing to **$150M pa**
  - Routine Investment: Fixed **$30M pa**
  - Safety Investment: Safety not Included
- **$100M_UNL_B**
  - Renewal Investment: Fixed **$100M pa**
  - Routine Investment: Fixed **$30M pa**
  - Safety Investment: **Unlimited**, Safety programme completed
- **$100M_V1**
  - Renewal Investment: Fixed **$100M pa**
  - Routine Investment: **Unlimited**
  - Safety Investment: Safety not Included
- **$100M_V2**
  - Renewal Investment: Fixed **$100M pa**
  - Routine Investment: Fixed **$30M pa**
  - Safety Investment: Safety not Included
- **FWP – Contractors 10 year Specimen Programmes adjusted by RAPT reviews**
  - Renewal Investment: **Unlimited**
  - Routine Investment: **Unlimited pa**
  - Safety Investment: Safety not Included

The second series compares the six (6) ONRC Classes as time series over 20 years for each 'Recommended Options' for each variable.

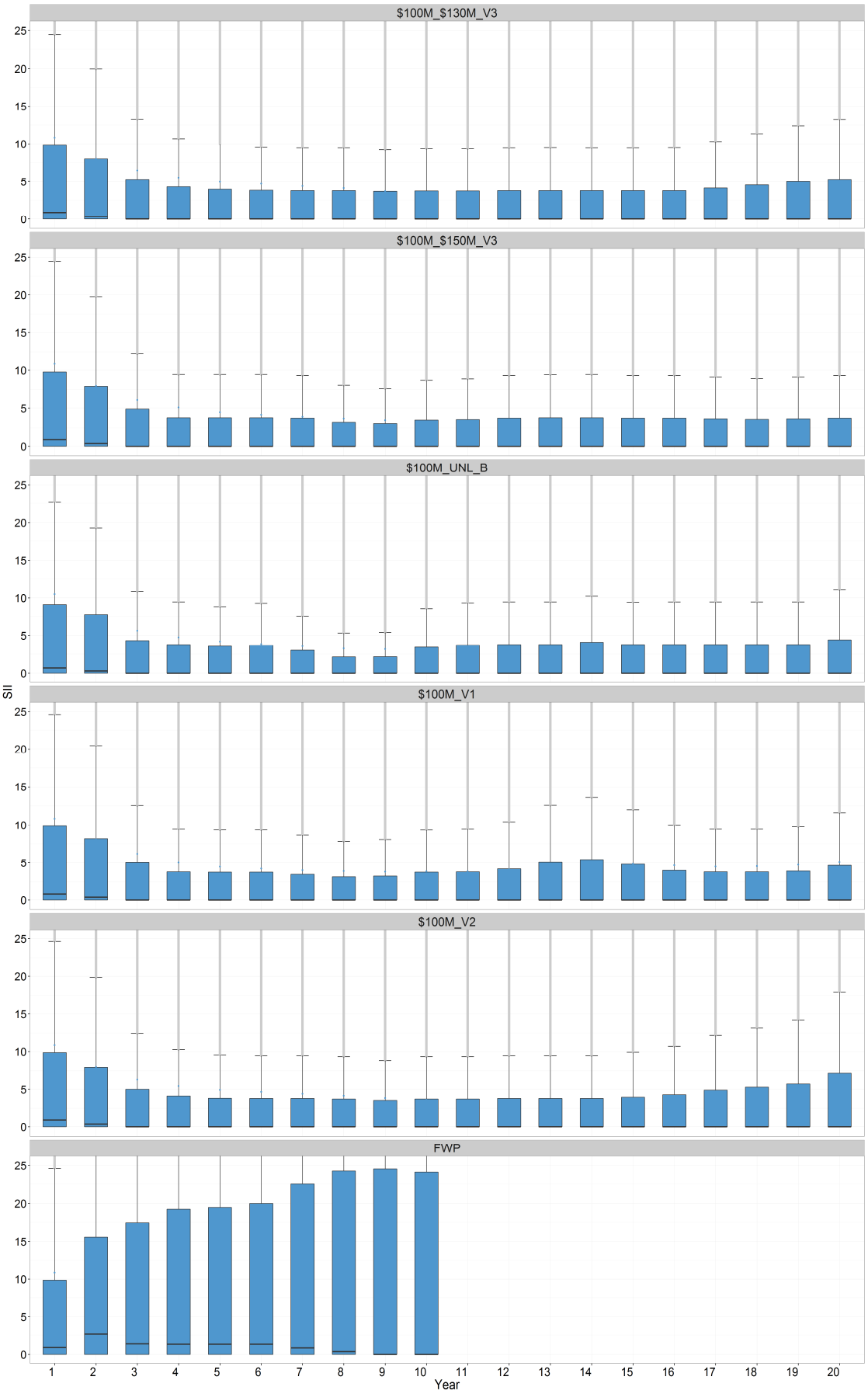
- Secondary Collector
- Primary Collector
- Arterial
- Regional
- National
- National High Volume

The final series compares the 'Recommended Options' by ONRC Class at three time snapshots (Current (Yr0), 10 Years and 20 Years) for each variable.

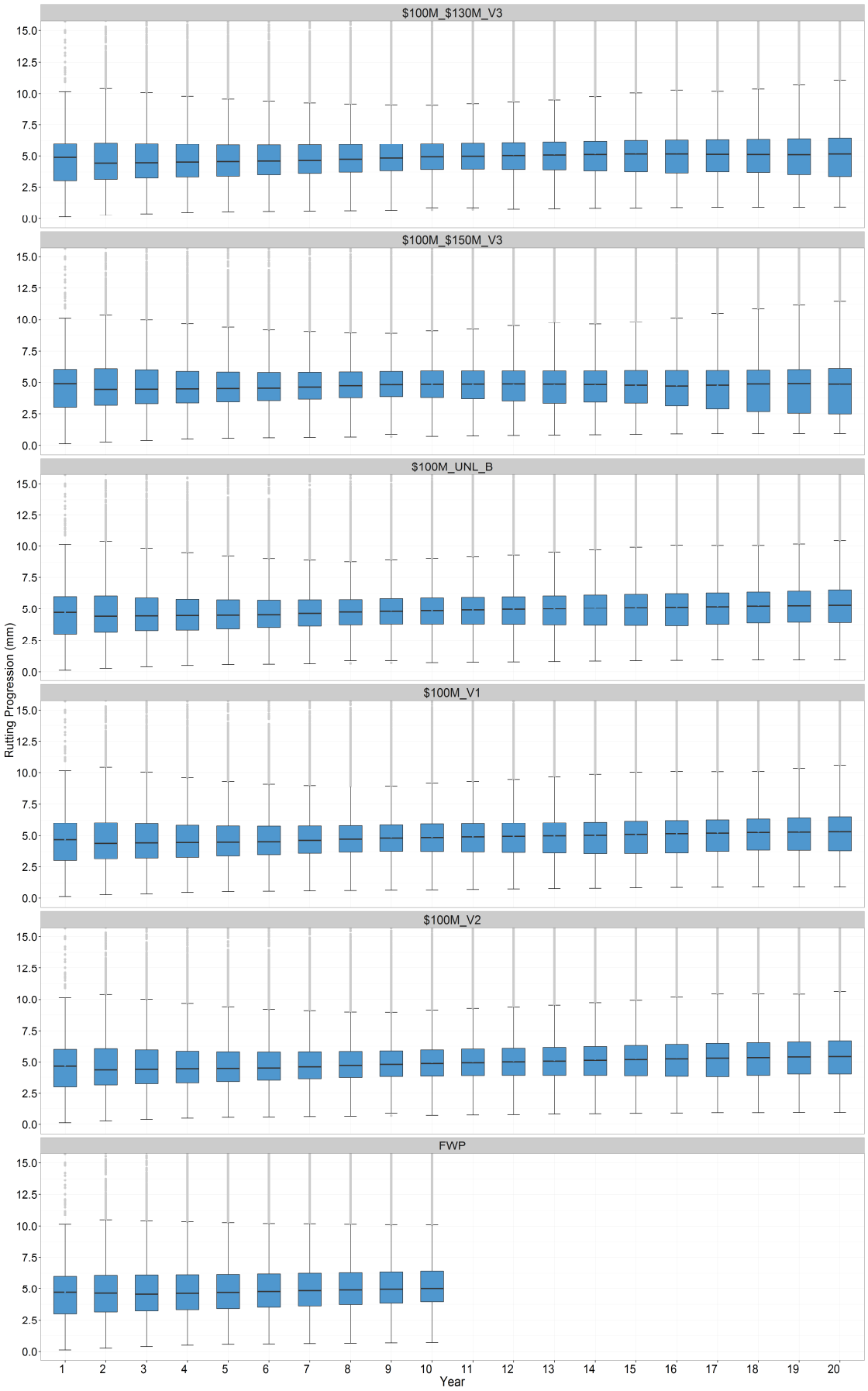
Roughness Distribution 20 Years



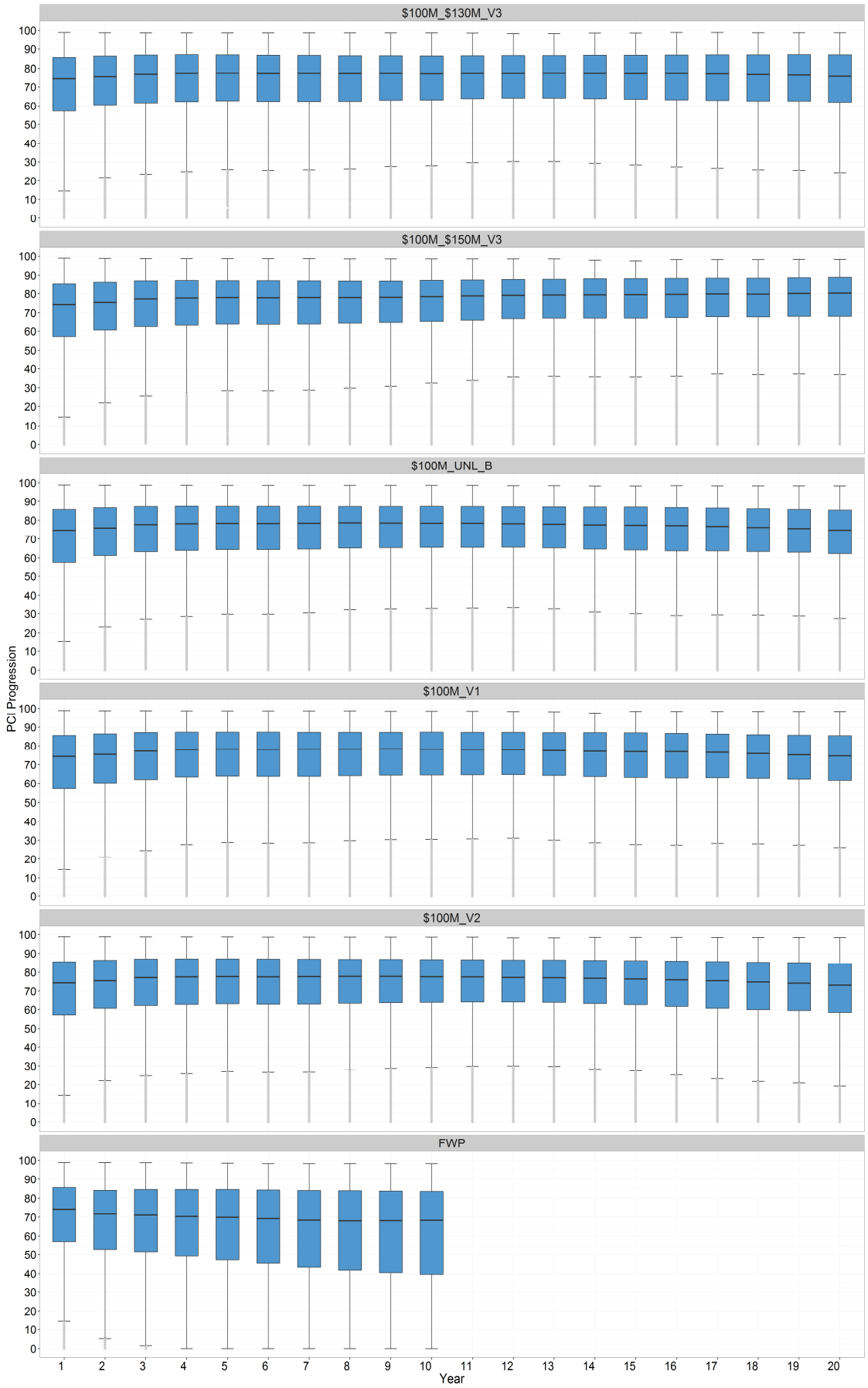
SII Distribution 20 Years



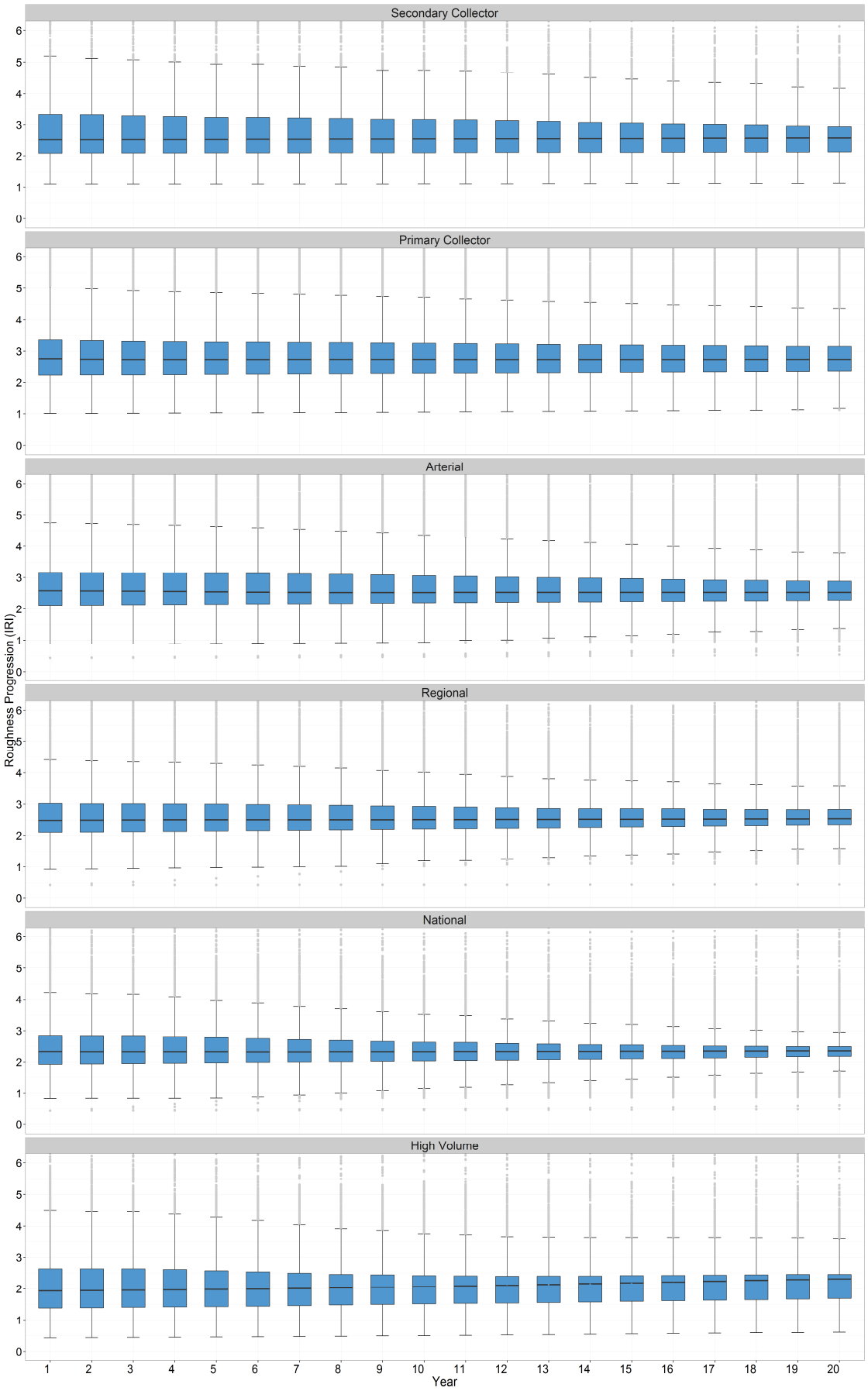
Rutting Distribution 20 Years



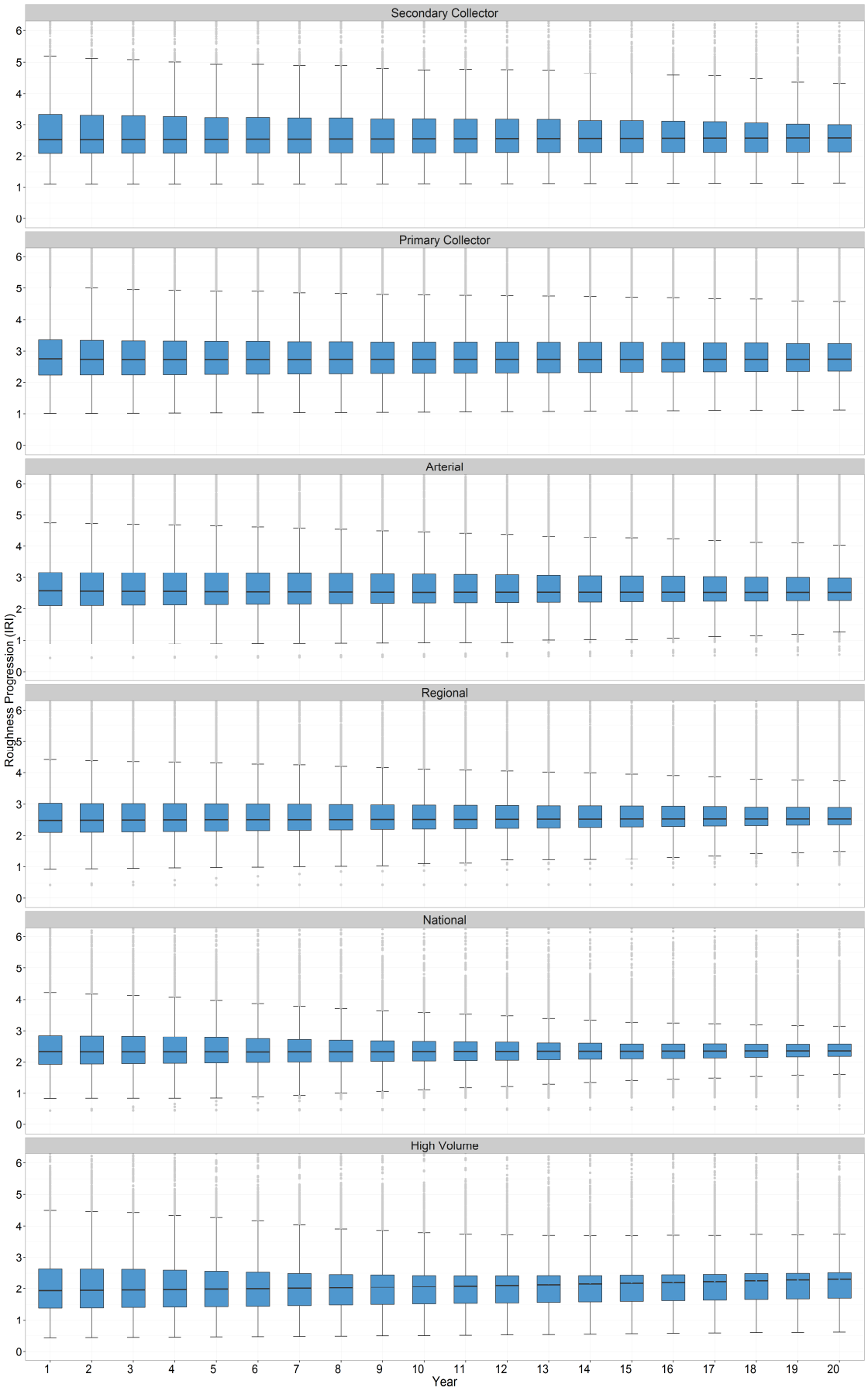
PCI Distribution 20 Years



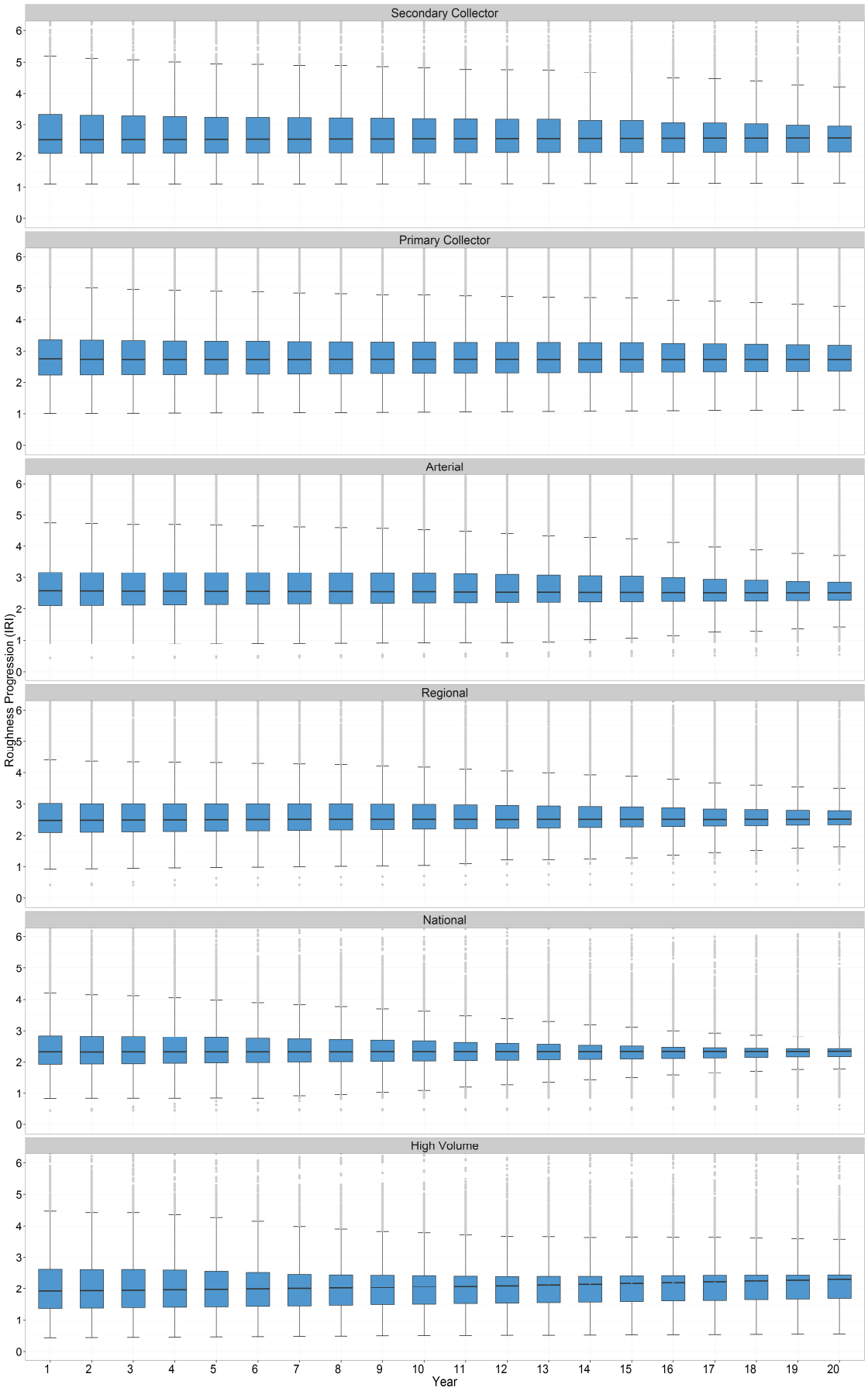
Roughness Distribution 20 Years- $100M_V1



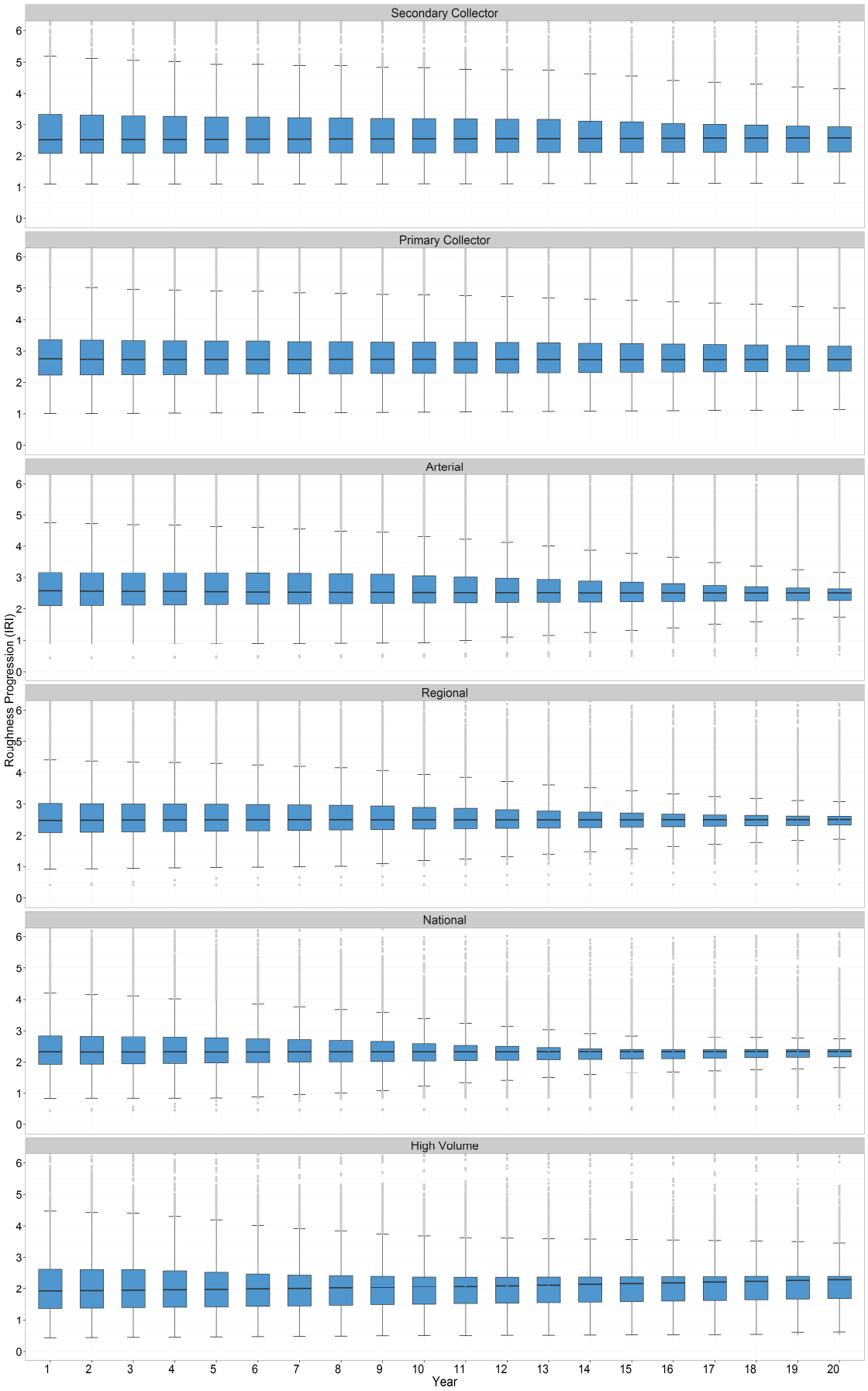
Roughness Distribution 20 Years- $100M_V2



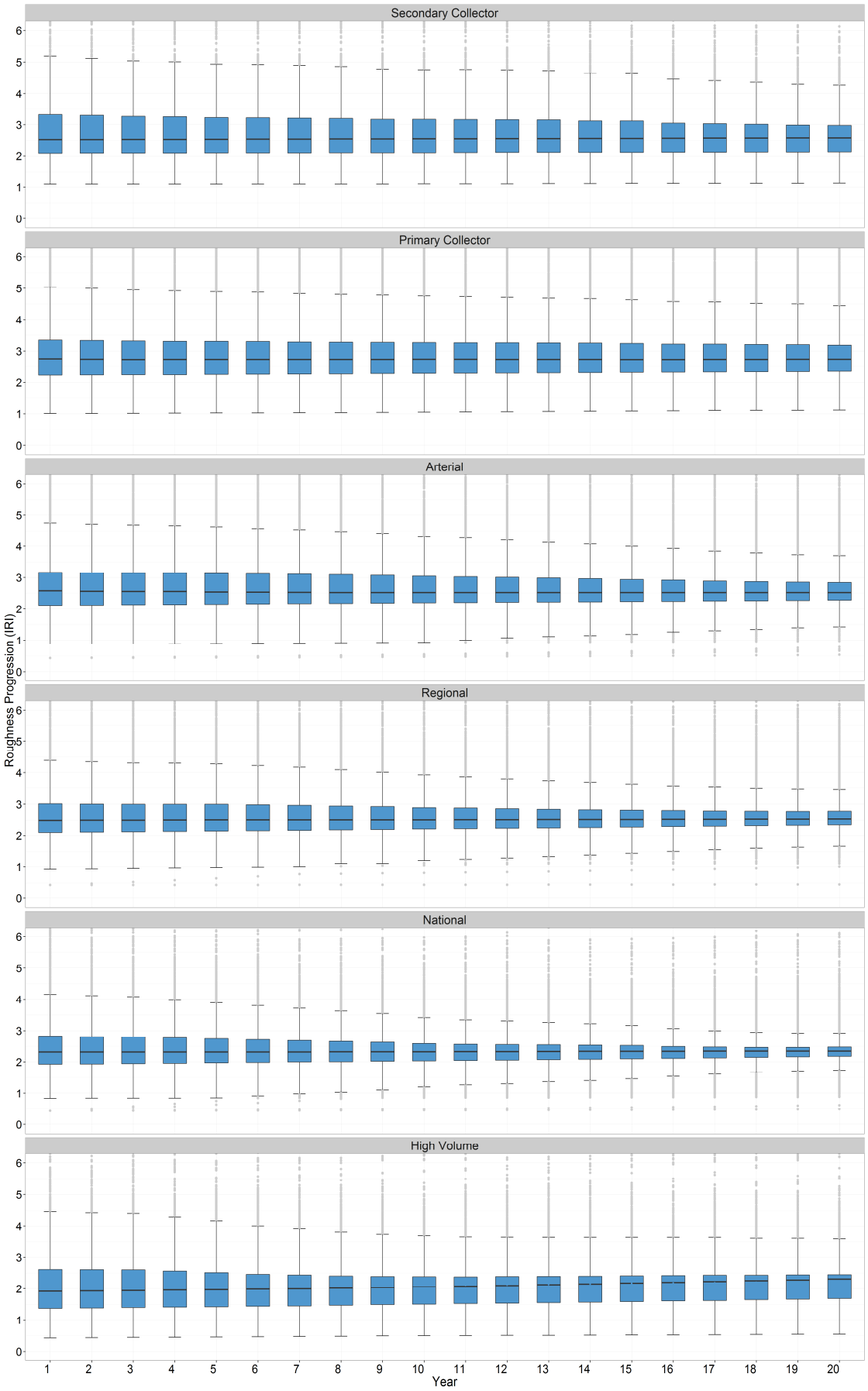
Roughness Distribution 20 Years- $100M_$130M_V3



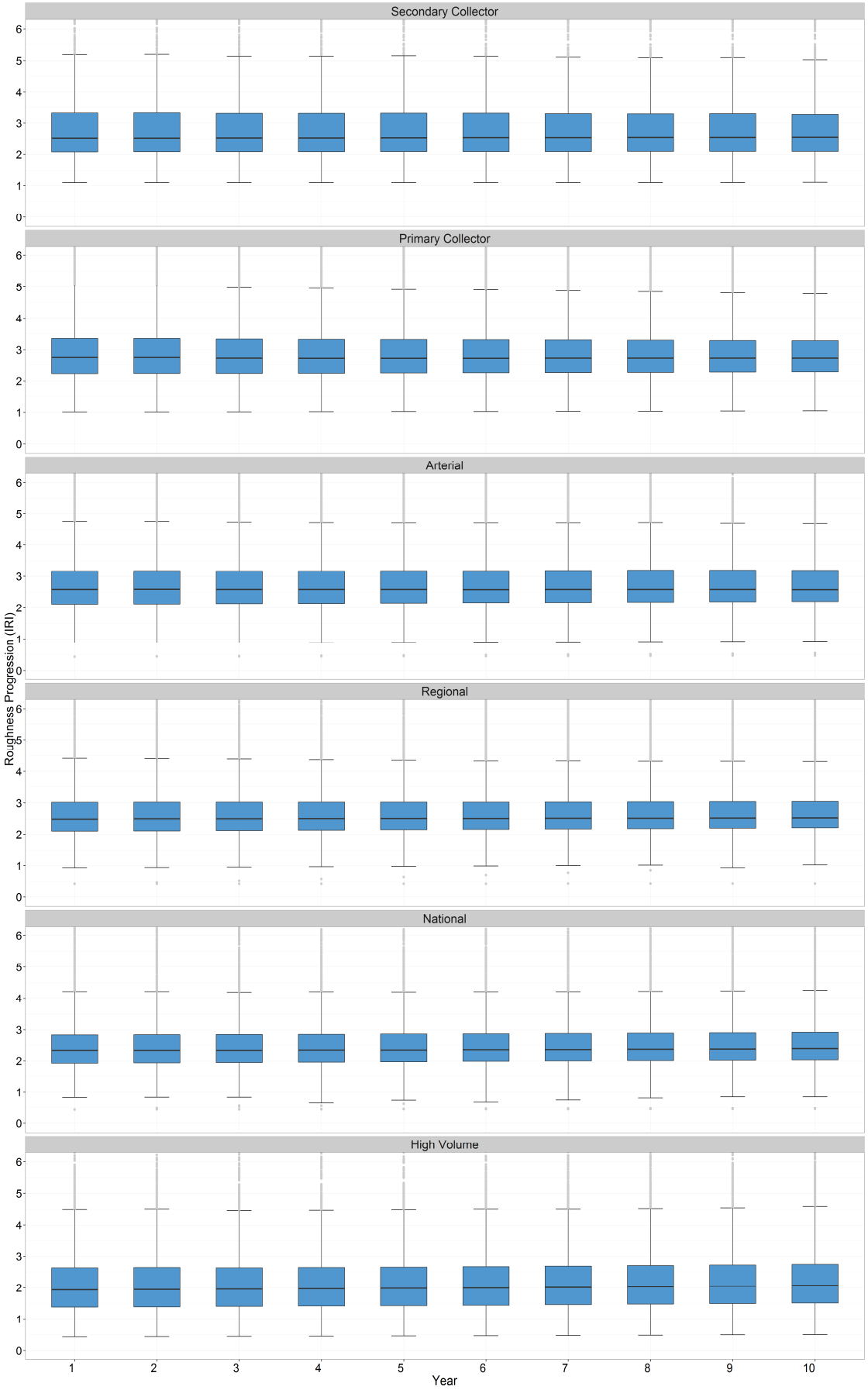
Roughness Distribution 20 Years- $100M_$150M_V3



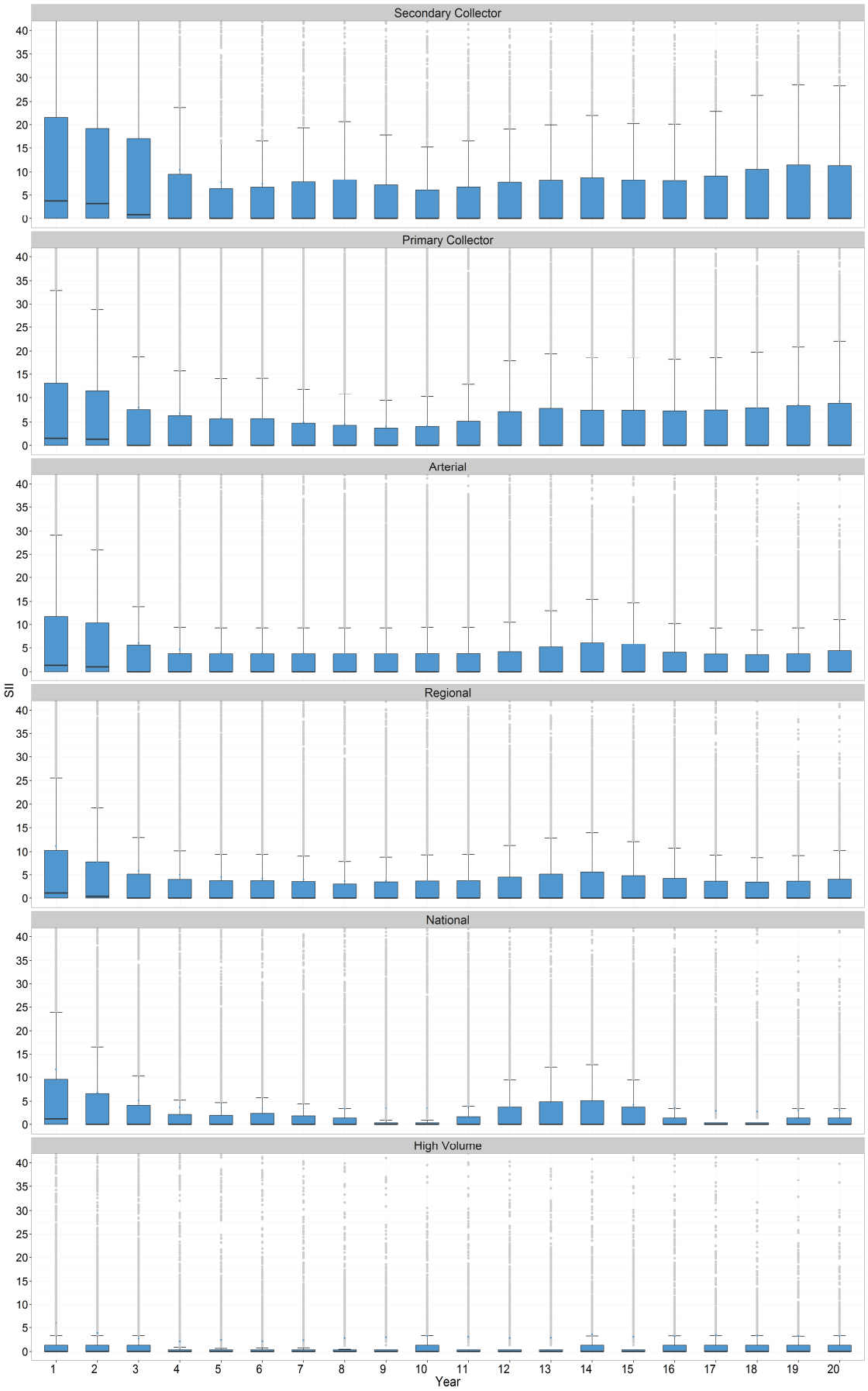
Roughness Distribution 20 Years- $100M_UNL_B



Roughness Distribution 20 Years- FWP



SII Distribution 20 Years - $100M_V1



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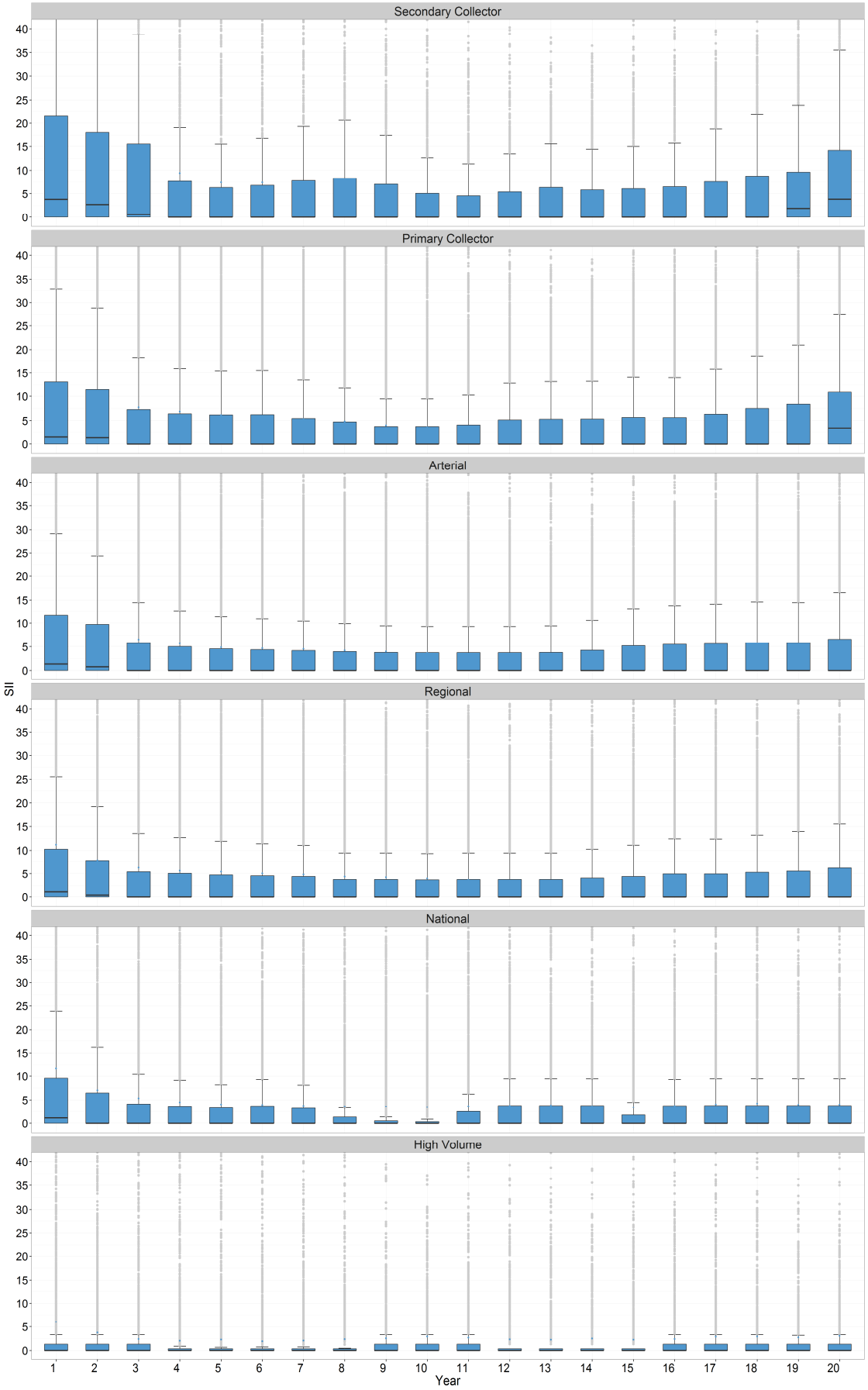
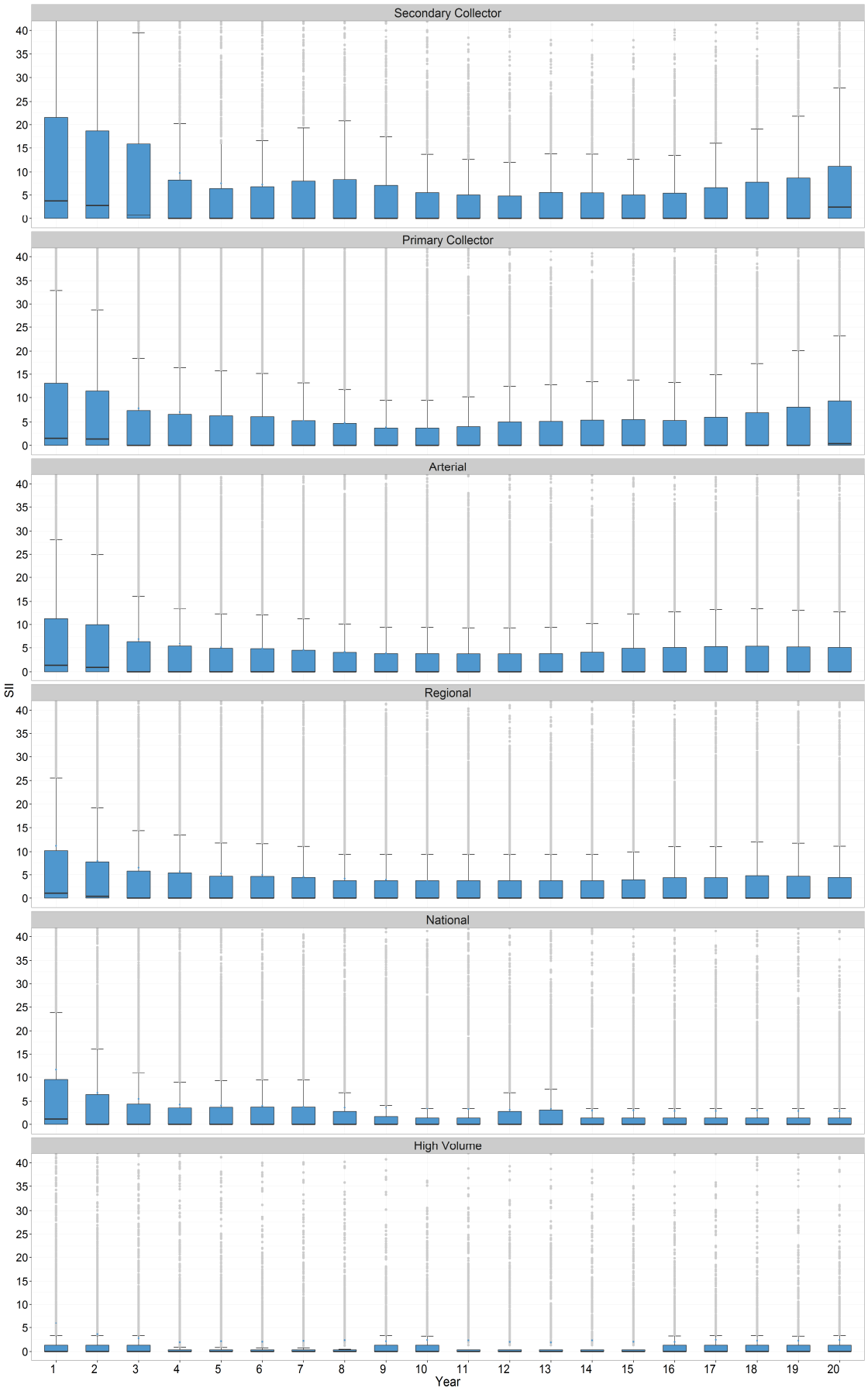
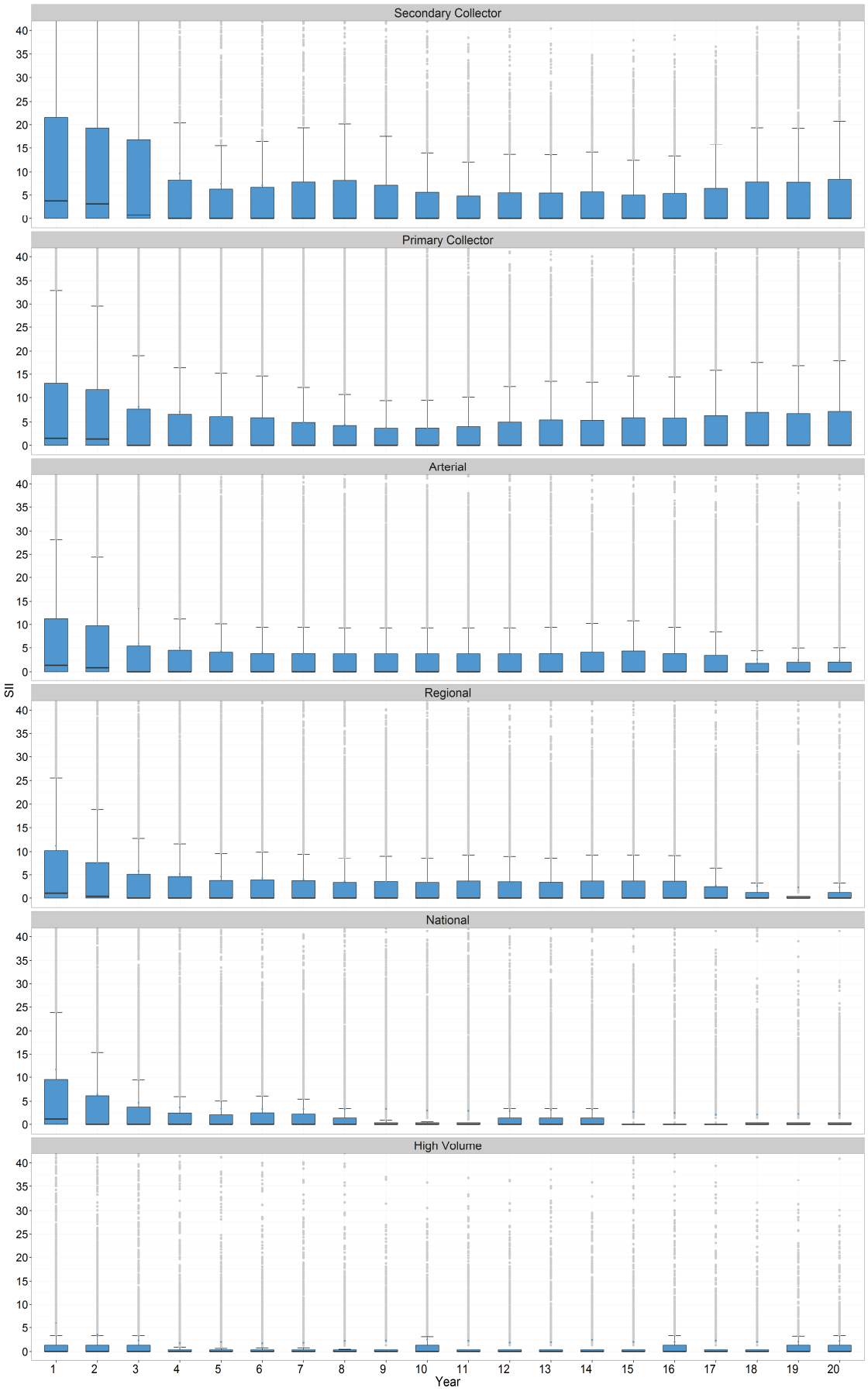


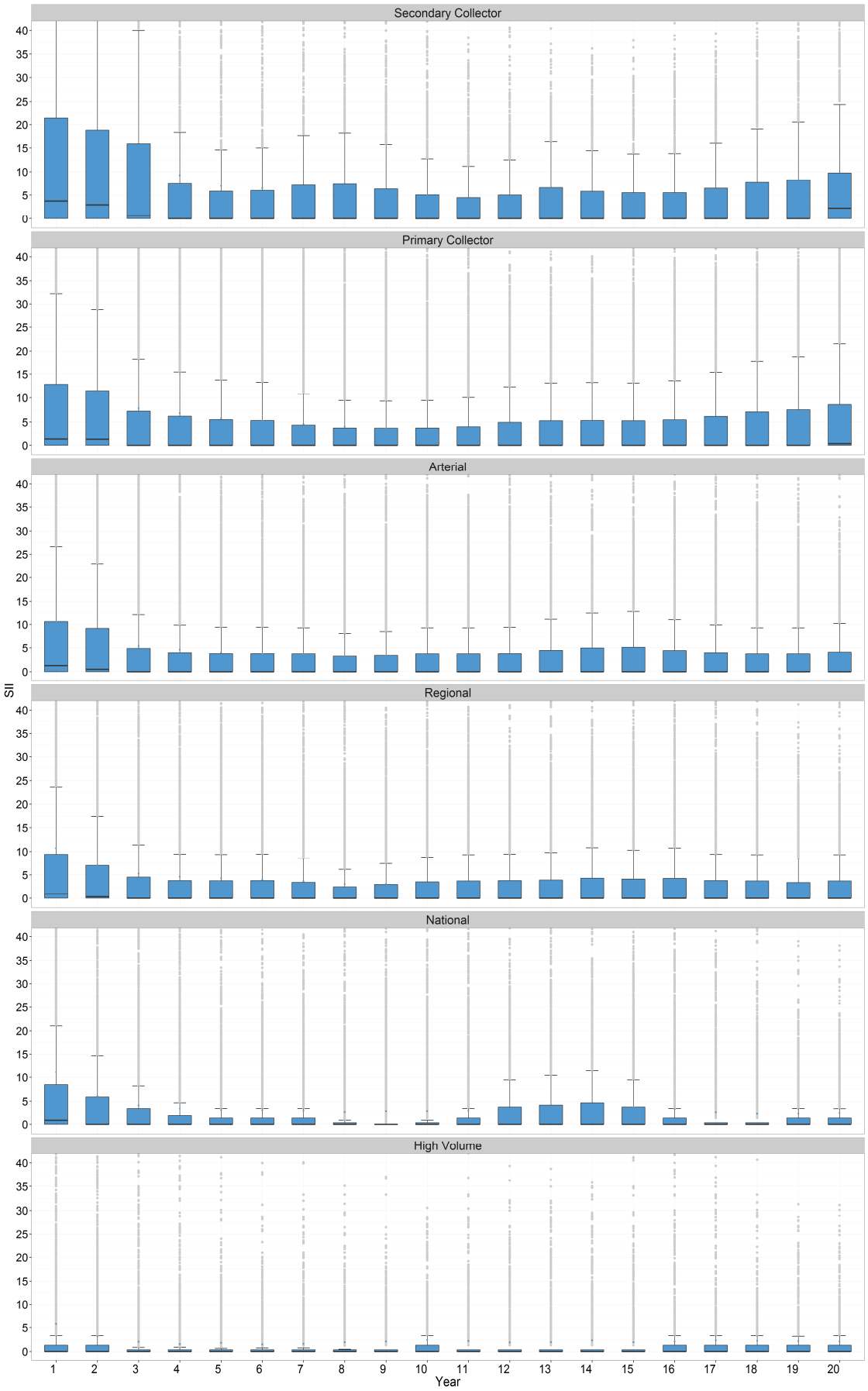
SII Distribution 20 Years - $100M_$130M_V3



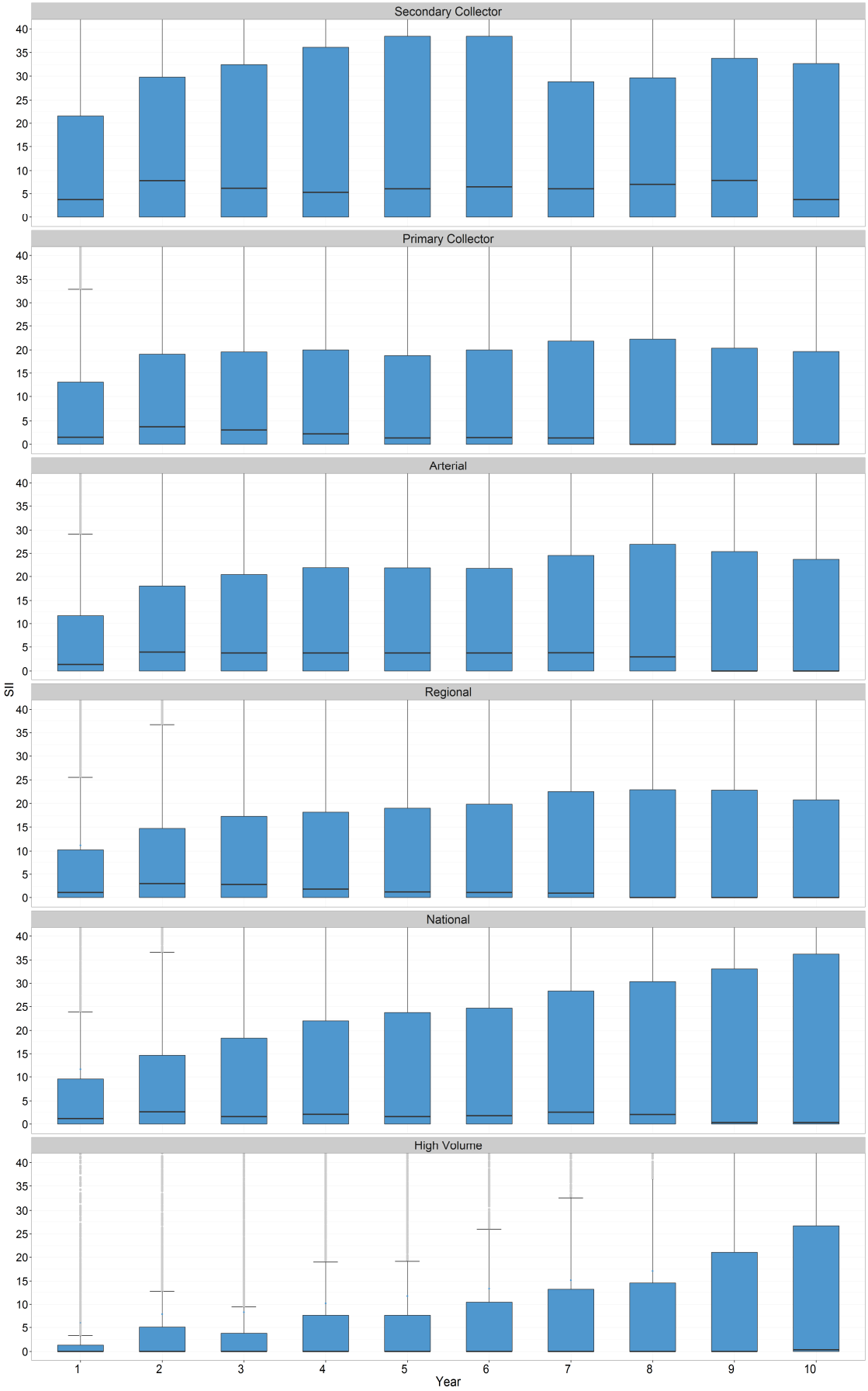
SII Distribution 20 Years - $100M_$150M_V3



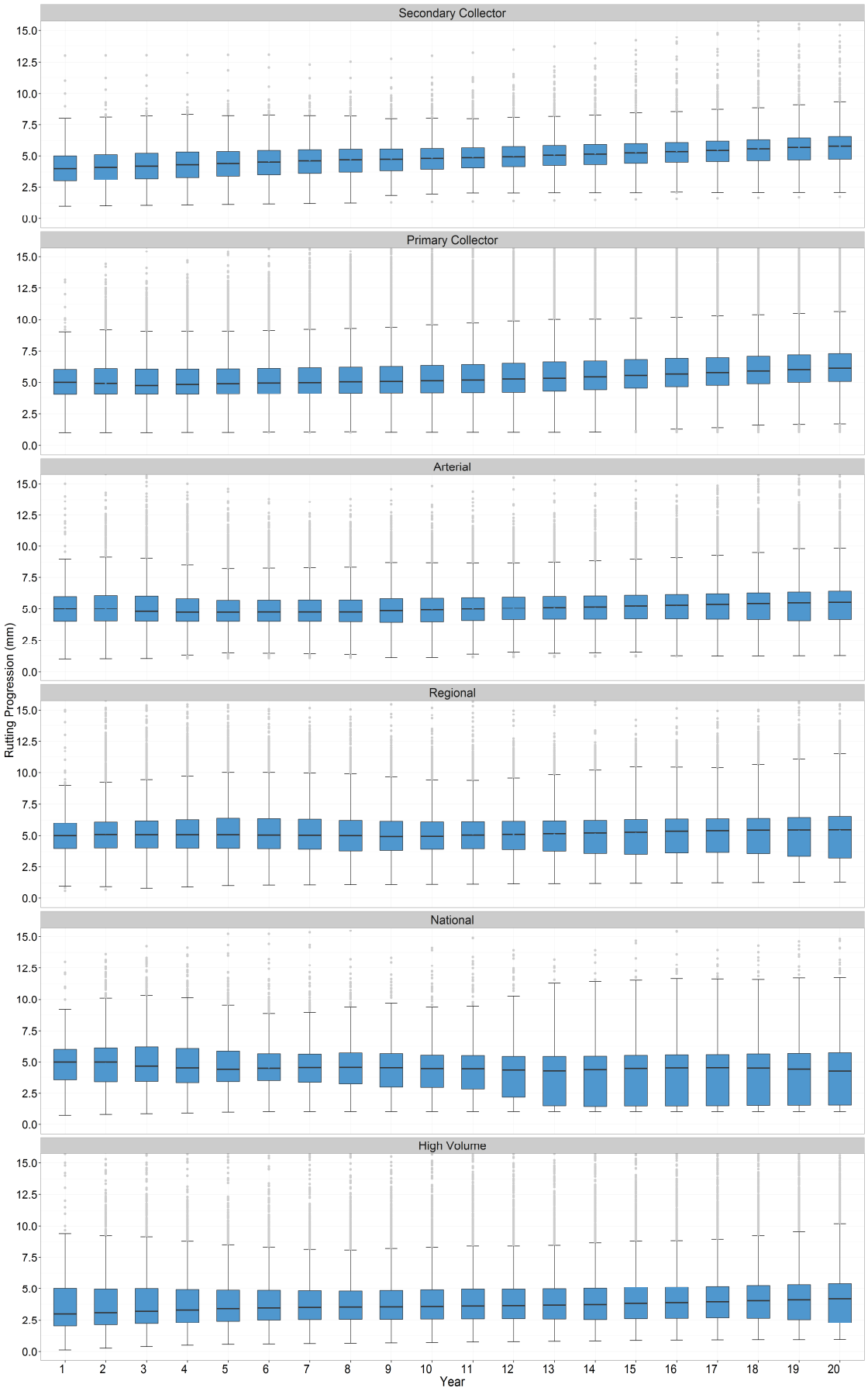
SII Distribution 20 Years - $100M_UNL_B



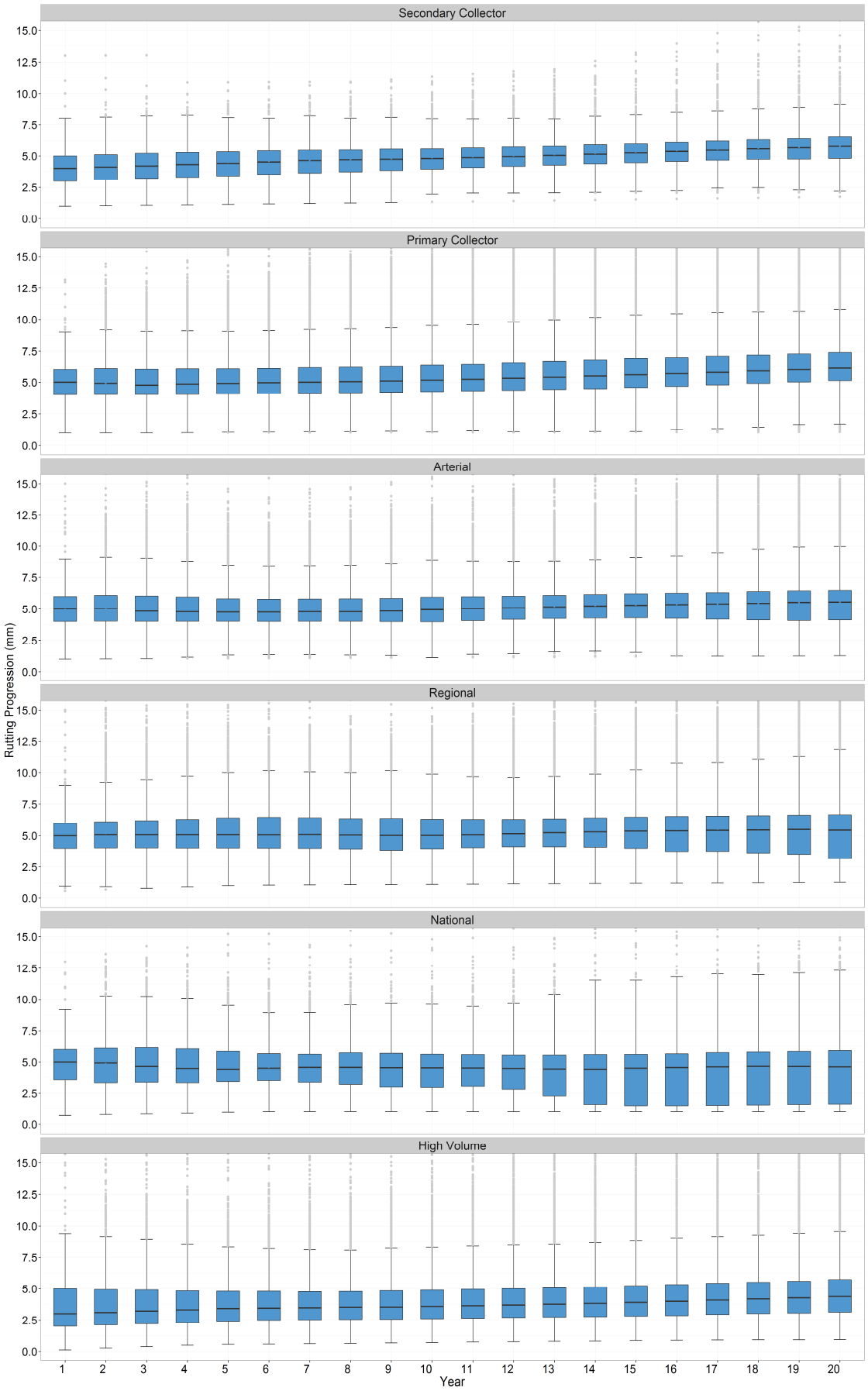
SII Distribution 20 Years - FWP



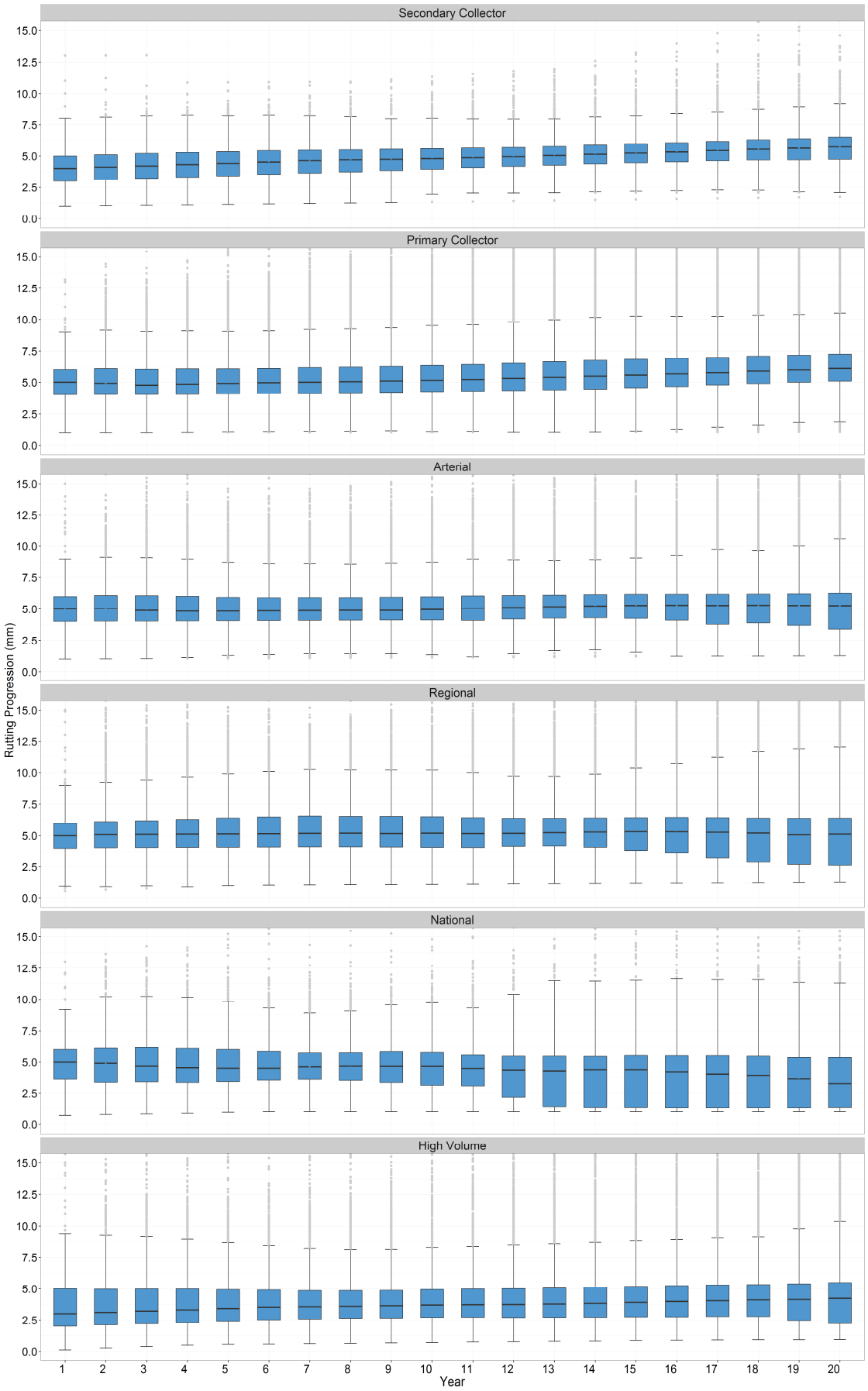
Rutting Distribution 20 Years - $100M_V1



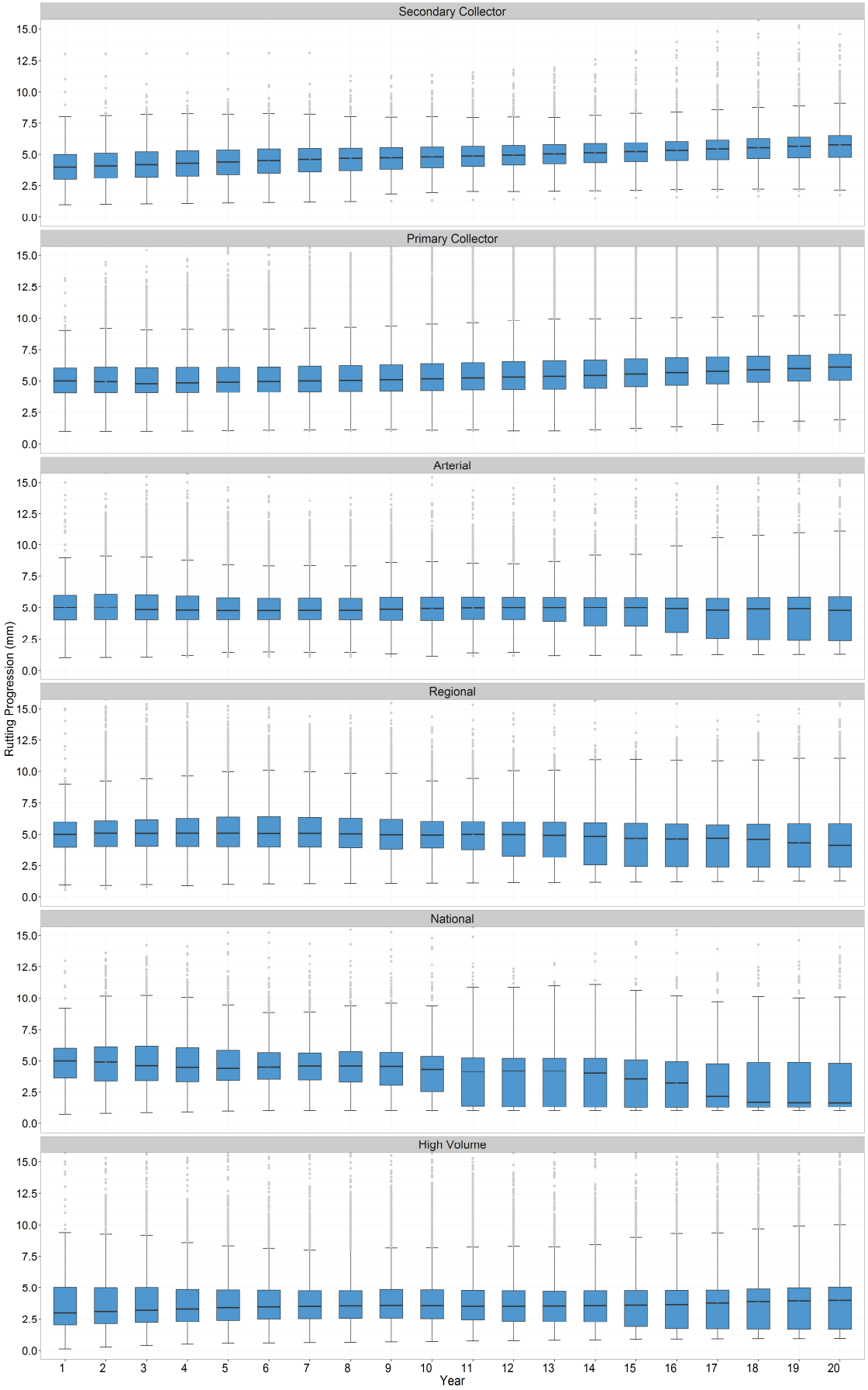
Rutting Distribution 20 Years - $100M_V2



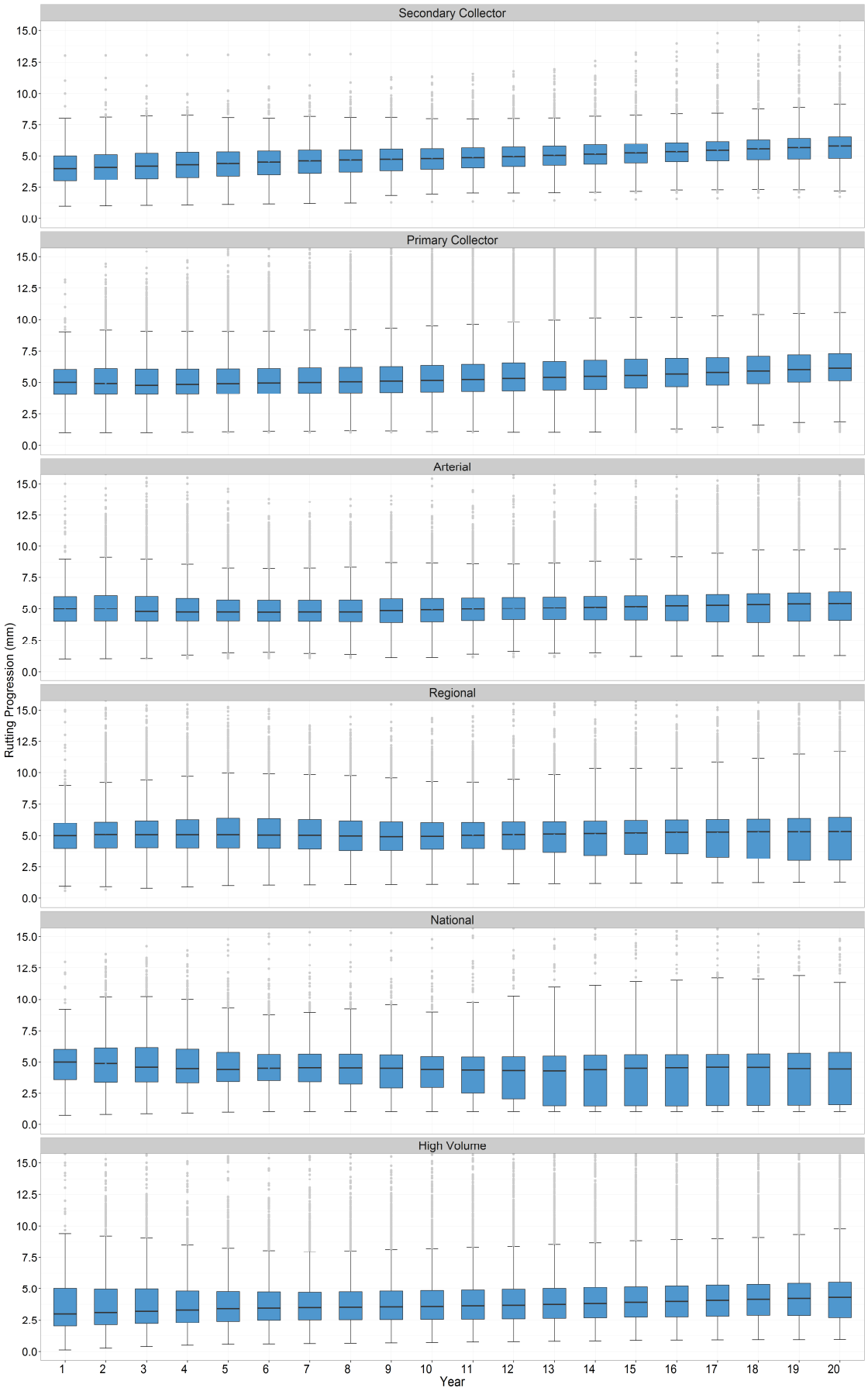
Rutting Distribution 20 Years - $100M_$130M_V3



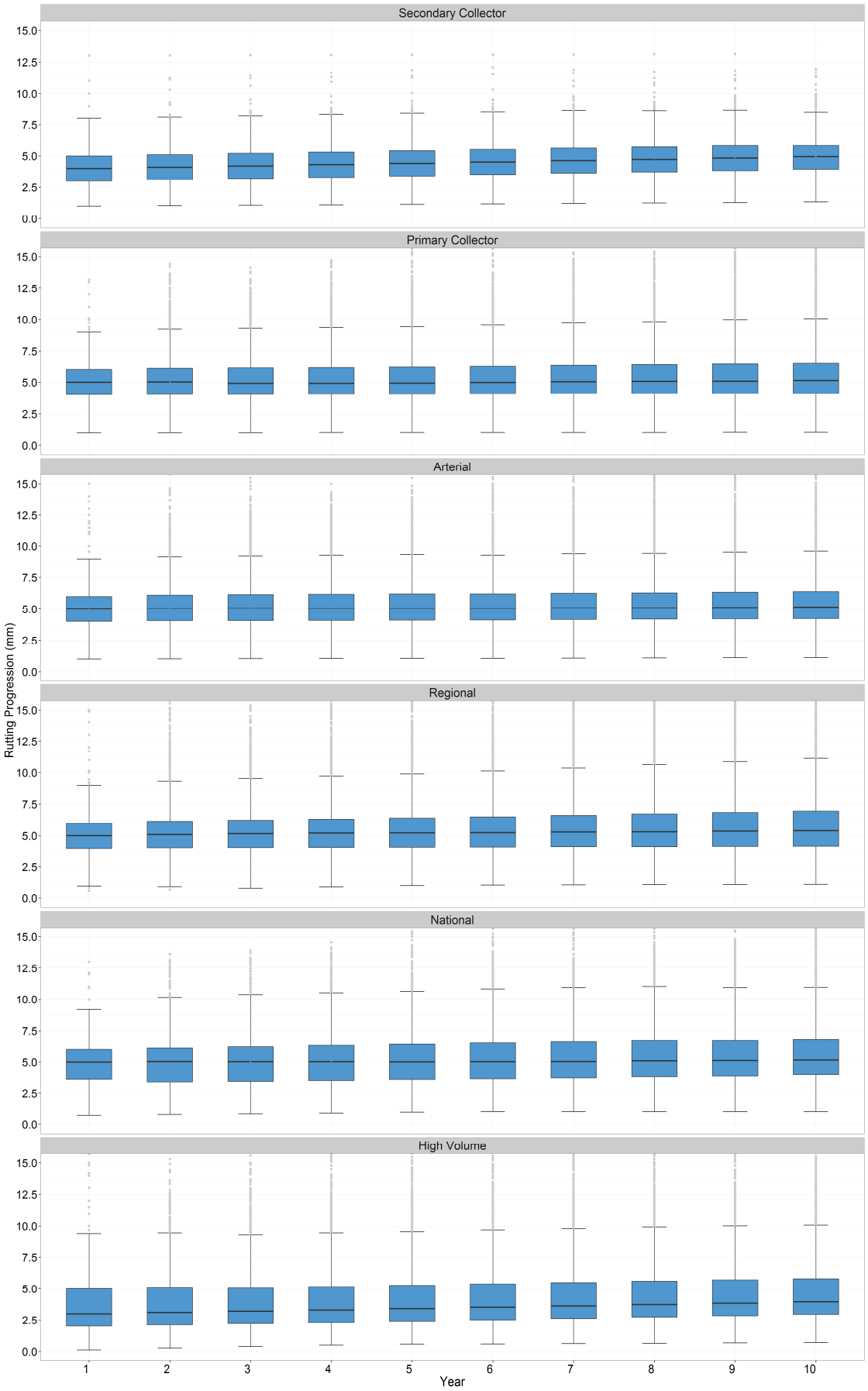
Rutting Distribution 20 Years - $100M_$150M_V3



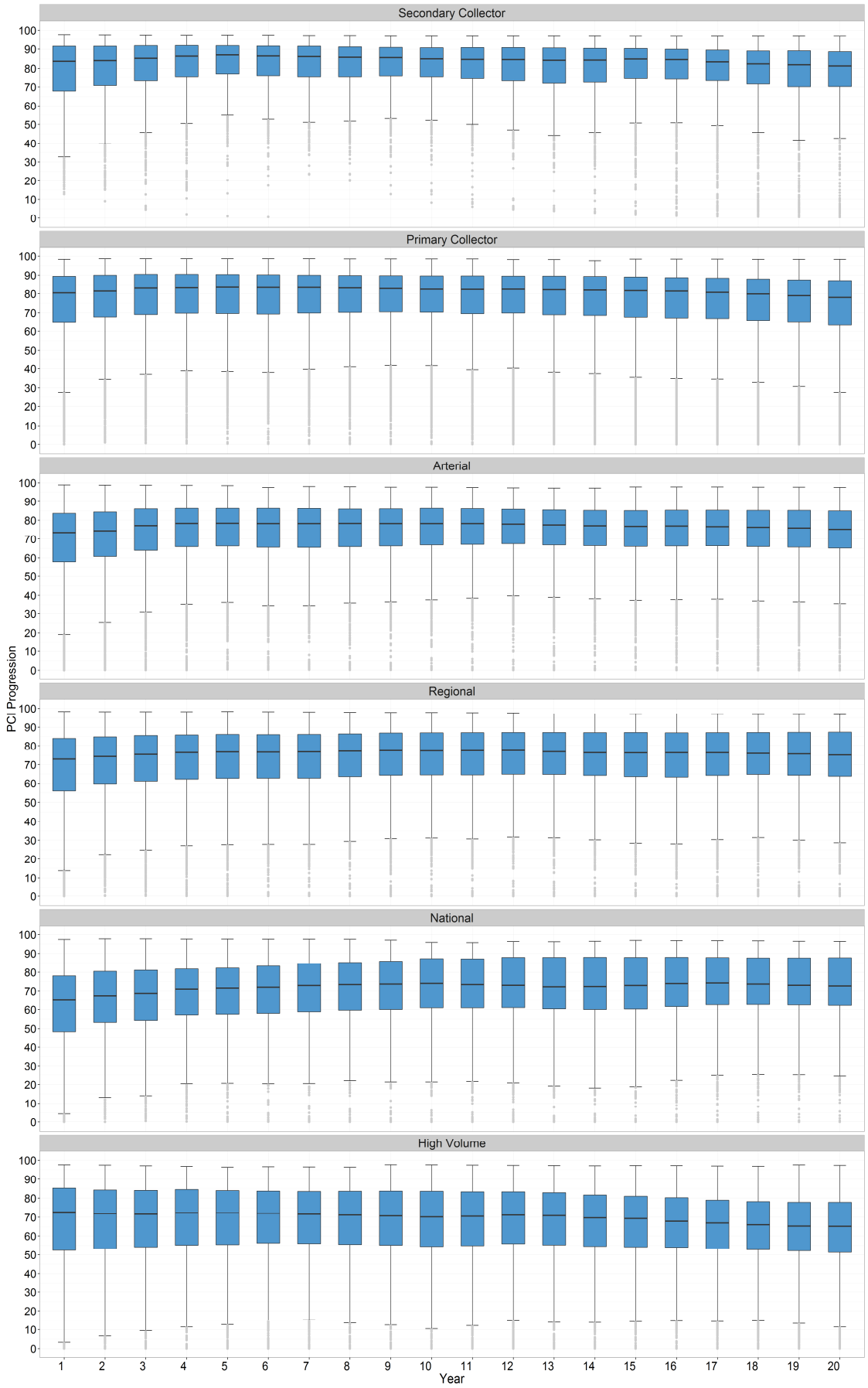
Rutting Distribution 20 Years - $100M_UNL_B



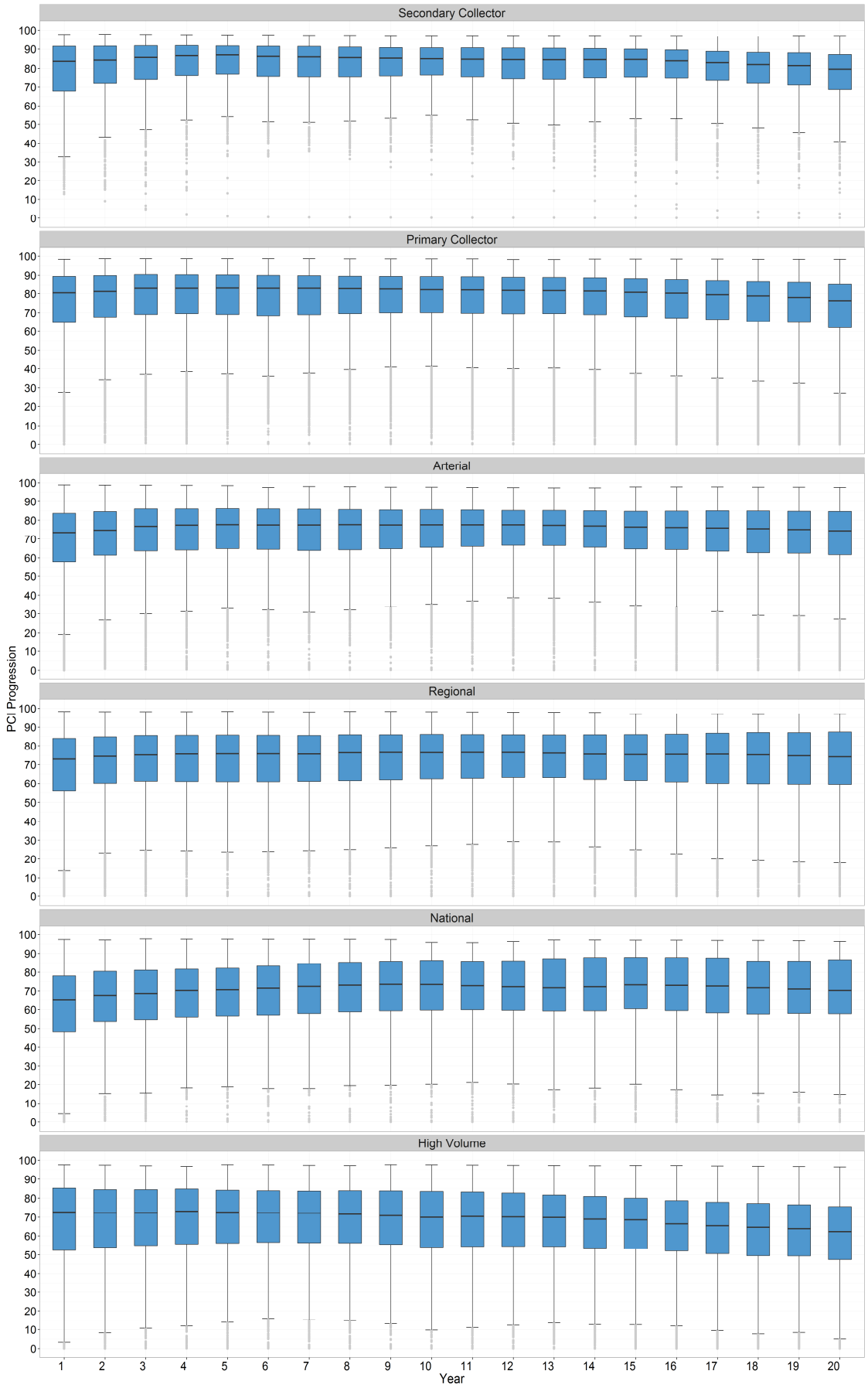
Rutting Distribution 20 Years - FWP



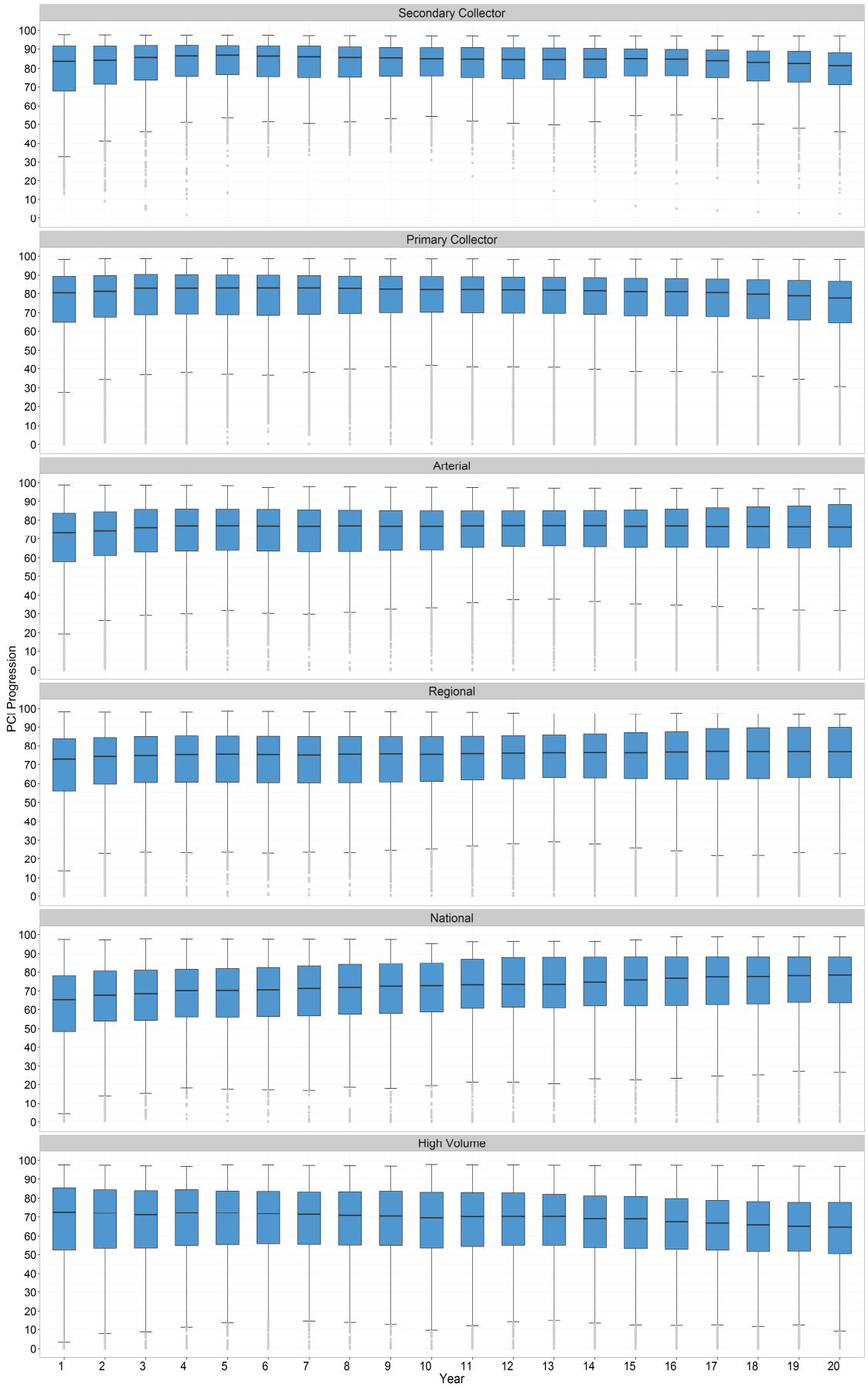
PCI Distribution 20 Years - $100M_V1



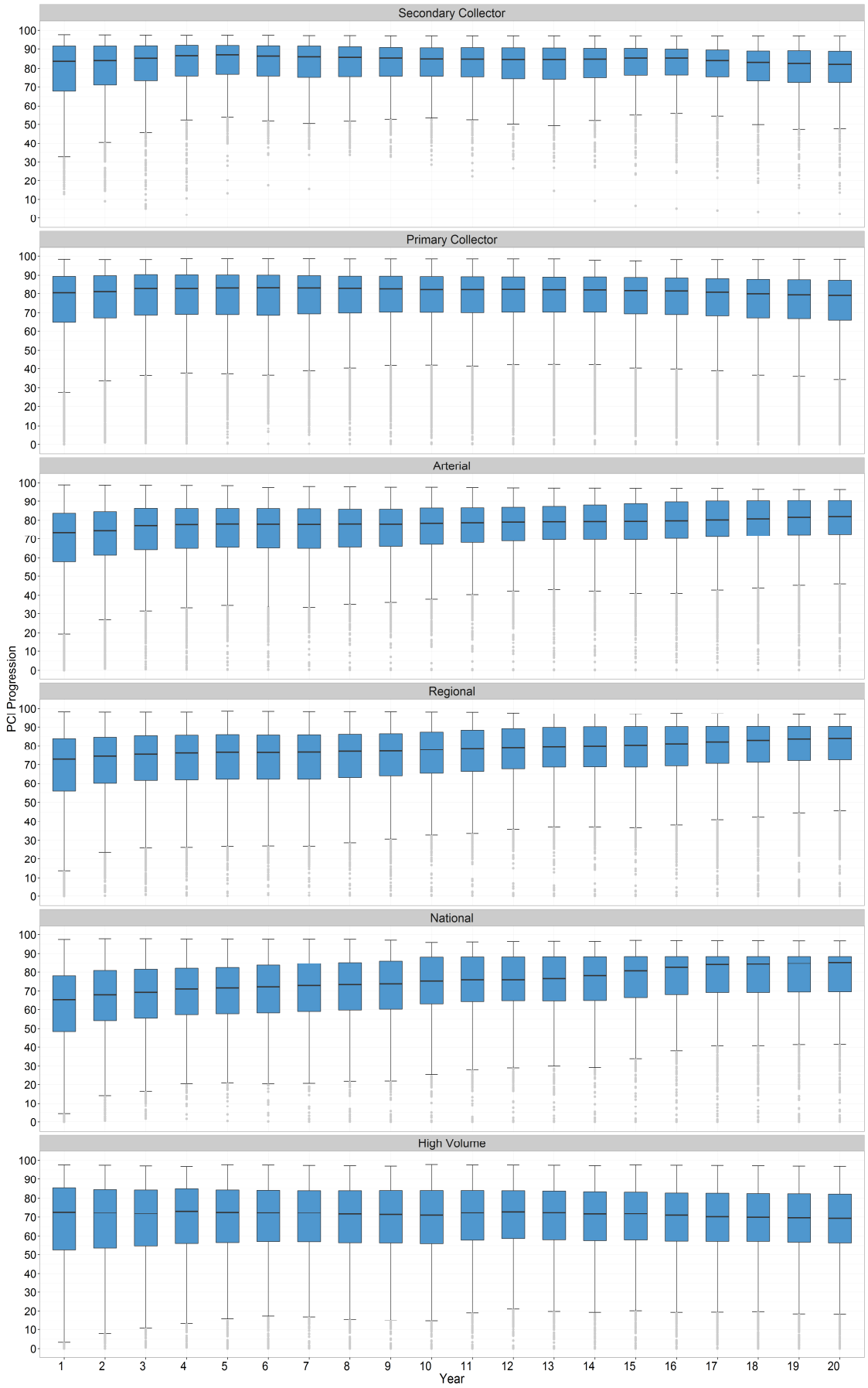
PCI Distribution 20 Years - $100M_V2



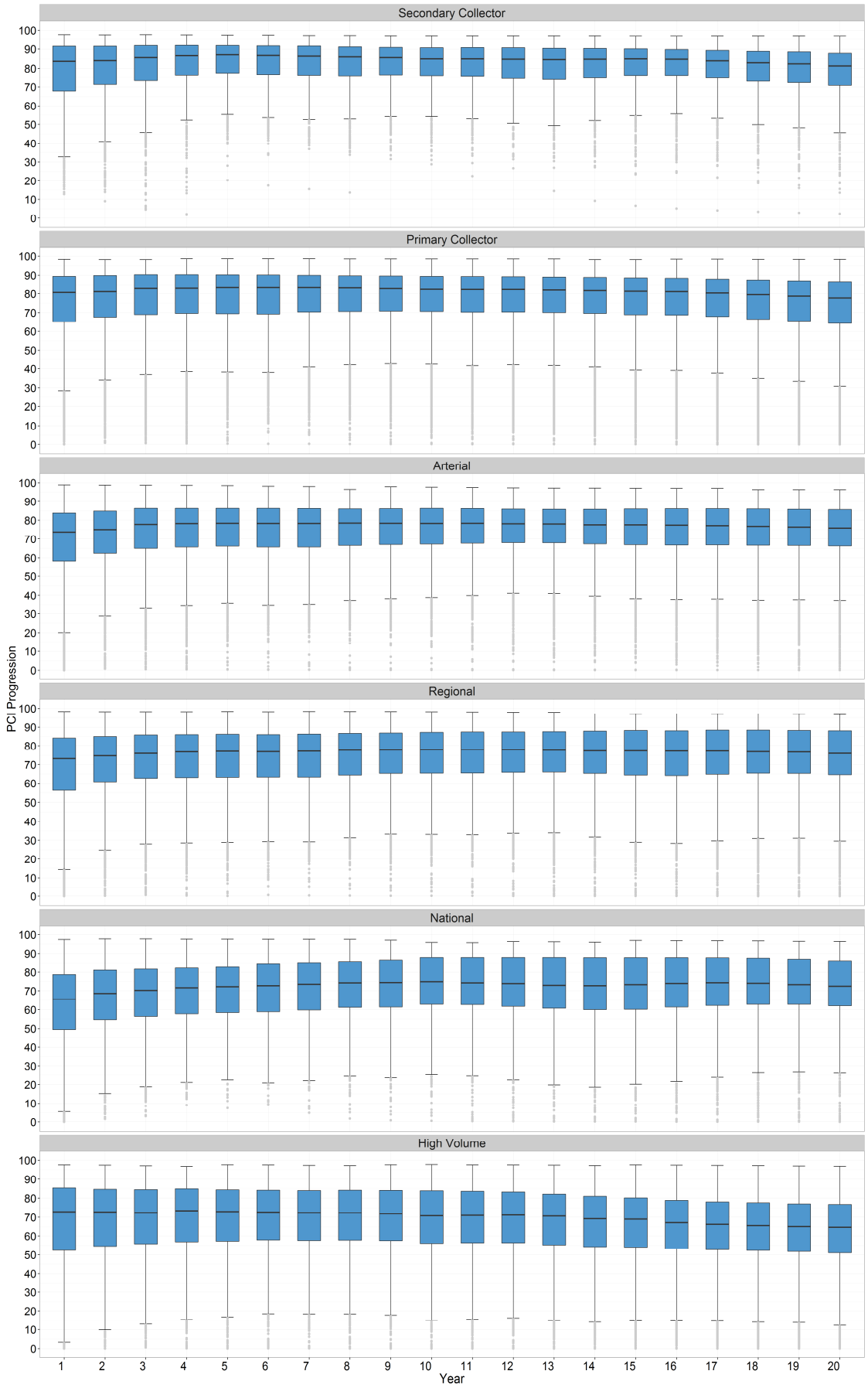
PCI Distribution 20 Years - $100M_$130M_V3



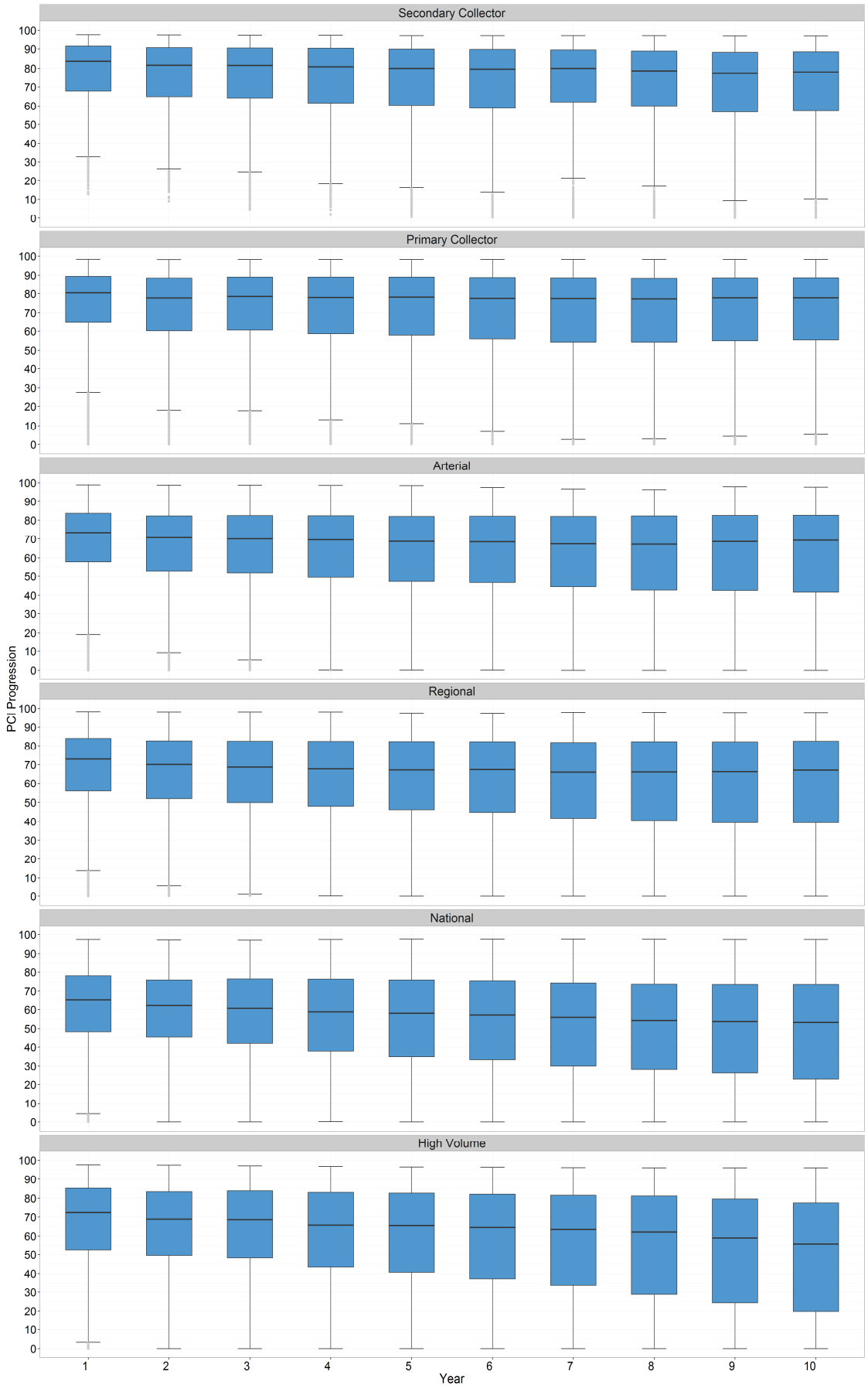
PCI Distribution 20 Years - $100M_$150M_V3



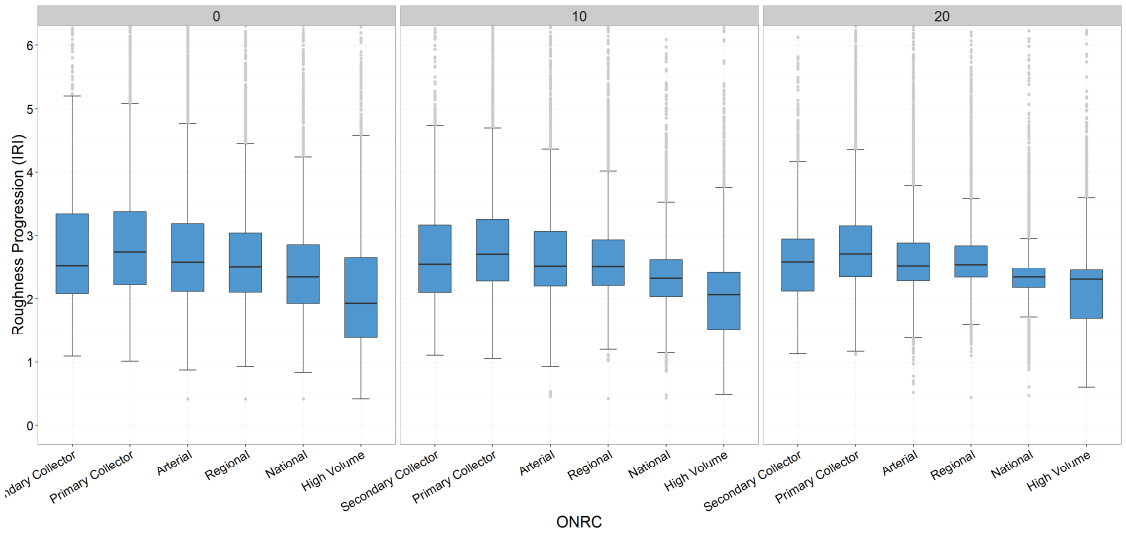
PCI Distribution 20 Years - $100M_UNL_B



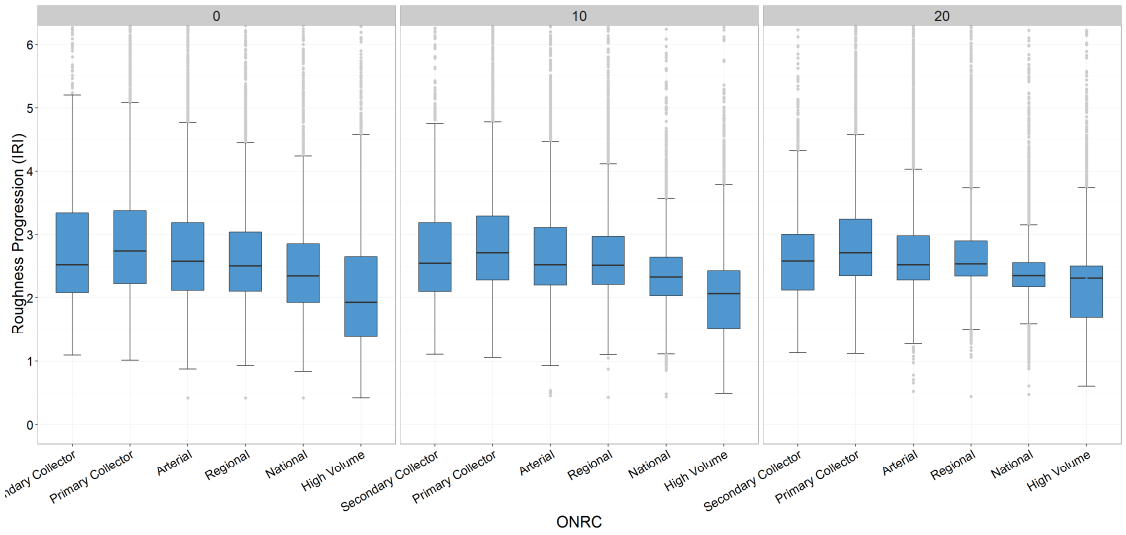
PCI Distribution 20 Years - FWP



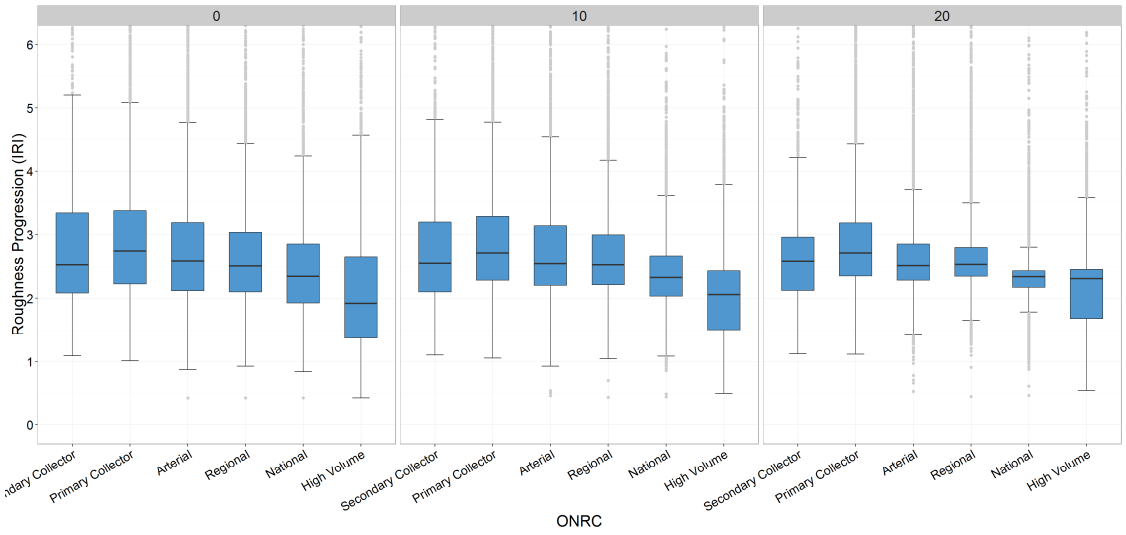
Roughness Distribution - $100M_V1



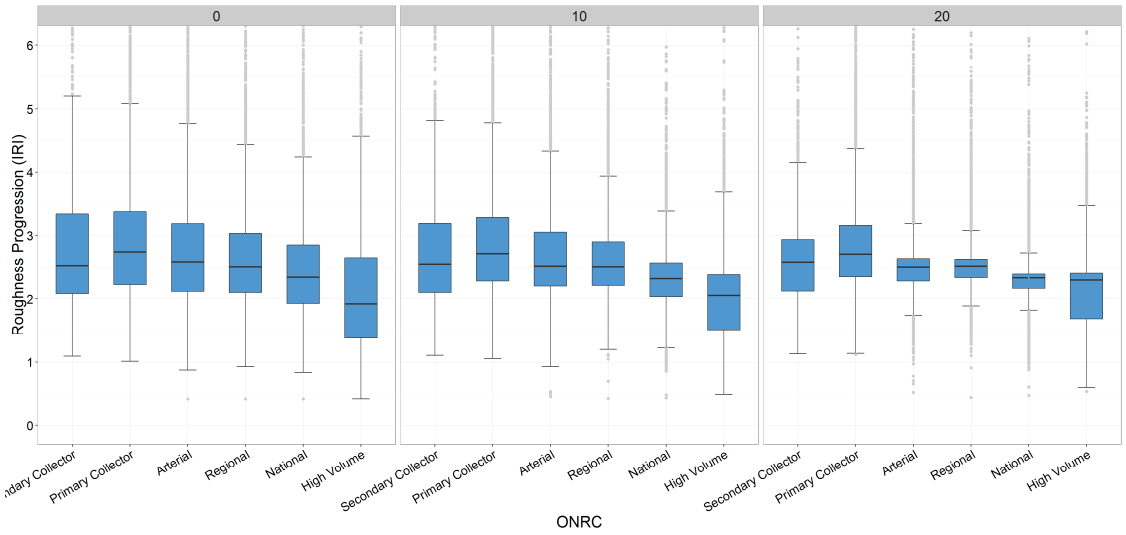
Roughness Distribution - $100M_V2



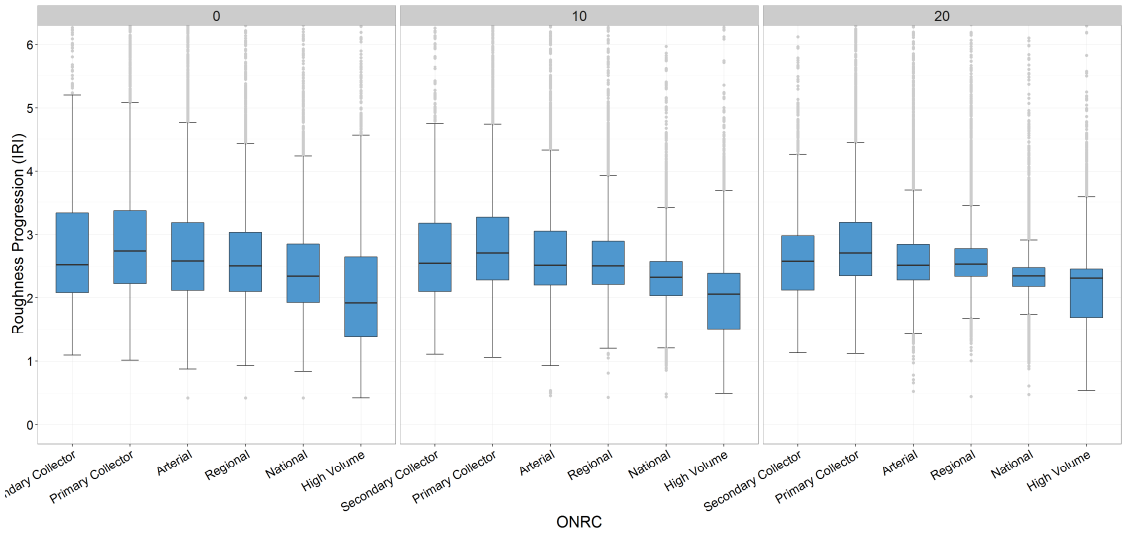
Roughness Distribution - $100M_$130M_V3



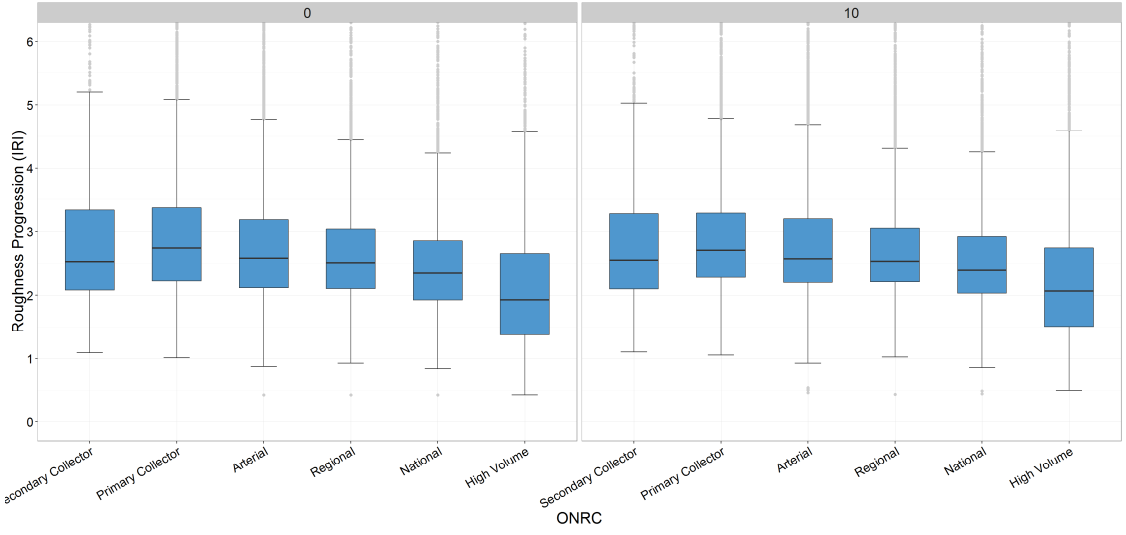
Roughness Distribution - $100M_$150M_V3



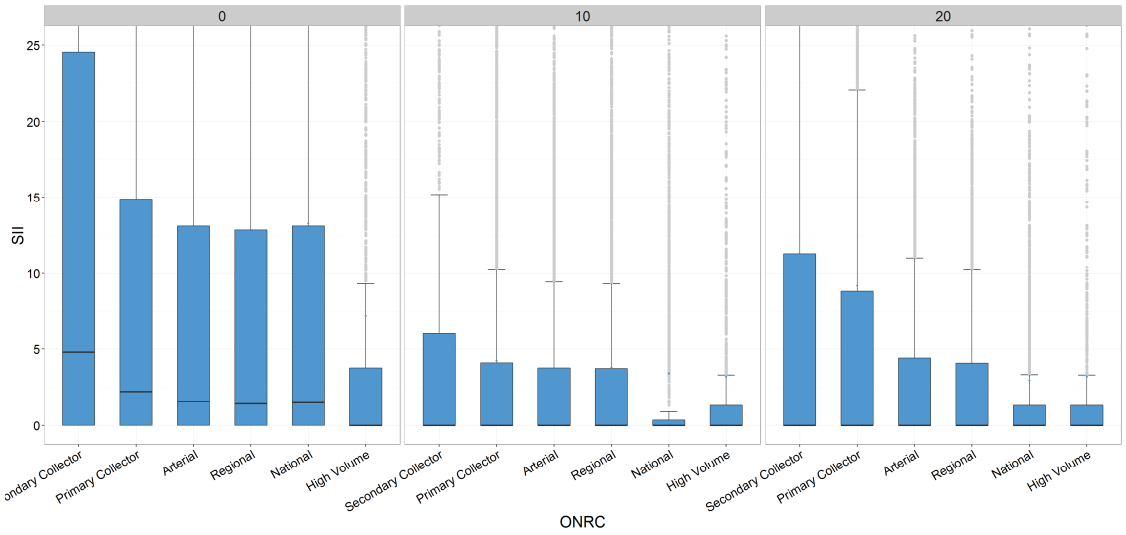
Roughness Distribution - $100M_UNL_B



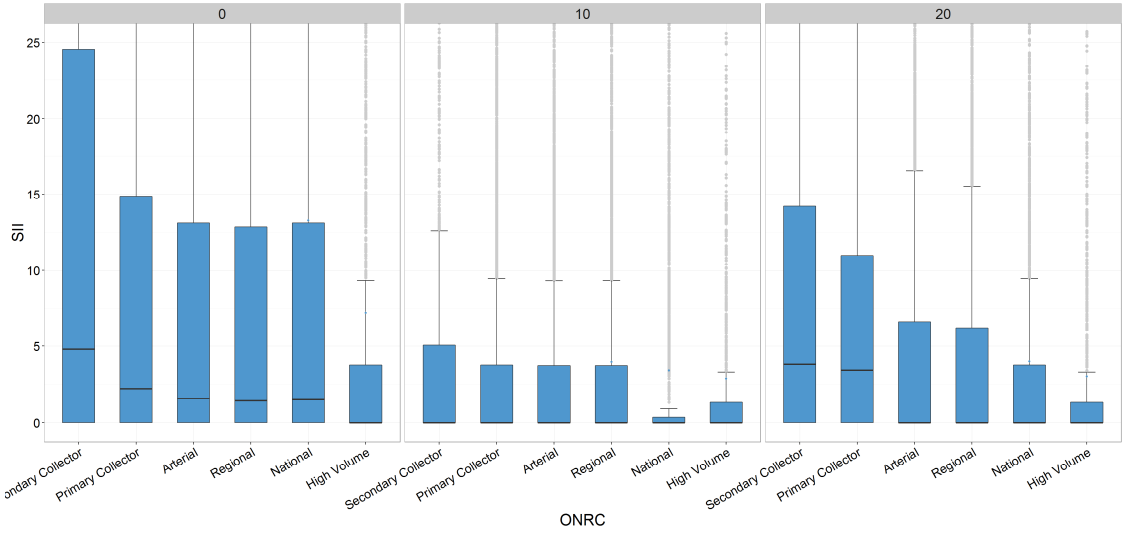
Roughness Distribution - FWP



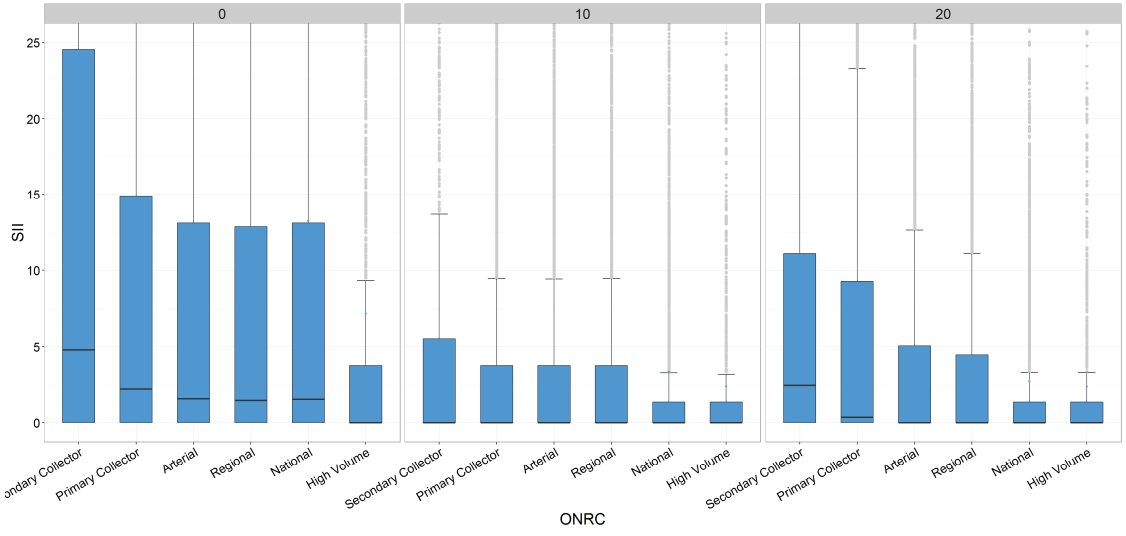
PCI Distribution - $100M_V1



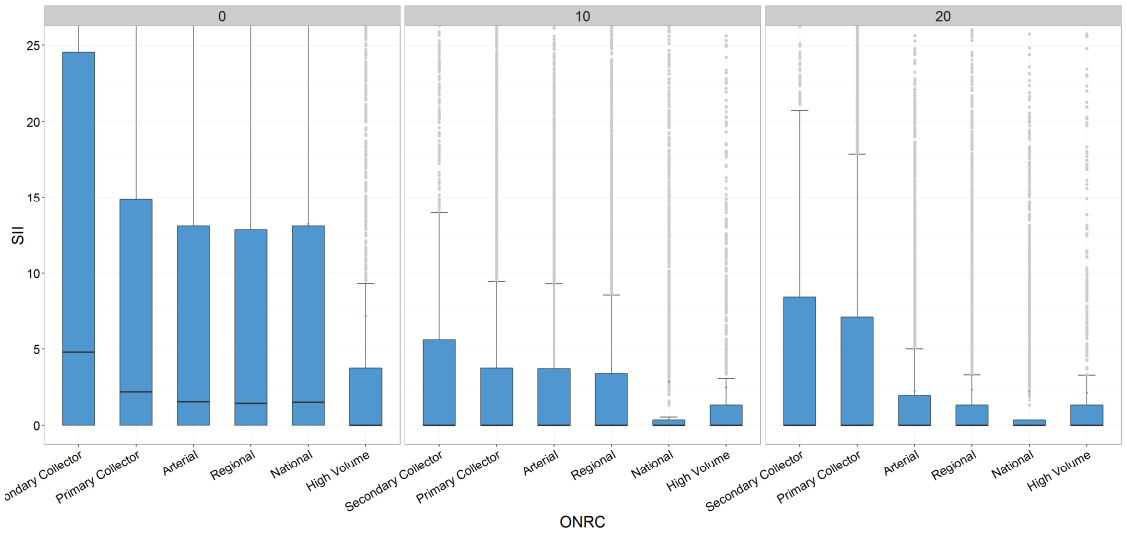
PCI Distribution - $100M_V2



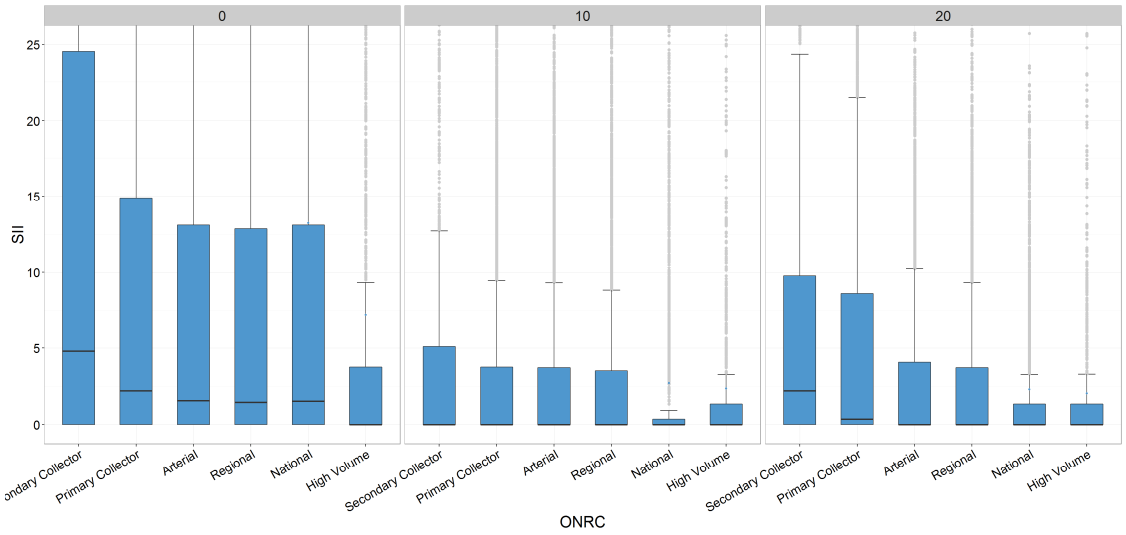
PCI Distribution - $100M_$130M_V3



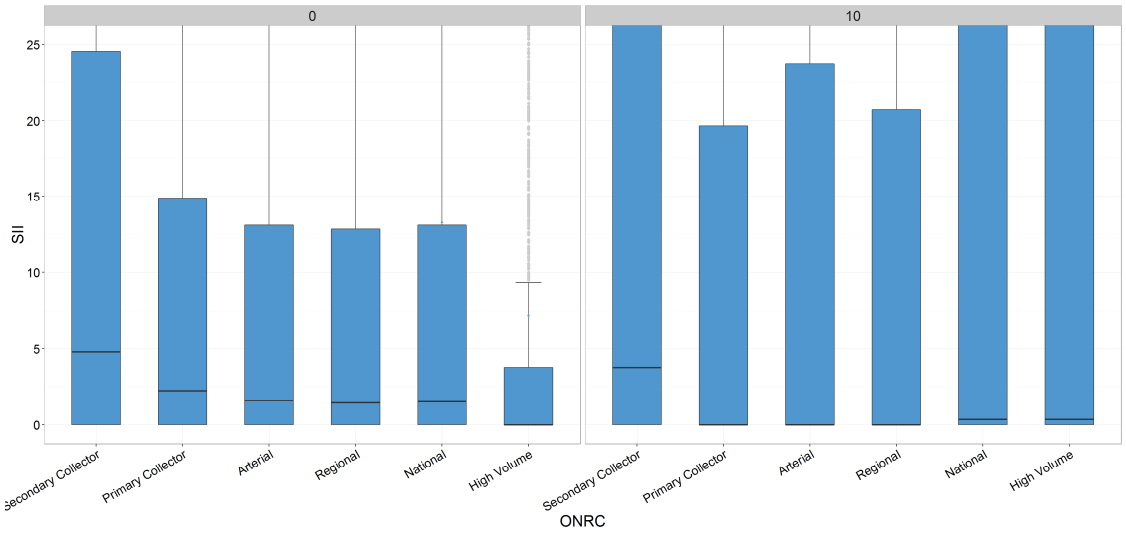
PCI Distribution - $100M_$150M_V3



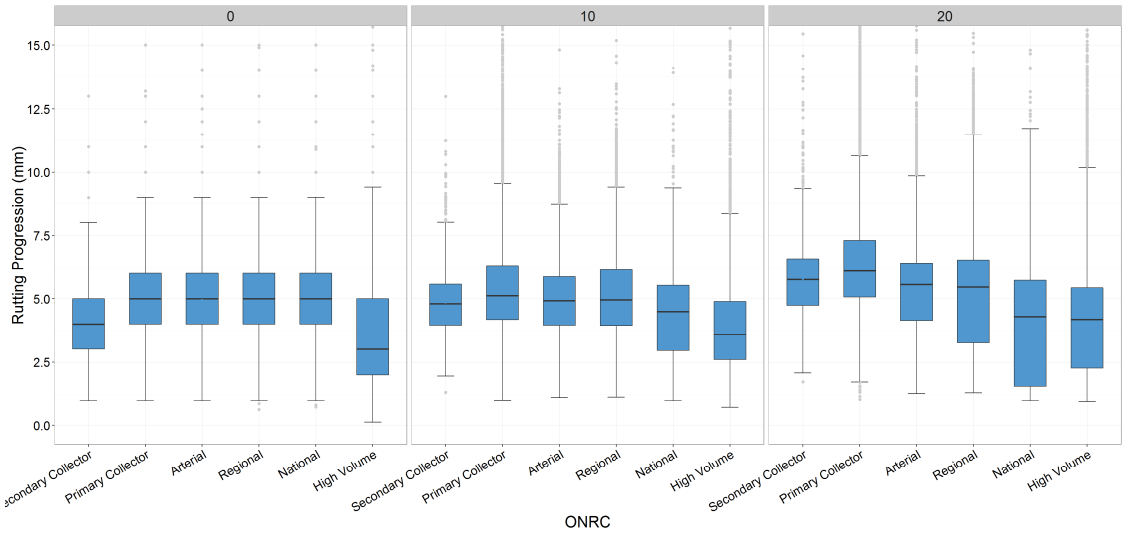
PCI Distribution - $100M_UNL_B



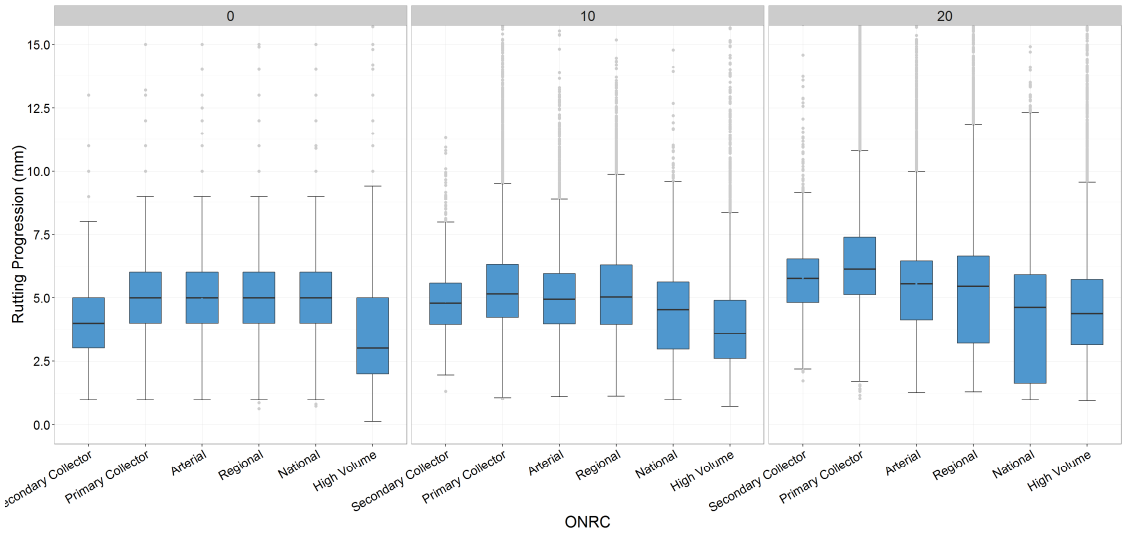
PCI Distribution - FWP



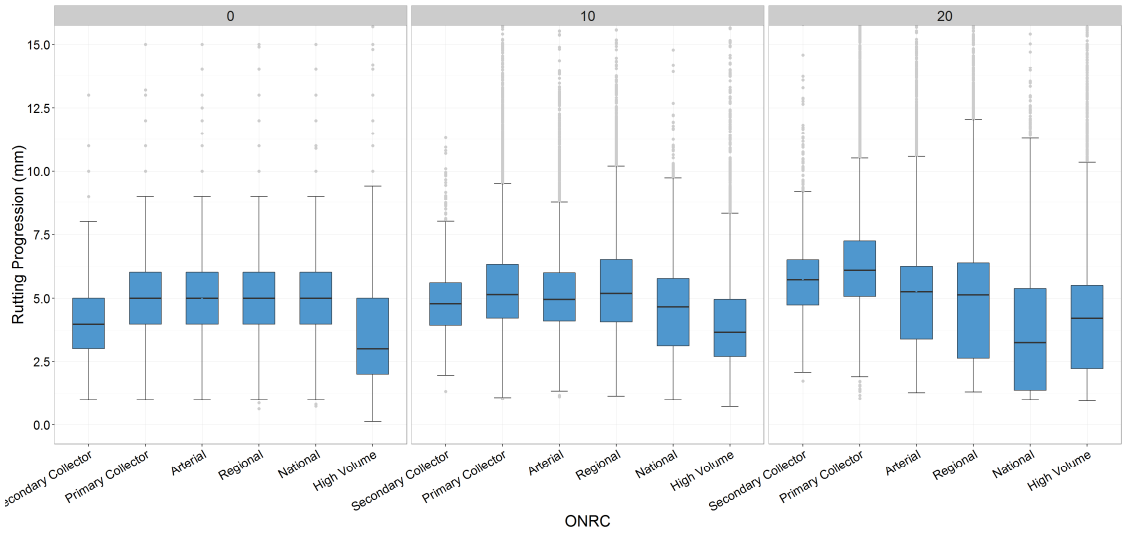
Rutting Distribution - $100M_V1



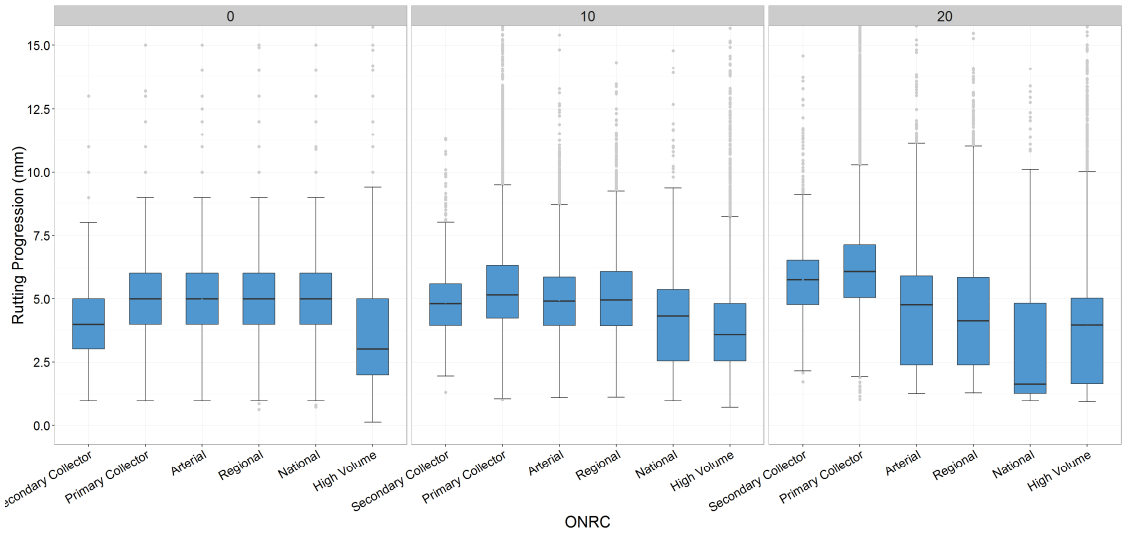
Rutting Distribution - $100M_V2



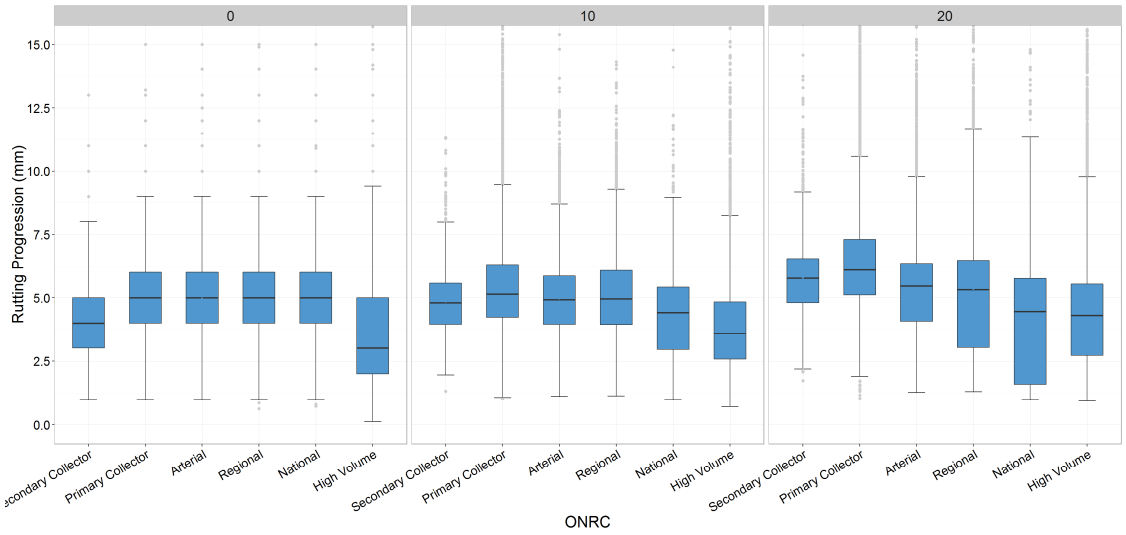
Rutting Distribution - $100M_$130M_V3



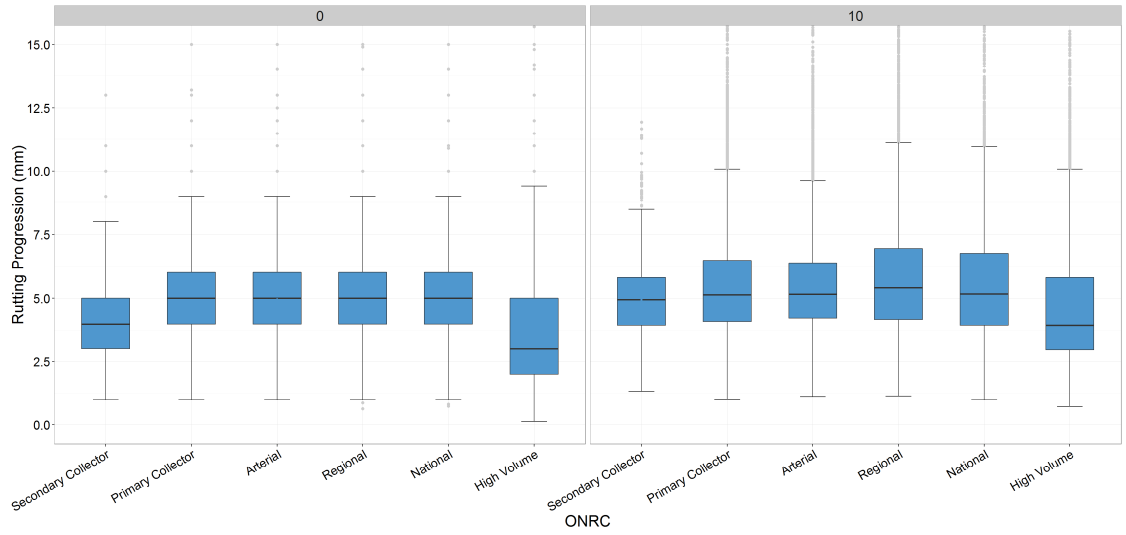
Rutting Distribution - $100M_$150M_V3



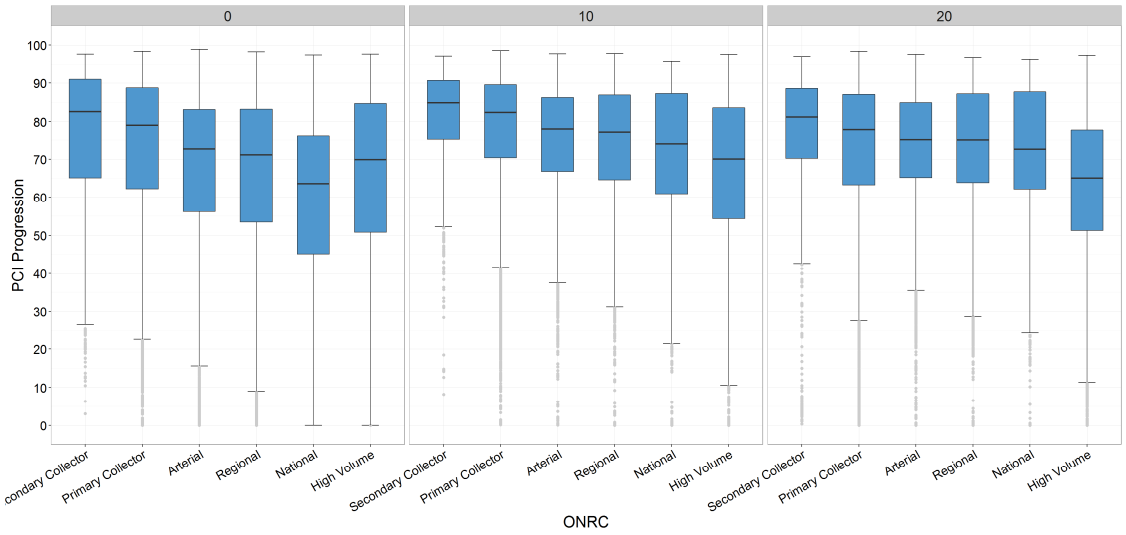
Rutting Distribution - $100M_UNL_B



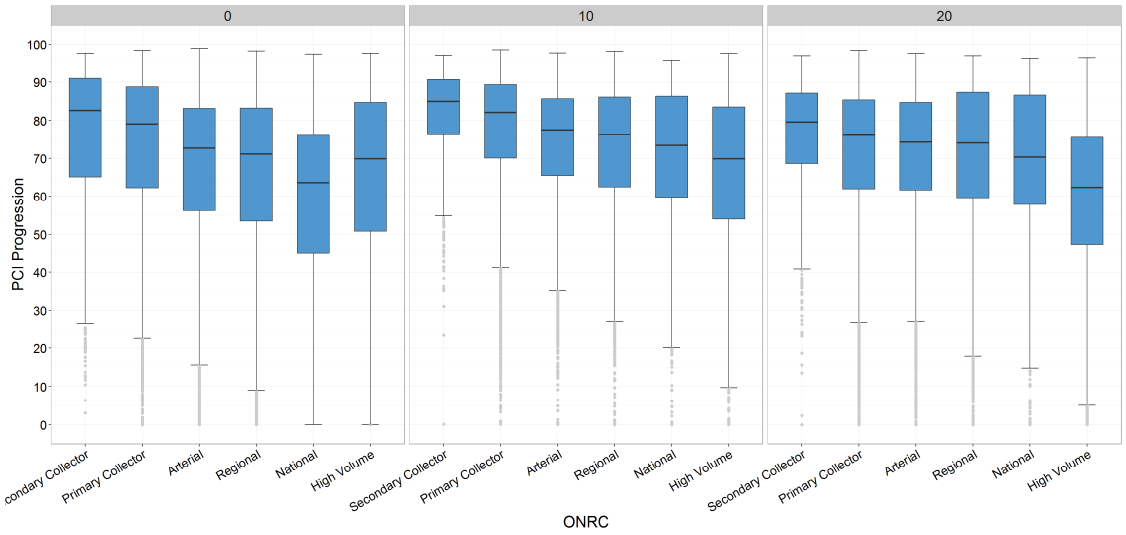
Rutting Distribution - FWP



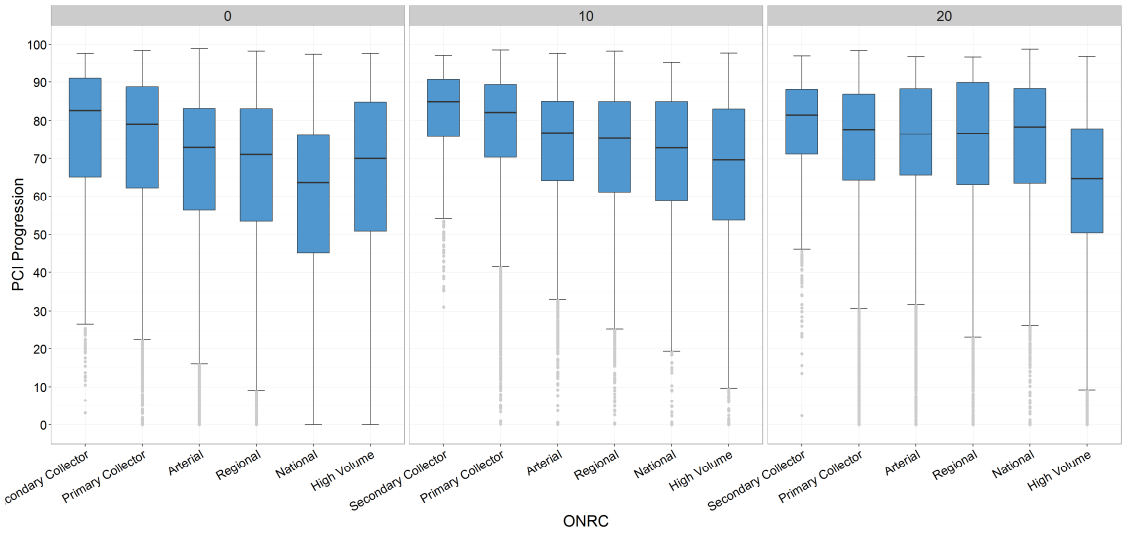
PCI Distribution - $100M_V1



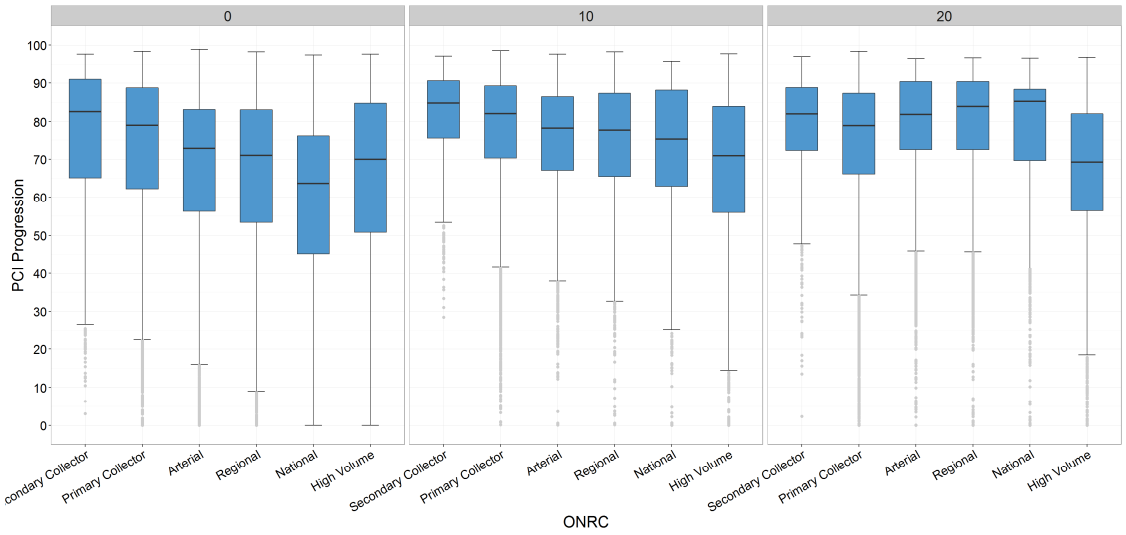
PCI Distribution - $100M_V2



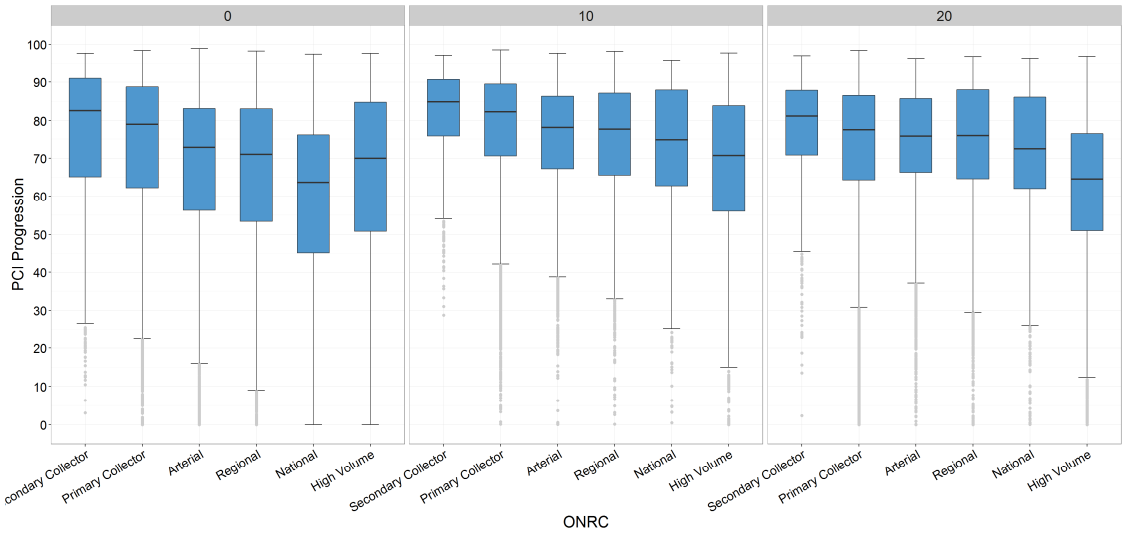
PCI Distribution - $100M_$130M_V3



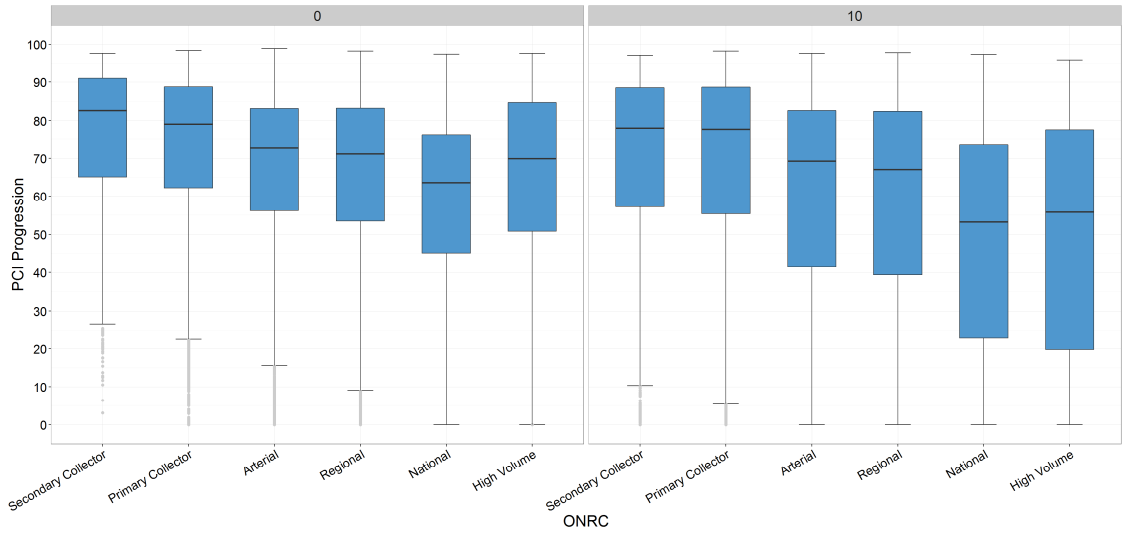
PCI Distribution - $100M_$150M_V3



PCI Distribution - $100M_UNL_B



PCI Distribution - FWP



2.1 Length Charts – Unlimited Routine Maintenance (V1)

This set of outputs includes Stacked Bar Charts showing predicted Treatment Length (Lane km) for each Treatment Type.

- Asphalt Surfacing - AC (light green)
- Chipseal Surfacing - CS (mid green)
- 2nd Coat (dark green)
- Pavement Rehabilitation - RHAB (yellow)
- Heavy Maintenance (orange)
- Safety (where applicable – red)

The first Chart/Table compares the seven (7) 'Unlimited RM Options as a 20 Year National Average Annual Lane km Length

- **$ Birthday_V1**
  - Treatments triggered when useful life is reached, does not try and meet Levels of Service
  - Renewal Investment: **Unlimited,** Routine Investment: **Unlimited**
  - Safety Investment: Safety not Included
- **$80M_V1**
  - Renewal Investment: Fixed **$80M** pa, Routine Investment: **Unlimited**
  - Safety Investment: Safety not Included
- **$90M_V1**
  - Renewal Investment: Fixed **$90M** pa, Routine Investment: **Unlimited**
  - Safety Investment: Safety not Included
- **$100M_V1**
  - Renewal Investment: Fixed **$100M** pa, Routine Investment: **Unlimited**
  - Safety Investment: Safety not Included
- **$110M_V1**
  - Renewal Investment: Fixed **$110M** pa, Routine Investment: **Unlimited**
  - Safety Investment: Safety not Included
- **$120M_V1**
  - Renewal Investment: Fixed **$120M** pa, Routine Investment: **Unlimited**
  - Safety Investment: Safety not Included
- **Least Cost_V1**
  - Generates the lowest overall cost treatment programme considering Renewal and Routine Investment – disallowing Do Nothing. Does not try and meet Levels of Service.
  - Safety Investment: Safety not Included

The second series compares the six (6) ONRC Classes as time series over 20 years for each 'Unlimited RM Options'.

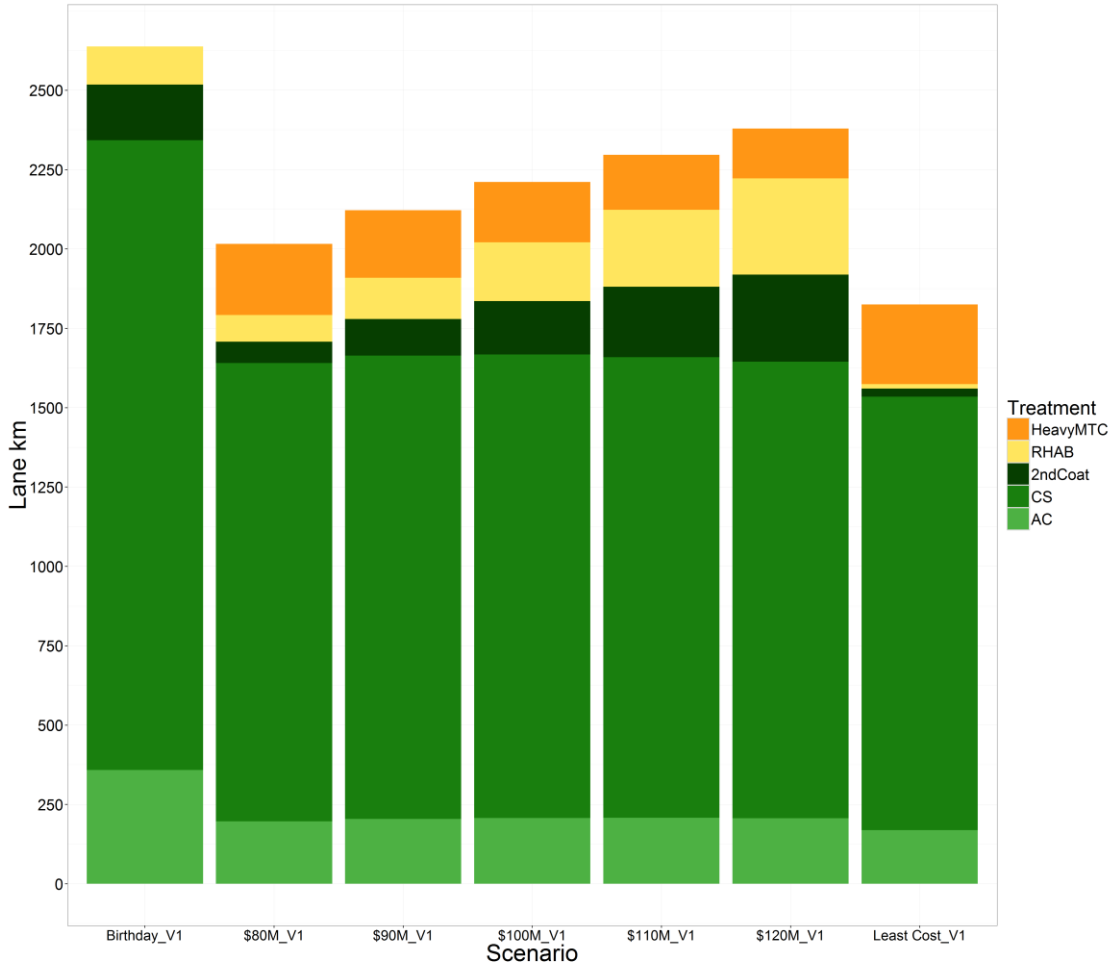
- Secondary Collector, Primary Collector
- Arterial, Regional
- National, National High Volume

The third series compares the 'Unlimited RM Options' by ONRC Class as time series over 20 years

The fourth series compares the twenty three (23) Regions as time series over 20 years for each 'Unlimited RM Option'.

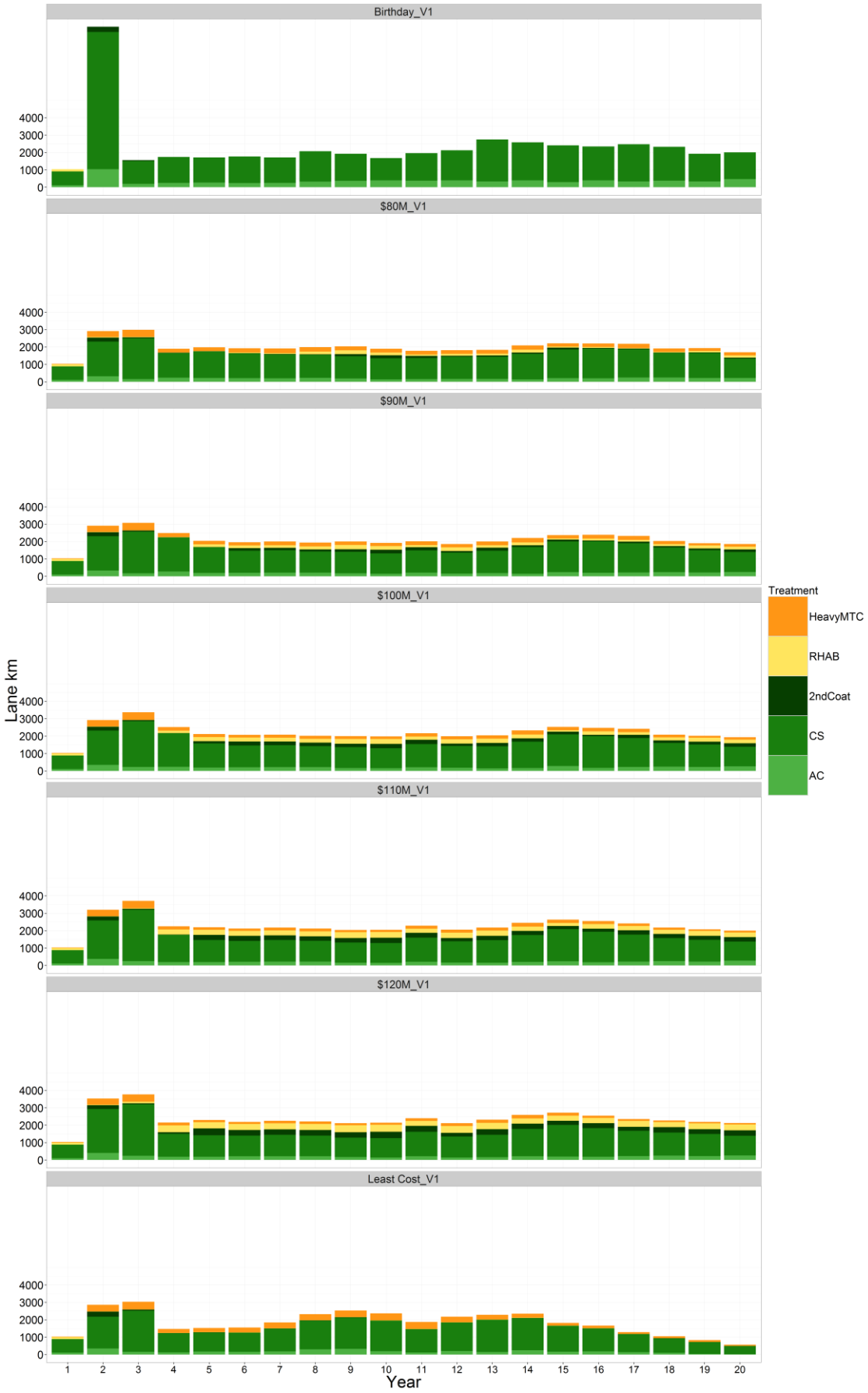
Length

National 20 Year Average Annual Length

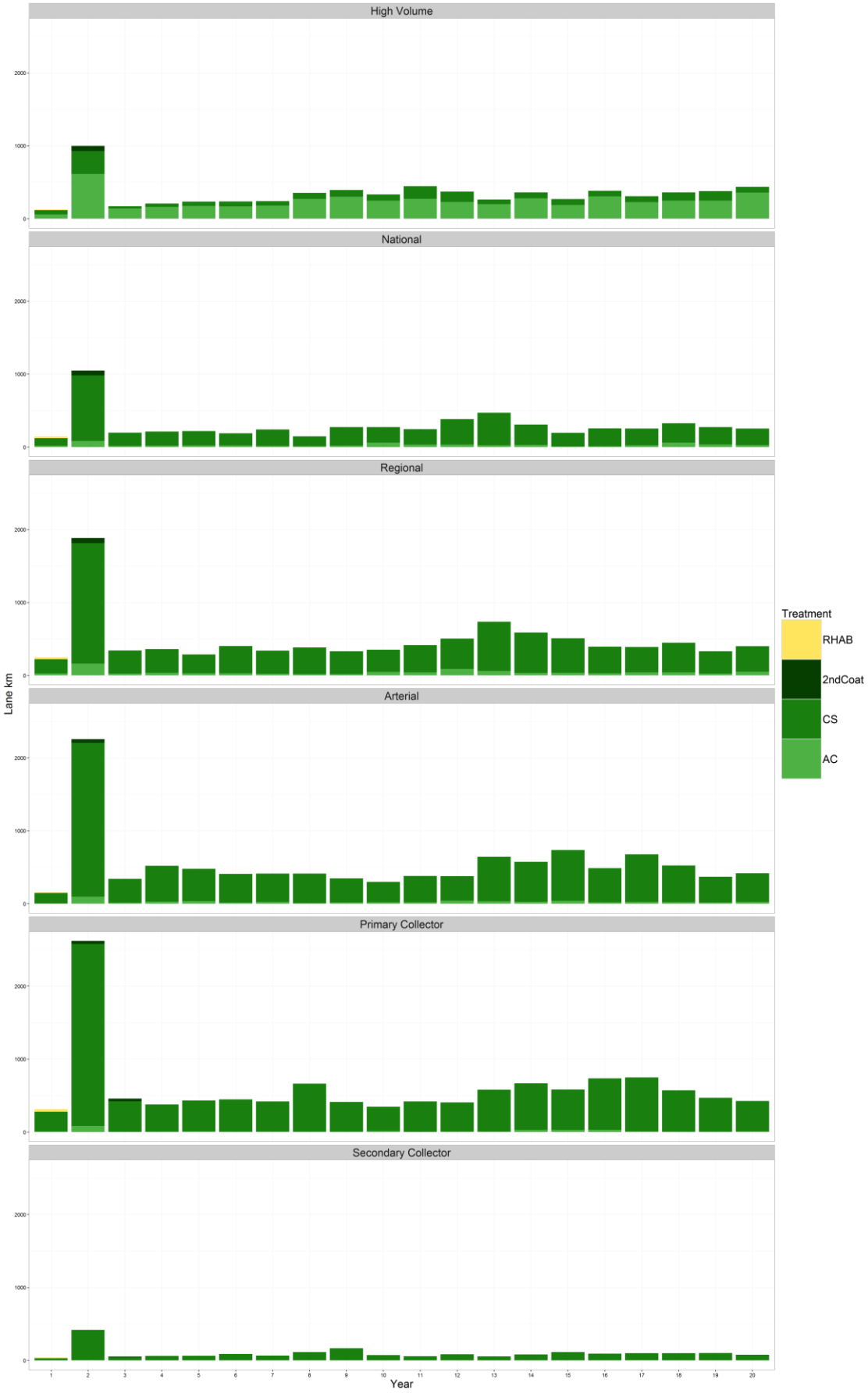


	Birthday_V1	$80M_V1	$90M_V1	$100M_V1	$110M_V1	$120M_V1	Least Cost_V1
AC	358.64	196.69	204.14	206.86	208.1	206.19	168.85
CS	1983.53	1443.62	1459.99	1460.68	1450.47	1438.62	1365.67
2ndCoat	175.19	67.55	114.62	168.12	222.11	273.92	25.43
RHAB	120.46	84.01	130.47	185.37	242.78	303.2	14.03
HeavyMTC	0	223.62	212.24	189.44	172.76	157.24	250.69

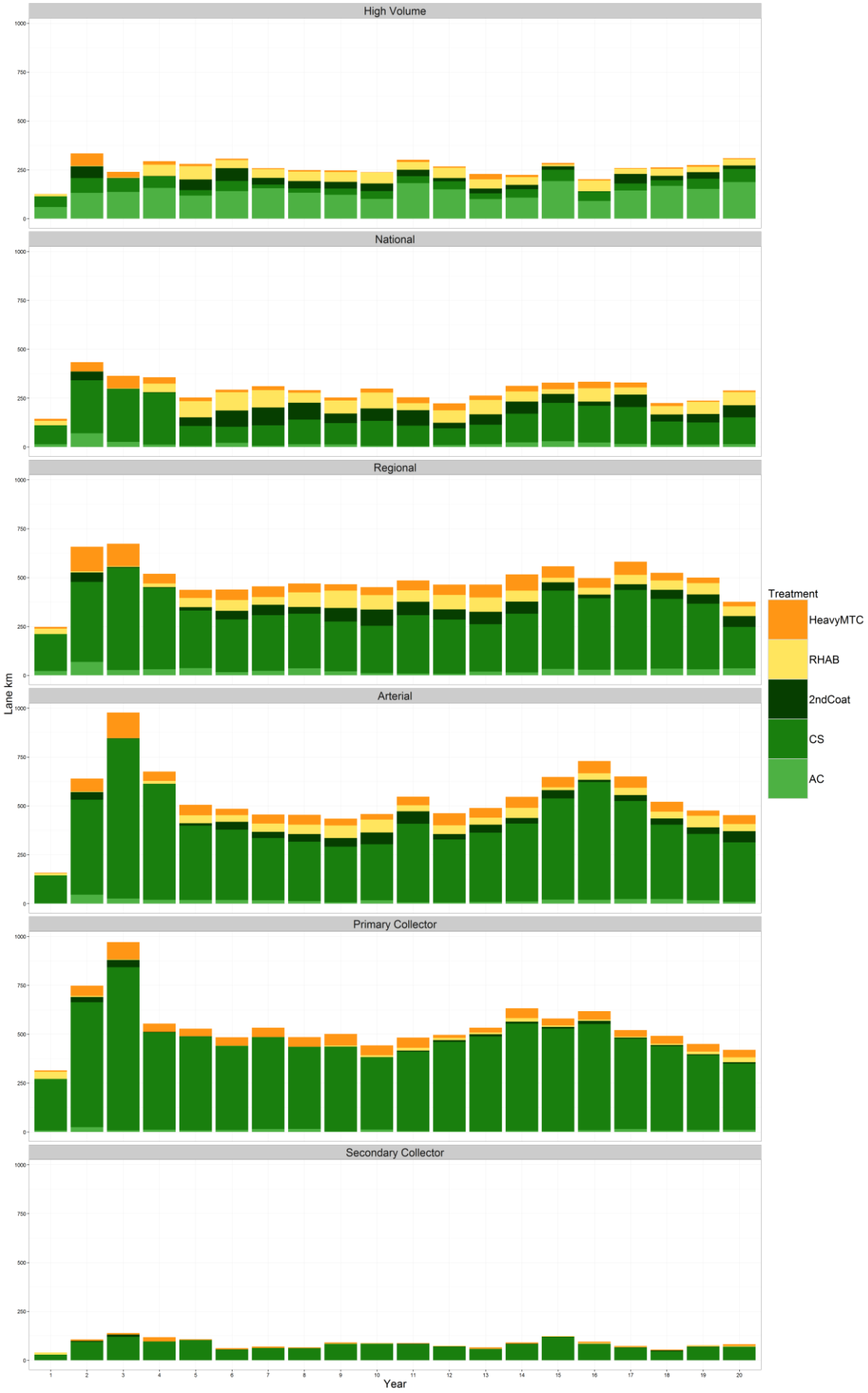
National - Total Network Lane km



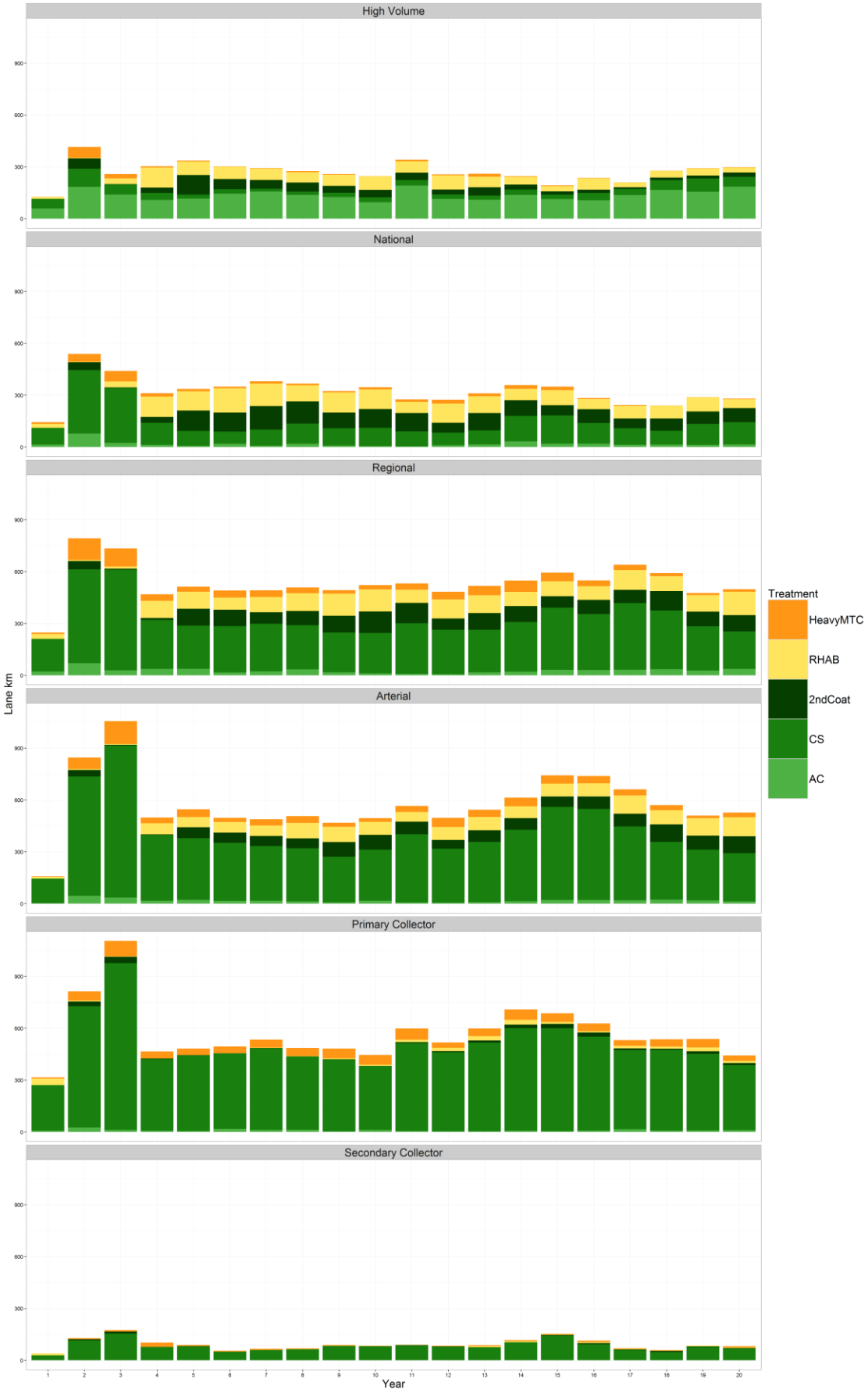
Lane km Birthday_V1 by ONRC



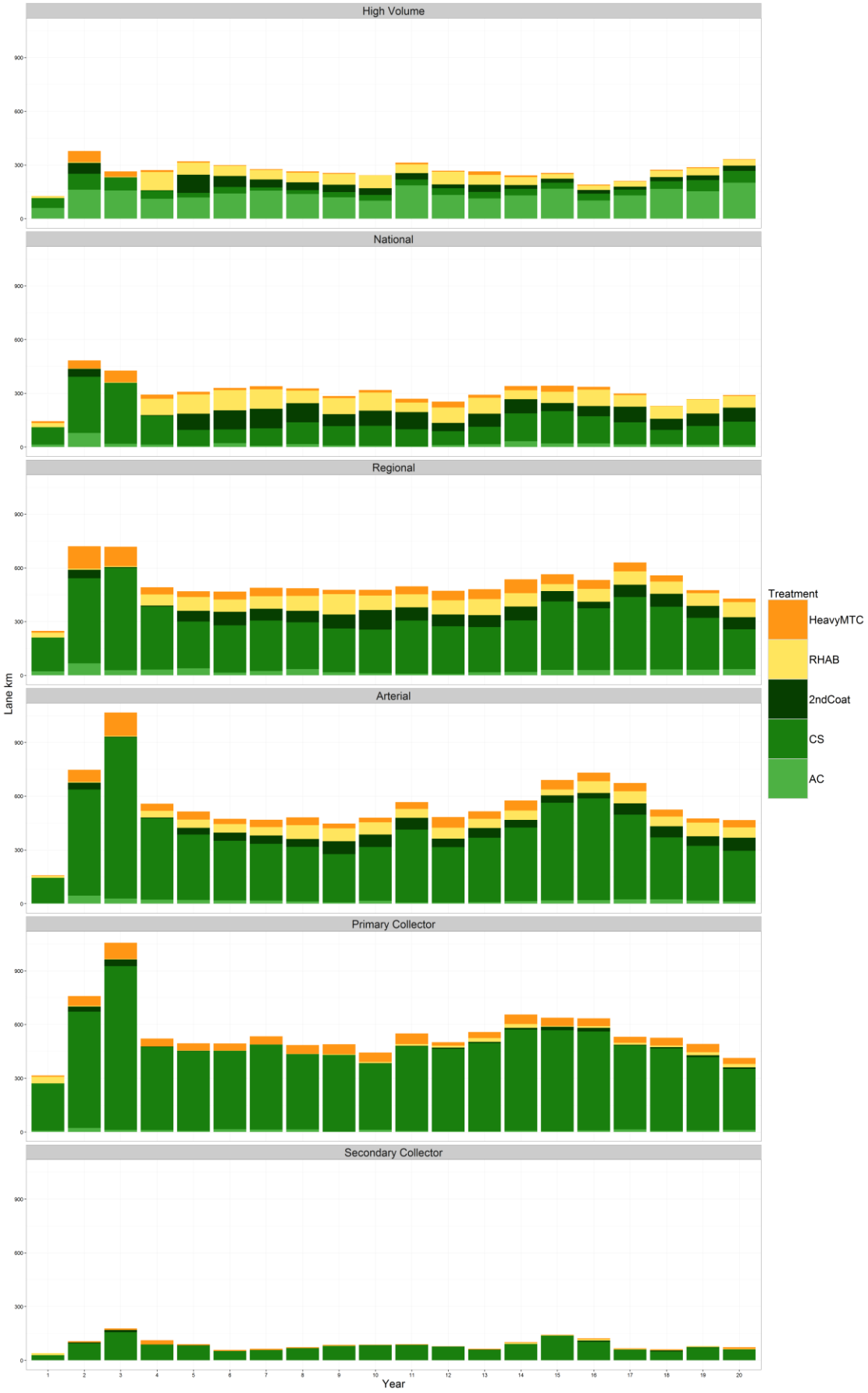
Lane km $100M_V1 by ONRC



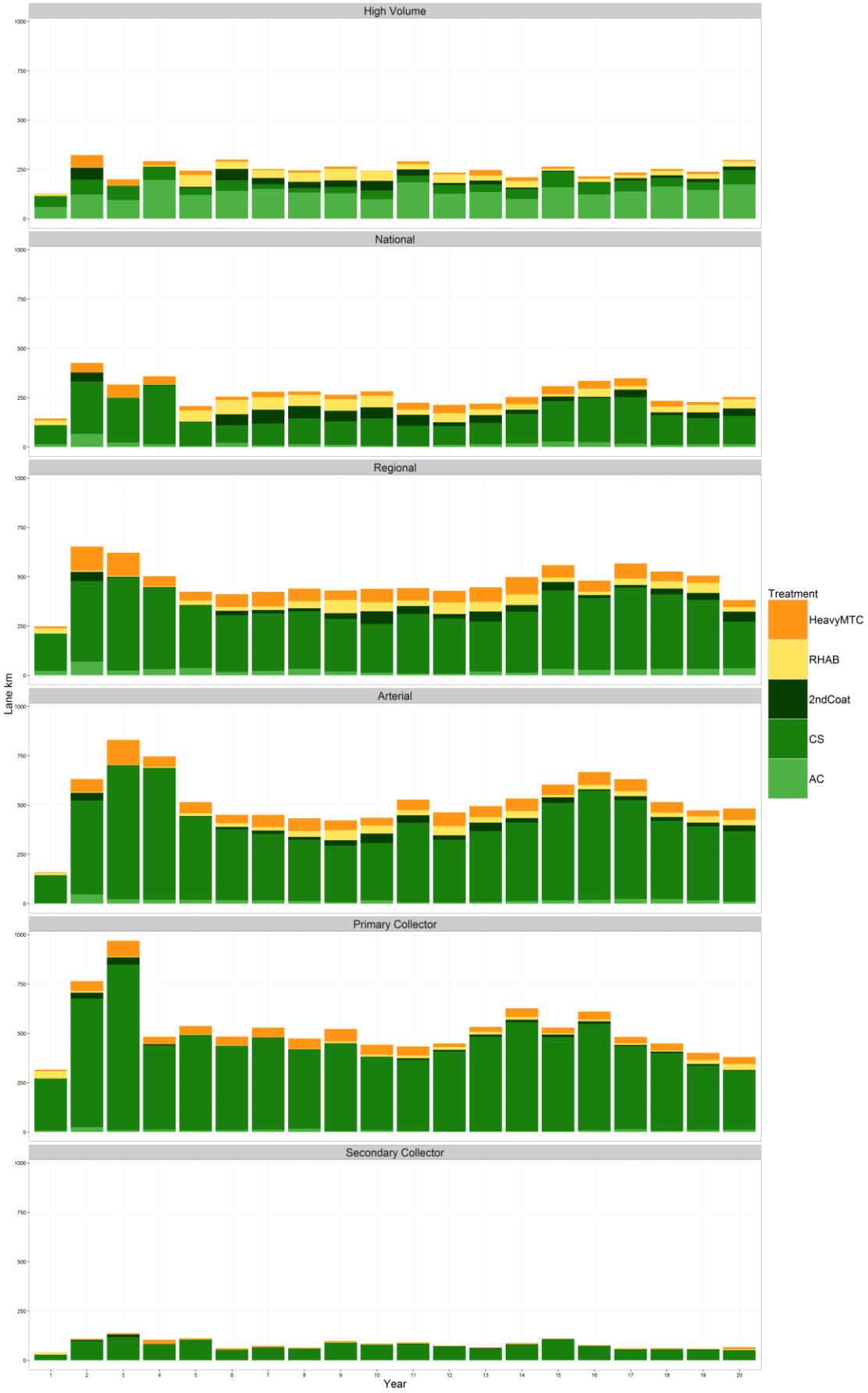
Lane km $120M_V1 by ONRC



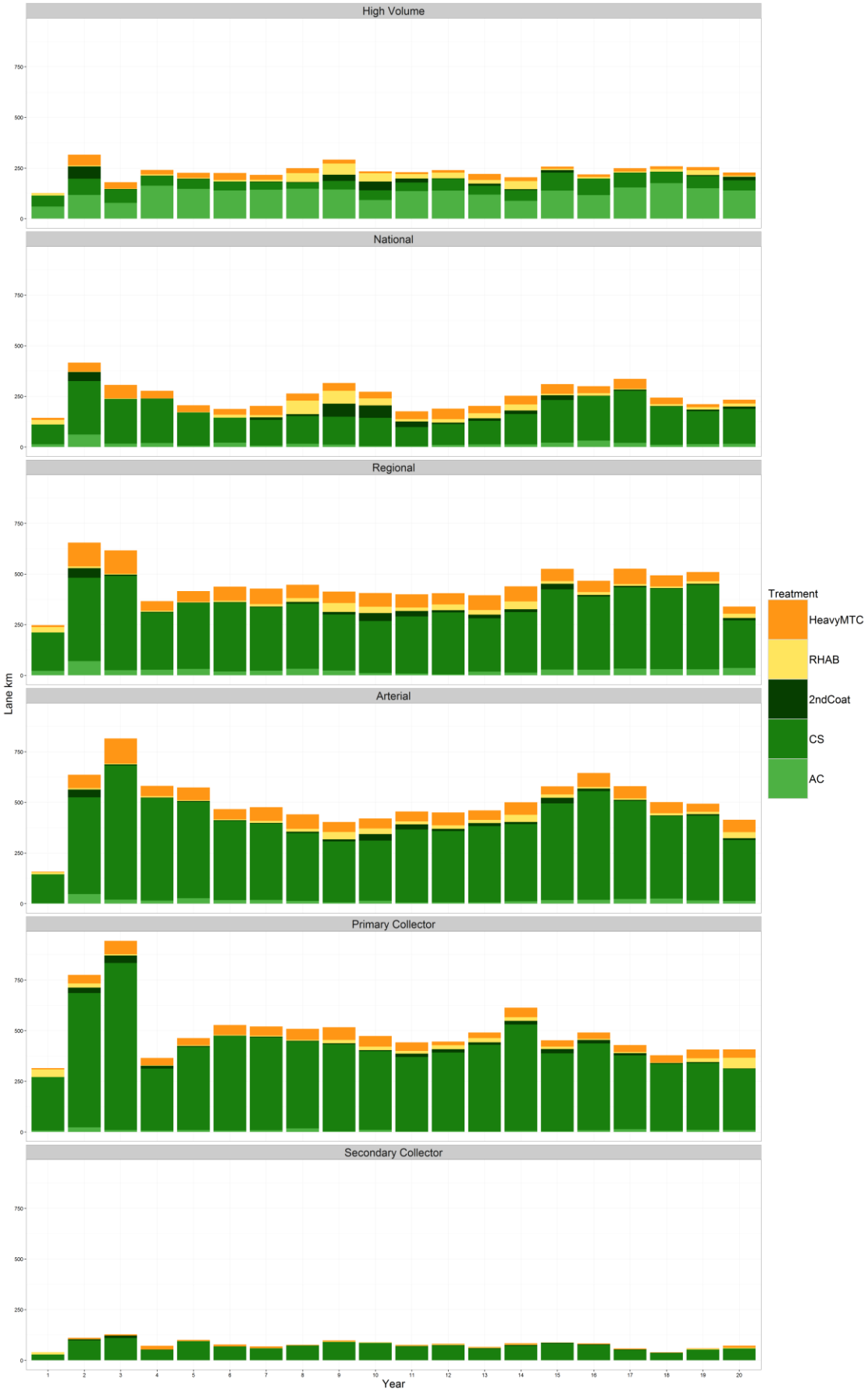
Lane km $110M_V1 by ONRC



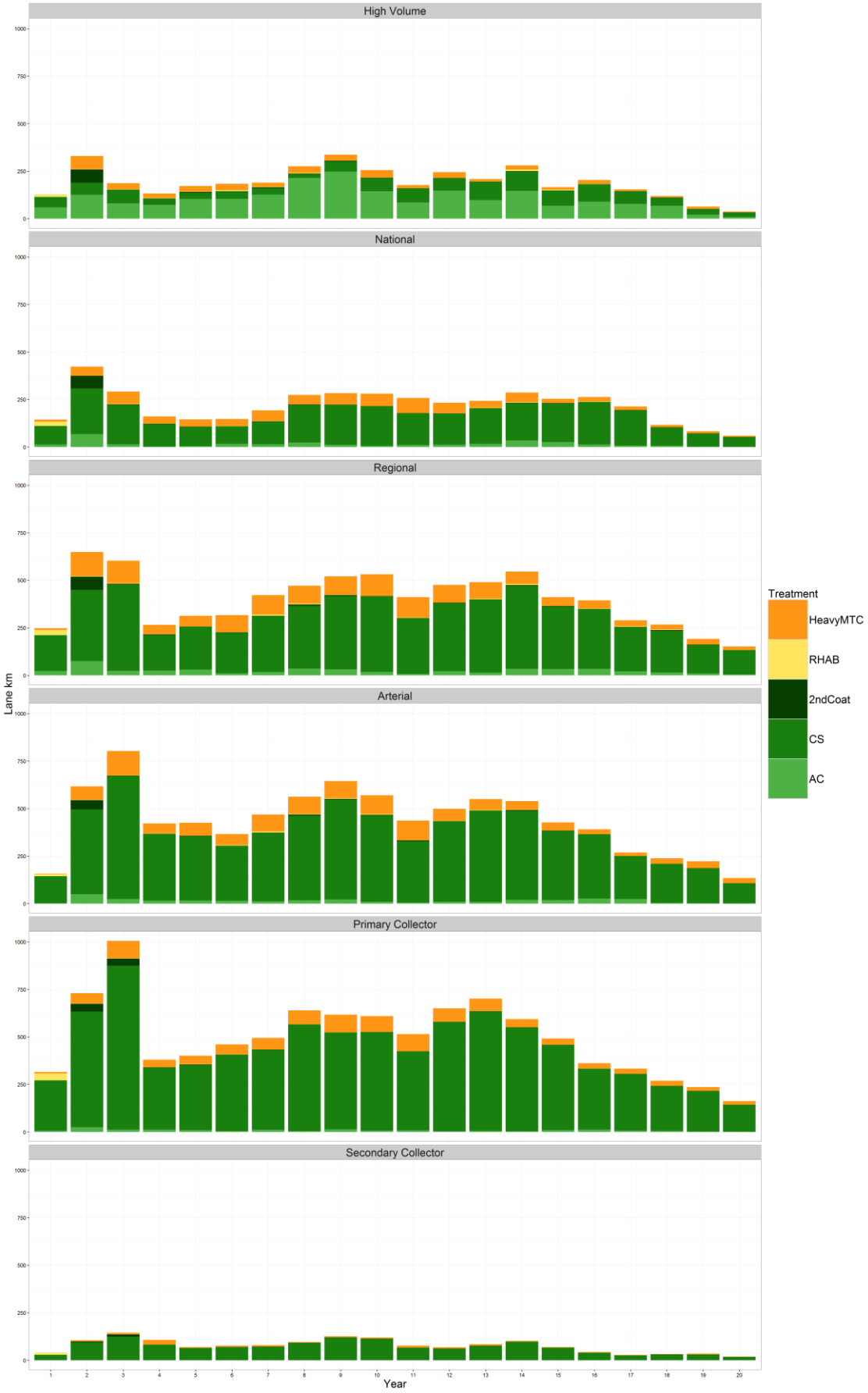
Lane km $90M_V1 by ONRC



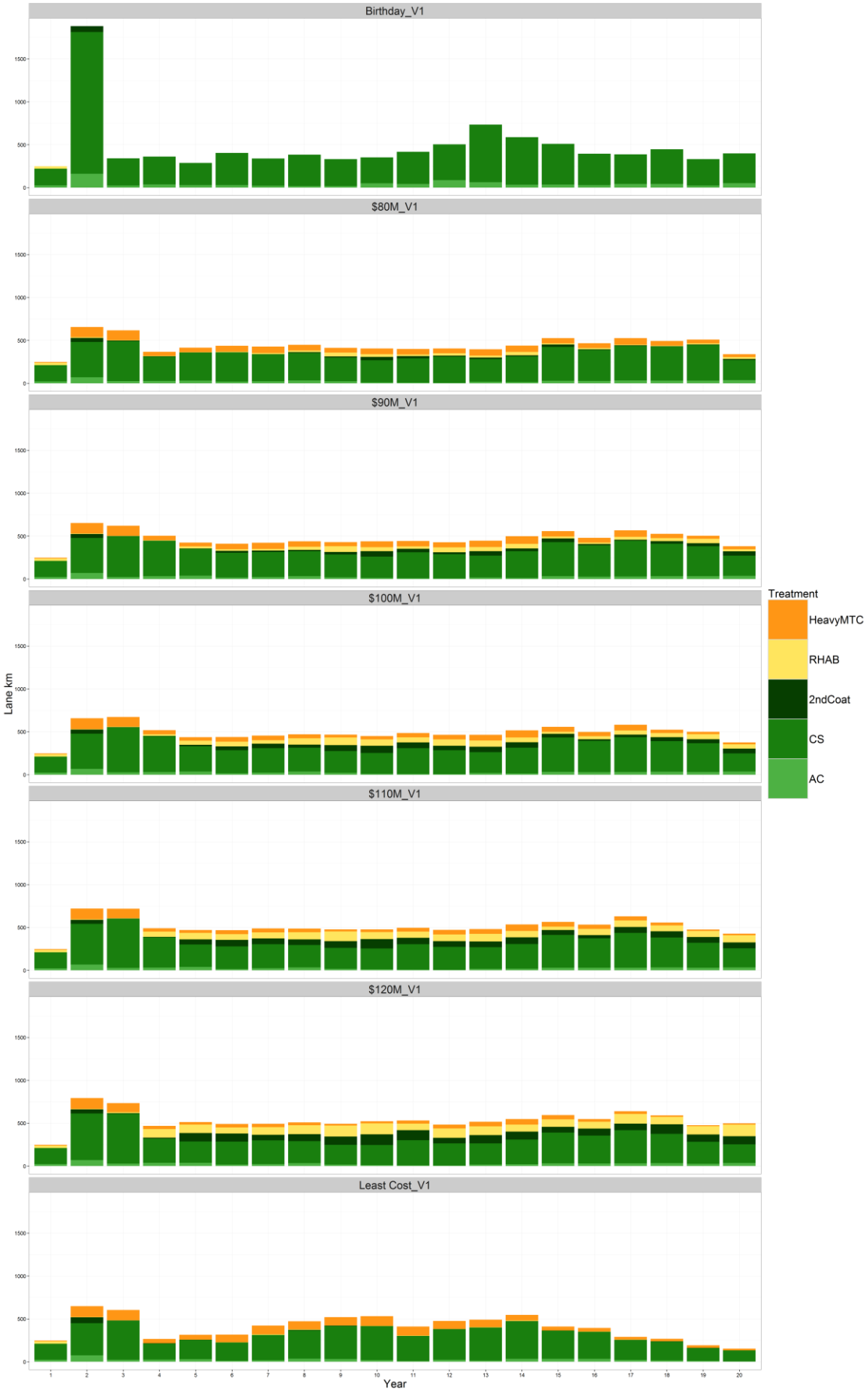
Lane km $80M_V1 by ONRC



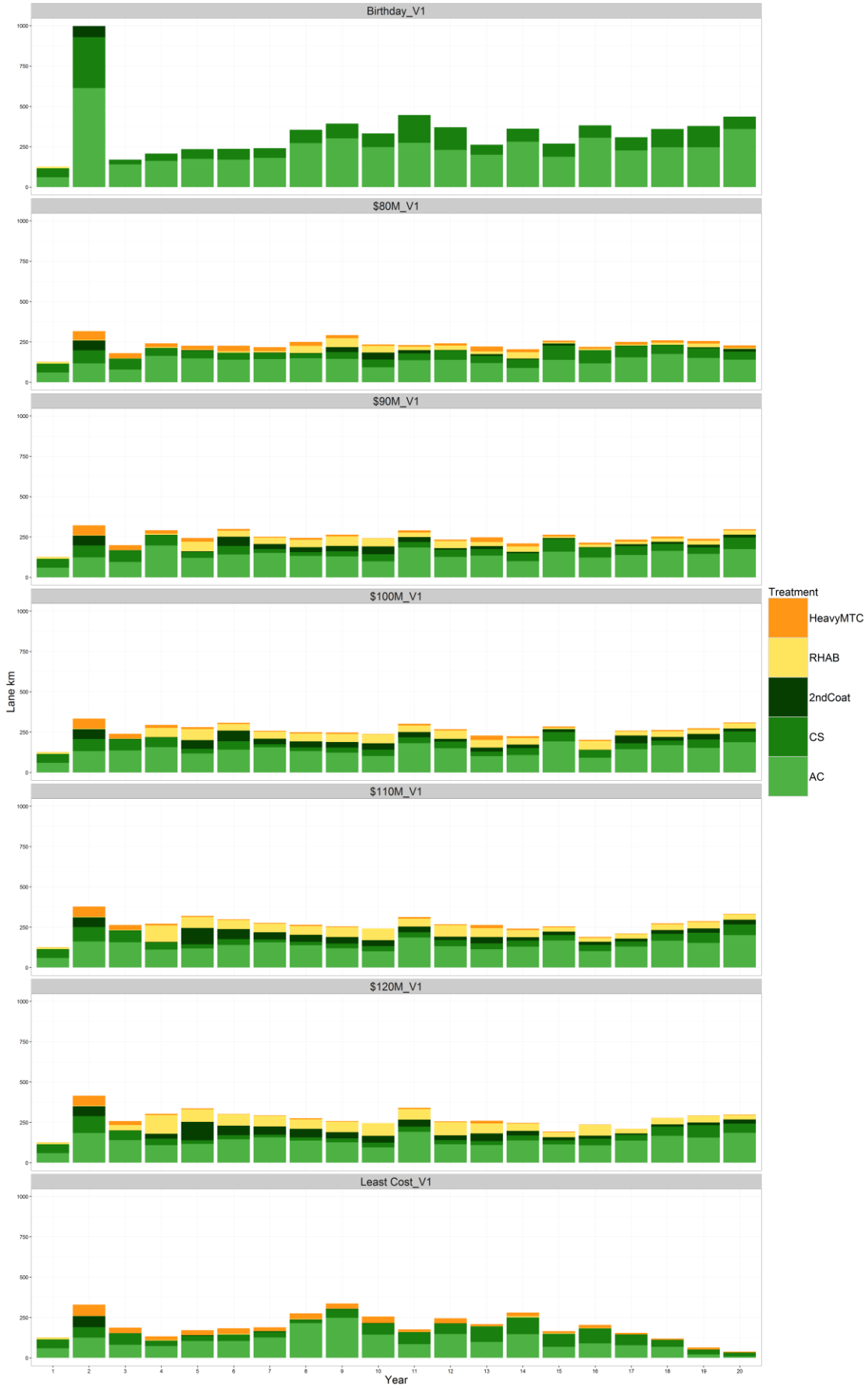
Lane km Least Cost_V1 by ONRC



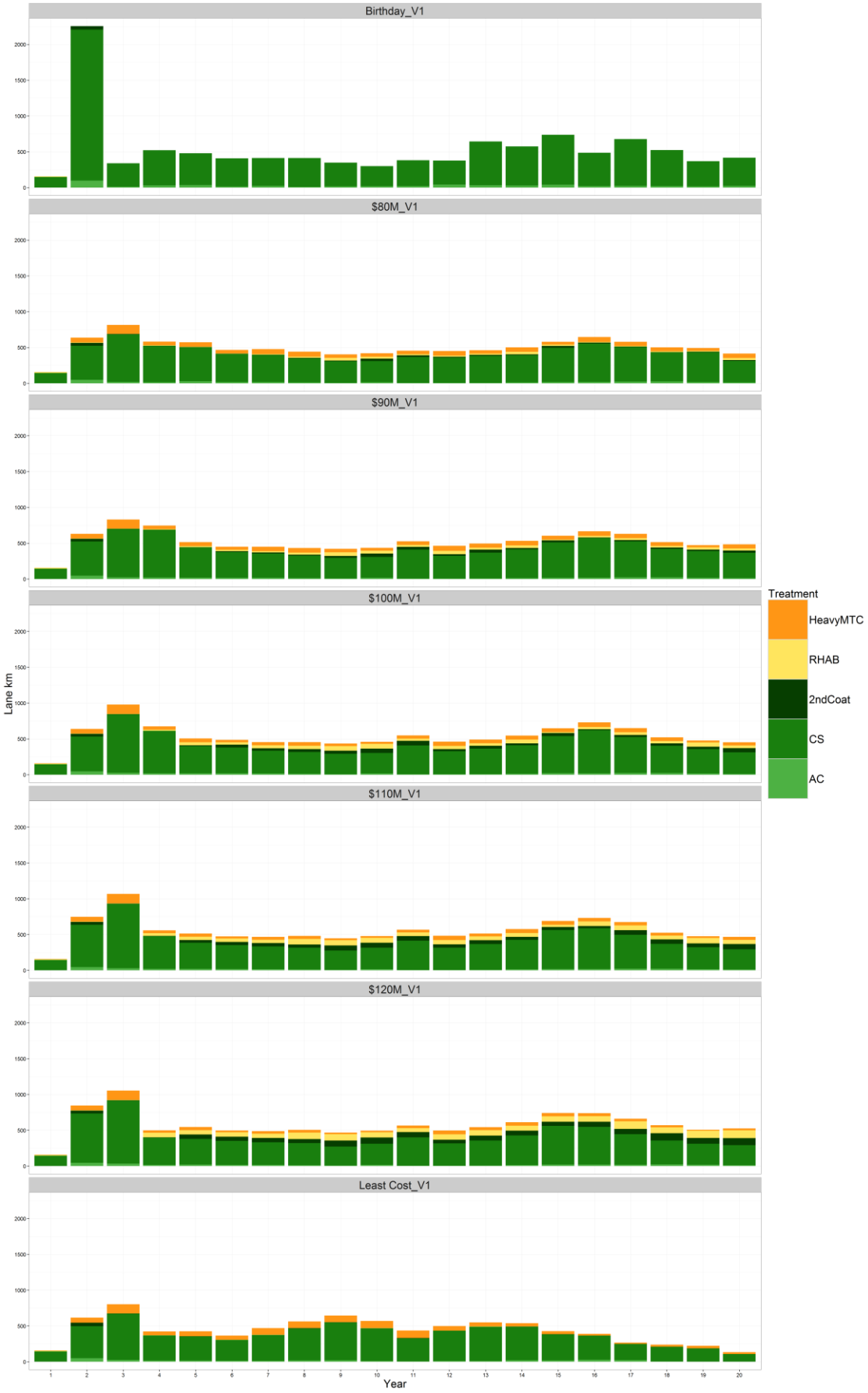
Lane km by ONRC - Regional



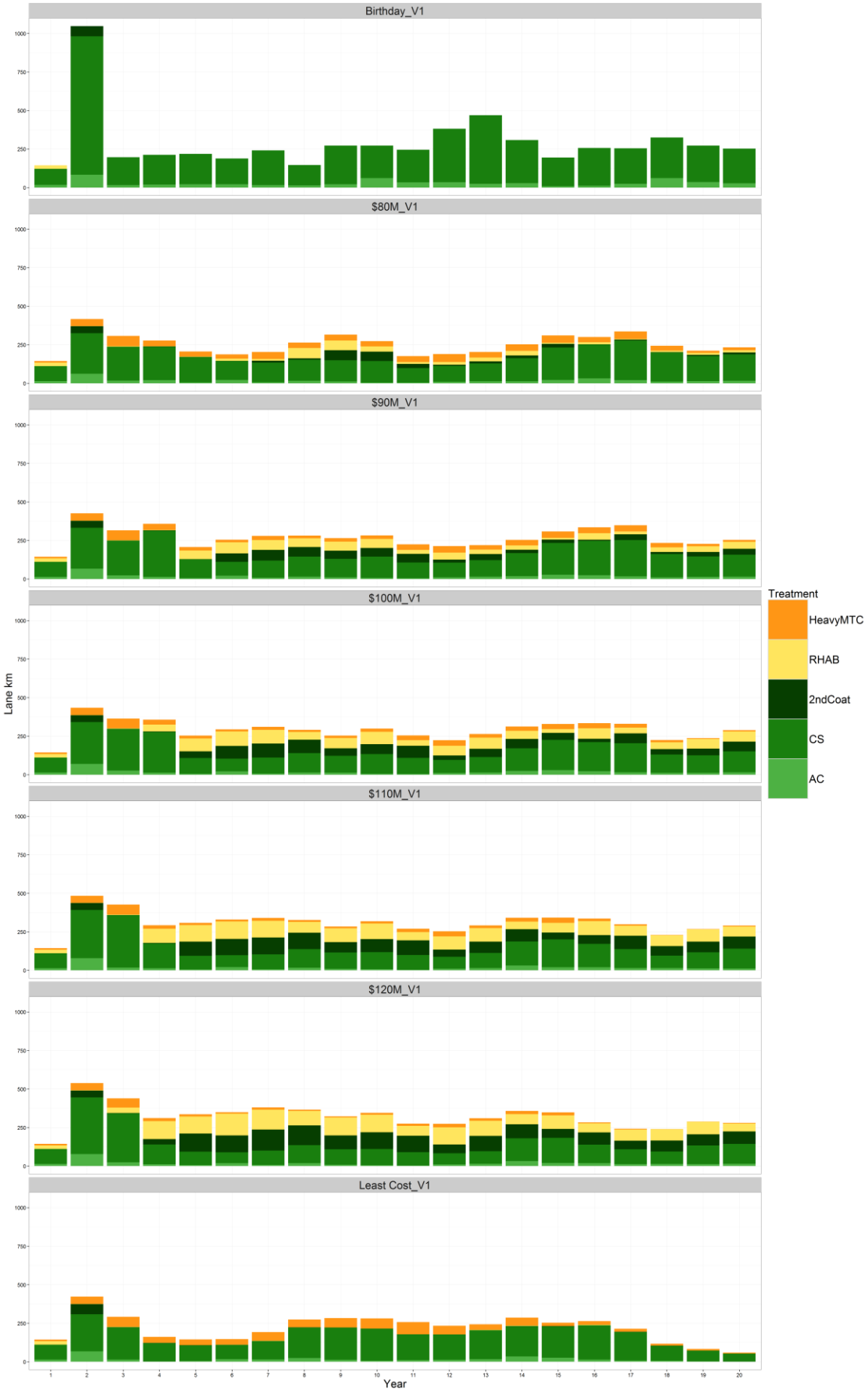
Lane km by ONRC - High Volume



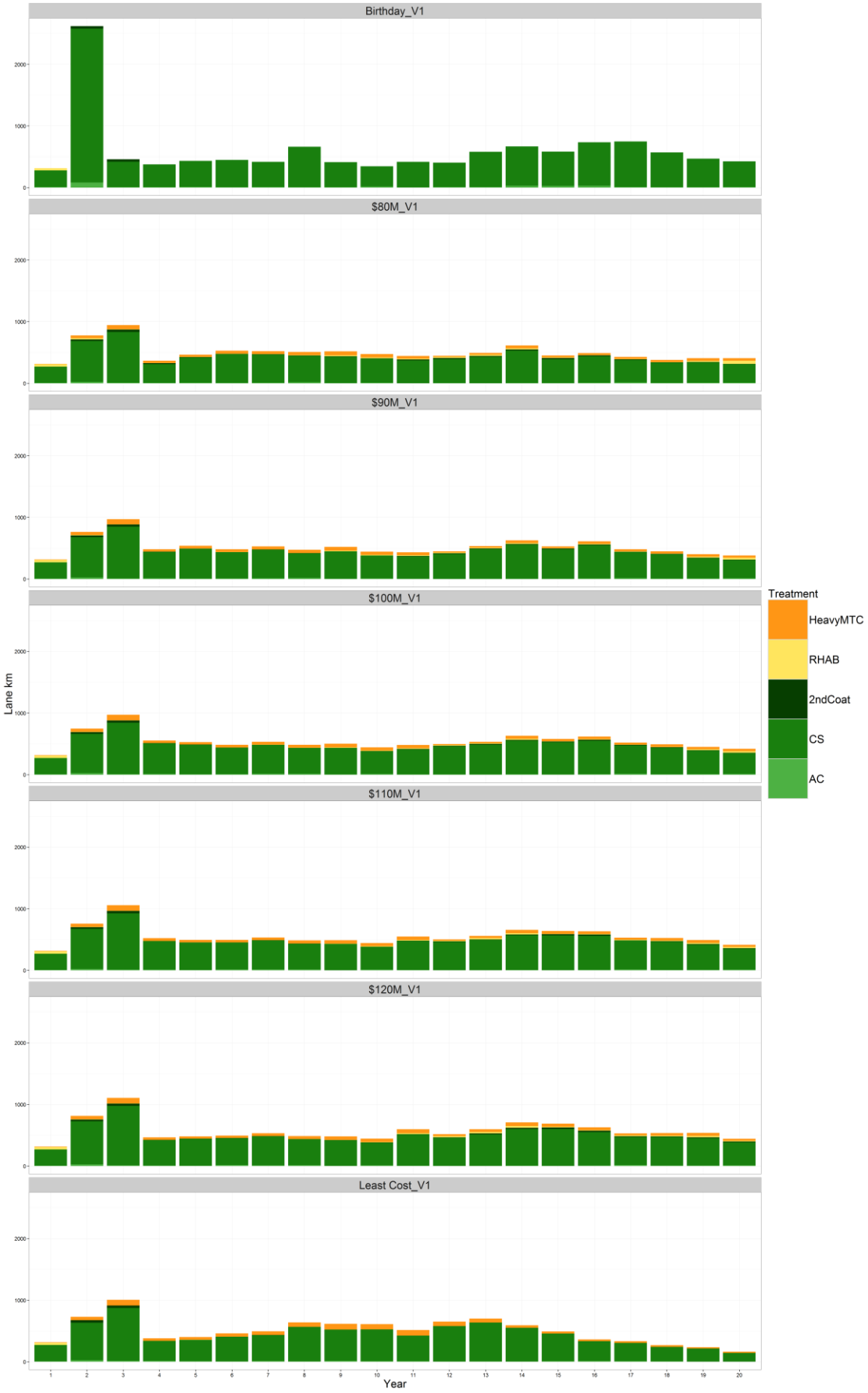
Lane km by ONRC - Arterial



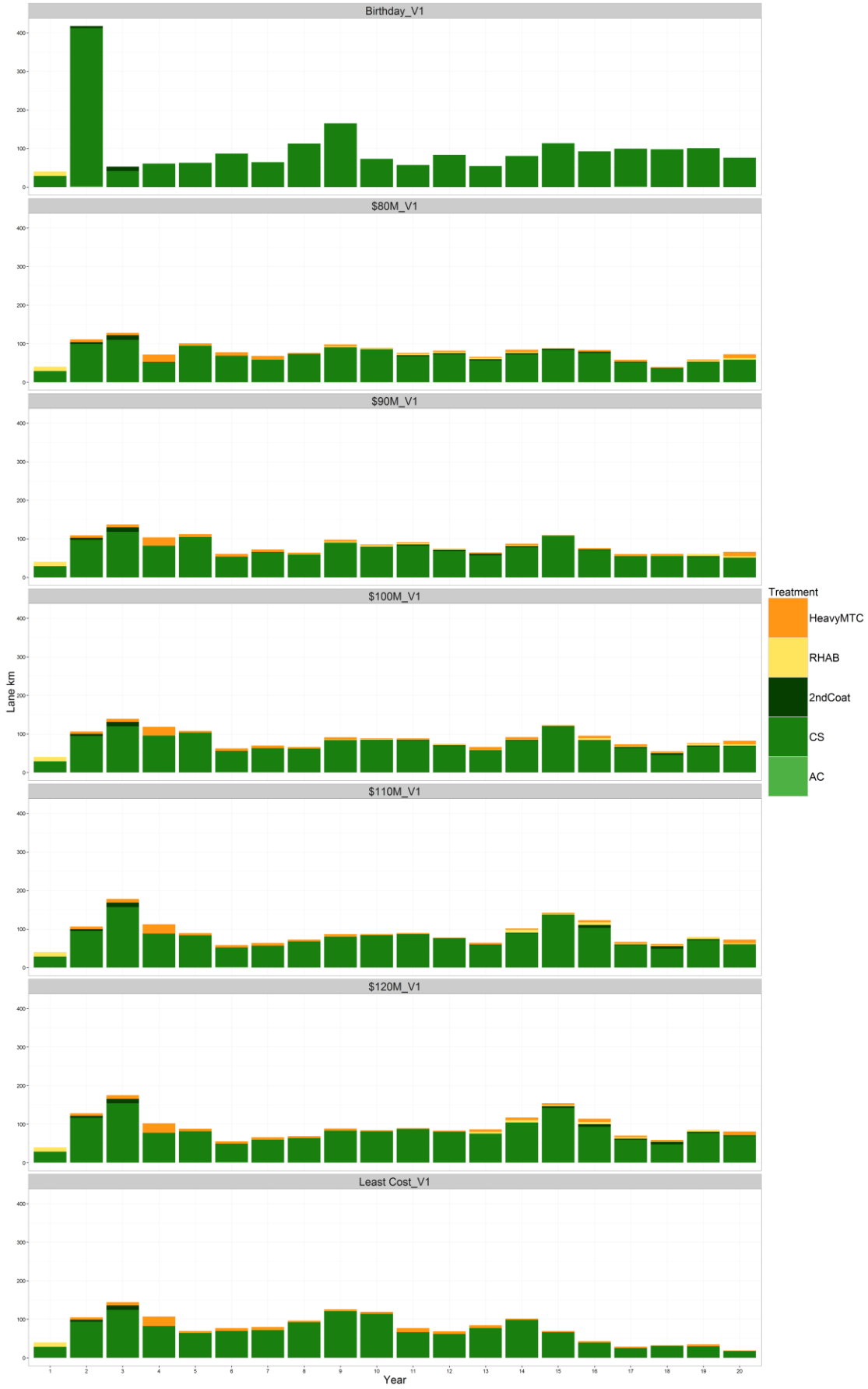
Lane km by ONRC - National



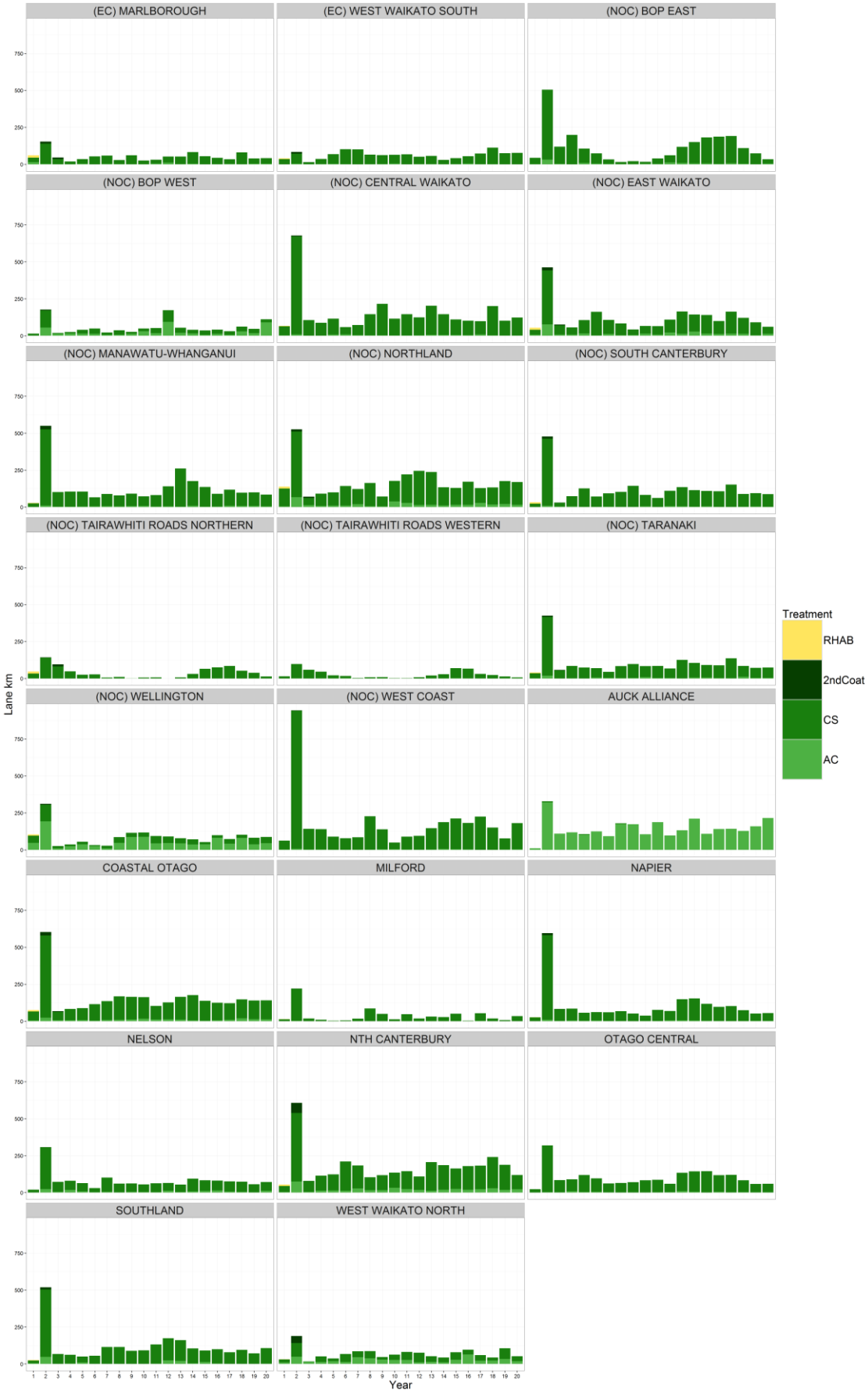
Lane km by ONRC - Primary Collector



Lane km by ONRC - Secondary Collector



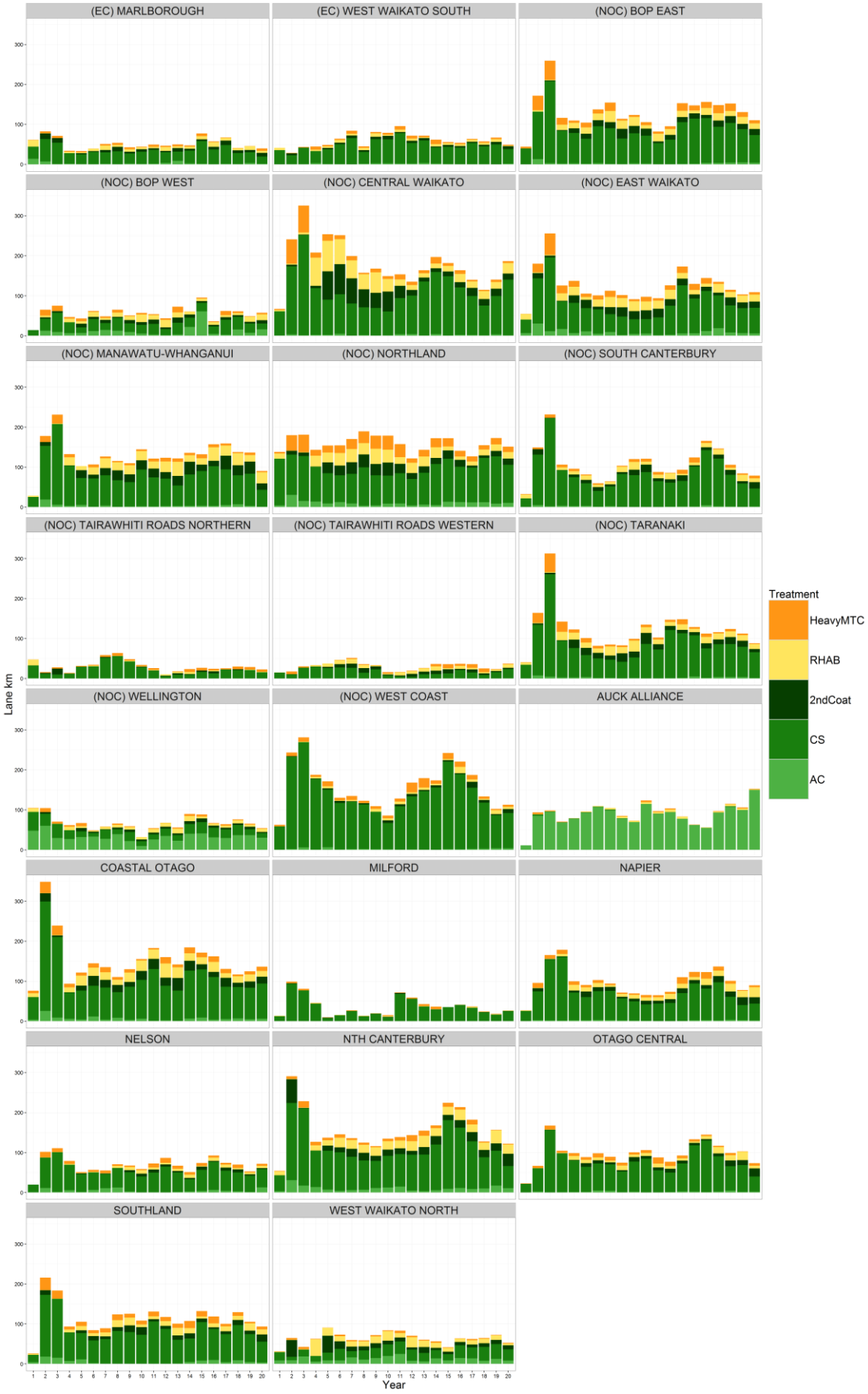
Lane km by NOC - Birthday_V1



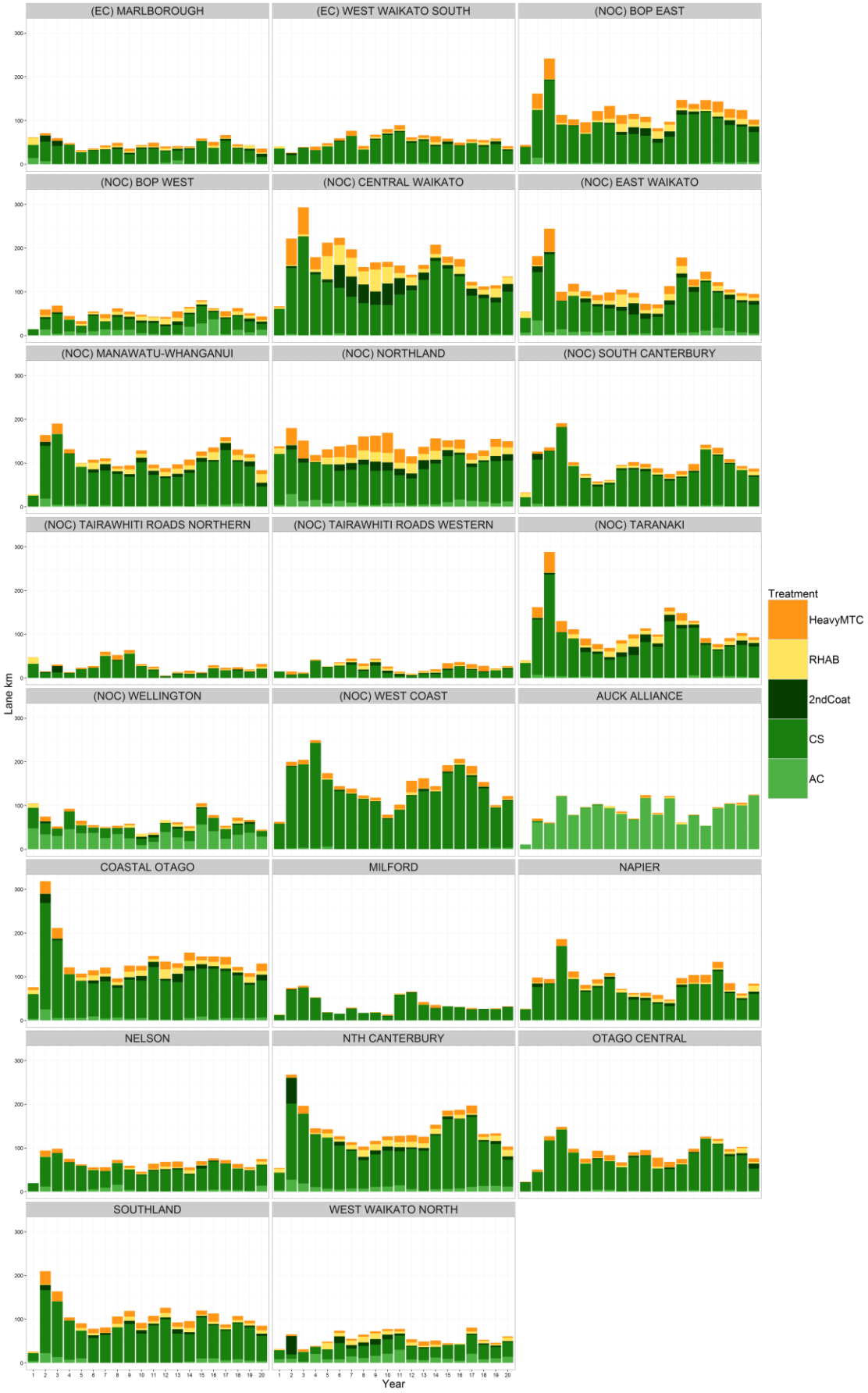
Lane km by NOC - $100M_V1

Lane km by NOC - $120M_V1

Lane km by NOC - $110M_V1



Lane km by NOC - $90M_V1



Lane km by NOC - $80M_V1

Lane km by NOC - Least Cost_V1

2.2 Cost Charts – Unlimited Routine Maintenance (V1)

This set of outputs includes Stacked Bar Charts showing predicted Treatment Cost ($ Million) for each Treatment Type

- Asphalt Surfacing - AC (light green)
- Chipseal Surfacing - CS (mid green), 2nd Coat (dark green)
- Pavement Rehabilitation - RHAB (yellow), Heavy Maintenance (orange)
- Safety (where applicable – red)
- Routine Maintenance – RTNE (light blue), Pre Reseal Repairs – PSEAL (dark blue)

The first Chart/Table compares the seven (7) 'Unlimited RM Options as a 20 Year National Average National Average Annual Cost ($ Million)

- **$ Birthday_V1**
  - Treatments triggered when useful life is reached, does not try and meet Levels of Service
  - Renewal Investment: **Unlimited,** Routine Investment: **Unlimited**
  - Safety Investment: Safety not Included
- **$80M_V1**
  - Renewal Investment: Fixed **$80M** pa, Routine Investment: **Unlimited**
  - Safety Investment: Safety not Included
- **$90M_V1**
  - Renewal Investment: Fixed **$90M** pa, Routine Investment: **Unlimited**
  - Safety Investment: Safety not Included
- **$100M_V1**
  - Renewal Investment: Fixed **$100M** pa, Routine Investment: **Unlimited**
  - Safety Investment: Safety not Included
- **$110M_V1**
  - Renewal Investment: Fixed **$110M** pa, Routine Investment: **Unlimited**
  - Safety Investment: Safety not Included
- **$120M_V1**
  - Renewal Investment: Fixed **$120M** pa, Routine Investment: **Unlimited**
  - Safety Investment: Safety not Included
- **Least Cost_V1**
  - Generates the lowest overall cost treatment programme considering Renewal and Routine Investment – disallowing Do Nothing. Does not try and meet Levels of Service.
  - Safety Investment: Safety not Included

The second series compares the six (6) ONRC Classes as time series over 20 years for each 'Unlimited RM Options'.

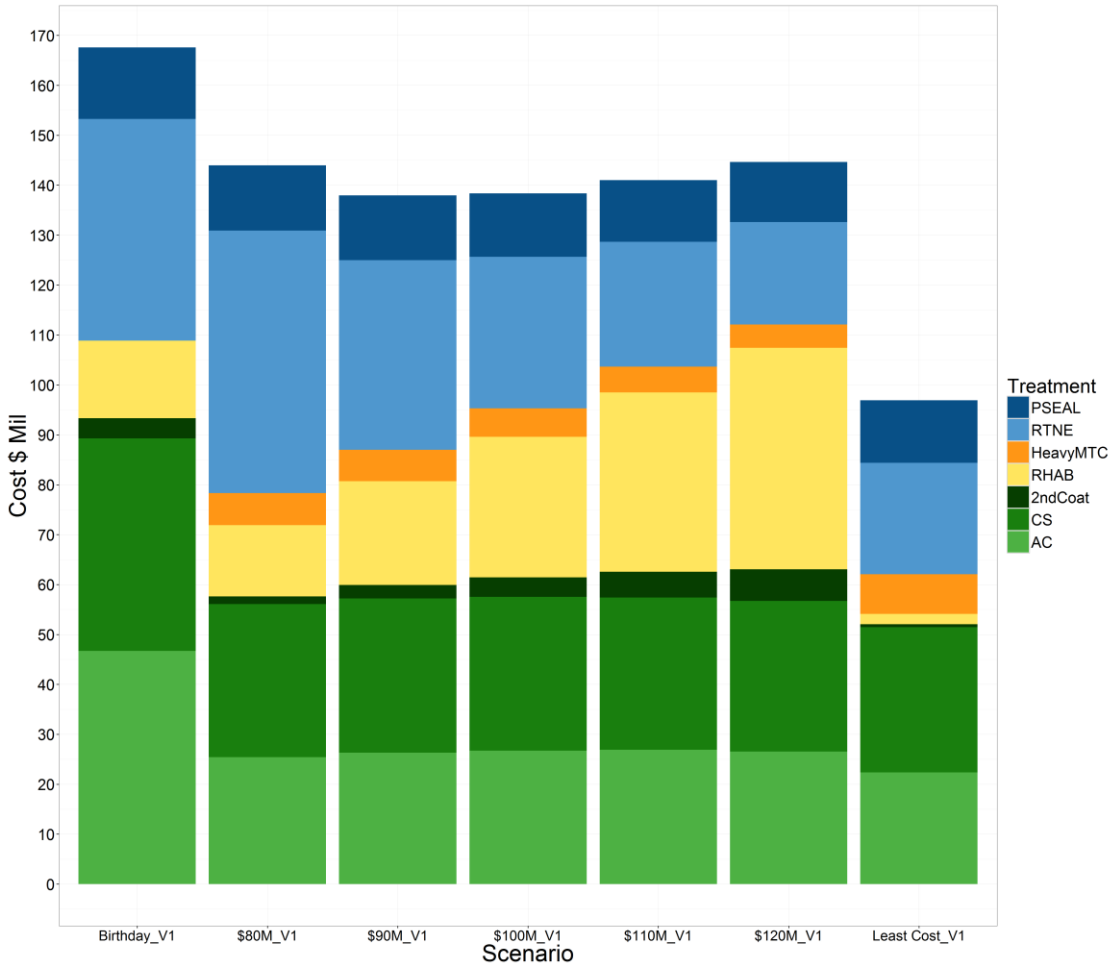
- Secondary Collector, Primary Collector
- Arterial, Regional
- National, National High Volume

The third series compares the 'Unlimited RM Options' by ONRC Class as time series over 20 years

The fourth series compares the twenty three (23) Regions as time series over 20 years for each 'Unlimited RM Option'.

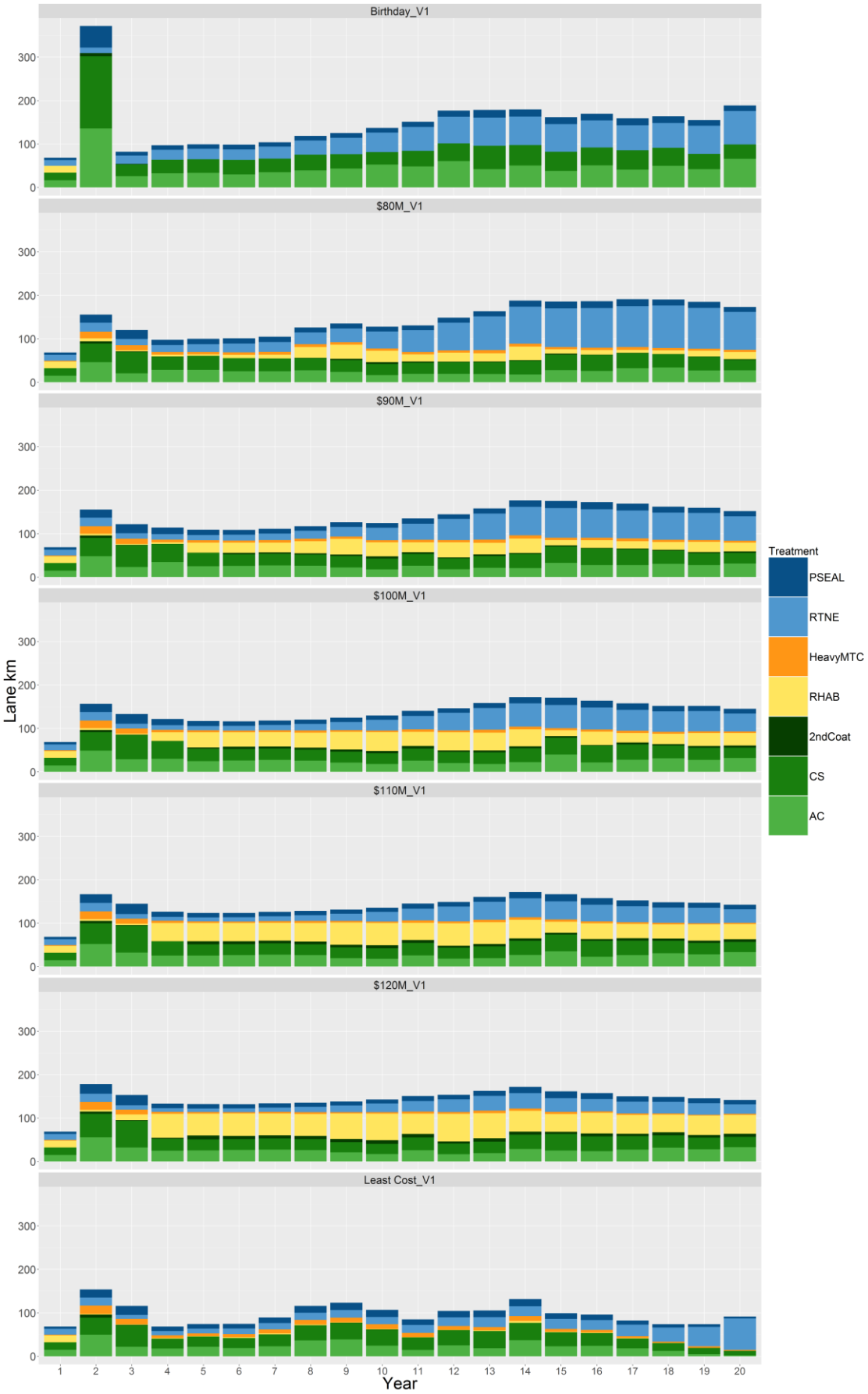
Costs

National 20 Year Average Annual Cost

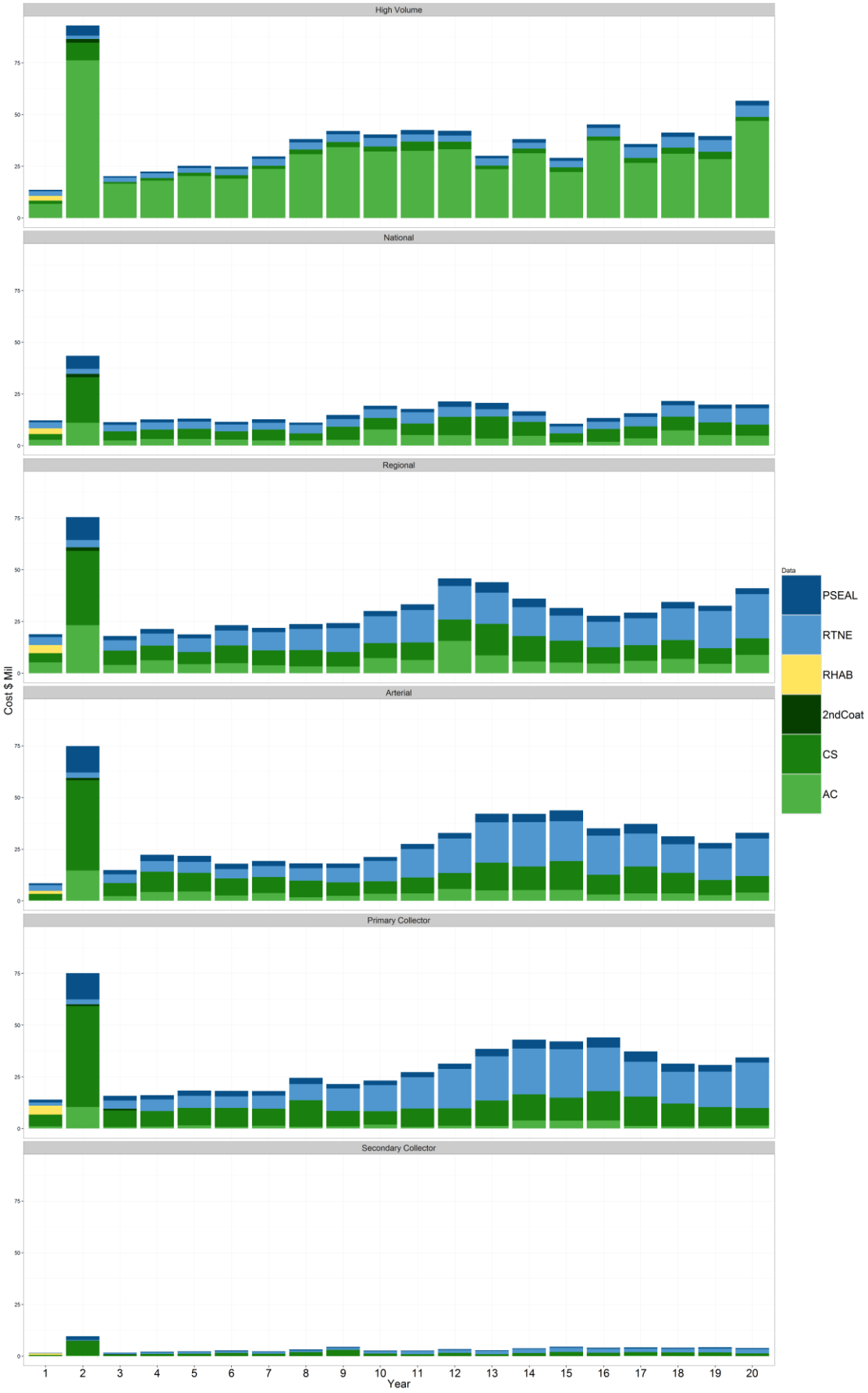


	Birthday_V1	$80M_V1	$90M_V1	$100M_V1	$110M_V1	$120M_V1	Least Cost_V1
AC	46.72	25.41	26.33	26.7	26.88	26.53	22.35
CS	42.54	30.67	30.9	30.81	30.51	30.2	29.1
2ndCoat	4.05	1.55	2.68	3.93	5.17	6.33	0.6
RHAB	15.54	14.28	20.81	28.17	35.92	44.35	2.08
HeavyMTC	0	6.41	6.27	5.7	5.17	4.7	7.95
RTNE	44.44	52.58	38	30.36	24.98	20.5	22.28
PSEAL	14.31	13.07	12.99	12.7	12.37	12.06	12.56

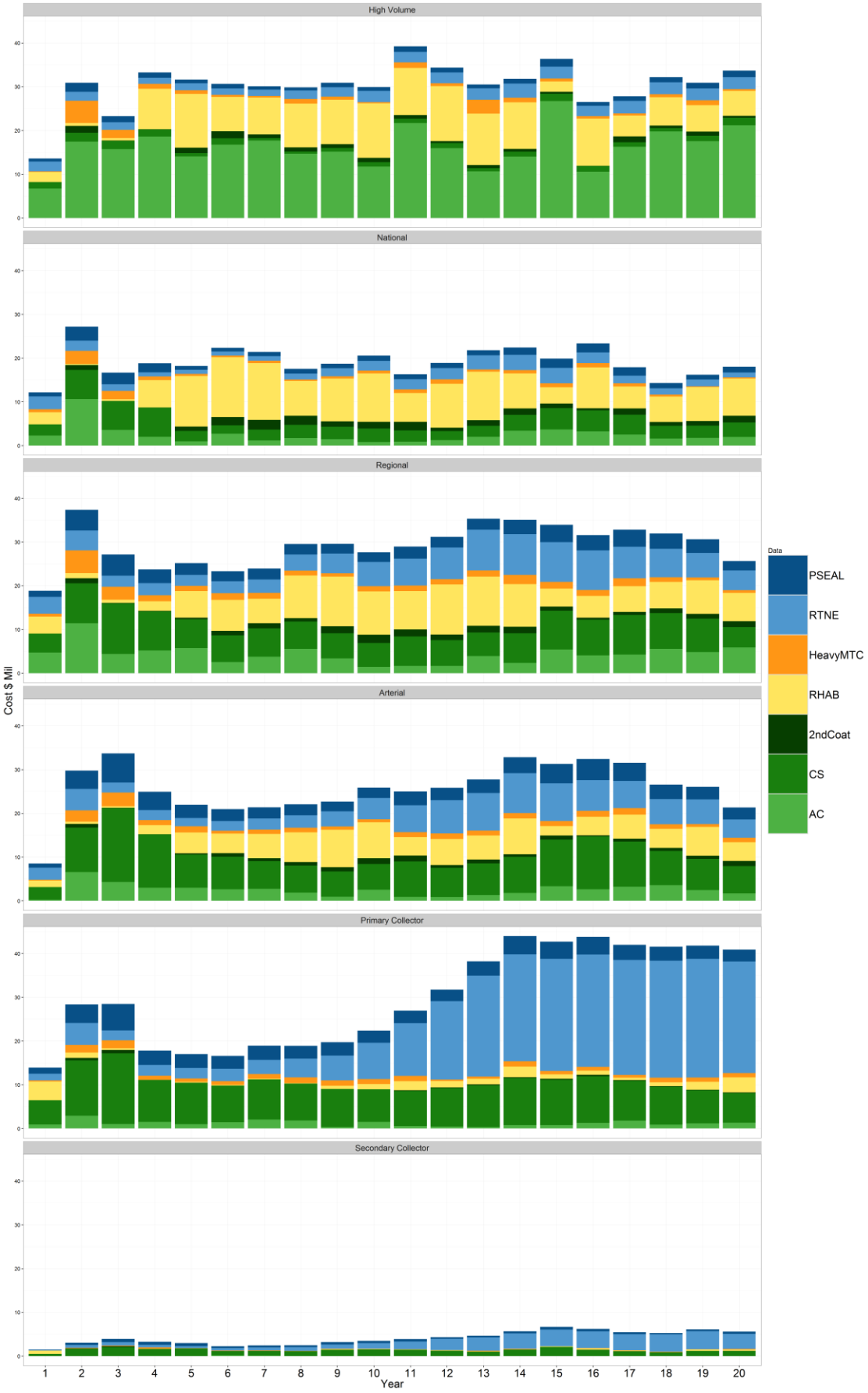
National Total Network Cost $ Mil



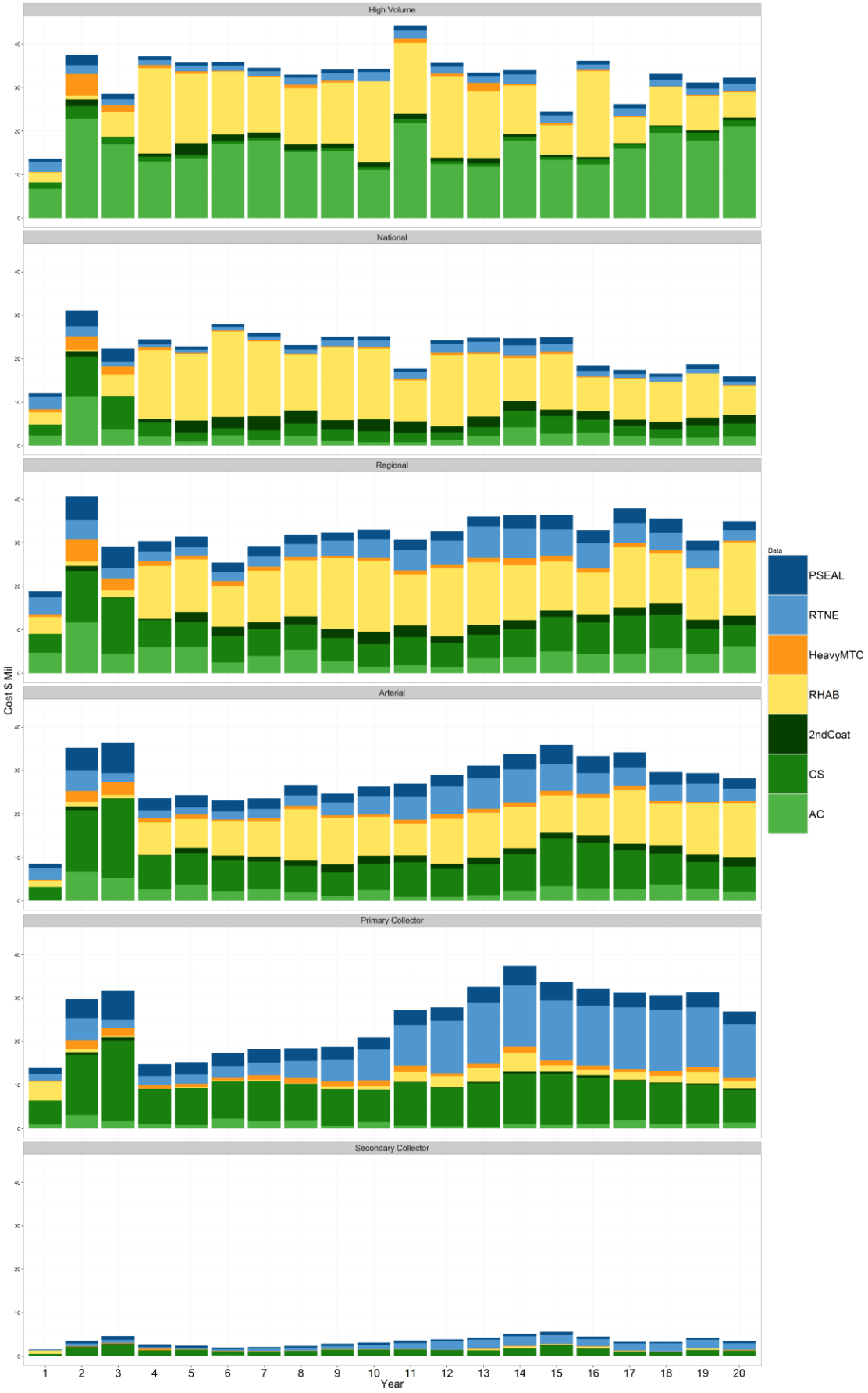
Cost $ Mil Birthday_V1 by ONRC



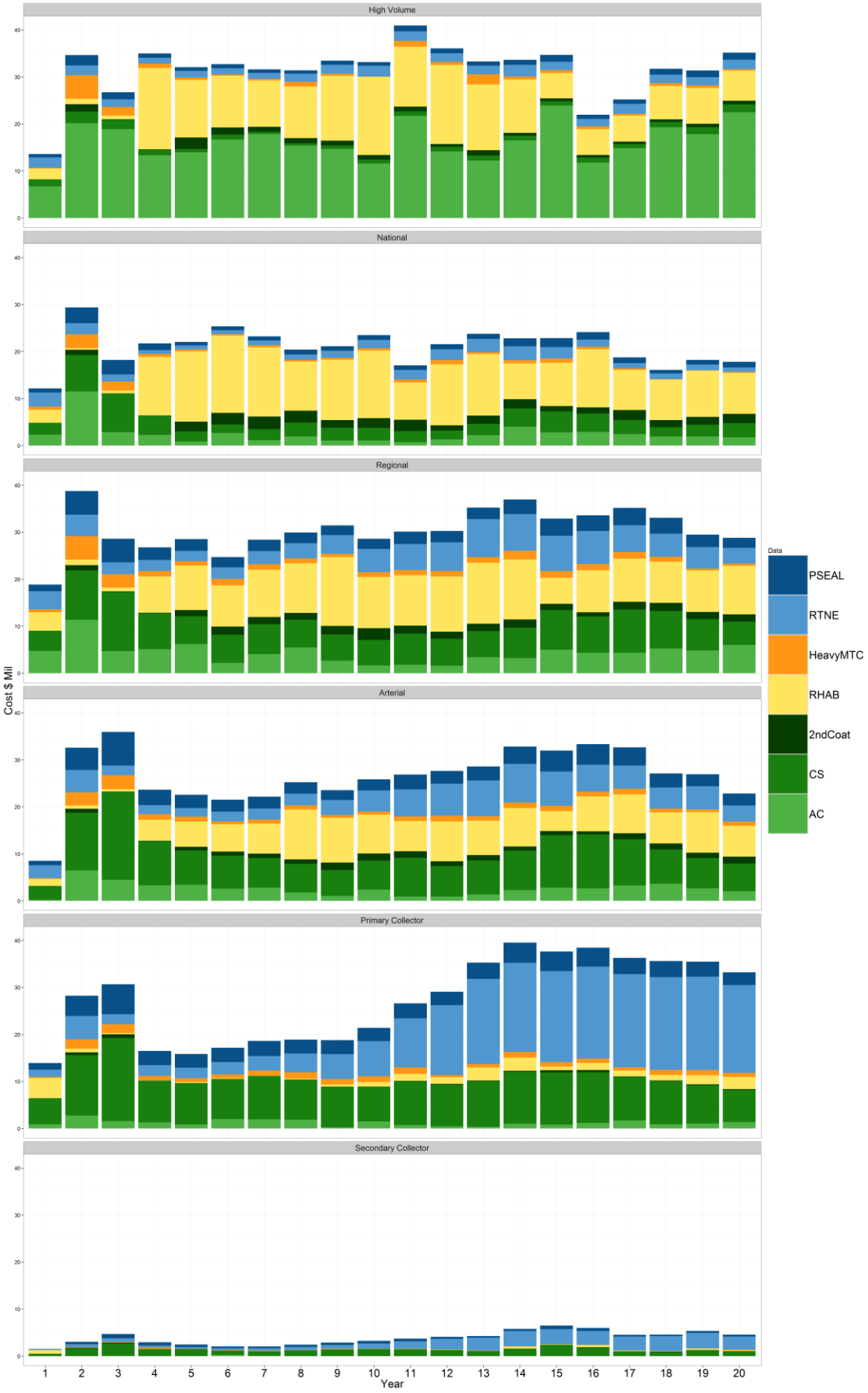
Cost $ Mil $100M_V1 by ONRC



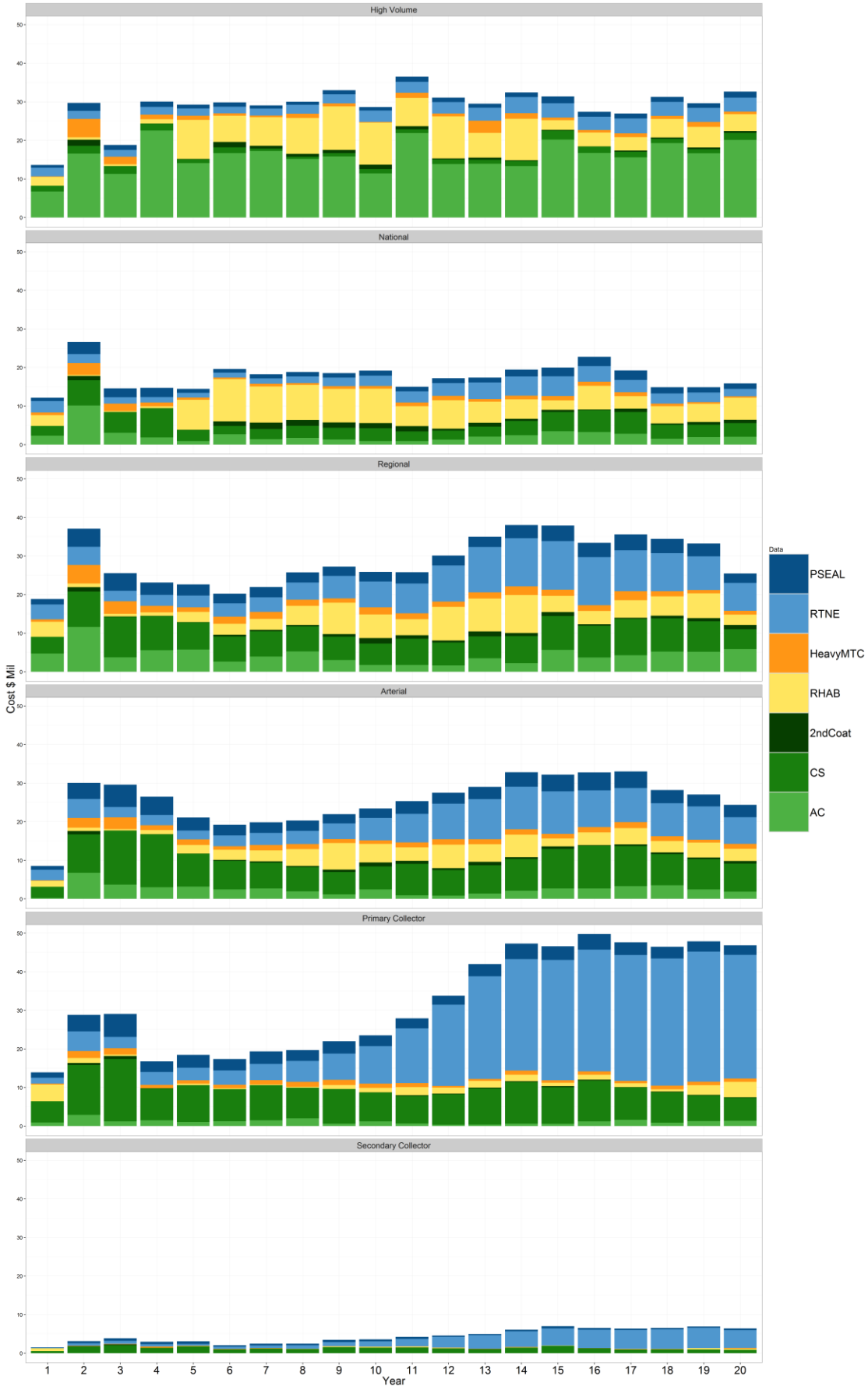
Cost $ Mil $120M_V1 by ONRC



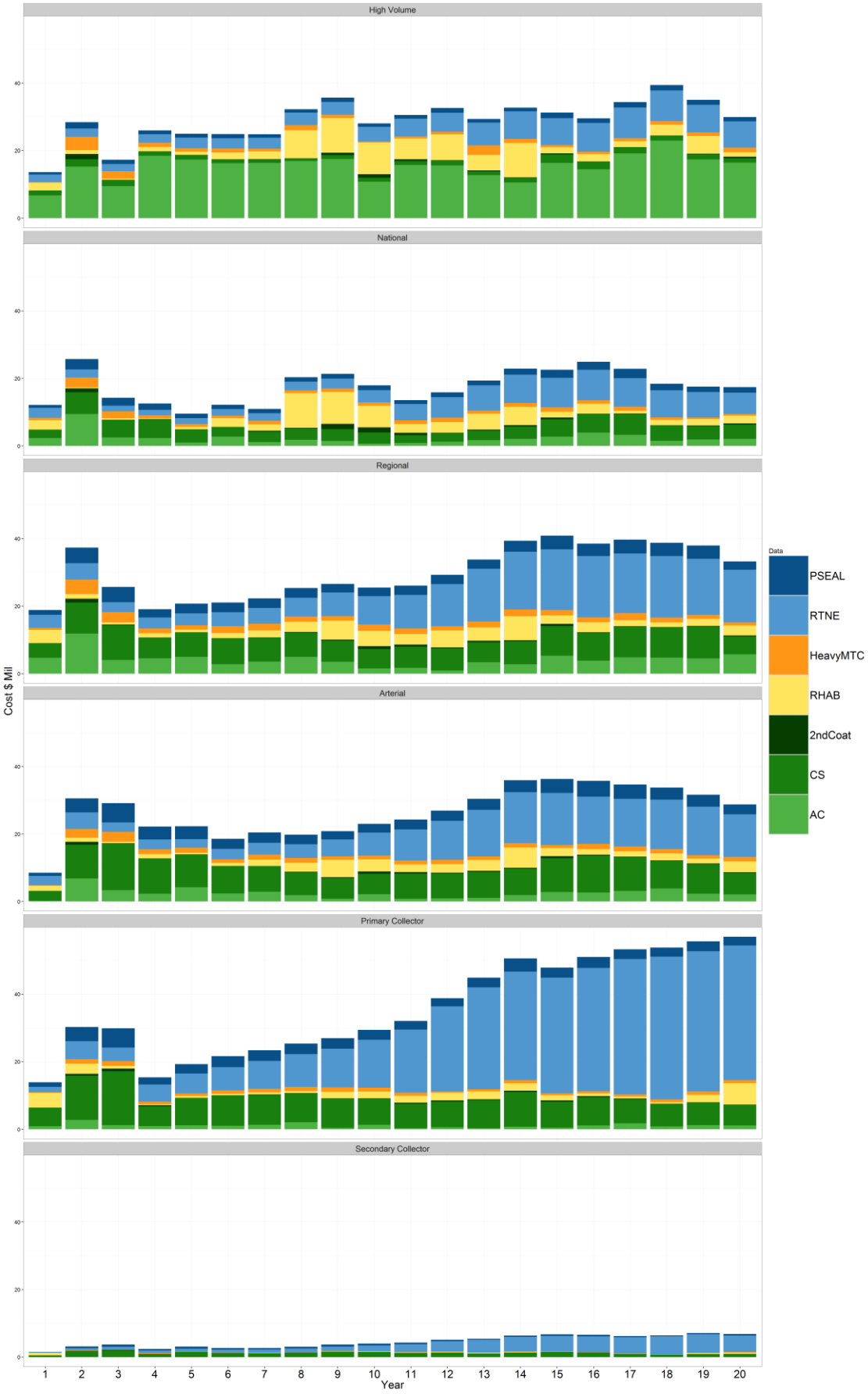
Cost $ Mil $110M_V1 by ONRC



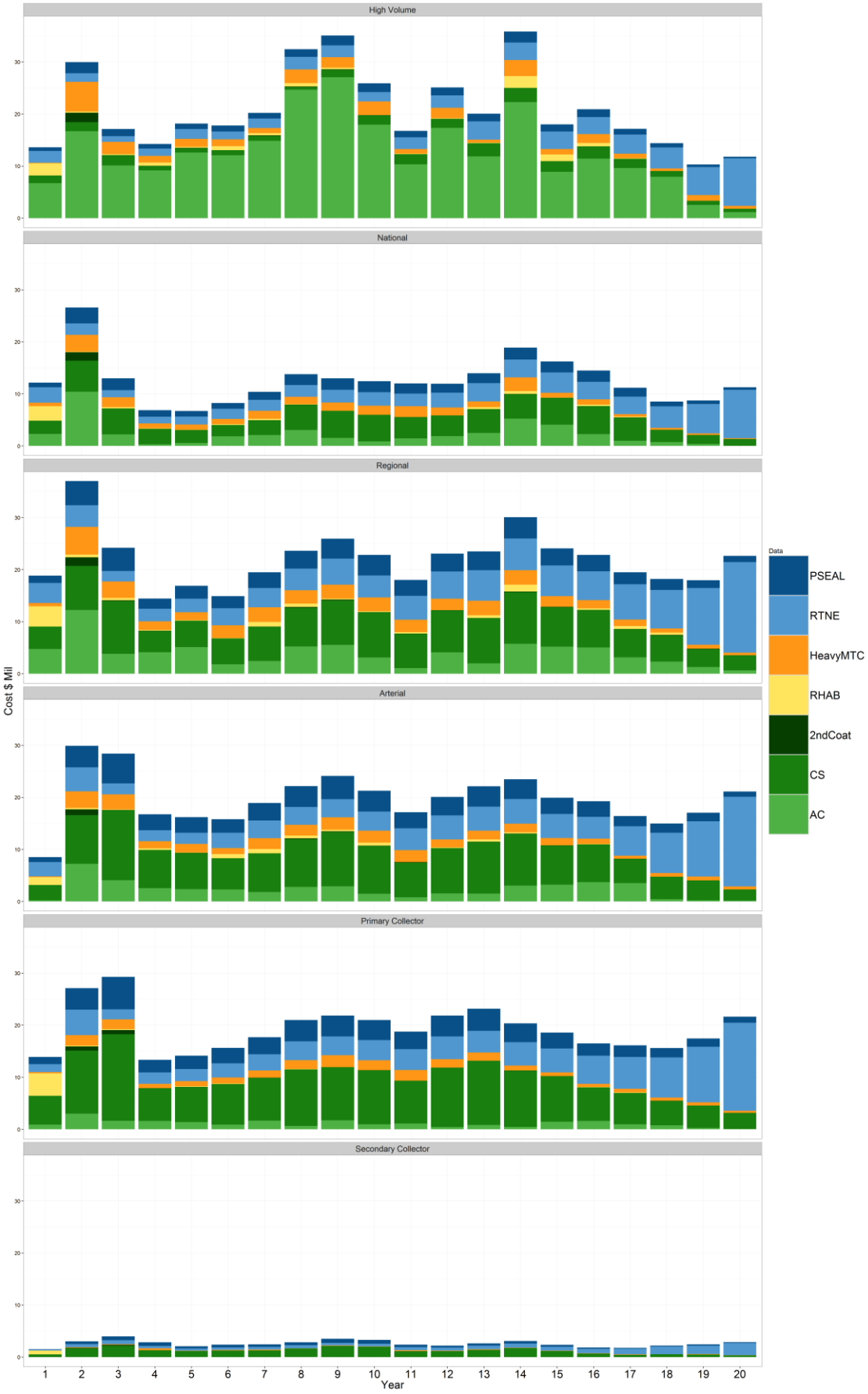
Cost $ Mil $90M_V1 by ONRC



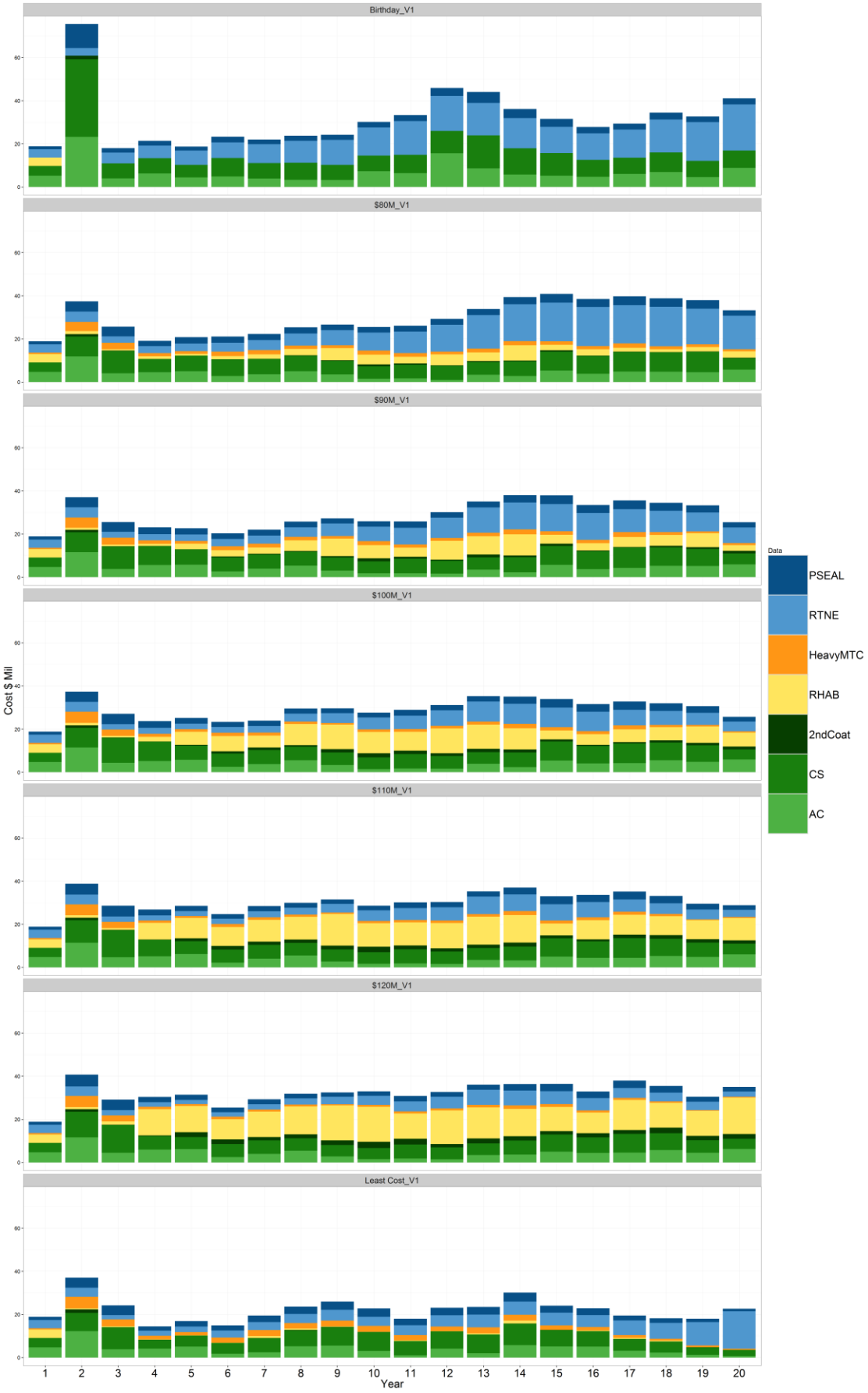
Cost $ Mil $80M_V1 by ONRC



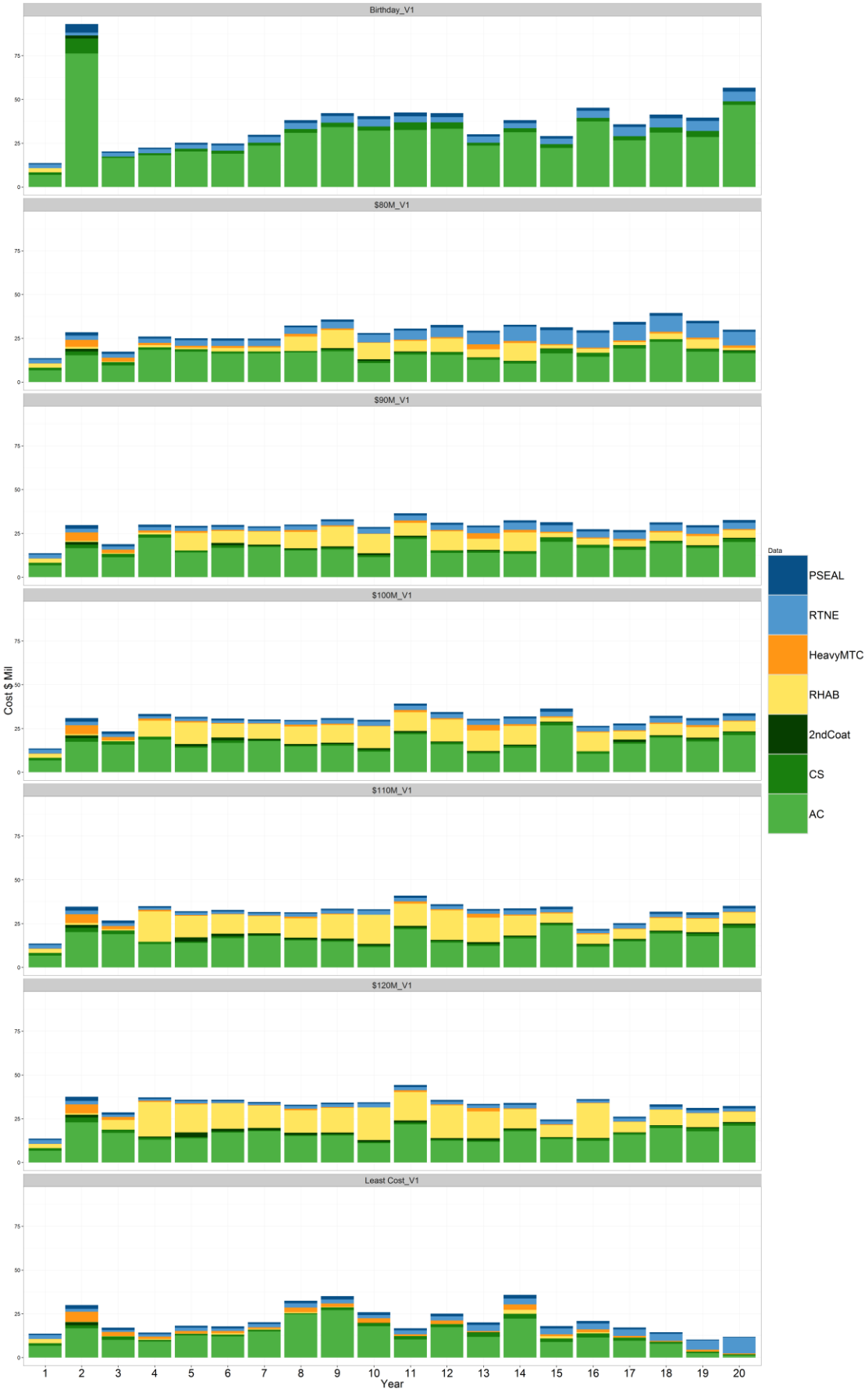
Cost $ Mil Least Cost_V1 by ONRC



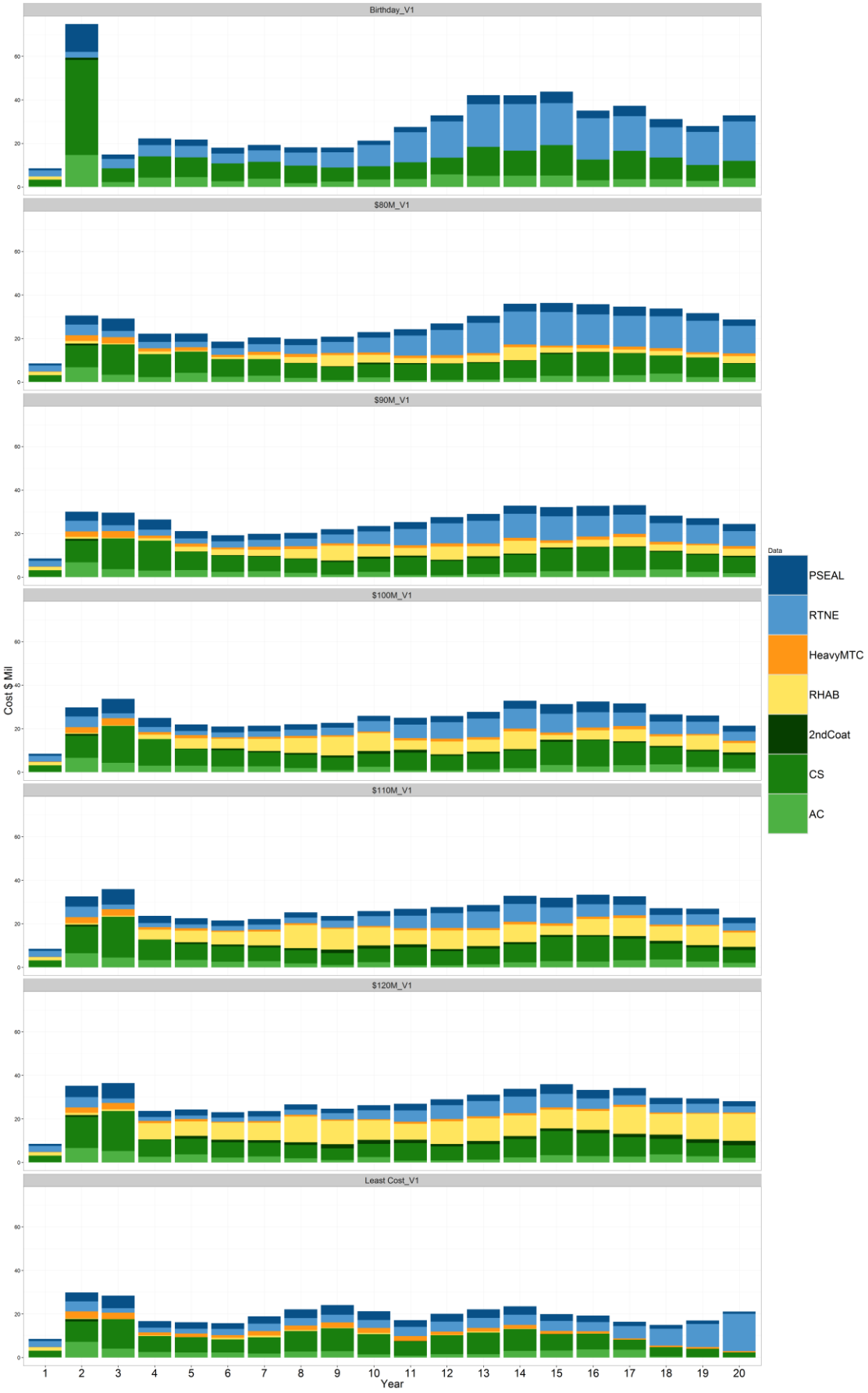
Cost $ Mil by ONRC - Regional



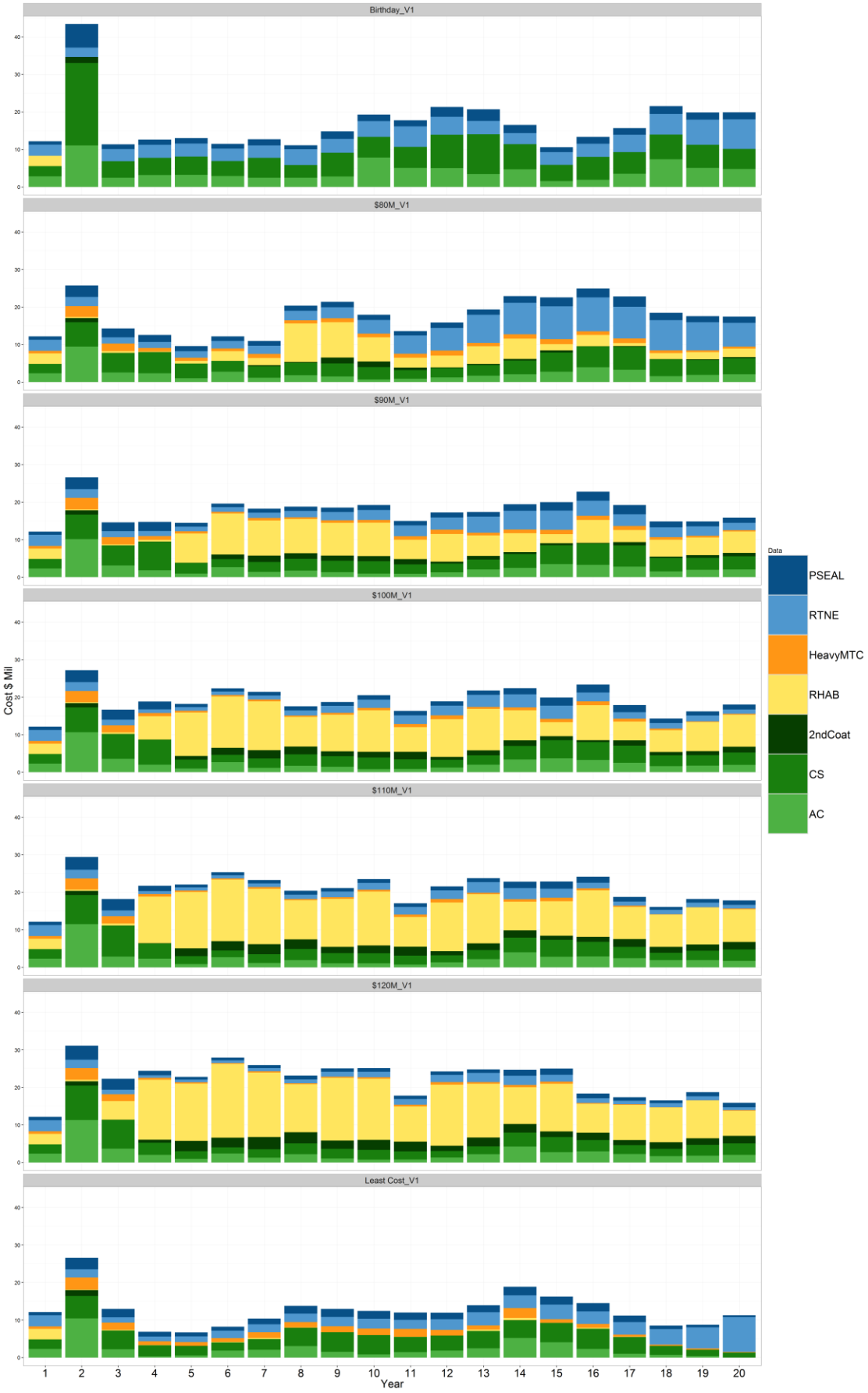
Cost $ Mil by ONRC - High Volume



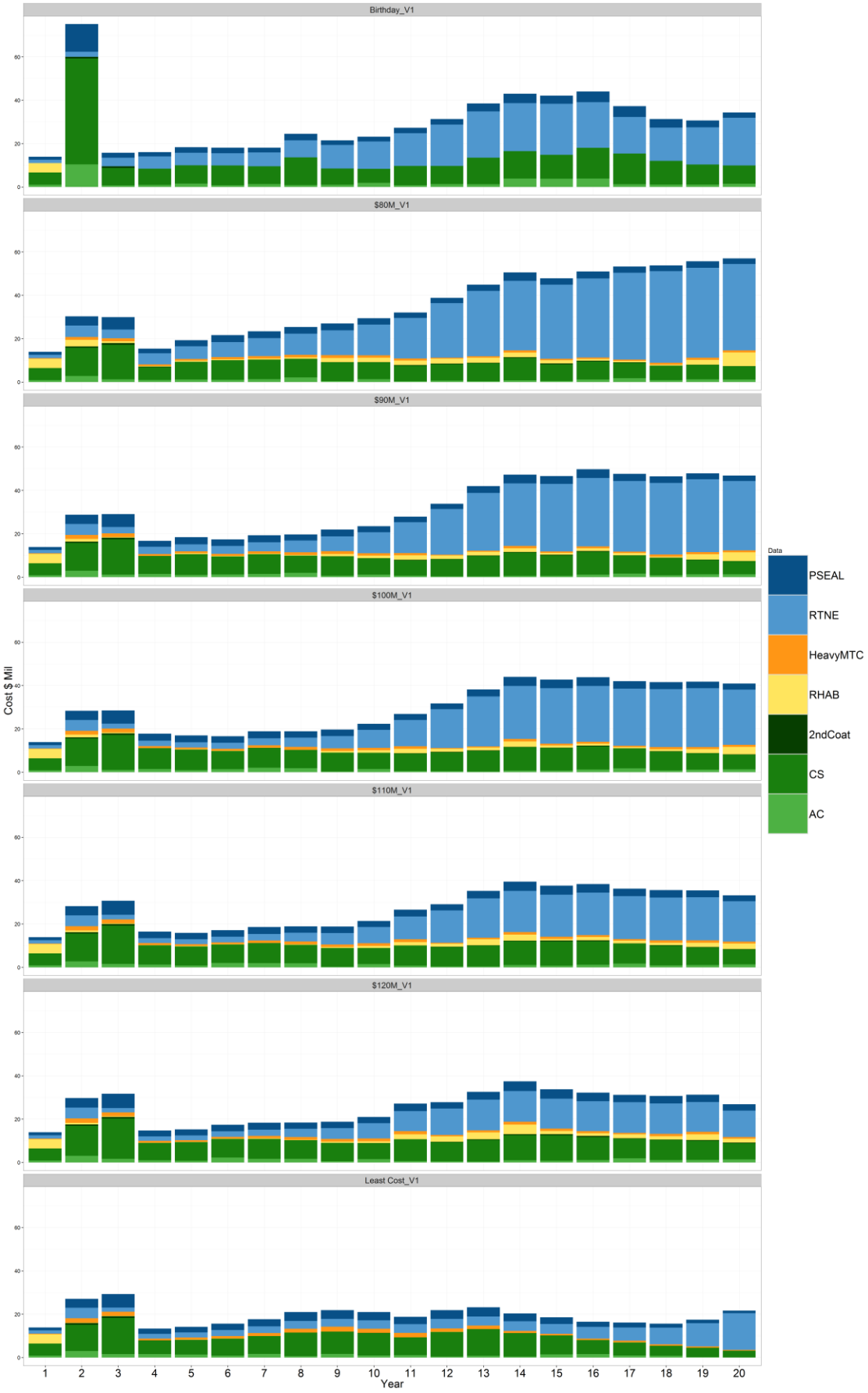
Cost $ Mil by ONRC - Arterial



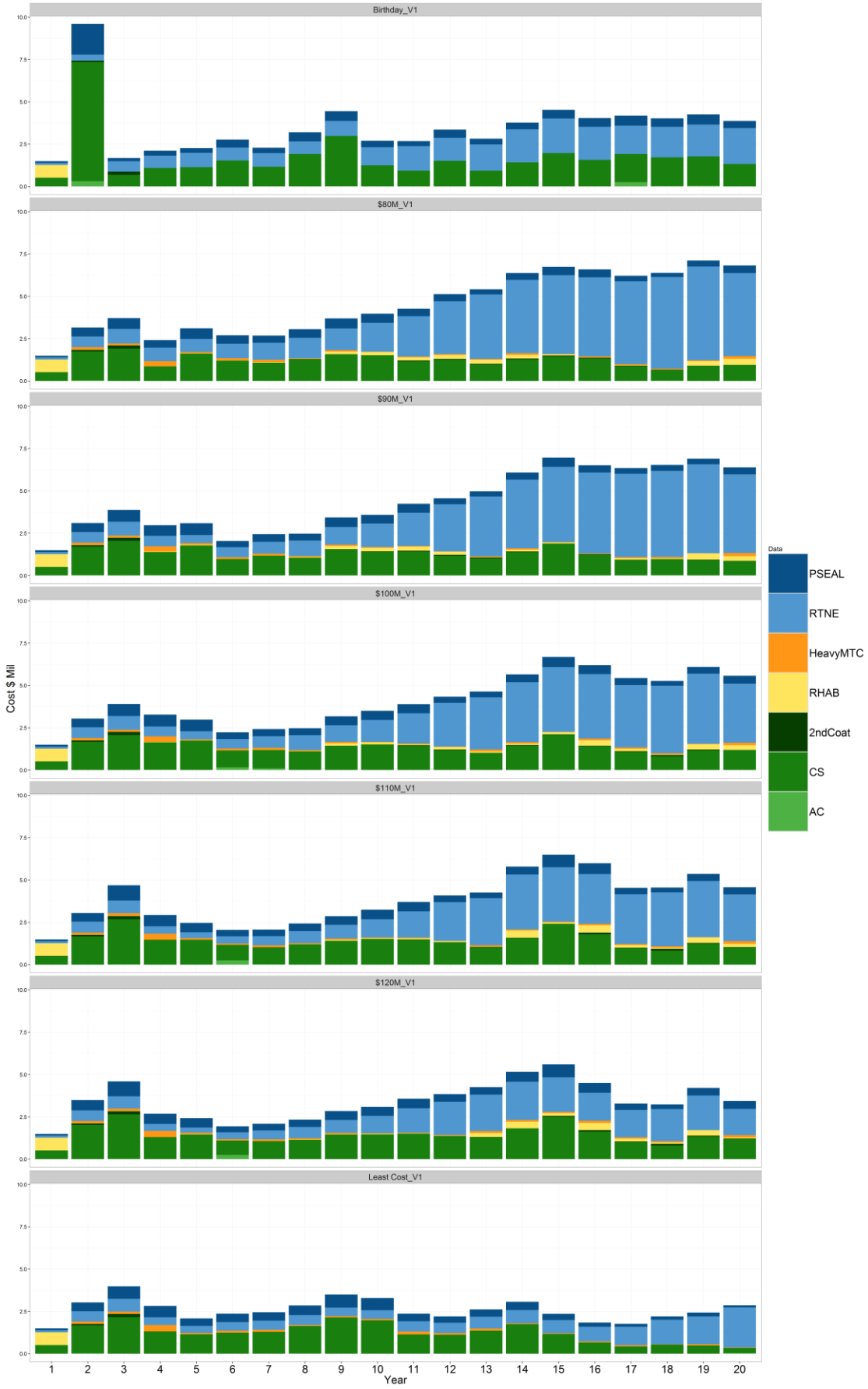
Cost $ Mil by ONRC - National



Cost $ Mil by ONRC - Primary Collector

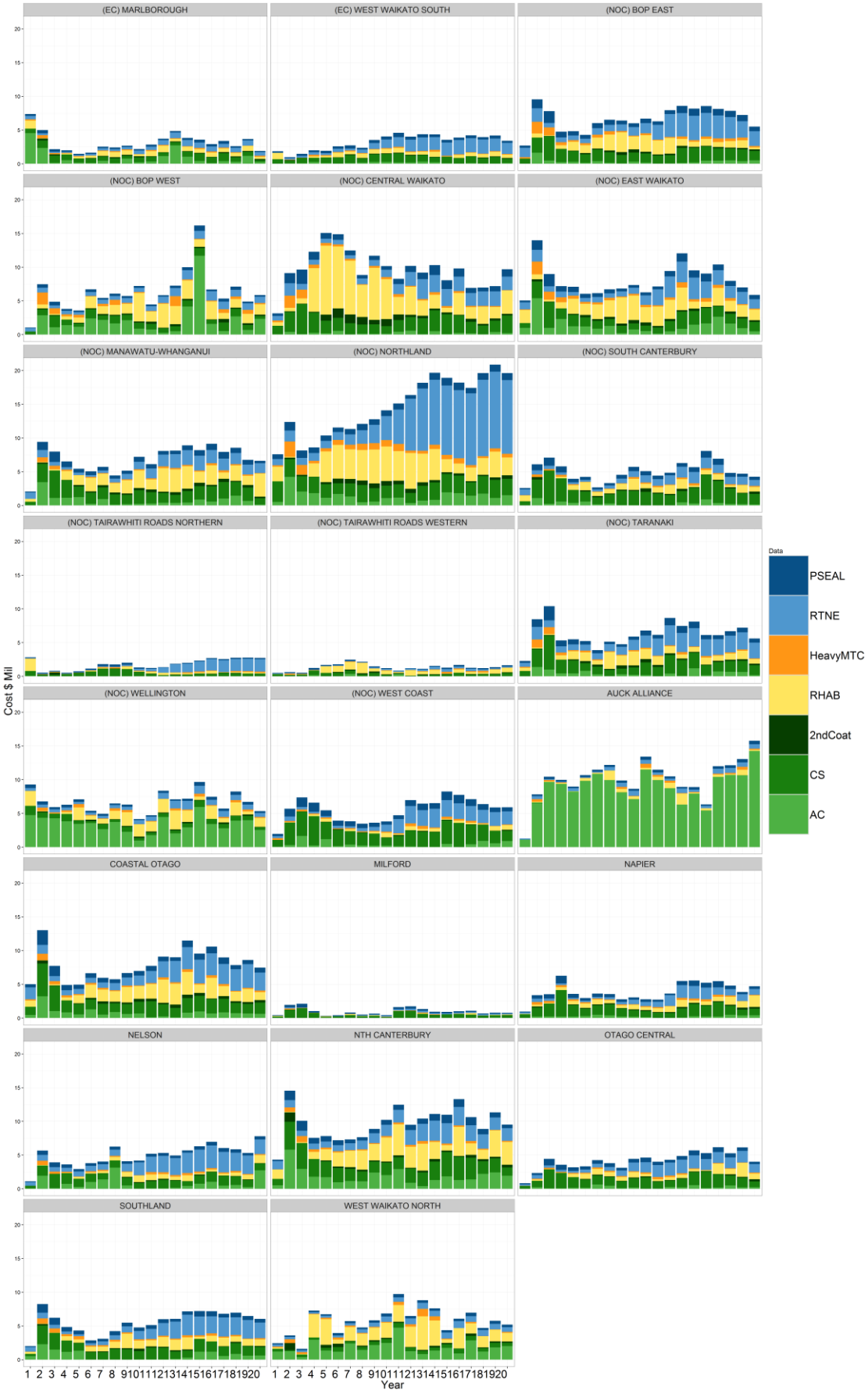


Cost $ Mil by ONRC - Secondary Collector

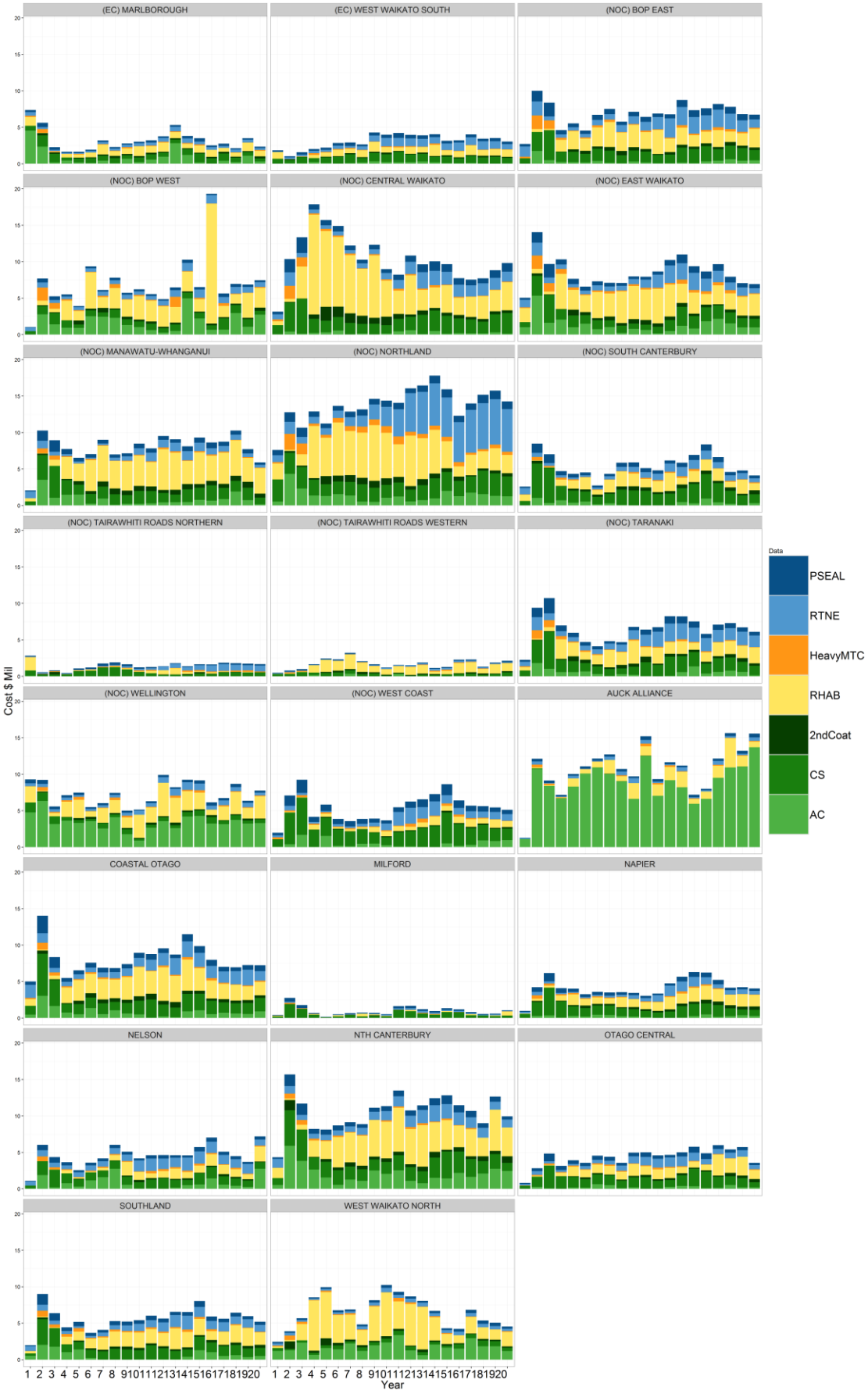


Cost $ Mil by NOC - Birthday_V1

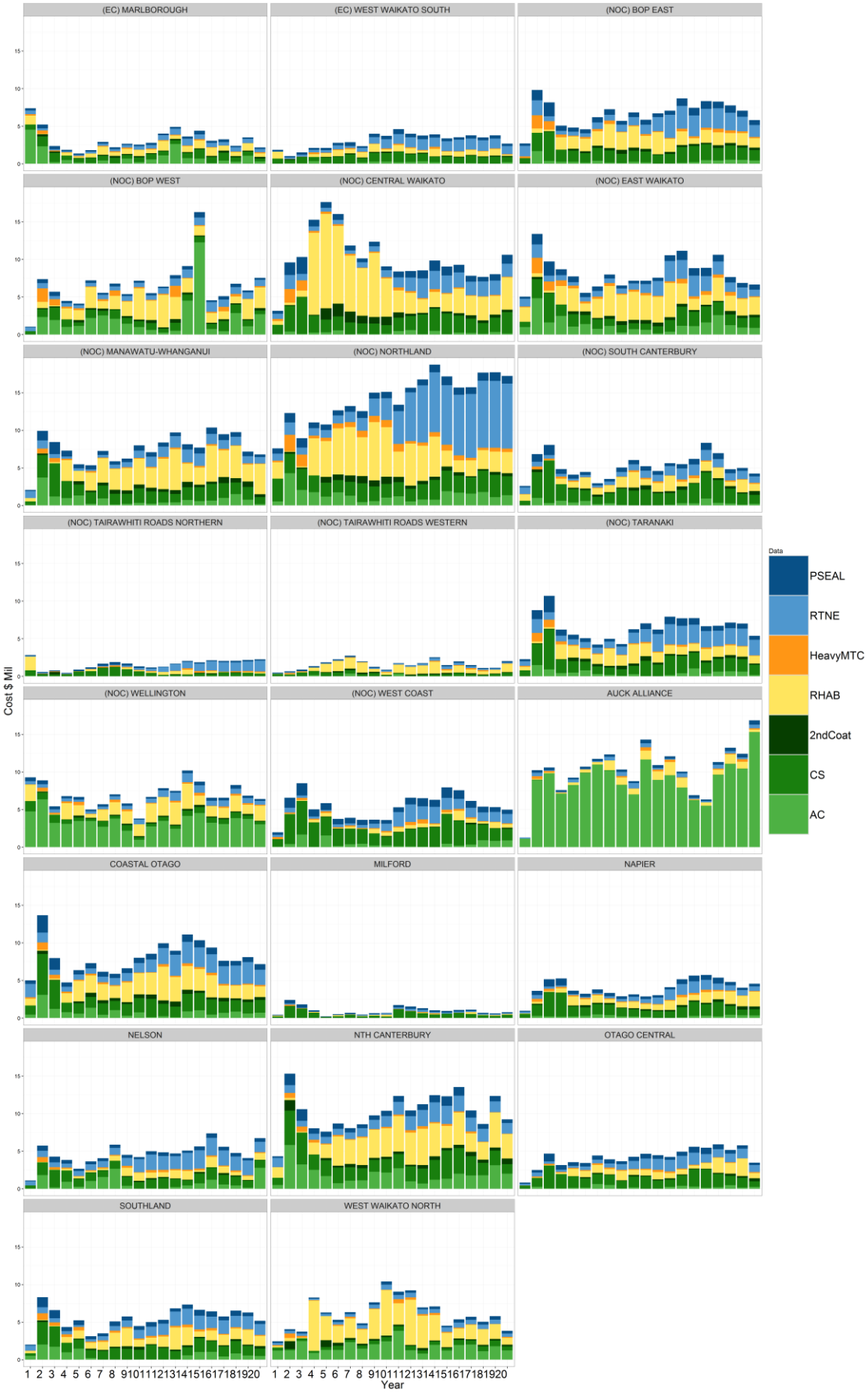
Cost $ Mil by NOC - $100M_V1



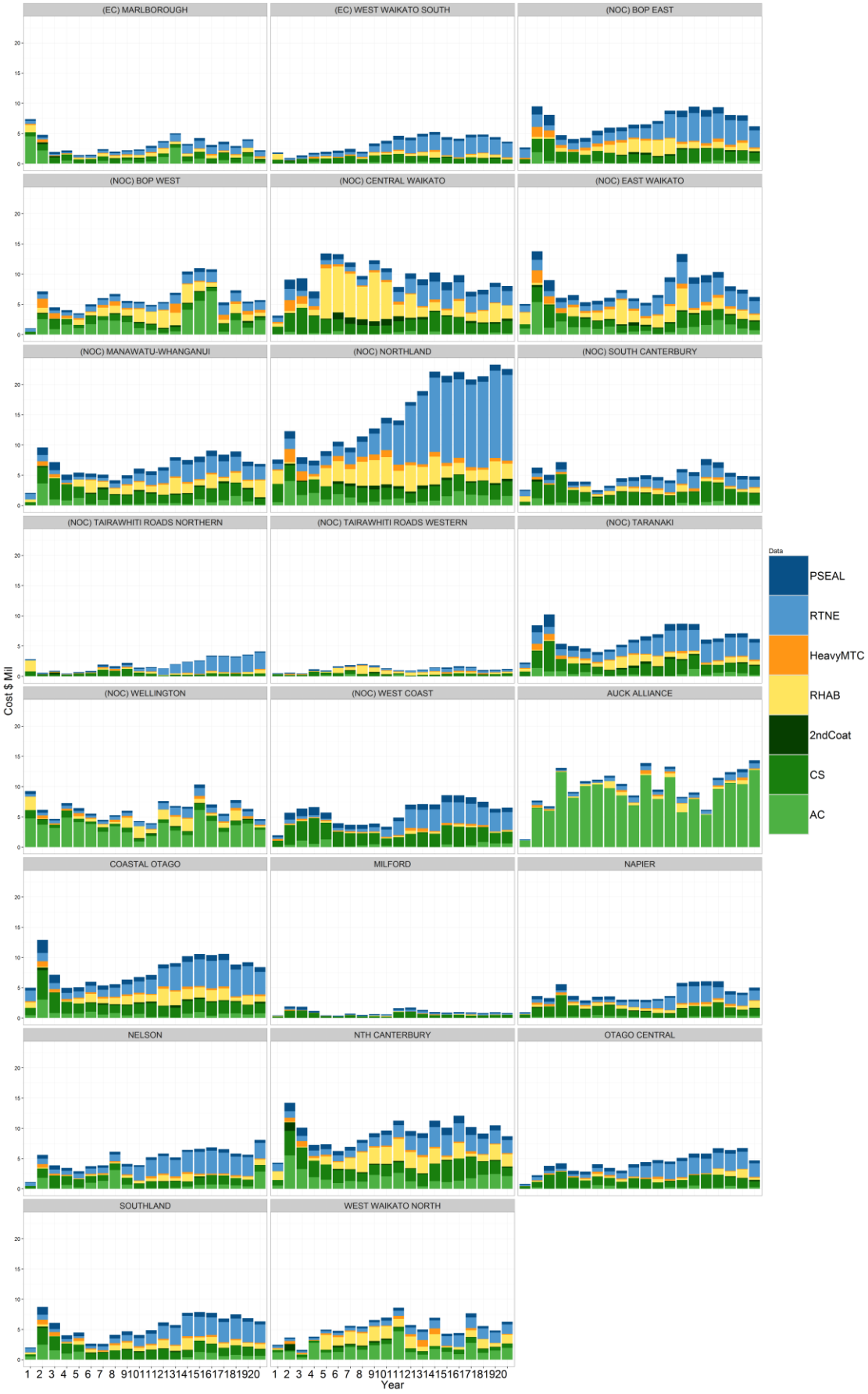
Cost $ Mil by NOC - $120M_V1



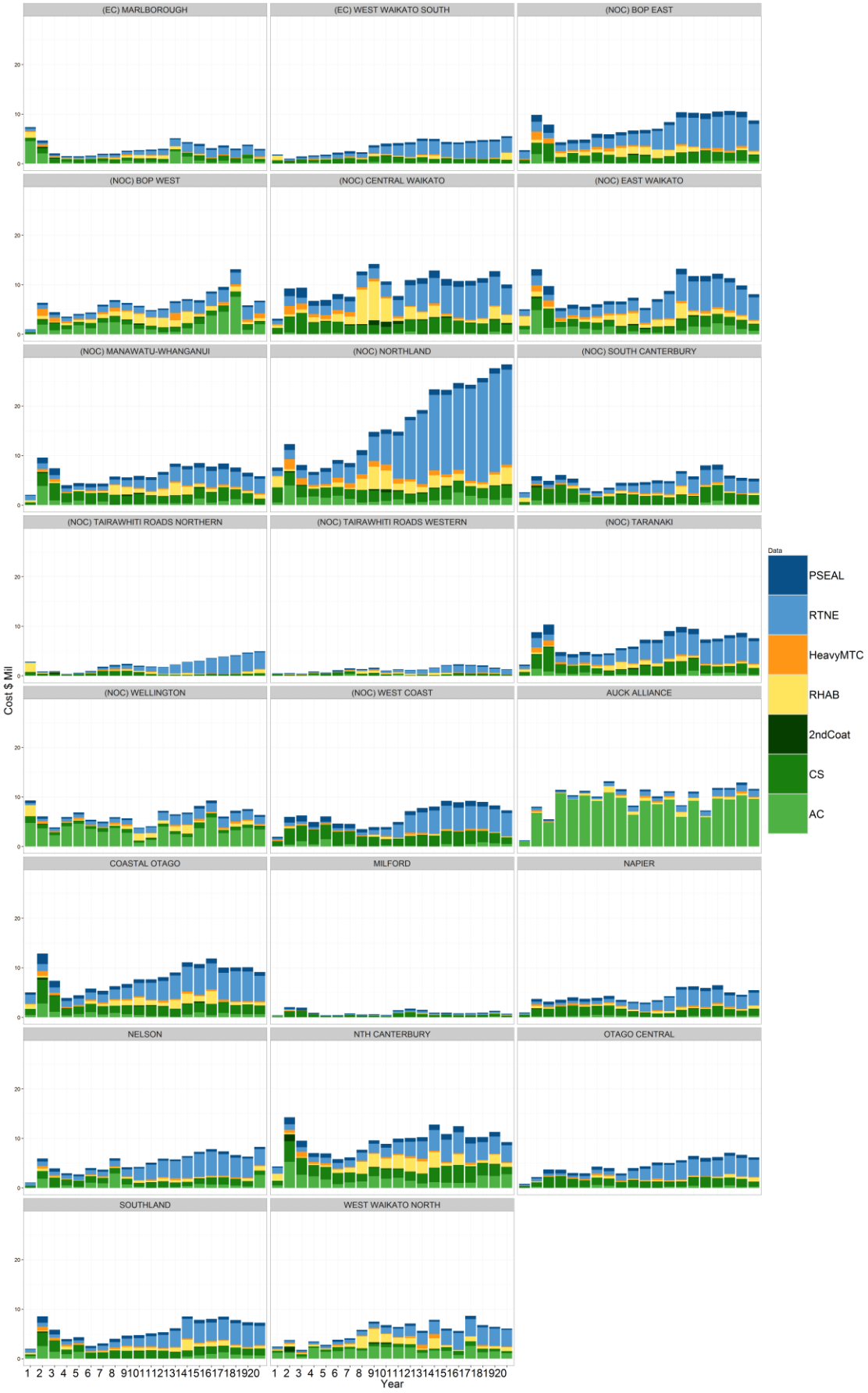
Cost $ Mil by NOC - $110M_V1



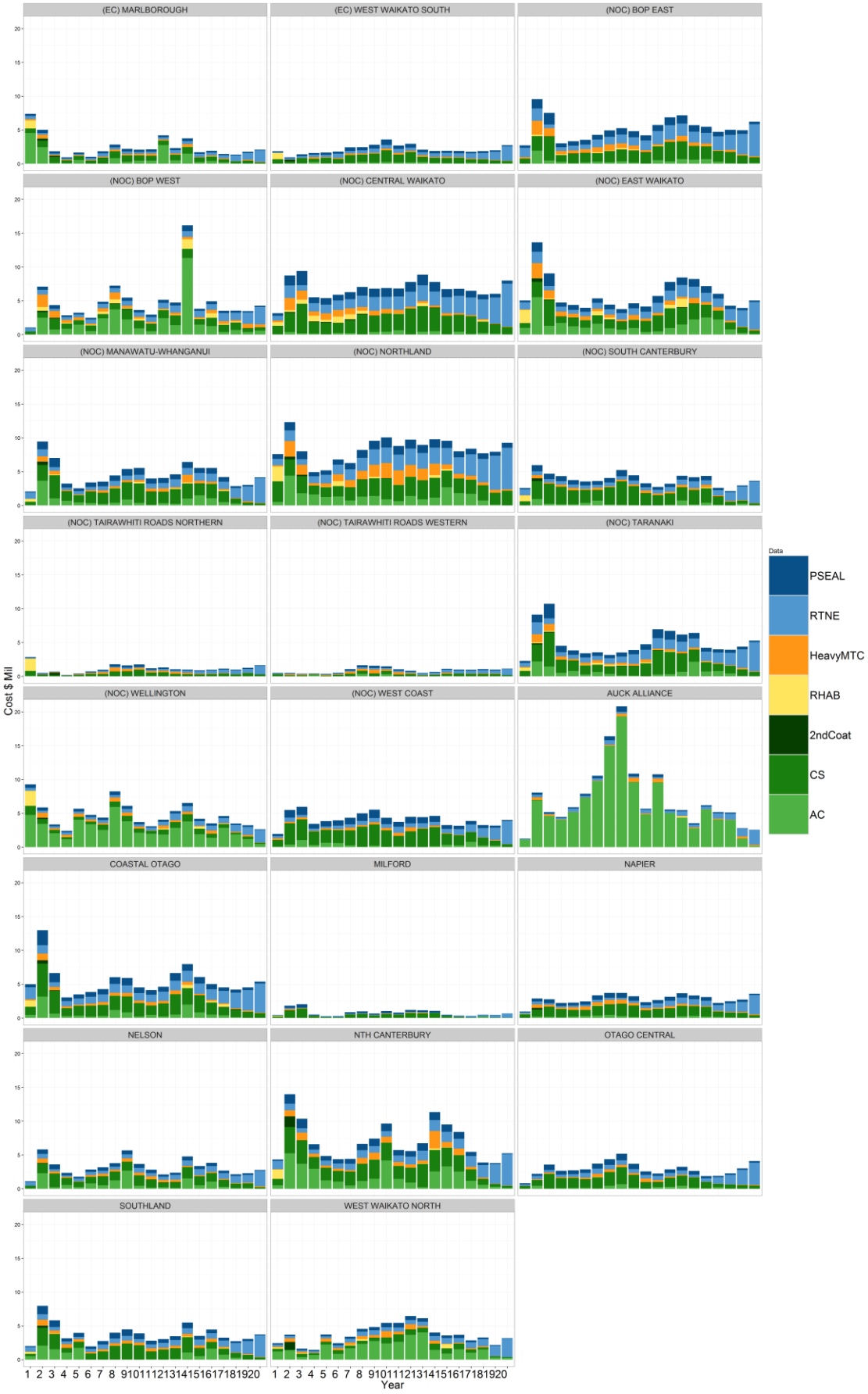
Cost $ Mil by NOC - $90M_V1



Cost $ Mil by NOC - $80M_V1



Cost $ Mil by NOC - Least Cost_V1



2.3 Output Variable Charts – Unlimited Routine Maintenance (V1)

This set of outputs includes Box & Whisker charts for each key variable.

- Roughness
- SII (Surfacing Integrity Index)
- Rutting
- PCI (Pavement Condition Index – overall condition)

The first series compares the seven (7) 'Unlimited RM Options' as time series over 20 years

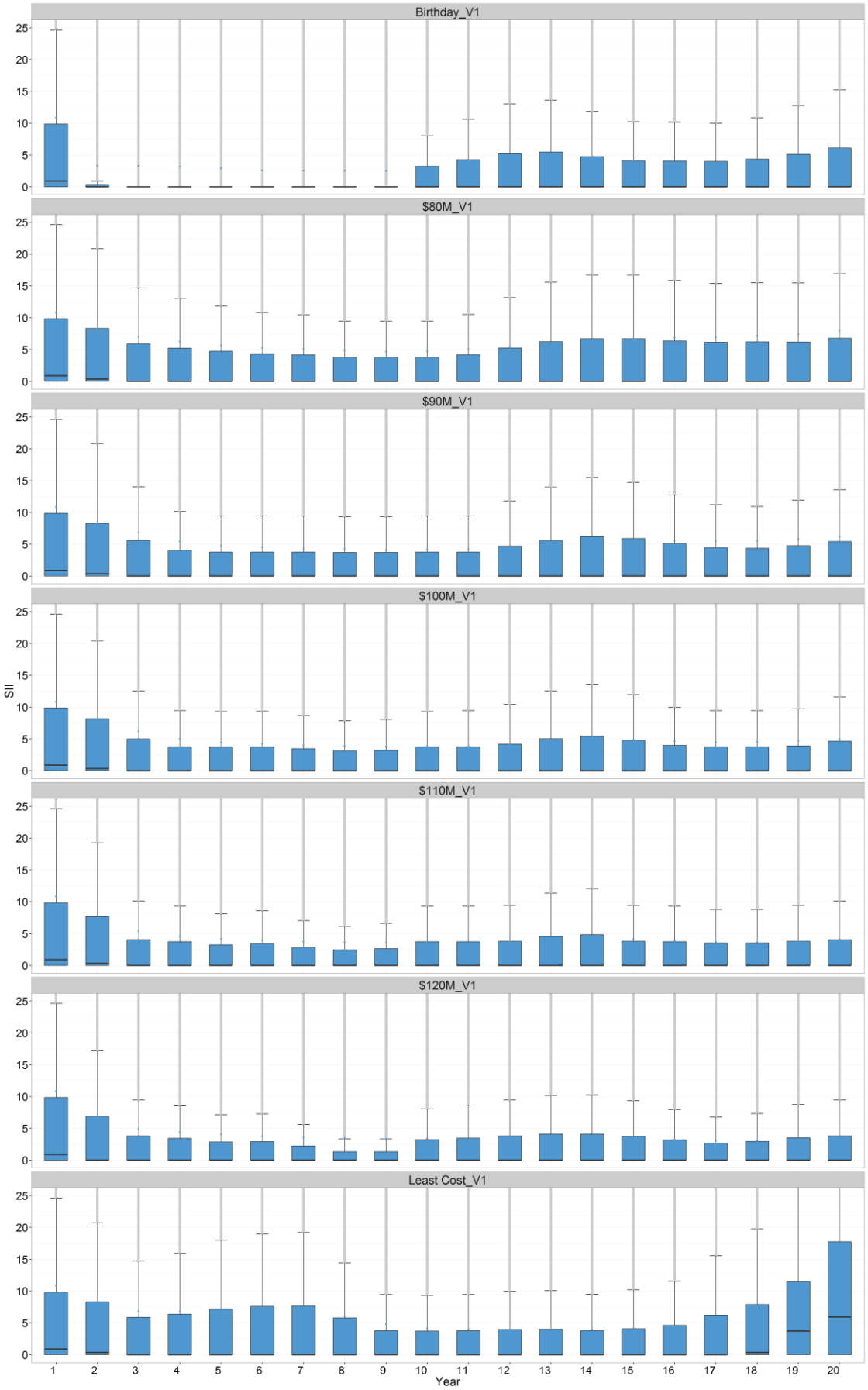
- **Birthday_V1**
  - Treatments triggered when useful life is reached, does not try and meet Levels of Service
  - Renewal Investment: **Unlimited,** Routine Investment: **Unlimited**
  - Safety Investment: Safety not Included
- **$80M_V1**
  - Renewal Investment: Fixed **$80M** pa, Routine Investment: **Unlimited**
  - Safety Investment: Safety not Included
- **$90M_V1**
  - Renewal Investment: Fixed **$90M** pa, Routine Investment: **Unlimited**
  - Safety Investment: Safety not Included
- **$100M_V1**
  - Renewal Investment: Fixed **$100M** pa, Routine Investment: **Unlimited**
  - Safety Investment: Safety not Included
- **$110M_V1**
  - Renewal Investment: Fixed **$110M** pa, Routine Investment: **Unlimited**
  - Safety Investment: Safety not Included
- **$120M_V1**
  - Renewal Investment: Fixed **$120M** pa, Routine Investment: **Unlimited**
  - Safety Investment: Safety not Included
- **Least Cost_V1**
  - Generates the lowest overall cost treatment programme considering Renewal and Routine Investment – disallowing Do Nothing. Does not try and meet Levels of Service.
  - Safety Investment: Safety not Included

The second series compares the six (6) ONRC Classes as time series over 20 years for each 'Unlimited RM Options' for each variable.

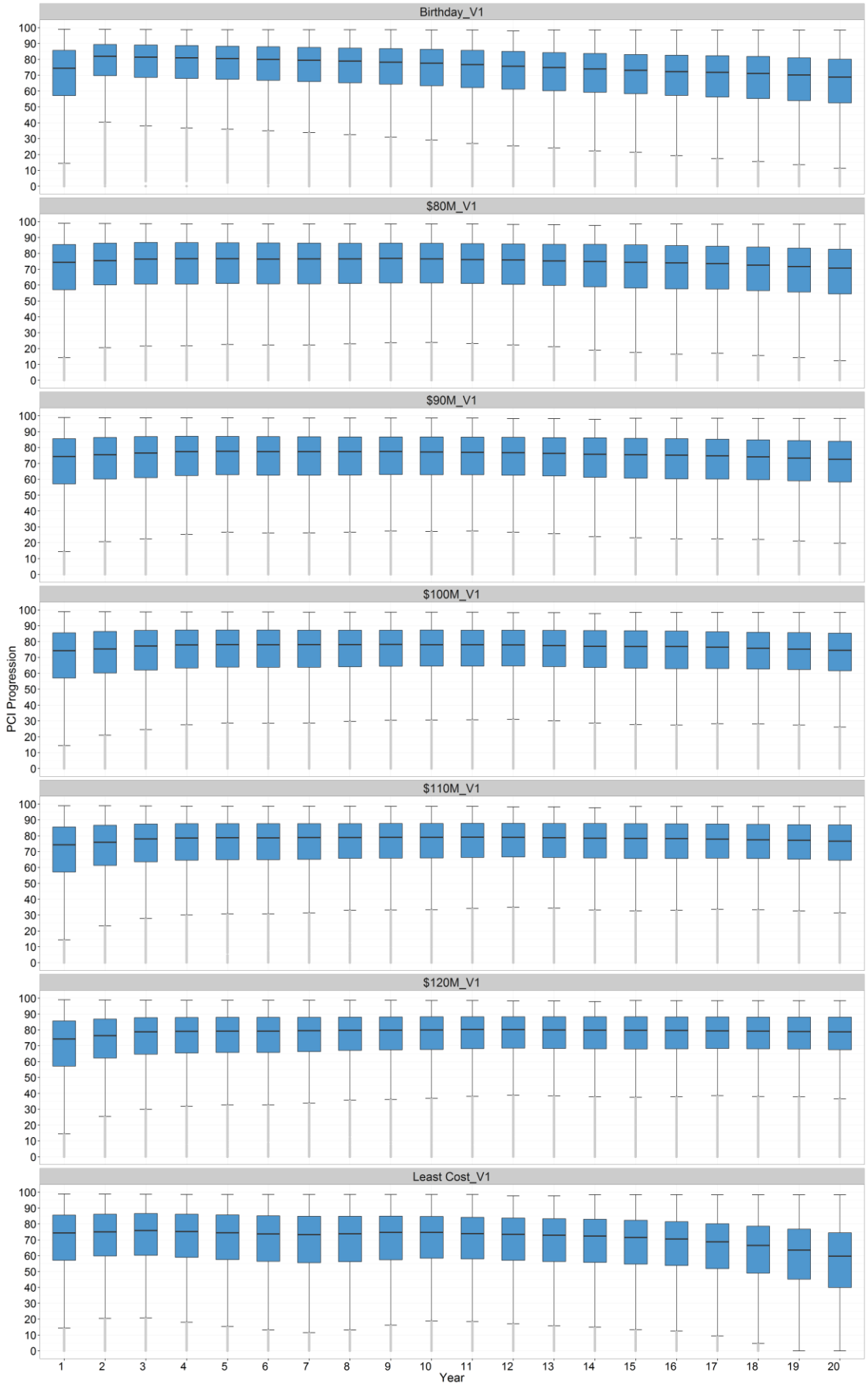
- Secondary Collector
- Primary Collector
- Arterial
- Regional
- National
- National High Volume

The final series compares the 'Unlimited RM Options' by ONRC Class at three time snapshots (Current (Yr0), 10 Years and 20 Years) for each variable.

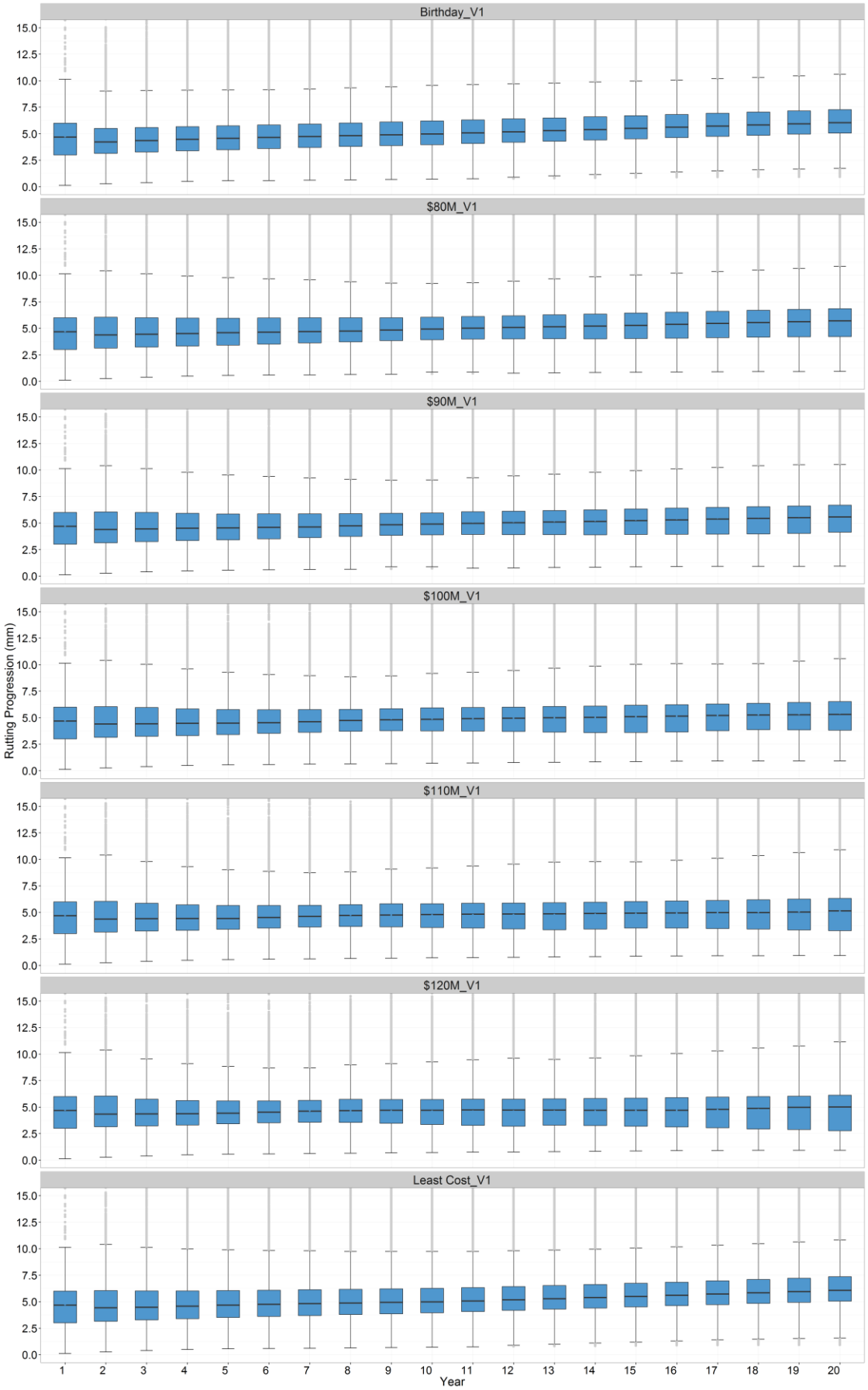
SII Distribution 20 Years



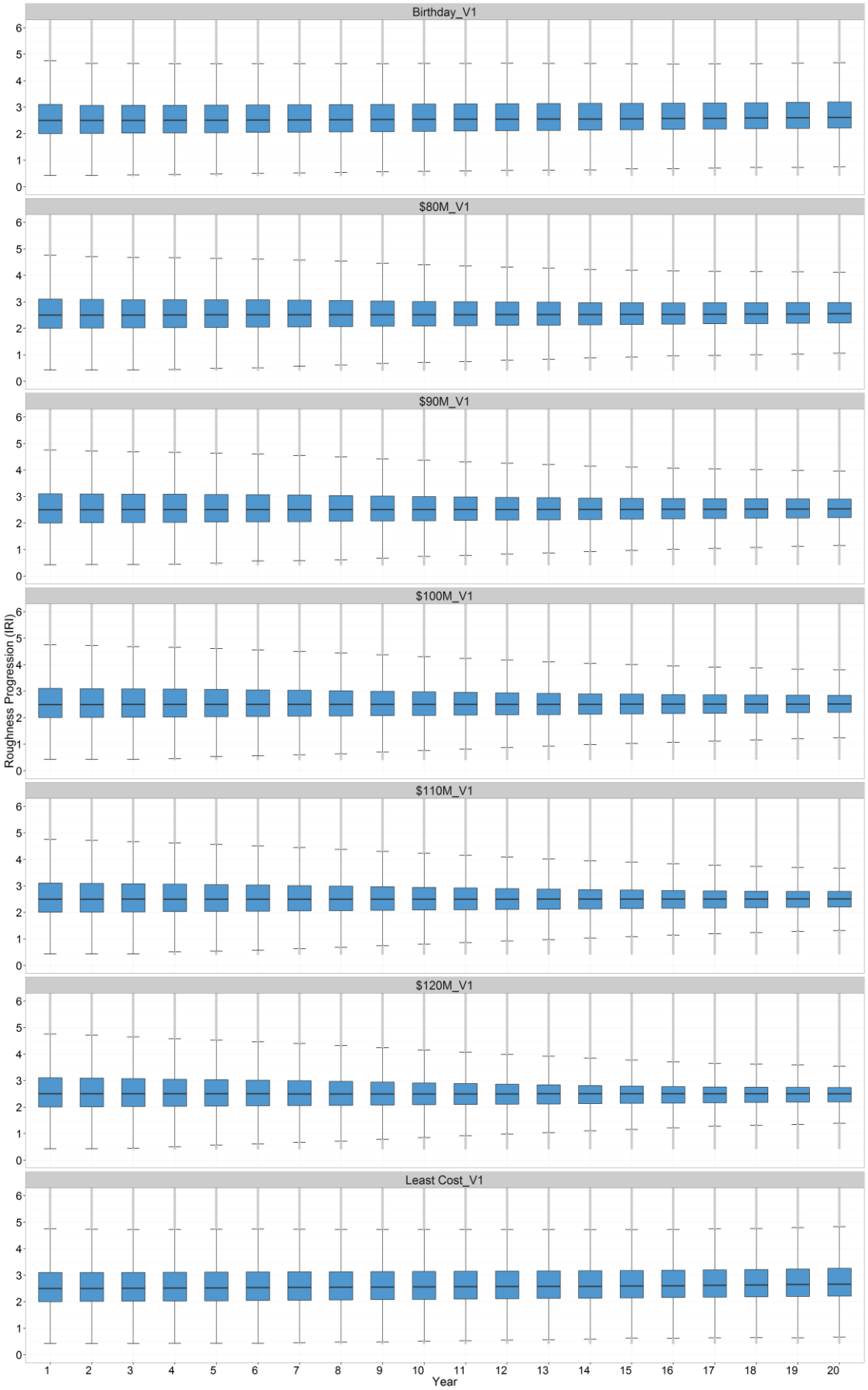
PCI Distribution 20 Years



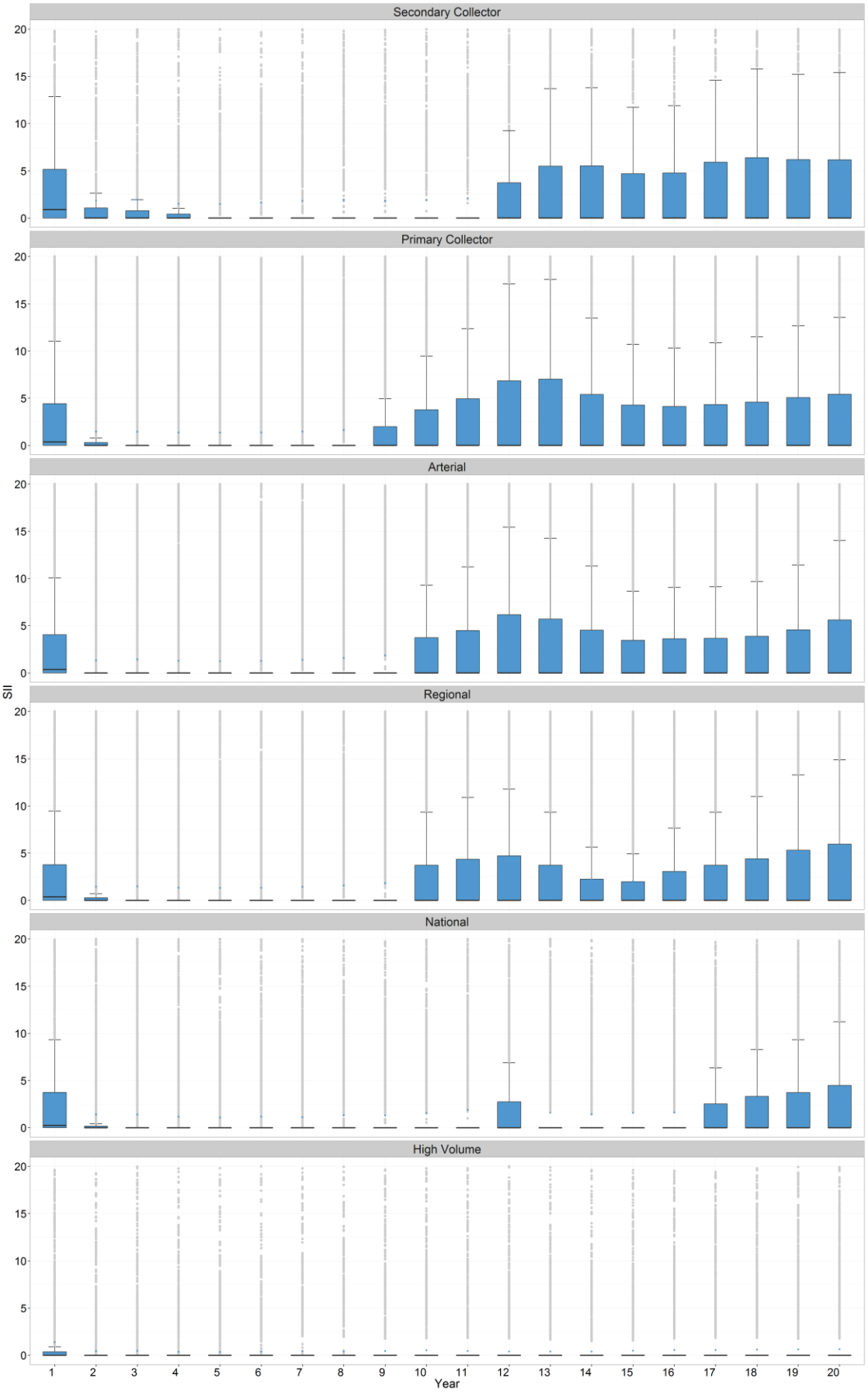
Rutting Distribution 20 Years



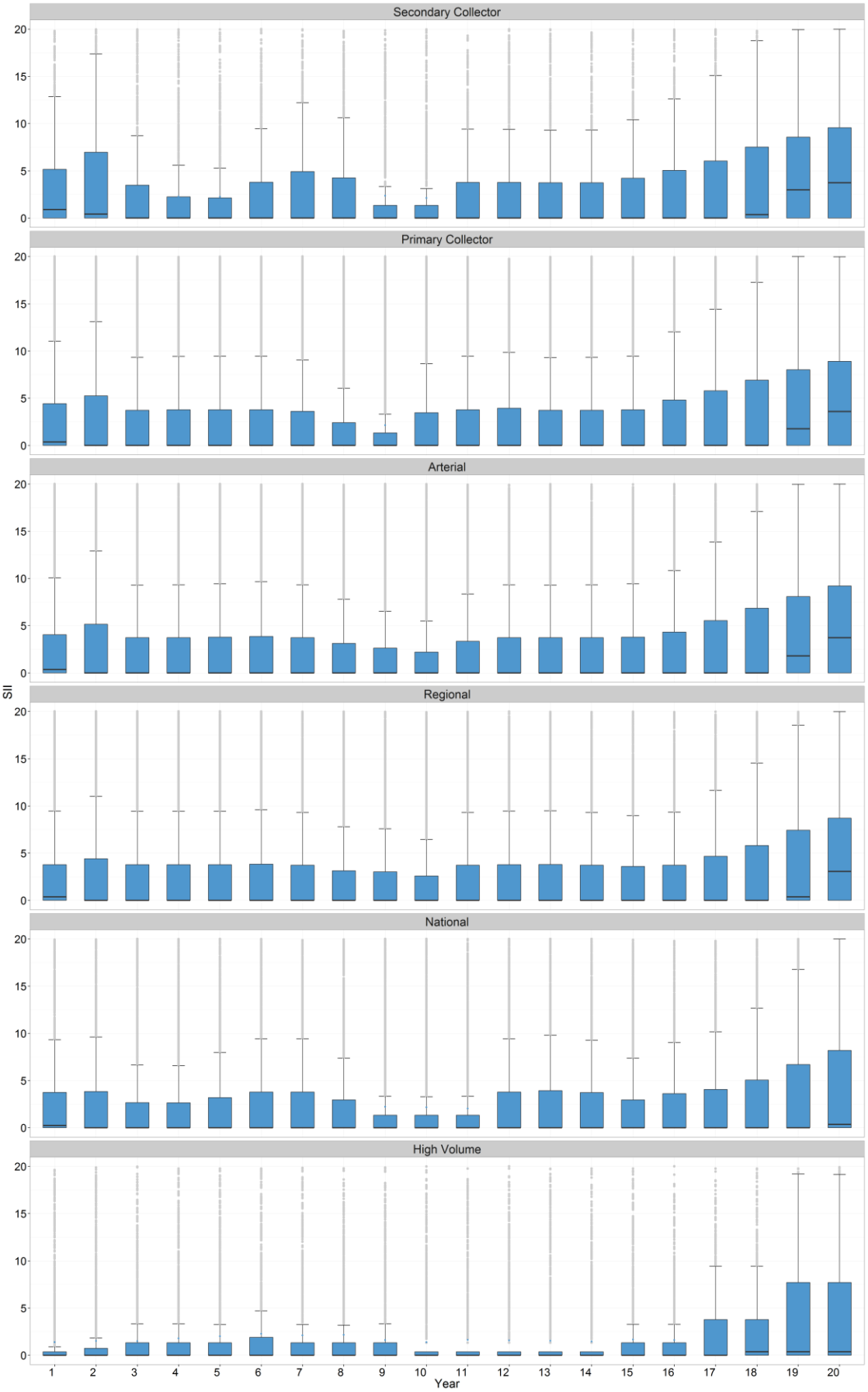
Roughness Distribution 20 Years



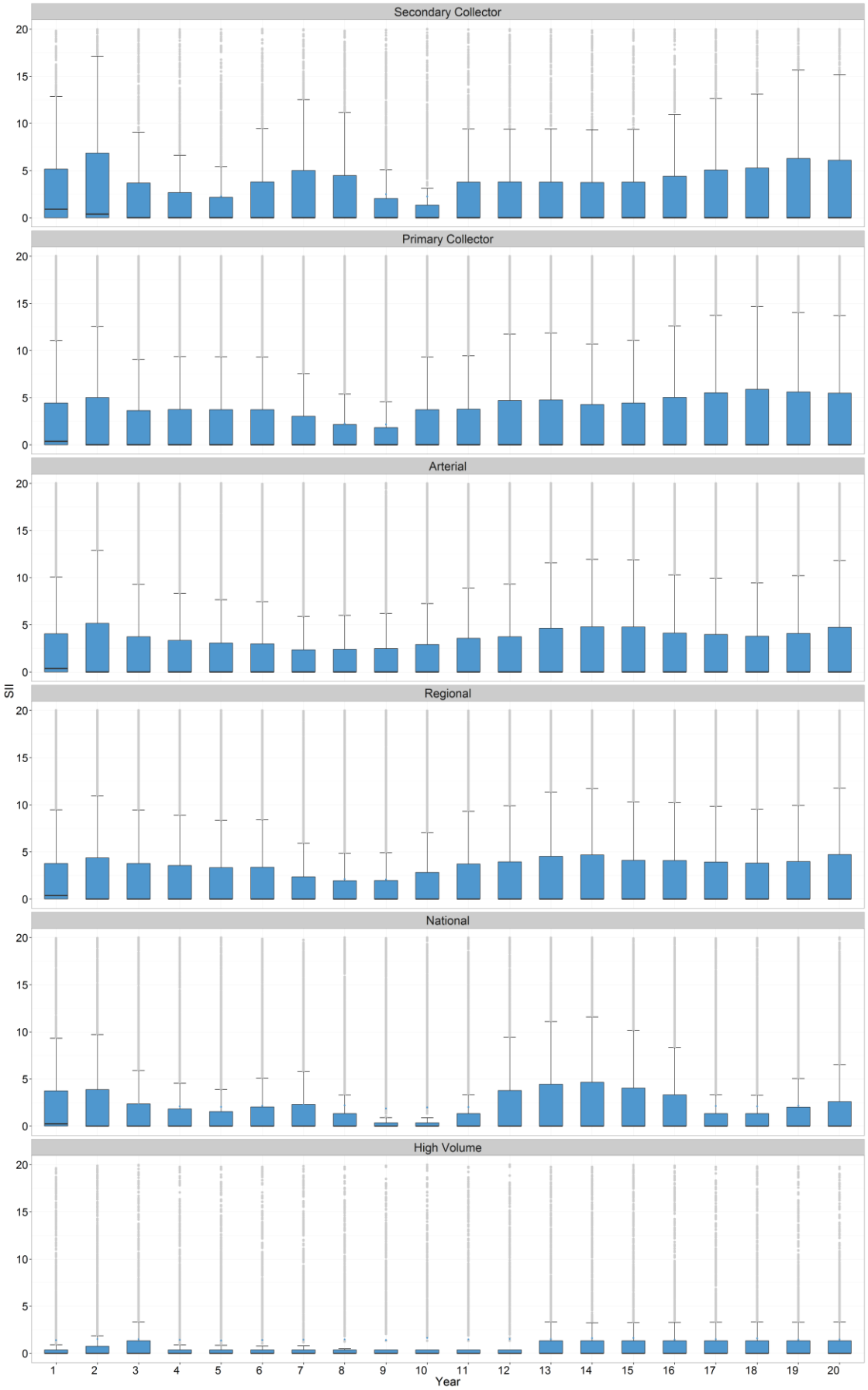
SII Distribution 20 Years - Birthday_V1



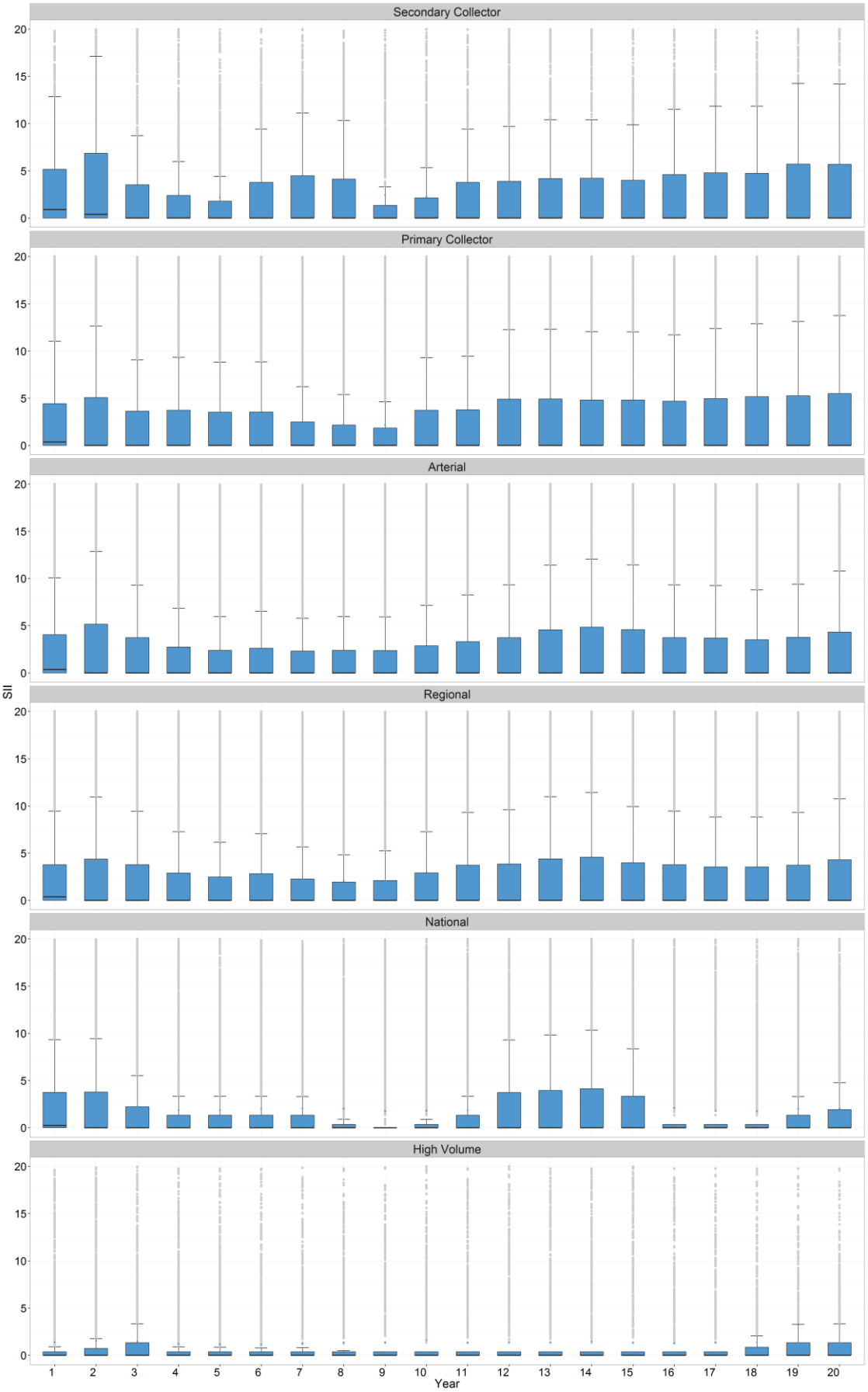
SII Distribution 20 Years - Least Cost_V1



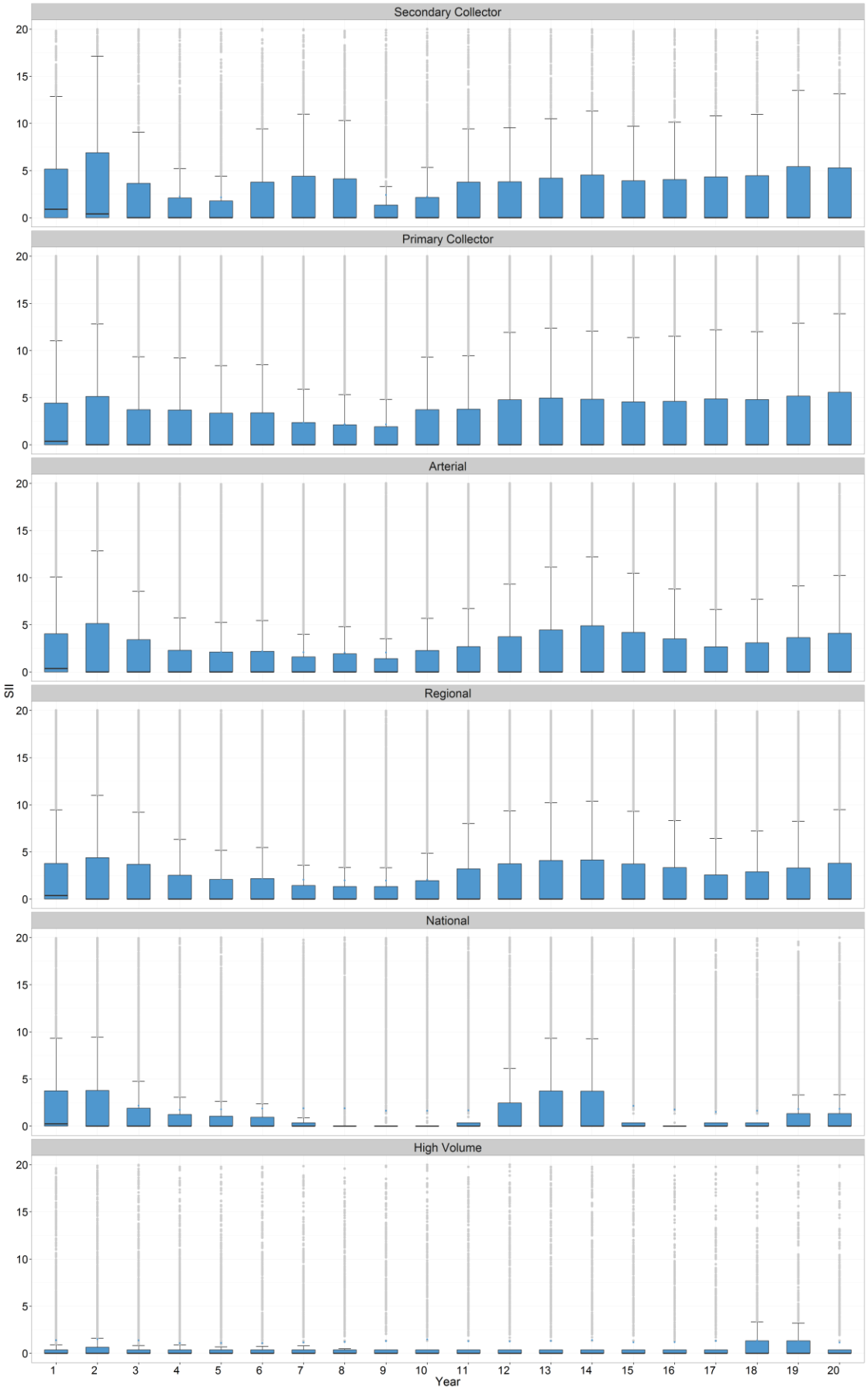
SII Distribution 20 Years - $80M_V1



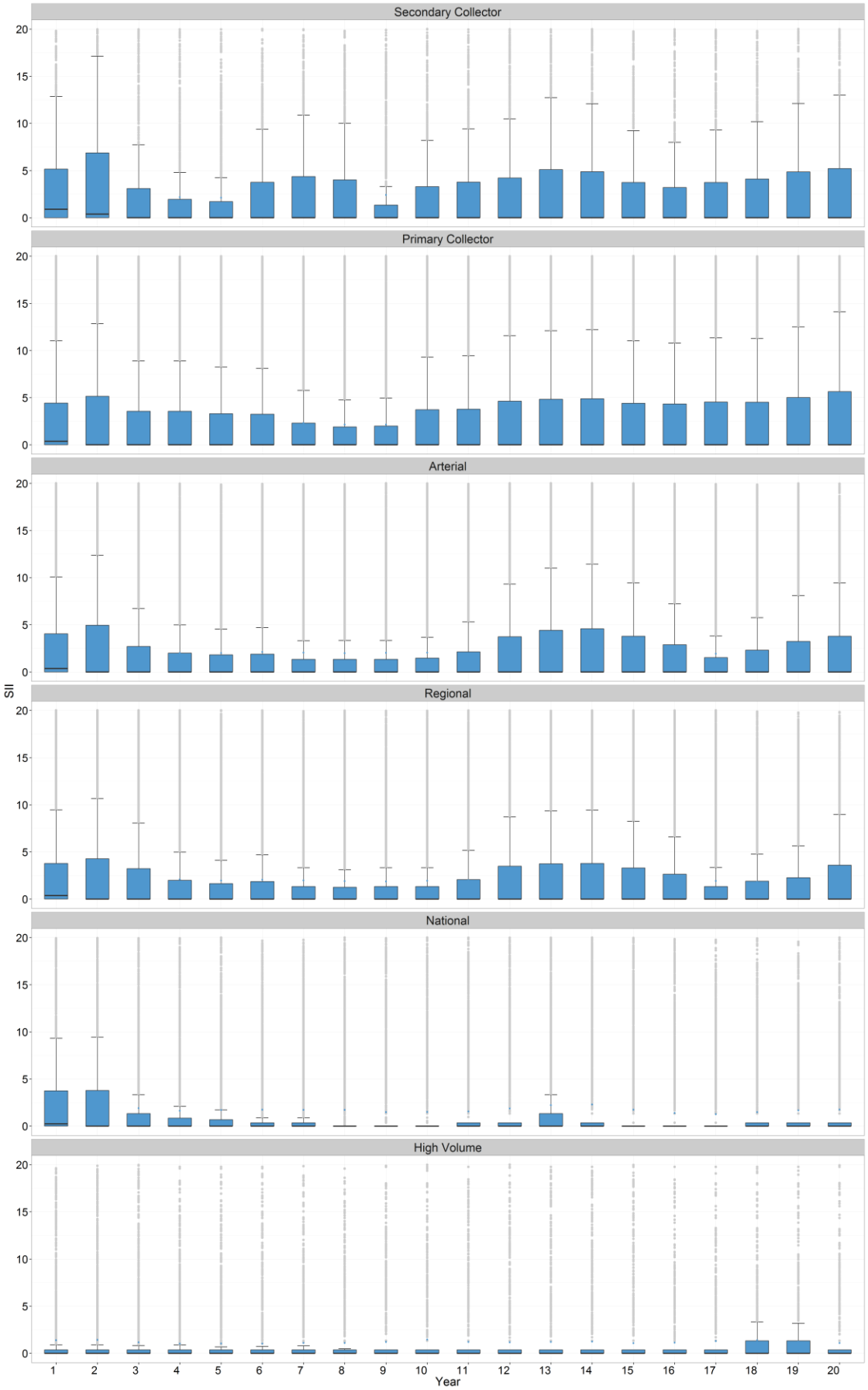
SII Distribution 20 Years - $90M_V1



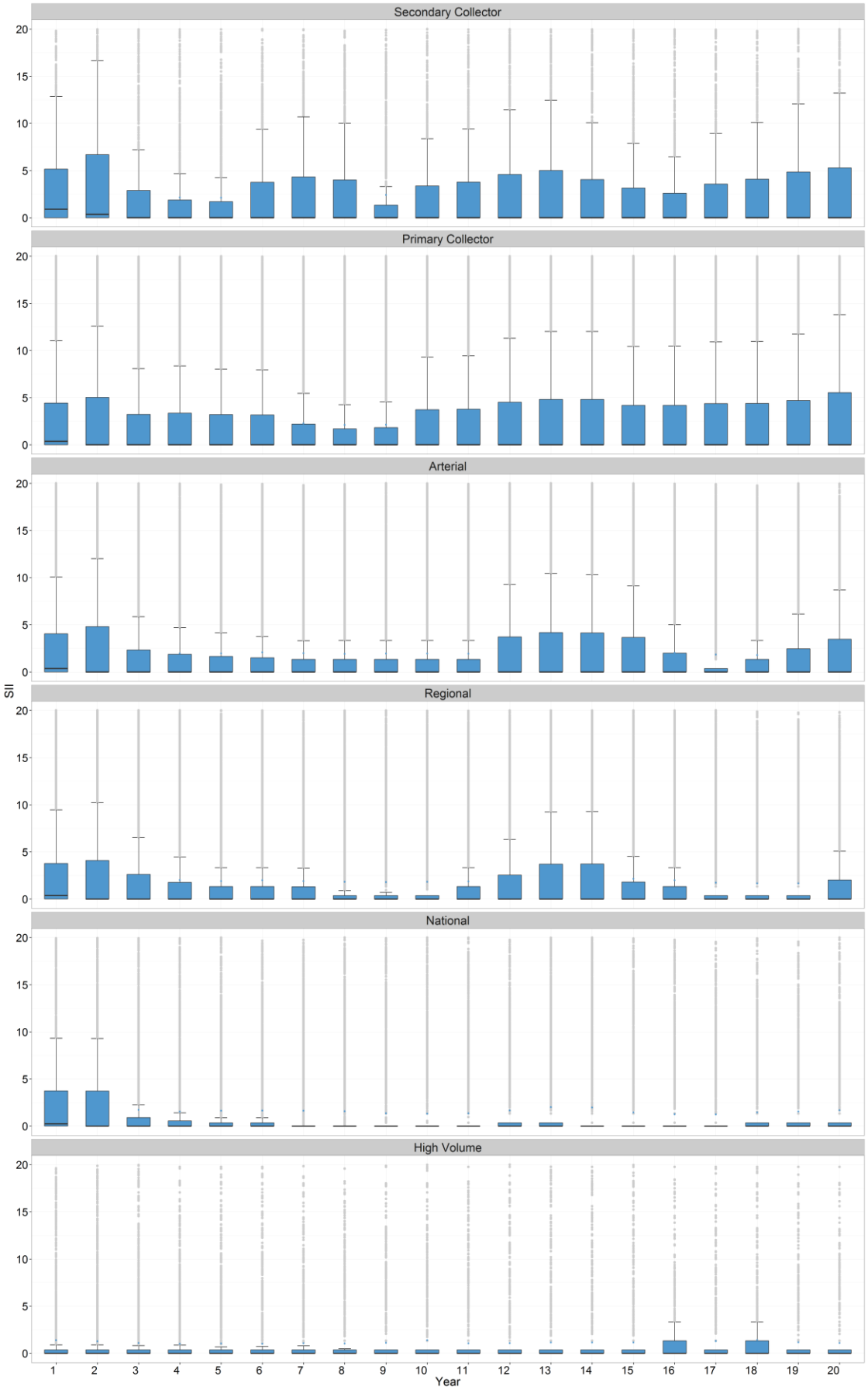
SII Distribution 20 Years - $100M_V1



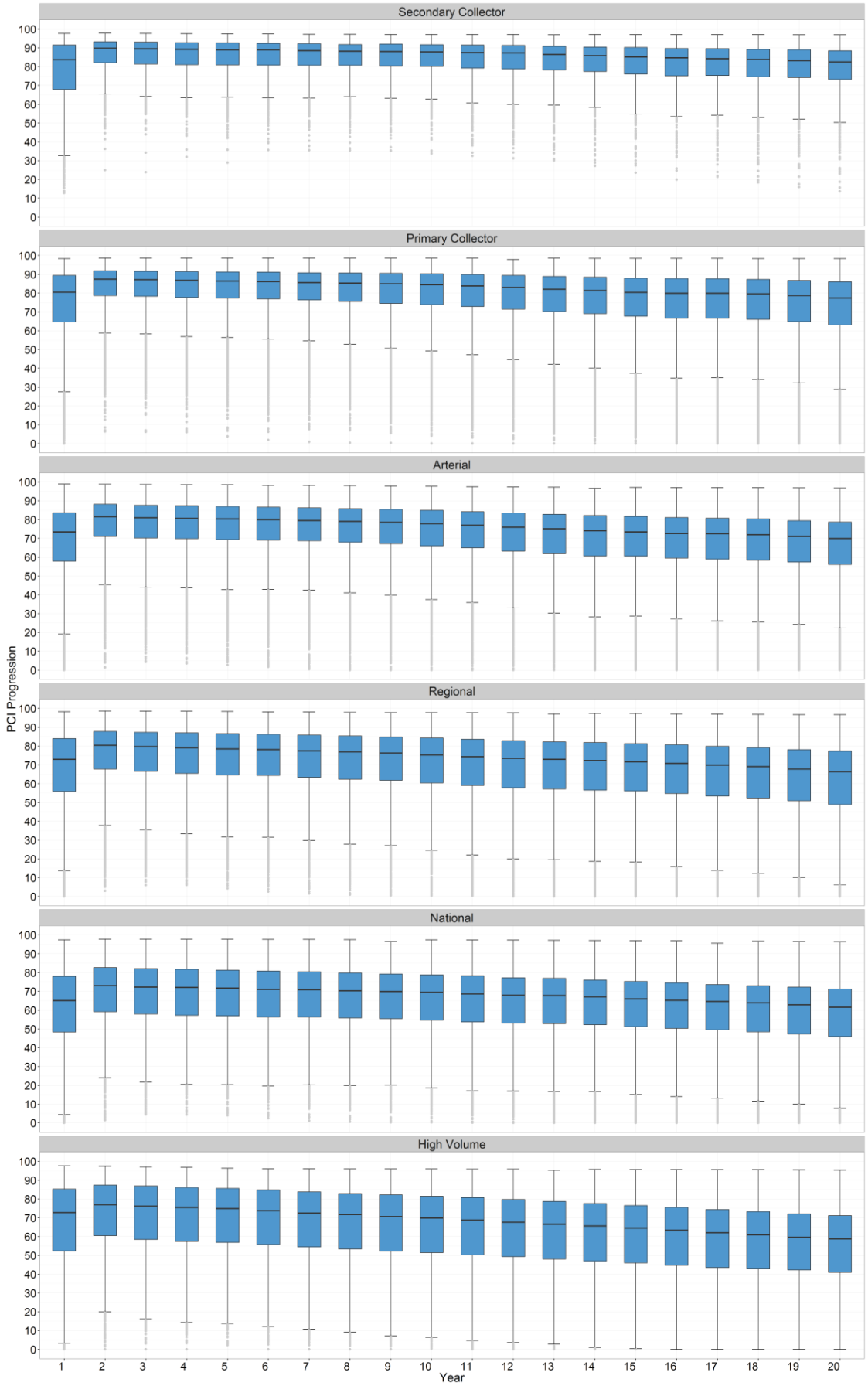
SII Distribution 20 Years - $110M_V1



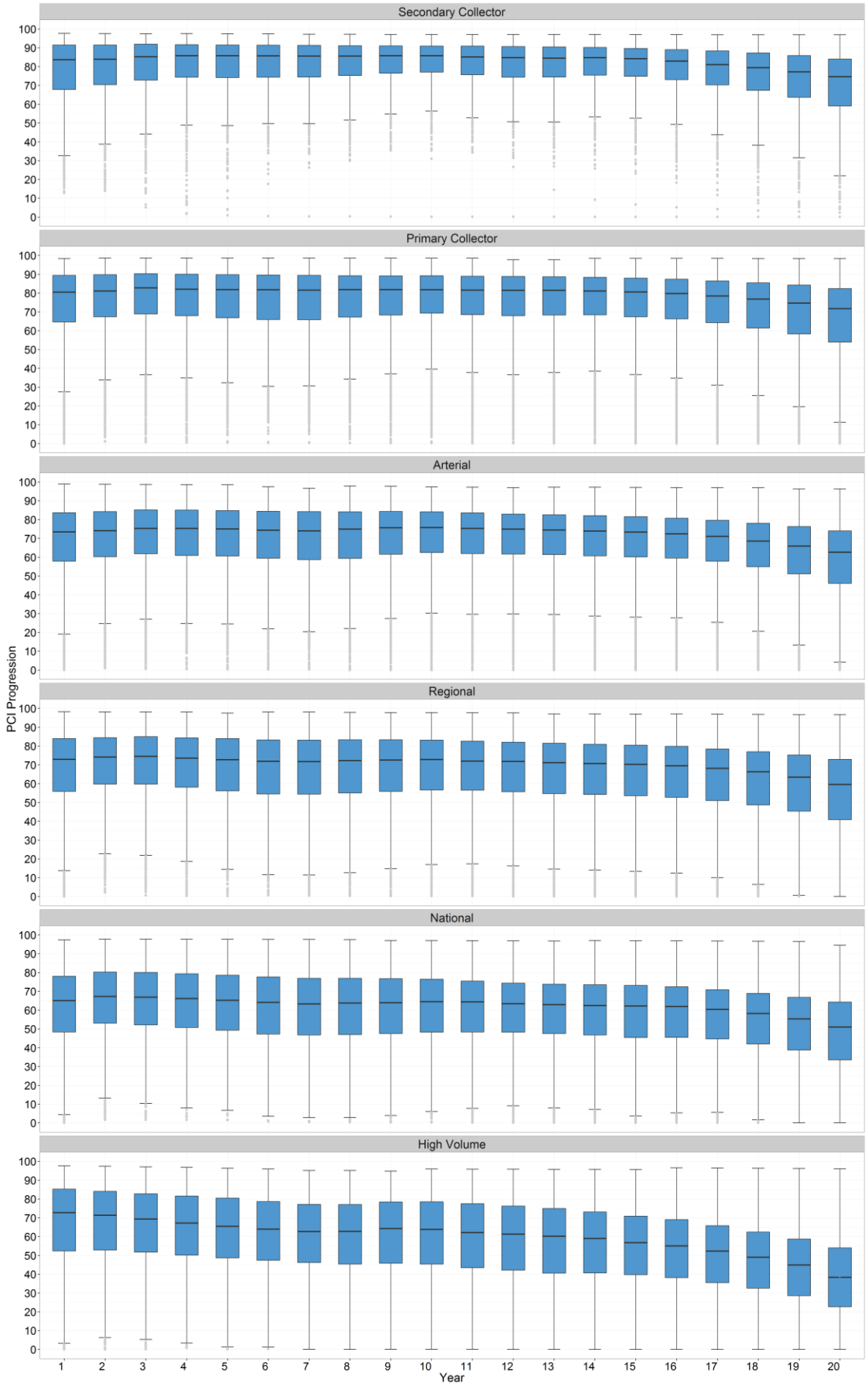
SII Distribution 20 Years - $120M_V1



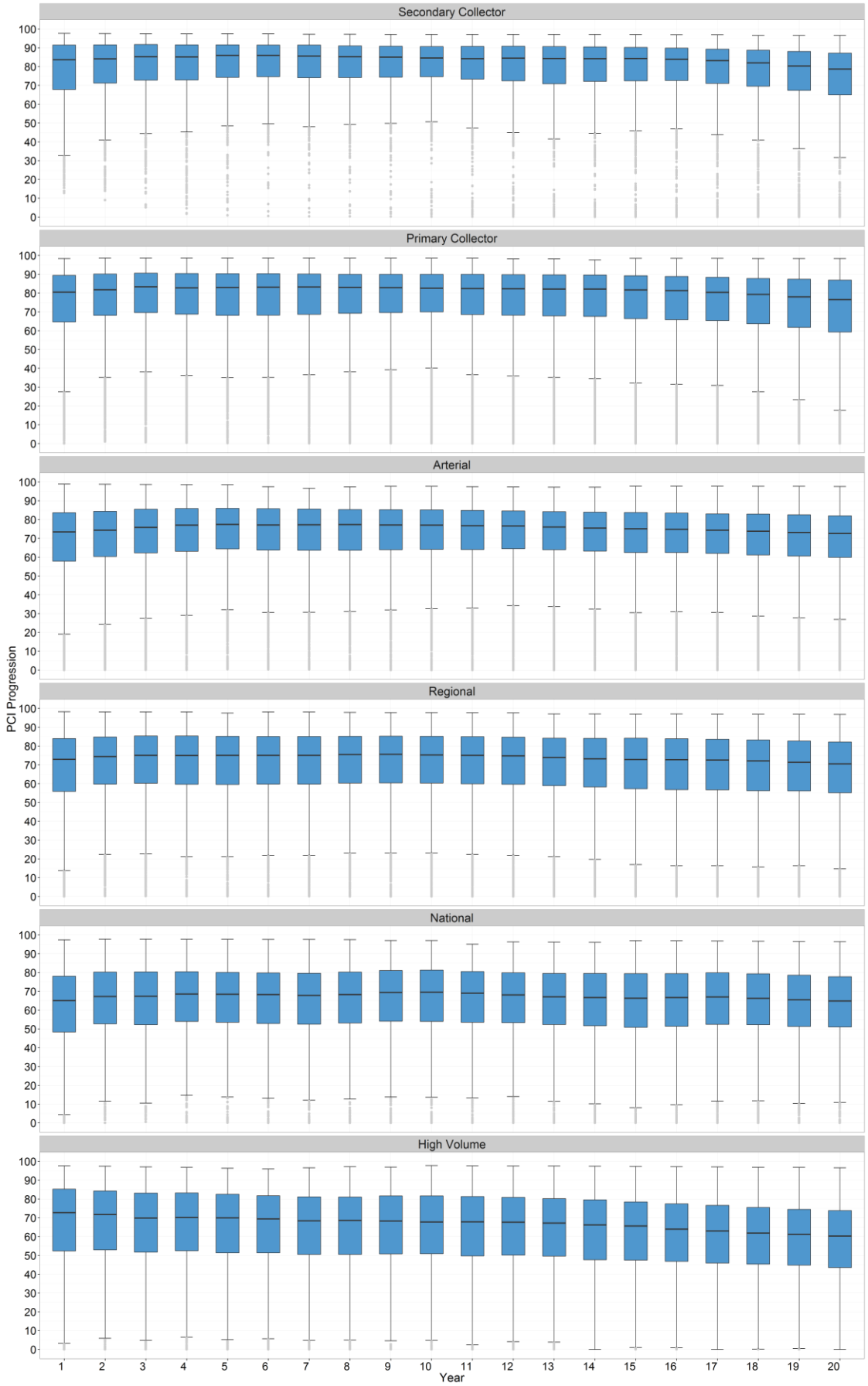
PCI Distribution 20 Years - Birthday_V1



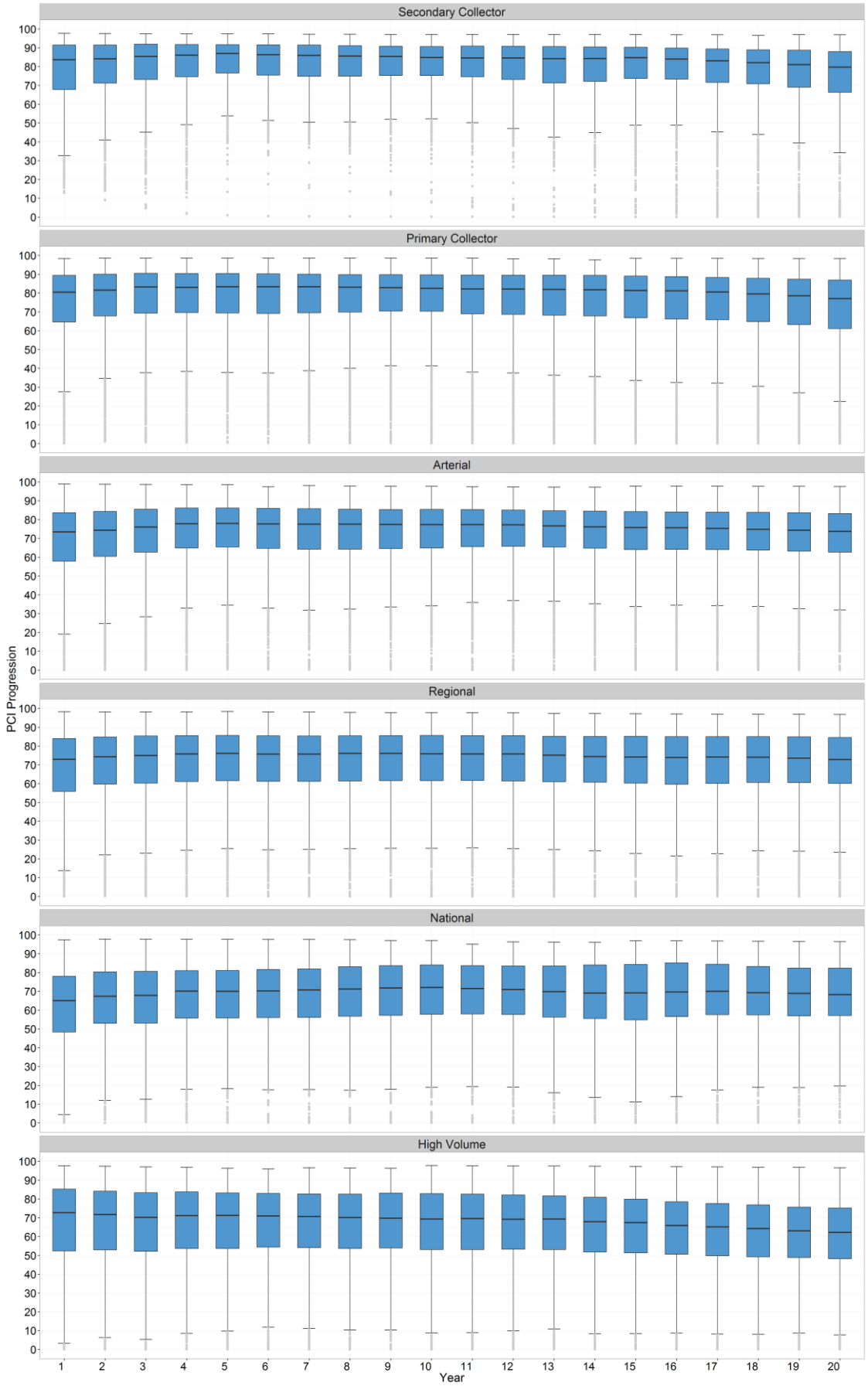
PCI Distribution 20 Years - Least Cost_V1



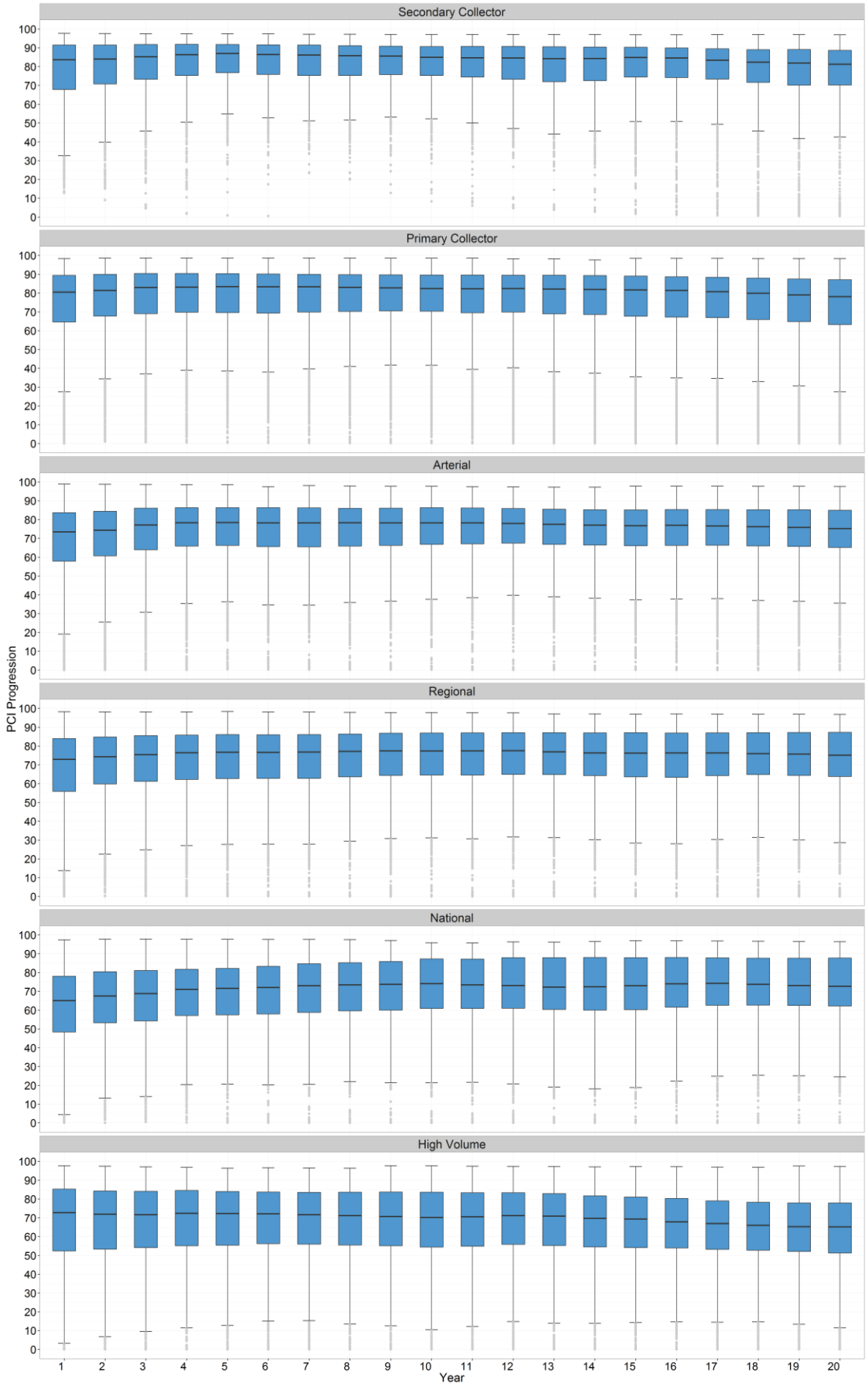
PCI Distribution 20 Years - $80M_V1



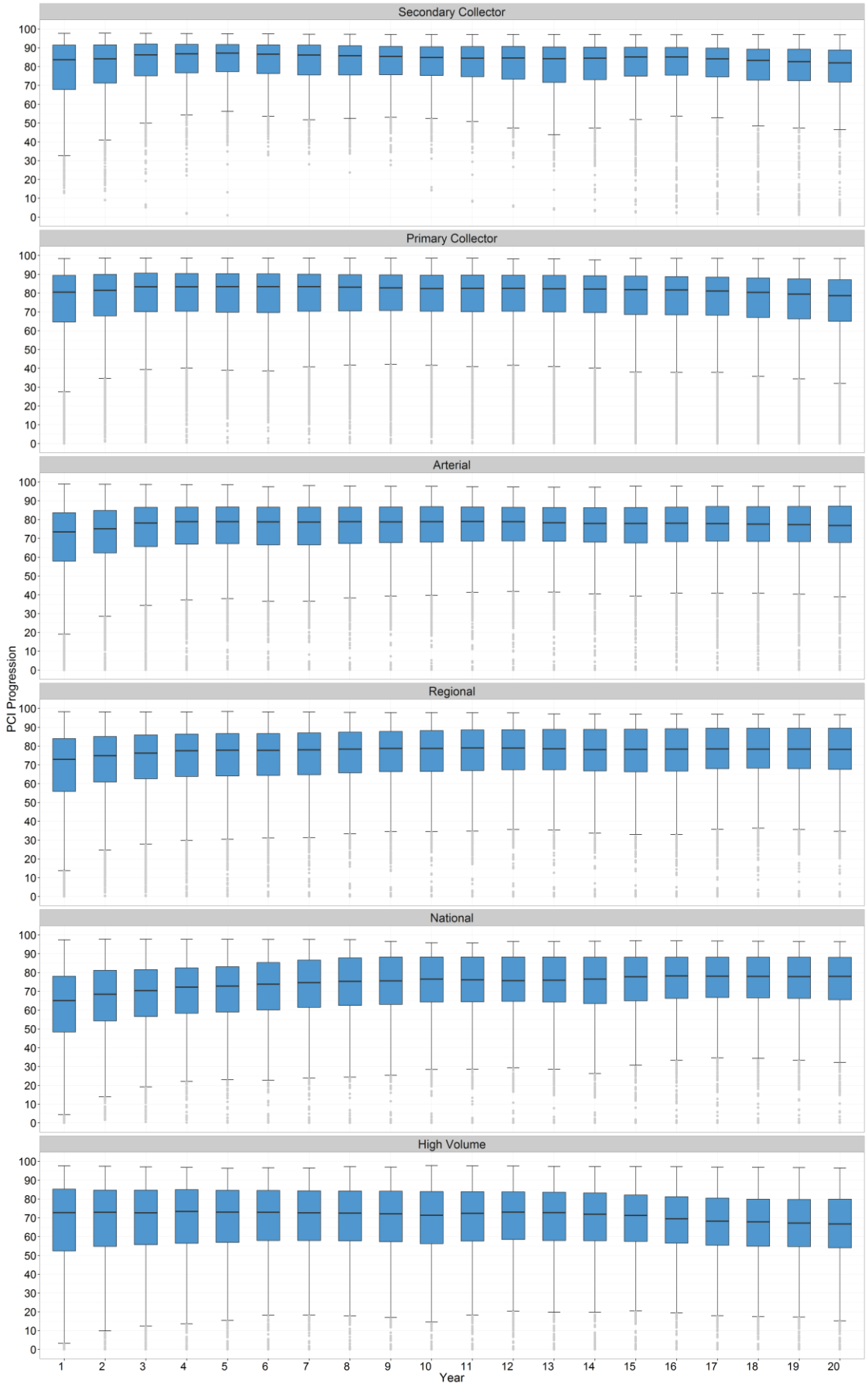
PCI Distribution 20 Years - $90M_V1



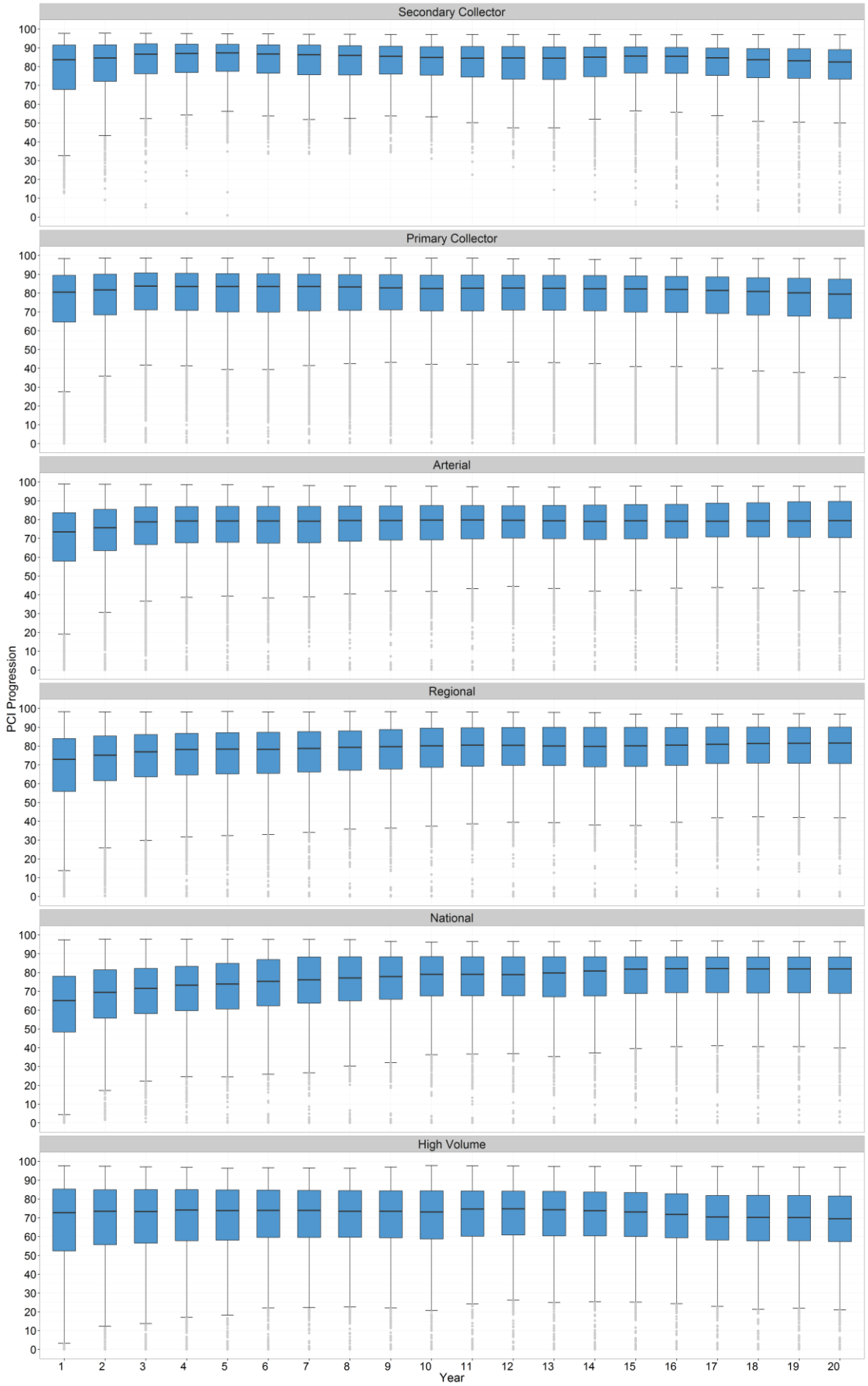
PCI Distribution 20 Years - $100M_V1



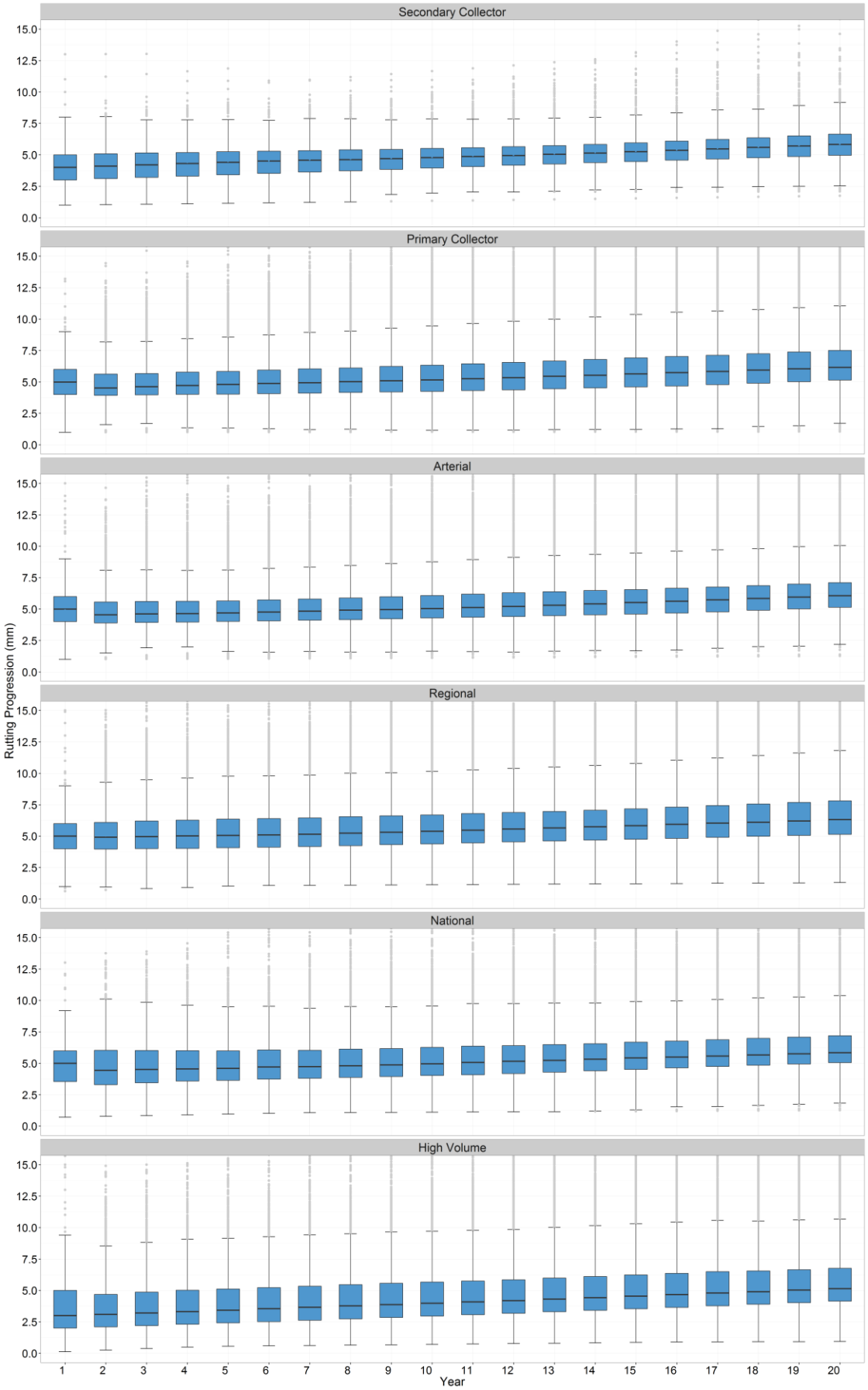
PCI Distribution 20 Years - $110M_V1



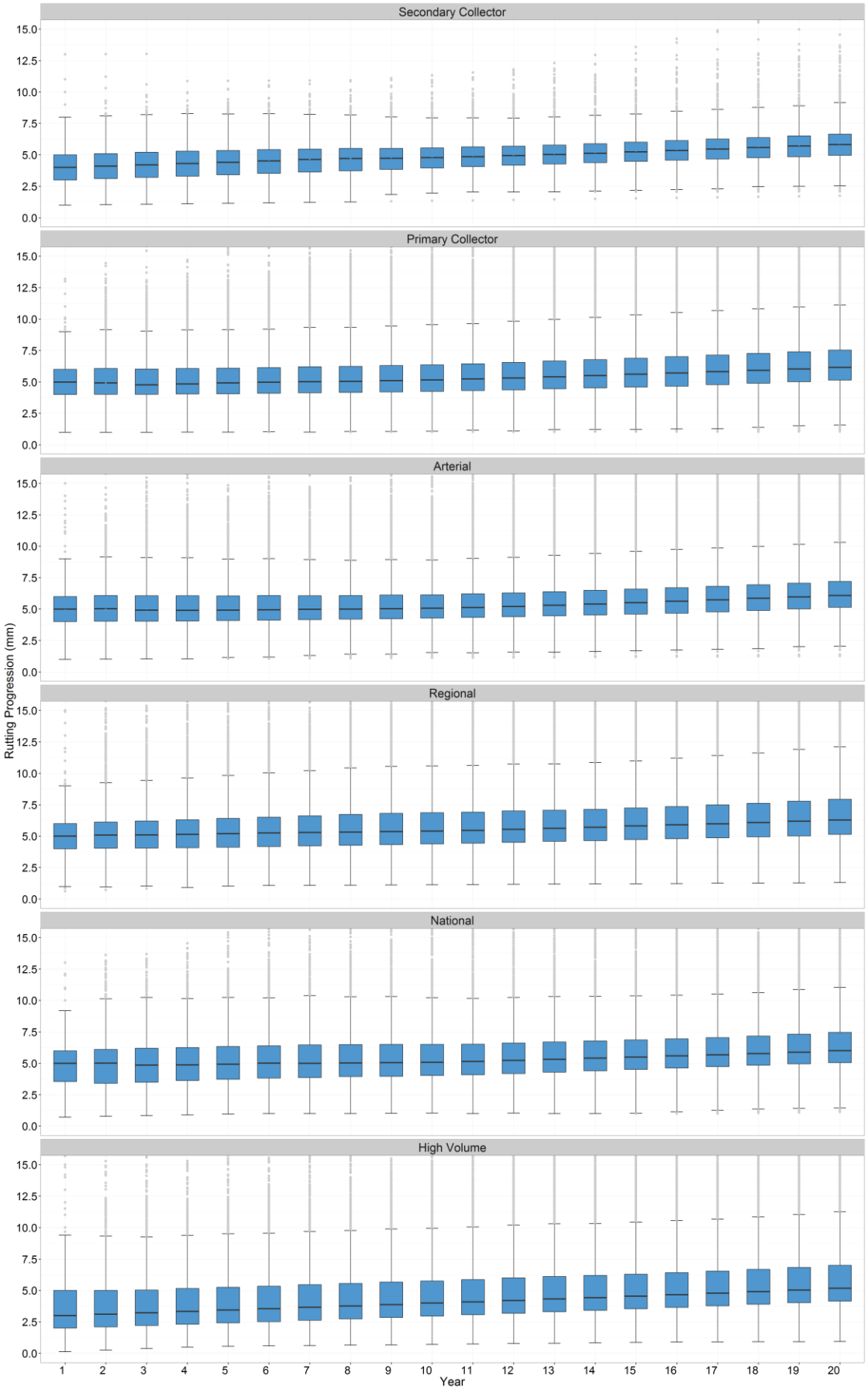
PCI Distribution 20 Years - $120M_V1



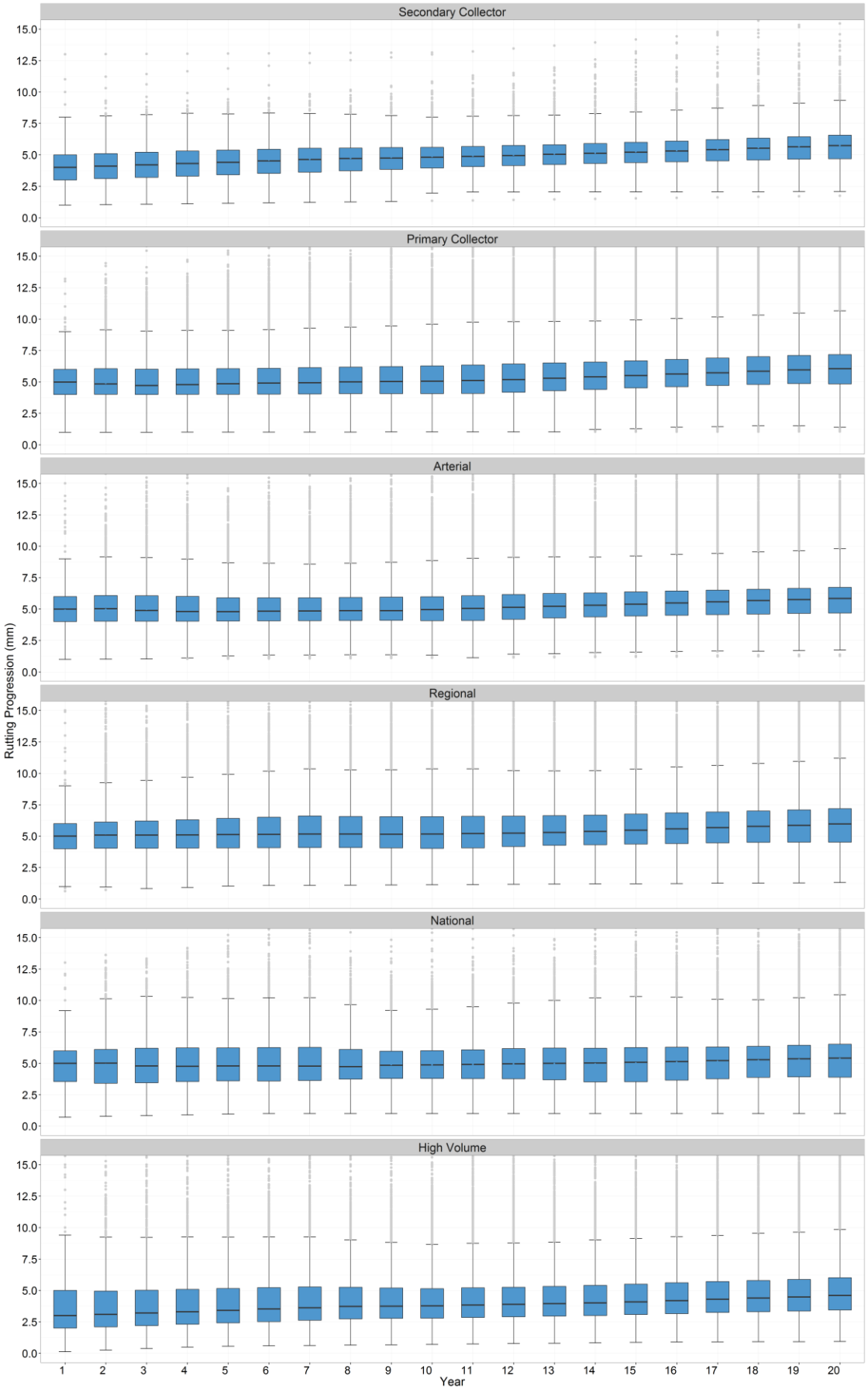
Rutting Distribution 20 Years - Birthday_V1



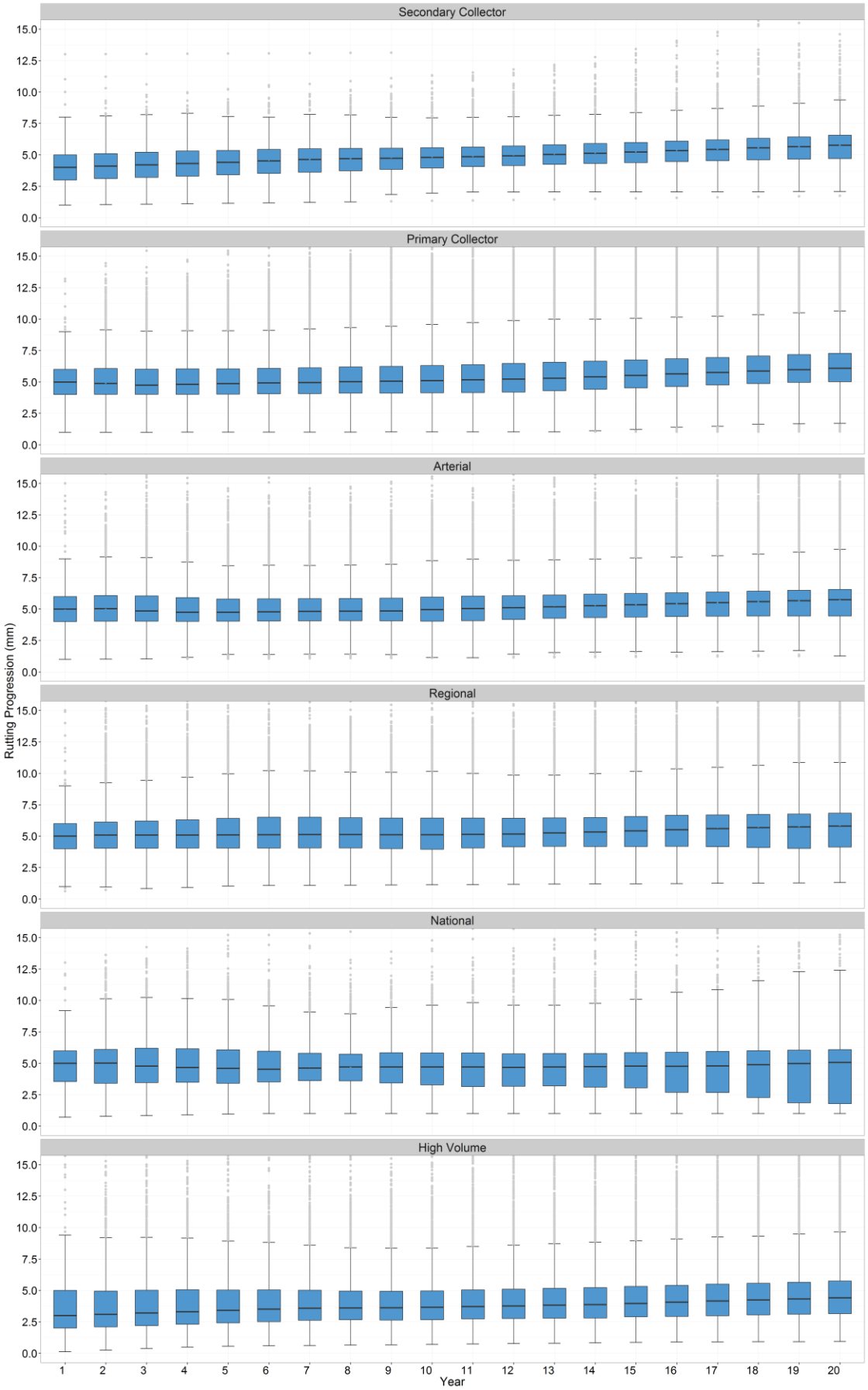
Rutting Distribution 20 Years - Least Cost_V1



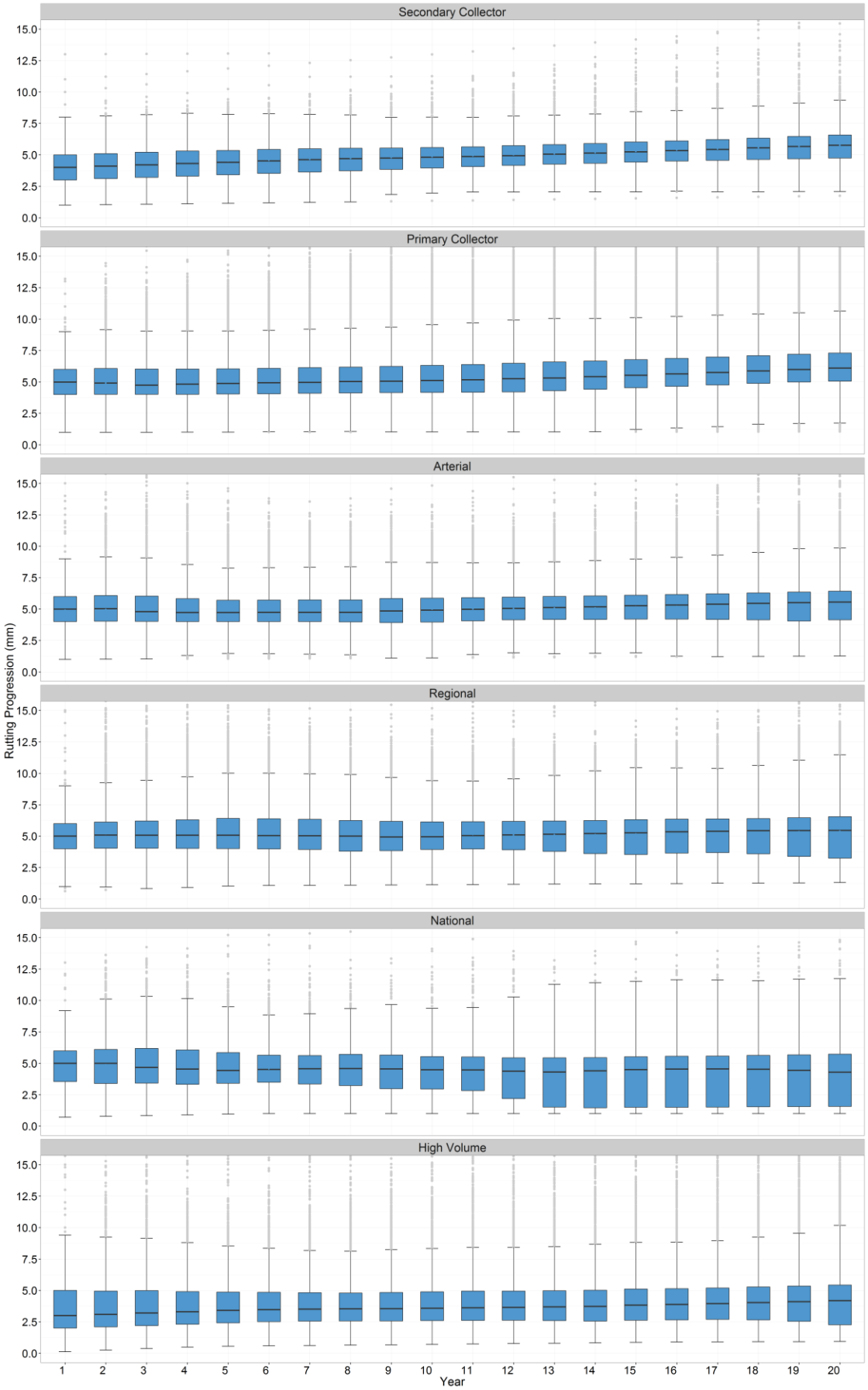
Rutting Distribution 20 Years - $80M_V1



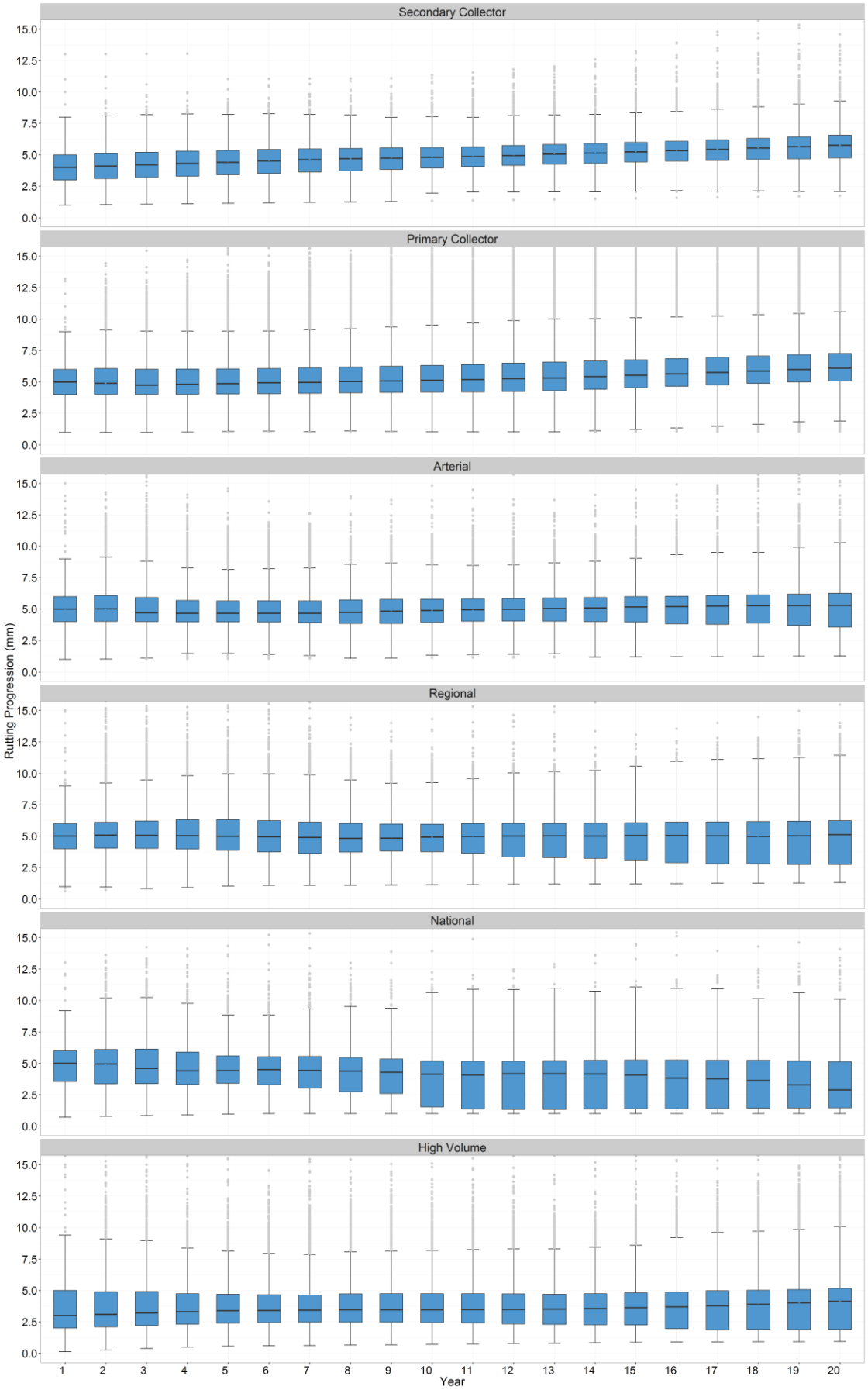
Rutting Distribution 20 Years - $90M_V1



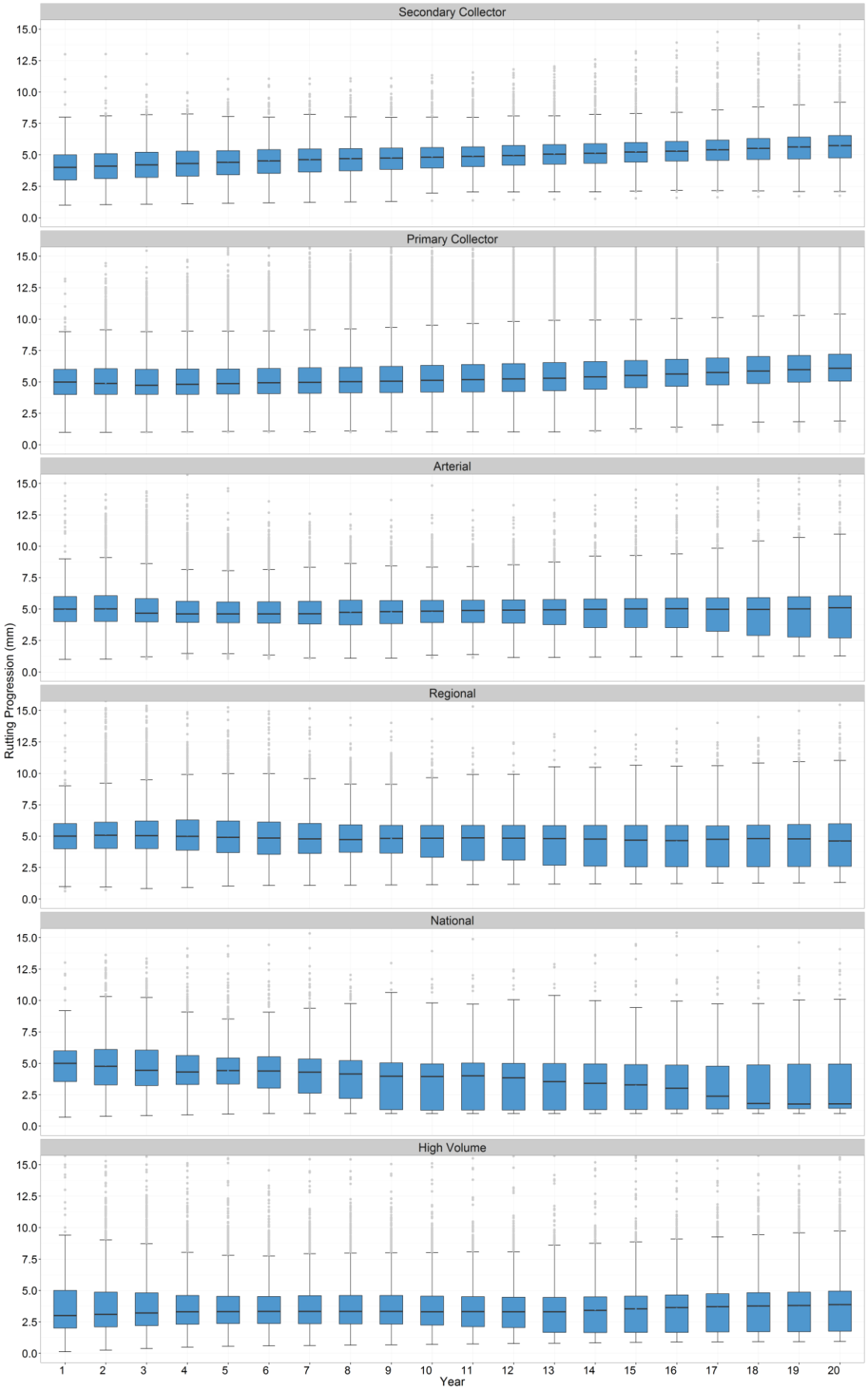
Rutting Distribution 20 Years - $100M_V1



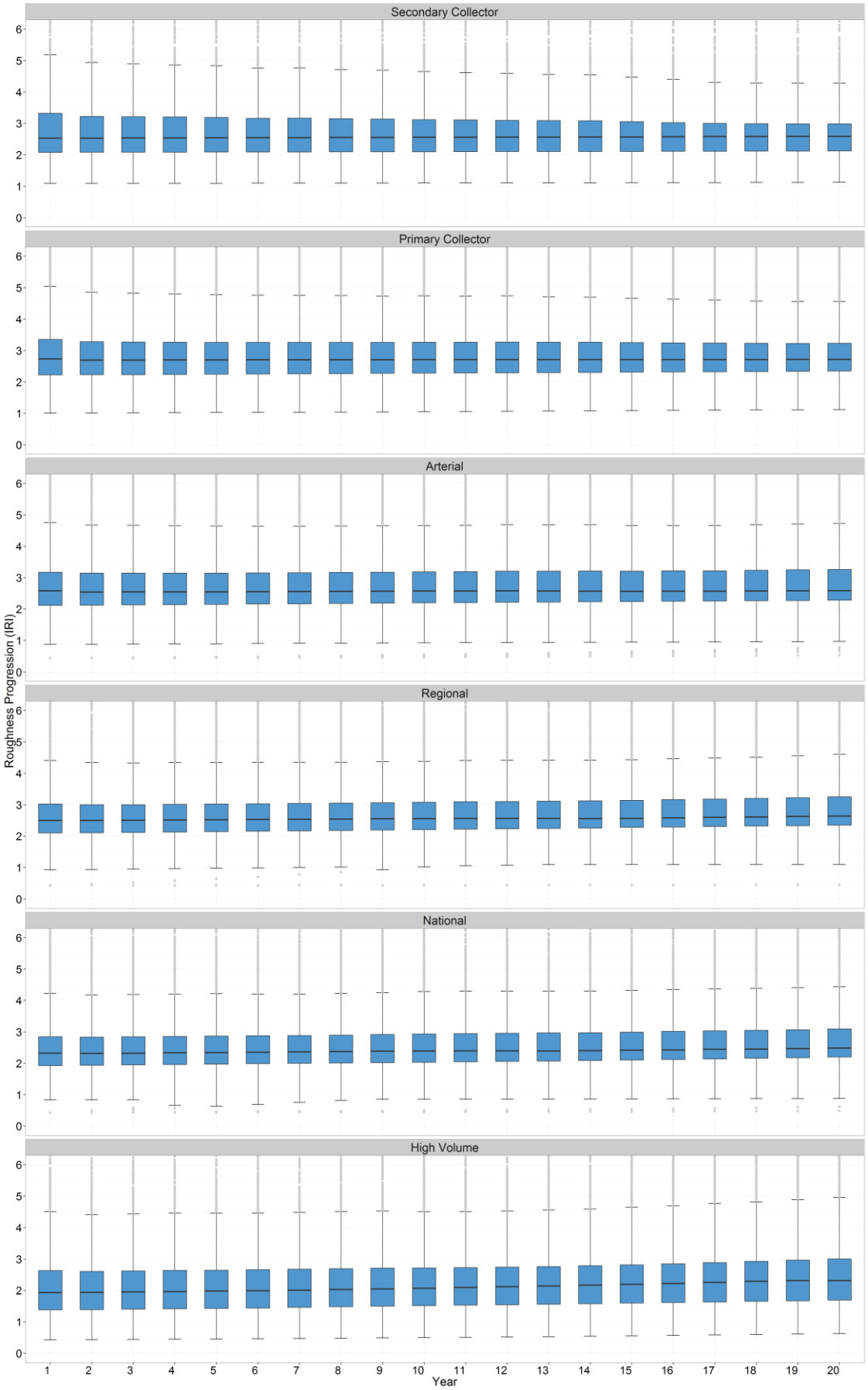
Rutting Distribution 20 Years - $110M_V1



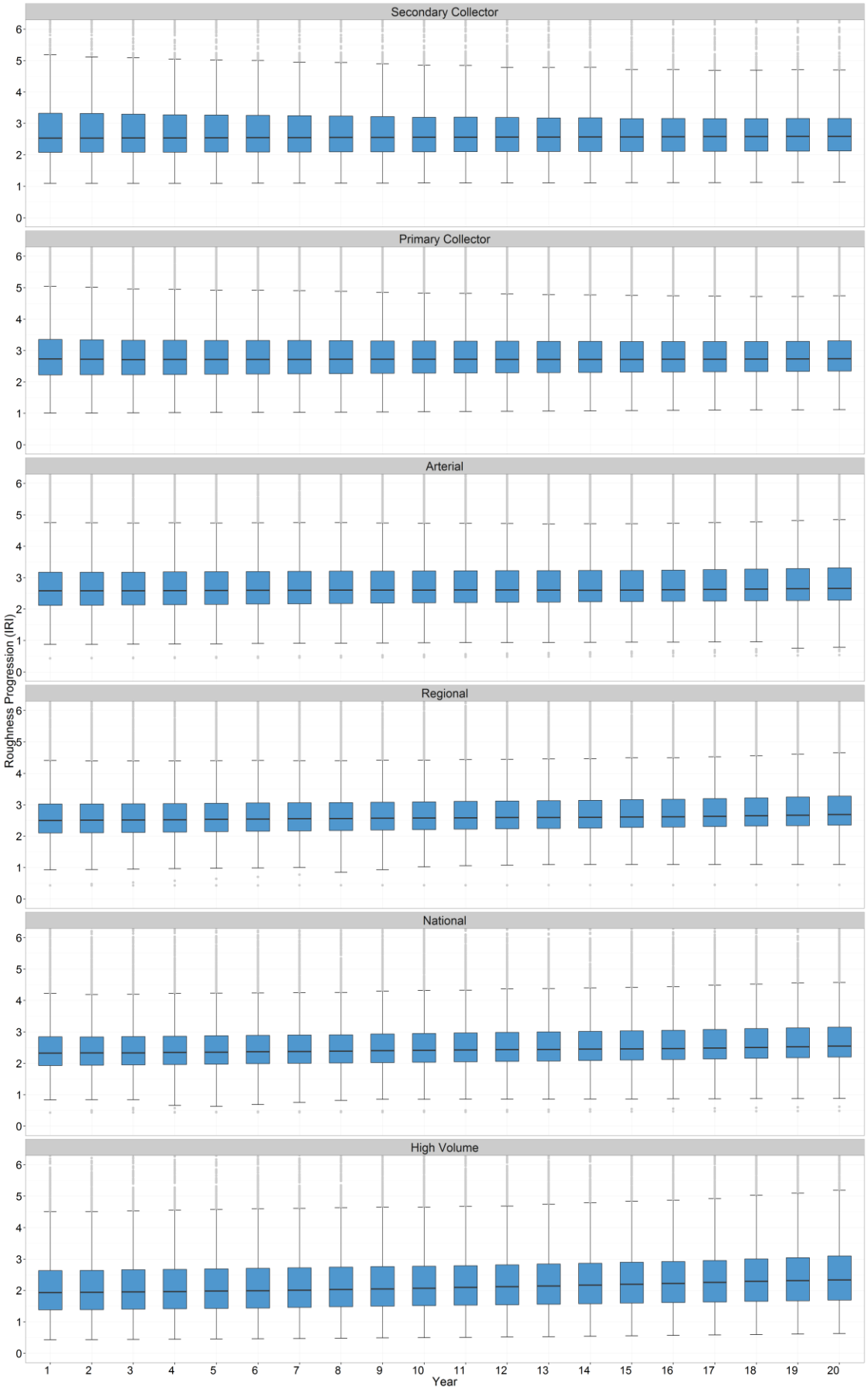
Rutting Distribution 20 Years - $120M_V1



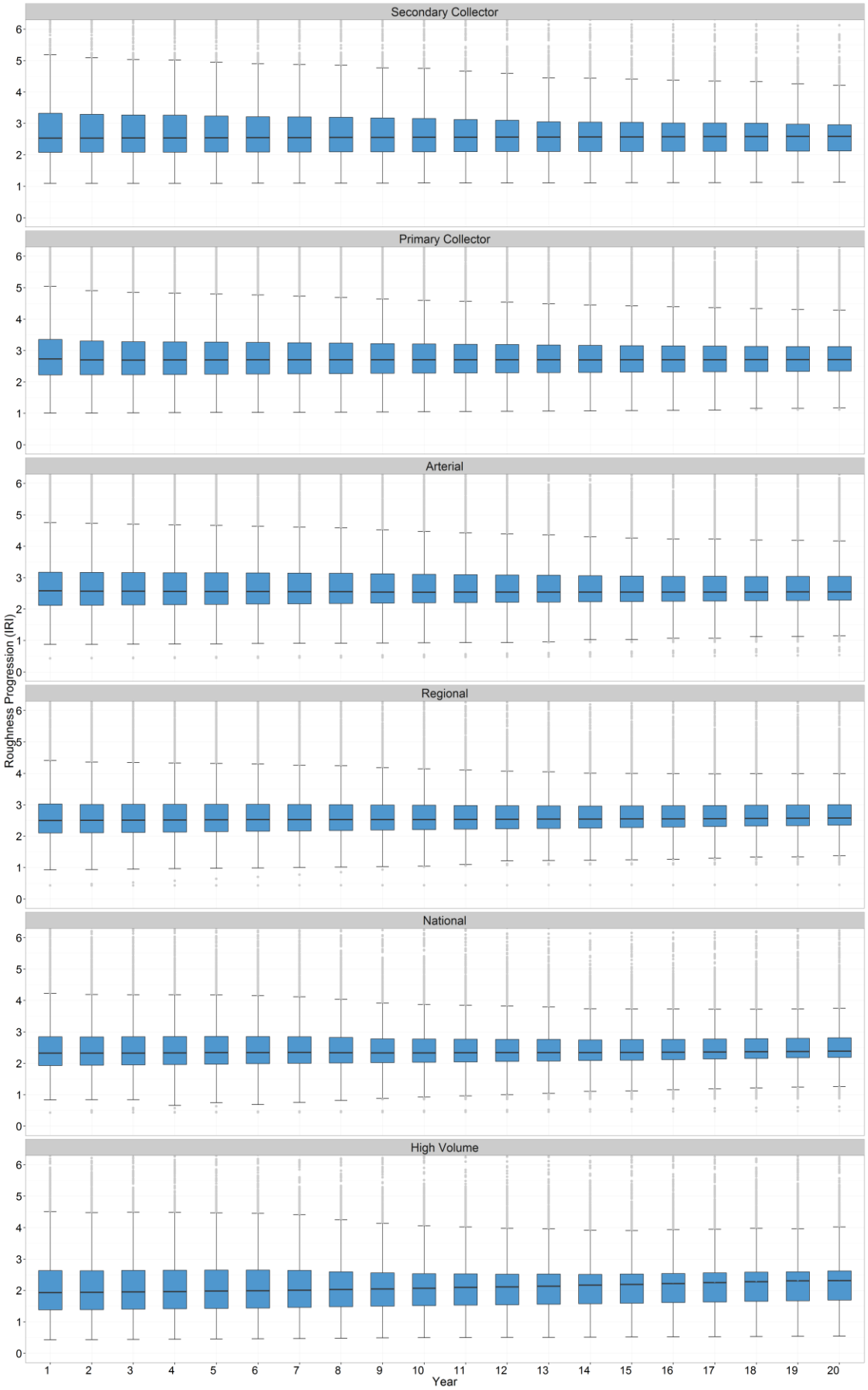
Roughness Distribution 20 Years- Birthday_V1



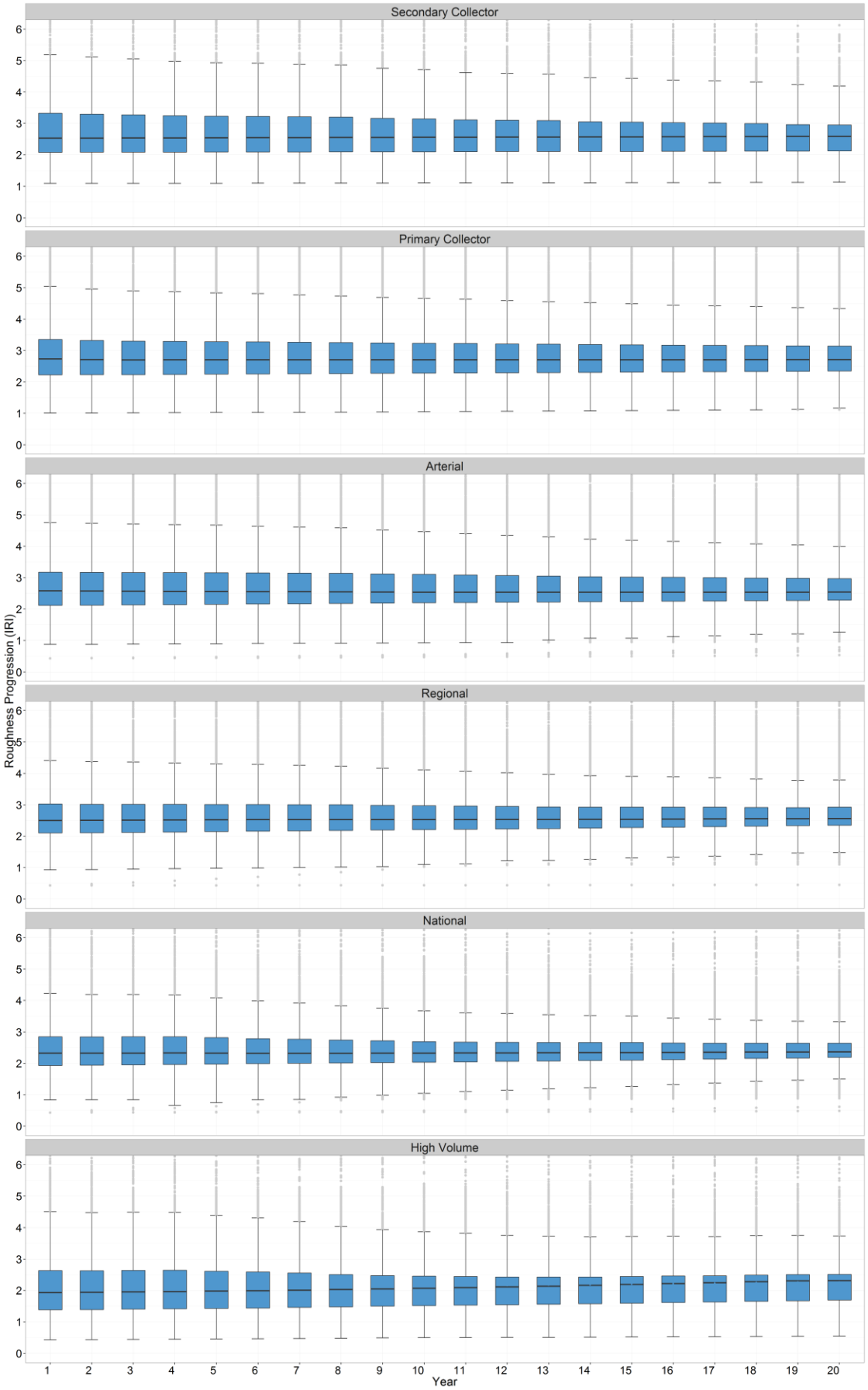
Roughness Distribution 20 Years- Least Cost_V1



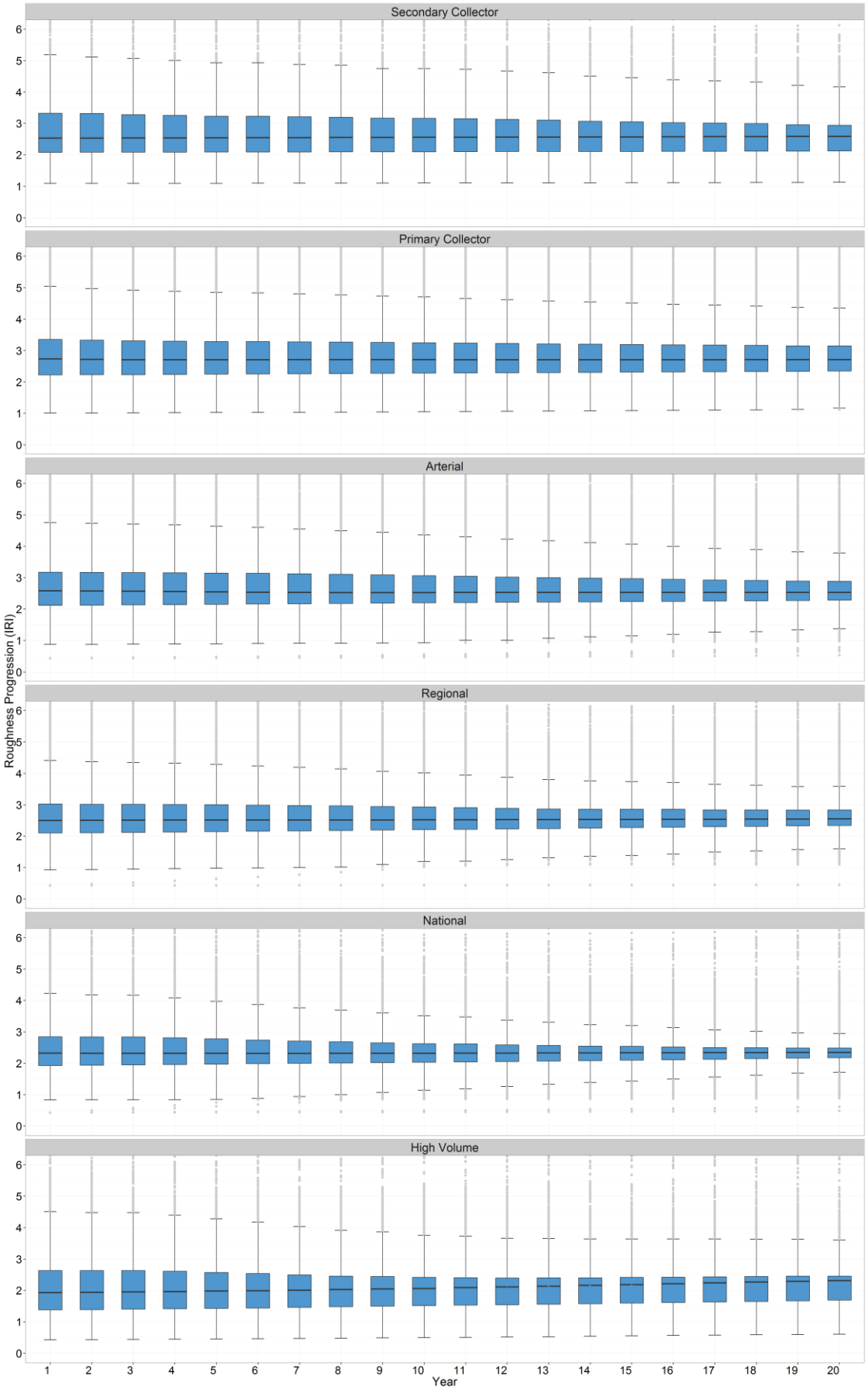
Roughness Distribution 20 Years- $80M_V1



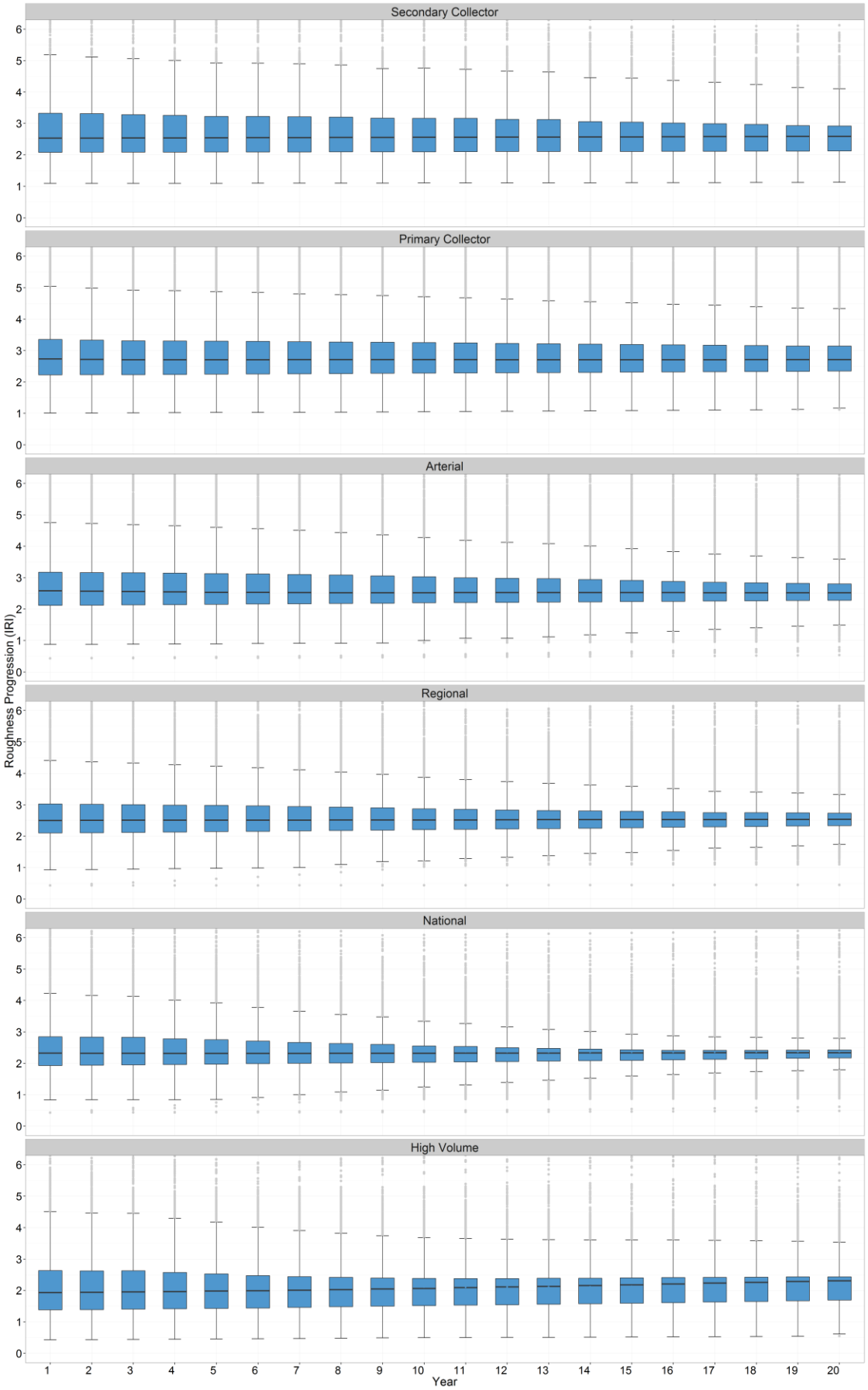
Roughness Distribution 20 Years- $90M_V1



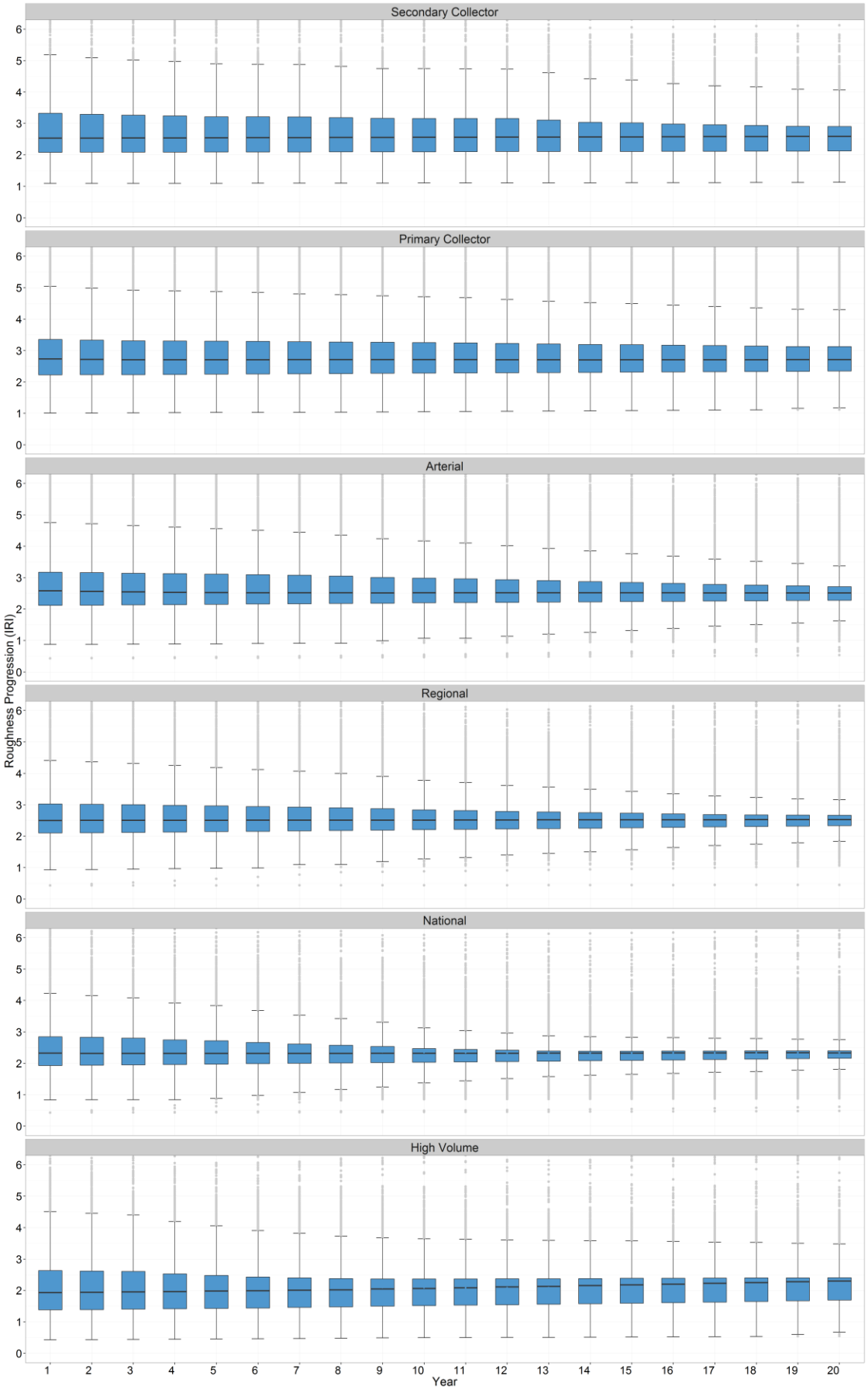
Roughness Distribution 20 Years- $100M_V1



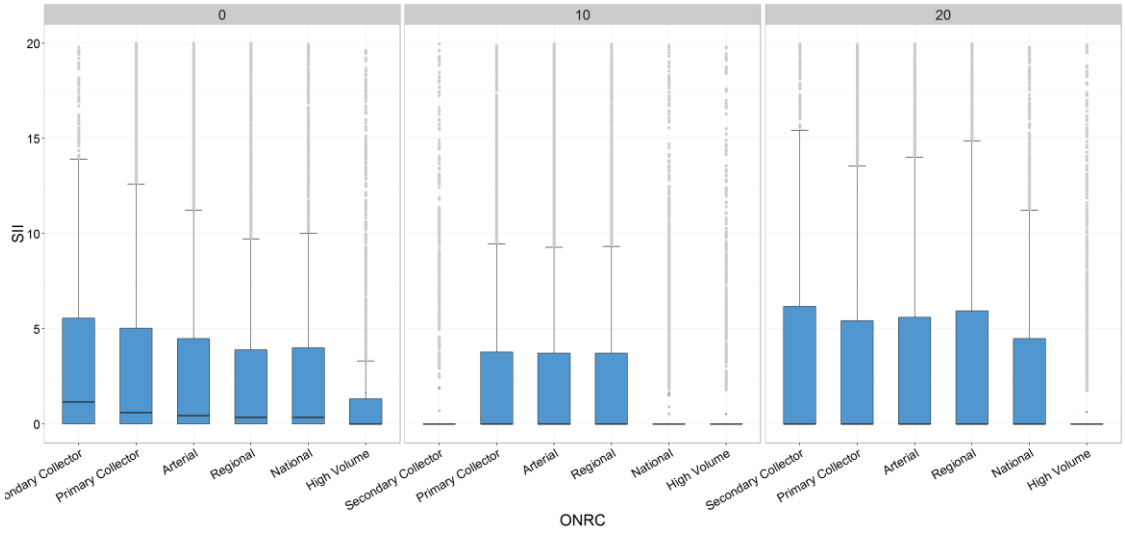
Roughness Distribution 20 Years- $110M_V1



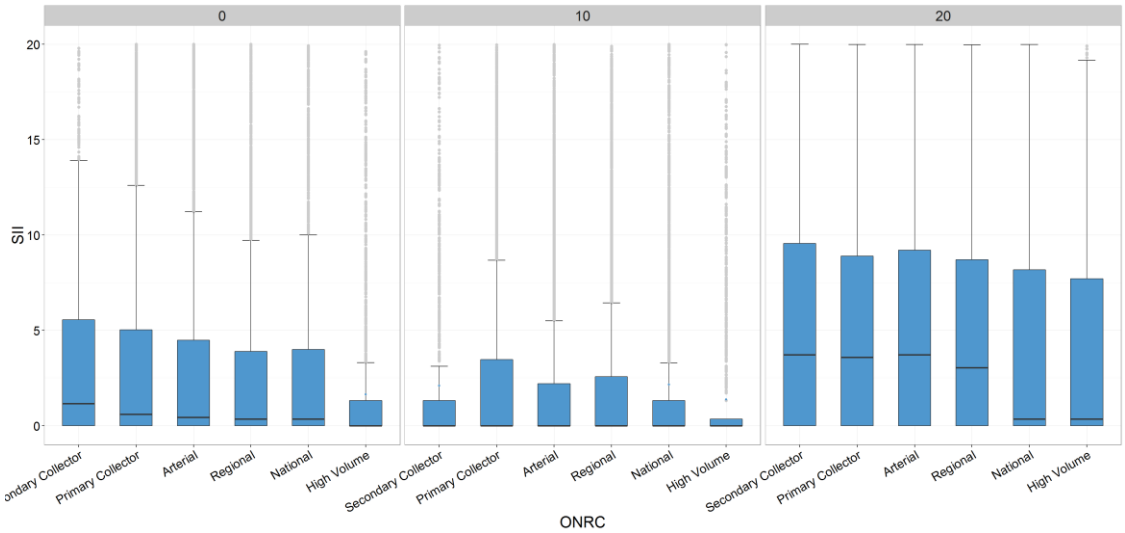
Roughness Distribution 20 Years- $120M_V1



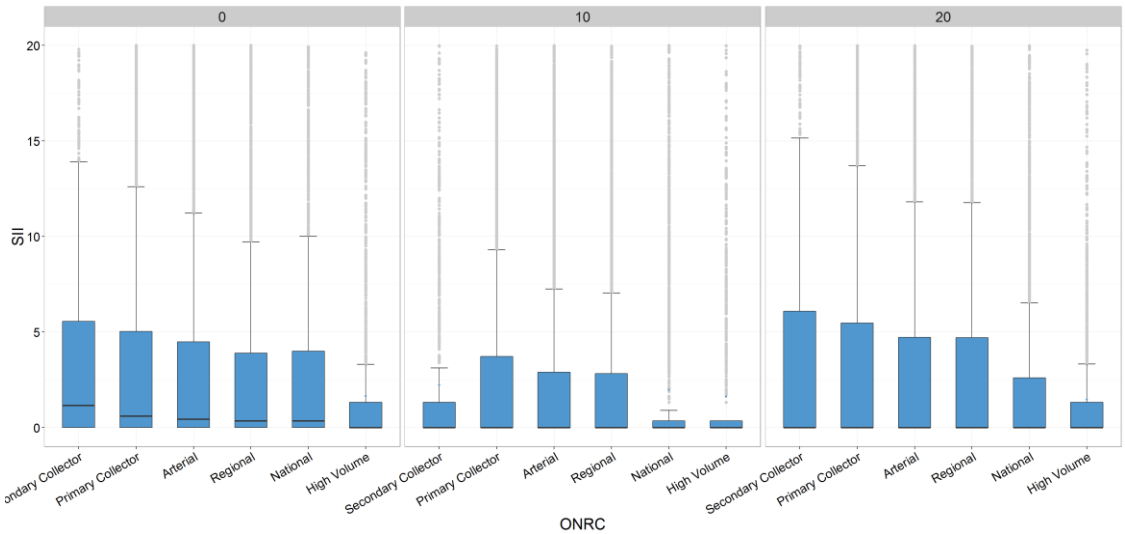
PCI Distribution - Birthday_V1



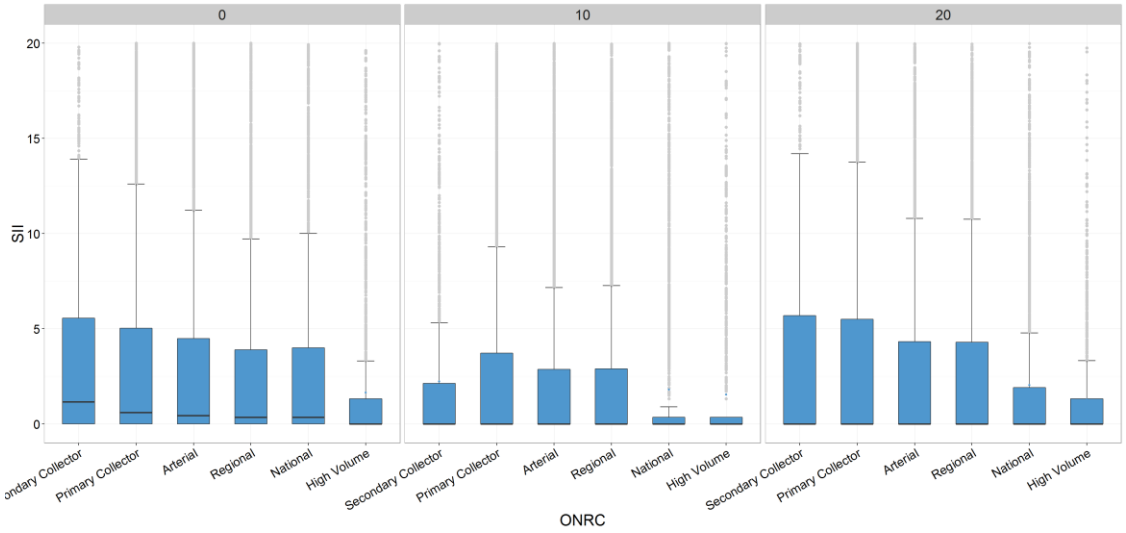
PCI Distribution - Least Cost_V1



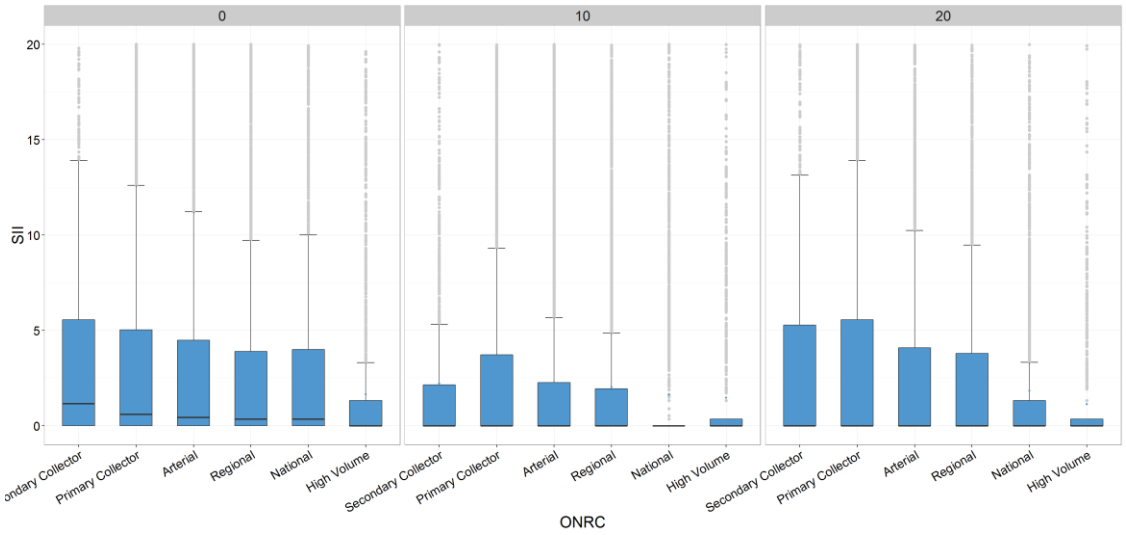
PCI Distribution - $80M_V1



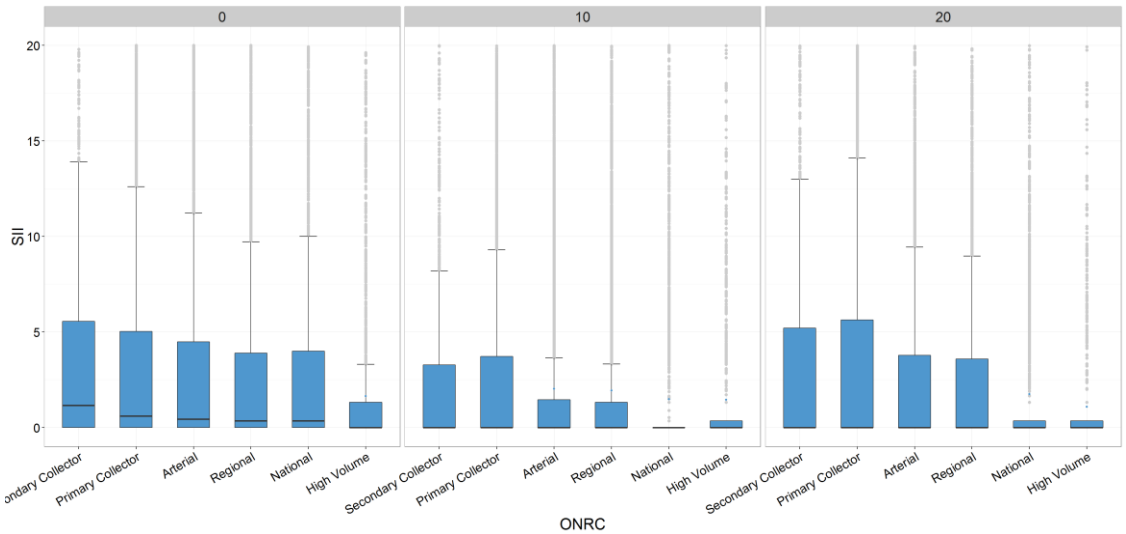
PCI Distribution - $90M_V1



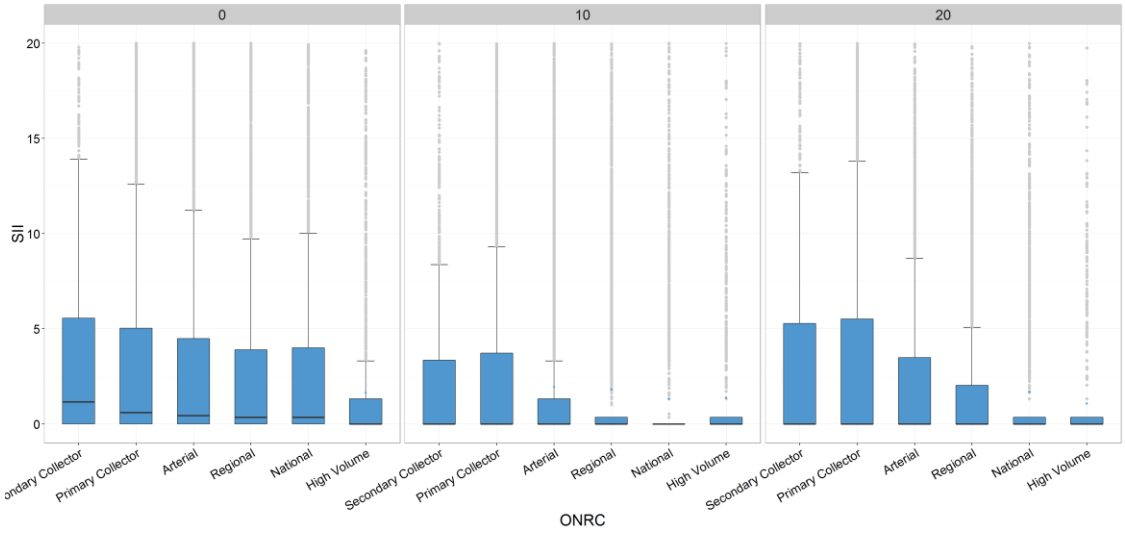
PCI Distribution - $100M_V1



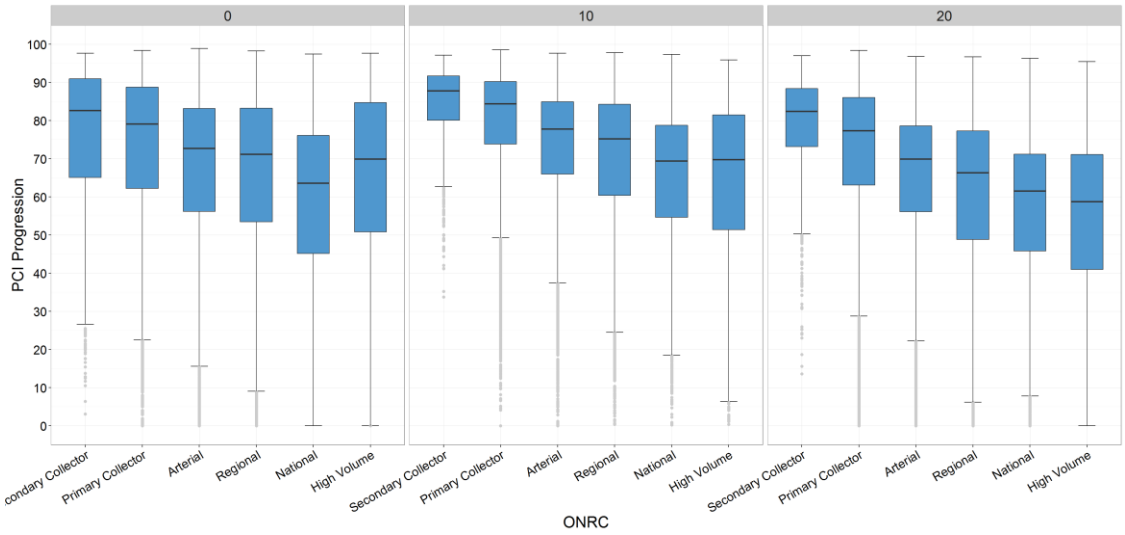
PCI Distribution - $110M_V1



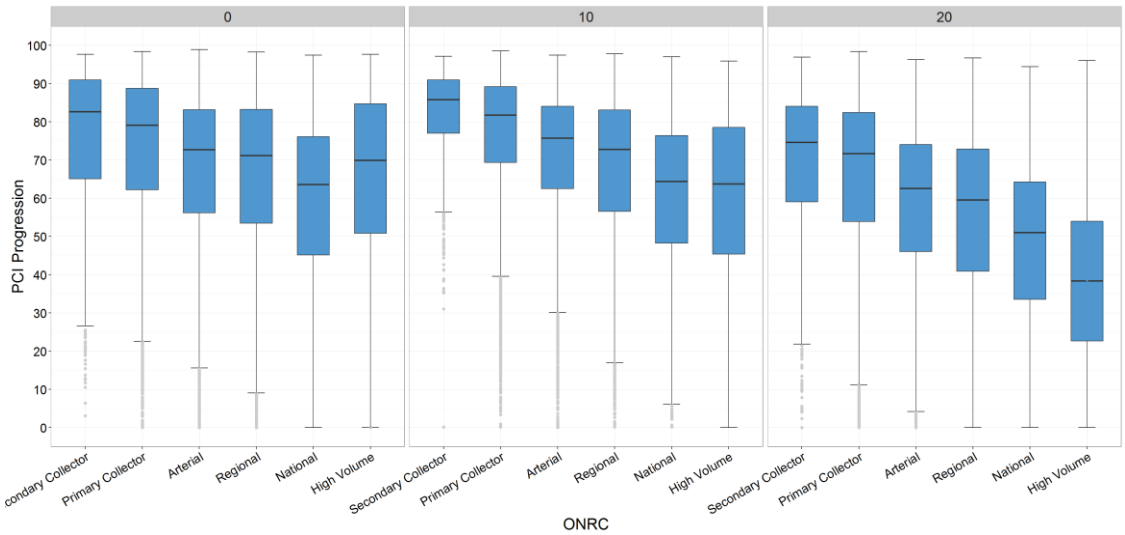
PCI Distribution - $120M_V1



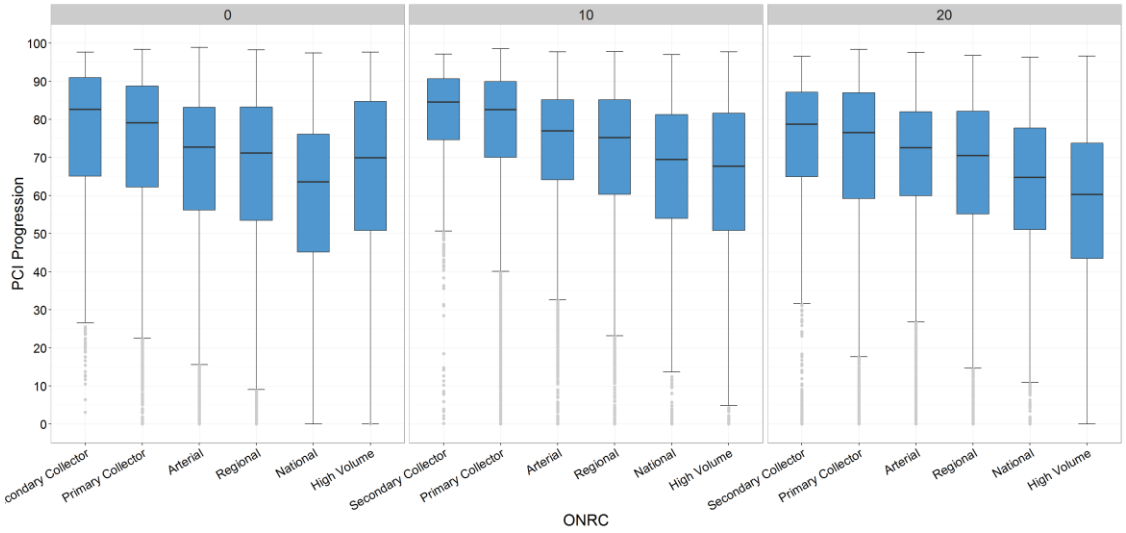
PCI Distribution - Birthday_V1



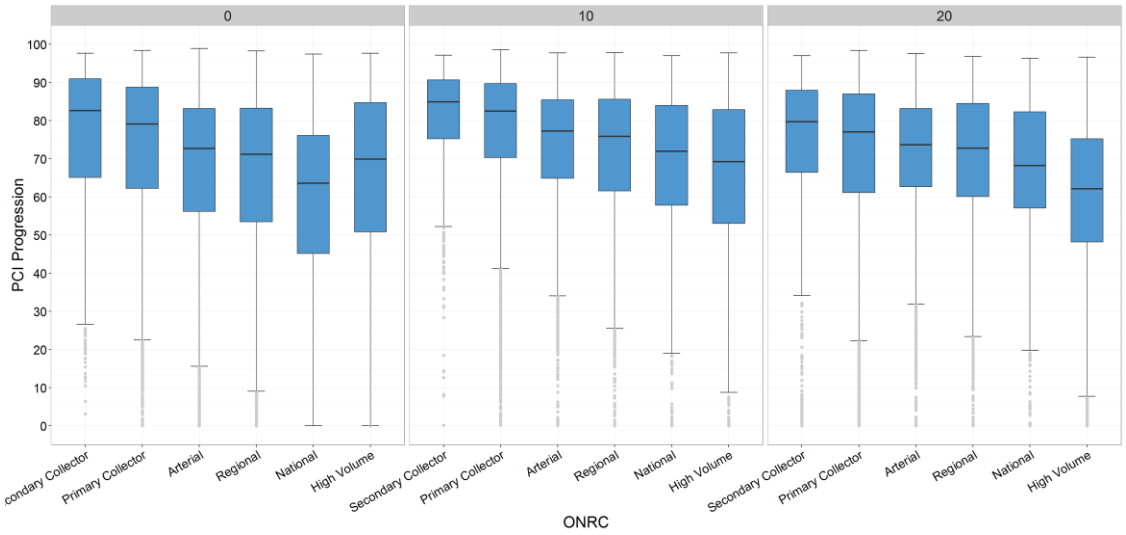
PCI Distribution - Least Cost_V1



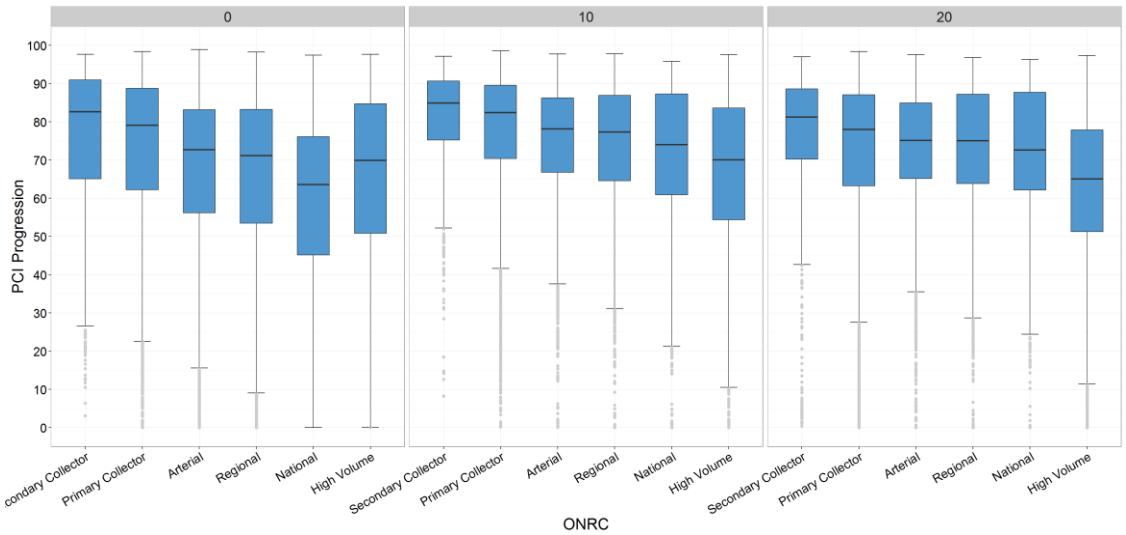
PCI Distribution - $80M_V1



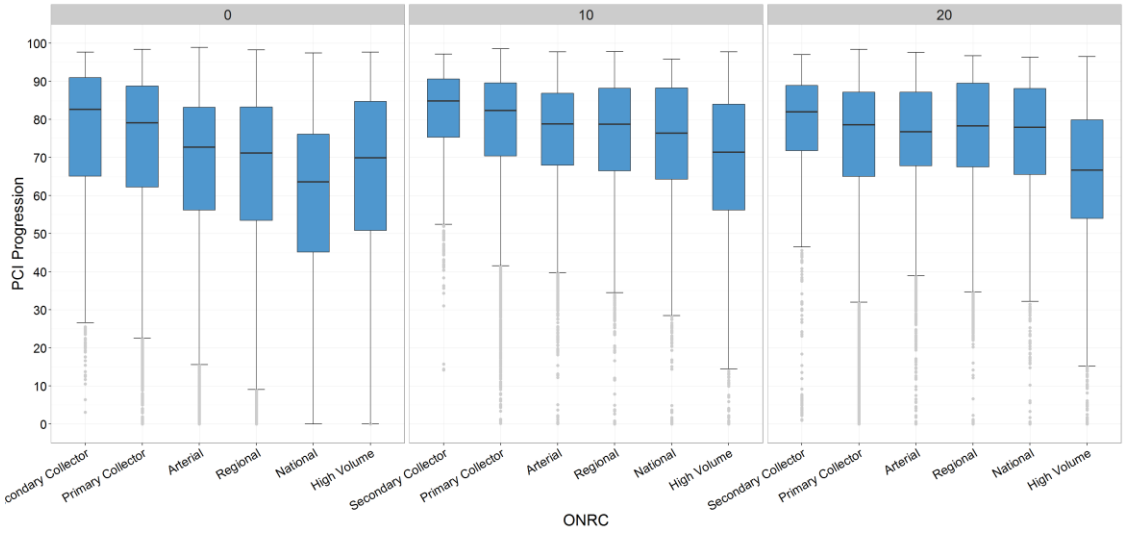
PCI Distribution - $90M_V1



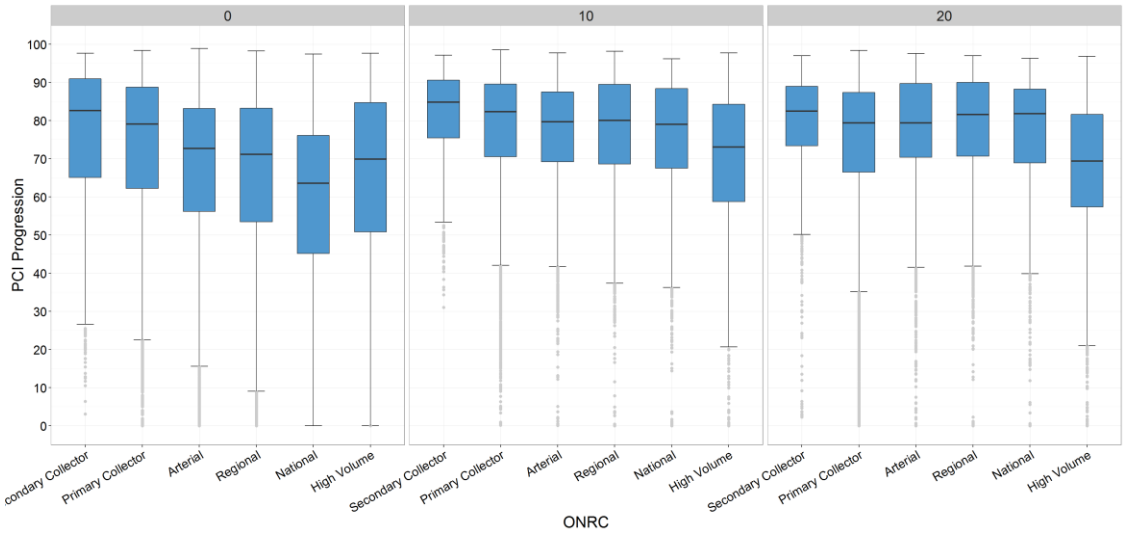
PCI Distribution - $100M_V1



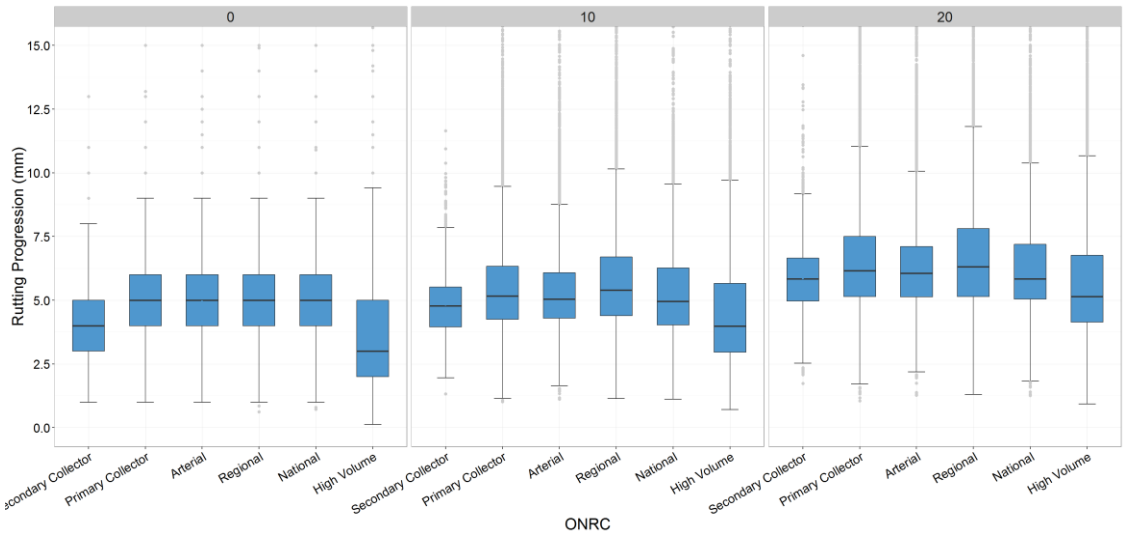
PCI Distribution - $110M_V1



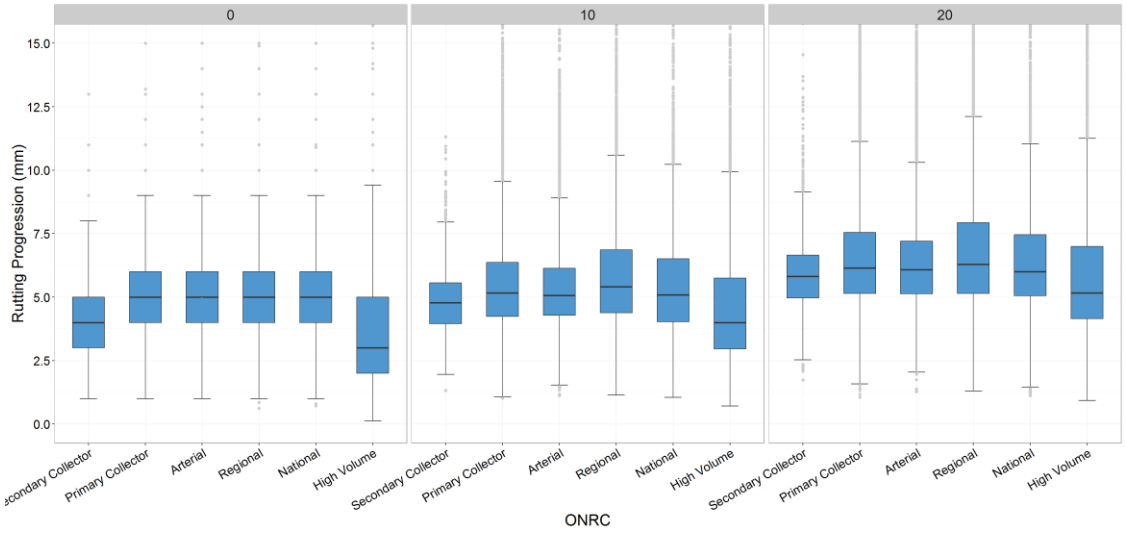
PCI Distribution - $120M_V1



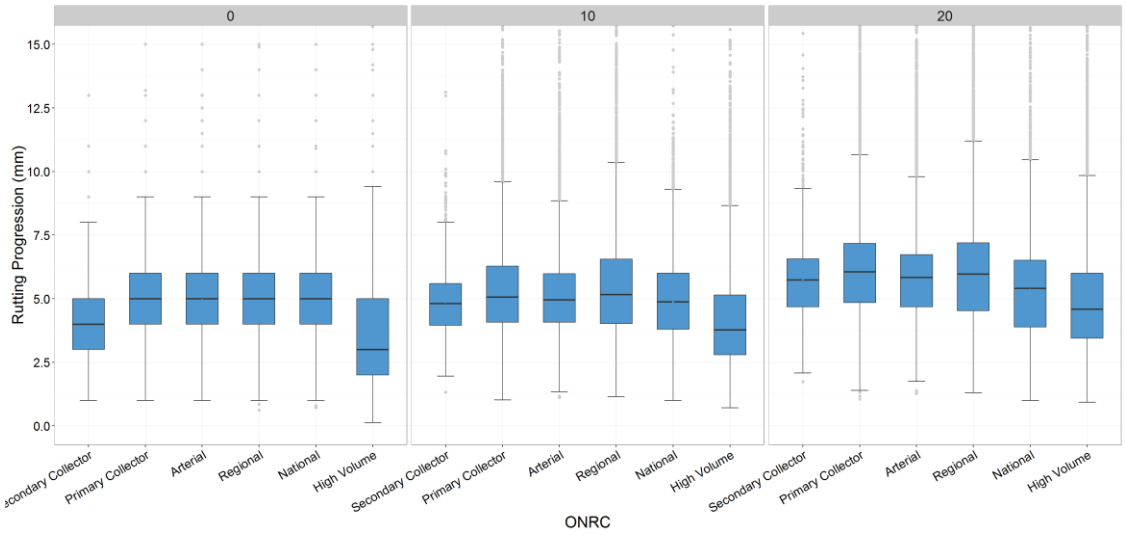
Rutting Distribution - Birthday_V1



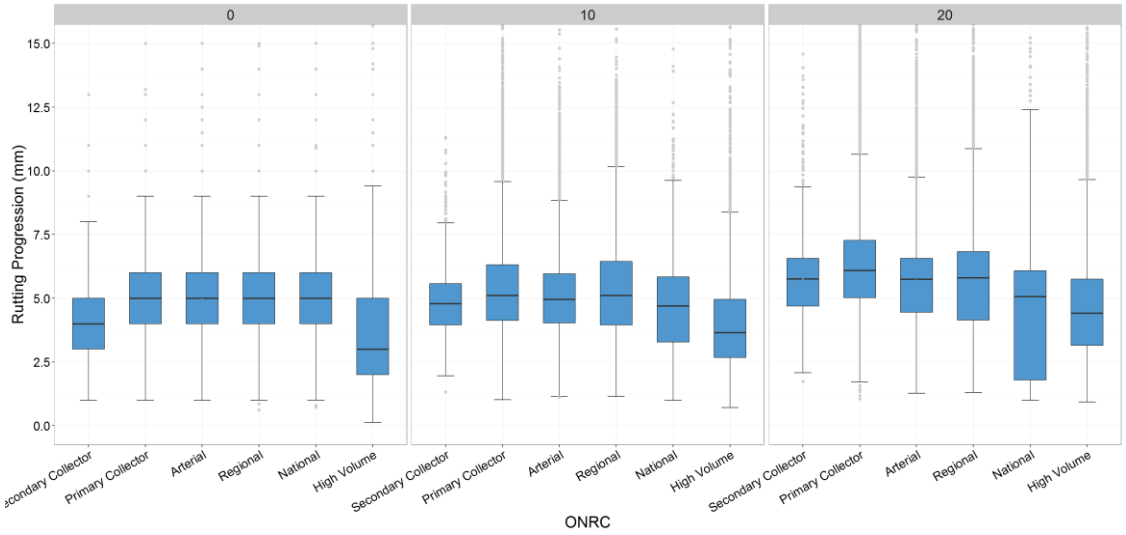
Rutting Distribution - Least Cost_V1



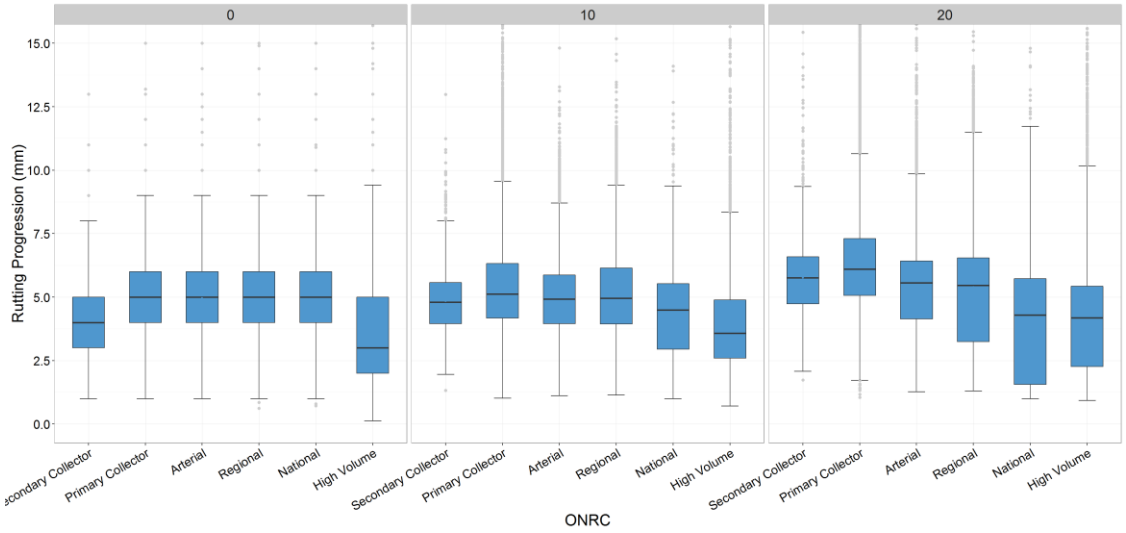
Rutting Distribution - $80M_V1



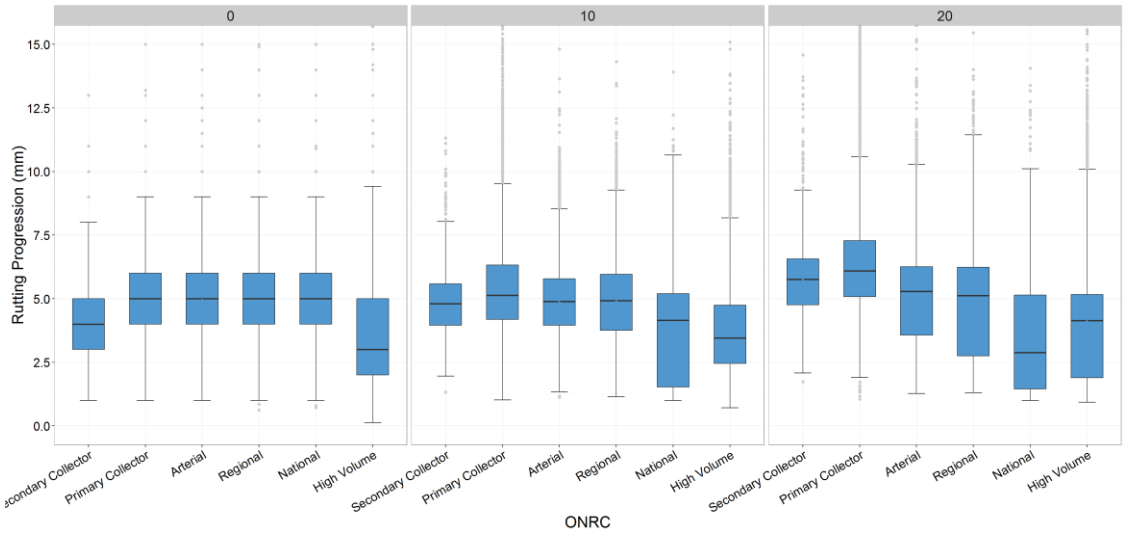
Rutting Distribution - $90M_V1



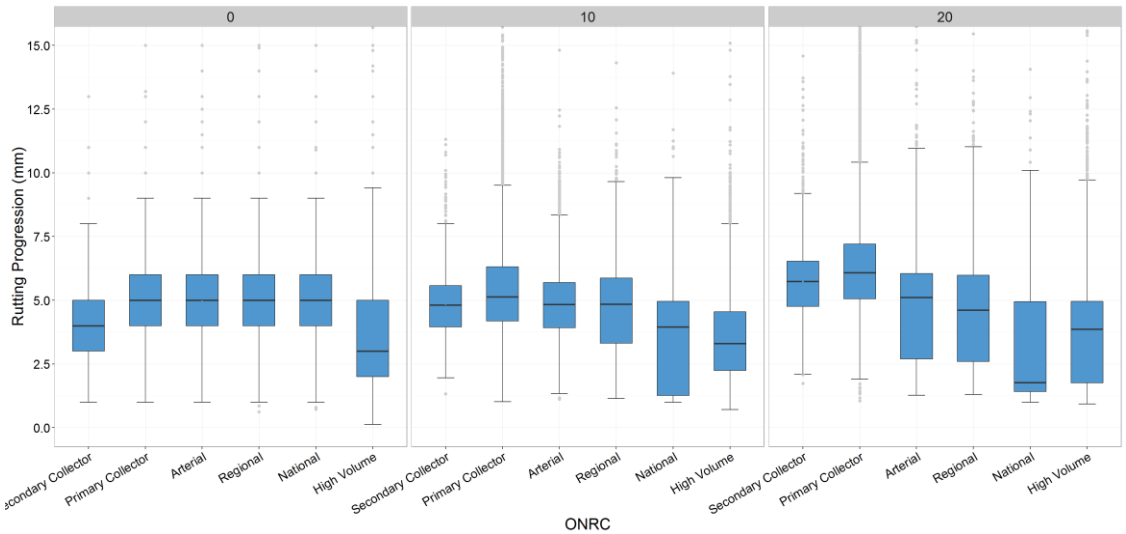
Rutting Distribution - $100M_V1



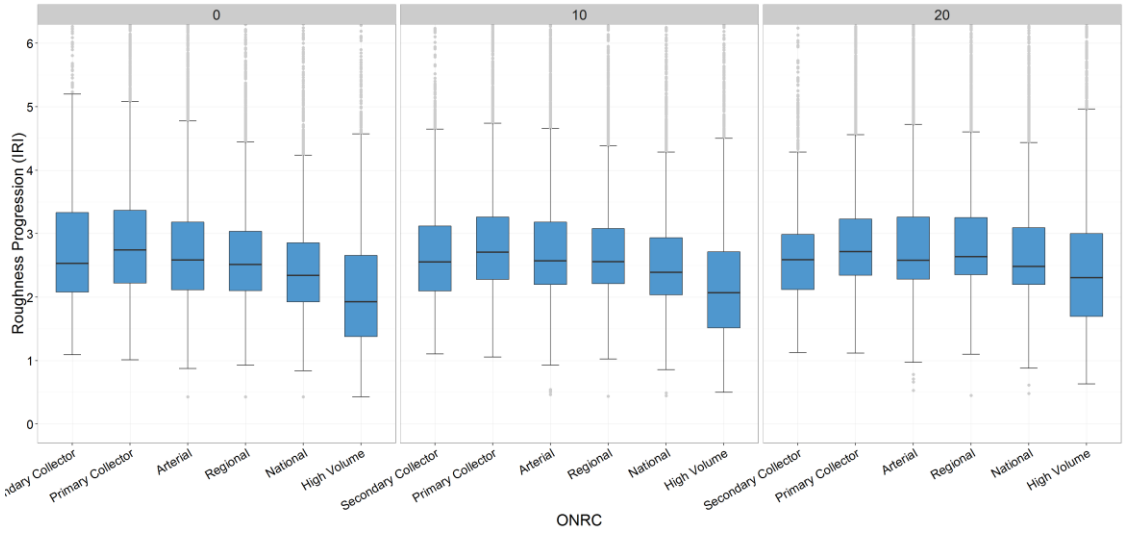
Rutting Distribution - $110M_V1



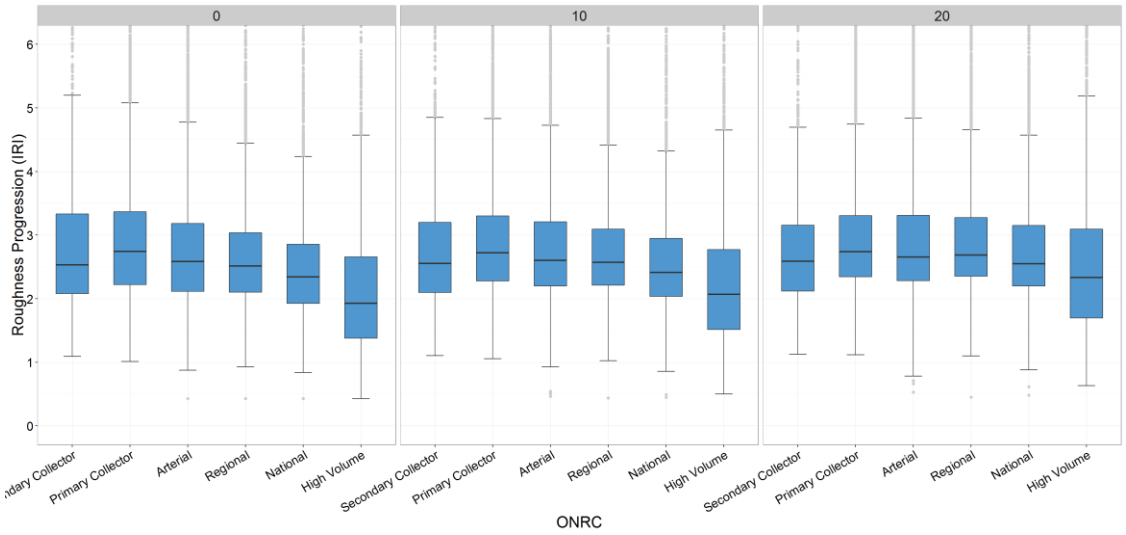
Rutting Distribution - $120M_V1



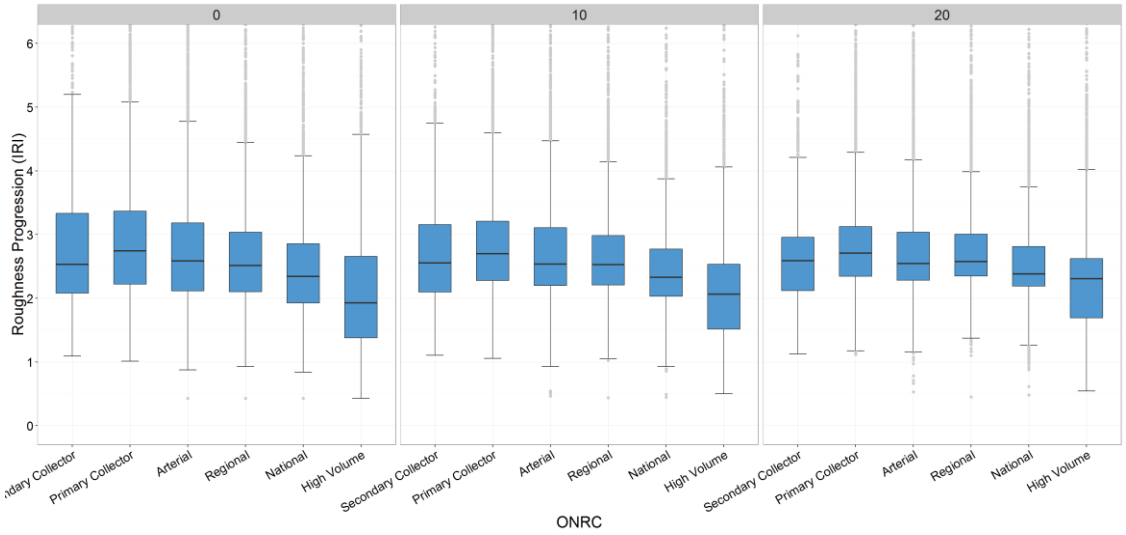
Roughness Distribution - Birthday_V1



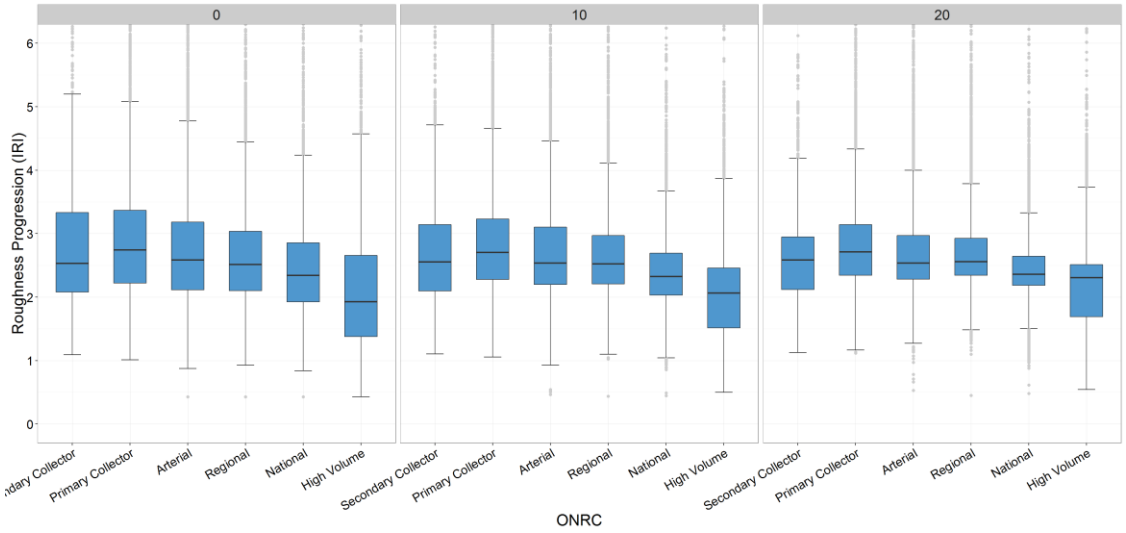
Roughness Distribution - Least Cost_V1



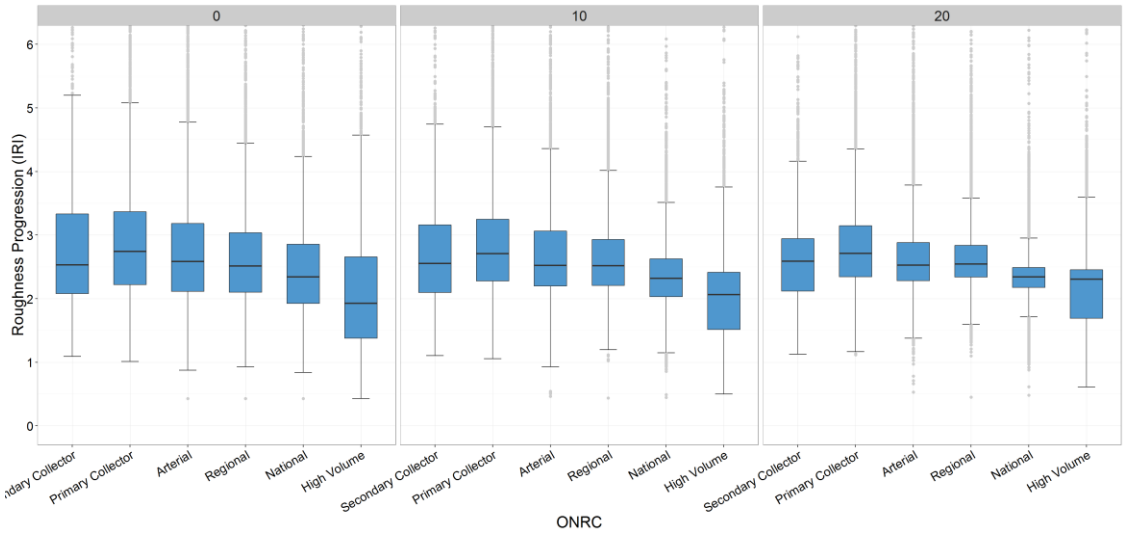
Roughness Distribution - $80M_V1



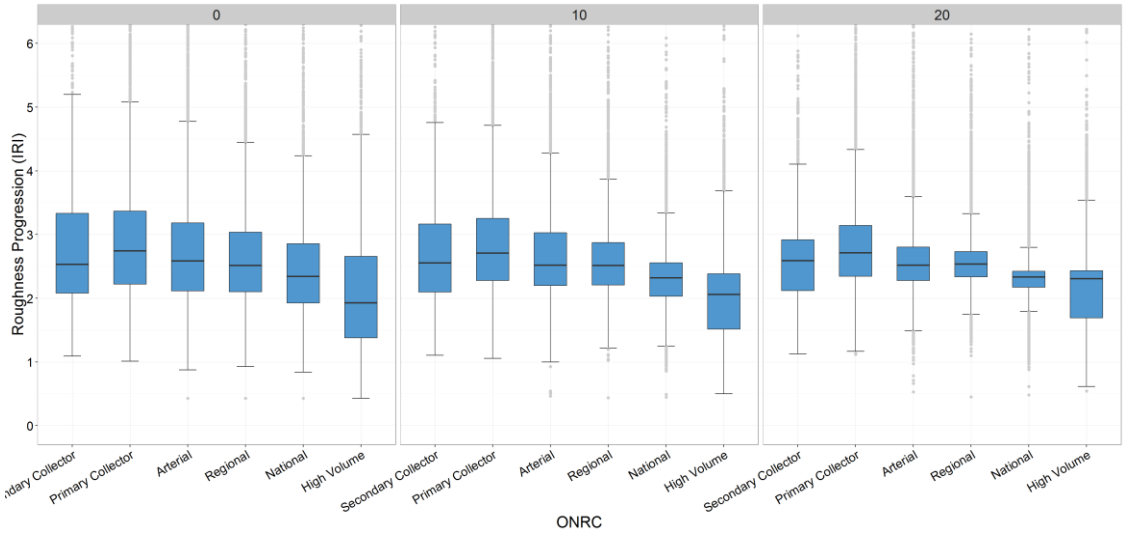
Roughness Distribution - $90M_V1



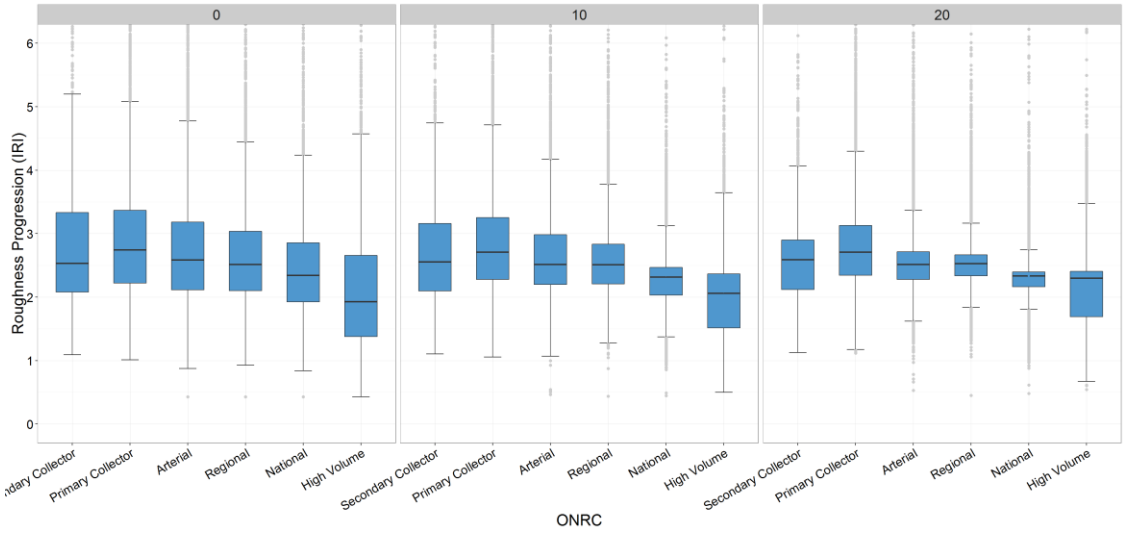
Roughness Distribution - $100M_V1



Roughness Distribution - $110M_V1



Roughness Distribution - $120M_V1



3.1 Length Charts – Fixed Routine Maintenance (V2)

This set of outputs includes Stacked Bar Charts showing predicted Treatment Length (Lane km) for each Treatment Type.

- Asphalt Surfacing - AC (light green)
- Chipseal Surfacing - CS (mid green)
- 2nd Coat (dark green)
- Pavement Rehabilitation - RHAB (yellow)
- Heavy Maintenance (orange)
- Safety (where applicable – red)

The first Chart/Table compares the seven (7) 'Fixed RM Options' as a 20 Year National Average Annual Lane km Length

- **Birthday_V2**
  - Treatments triggered when useful life is reached, does not try and meet Levels of Service
  - Renewal Investment: **Unlimited,** Routine Investment: **$30M pa**
  - Safety Investment: Safety not Included
- **$80M_V2**
  - Renewal Investment: Fixed **$80M** pa, Routine Investment: **$30M pa**
  - Safety Investment: Safety not Included
- **$90M_V2**
  - Renewal Investment: Fixed **$90M** pa, Routine Investment: **$30M pa**
  - Safety Investment: Safety not Included
- **$100M_V2**
  - Renewal Investment: Fixed **$100M** pa, Routine Investment: **$30M pa**
  - Safety Investment: Safety not Included
- **$110M_V2**
  - Renewal Investment: Fixed **$110M** pa, Routine Investment: **$30M pa**
  - Safety Investment: Safety not Included
- **$120M_V2**
  - Renewal Investment: Fixed **$120M** pa, Routine Investment: **$30M pa**
  - Safety Investment: Safety not Included
- **Least Cost_V2**
  - Generates the lowest overall cost treatment programme considering Renewal and Routine Investment – disallowing Do Nothing. Does not try and meet Levels of Service.
  - Safety Investment: Safety not Included

The second series compares the six (6) ONRC Classes as time series over 20 years for each 'Fixed RM Options.

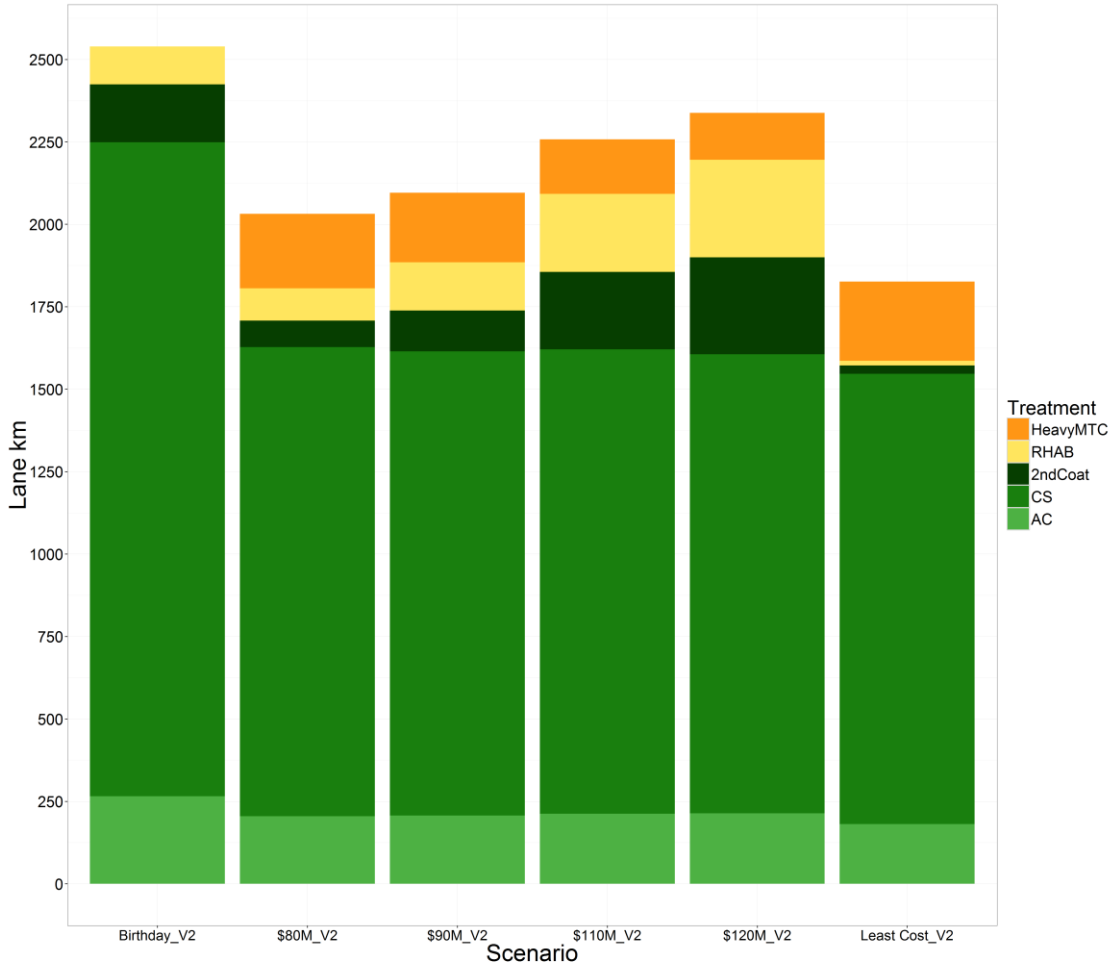
- Secondary Collector, Primary Collector
- Arterial, Regional
- National, National High Volume

The third series compares the 'Fixed RM Options' by ONRC Class as time series over 20 years

The fourth series compares the twenty three (23) Regions as time series over 20 years for each 'Fixed RM Option'.

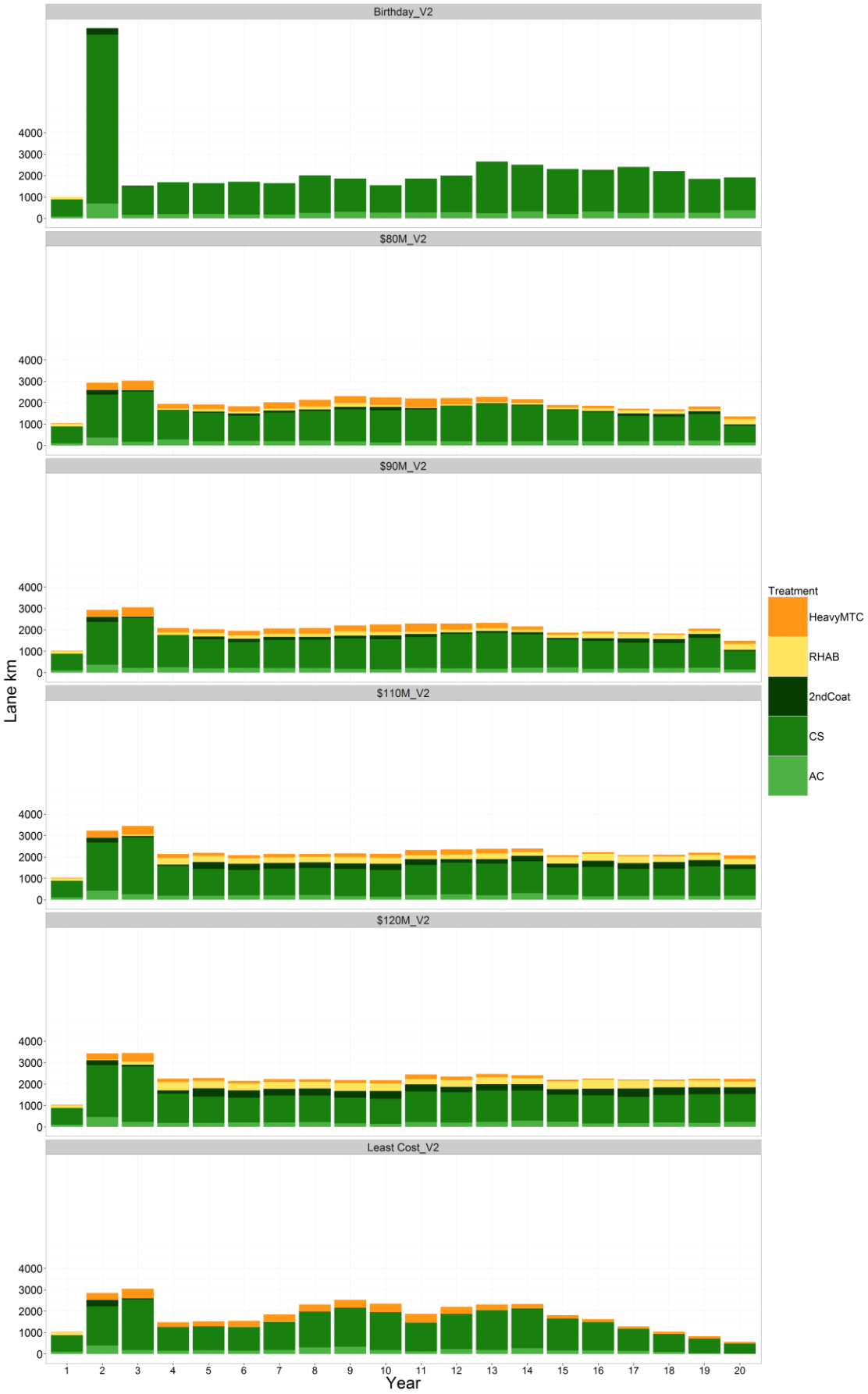
Length

National 20 Year Average Annual Length

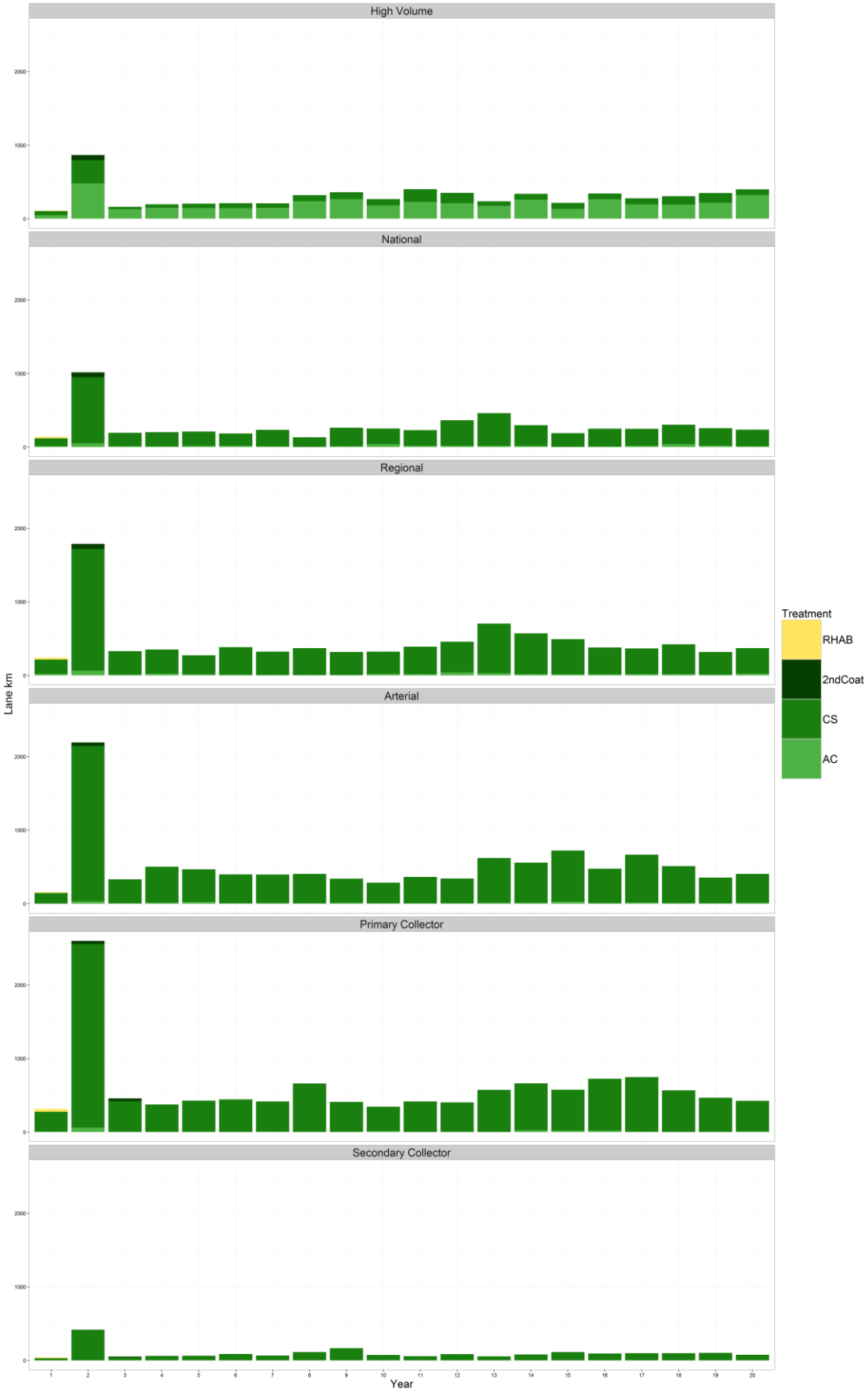


	Birthday_V2	$80M_V2	$90M_V2	$100M_V2	$110M_V2	$120M_V2	Least Cost_V2
AC	265.69	204.65	206.82	0	212.02	213.59	180.73
CS	1983.18	1422.91	1408.03	0	1408.56	1391.92	1365.75
2ndCoat	175.19	79.95	123.4	0	234.68	294.3	25.38
RHAB	115.2	98.25	146.68	0	236.63	295.83	14.04
HeavyMTC	0	226.17	210.64	0	165.79	142.39	240.03

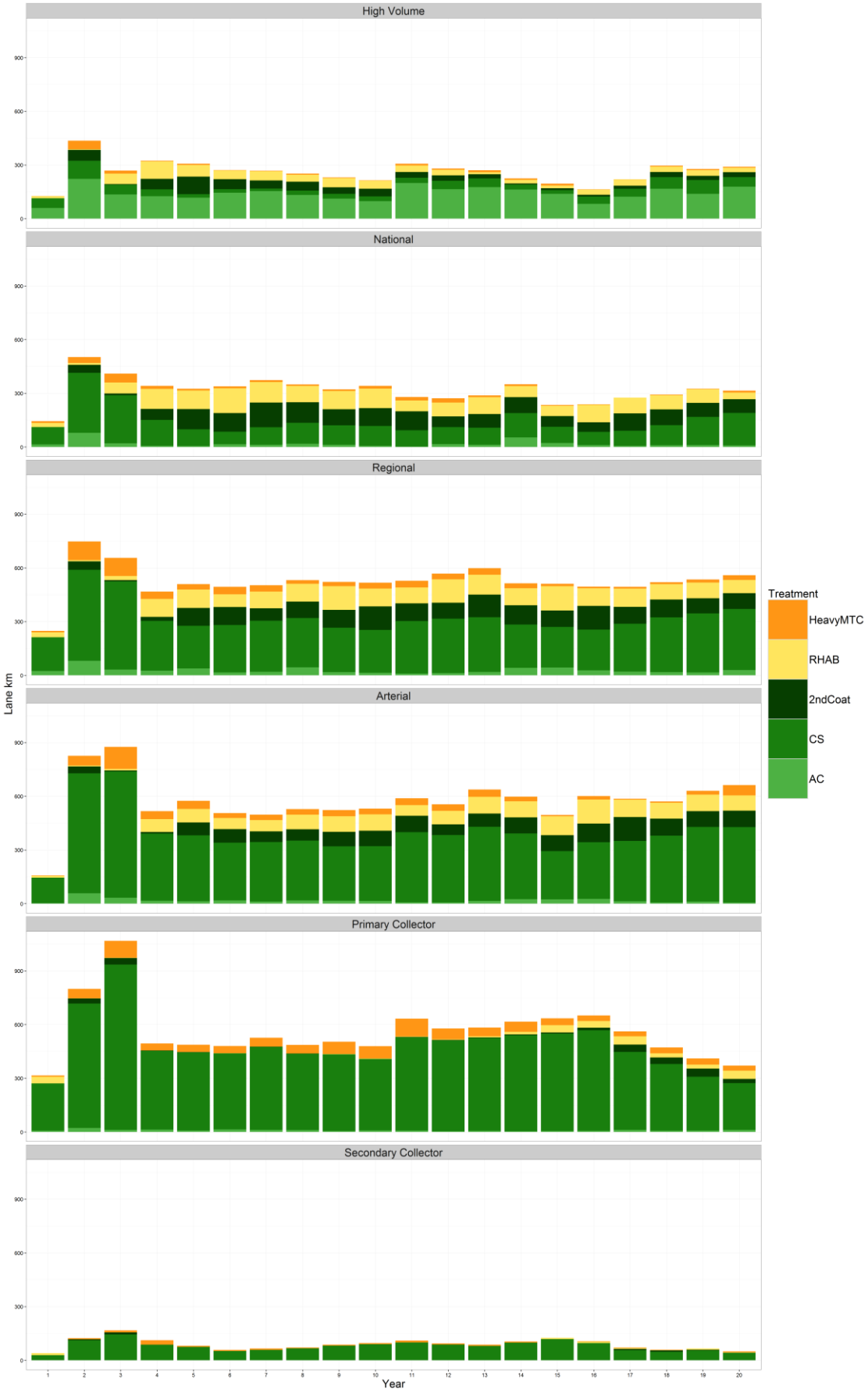
National - Total Network Lane km



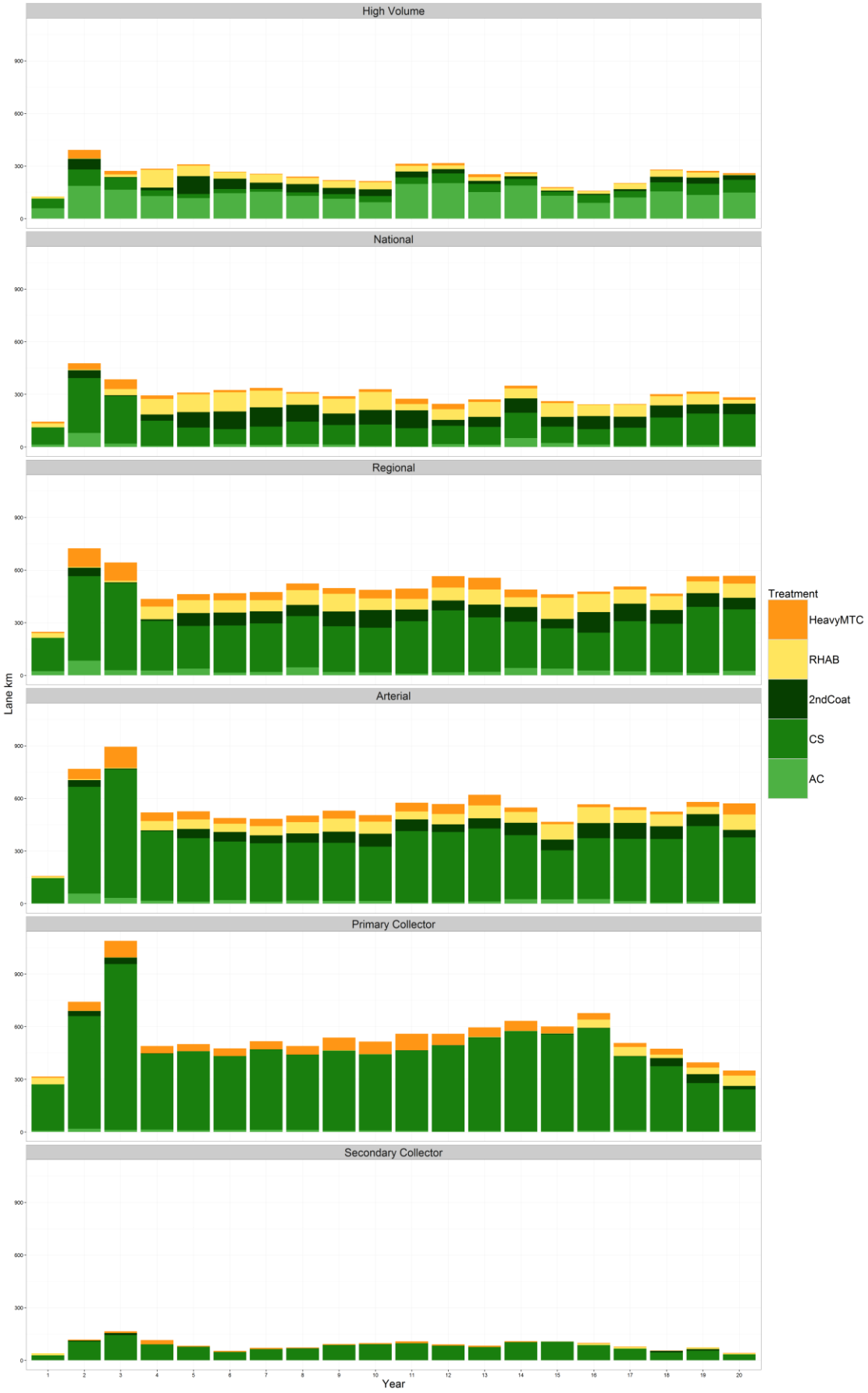
Lane km Birthday_V2 by ONRC



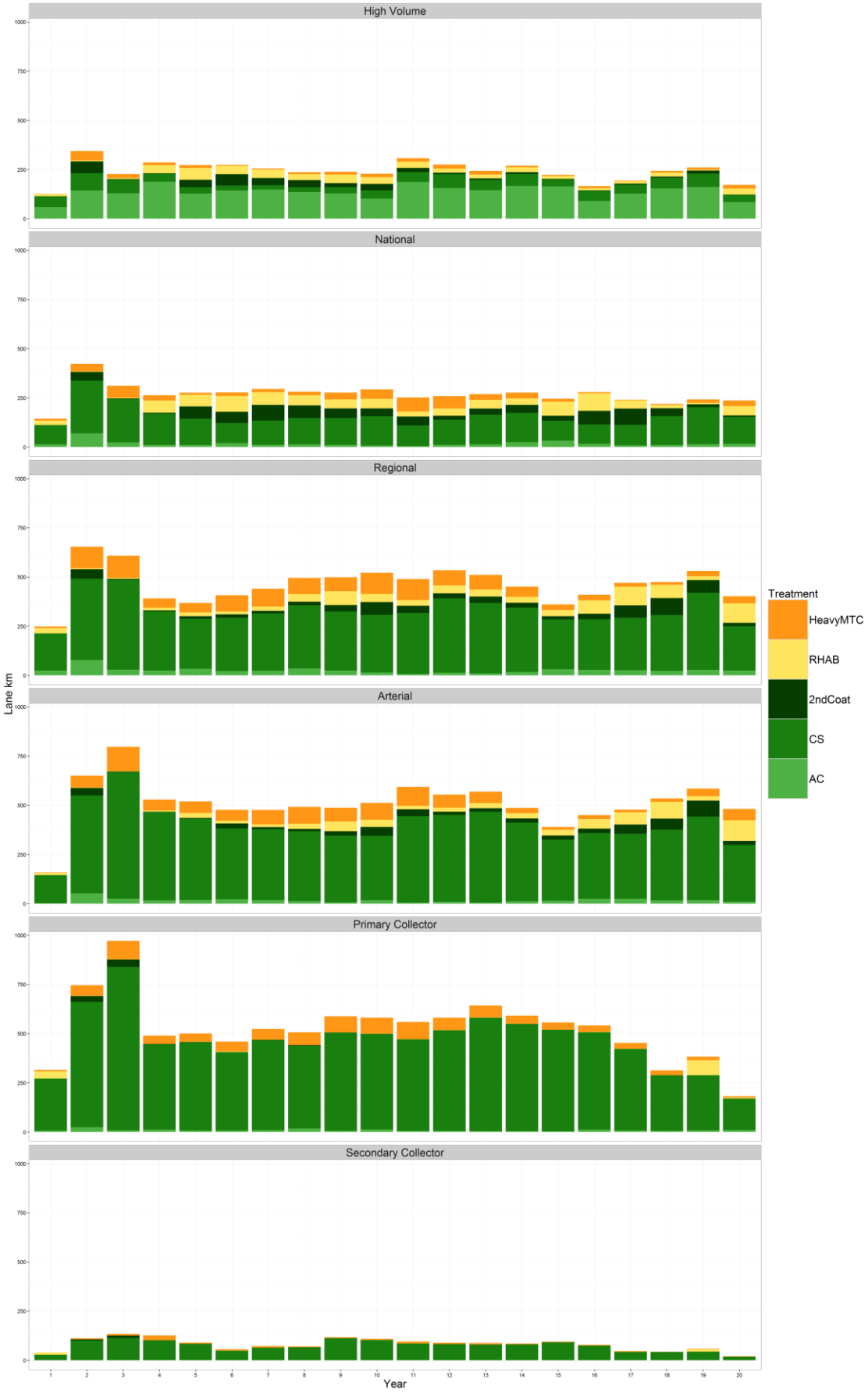
Lane km $120M_V2 by ONRC



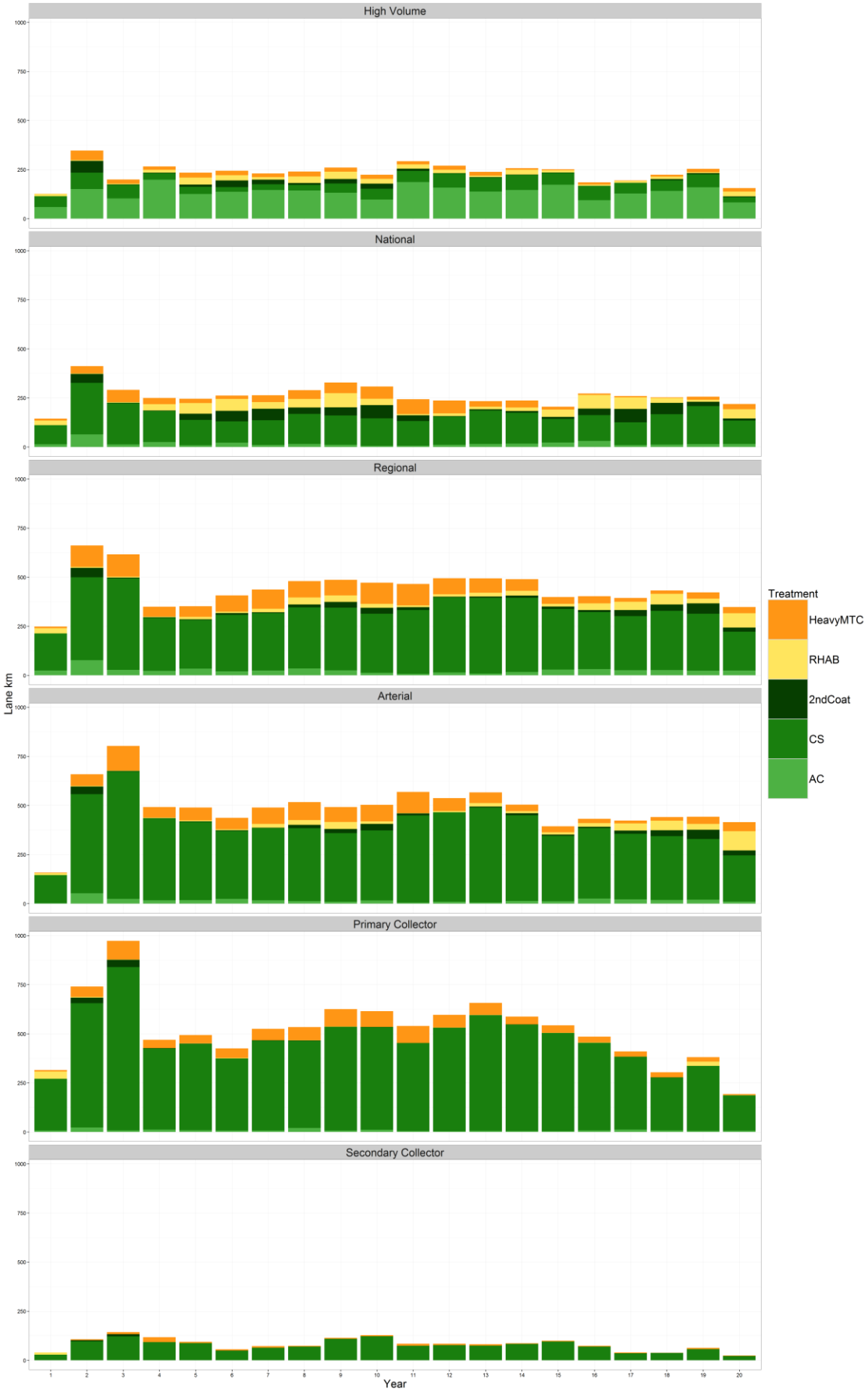
Lane km $110M_V2 by ONRC



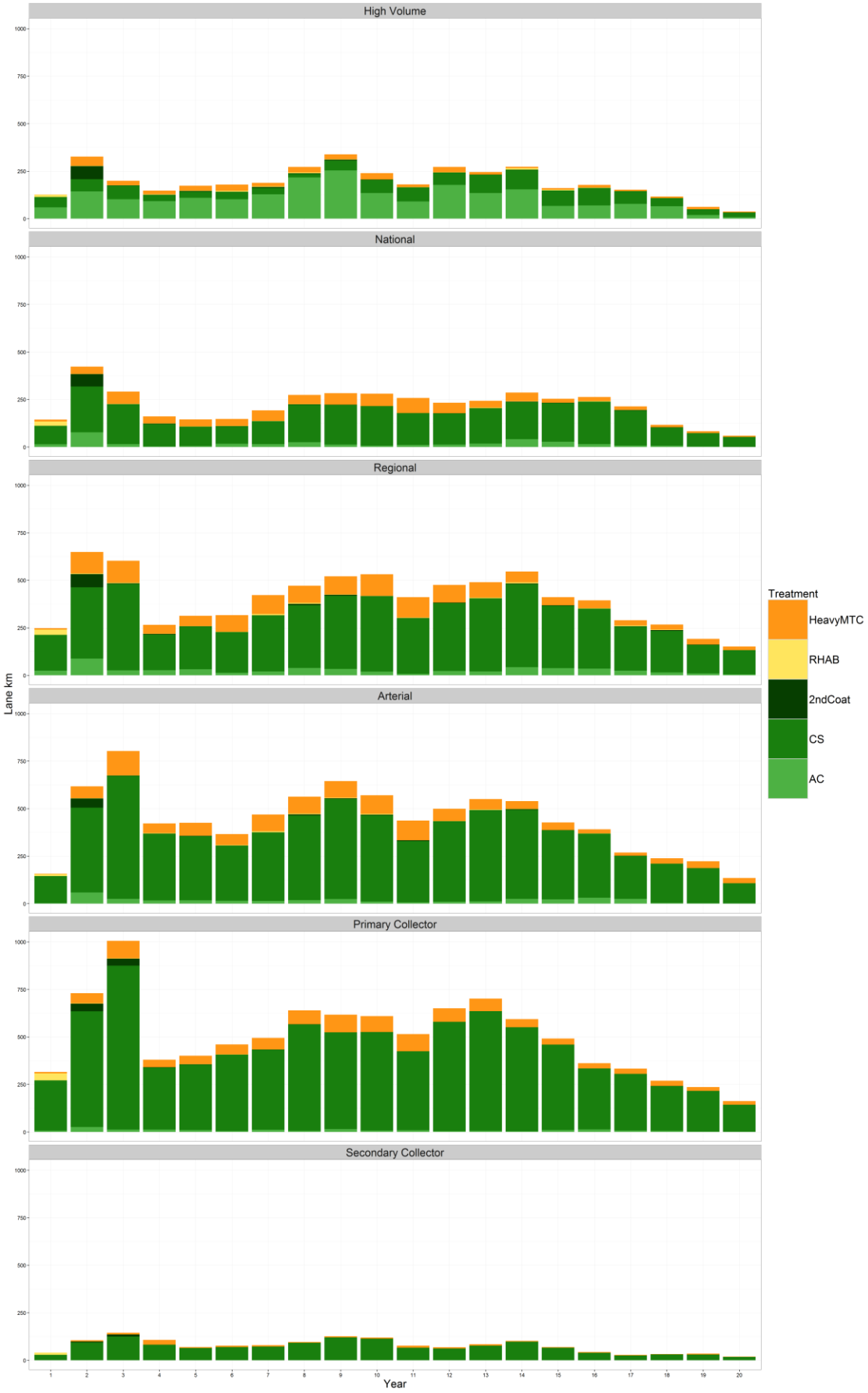
Lane km $90M_V2 by ONRC



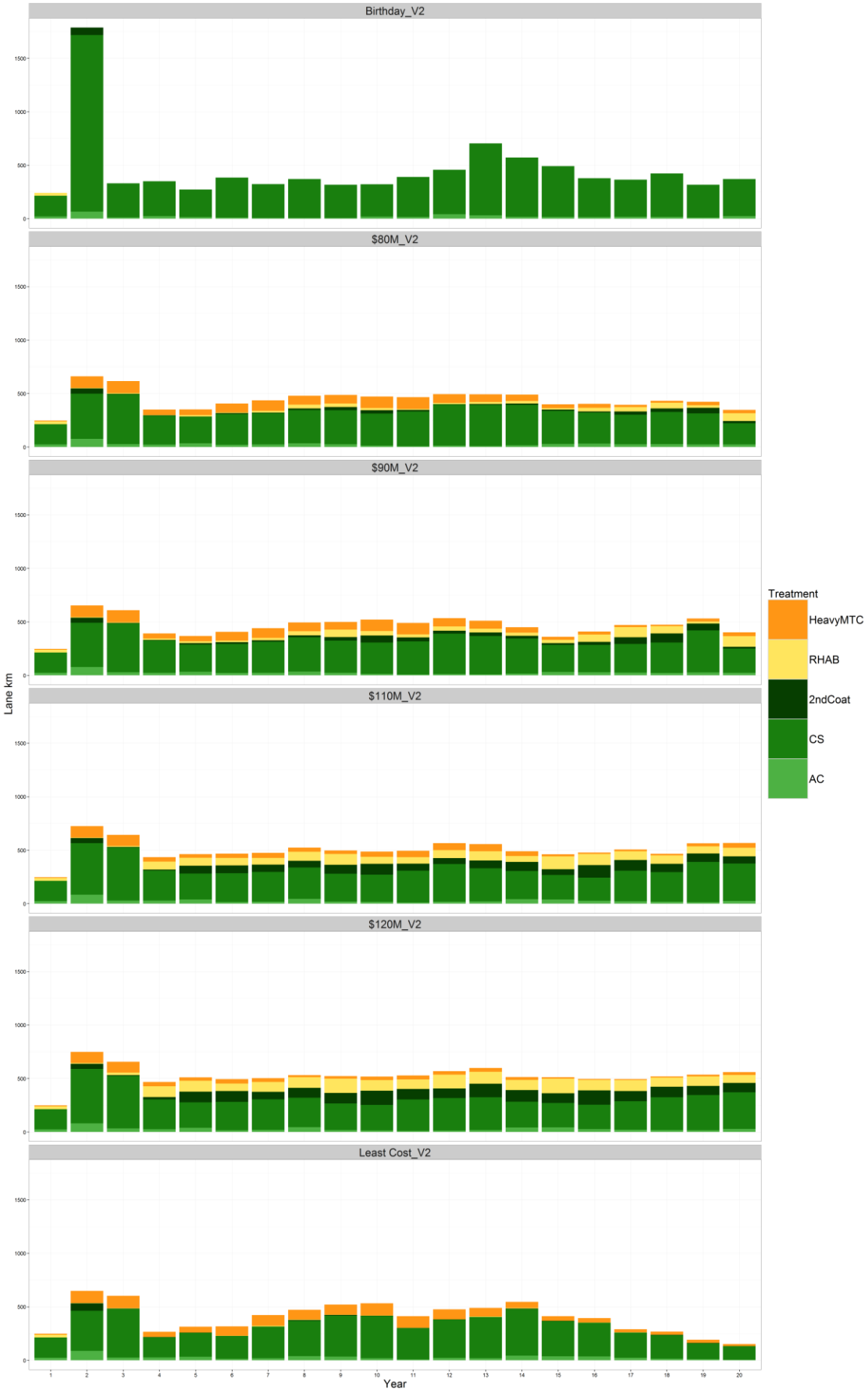
Lane km $80M_V2 by ONRC



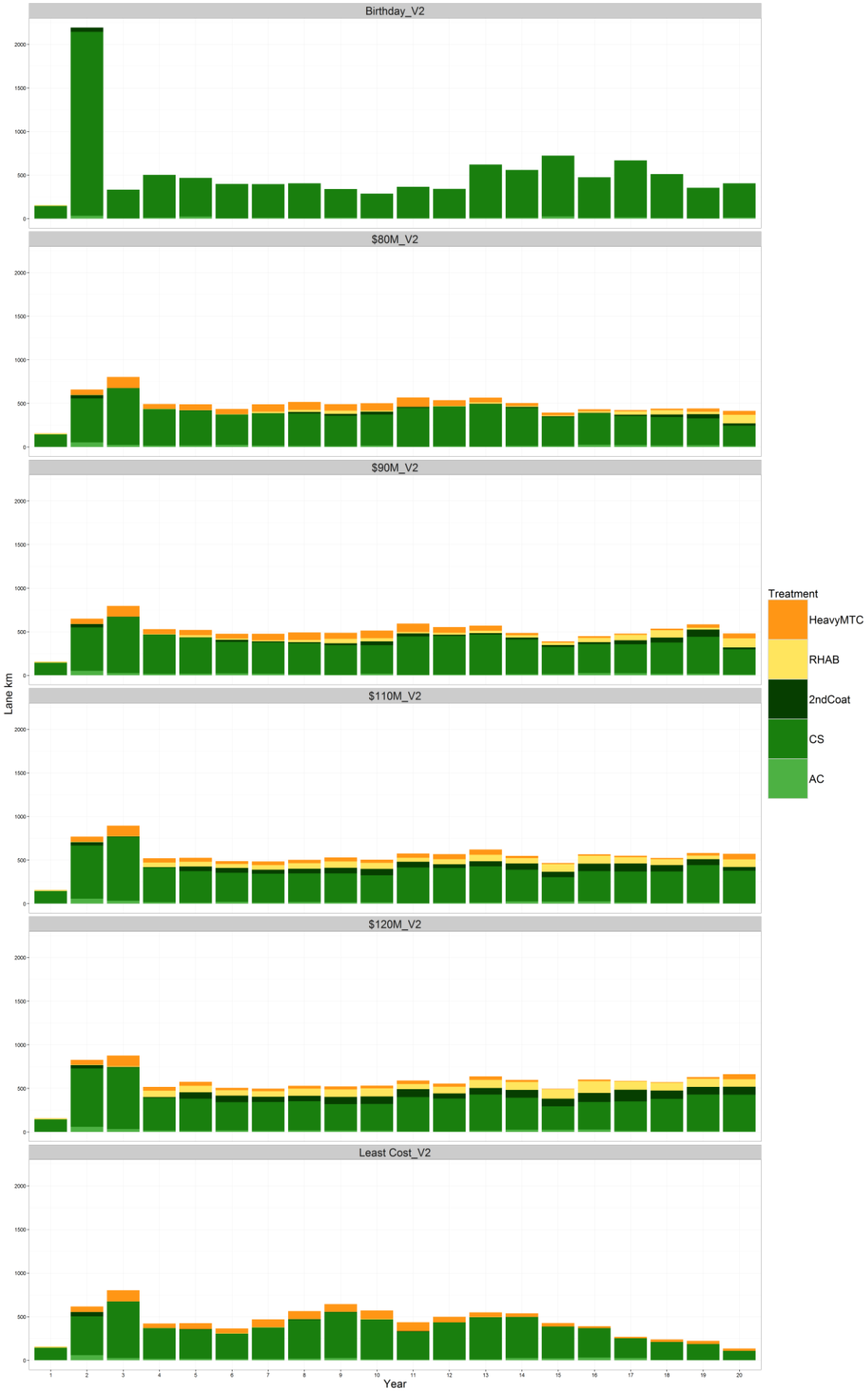
Lane km Least Cost_V2 by ONRC



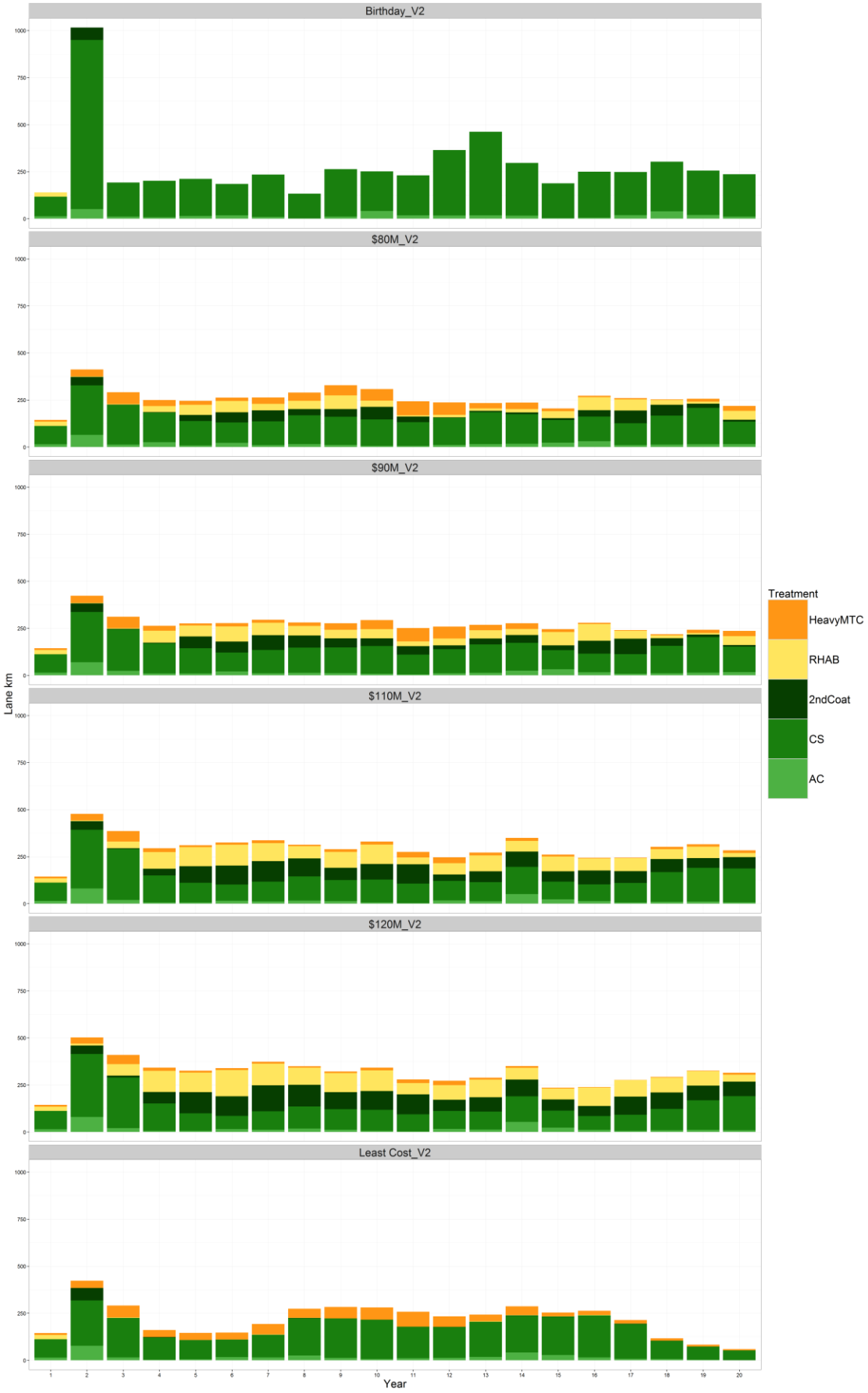
Lane km by ONRC - Regional



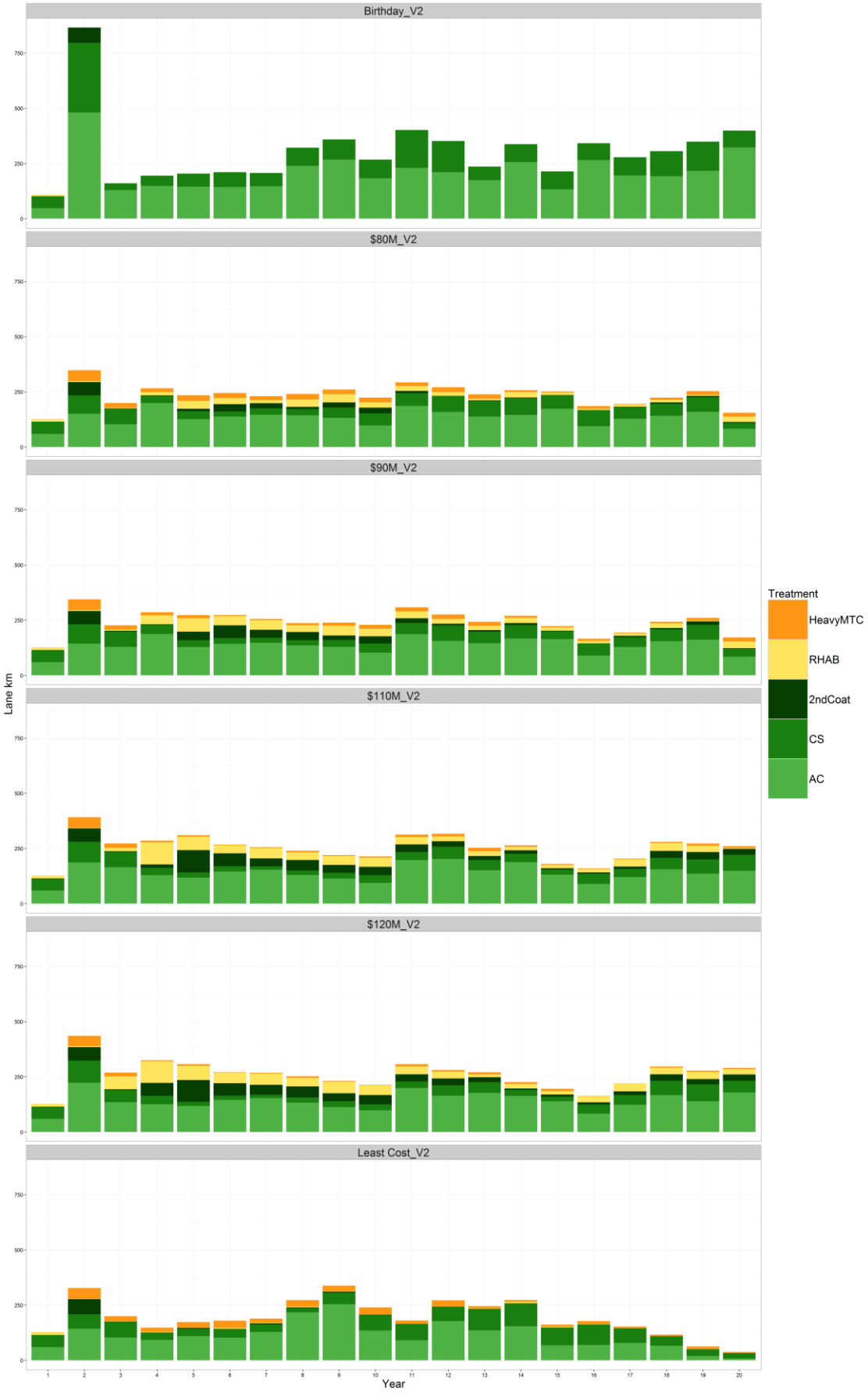
Lane km by ONRC - Arterial



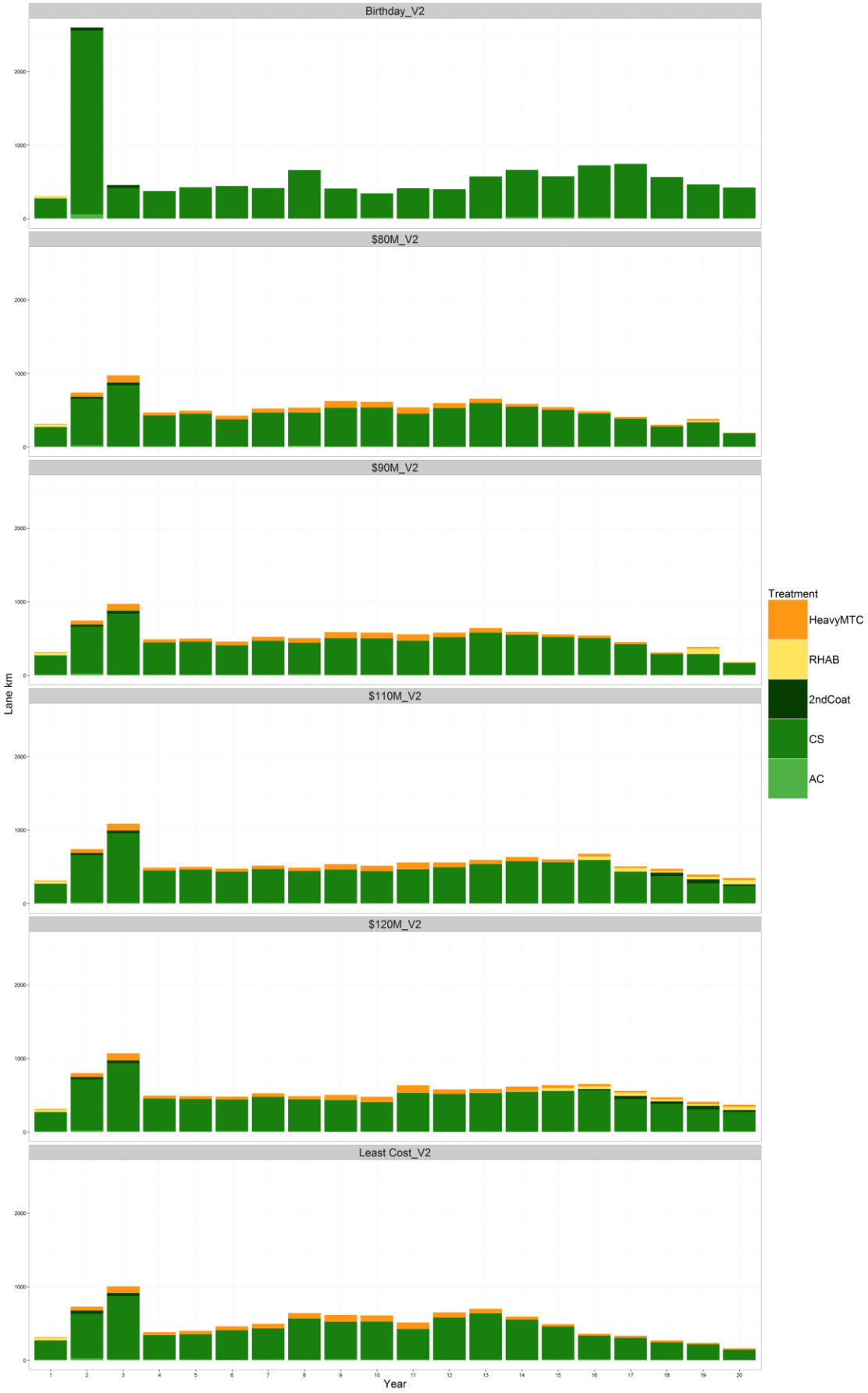
Lane km by ONRC - National



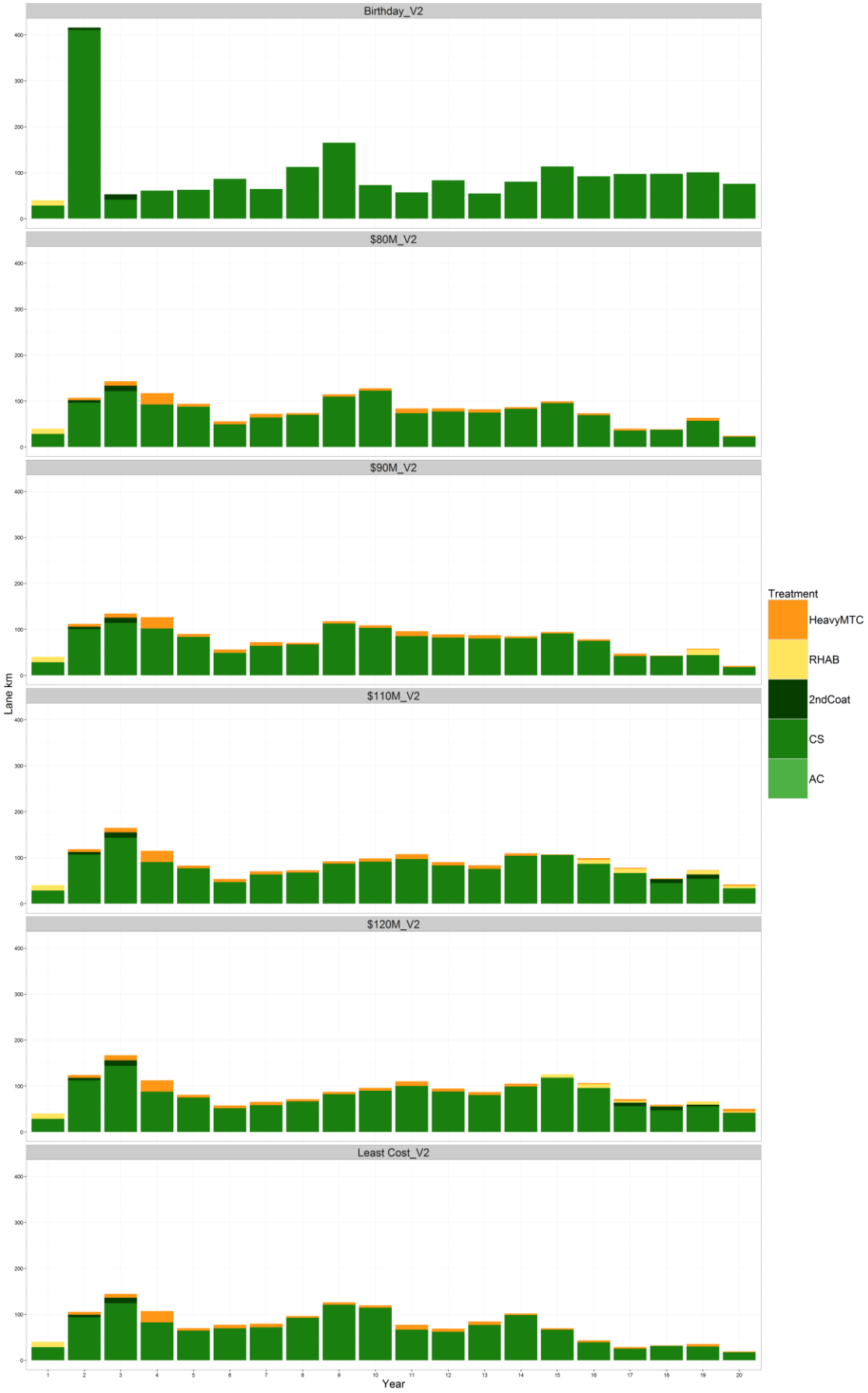
Lane km by ONRC - High Volume



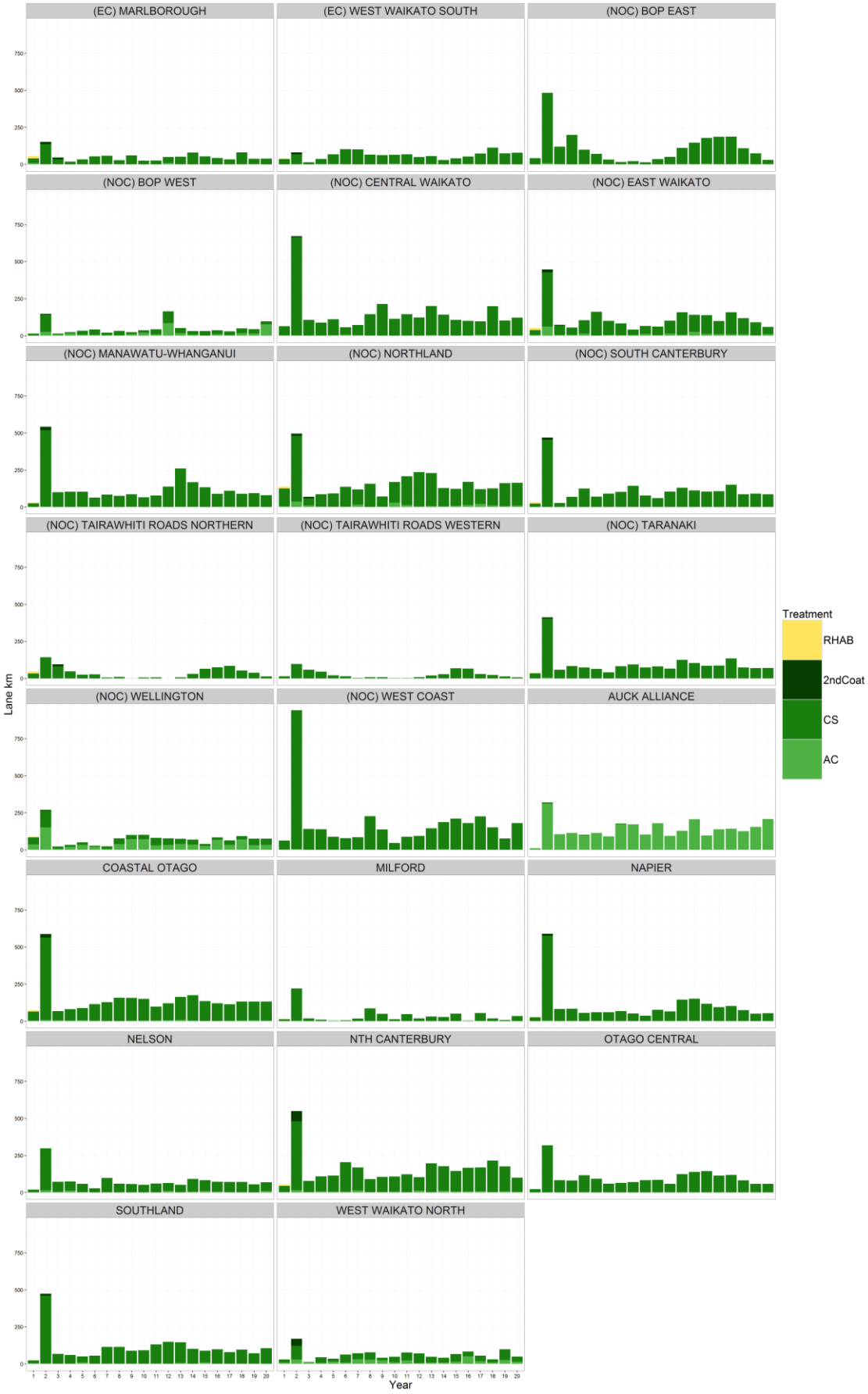
Lane km by ONRC - Primary Collector



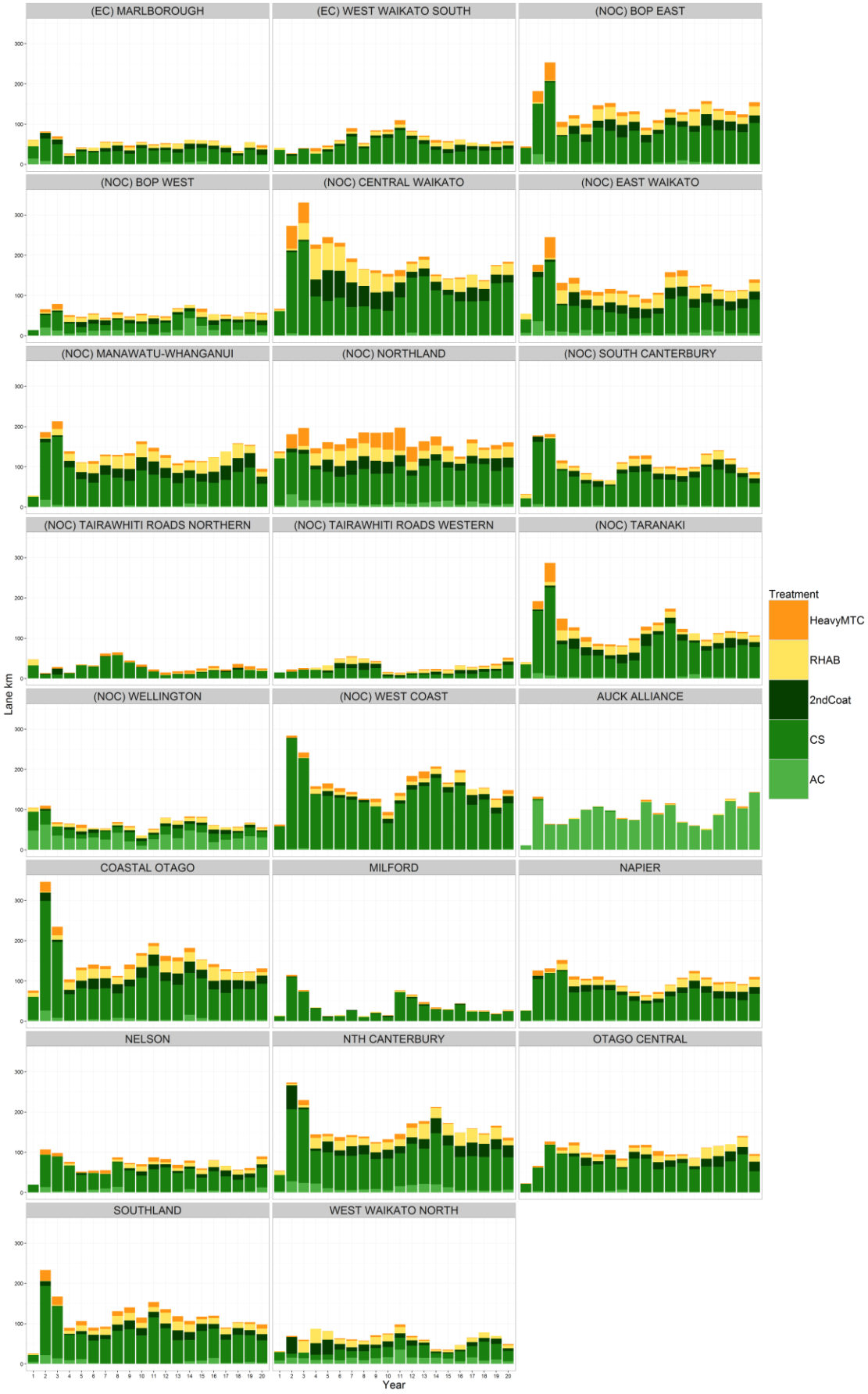
Lane km by ONRC - Secondary Collector



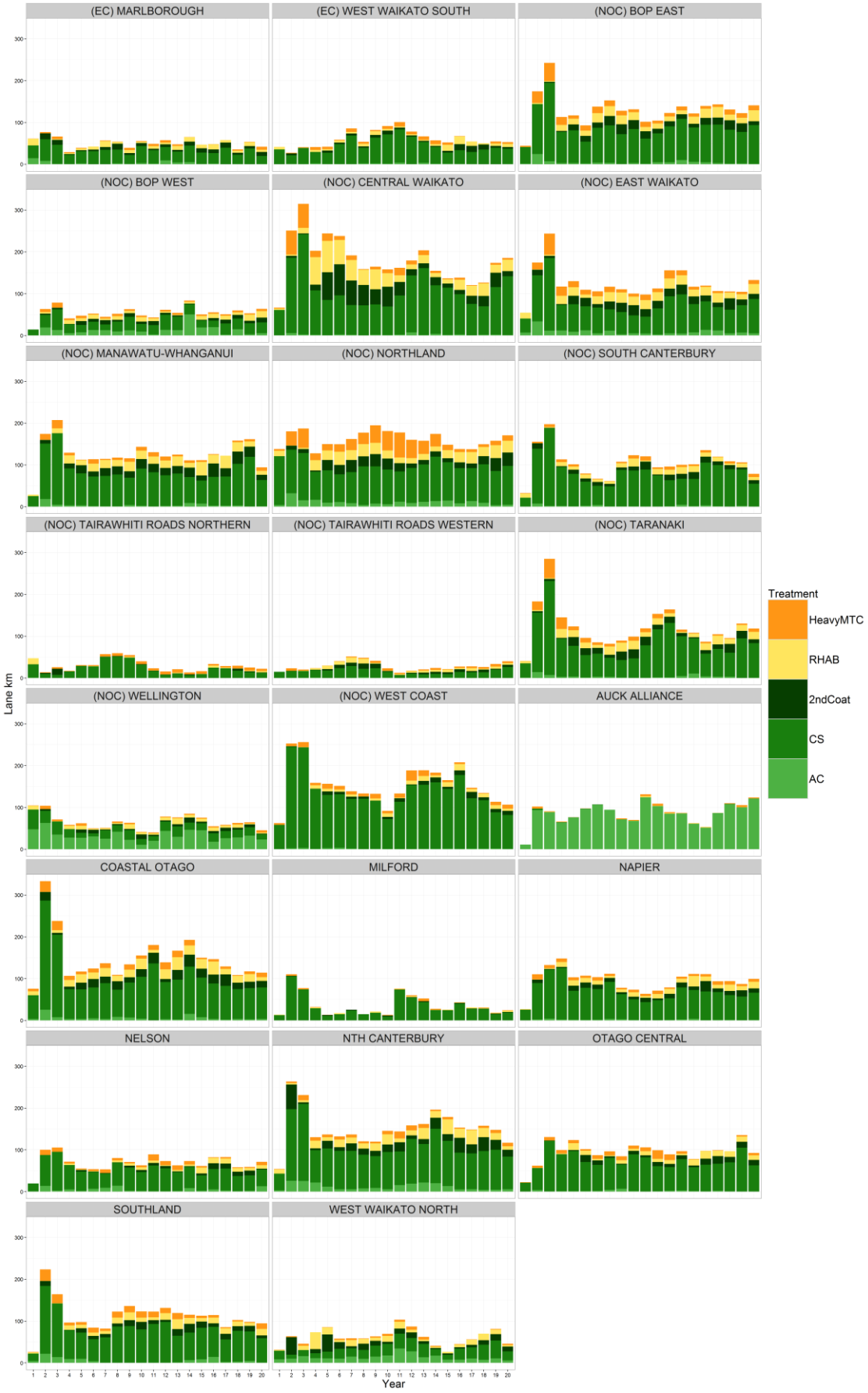
Lane km by NOC - Birthday_V2



Lane km by NOC - $120M_V2

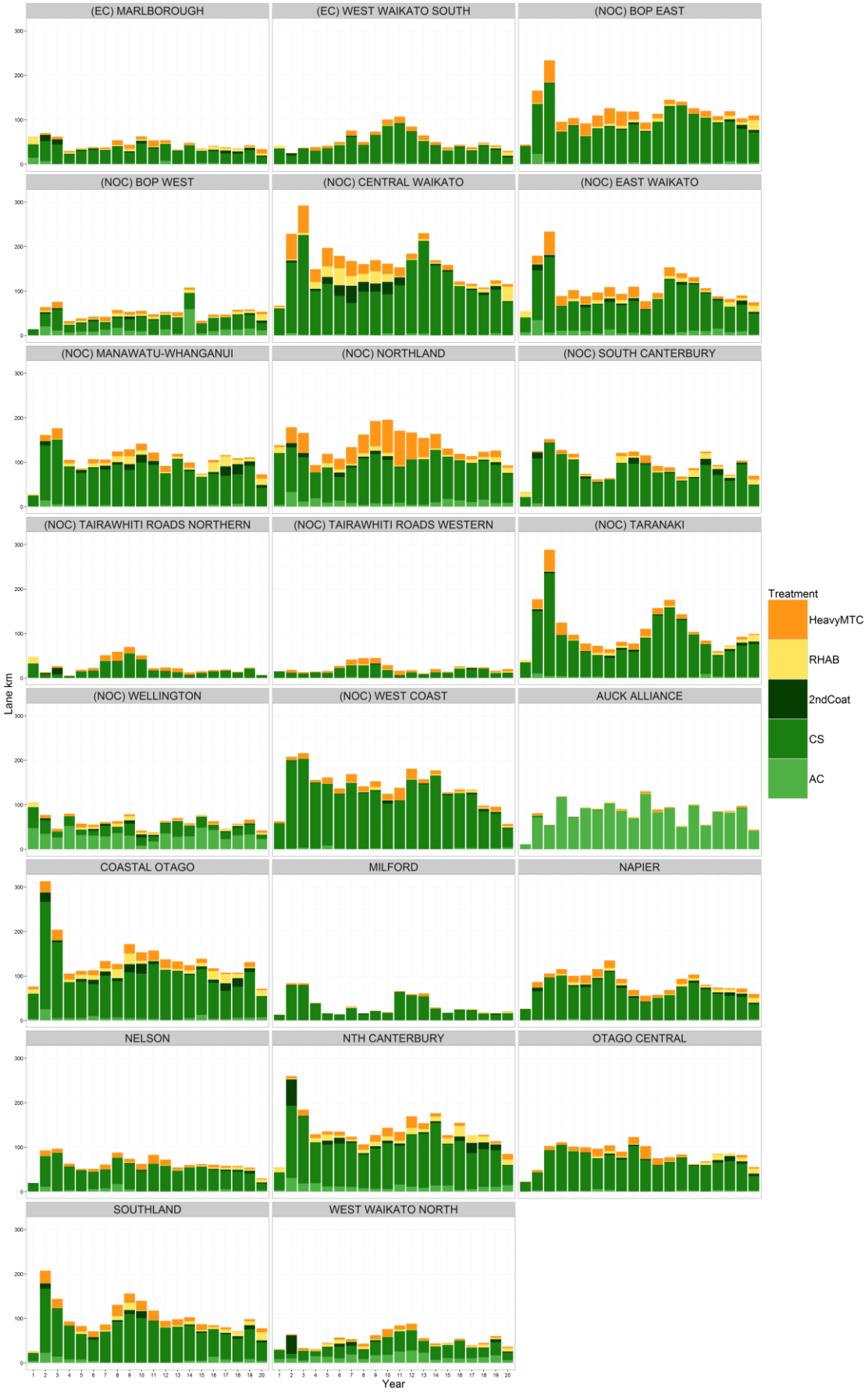


Lane km by NOC - $110M_V2



Lane km by NOC - $90M_V2

Lane km by NOC - $80M_V2



Lane km by NOC - Least Cost_V2

3.2 Cost Charts – Unlimited Routine Maintenance (V2)

This set of outputs includes Stacked Bar Charts showing predicted Treatment Cost ($ Million) for each Treatment Type

- Asphalt Surfacing - AC (light green)
- Chipseal Surfacing - CS (mid green), 2nd Coat (dark green)
- Pavement Rehabilitation - RHAB (yellow), Heavy Maintenance (orange)
- Safety (where applicable – red)
- Routine Maintenance – RTNE (light blue), Pre Reseal Repairs – PSEAL (dark blue)

The first Chart/Table compares the seven (7) 'Unlimited RM Options as a 20 Year National Average National Average Annual Cost ($ Million)

- **Birthday_V2**
  - Treatments triggered when useful life is reached, does not try and meet Levels of Service
  - Renewal Investment: **Unlimited,** Routine Investment: **$30M pa**
  - Safety Investment: Safety not Included
- **$80M_V2**
  - Renewal Investment: Fixed **$80M** pa, Routine Investment: **$30M pa**
  - Safety Investment: Safety not Included
- **$90M_V2**
  - Renewal Investment: Fixed **$90M** pa, Routine Investment: **$30M pa**
  - Safety Investment: Safety not Included
- **$100M_V2**
  - Renewal Investment: Fixed **$100M** pa, Routine Investment: **$30M pa**
  - Safety Investment: Safety not Included
- **$110M_V2**
  - Renewal Investment: Fixed **$110M** pa, Routine Investment: **$30M pa**
  - Safety Investment: Safety not Included
- **$120M_V2**
  - Renewal Investment: Fixed **$120M** pa, Routine Investment: **$30M pa**
  - Safety Investment: Safety not Included
- **Least Cost_V2**
  - Generates the lowest overall cost treatment programme considering Renewal and Routine Investment – disallowing Do Nothing. Does not try and meet Levels of Service.
  - Safety Investment: Safety not Included

The second series compares the six (6) ONRC Classes as time series over 20 years for each 'Fixed RM Options.

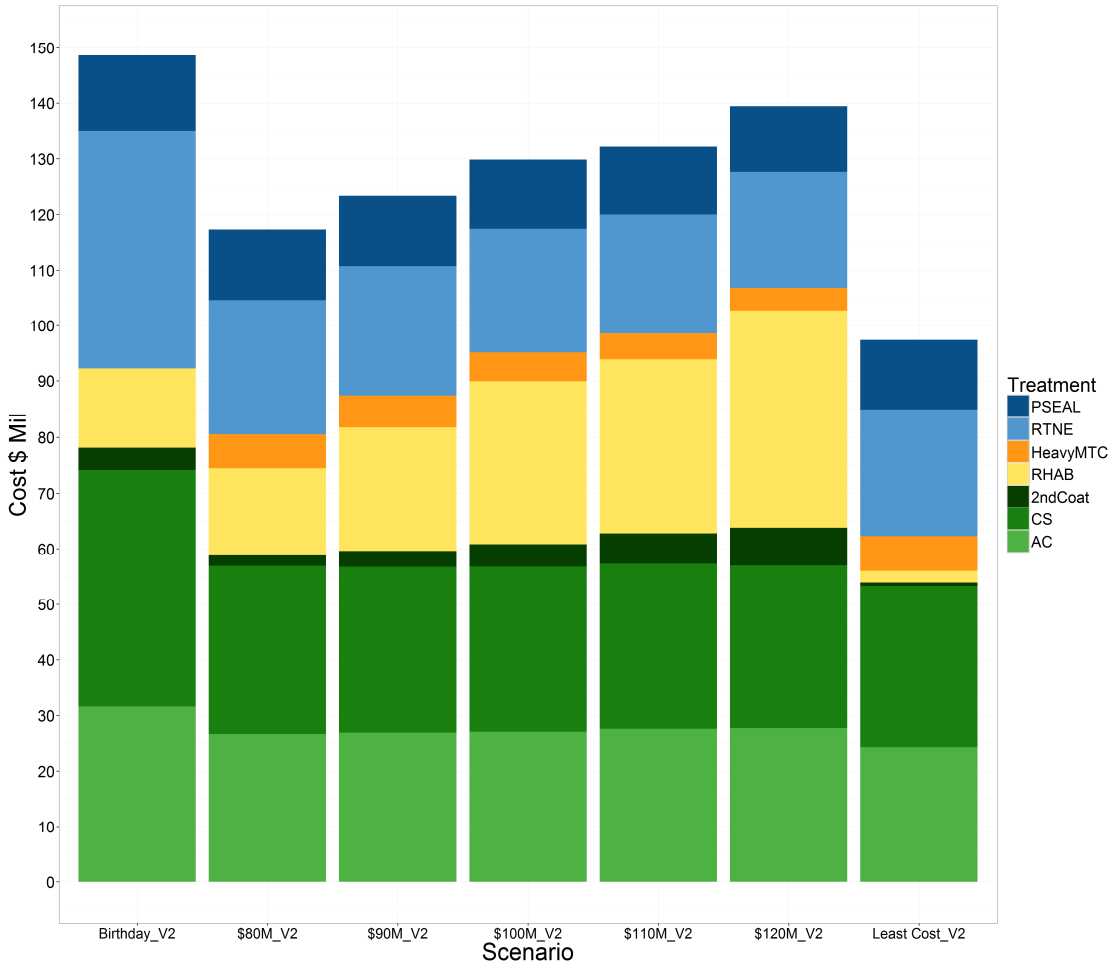
- Secondary Collector, Primary Collector
- Arterial, Regional
- National, National High Volume

The third series compares the 'Fixed RM Options' by ONRC Class as time series over 20 years

The fourth series compares the twenty three (23) Regions as time series over 20 years for each 'Fixed RM Option'.

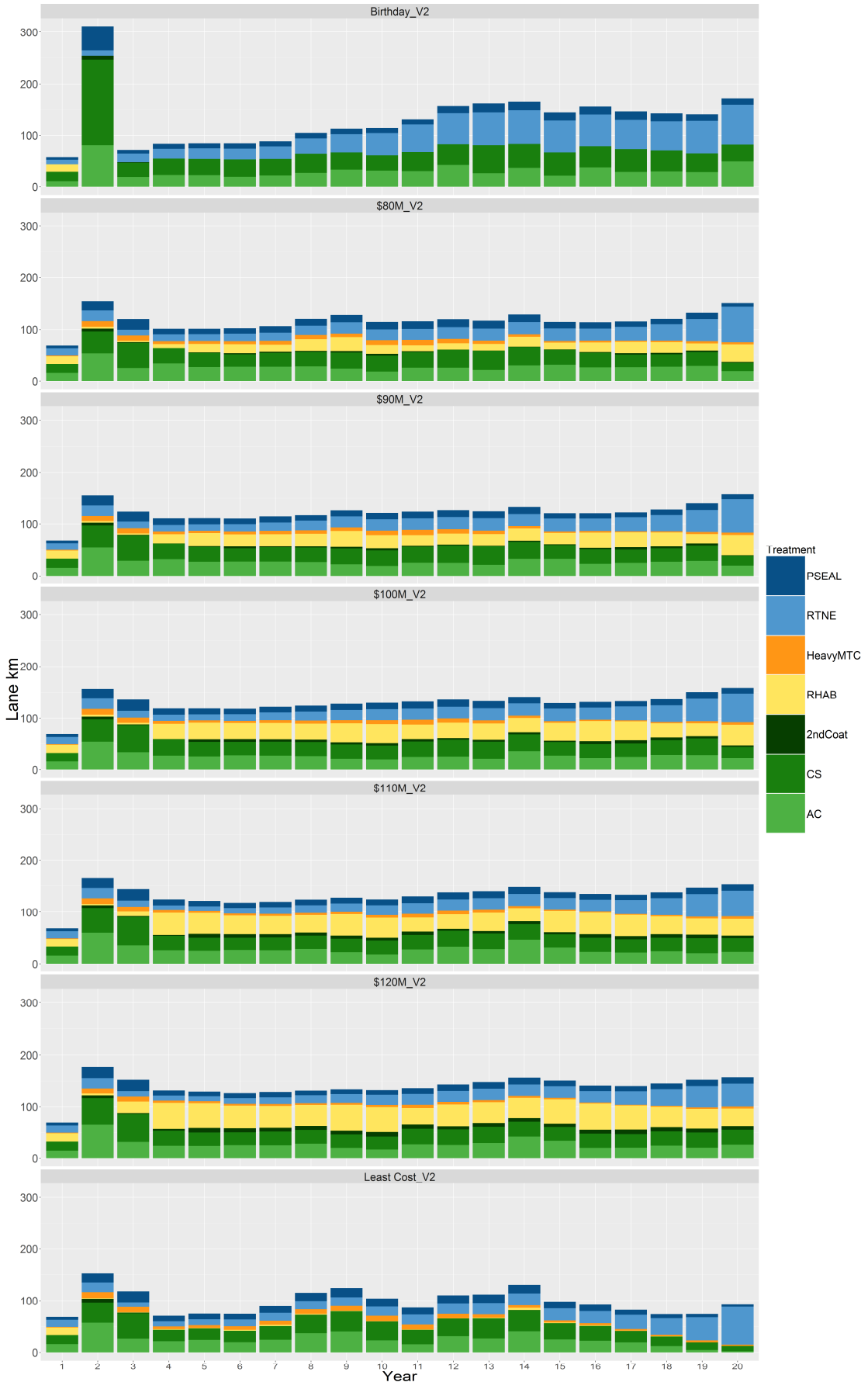
Costs

National 20 Year Average Annual Cost

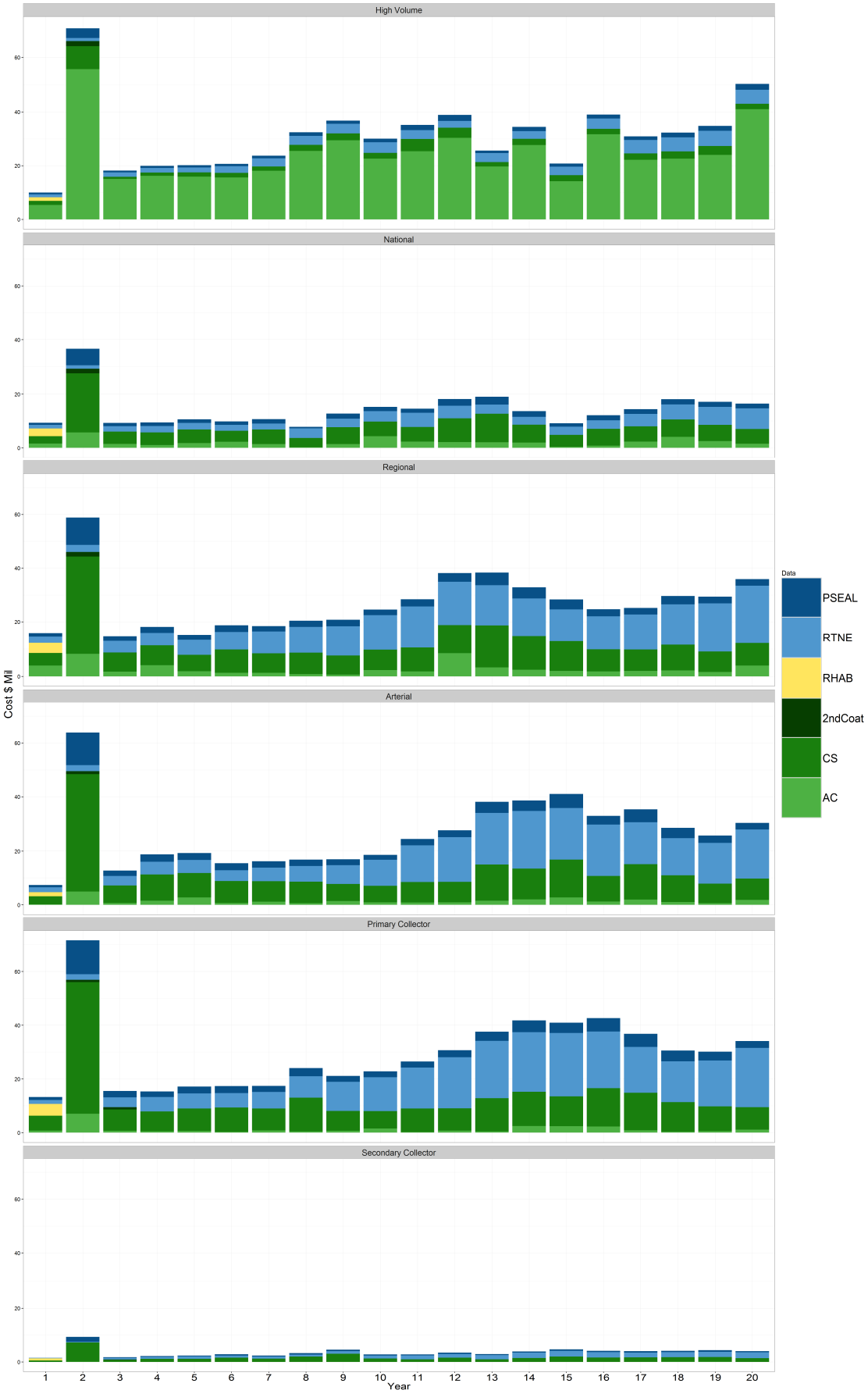


	Birthday_V2	$80M_V2	$90M_V2	$100M_V2	$110M_V2	$120M_V2	Least Cost_V2
AC	31.59	26.74	26.96	27.15	27.67	27.75	24.25
CS	42.53	30.18	29.78	29.64	29.65	29.23	29.1
2ndCoat	4.05	1.86	2.85	4.03	5.42	6.77	0.6
RHAB	14.21	15.67	22.11	29.1	31.21	38.94	2.09
HeavyMTC	0	6.05	5.66	5.27	4.63	4.02	6.23
RTNE	42.7	24.03	23.37	22.3	21.42	20.96	22.61
PSEAL	13.55	12.82	12.57	12.35	12.14	11.77	12.57

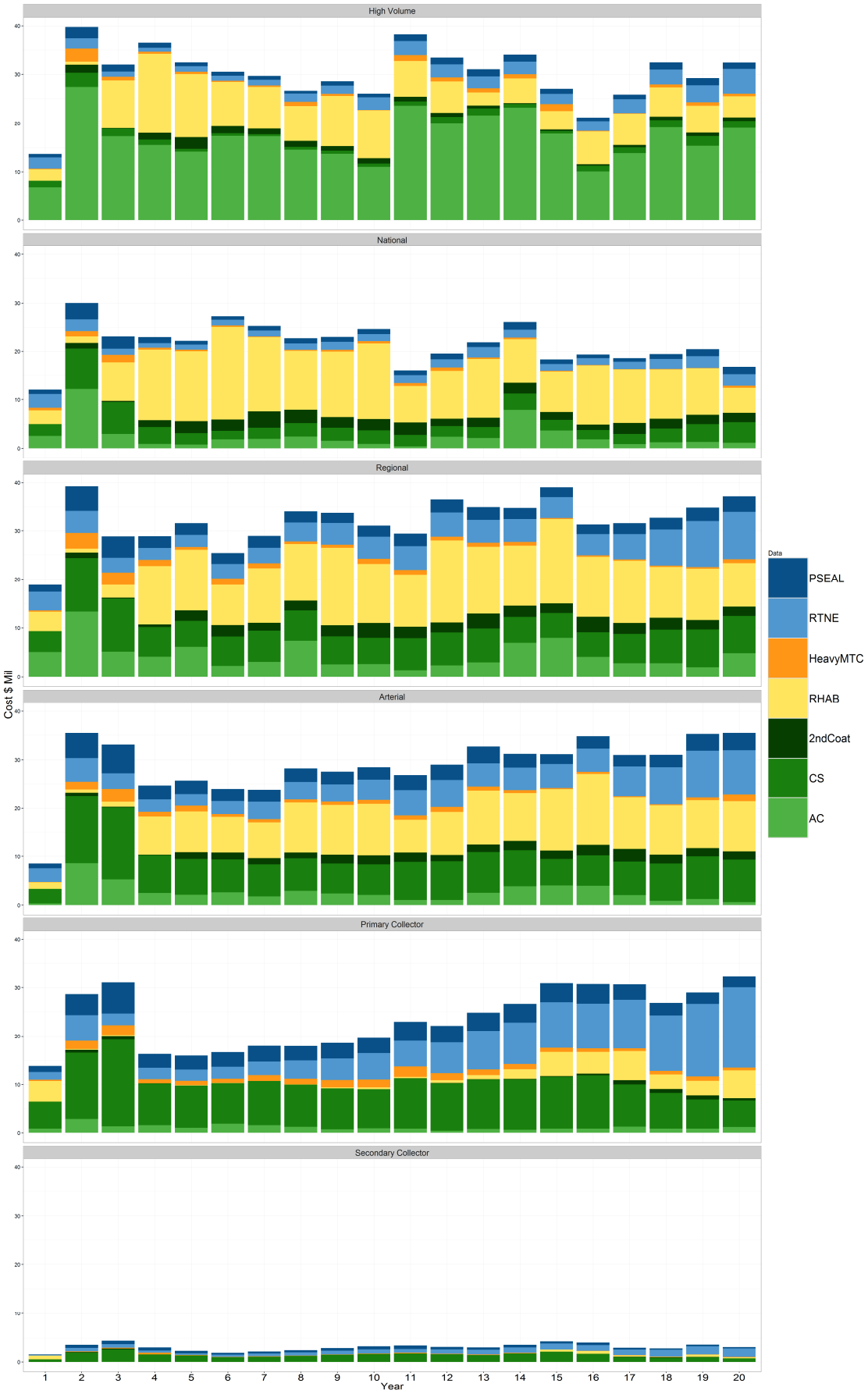
National Total Network Cost $ Mil



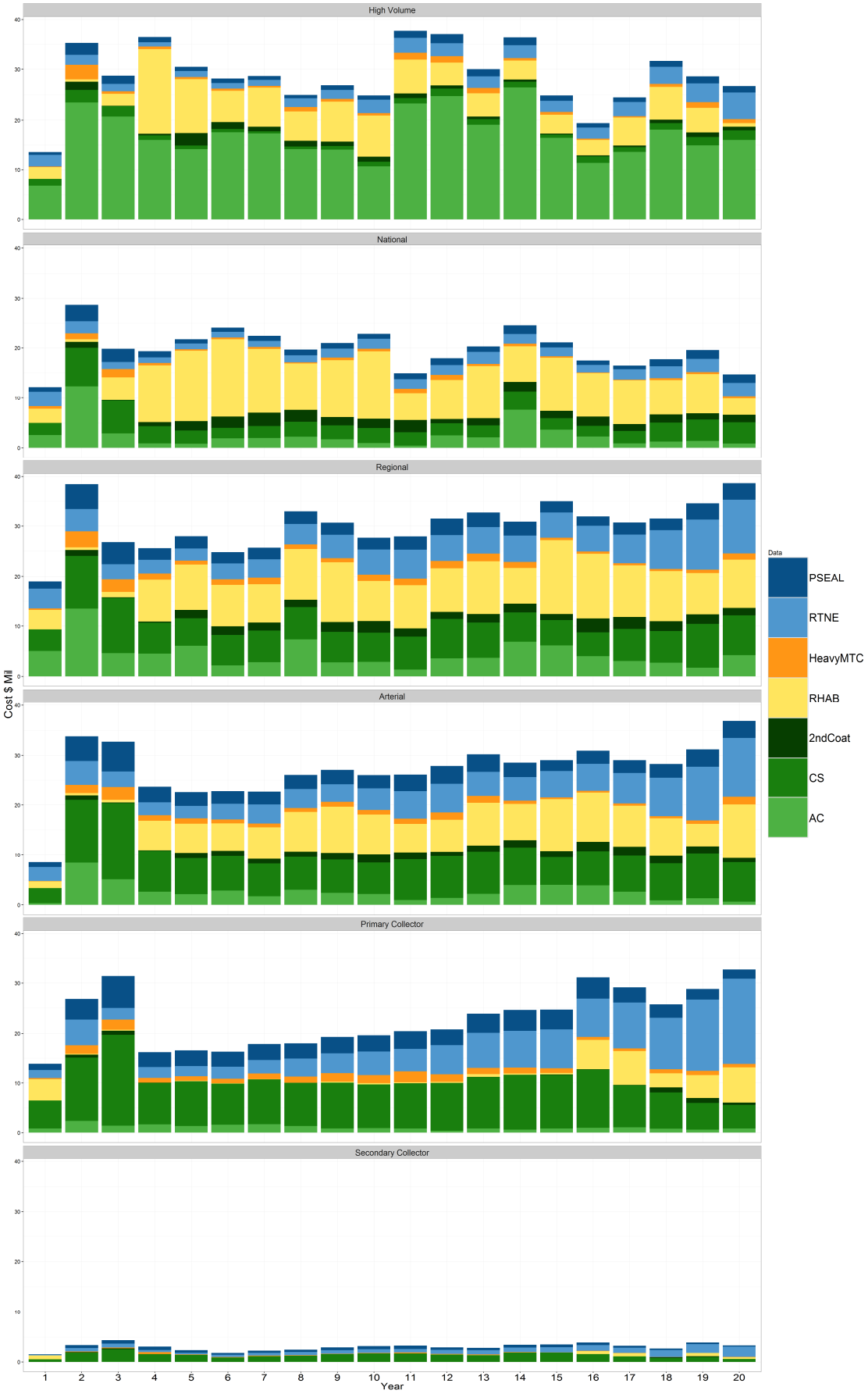
Cost $ Mil Birthday_V2 by ONRC



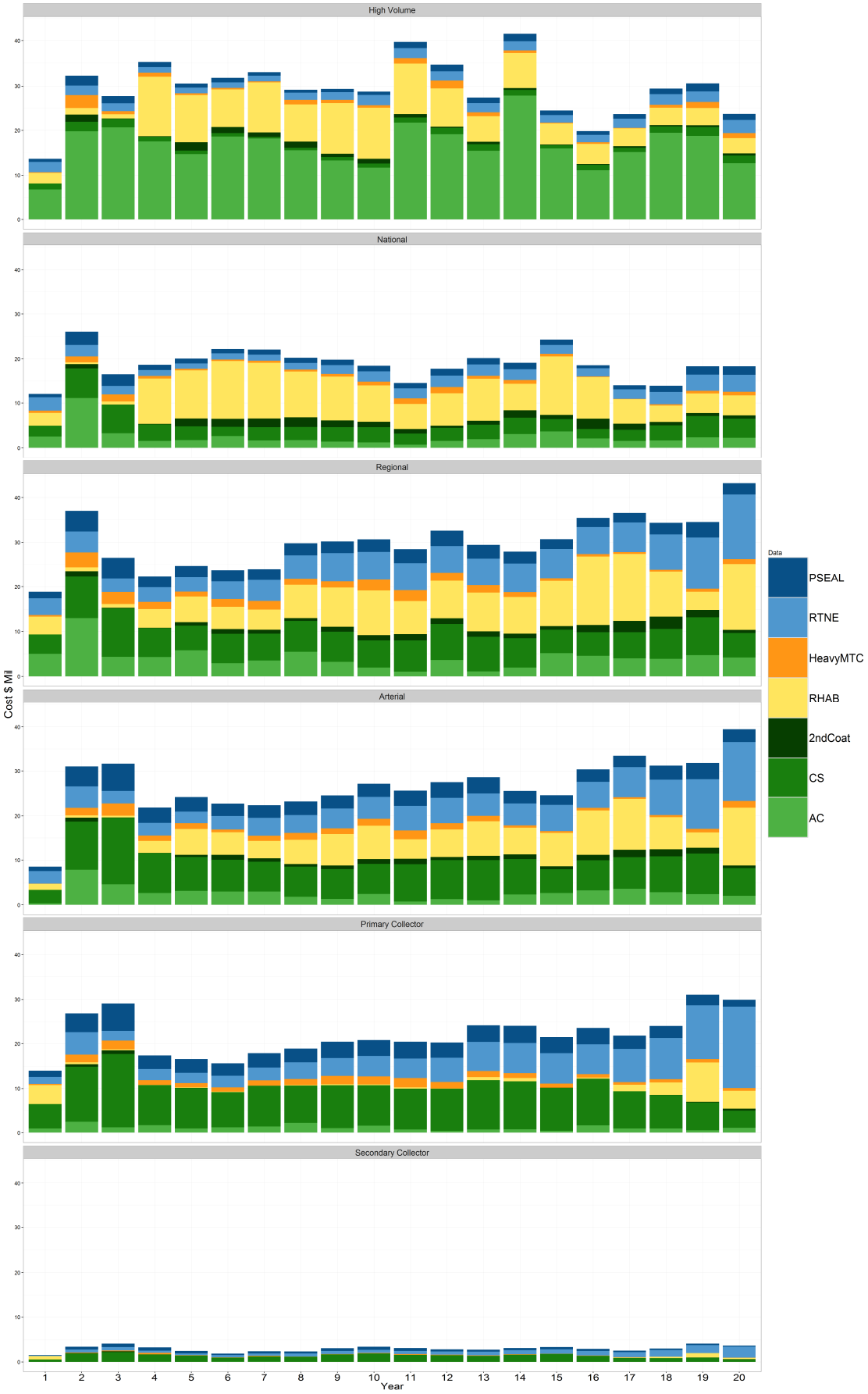
Cost $ Mil $120M_V2 by ONRC



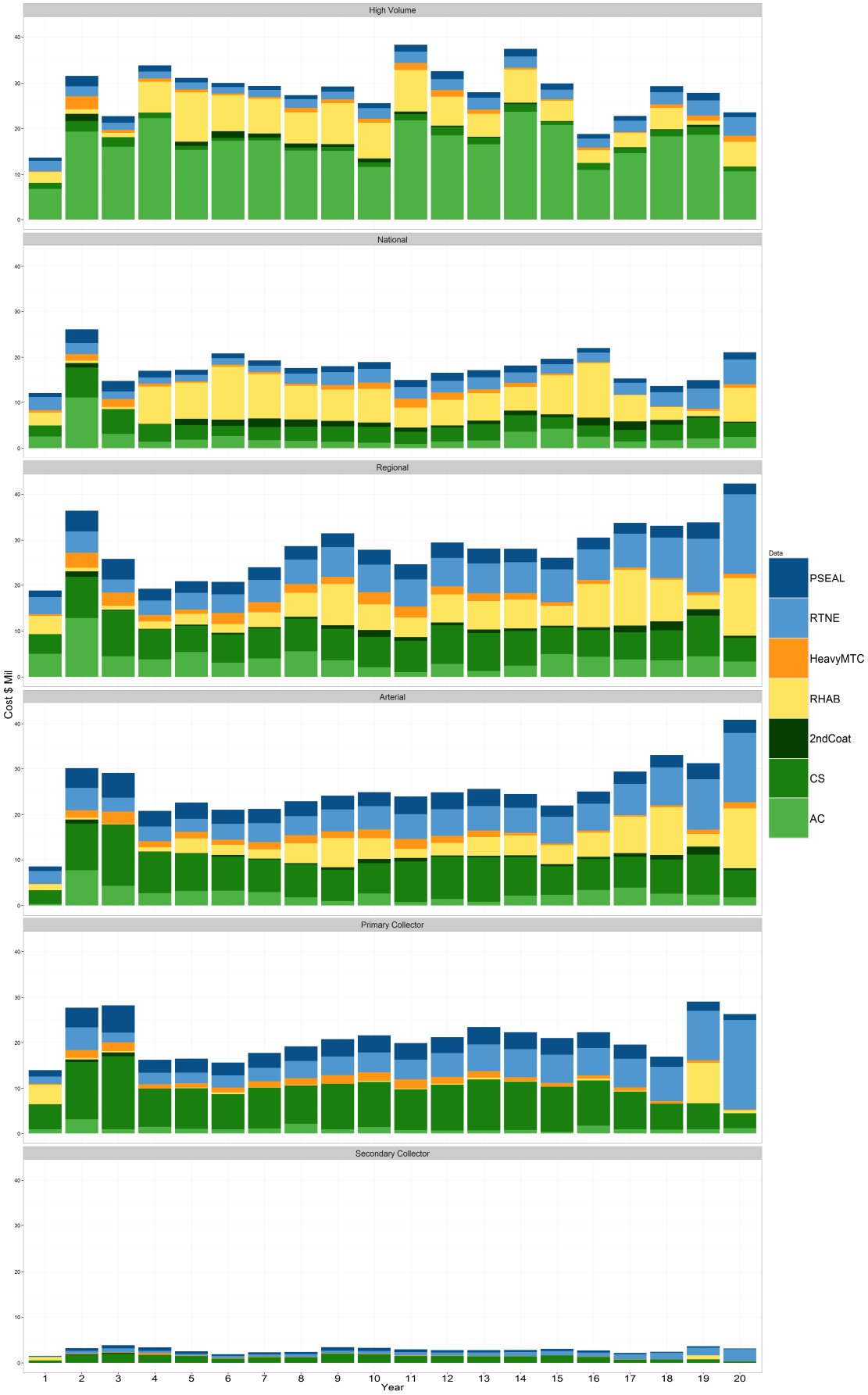
Cost $ Mil $110M_V2 by ONRC



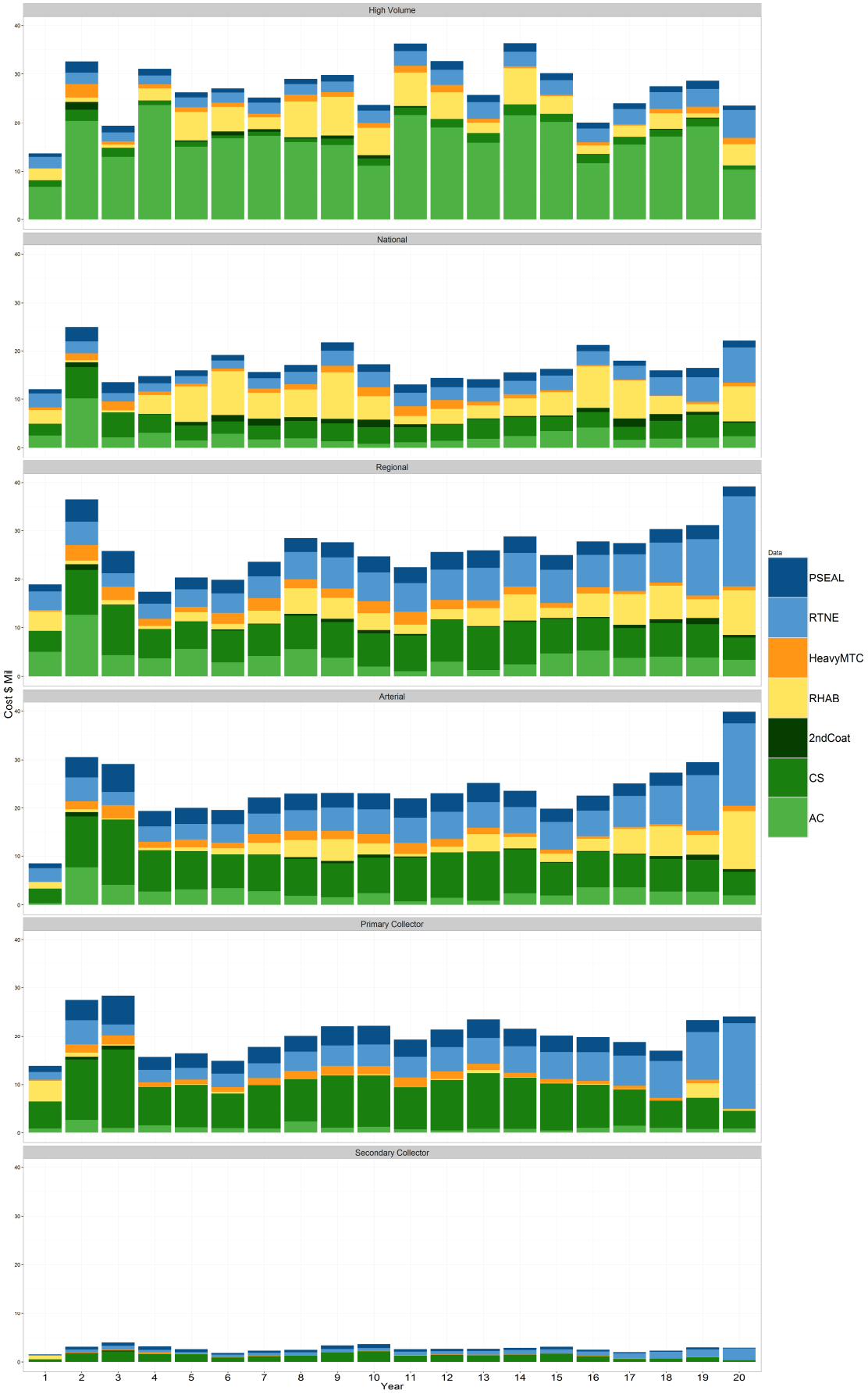
Cost $ Mil $100M_V2 by ONRC



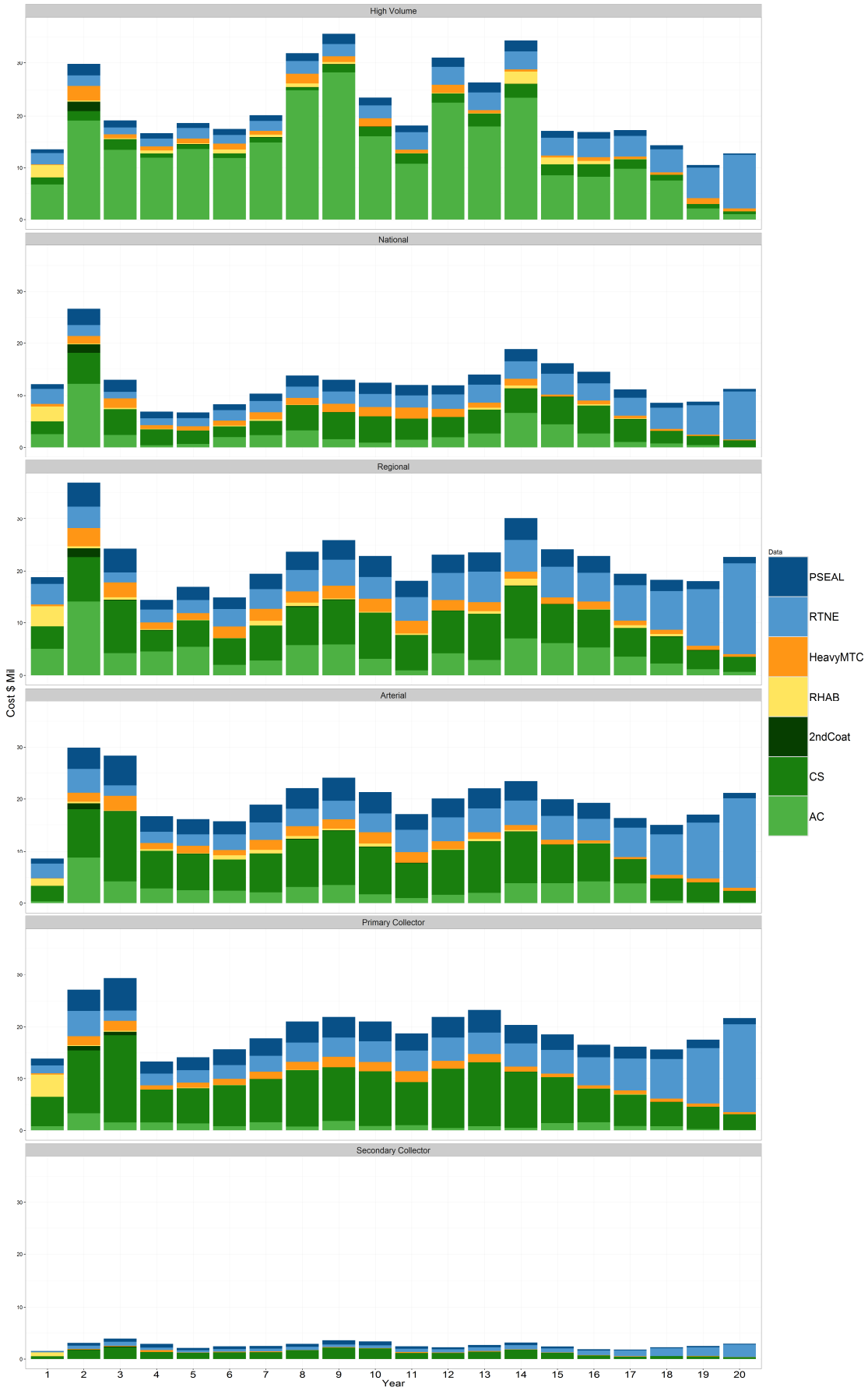
Cost $ Mil $90M_V2 by ONRC



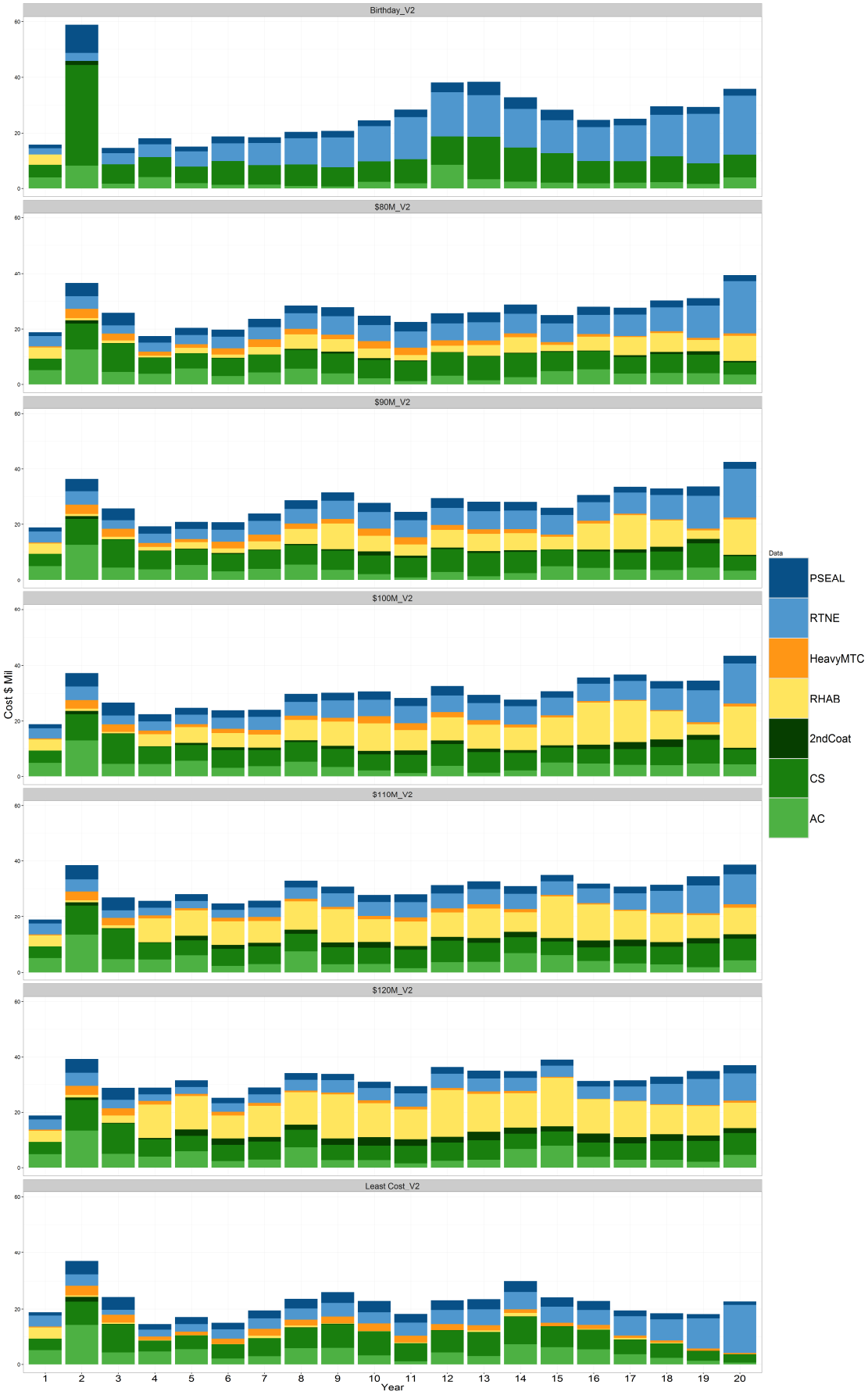
Cost $ Mil $80M_V2 by ONRC



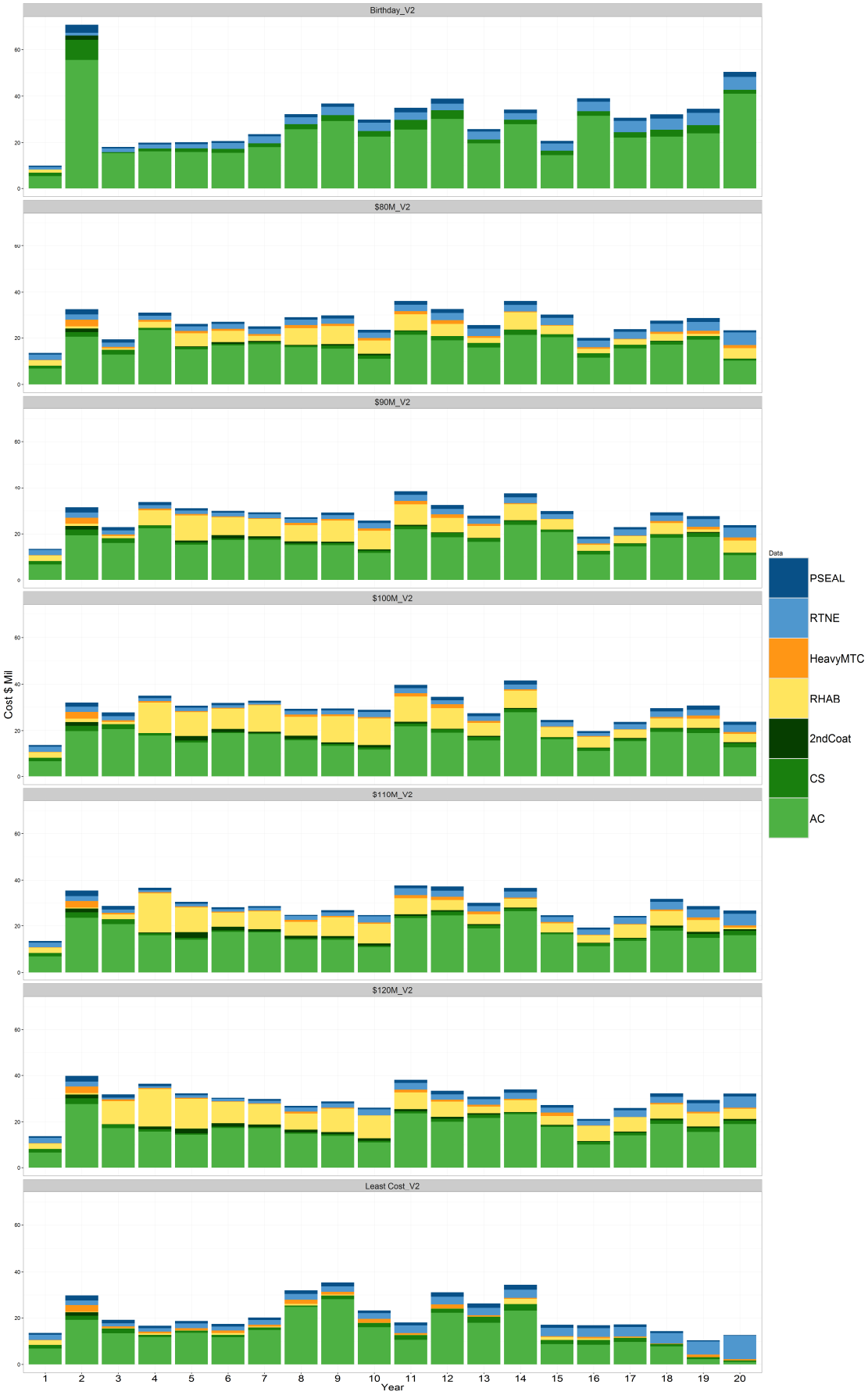
Cost $ Mil Least Cost_V2 by ONRC



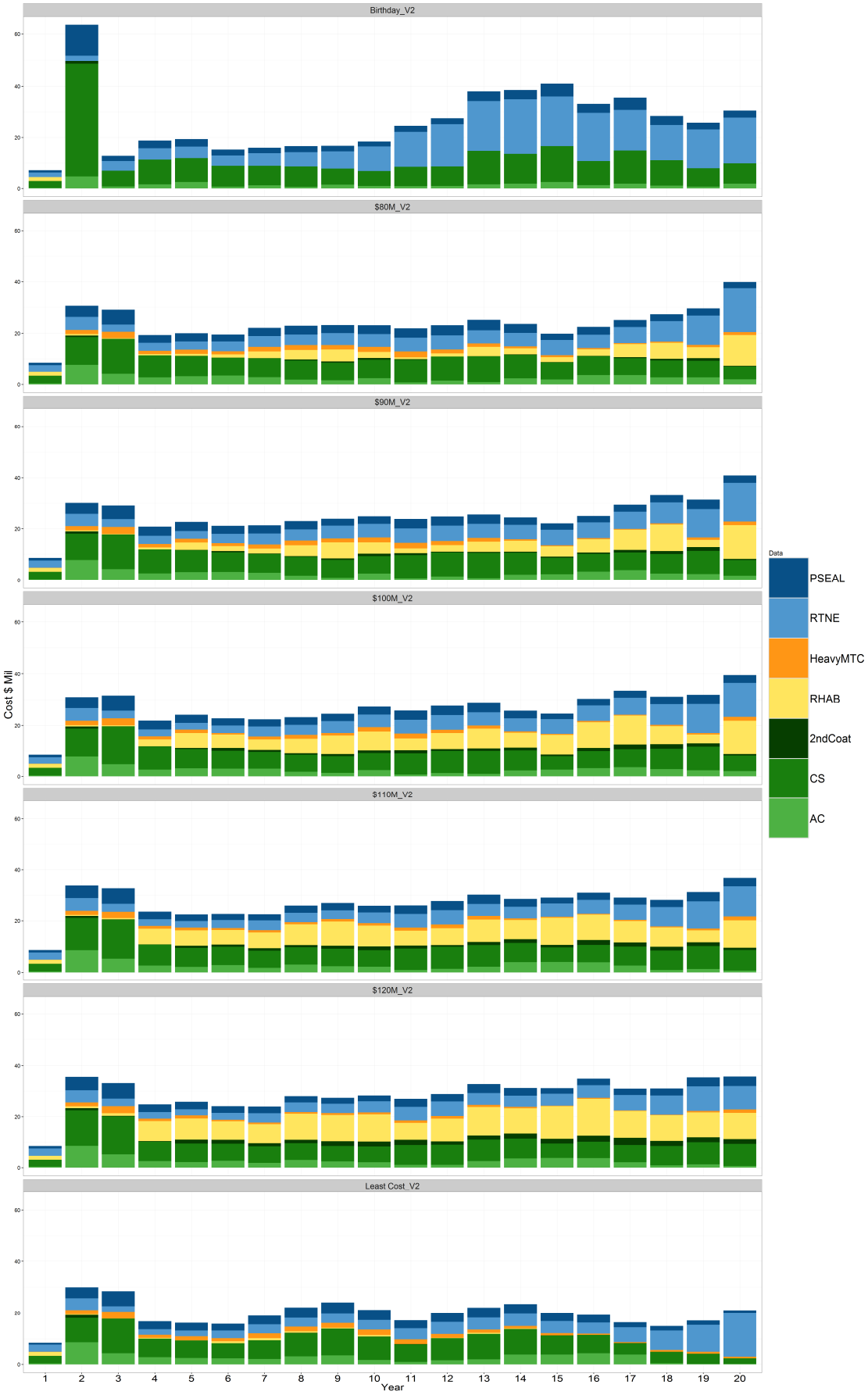
Cost $ Mil by ONRC - Regional



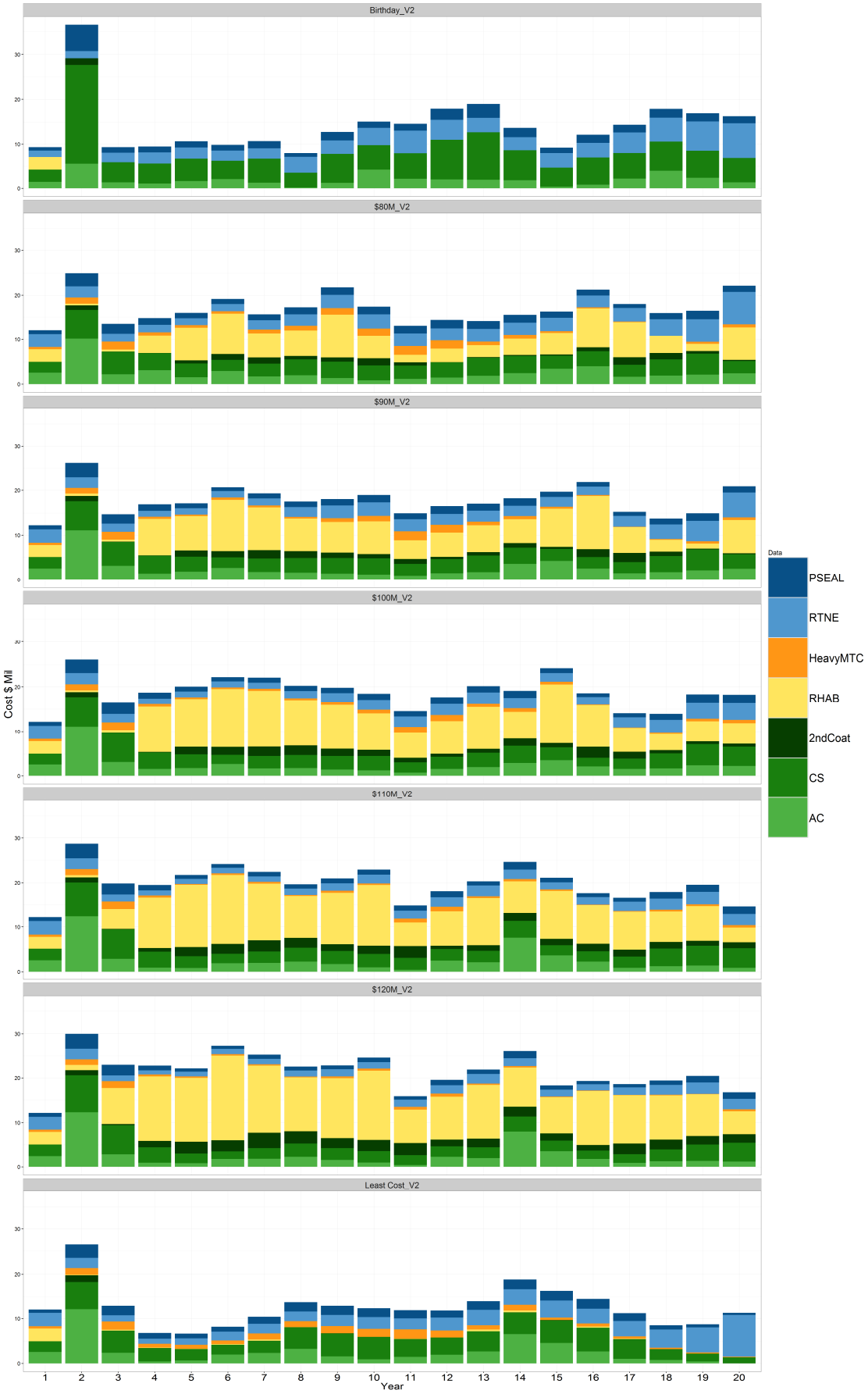
Cost $ Mil by ONRC - High Volume



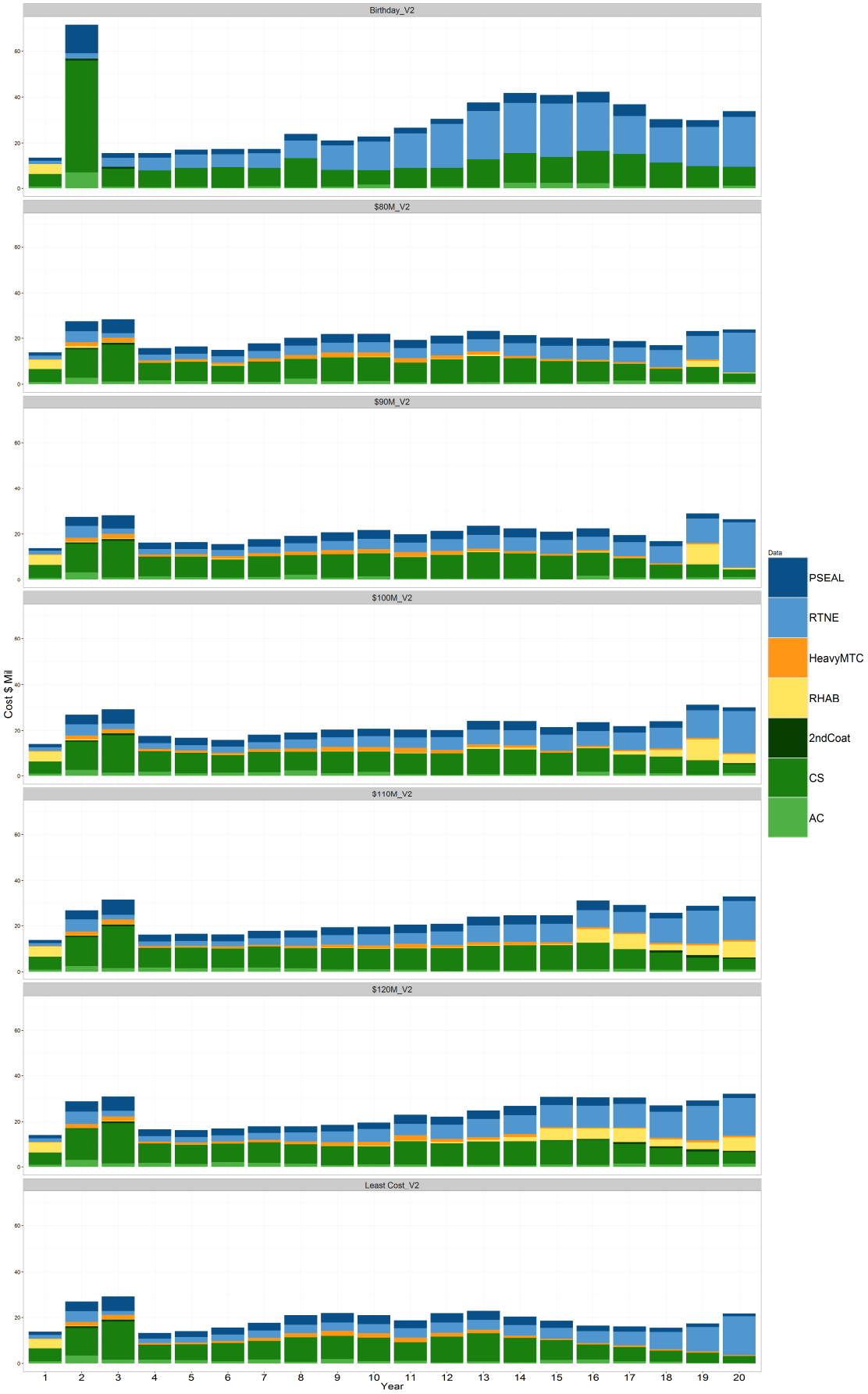
Cost $ Mil by ONRC - Arterial



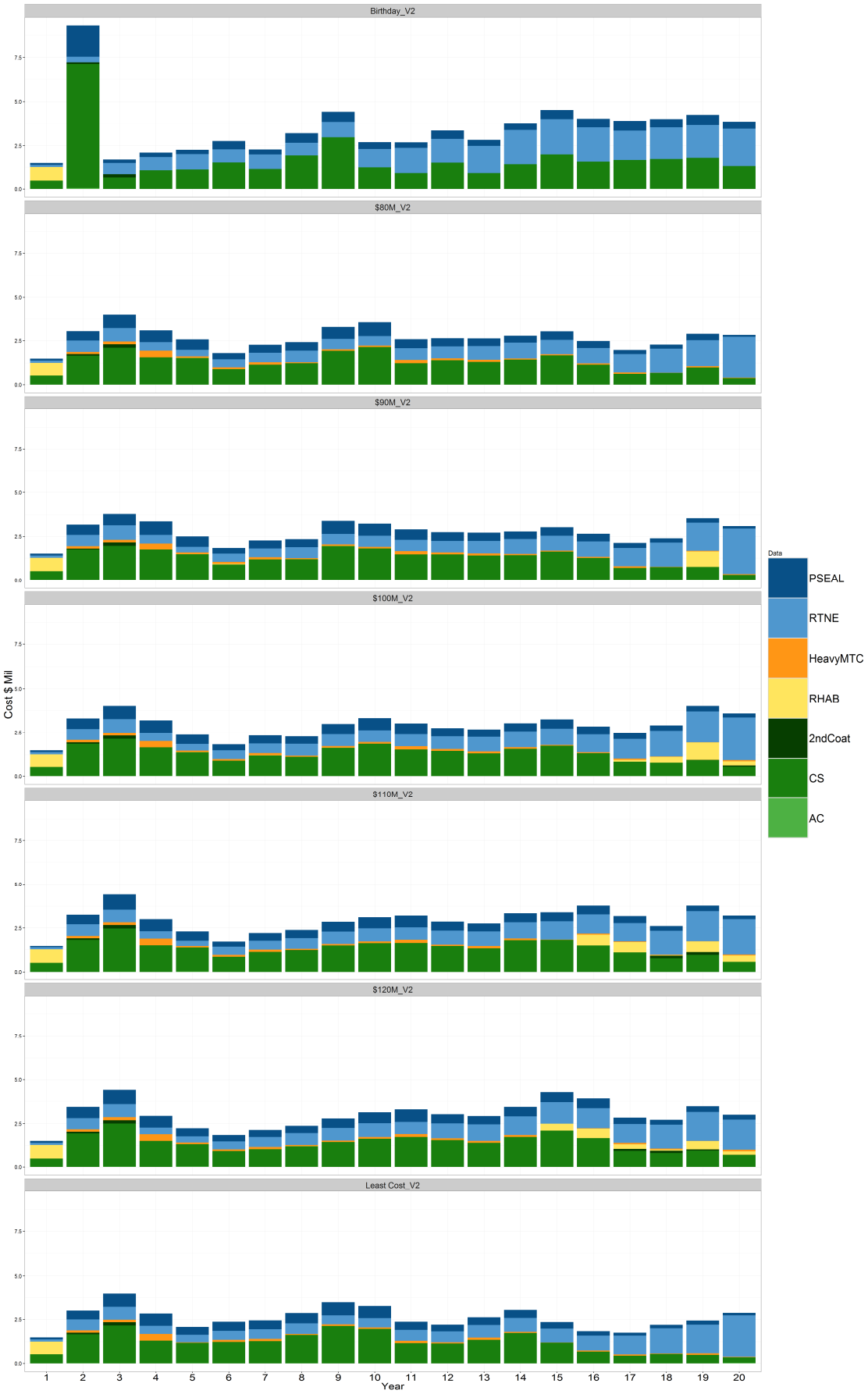
Cost $ Mil by ONRC - National



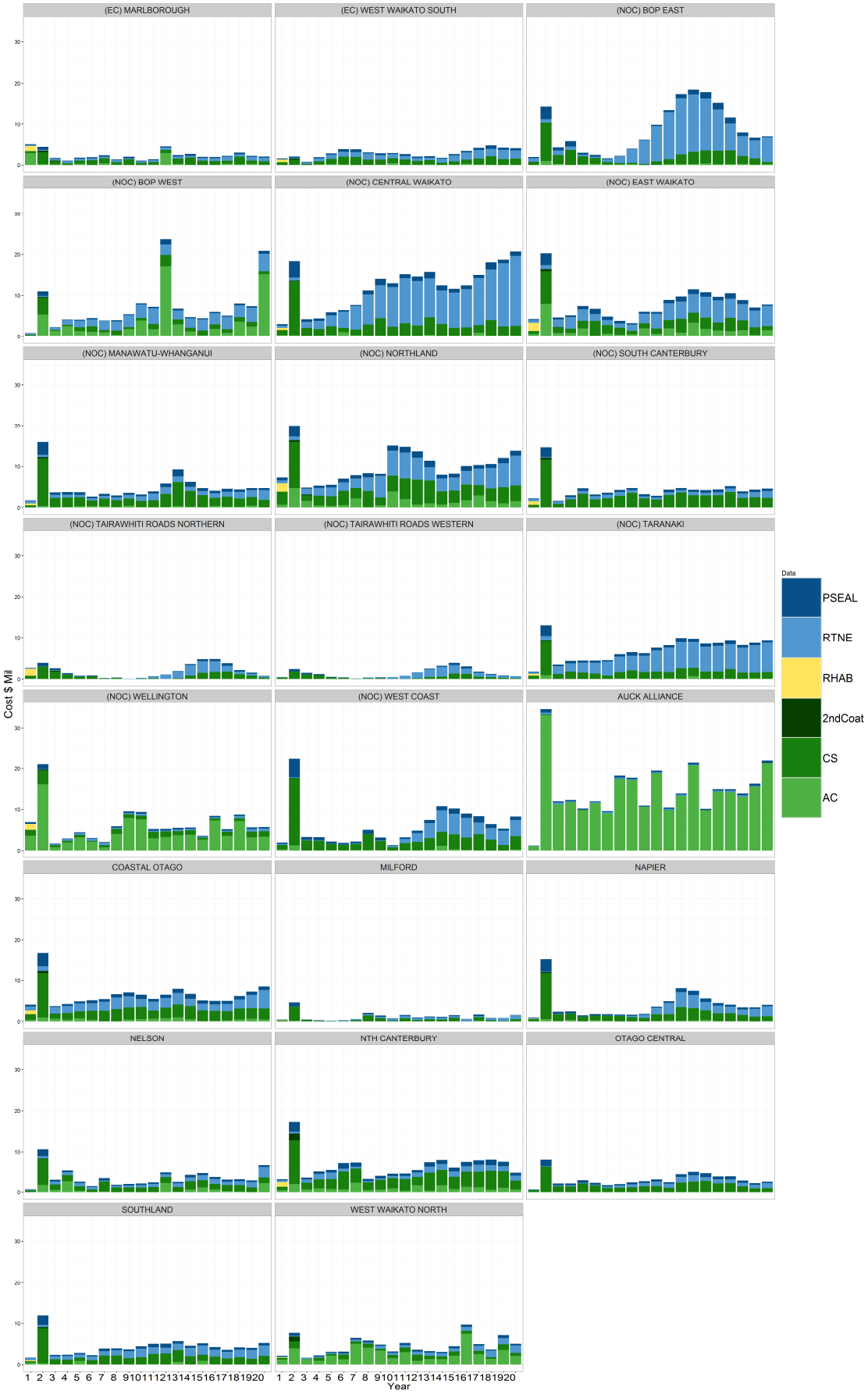
Cost $ Mil by ONRC - Primary Collector



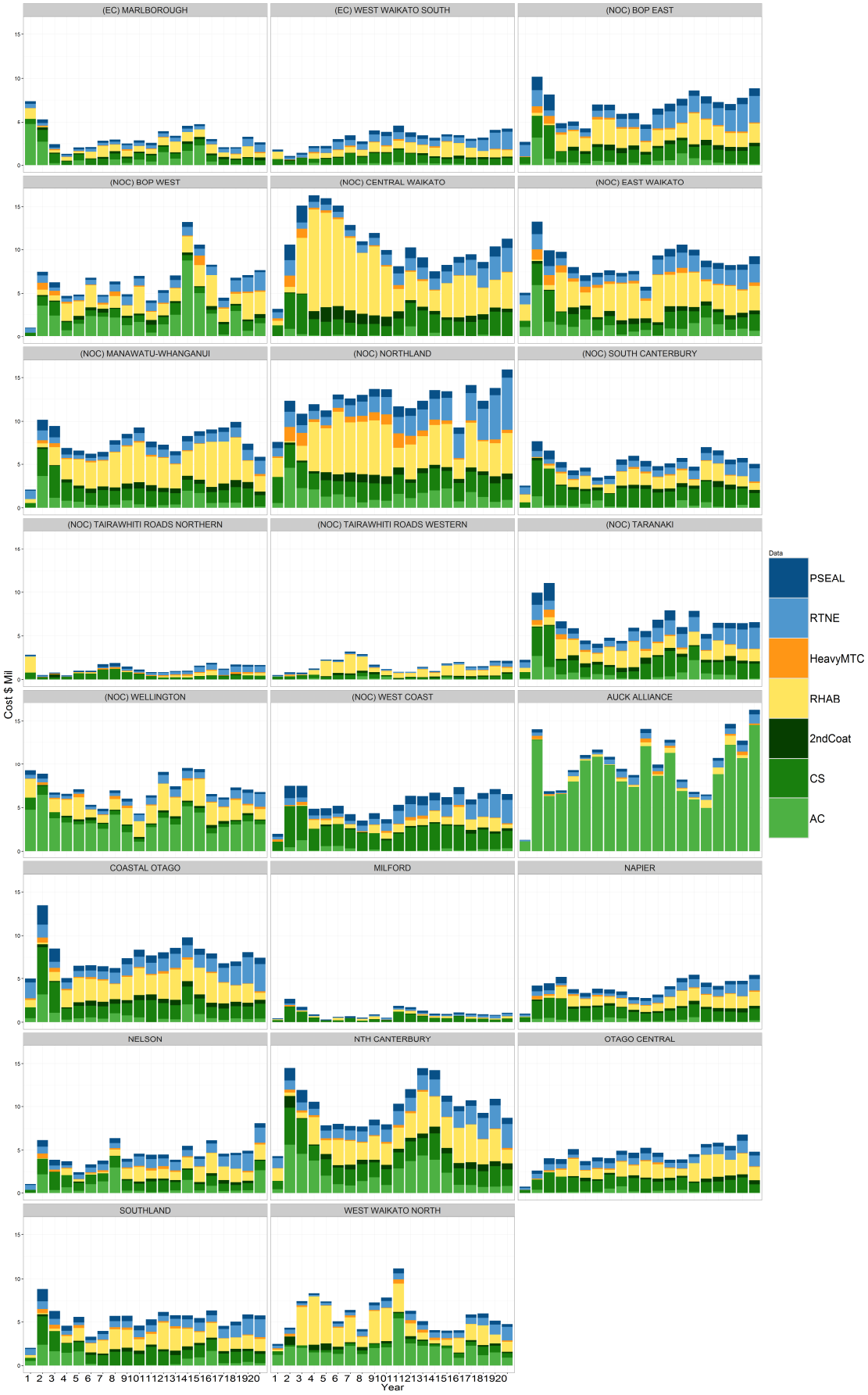
Cost $ Mil by ONRC - Secondary Collector



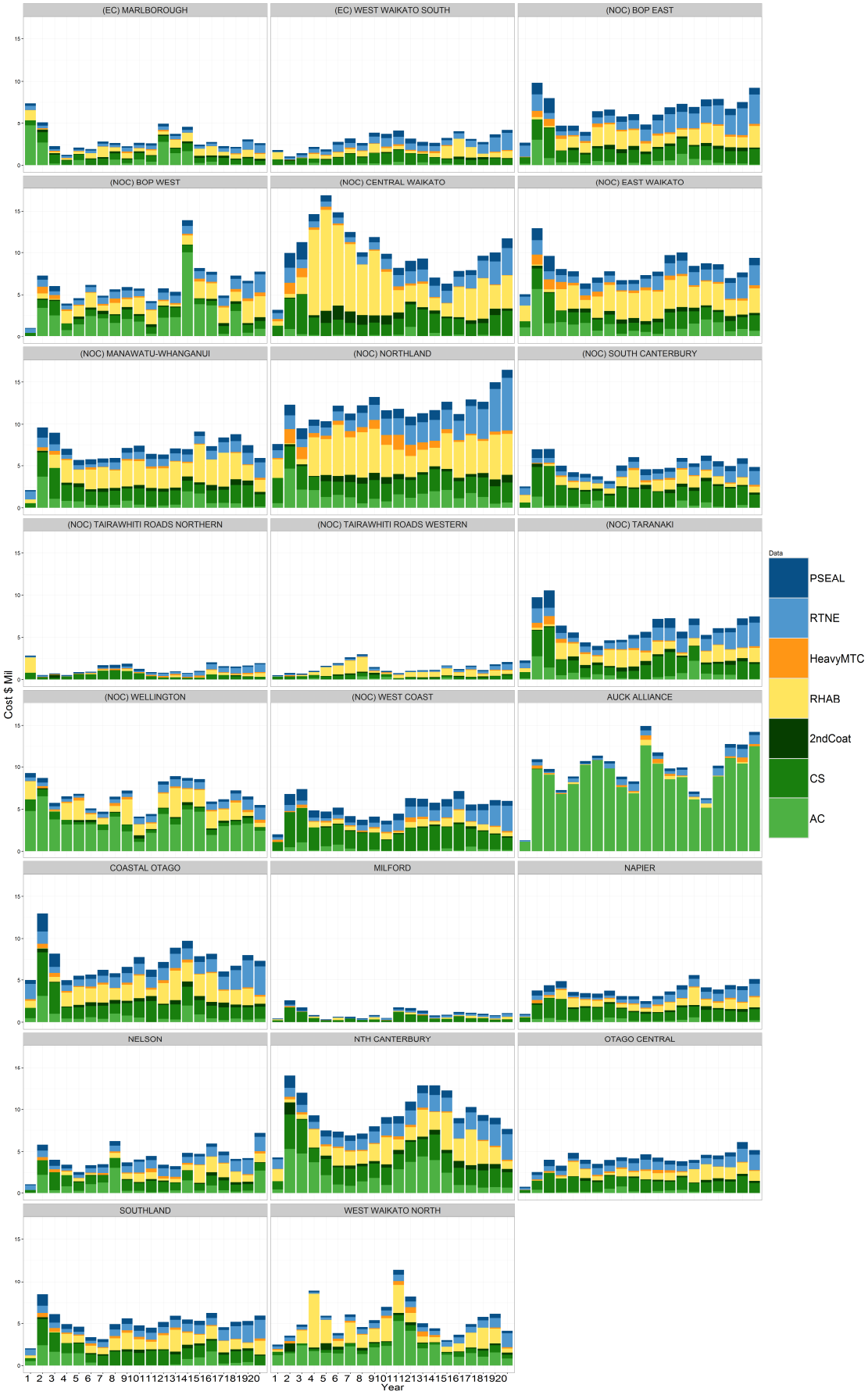
Cost $ Mil by NOC - Birthday_V2



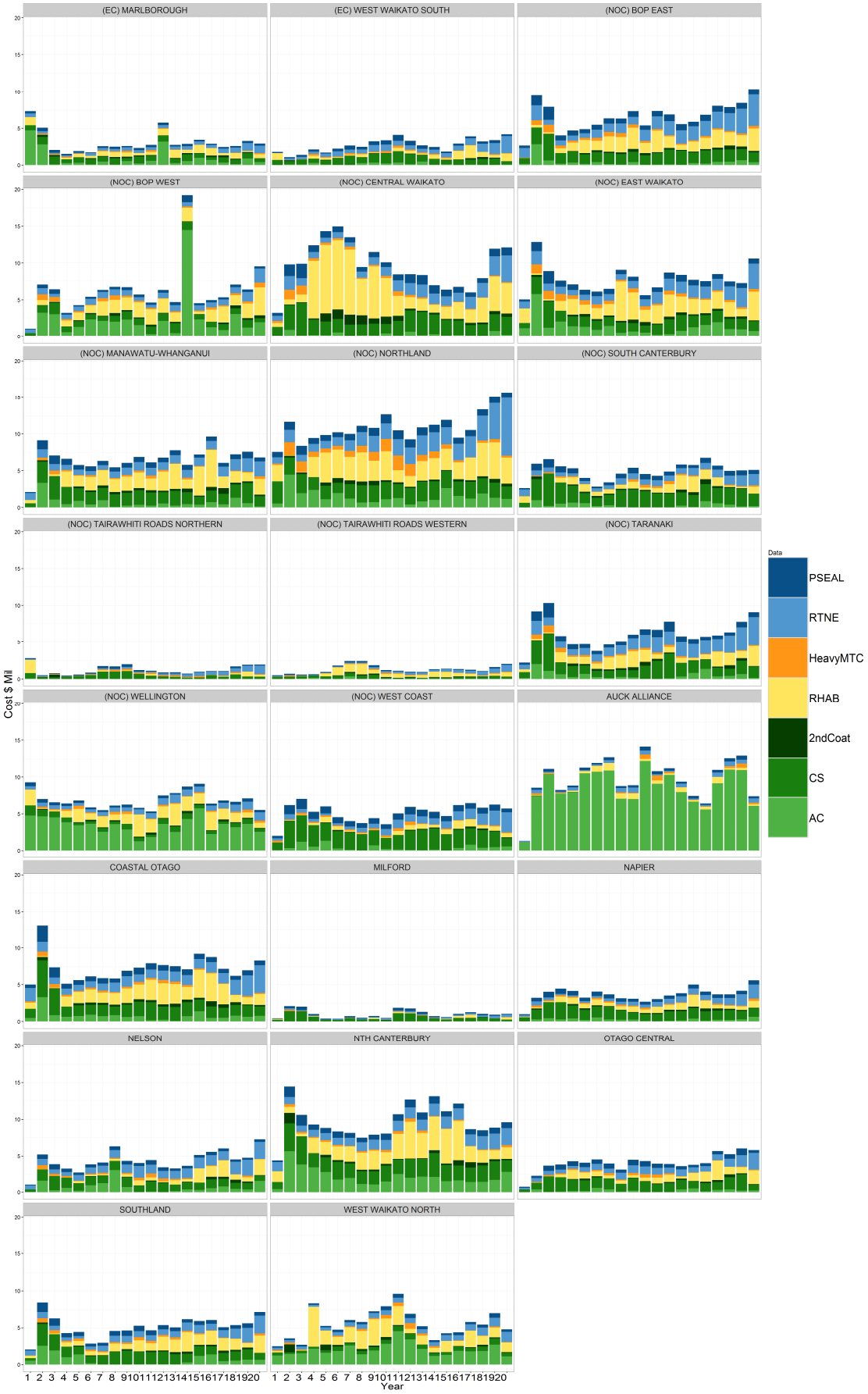
Cost $ Mil by NOC - $120M_V2



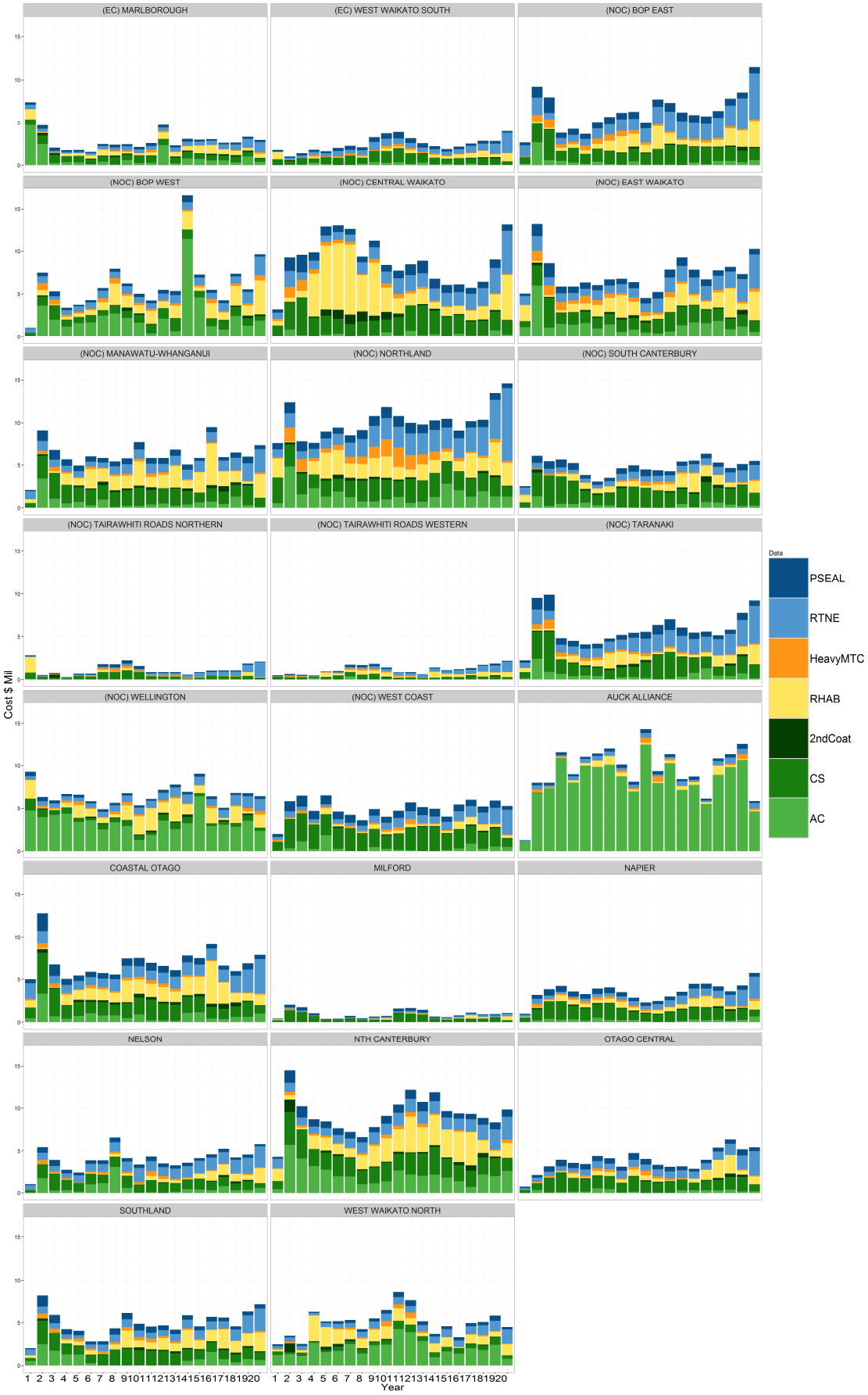
Cost $ Mil by NOC - $110M_V2



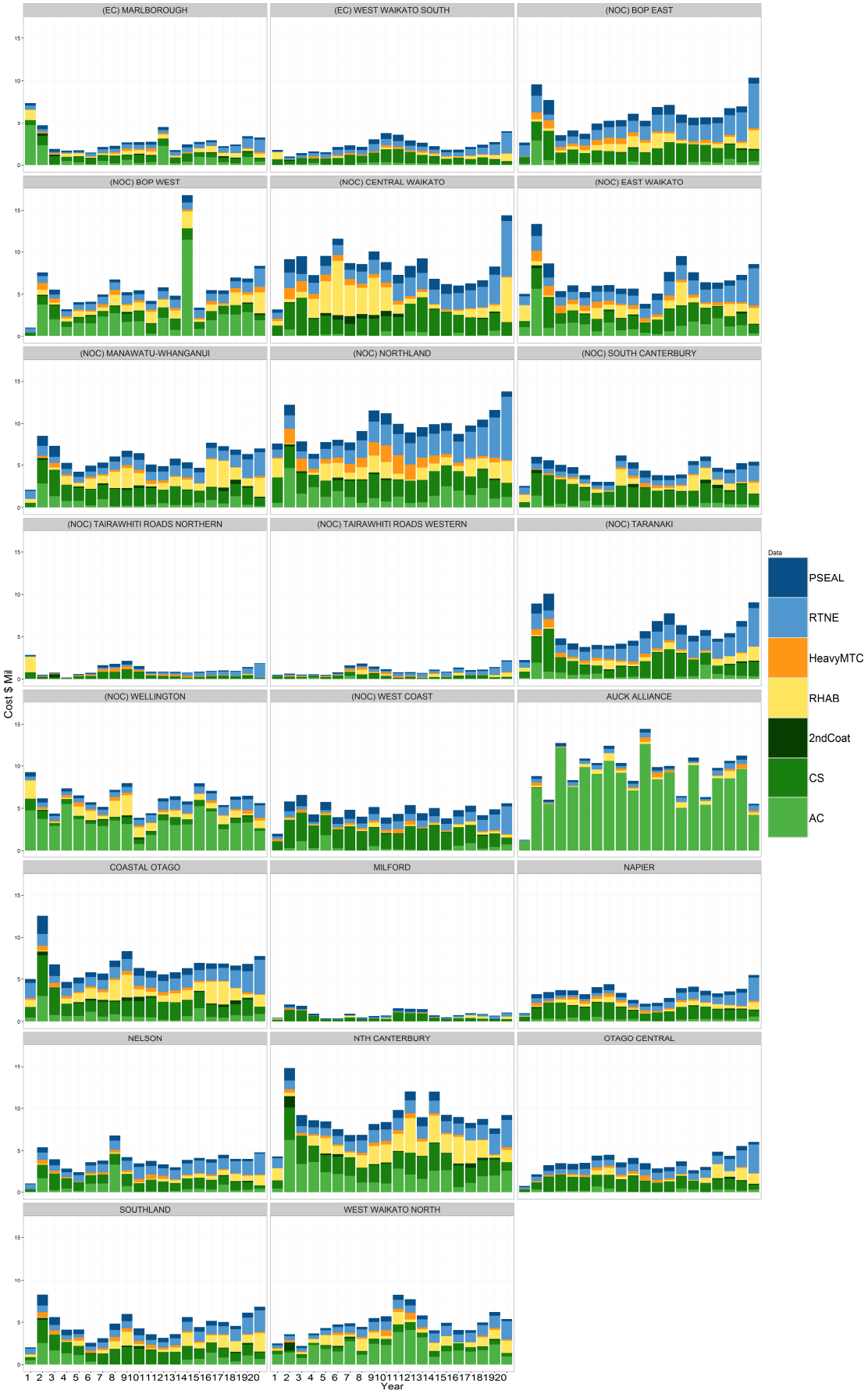
Cost $ Mil by NOC - $100M_V2



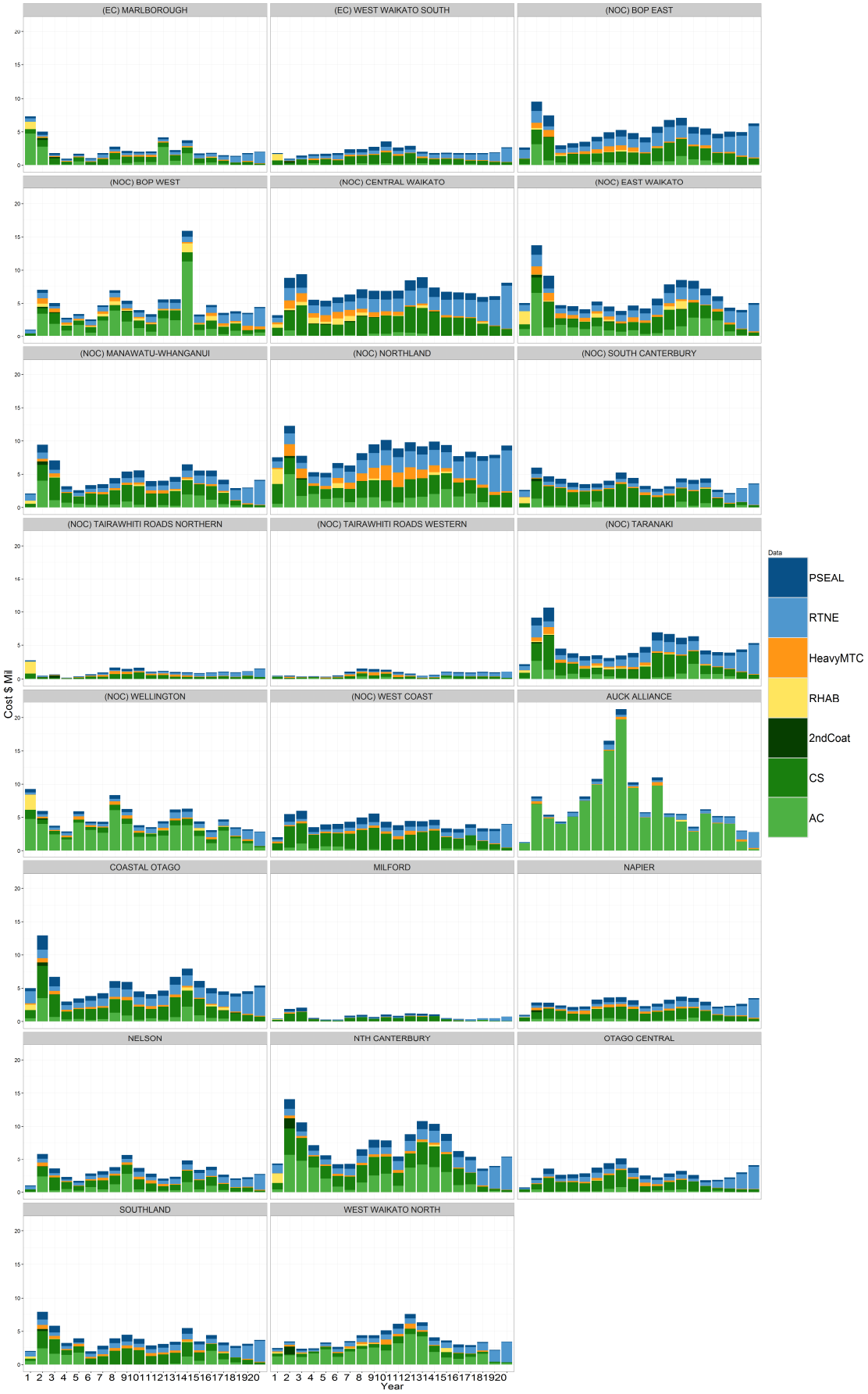
Cost $ Mil by NOC - $90M_V2



Cost $ Mil by NOC - $80M_V2



Cost $ Mil by NOC - Least Cost_V2



3.3 Output Variable Charts – Fixed Routine Maintenance (V2)

This set of outputs includes Box & Whisker charts for each key variable.

- Roughness
- SII (Surfacing Integrity Index)
- Rutting
- PCI (Pavement Condition Index – overall condition)

The first series compares the seven (7) 'Fixed RM Options' as time series over 20 years

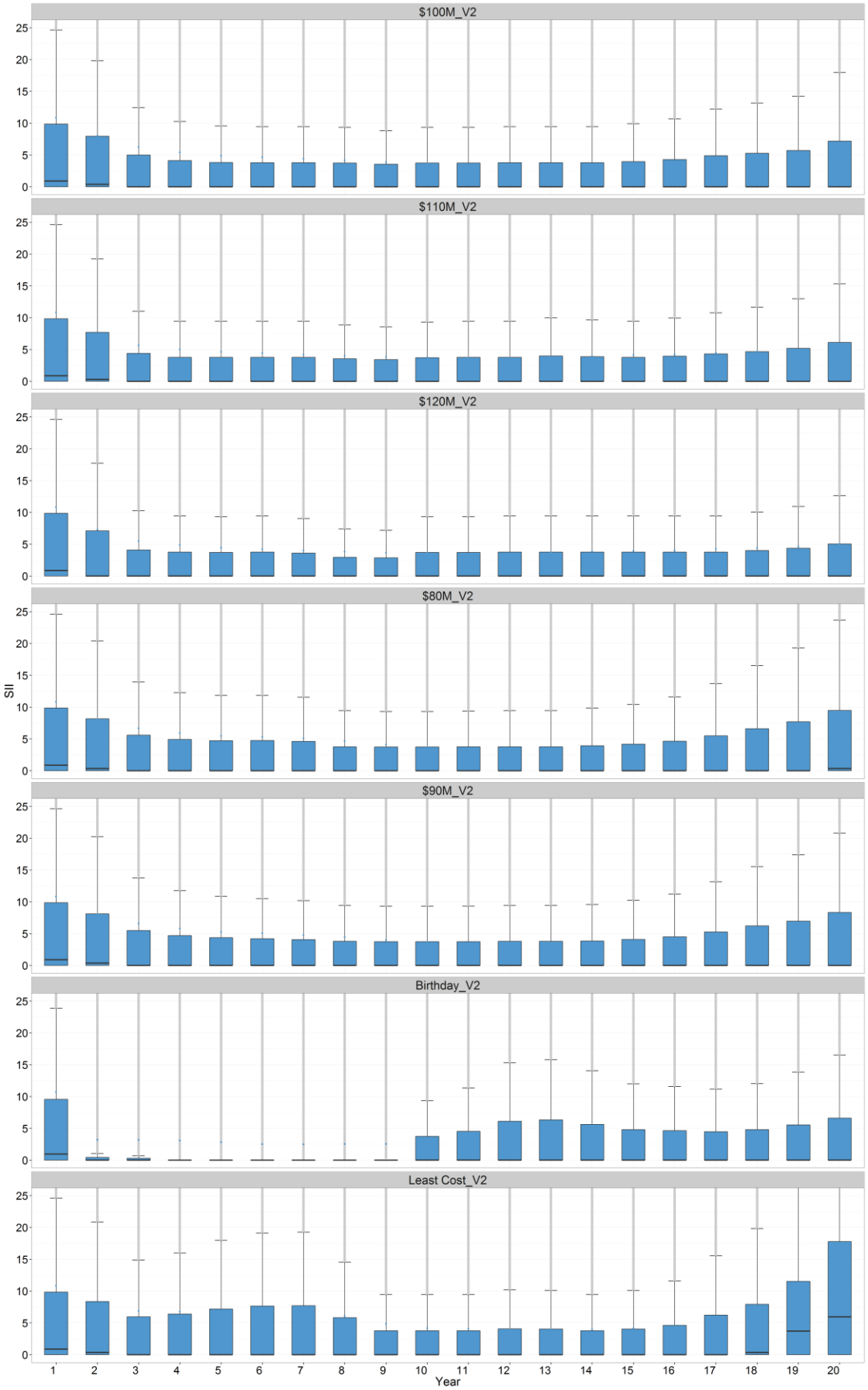
- **Birthday_V2**
  - Treatments triggered when useful life is reached, does not try and meet Levels of Service
  - Renewal Investment: **Unlimited,** Routine Investment: **$30M pa**
  - Safety Investment: Safety not Included
- **$80M_V2**
  - Renewal Investment: Fixed **$80M** pa, Routine Investment: **$30M pa**
  - Safety Investment: Safety not Included
- **$90M_V2**
  - Renewal Investment: Fixed **$90M** pa, Routine Investment: **$30M pa**
  - Safety Investment: Safety not Included
- **$100M_V2**
  - Renewal Investment: Fixed **$100M** pa, Routine Investment: **$30M pa**
  - Safety Investment: Safety not Included
- **$110M_V2**
  - Renewal Investment: Fixed **$110M** pa, Routine Investment: **$30M pa**
  - Safety Investment: Safety not Included
- **$120M_V2**
  - Renewal Investment: Fixed **$120M** pa, Routine Investment: **$30M pa**
  - Safety Investment: Safety not Included
- **Least Cost_V2**
  - Generates the lowest overall cost treatment programme considering Renewal and Routine Investment – disallowing Do Nothing. Does not try and meet Levels of Service.
  - Safety Investment: Safety not Included

The second series compares the six (6) ONRC Classes as time series over 20 years for each 'Fixed RM Options' for each variable.

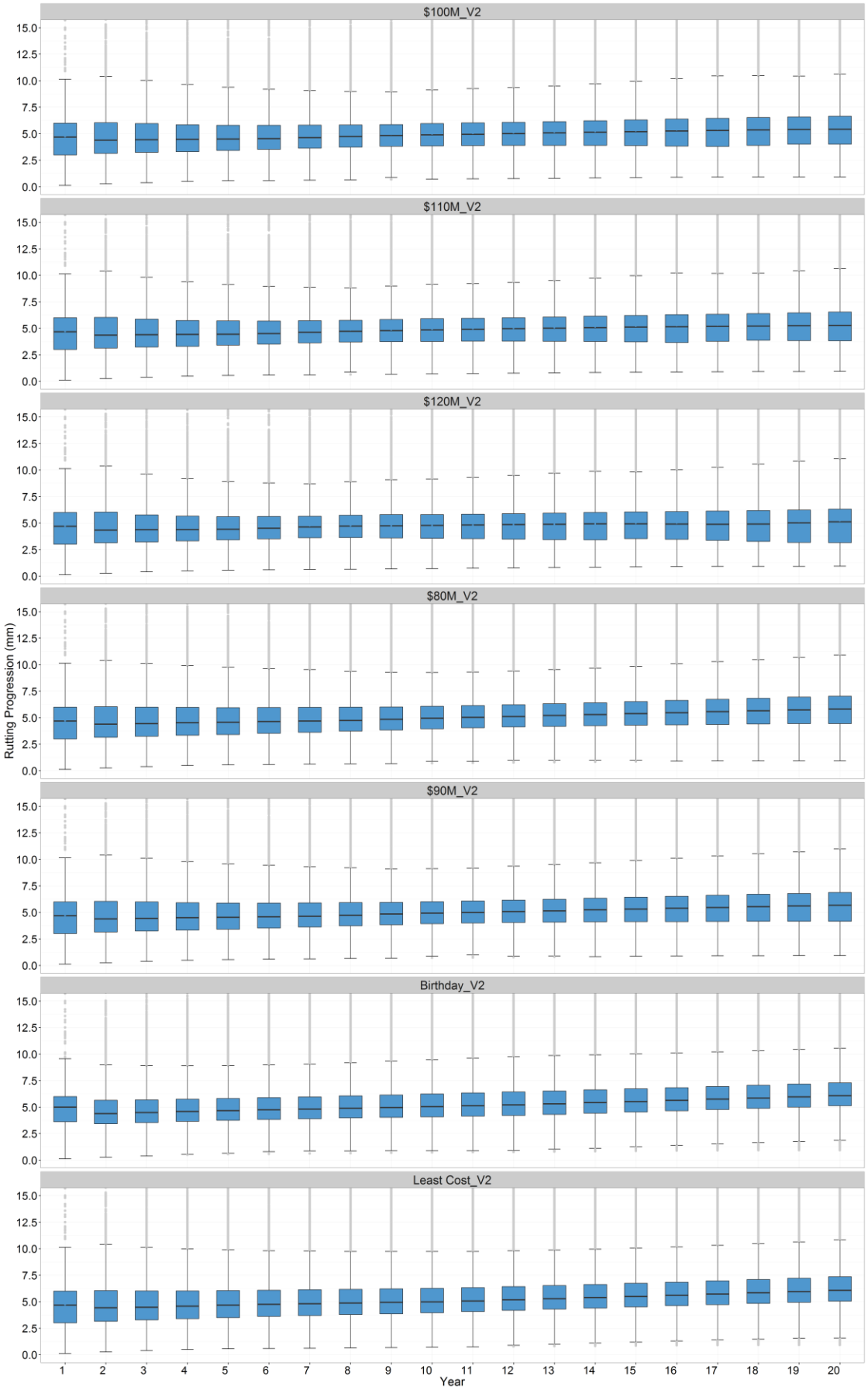
- Secondary Collector
- Primary Collector
- Arterial
- Regional
- National
- National High Volume

The final series compares the 'Fixed RM Options' by ONRC Class at three time snapshots (Current (Yr0), 10 Years and 20 Years) for each variable.

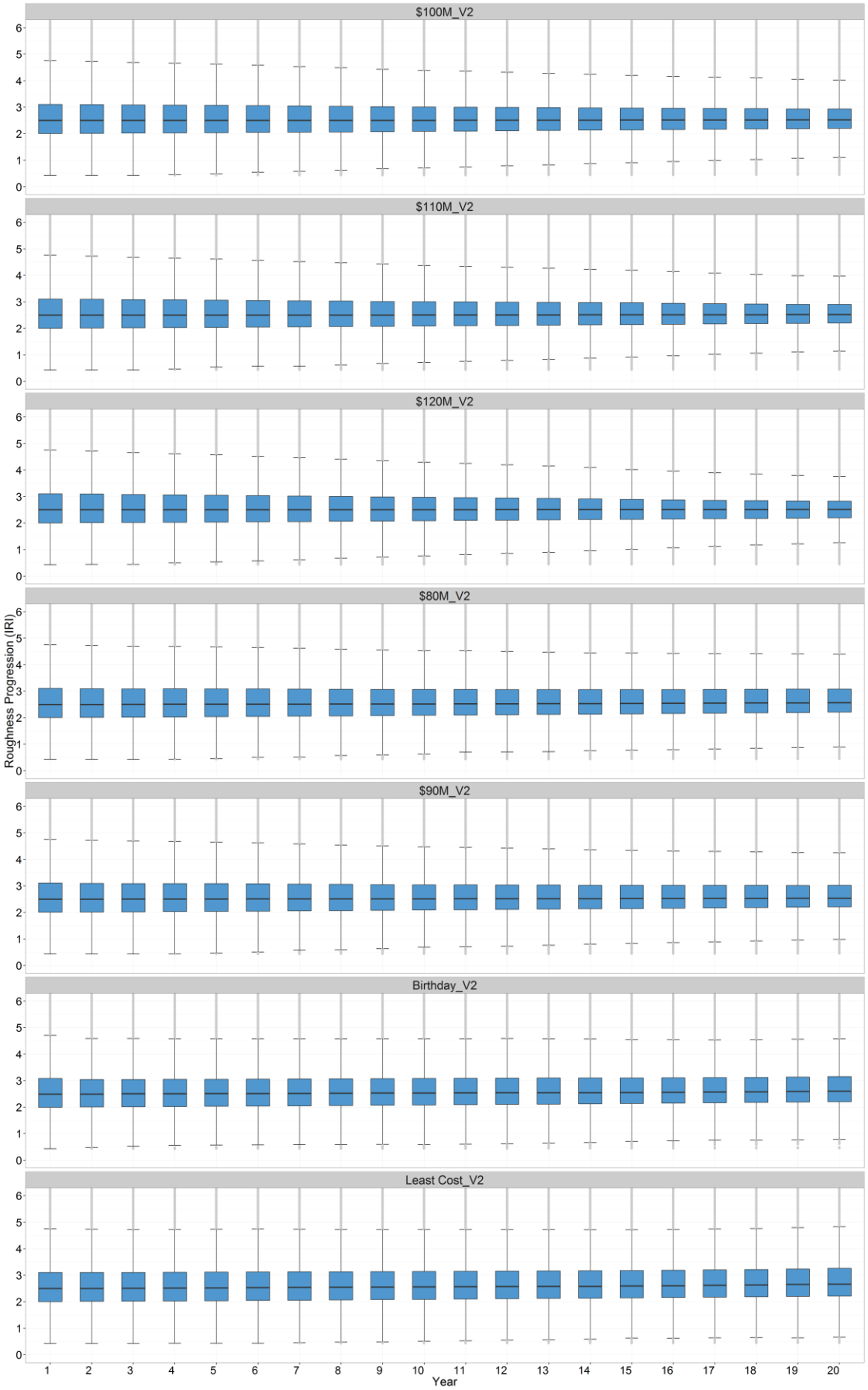
SII Distribution 20 Years



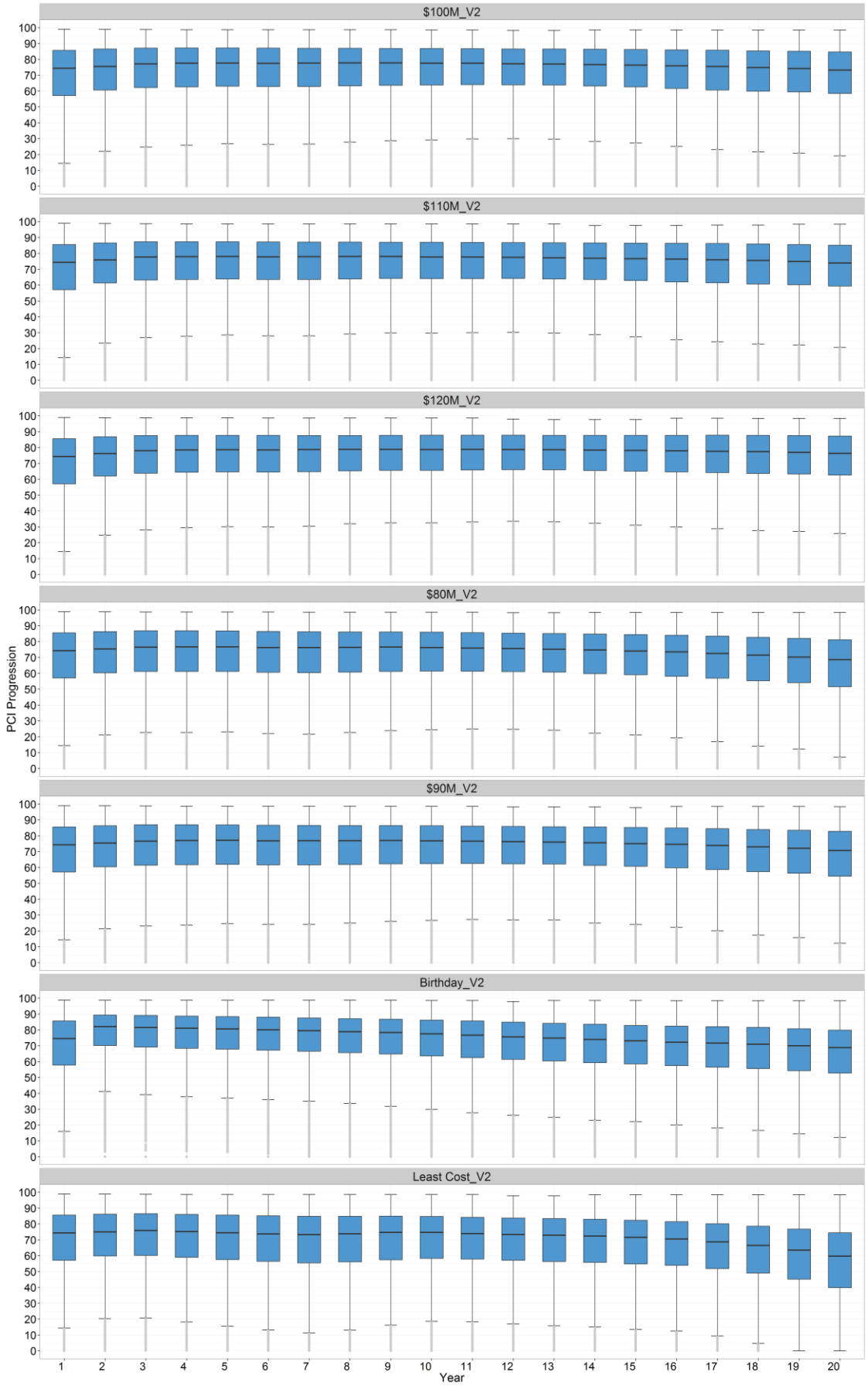
Rutting Distribution 20 Years



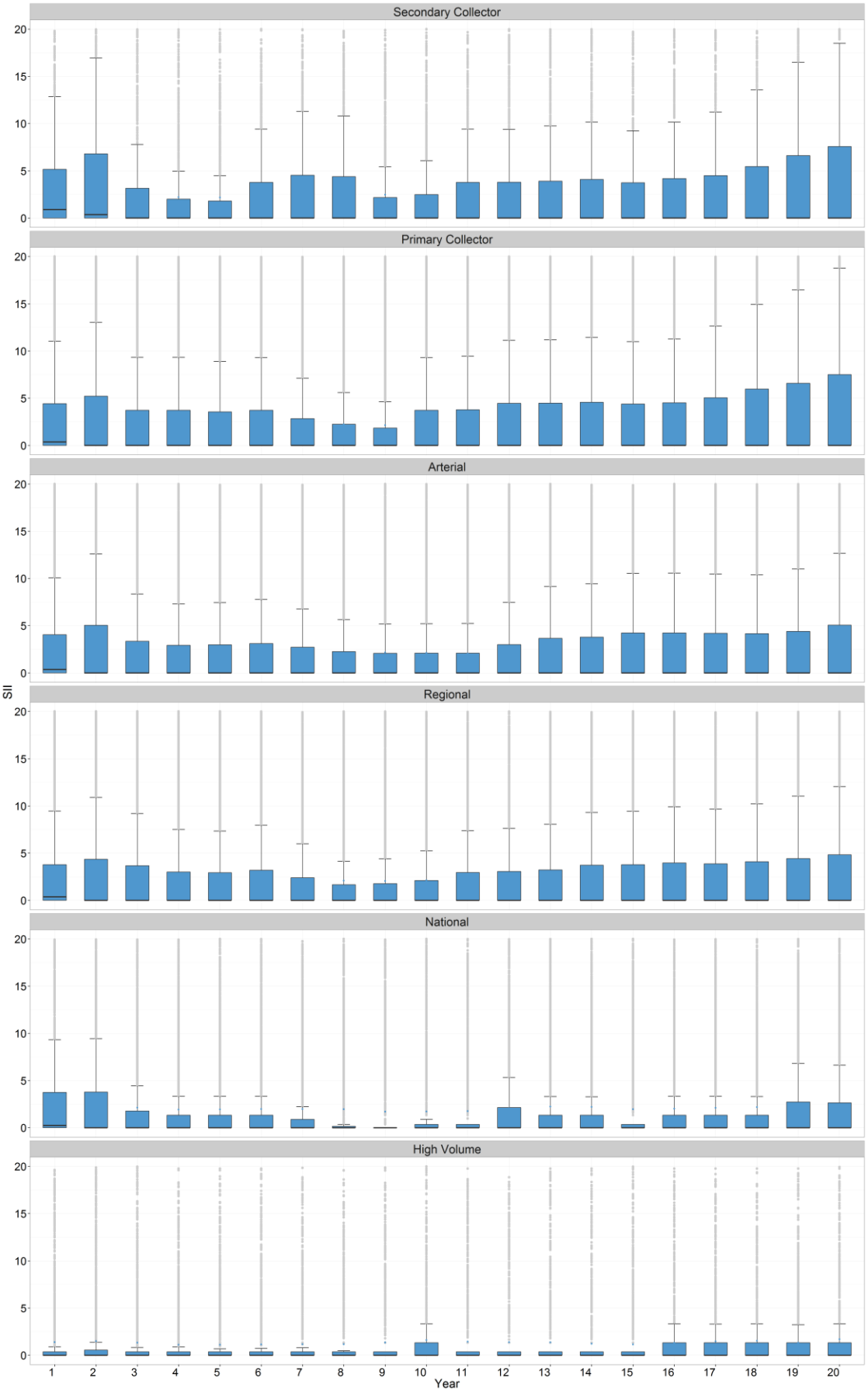
Roughness Distribution 20 Years



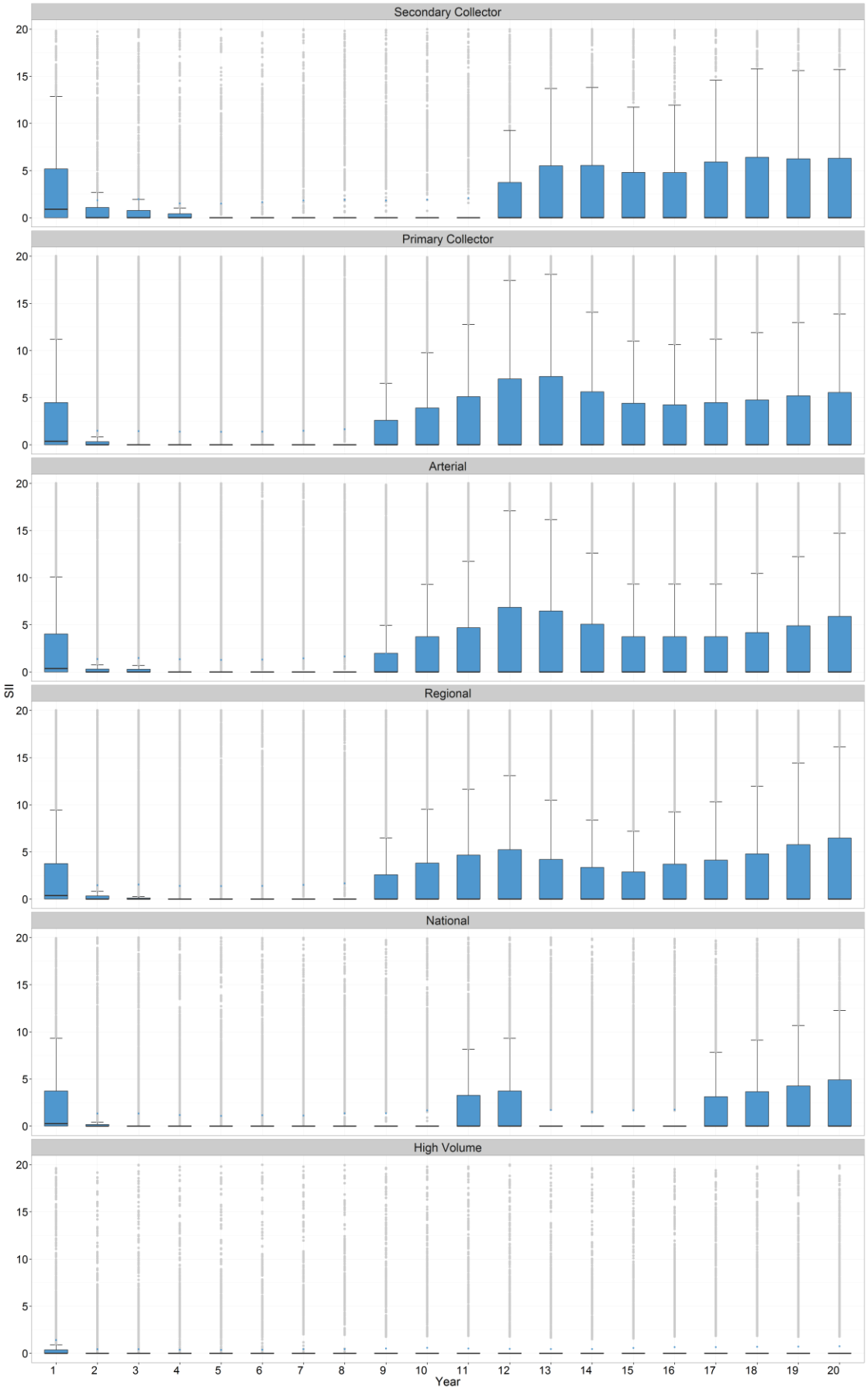
PCI Distribution 20 Years



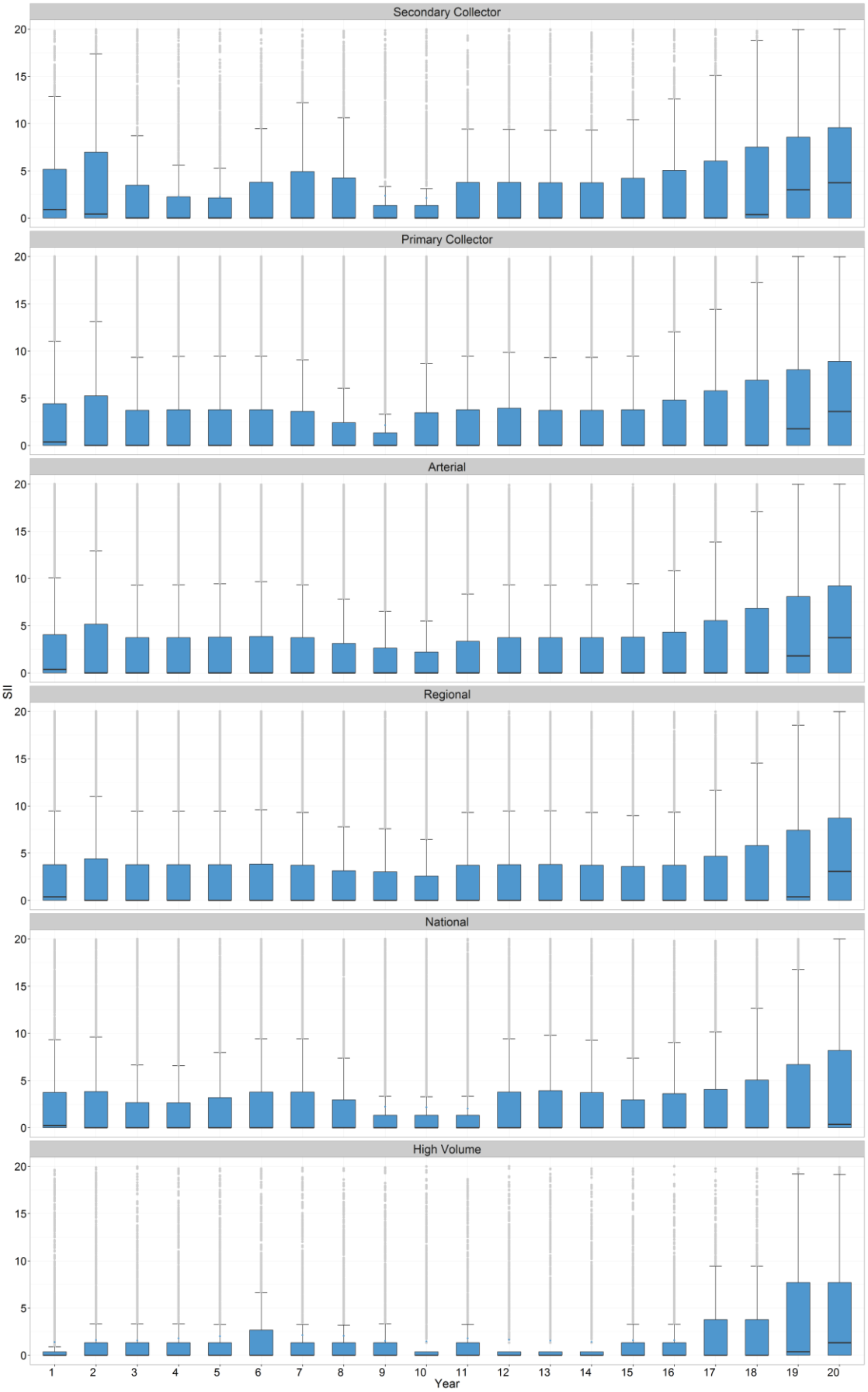
SII Distribution 20 Years - $100M_V2



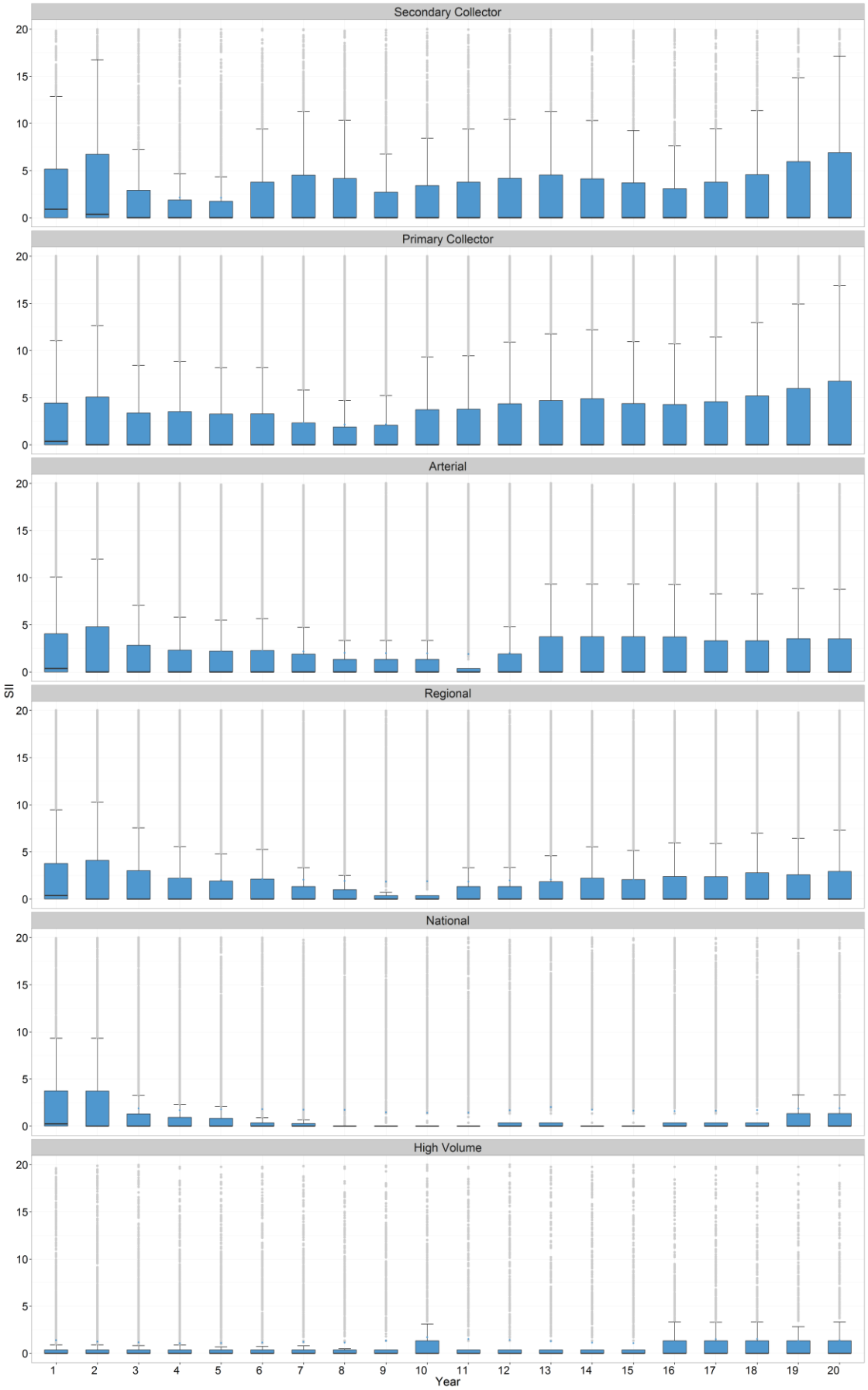
SII Distribution 20 Years - Birthday_V2



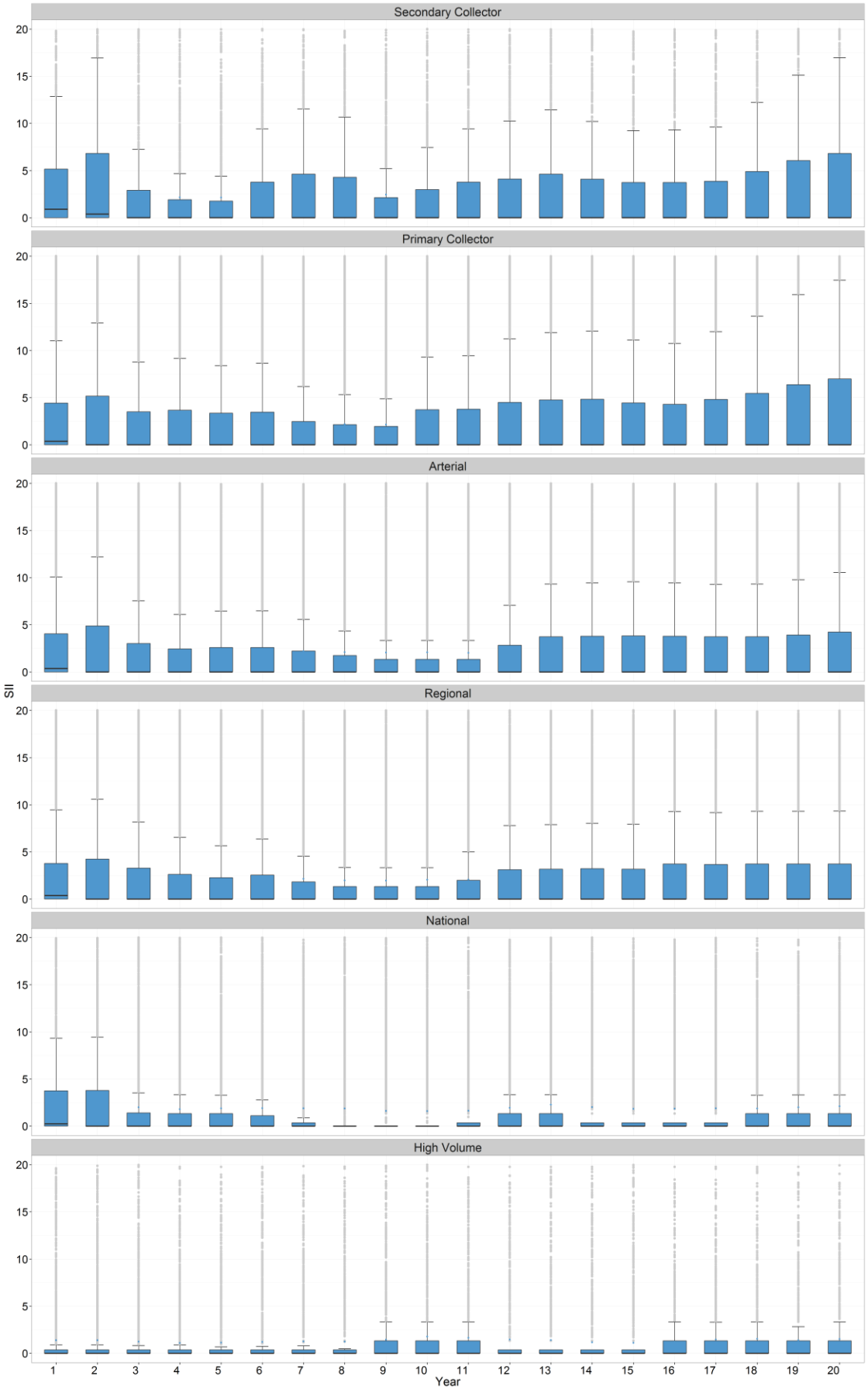
SII Distribution 20 Years - Least Cost_V2



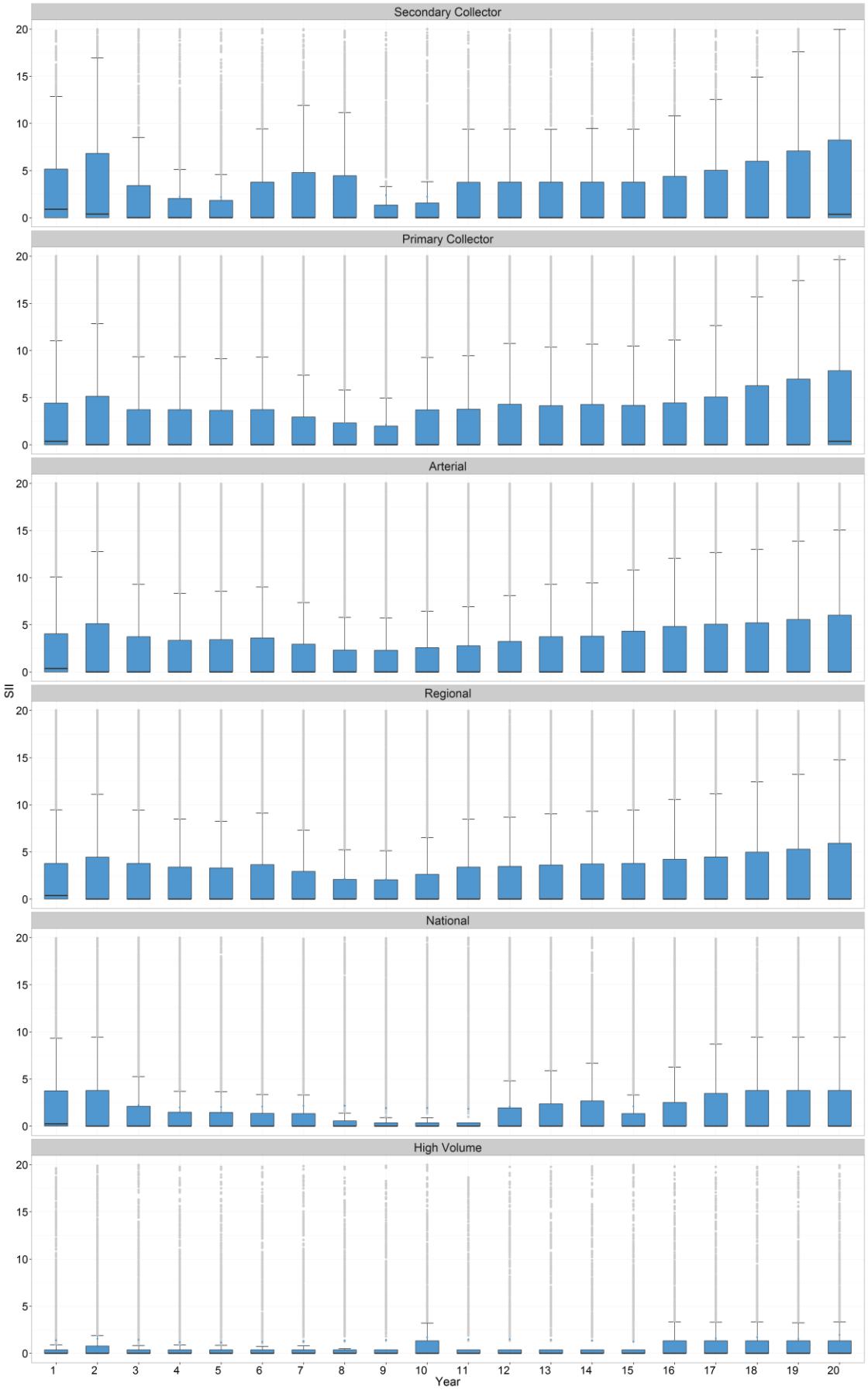
SII Distribution 20 Years - $120M_V2



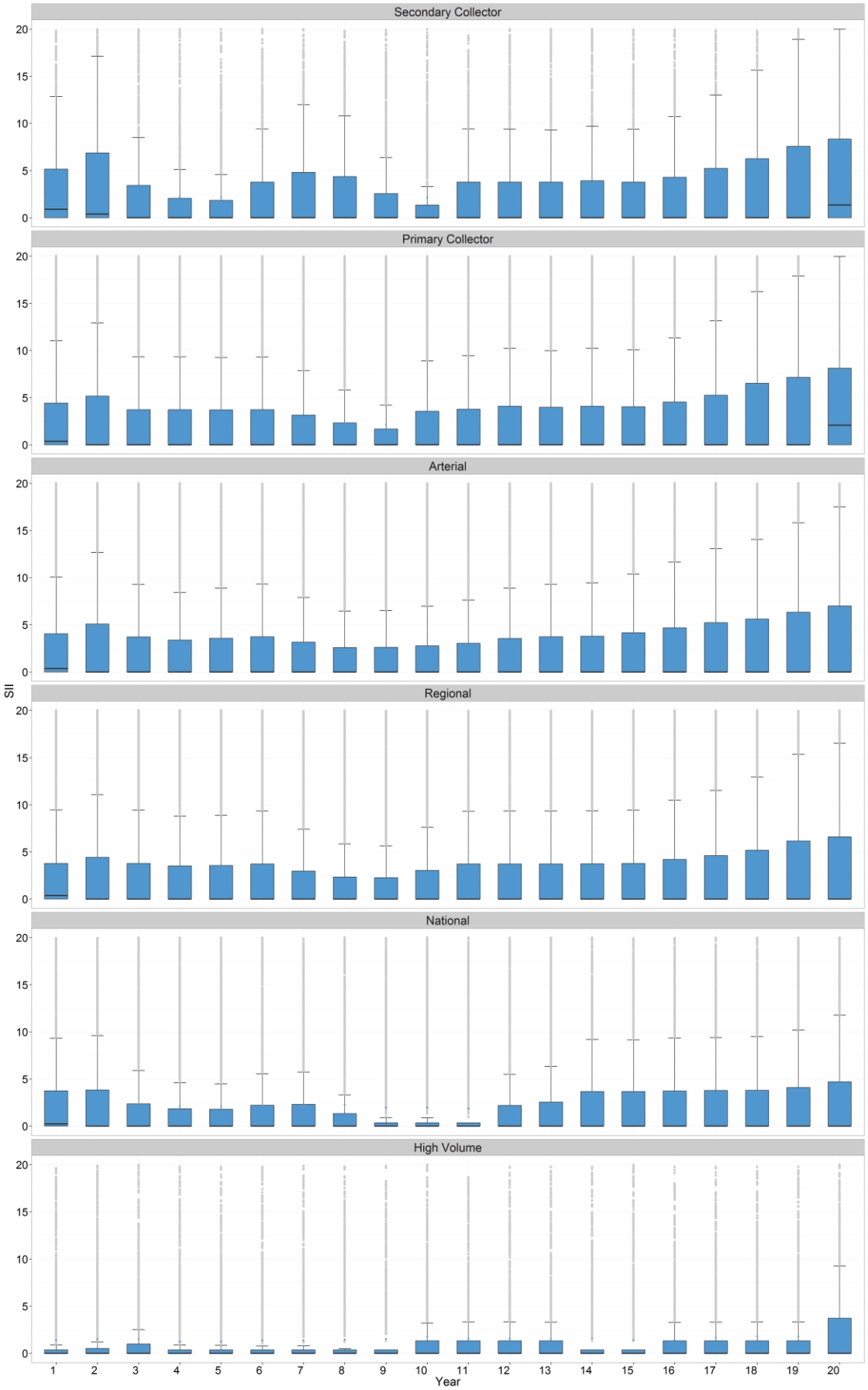
SII Distribution 20 Years - $110M_V2



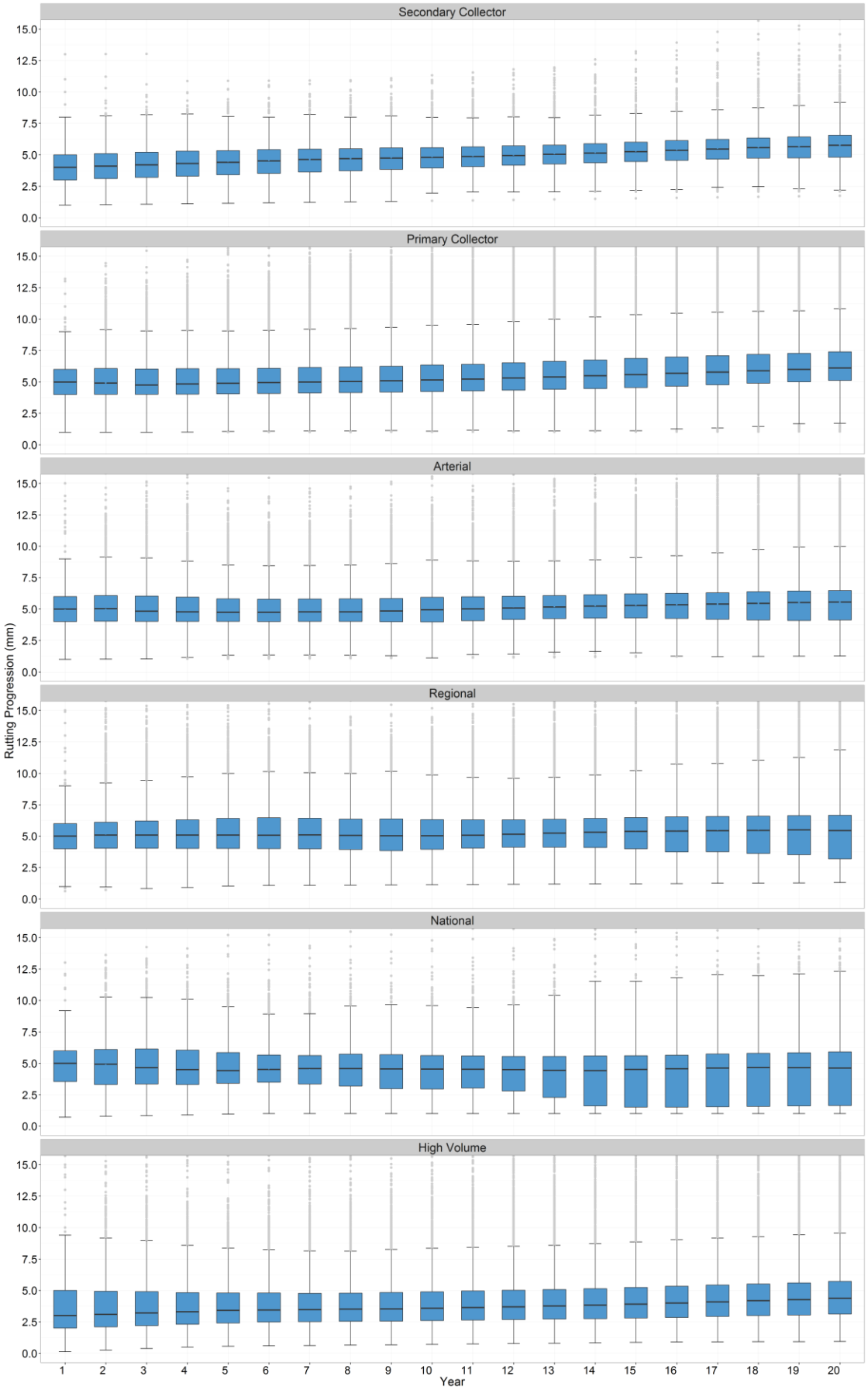
SII Distribution 20 Years - $90M_V2



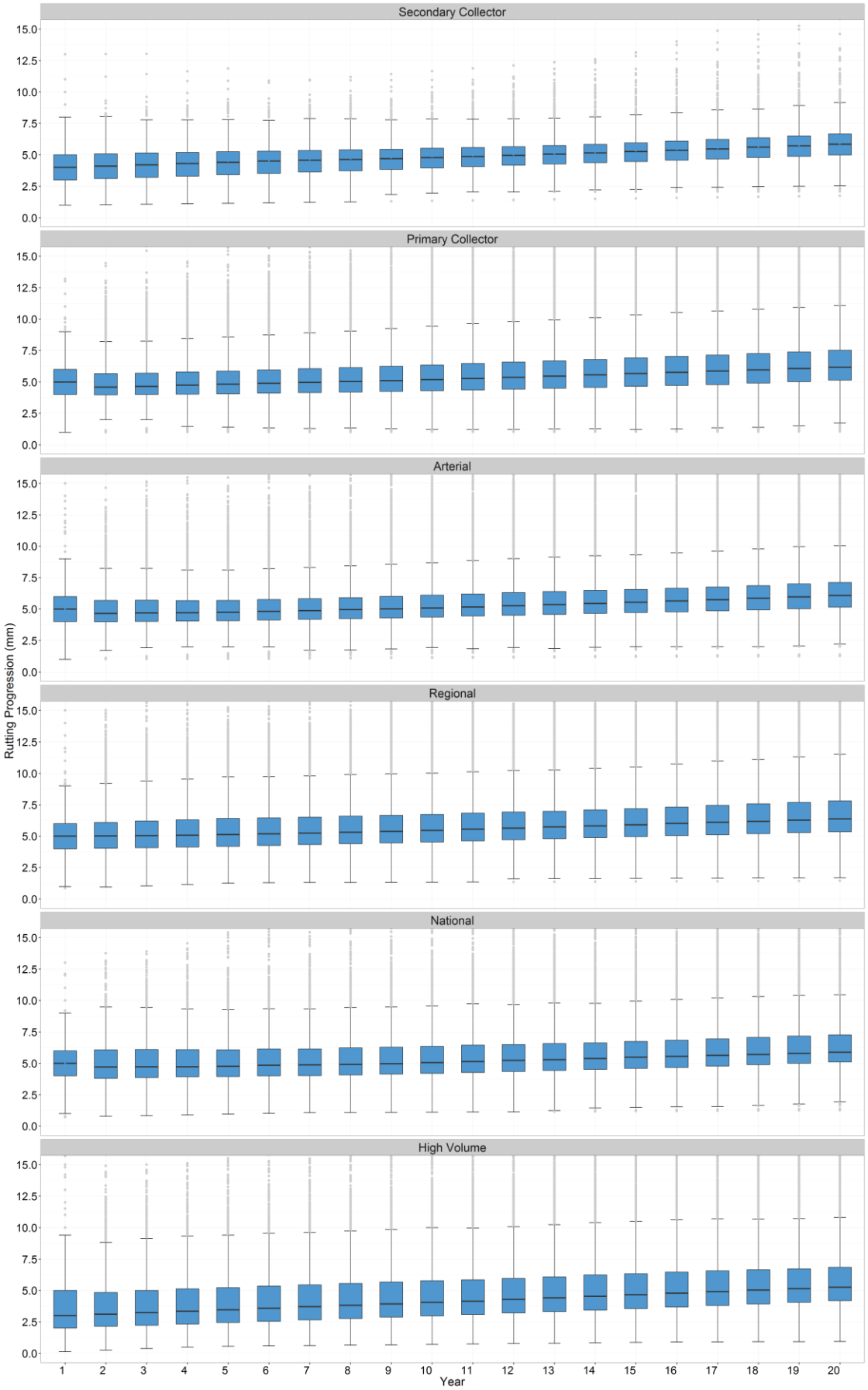
SII Distribution 20 Years - $80M_V2



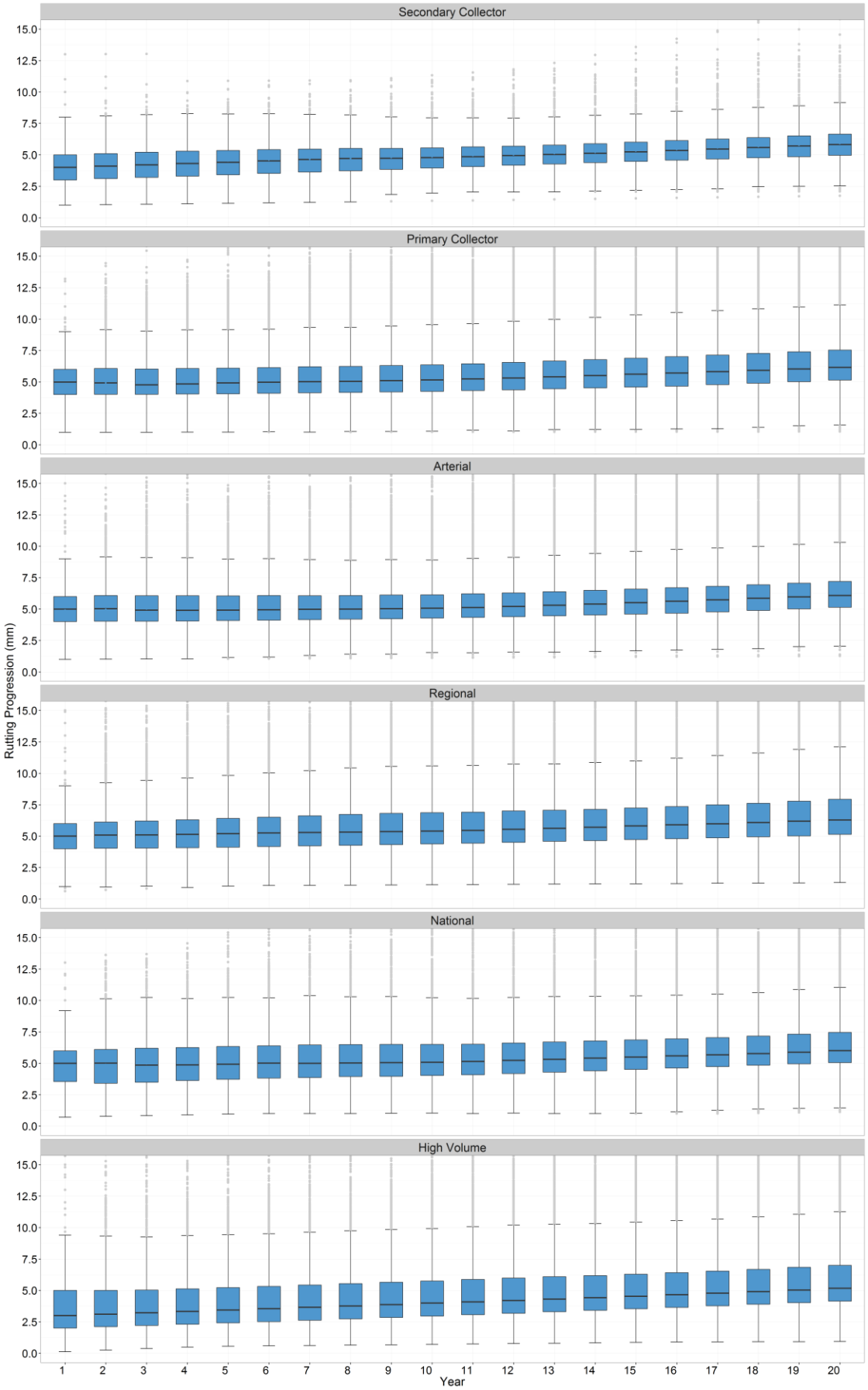
Rutting Distribution 20 Years - $100M_V2



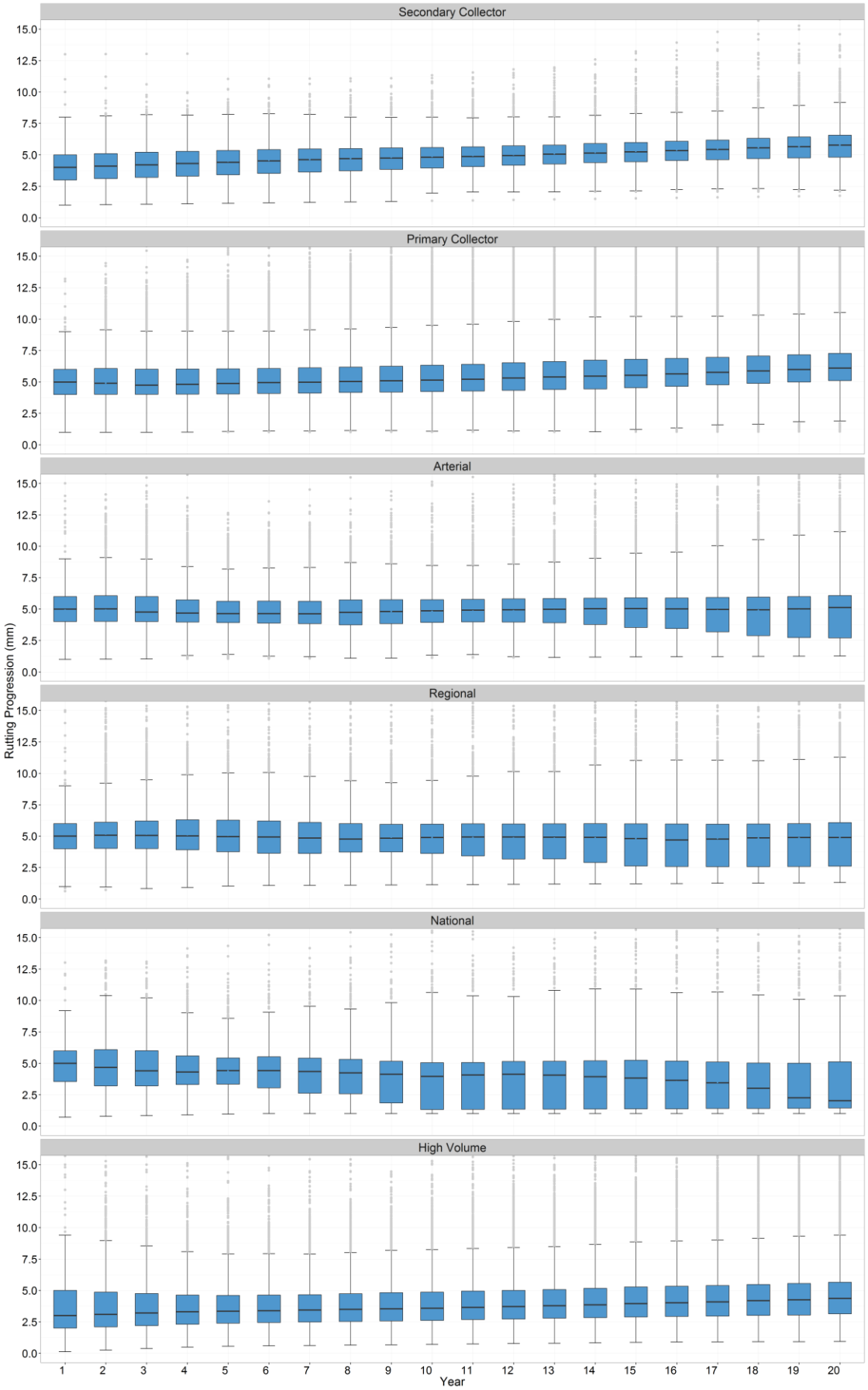
Rutting Distribution 20 Years - Birthday_V2



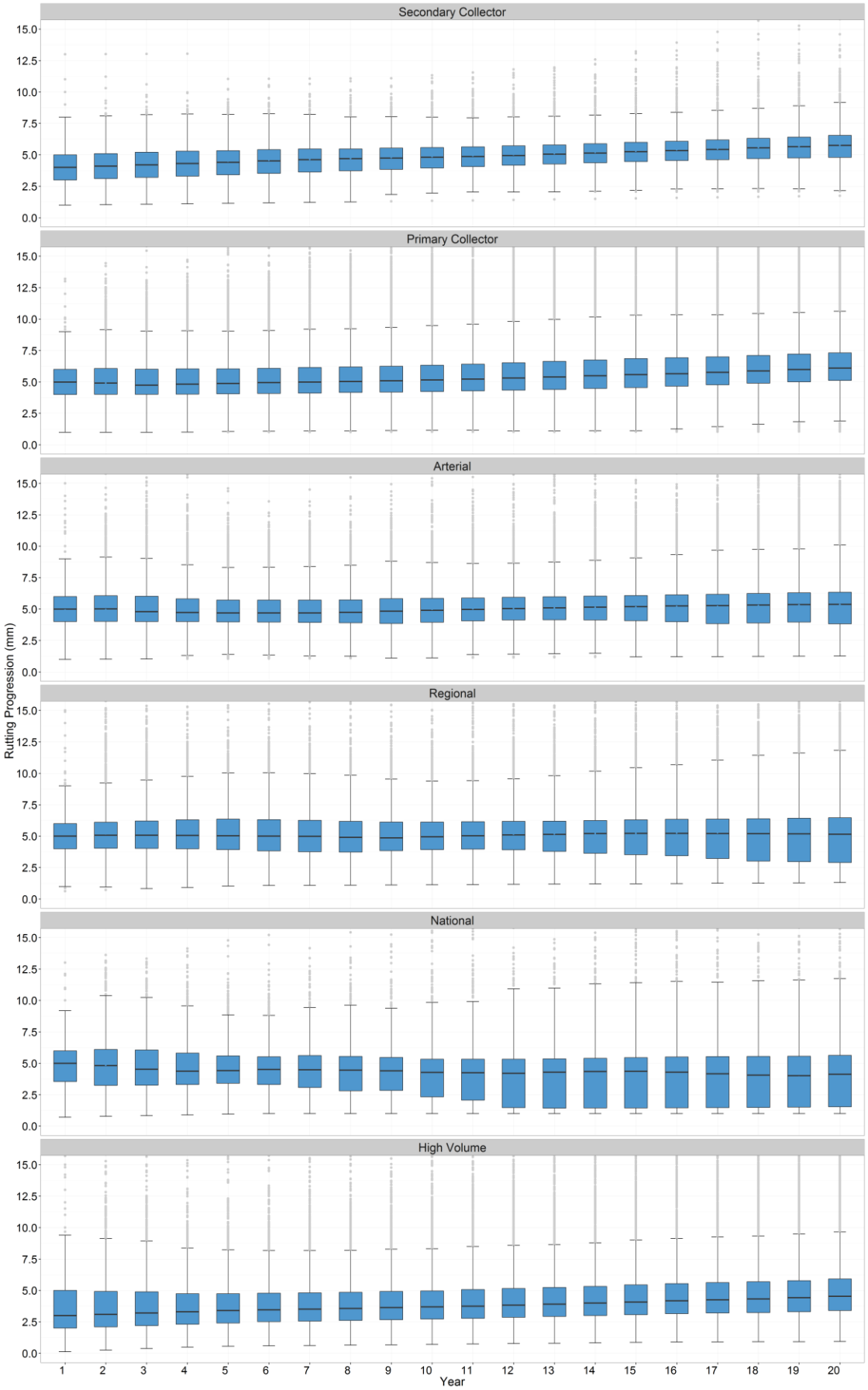
Rutting Distribution 20 Years - Least Cost_V2



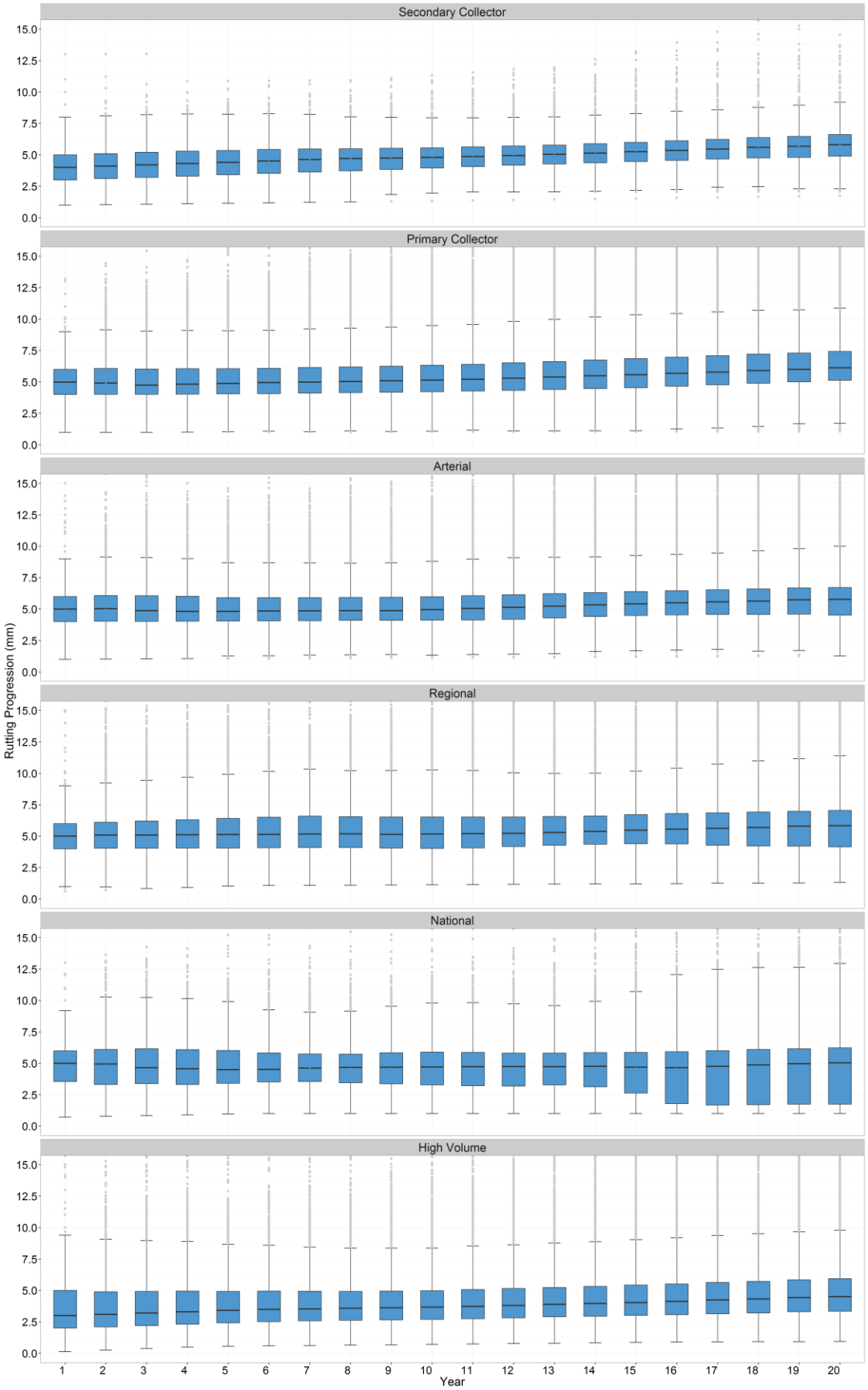
Rutting Distribution 20 Years - $120M_V2



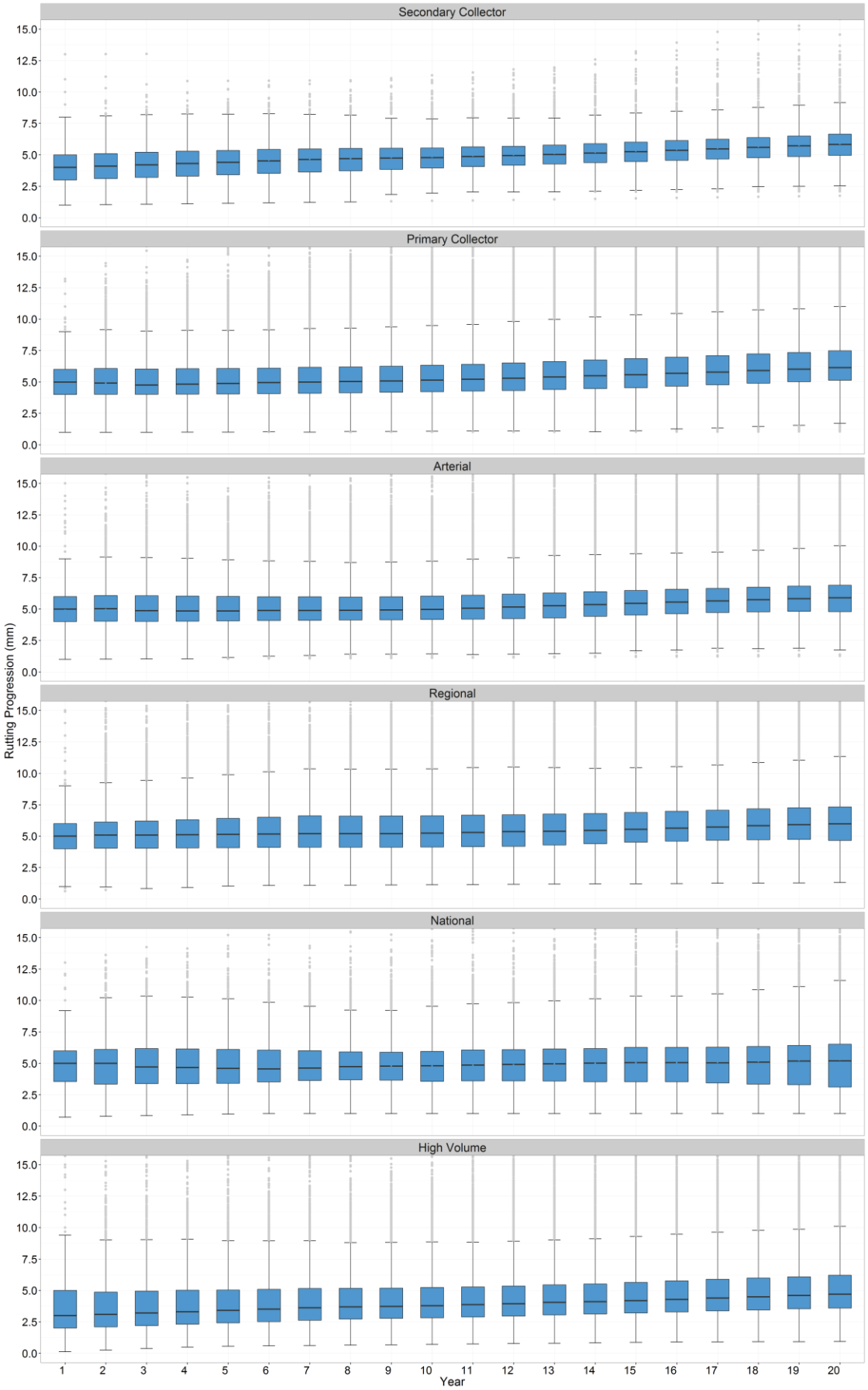
Rutting Distribution 20 Years - $110M_V2



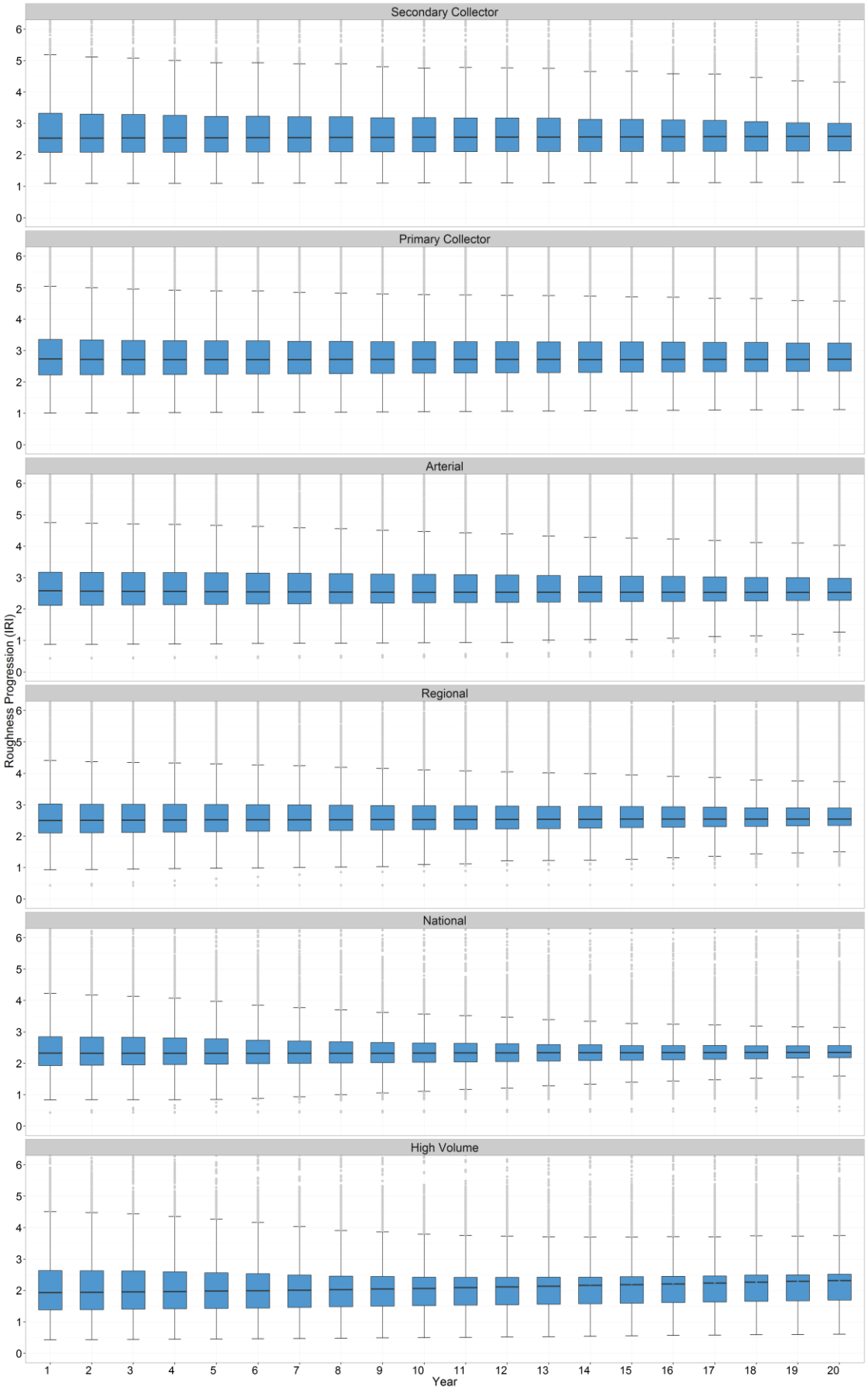
Rutting Distribution 20 Years - $90M_V2



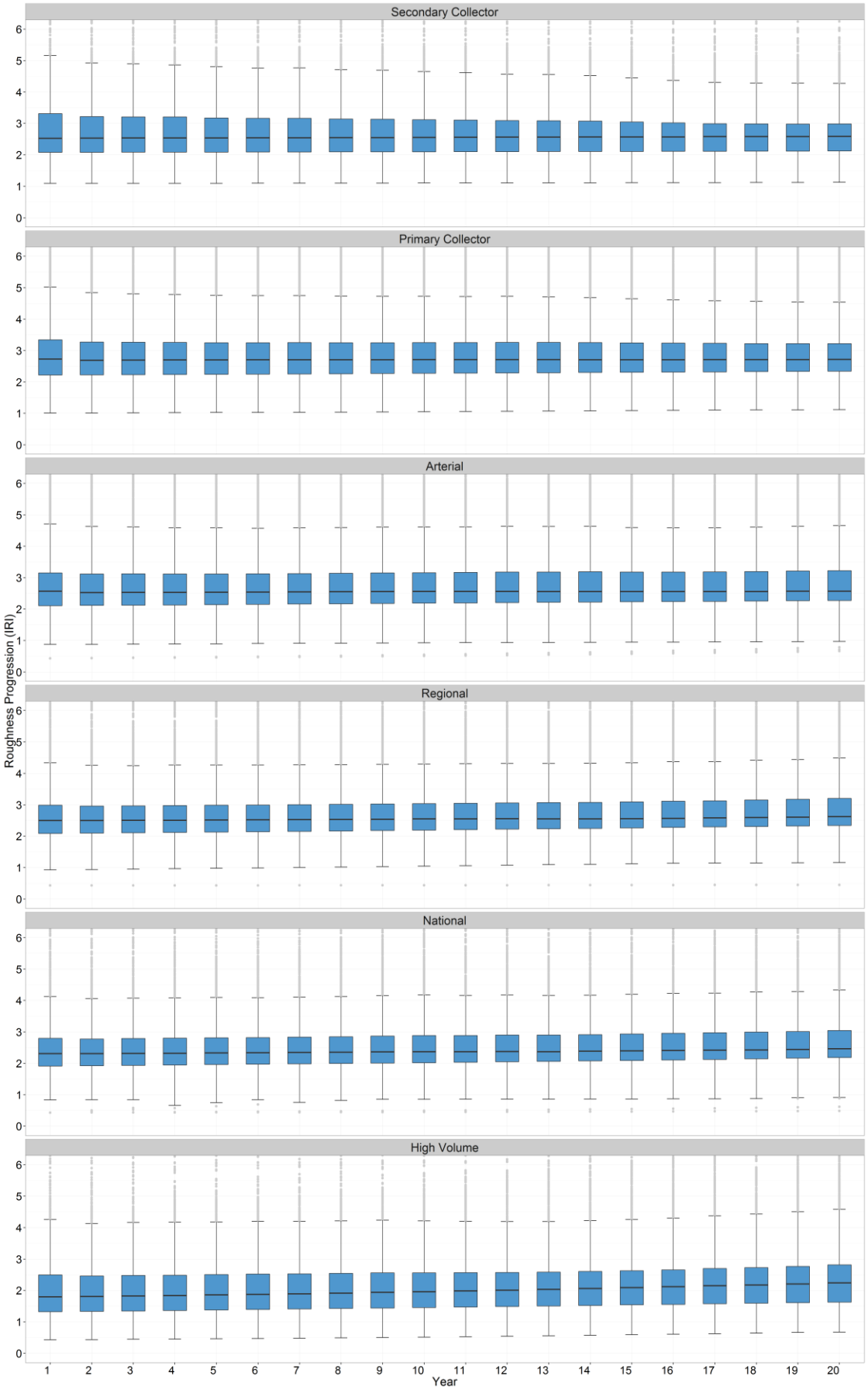
Rutting Distribution 20 Years - $80M_V2



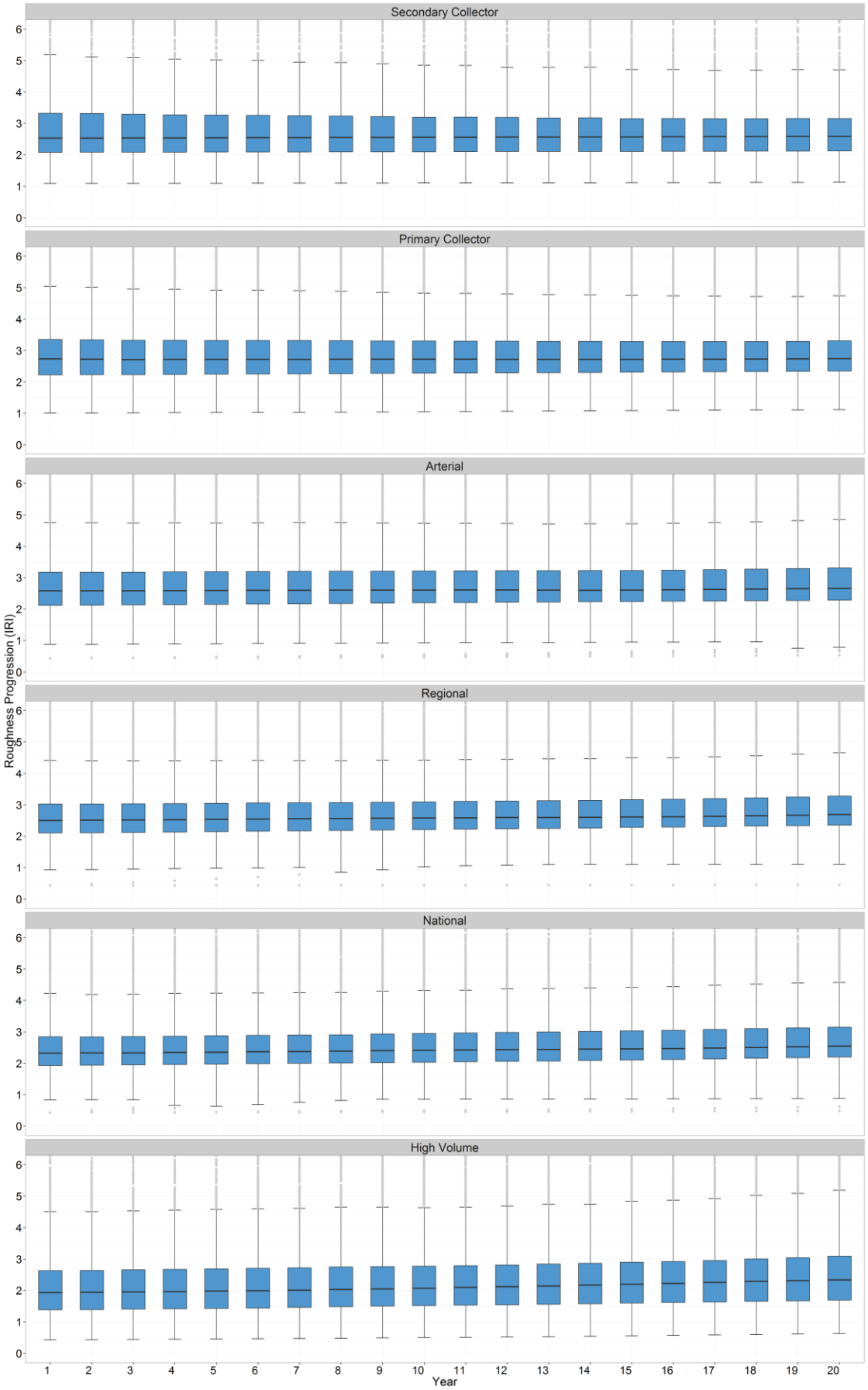
Roughness Distribution 20 Years- $100M_V2



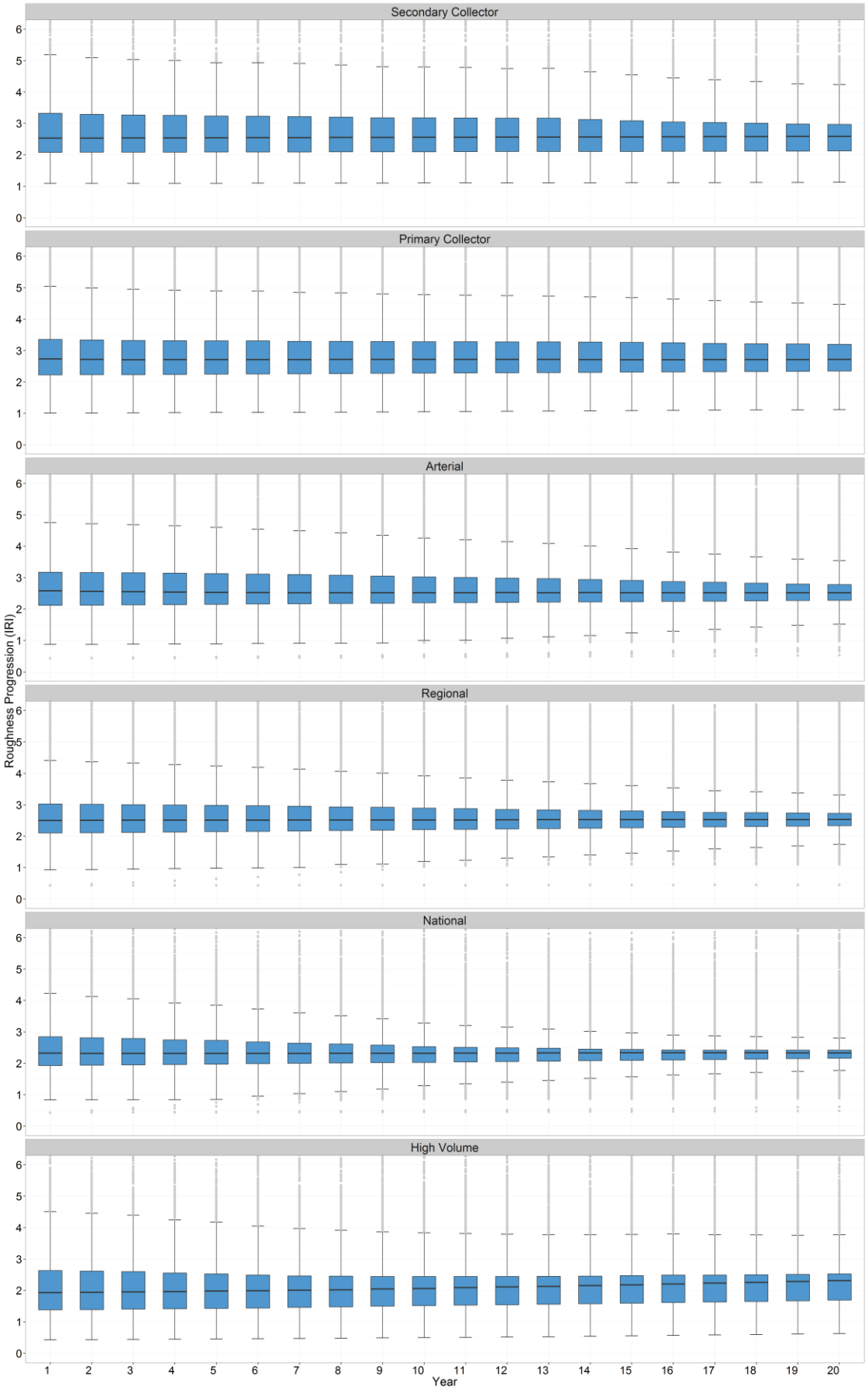
Roughness Distribution 20 Years- Birthday_V2



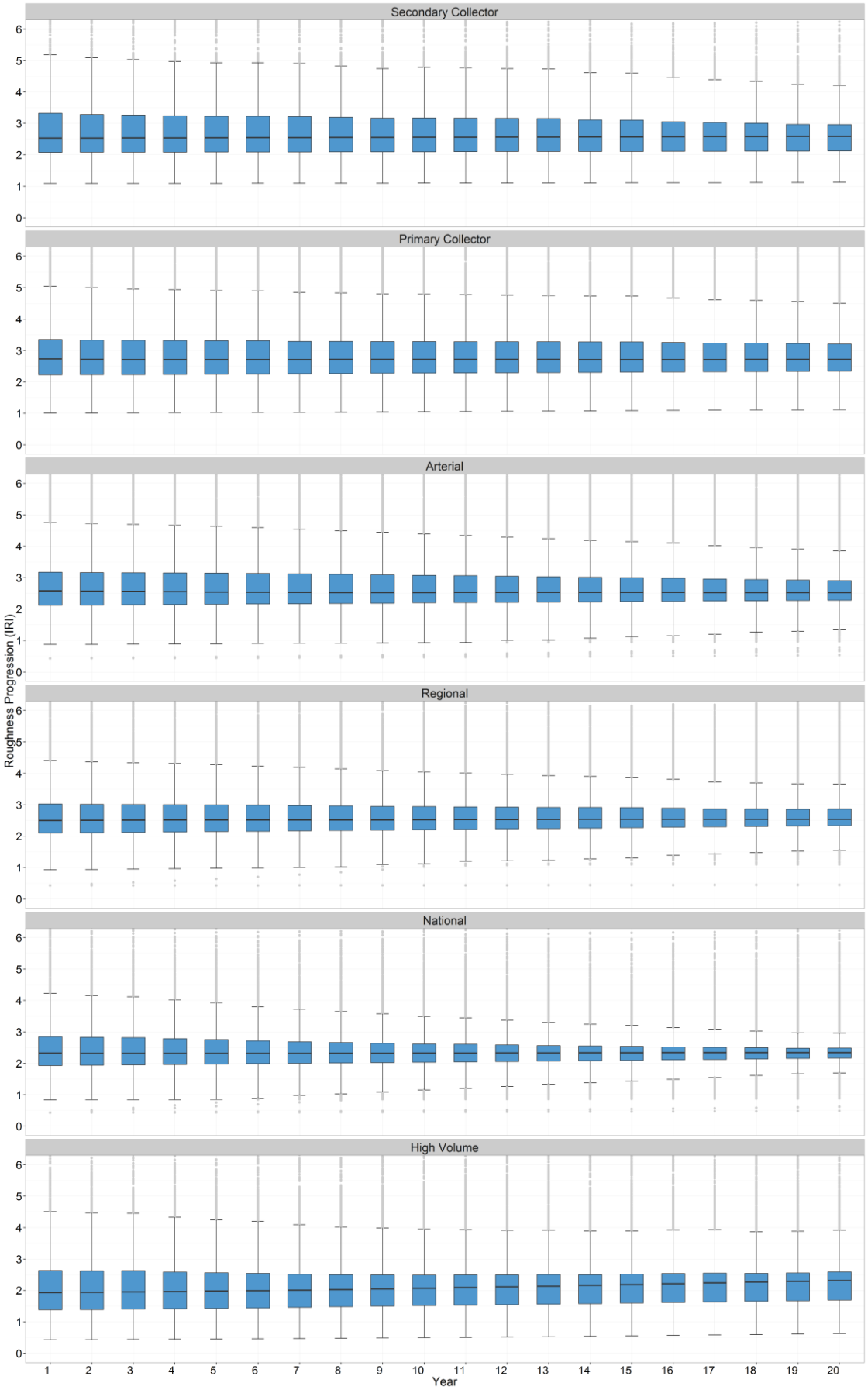
Roughness Distribution 20 Years- Least Cost_V2



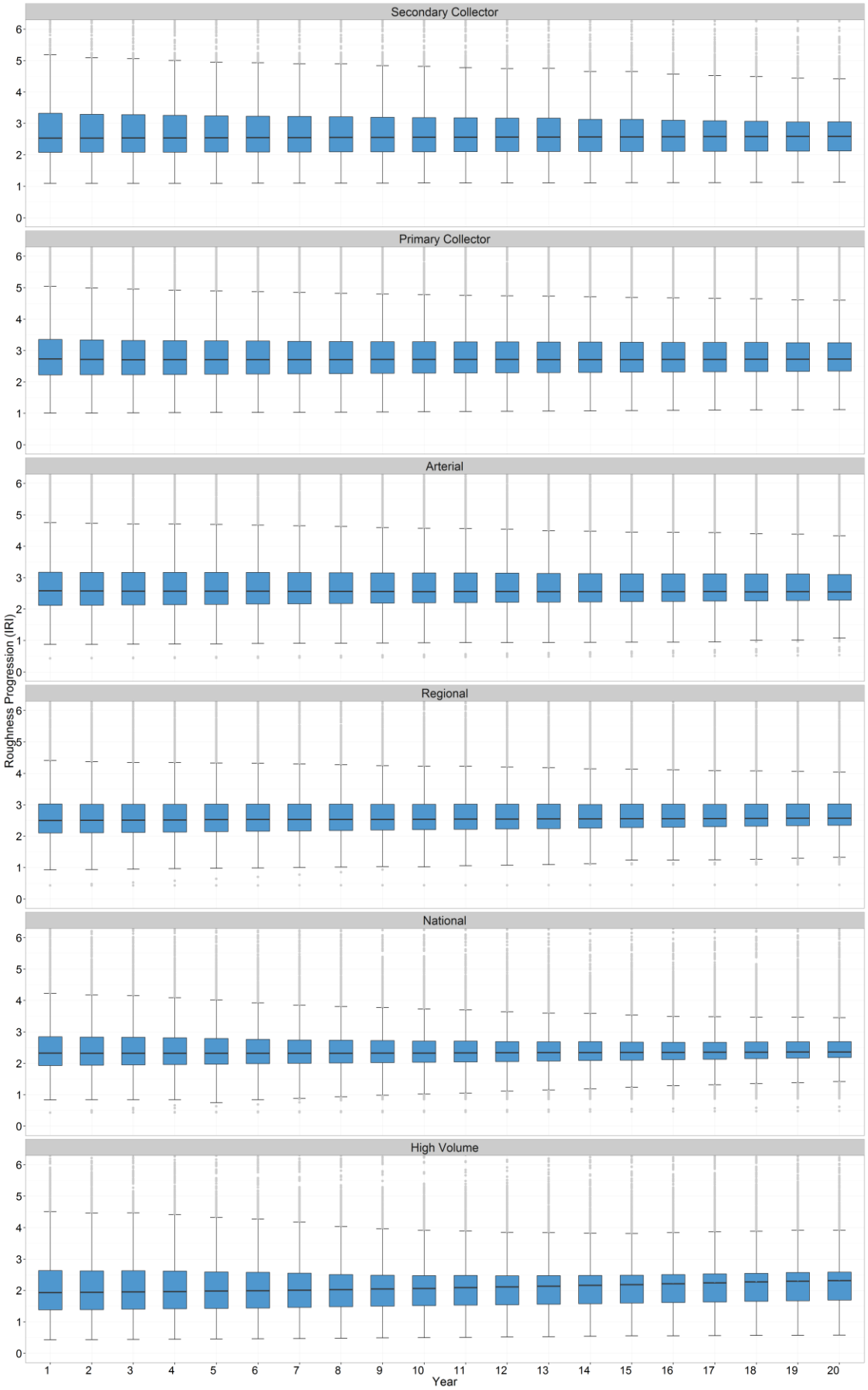
Roughness Distribution 20 Years- $120M_V2



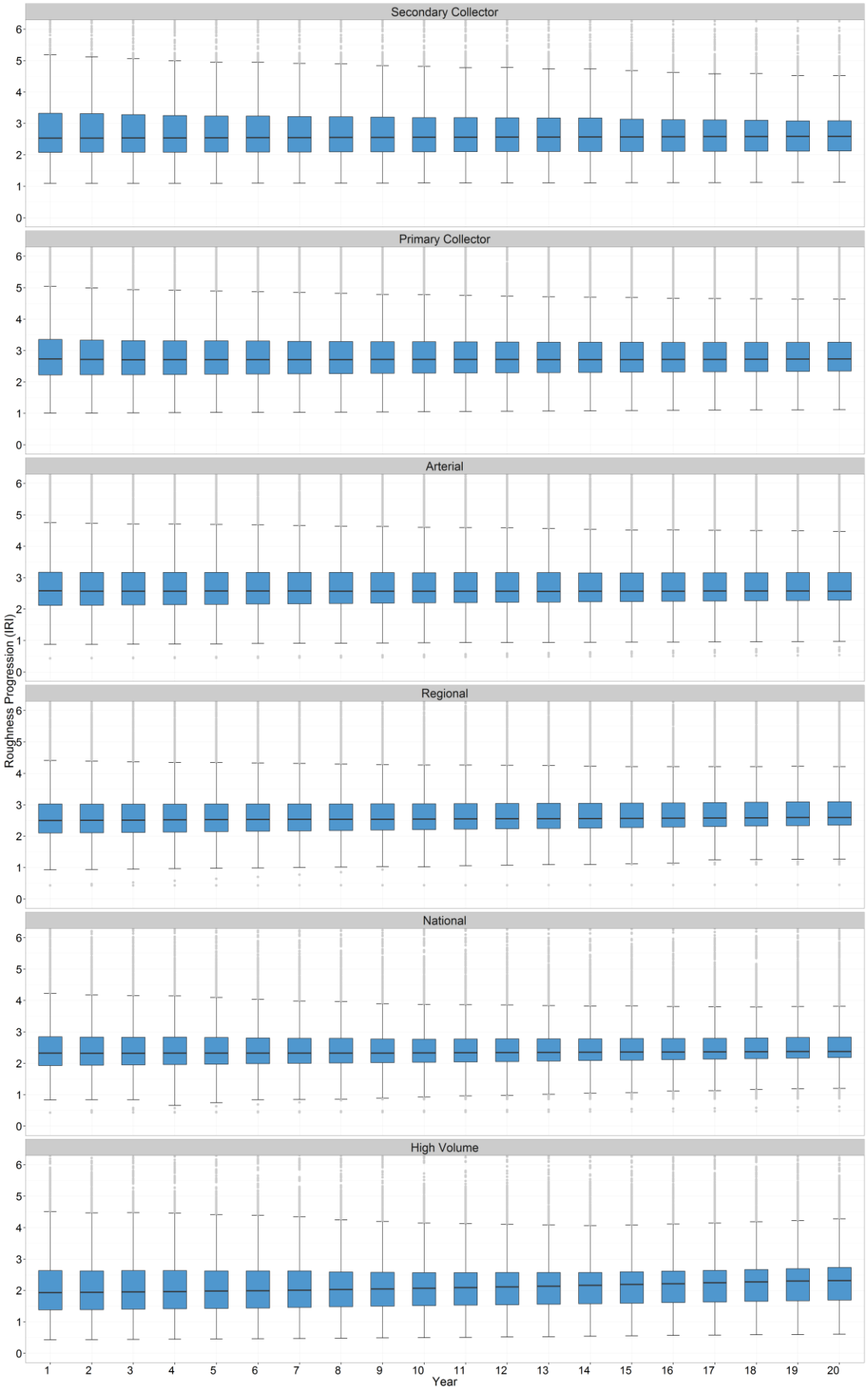
Roughness Distribution 20 Years- $110M_V2



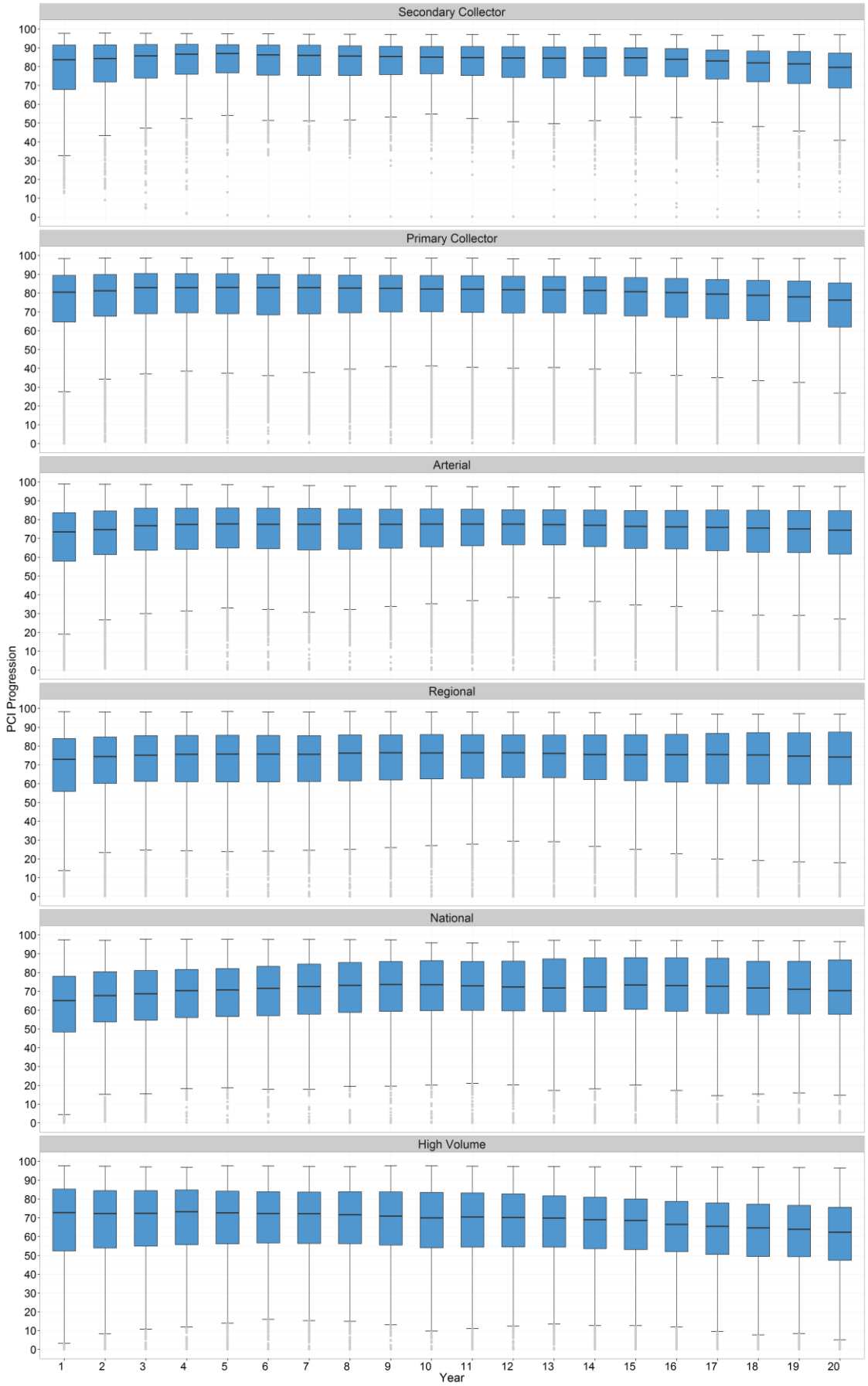
Roughness Distribution 20 Years- $90M_V2



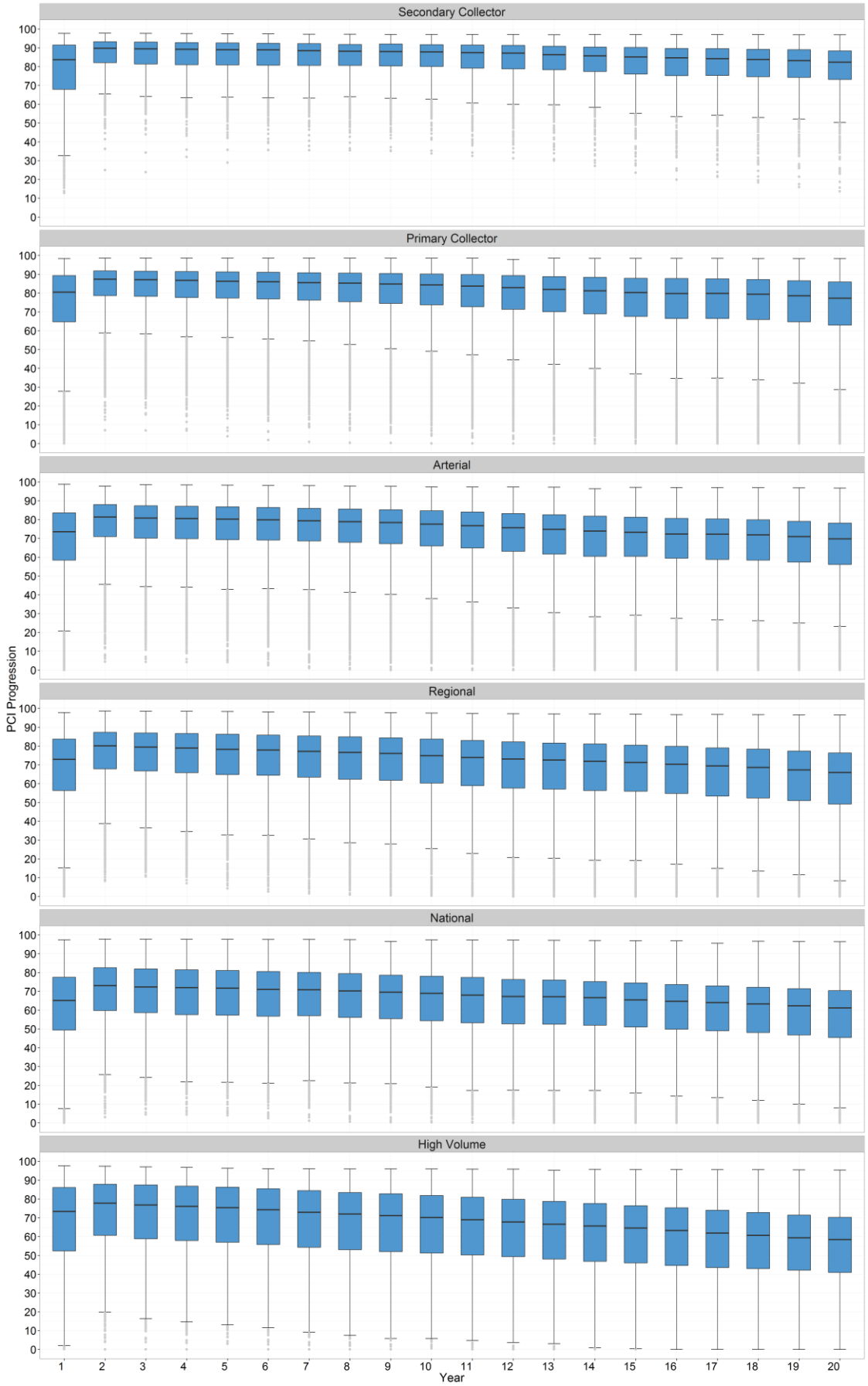
Roughness Distribution 20 Years- $80M_V2



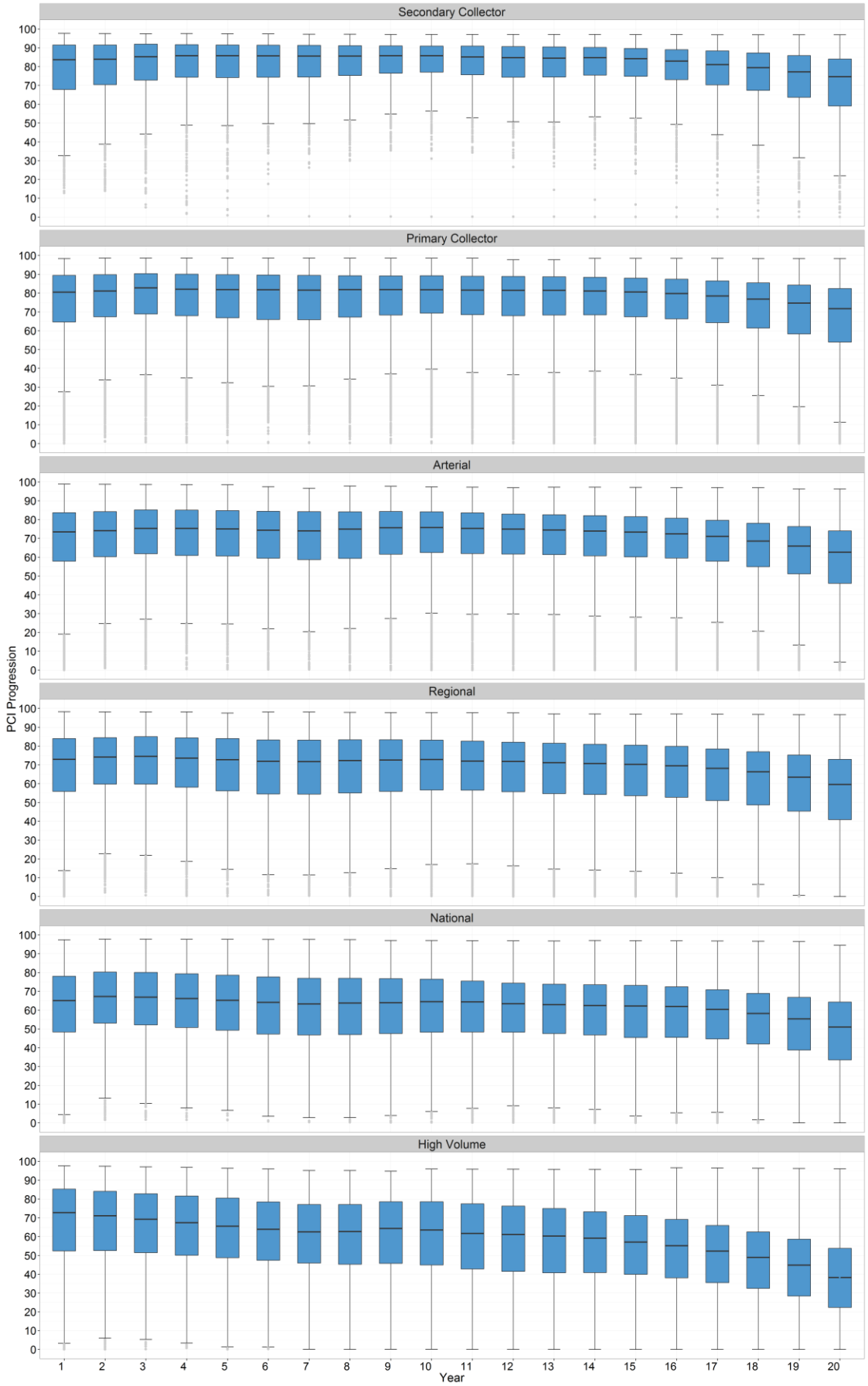
PCI Distribution 20 Years - $100M_V2



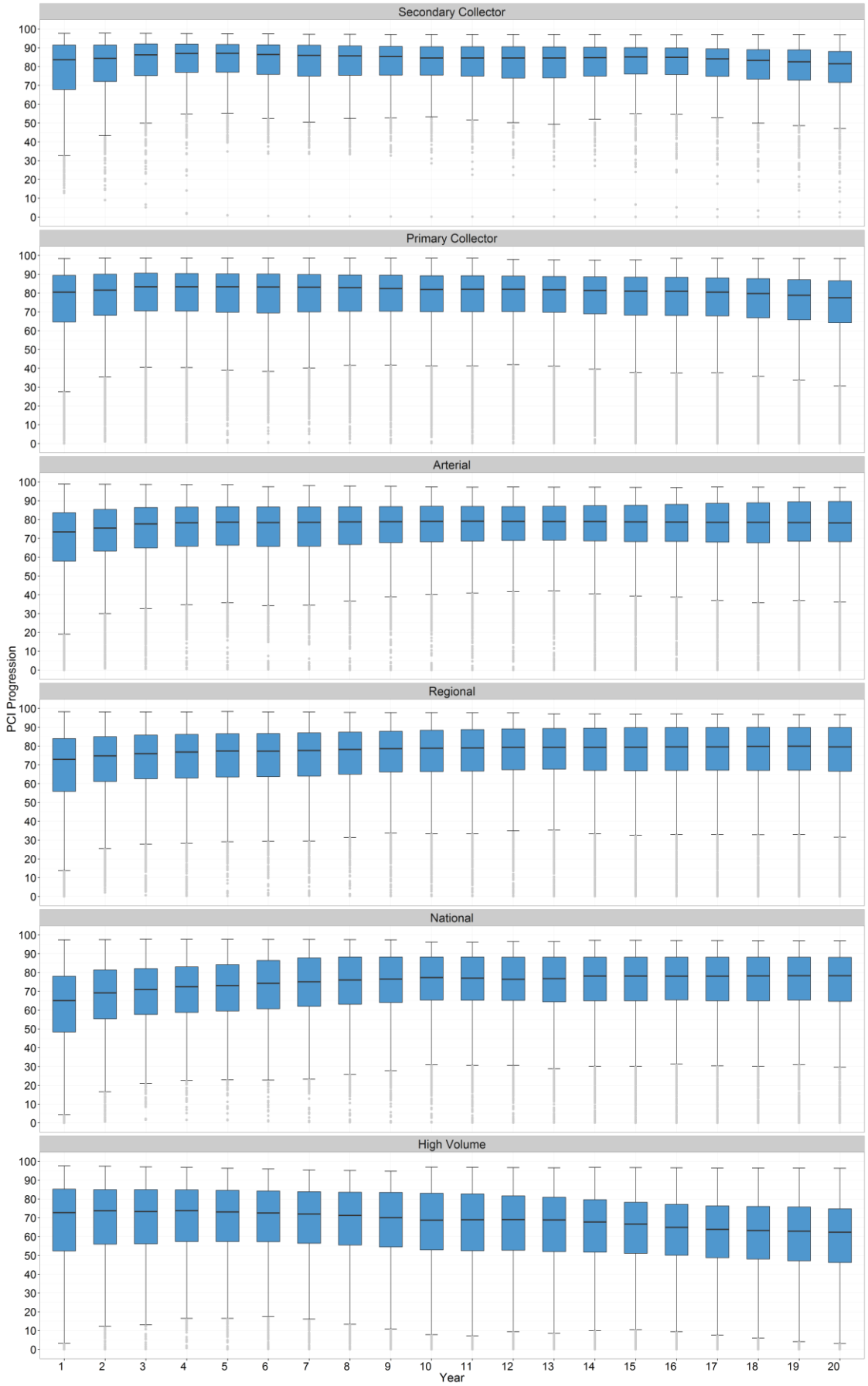
PCI Distribution 20 Years - Birthday_V2



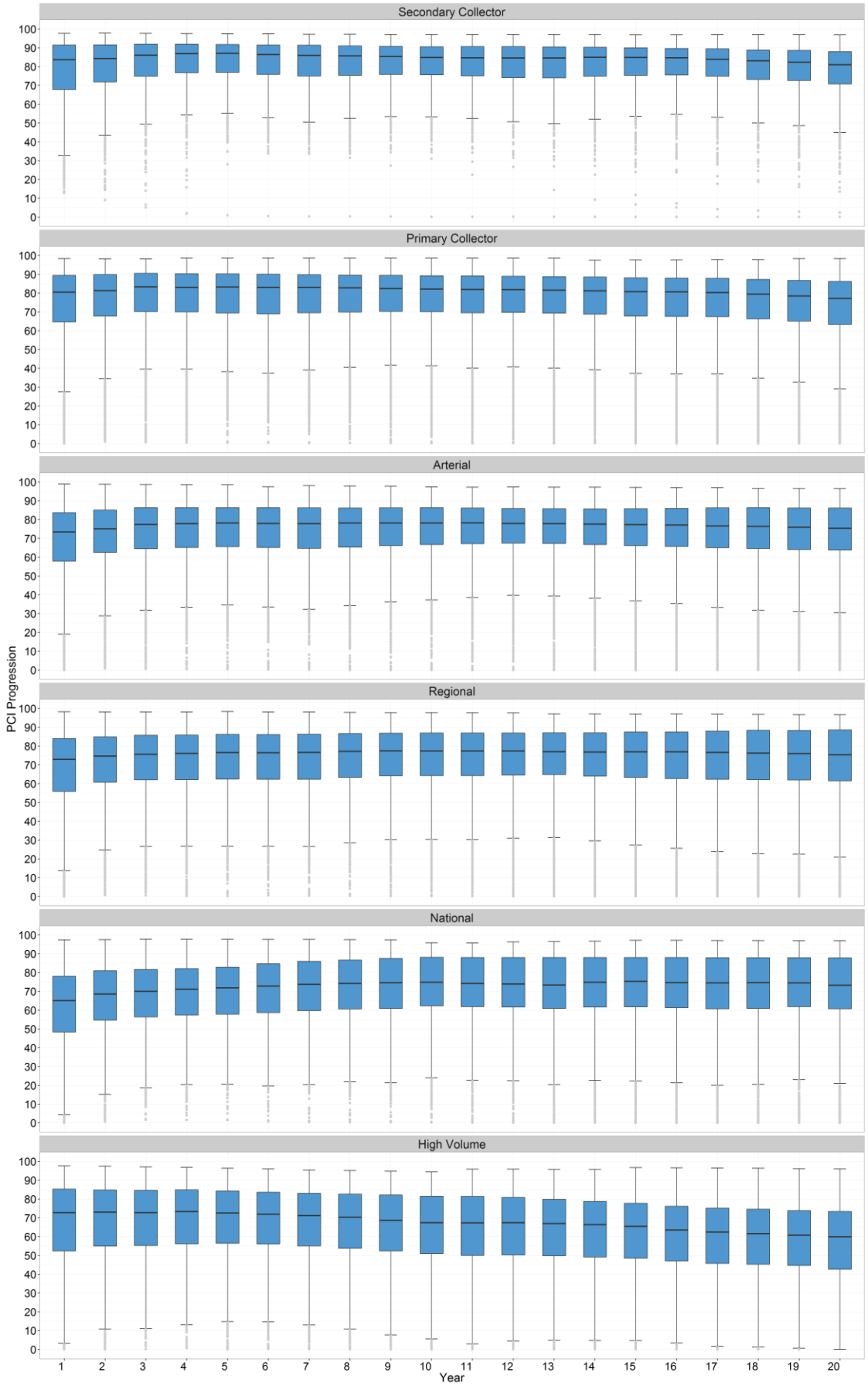
PCI Distribution 20 Years - Least Cost_V2



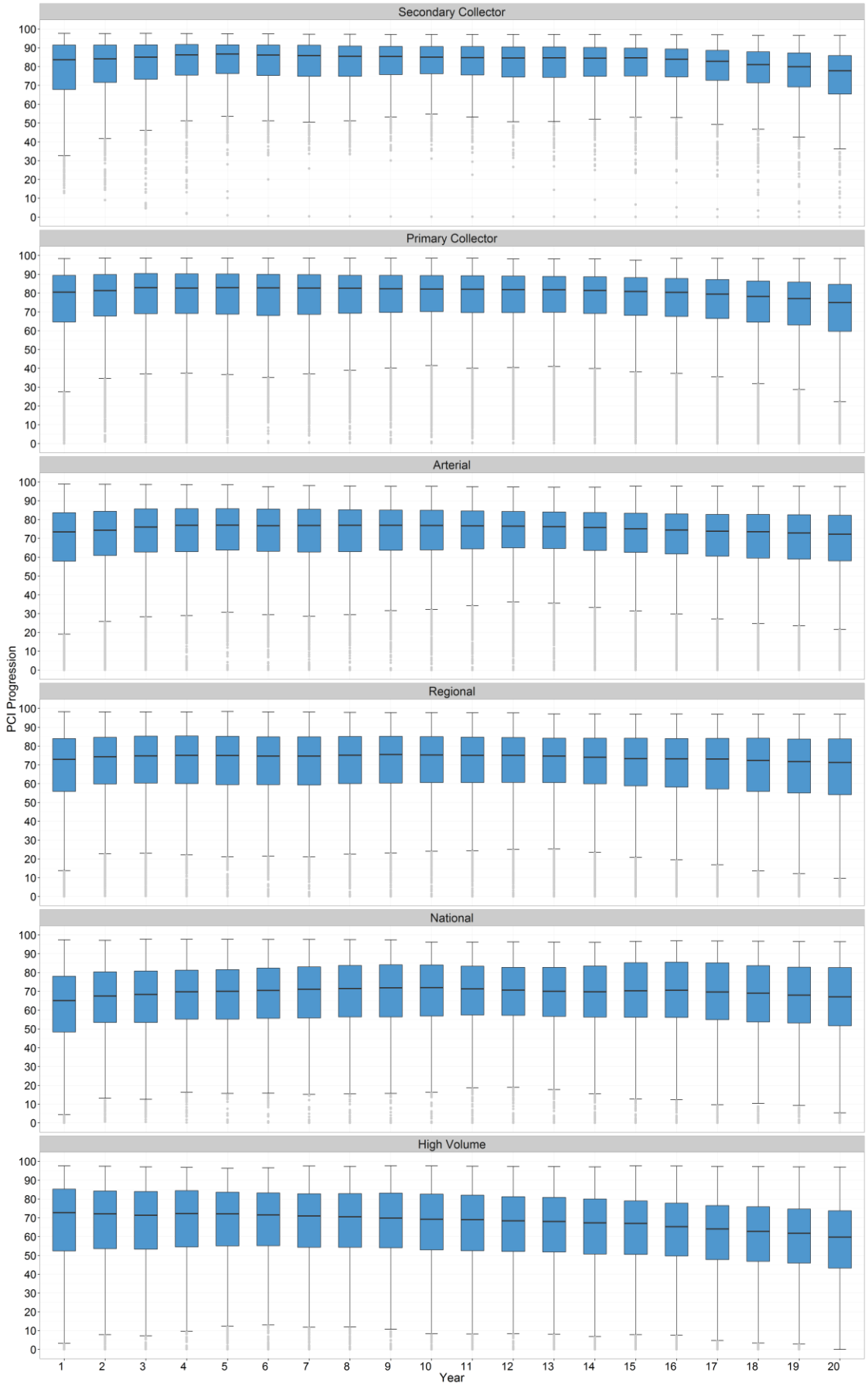
PCI Distribution 20 Years - $120M_V2



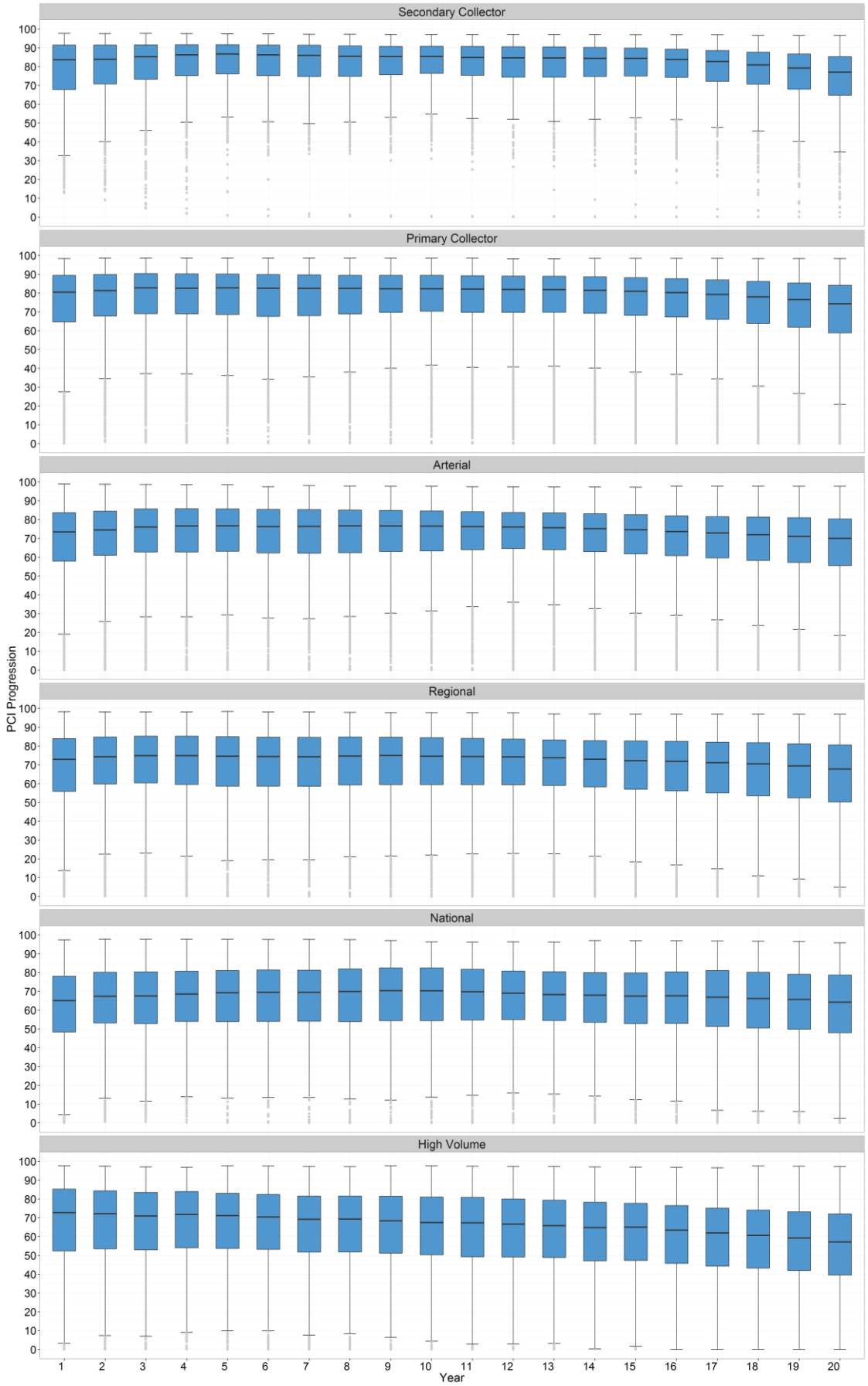
PCI Distribution 20 Years - $110M_V2



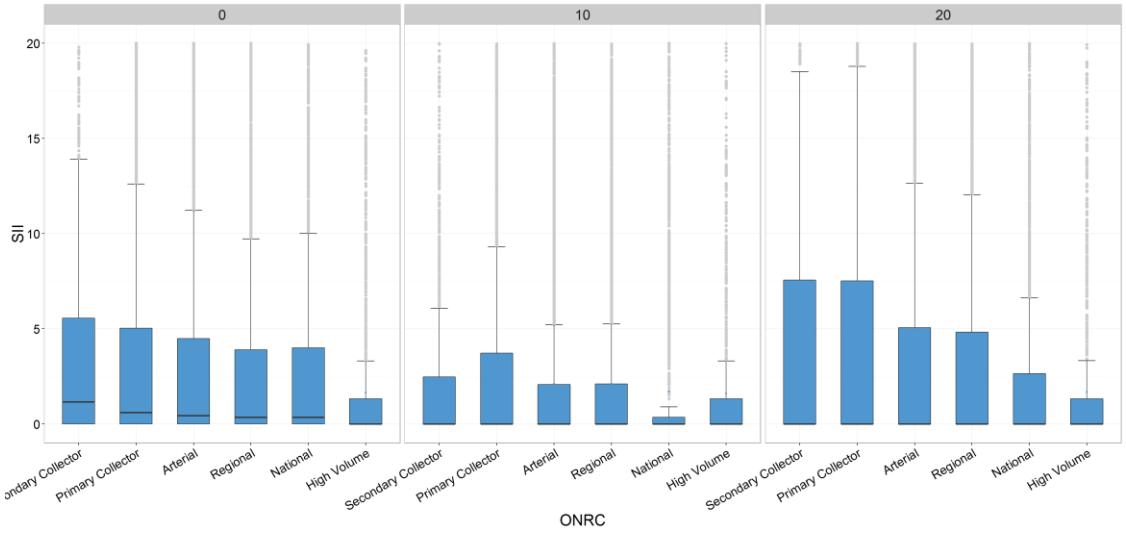
PCI Distribution 20 Years - $90M_V2



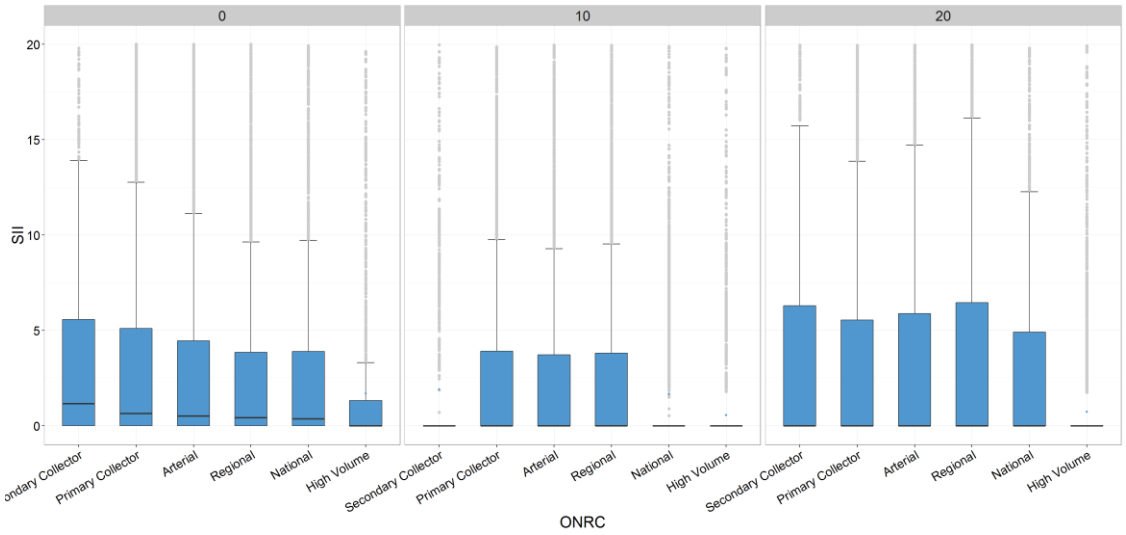
PCI Distribution 20 Years - $80M_V2



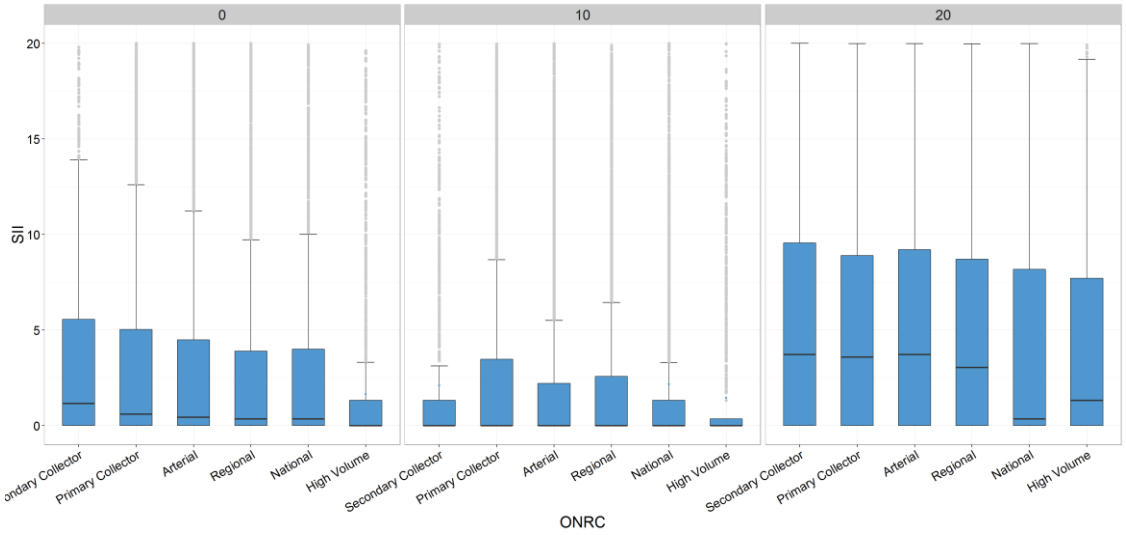
PCI Distribution - $100M_V2



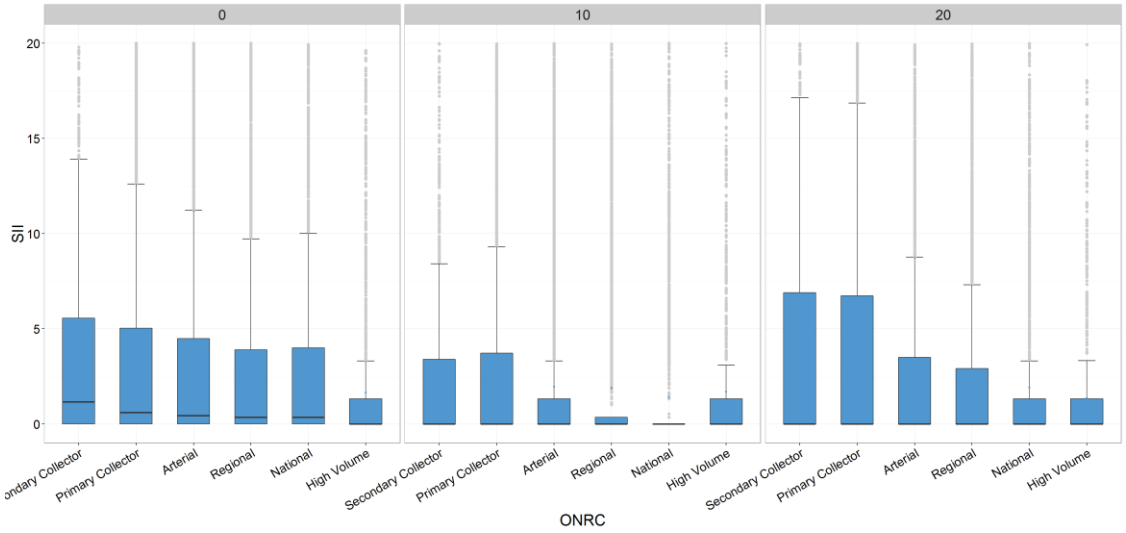
PCI Distribution - Birthday_V2



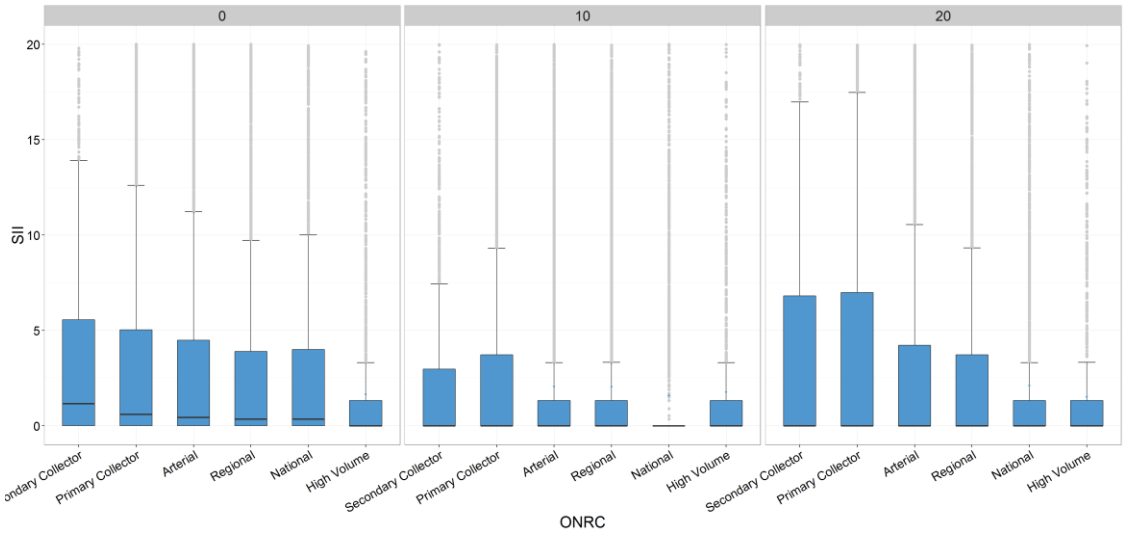
PCI Distribution - Least Cost_V2



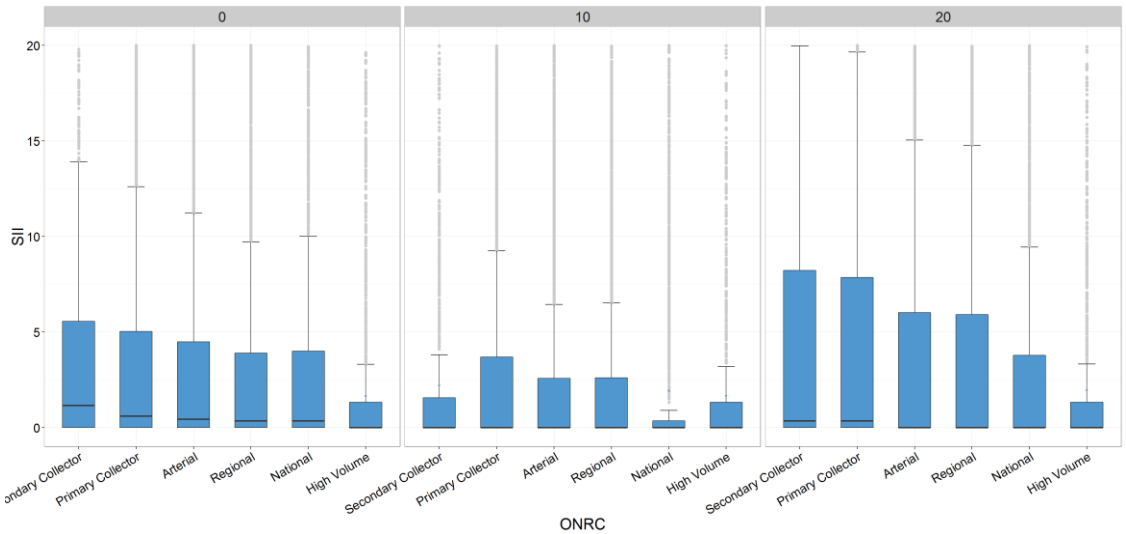
PCI Distribution - $120M_V2



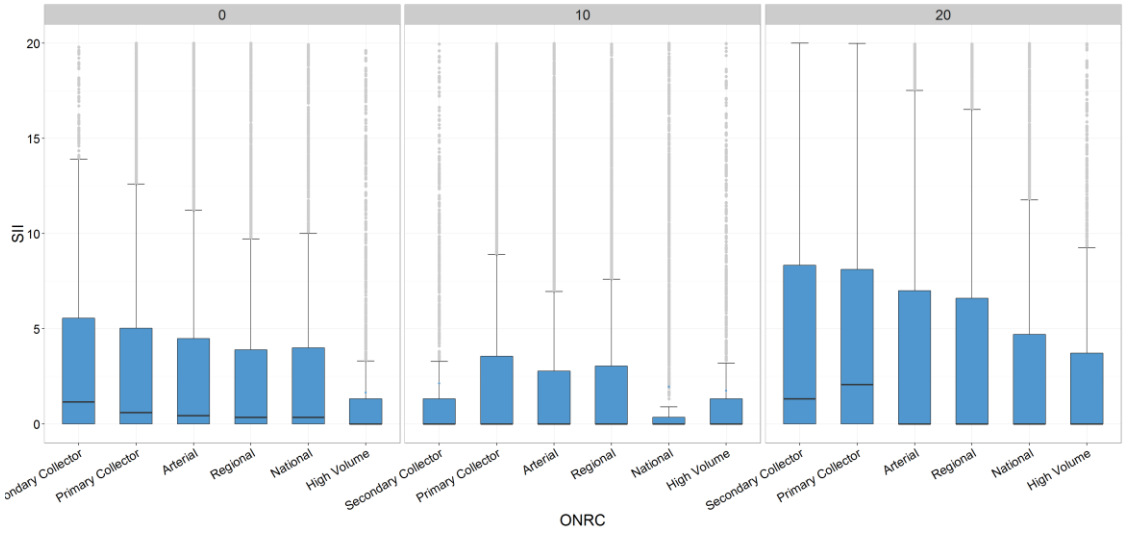
PCI Distribution - $110M_V2



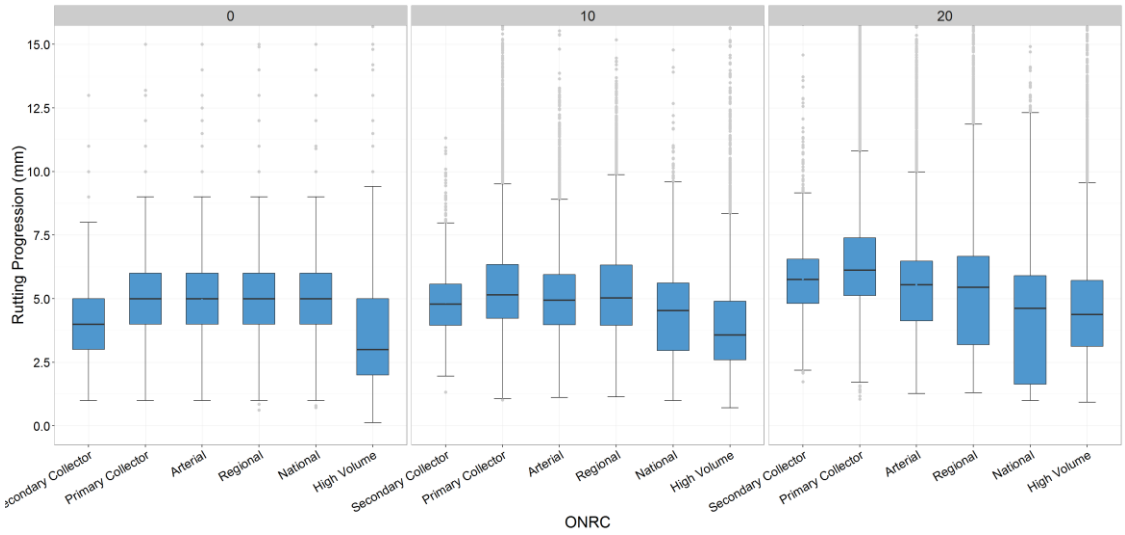
PCI Distribution - $90M_V2



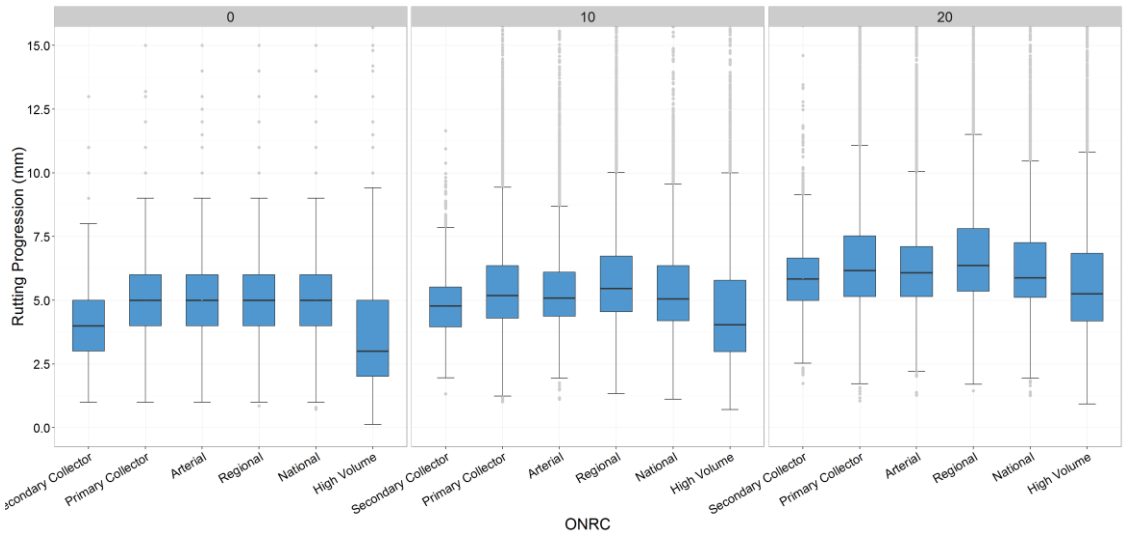
PCI Distribution - $80M_V2



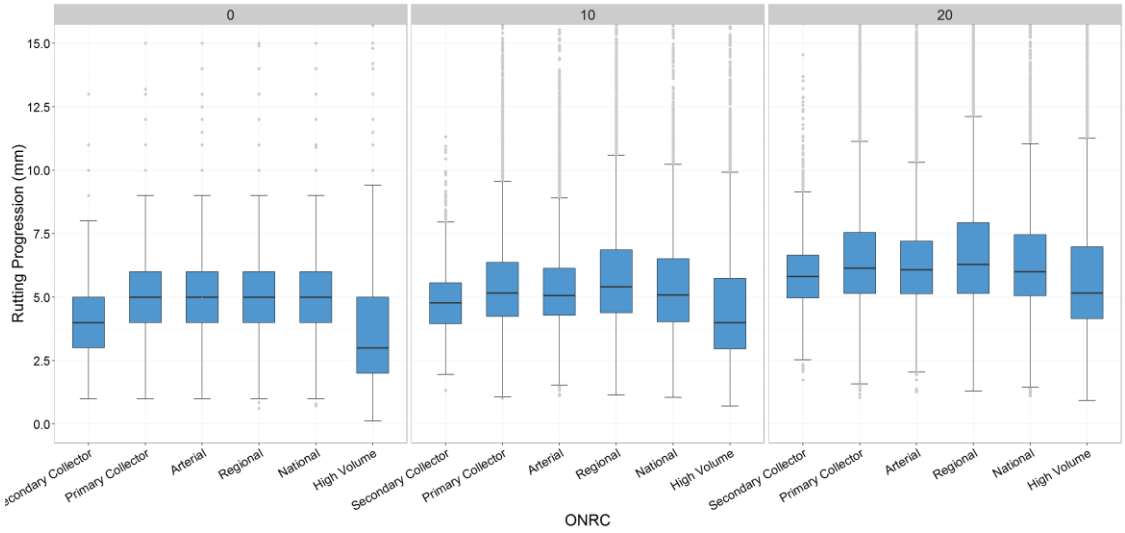
Rutting Distribution - $100M_V2



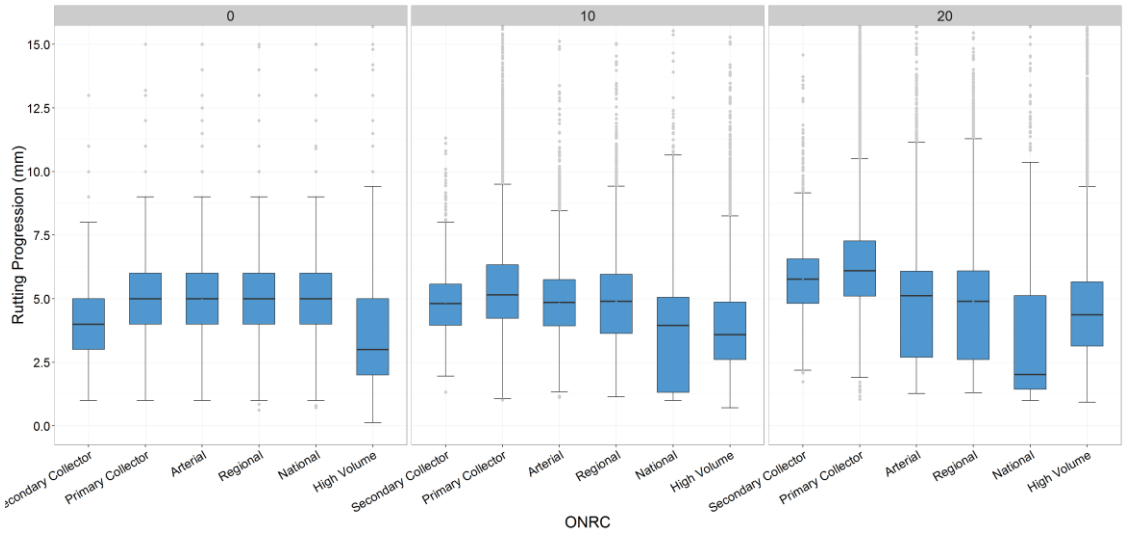
Rutting Distribution - Birthday_V2



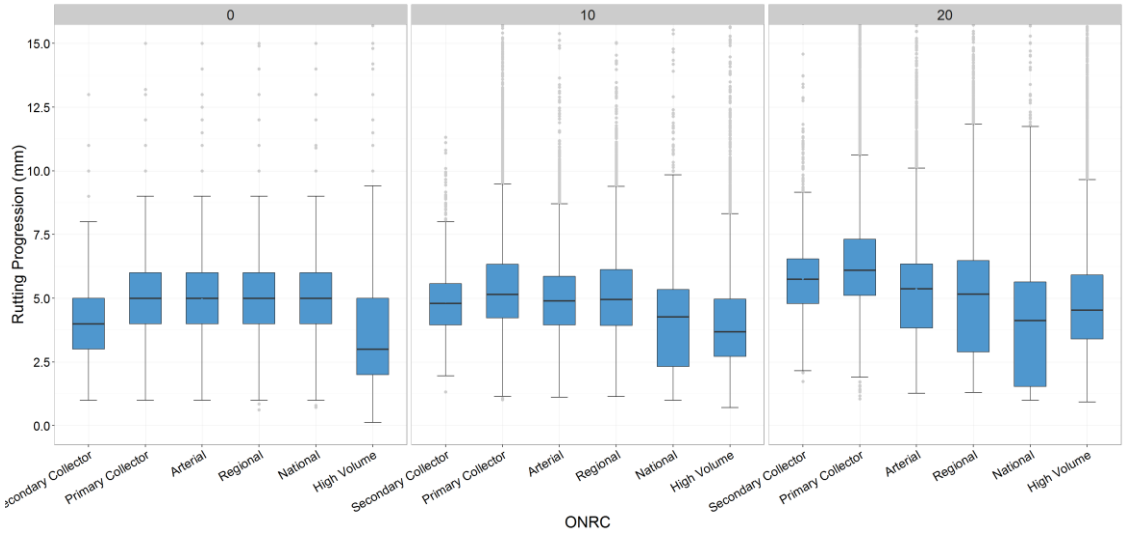
Rutting Distribution - Least Cost_V2



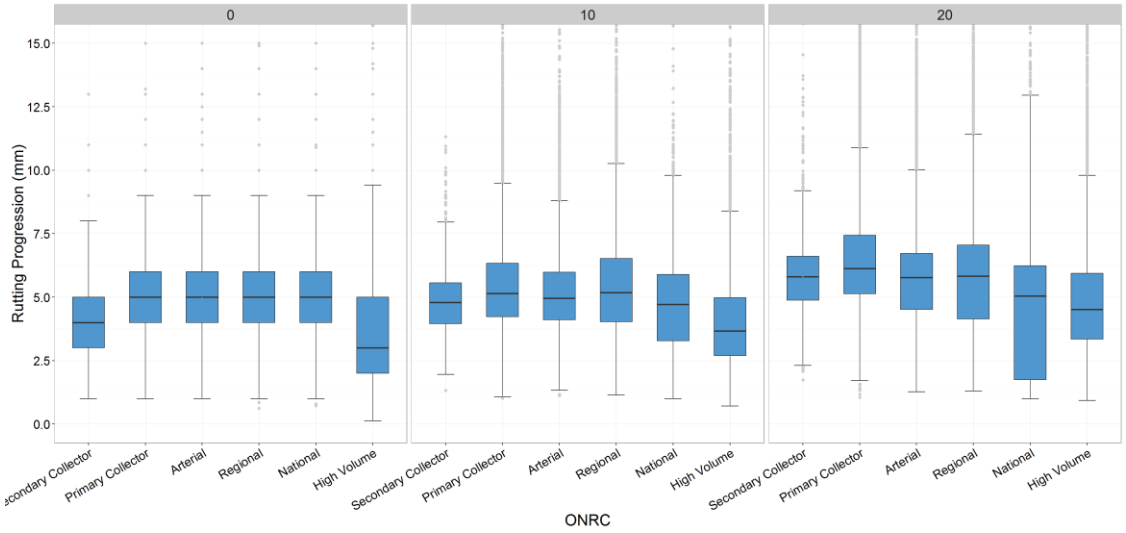
Rutting Distribution - $120M_V2



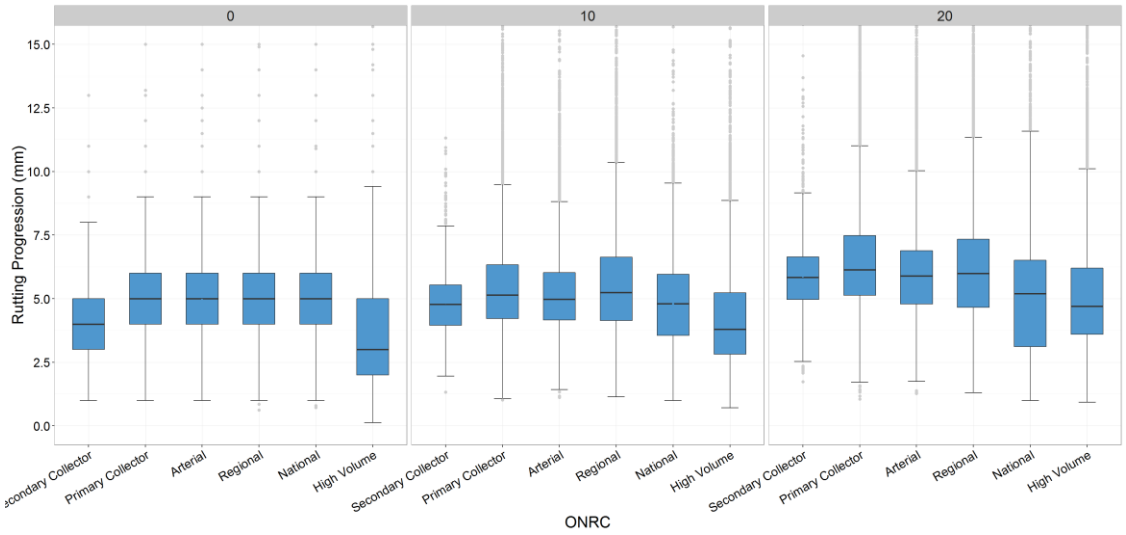
Rutting Distribution - $110M_V2



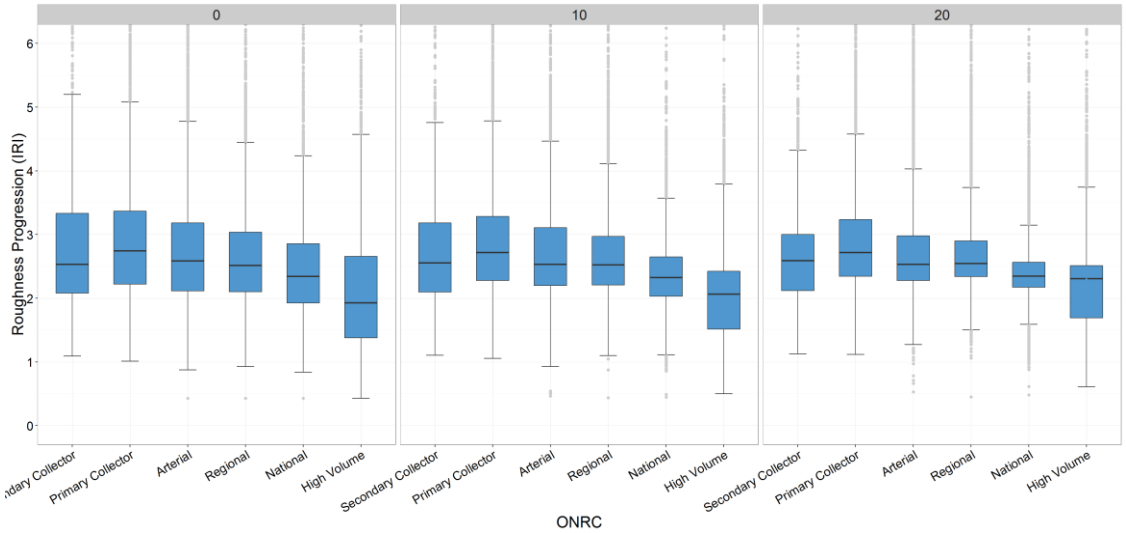
Rutting Distribution - $90M_V2



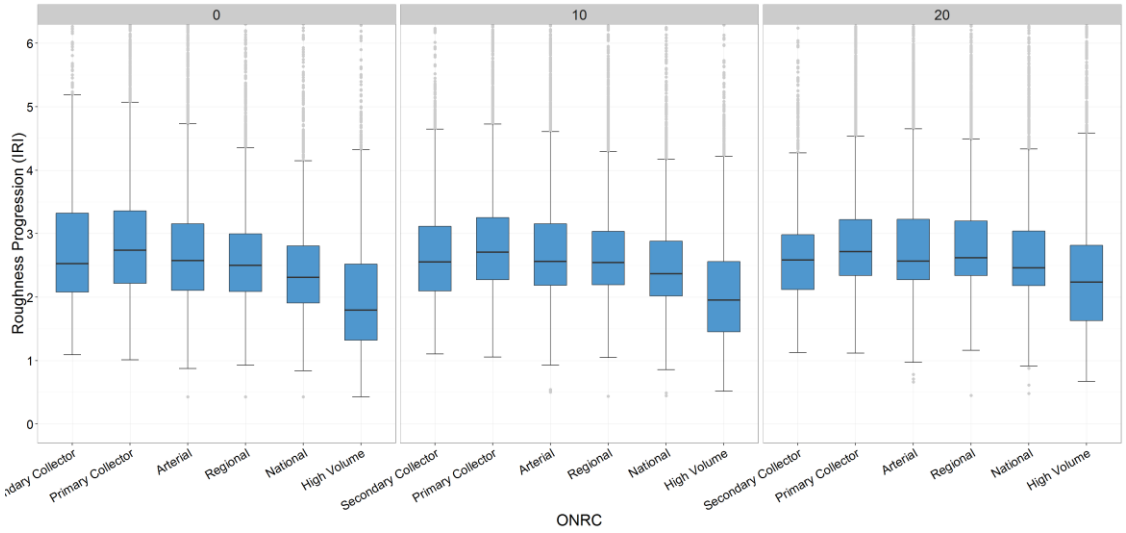
Rutting Distribution - $80M_V2



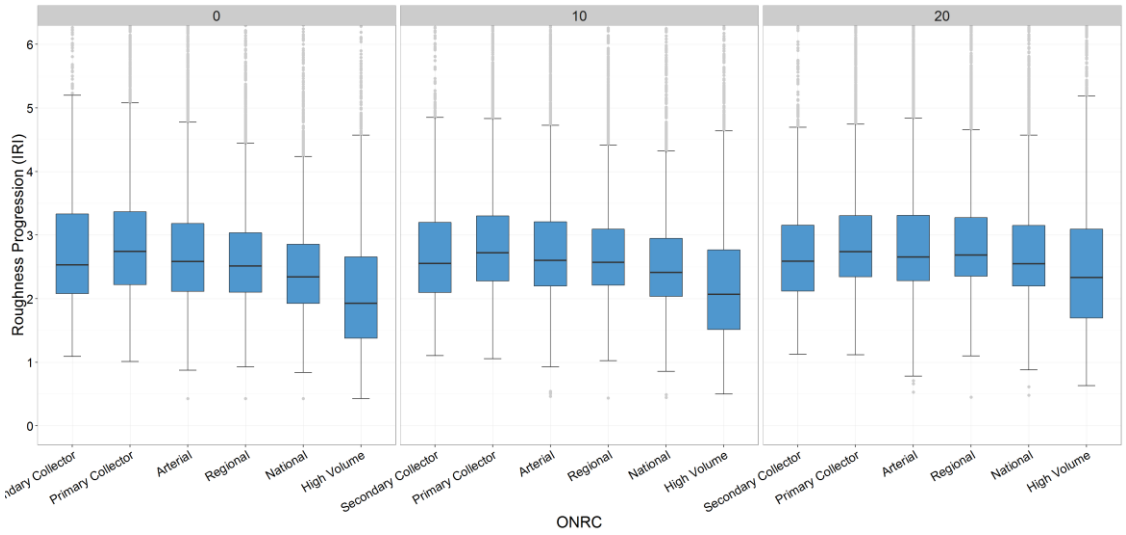
Roughness Distribution - $100M_V2



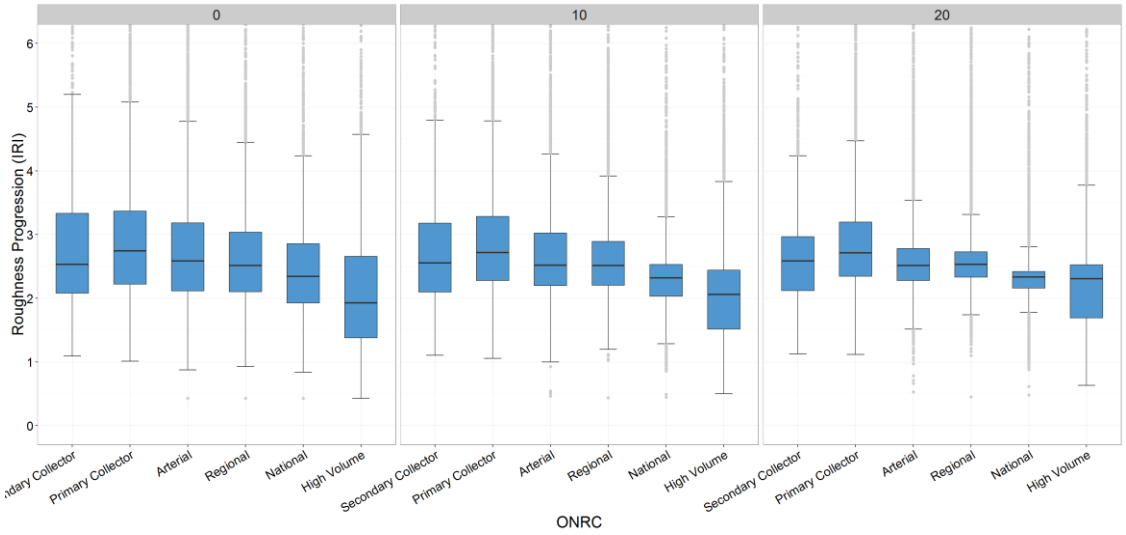
Roughness Distribution - Birthday_V2



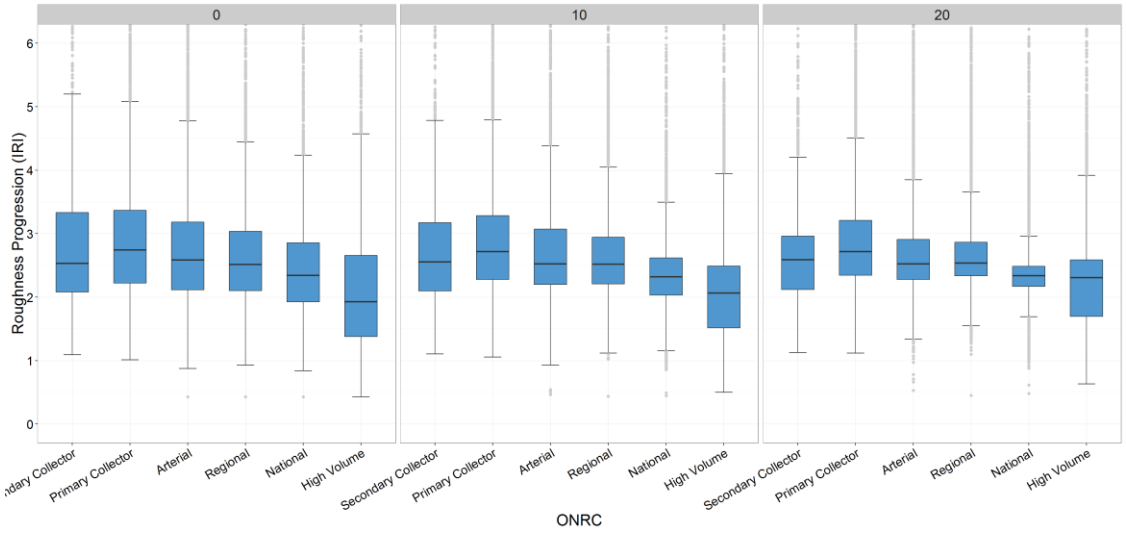
Roughness Distribution - Least Cost_V2



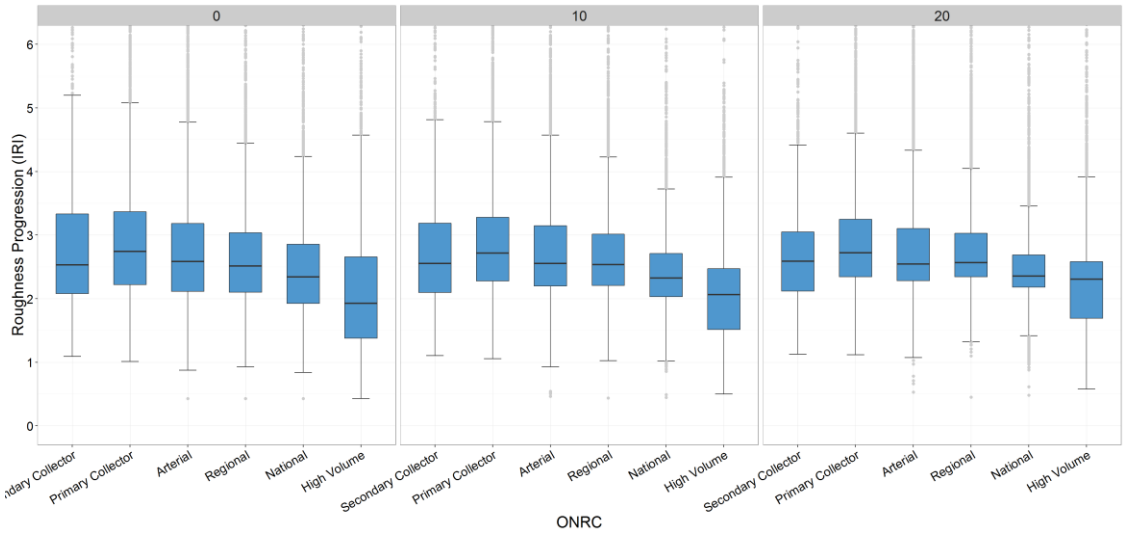
Roughness Distribution - $120M_V2



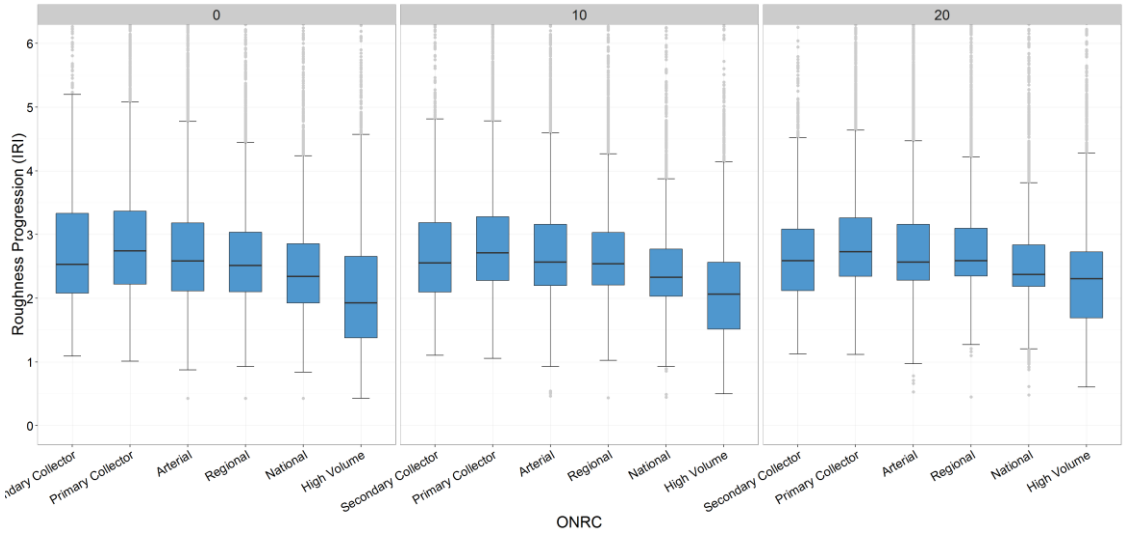
Roughness Distribution - $110M_V2



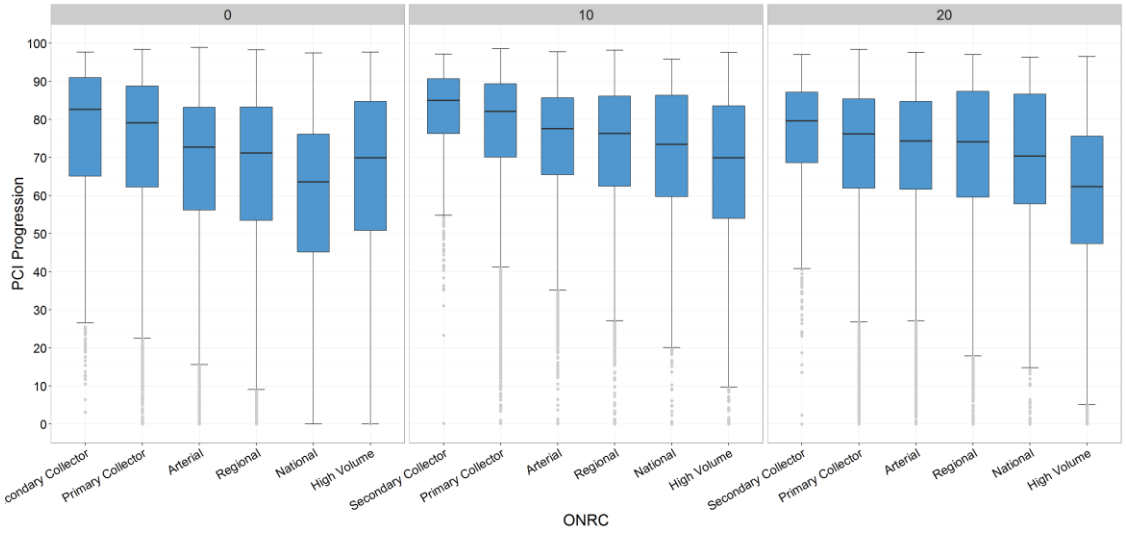
Roughness Distribution - $90M_V2



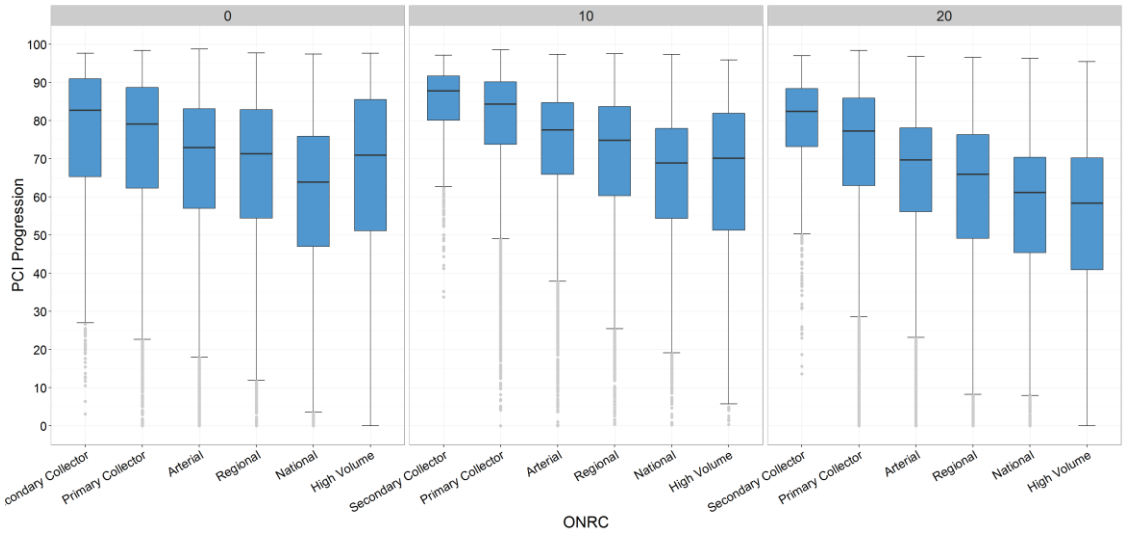
Roughness Distribution - $80M_V2



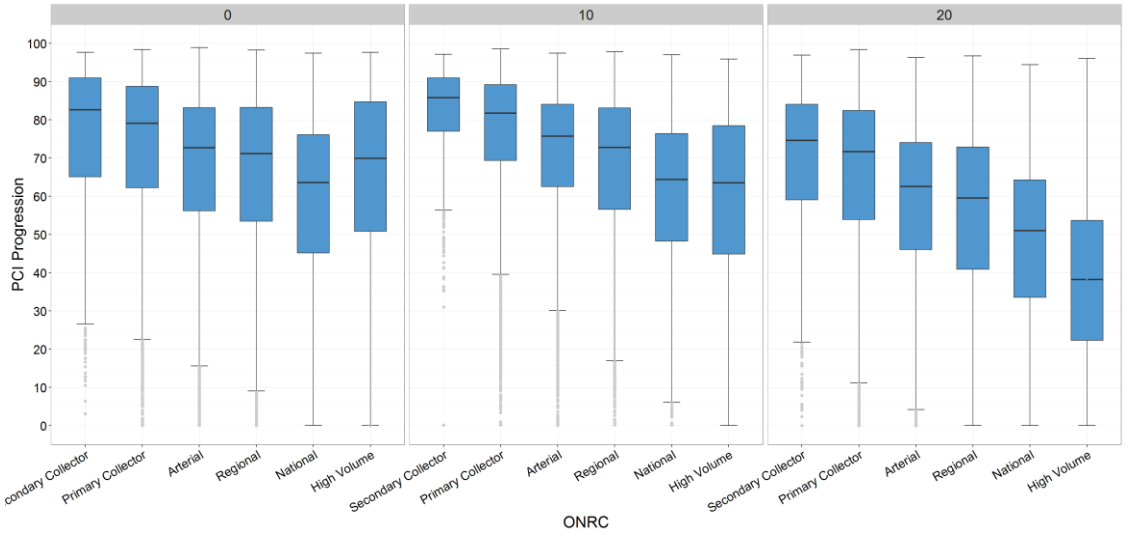
PCI Distribution - $100M_V2



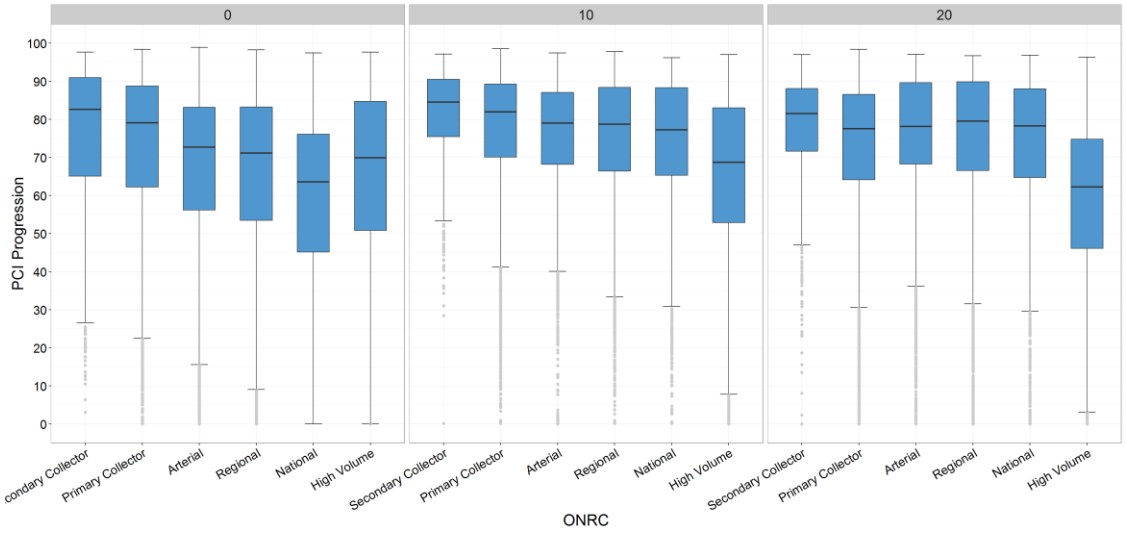
PCI Distribution - Birthday_V2



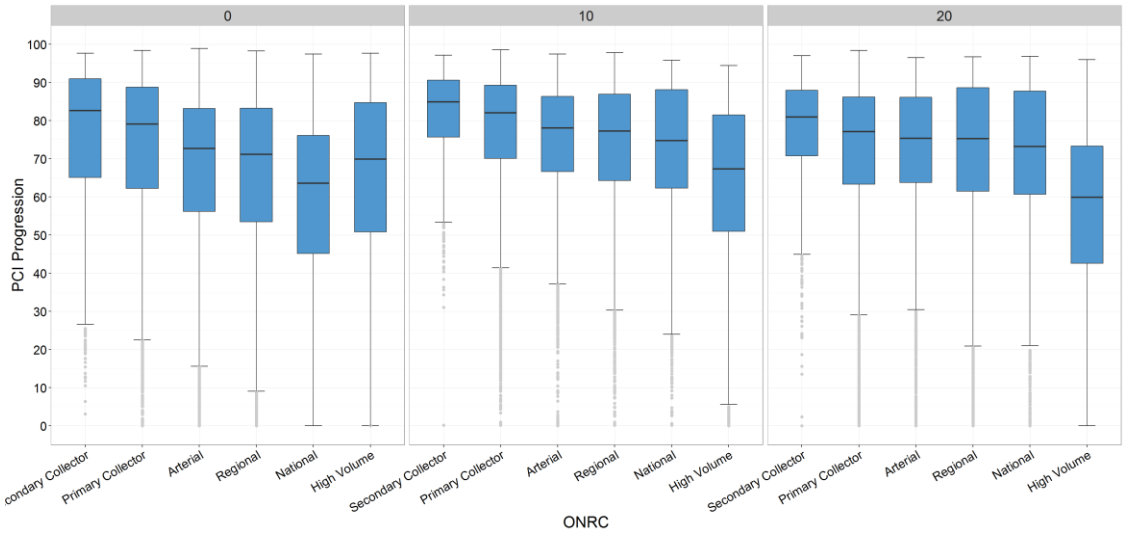
PCI Distribution - Least Cost_V2



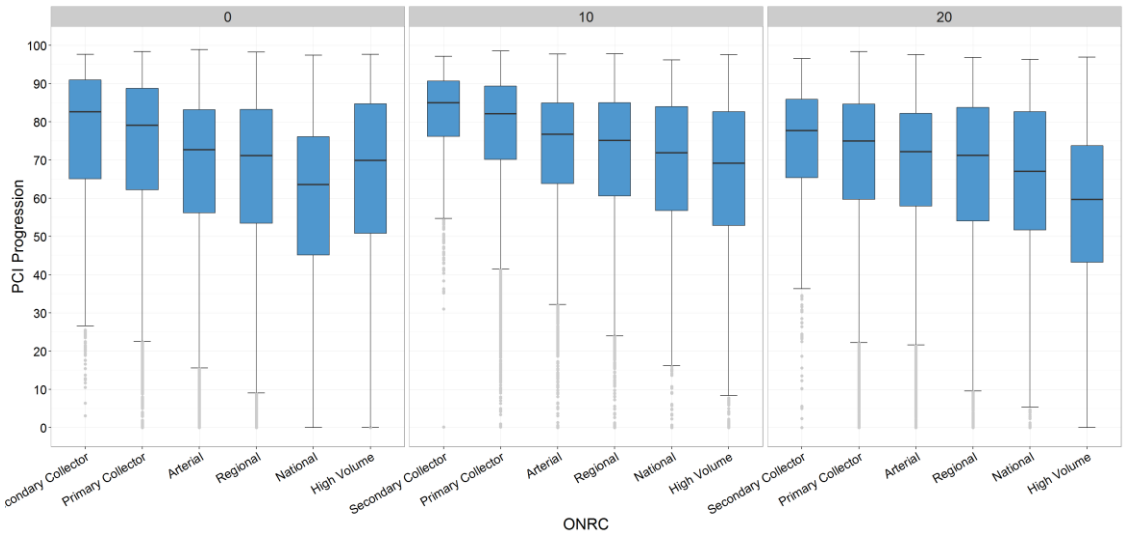
PCI Distribution - $120M_V2



PCI Distribution - $110M_V2



PCI Distribution - $90M_V2



PCI Distribution - $80M_V2