Analysis of Nutrient Levels in Canadian Coastal Waters and A Case Study on the Influence of Agricultural Activity on Nutrient Concentrations in Prince Edward Island

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SUMMARY

The National Marine Nutrient Database recently developed by Environment Canada was analyzed with the objective of elucidating regional trends in the extent of nutrient over-enrichment in Canadian nearshore coastal waters, and to provide an indication of the nutrient levels that may be used to establish initial regional guidelines and/or reference conditions for dealing with coastal systems exhibiting symptoms of nutrient over-enrichment. In addition, an analysis to determine if any relationship exists between nutrient over-enrichment and the level of agricultural activity that occurs within coastal watersheds was carried out.

The analyses consisted of mapping the levels of four parameters typically used to assess nutrient over-enrichment (nitrogen, phosphorus, chlorophyll *a* and dissolved oxygen concentration), and basic statistical analyses to determine the degree of regional differences between these parameters. The relationship between agricultural activity and nutrient over-enrichment was carried using information obtained for Prince Edward Island which has a high level of agricultural land use and has been experiencing coastal eutrophication problems for the last several decades.

Results of the regional analyses suggest that West coast nearshore waters have higher nutrient concentrations than East coast nearshore waters. However, this must be considered to be a tentative conclusion as further data screening and validation of the database is required in addition to incorporation of missing datasets.

The analysis of the relationship between nutrient over-enrichment parameters and agricultural activity showed positive relationships between the two for phosphorus, chlorophyll *a* and dissolved oxygen levels, but no clear relationship to nitrogen levels.

The results of this study provide a general overview of nutrient levels in Canadian nearshore marine waters and represent an important first step toward the development of specific nutrient guidelines to prevent or reduce the impacts of nutrient over-enrichment in our coastal systems.

Table of Contents

List of Figures

Page

List of Tables

Page

Analysis of Nutrient Levels in Canadian Coastal Waters and A Case Study on the Influence of Agricultural Activity on Nutrient Concentrations in Prince Edward Island

1. Background

The Agricultural Policy Framework (APF) includes the need to develop a suite of non-regulatory standards to specify desired levels of environmental quality required in waters receiving inputs from agricultural areas, and for validating best management practices. Marine eutrophication is a growing concern in many estuaries, inlets and coastal systems on both the east and west coasts of Canada and agricultural practices are often thought to play a prominent role in nutrient over-enrichment of coastal systems.

Environment Canada has recently developed a National Nearshore Marine Nutrient Database containing 25 nutrient and biological parameters. The major purpose of this project was to examine this database with the following aims:

1. Prepare a series of maps depicting the distribution of available data on nutrient and related eutrophication parameters for nearshore waters,

2. Carry out a critical analysis of the database to identify spatial patterns and differences in nutrient concentrations between regions,

3. Identify and recommend initial acceptable (reference or background) nutrient concentrations for coastal waters based on the percentile approach commonly employed for establishing acceptable nutrient levels,

4. Using data available for agricultural activities within Prince Edward Island coastal watersheds, determine the degree to which the levels of eutrophication related parameters are correlated to agricultural activities and,

5. Identify data and knowledge gaps.

2. Approach

2.1 Data Selection

The original National Nearshore Marine Nutrient Database contains in excess of 600,000 records. Many of these records, however, are for sites located well offshore. In order to produce a database more reflective of conditions within nearshore coastal waters, a subset of the main database was created by selecting only those data for waters having salinities

≤30 ppt[1] and sampling depths ≤6 metres. Of the 25 parameters contained within the database, six were originally selected for analysis: these included four causal[2] variables (total nitrogen, total dissolved nitrate, total phosphorus and phosphate), and two response[3] variables (chlorophyll *a* and dissolved oxygen). In the final analysis, however, total nitrogen and total phosphorus were omitted as the number of observations for these parameters is very limited for most regions. The final subset of the main database that was used for the analysis contains 33,391 records.

2.2 Mapping

Maps were generated using the ArcGIS 9 Geographic Information System software. Base maps were obtained from the ESRI Data and Maps Media Kit that accompanies this software package. Data was displayed using NAD 27 coordinates.

In addition to maps showing the distribution and magnitude of data for all of Canada, maps were also generated on a regional basis in order to produce larger scale maps that allowed for better resolution of the data, and for determining if there are significant differences between regions. The regions selected were East, Northeast, West and Northwest. The geographic coordinates used to define each region are listed in Table 2.1 and the regions are depicted in Figure 2.1.

The levels of causal and response parameters for each region were also mapped and are contained in Appendix I. The criteria used to determine low, medium and high levels is based on that proposed by Bricker et al. (1999) and are listed in Table 2.2. These criteria are based on an extensive survey of US coastal waters and represent a general guideline for determining the degree of nutrient over-enrichment within a particular coastal system.

Table 2.1 Coordinates used to define each region.

REGION	Latitude	Longitude
East	≤ 52.00	≥ -77.68
Northeast	> 52.00	≥ -77.68
West	≤ 52.00	< -77.68
Northwest	>52.00	< -77.68

[1] Offshore marine waters generally have salinities >34 ppt. The value of ≤30 ppt is based on the assumption that salinities within this range would represent marine waters that are likely to have been diluted by freshwater run off and therefore receive land based nutrient inputs.

[2] The term 'causal' refers to parameters that are considered to be the main causes of nutrient over-enrichment

[3] The term 'response' refers to parameters that are considered to be indicative of the degree of nutrient over-enrichment.

Figure 2.1 Delineation of regions.

Table 2.2 Eutrophication criteria based on guidelines proposed by Bricker et al. (1999).

Degree of Nutrient Over-enrichment	Total Dissolved N (mg L^{-1})	Total Dissolved P (mg L^{-1})	Chl *a* (*u*g L^{-1})	Dissolved Oxygen (mg/L)
Low	0 - ≤0.1	0 - ≤0.01	0 - ≤5	> 4
Medium	>0.1 - ≤1	>0.01 - ≤0.1	>5 - ≤20	-
High	>1	>0.1	>20 - 60	≤ 4

3. Results

3.1 Distribution of Data

Figure 3.1 shows the distribution of data available for each nutrient criteria parameter. The East region contains by far the largest amount of data and the West and Northwest regions the least.

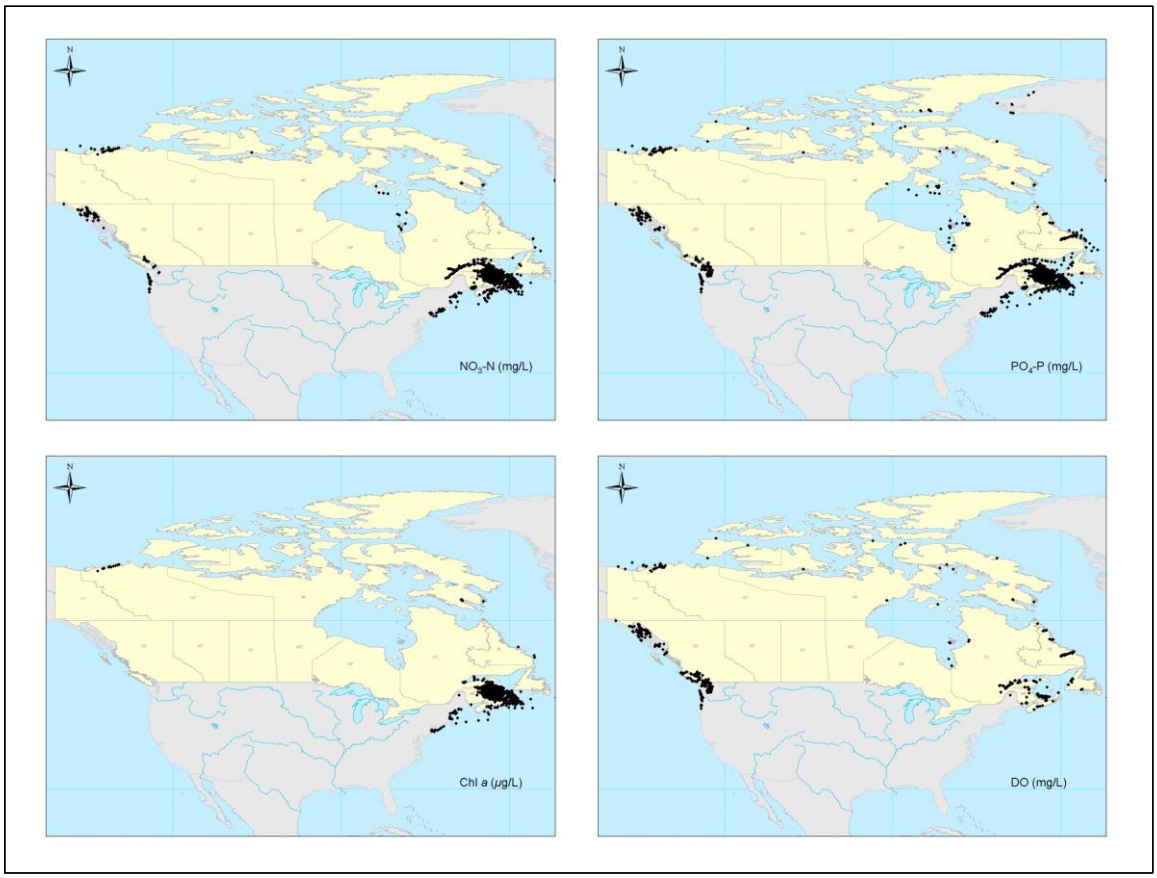


Figure 3.2 Distribution of data for nutrient criteria parameters.

3.2 Nutrient Criteria Analyses

Table 3.1 contains a summary of the number and percentage of values that fall into each of the Bricker et al. (1999) nutrient over-enrichment criteria guidelines.[4] Maps showing

[4] The values for dissolved inorganic nitrogen available within the main database are slightly different than those used in the Bricker et al. (1999) guidelines. Total dissolved nitrogen consists primarily of ammonia, nitrite and nitrate nitrogen. The main database, however, contains relatively little data on ammonia and nitrite nitrogen so the analysis was limited to nitrate nitrogen concentrations. This, however, should make little difference since ammonia and nitrite are typically present in significant amounts only under conditions of low dissolved oxygen concentration which was relatively rare within the database.

the distribution of values for each category within each region are contained in Appendix I.

For nitrate and phosphate, the majority of values fall within the ranges indicative of low levels of nutrient over-enrichment. The West region exhibits the highest percentage of values falling into the moderate level for both nitrate and phosphorus. The East and the Northeast regions have the lowest percentages falling within the low category. For all regions, only a small percentage of values, typically less than one percent, fall within the ranges indicative of high levels of nutrient over-enrichment.

For the response parameter chlorophyll *a*, values for the Northwest region all fall within the low range. The East region has the lowest percentage of values falling within the low range and the Northwest region is intermediate between the two. There is no data available on chlorophyll *a* for the West region. The East region had the highest percentage of values falling within both the moderate and high ranges of chlorophyll *a*.

In contrast to the other parameters, low levels of dissolved oxygen are indicative of nutrient over-enrichment and high levels are indicative of more pristine environments. The East region has the highest percentage of low dissolved oxygen values. In contrast, the Northeast region has no low values. The Northwest and West are intermediate in percentages of both low and high values.

Figure 3.2 illustrates the mean value of each parameter within each region, and its relationship to the nutrient criteria guidelines proposed by Bicker et al. (1999).

3.3 Development of Nutrient Guidelines

A commonly used method for establishing nutrient guidelines involves analysis of the frequency distribution of each parameter. In cases where the data is known to have come from relatively pristine unimpacted sites, the upper 75th percentile is typically chosen as a reference condition guideline. If the data is from both pristine sites and sites known to have been subjected to some anthropogenic impacts, the lower 25th percentile is typically chosen.

Table 3.2 contains a statistical summary for each parameter for all data as well as for each region. Histograms and quantile plots for the same are contained in Appendix II.[5]

Adoption of these as reference condition criteria would result in guidelines that differ considerably from those proposed by Bricker et al. (1999).

[5] The histograms and quantile plots contained in Appendix III clearly illustrate the main database should be further validated. The high frequencies associated with very low values suggests that t is likely much of the data has not been correctly converted into similar measurement units and/or there may be errors in the measurement units reported in the databases originally supplied. This is obvious for chlorophyll *a* data for All regions, and East and Northeast region nitrate data.

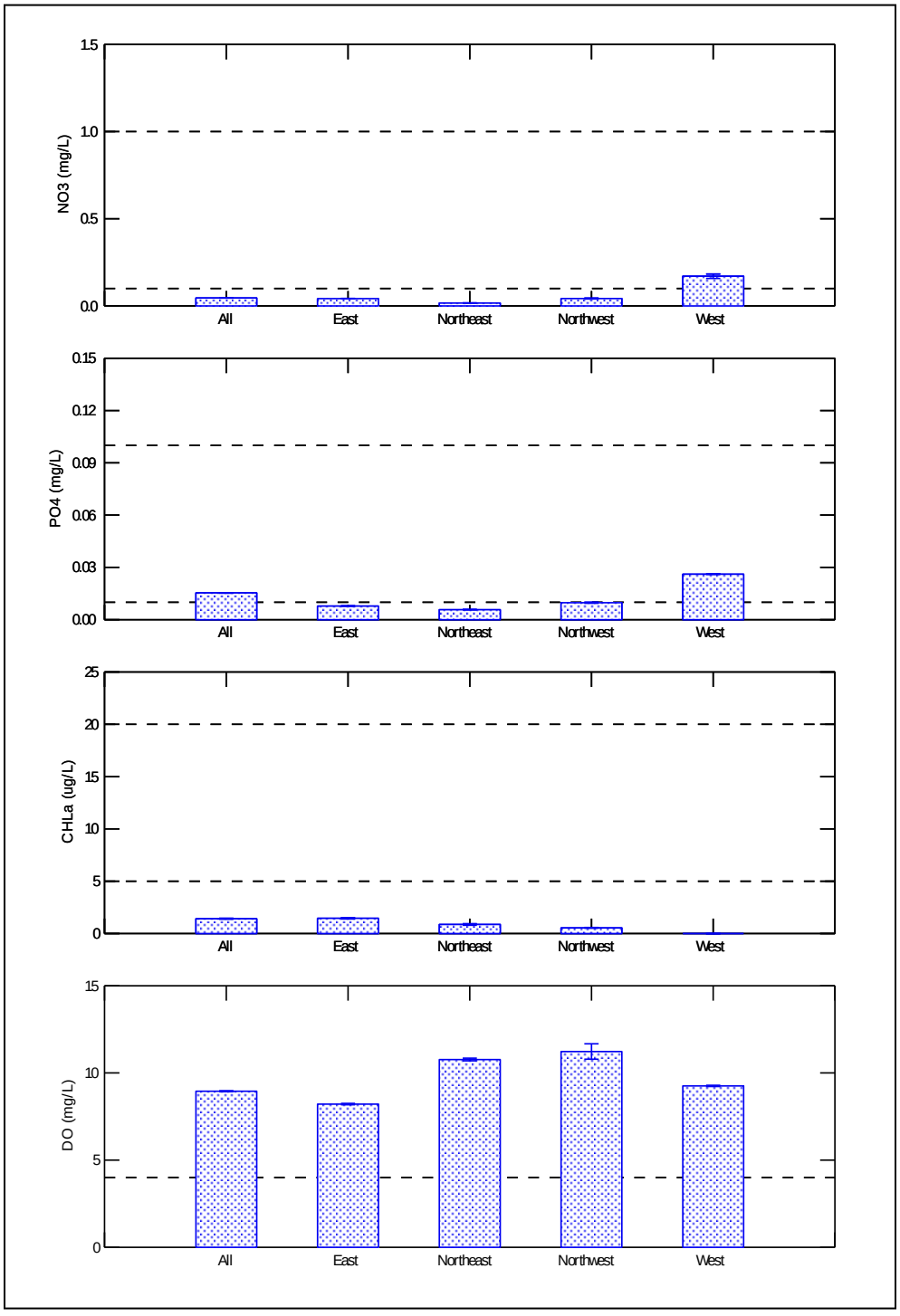


Figure 3.2 Mean values of each parameter for each region (error bars are one standard error of the mean). The dashed lines represent the Bricker et al. (1999) boundaries.

Table 3.1 Number and percentage of values falling into each nutrient criteria category (based on Bricker et al. 1999)*.

REGION	NO_3-N (mg/L)			PO_4-P (mg/L)			Chl *a* (*μ*g/L)			DO (mg/L)	
	Low (≤0.1)	**Moderate** (>0.1-≤1)	**High** (>1)	**Low** (≤0.01)	**Moderate** (>0.01-≤0.1)	**High** (>0.1)	**Low** (≤5)	**Moderate** (>5-≤20)	**High** (>20)	**Low** (≤4)	**High** (>4)
EAST	4826 (85.1)	841 (14.9)	0	3427 (76.2)	1059 (23.6)	6 (0.2)	4439 (90.3)	445 (9.1)	28 (0.6)	266 (6.3)	3943 (93.7)
NORTHEAST	237 (98.3)	4 (1.7)	0	484 (86.6)	74 (13.4)	0	190 (96.9)	6 (3.1)	0	0	133 (100)
WEST	149 (54.2)	122 (44.4)	4 (1.4)	586 (13.8)	3666 (86.1)	5 (0.1)	No Data	No Data	No Data	66 (1.2)	5247 (98.8)
NORTHWEST	725 (86.5)	112 (13.5)	0	763 (64.0)	429 (36.0)	0	102 (100)	0	0	42 (4.2)	965 (95.8)

*Data has been filtered to exclude salinities > 30 ppt and sample depths > 6 metres.

Table 3.2 Data summary illustrating 25th and 75th percentiles.

Region	Nitrate-N (mg/L)				Phosphate-P (mg/L)				Chlorophyll *a* (ug/L)				Dissolved Oxygen (mg/L)			
	Number	25th Percentile	Median	75th Percentile	Number	25th Percentile	Median	75th Percentile	Number	25th Percentile	Median	75th Percentile	Number	25th Percentile	Median	75th Percentile
All	13447	0.007	0.031	0.200	10502	0.030	0.068	0.172	10518	0.001	0.004	0.840	10665	7.6	8.8	10.4
East	5668	0.007	0.027	0.200	4494	0.023	0.040	0.066	4914	0.001	0.003	0.800	4210	7.4	8.3	9.4
Northeast	241	0.001	0.011	0.087	559	0.022	0.032	0.049	196	0.001	0.320	1.100	133	9.7	10.6	11.4
West	275	0.155	0.360	0.949	275	0.017	0.024	0.032	No Data				5313	7.7	9.0	10.5
Northwest	838	0.012	0.037	0.180	1192	0.009	0.038	0.101	102	0.300	0.500	0.700	1009	9.8	11.0	11.9

4. Relating Nearshore Nutrient Over-enrichment to Agricultural Practices

A major objective of this study was to determine if a significant relationship exists between nearshore nutrient over-enrichment and the level of agricultural activity within a watershed. Adequate data to test this was only readily available for Prince Edward Island which has been experiencing nearshore nutrient over-enrichment problems for the last several decades. The required data on land use activities within 21 watersheds (Figure 4.1) that have been monitored for causal and response variables[6] was collated into a single database for analysis. Appendix III contains a listing of the watersheds and the area of various land uses within each sub-watershed of each main watershed, and Table 4.1 lists the percentage of agricultural land use within each main watershed. Percent agricultural land use ranged from 20.1 to 70.2.

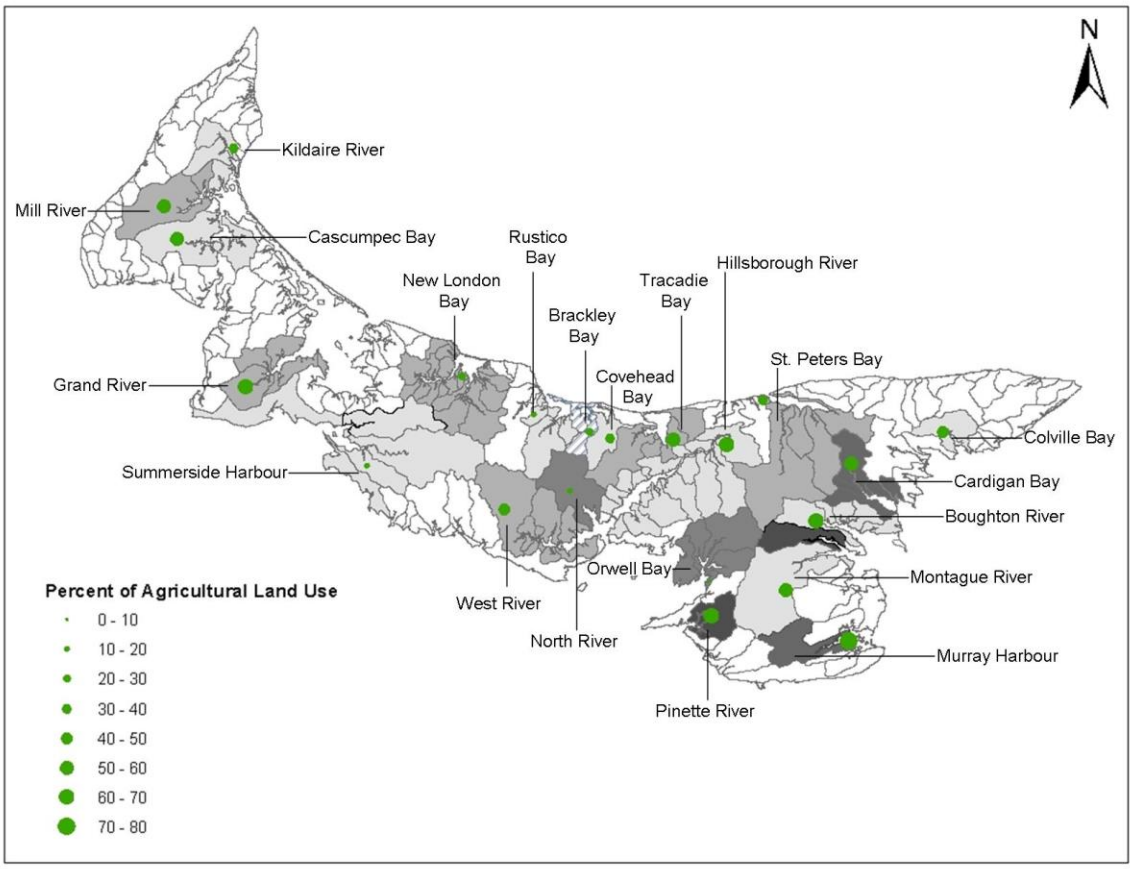


Figure 4.1 Location and percent agricultural land use in PEI watersheds.

[6] For this analysis total phosphorus rather than dissolved phosphate was used as a causal parameter because it is the preferred form of phosphorus measured within PEI and, as a result, the amount of data on dissolved phosphorus is very limited.

Table 4.1 Percentage of agricultural land use in each main watershed.

Main Watershed	Area (ha)		% Agriculture
	Agriculture	Total	
Boughton River	180.8	1113.03	29.0
Brackley Bay	1277.19	2085.66	47.3
Cardigan Bay	160.76	807.79	21.8
Cascumpec Bay	383.1	4239.54	31.2
Colville Bay	2037.12	5309.54	38.4
Covehead Bay	2194.63	4323.74	49.2
Grand River	1162.41	5145.99	37.1
Hillsborough River	401.34	869.77	40.6
Kildare River	909.65	1828.9	55.5
Mill River	995.75	1395.45	44.8
Murray Harbour	1424.07	7090.81	20.1
New London Bay	550.85	1115.29	59.1
North River	5855.84	9897.76	59.2
Orwell Bay	1874.32	2710	53.1
Pinette River	1672.7	5455.3	30.7
Rustico Bay	790.46	1115.92	70.2
St. Peters Bay	1249.48	2929.6	28.8
Summerside Harbour	3245.89	4603.59	58.3
Tracadie Bay	472.42	967.74	35.5
West River	387.12	882.97	51.2

4.1 Description of Data

Table 4.2 and 4.3 list the number and percentage of observations falling within each nutrient category for each parameter within each watershed.

Table 4.2 Number of observations falling within each nutrient criteria category for each parameter.

Watershed	Nitrate-N (mg/L)			Total P (ug/L)			Chlorophyll *a* (ug/L)			Dissolved Oxygen (mg/L)	
	LOW (≤0.1)	**MED** (>0.1-≤ 1.0)	**HIGH** (>1)	**LOW** (≤0.01)	**MED** (>0.01-≤ 0.1)	**HIGH** (>0.1)	**LOW** (≤5)	**MED** (>5-≤ 20)	**HIGH** (>20)	**LOW** (≤4)	**HIGH** (>4)
Boughton River	117	44	15	0	115	11	91	33	3	17	199
Brackley Bay	10	1	0	0	35	0	1	33	1	4	31
Cardigan Bay	11	0	0	0	32	3	21	12	2	0	31
Cascumpec Bay	13	0	0	0	28	9	8	25	4	1	36
Colville Bay	185	59	79	4	311	9	182	64	3	3	336
Covehead Bay	178	37	54	5	290	4	78	172	43	8	281
Grand River	12	0	0	0	31	5	12	22	2	2	34
Hillsborough River	7	5	0	0	22	14	5	25	6	0	36
Kildare River	9	1	1	0	29	6	7	15	13	7	27
Mill River	685	234	109	16	1247	42	522	335	24	11	999
Montague River	13	24	8	0	54	7	13	16	8	1	29
Murray Harbour	8	0	0	0	29	3	19	12	0	0	32
New London Bay	1095	117	54	17	1149	169	191	297	97	131	1401
North River	50	424	134	14	519	89	7	21	0	55	727
Orwell Bay	117	29	1	0	118	38	23	17	0	6	153
Pinette River	112	12	0	0	129	22	106	13	3	1	149
Rustico Bay	187	76	15	0	196	104	7	20	8	63	265
St. Peters Bay	12	25	144	1	83	1	127	51	3	2	168
Summerside Harbour	10	4	0	0	38	2	5	32	1	0	37
Tracadie Bay	43	1	0	0	71	470	48	25	0	0	72
West River	1205	320	6	24	1055	0	477	137	7	27	1467

Table 4.3 Percentage of observations falling within each nutrient criteria category for each parameter.

Watershed	Nitrate-N (mg/L)			Total P (ug/L)			Chlorophyll *a* (ug/L)			Dissolved Oxygen (mg/L)	
	LOW (≤0.1)	**MED** (>0.1-≤ 1.0)	**HIGH** (>1)	**LOW** (≤0.01)	**MED** (>0.01-≤ 0.1)	**HIGH** (>0.1)	**LOW** (≤5)	**MED** (>5-≤ 20)	**HIGH** (>20)	**LOW** (≤4)	**HIGH** (>4)
Boughton River	66.5	25.0	8.5	0.0	91.3	8.7	71.7	26.0	2.4	7.9	92.1
Brackley Bay	90.9	9.1	0.0	0.0	100.0	0.0	2.9	94.3	2.9	11.4	88.6
Cardigan Bay	100.0	0.0	0.0	0.0	91.4	8.6	60.0	34.3	5.7	0.0	100.0
Cascumpec Bay	100.0	0.0	0.0	0.0	75.7	24.3	21.6	67.6	10.8	2.7	97.3
Colville Bay	57.3	18.3	24.5	1.2	96.0	2.8	73.1	25.7	1.2	0.9	99.1
Covehead Bay	66.2	13.8	20.1	1.7	97.0	1.3	26.6	58.7	14.7	2.8	97.2
Grand River	100.0	0.0	0.0	0.0	86.1	13.9	33.3	61.1	5.6	5.6	94.4
Hillsborough River	58.3	41.7	0.0	0.0	61.1	38.9	13.9	69.4	16.7	0.0	100.0
Kildare River	81.8	9.1	9.1	0.0	82.9	17.1	20.0	42.9	37.1	20.6	79.4
Mill River	66.6	22.8	10.6	1.2	95.6	3.2	59.3	38.0	2.7	1.1	98.9
Montague River	28.9	53.3	17.8	0.0	88.5	11.5	35.1	43.2	21.6	3.3	96.7
Murray Harbour	100.0	0.0	0.0	0.0	90.6	9.4	61.3	38.7	0.0	0.0	100.0
New London Bay	86.5	9.2	4.3	1.3	86.1	12.7	32.6	50.8	16.6	8.6	91.4
North River	8.2	69.7	22.0	2.3	83.4	14.3	25.0	75.0	0.0	7.0	93.0
Orwell Bay	79.6	19.7	0.7	0.0	75.6	24.4	57.5	42.5	0.0	3.8	96.2
Pinette River	90.3	9.7	0.0	0.0	85.4	14.6	86.9	10.7	2.5	0.7	99.3
Rustico Bay	67.3	27.3	5.4	0.0	65.3	34.7	20.0	57.1	22.9	19.2	80.8
St. Peters Bay	6.6	13.8	79.6	1.2	97.6	1.2	70.2	28.2	1.7	1.2	98.8
Summerside Harbour	71.4	28.6	0.0	0.0	95.0	5.0	13.2	84.2	2.6	0.0	100.0
Tracadie Bay	97.7	2.3	0.0	0.0	13.1	86.9	65.8	34.2	0.0	0.0	100.0
West River	78.7	20.9	0.4	2.2	97.8	0.0	76.8	22.1	1.1	1.8	98.2

4.2 Agriculture Land Use and Nutrient Criteria Parameters

Figure 4.1 contains scatterplots illustrating the relationship between low, medium and high nutrient criteria categories and the percentage of agricultural land use within each PEI watershed. This same information is also presented as bar plots in Appendix IV There are obvious positive relationships between high total phosphorus, high chlorophyll *a*, and low dissolved oxygen levels and the percentage of agricultural land use. The relationship between nitrate concentrations and percentage of agricultural land use is less clear.

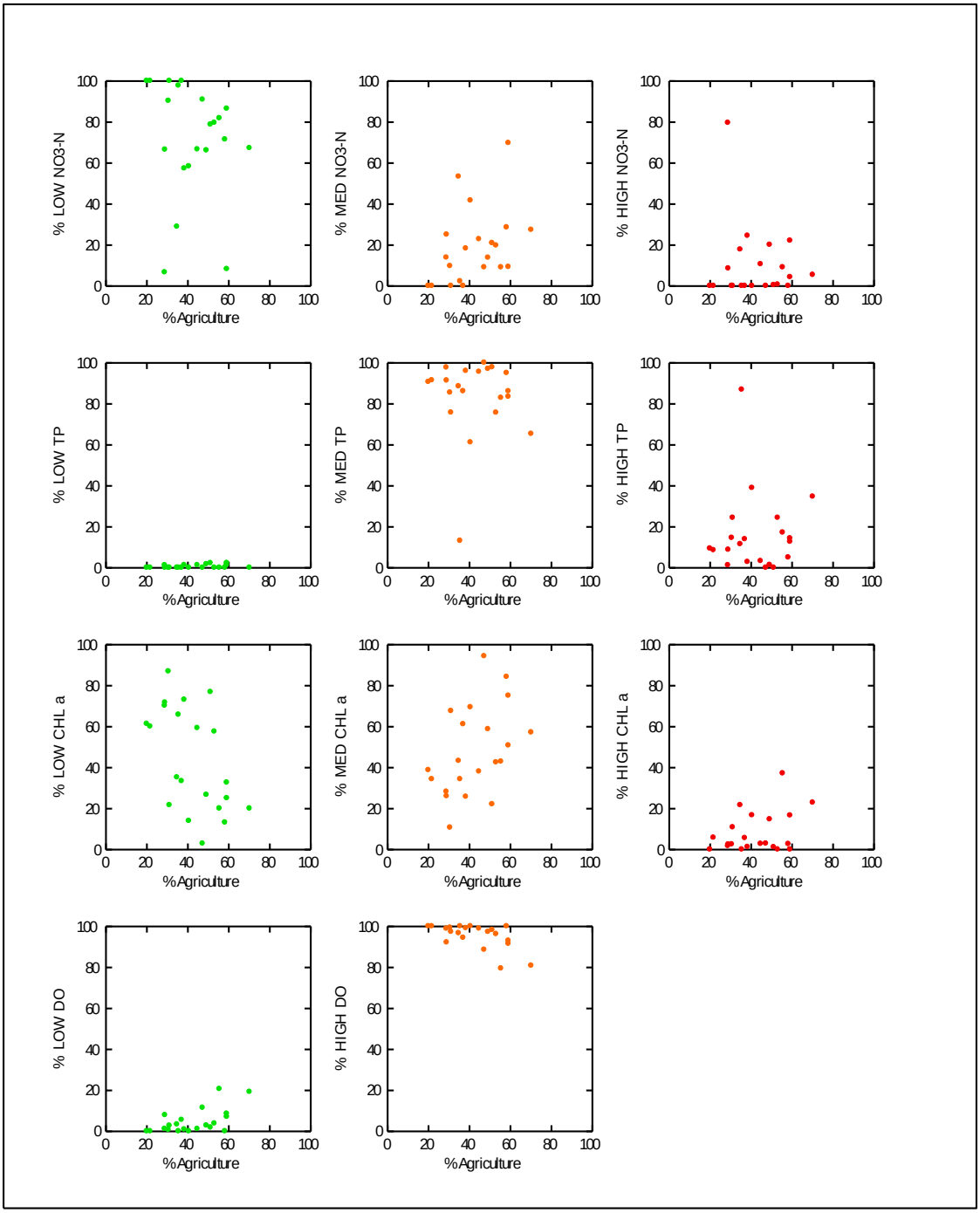


Figure 4.2 Scatterplots illustrating the relationship between low, moderate and high nutrient criteria categories and the percentage of agricultural land use within each watershed.

Figure 4.2 contains bar graphs of the relationship between the mean values of each parameter and percent agricultural activity within each watershed. In this case the relationship between agricultural activity and chlorophyll *a* and dissolved oxygen levels is quite clear, but is less so for total phosphorus. However, this is still encouraging

considering that differences in the physical characteristics, especially assimilation capacity, of the coastal waters associated with each watershed have not been considered.

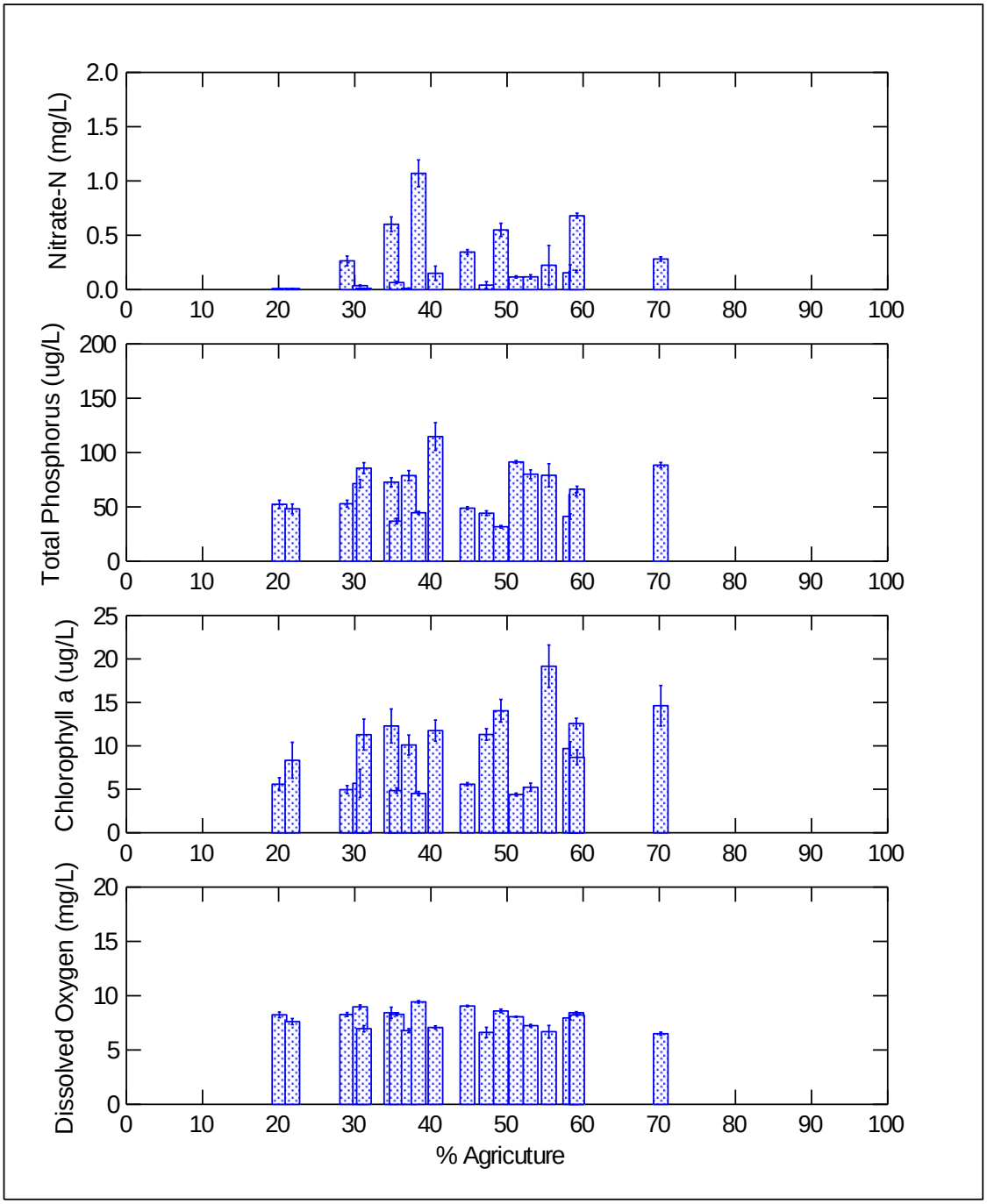


Figure 4.3 Relationship of the mean value of each parameter and percent agricultural land use within each watershed (error bars are one standard error of the mean).

Figure 4.2 contains a scatterplot matrix illustrating the relationships between the mean values of all of the nutrient criteria parameters within each watershed. With the exception of nitrate, all of the parameters show significant relationships to each other which could also likely be improved if assimilation capacity was taken into consideration.

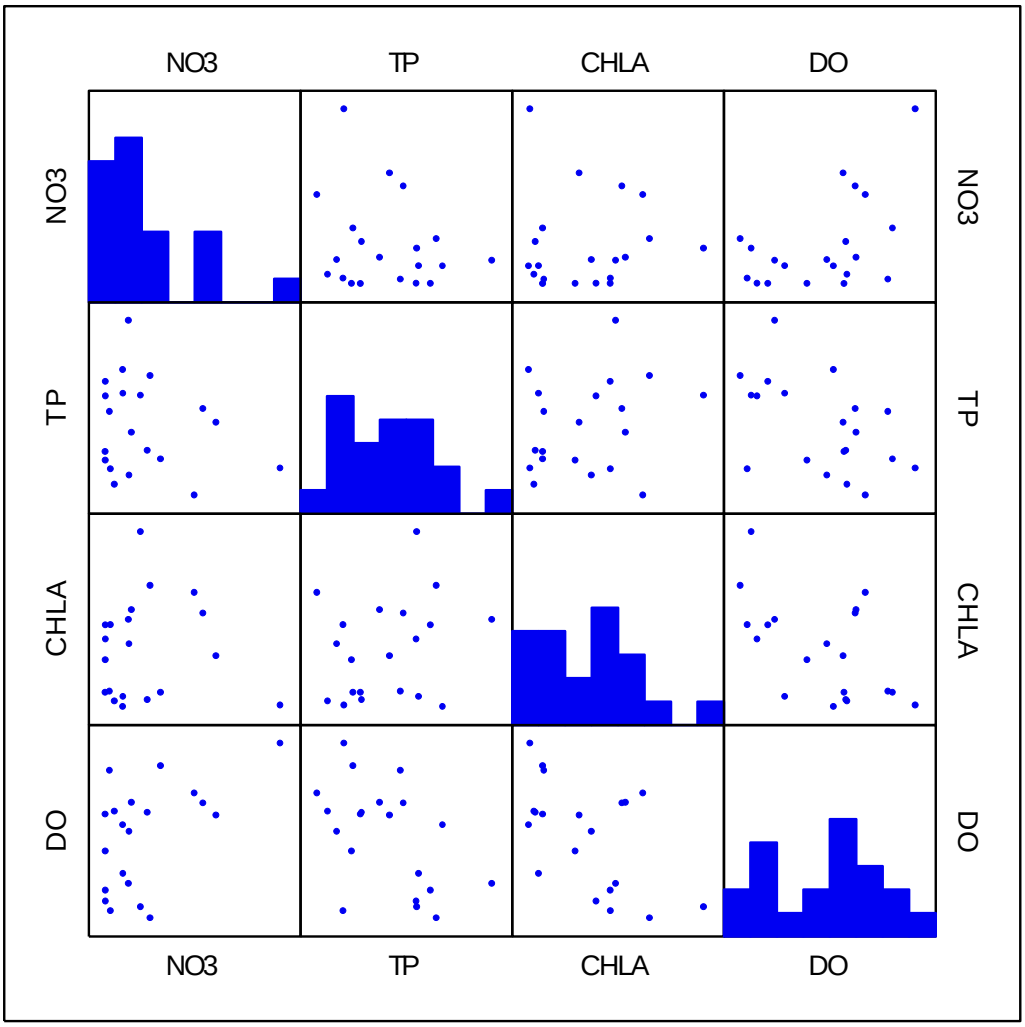


Figure 4.4 **S**catterplot matrix illustrating the relationships between the mean values of all of the nutrient criteria parameters within each watershed.

5. Discussion

Both the mapping and statistical analyses appear to indicate that Canadian nearshore waters are relatively pristine, and that the Western region nearshore waters have higher nutrient concentrations than Eastern region nearshore waters. This, however, is based on the assumption that the nutrient over-enrichment criteria proposed by Bricker et al. (1999), which were developed for US coastal waters, are applicable to Canadian waters. Because of the more northern distribution of Canadian coastal waters, which results in a

shorter growing season and generally cooler waters, the Bricker et al. (1999) criteria may not be entirely applicable within Canada.

There are, however, other reasons to believe that this conclusion may not be entirely valid. The main database appears to contain significant errors with respect to the measurement units allocated to the parameters used in this analysis. This was found to be true for PEI total phosphorous data[7], and the quantile plots suggest it may be true for some of the other parameters. The problem appears to be that the database was compiled from data reported in some instances as milligrams per litre, and in other instances as micrograms per litre, and that the appropriate conversion to similar measurement units may not have been always made. It may also be true that the value of some parameters may have been entered into the database using different conventions (e.g., nitrate can be reported as the total weight of nitrate or as the weight of nitrogen only).

Another major shortcoming of the analysis is that the data is very poorly distributed within Canada. Most is from Eastern regions and the Western region is poorly represented. This makes it difficult to draw any strong conclusions regarding major differences between regions, such as the noted higher concentrations of nutrients within the Western region. Another factor that may confound any conclusions regarding regional differences is the objective of the study during which the data was collected. The abundance of dissolved oxygen observations within the Western region relative to other parameters suggests that this data was collected as part of surveys that were specifically looking for areas of depleted dissolved oxygen levels and, if so, can not be validly compared to data that was collected as part of a routine or exploratory survey. As a result, it is difficult to reach any definitive conclusions from the regional analyses carried out using this database. The only real solution to this problem is to have the databases verified by someone experienced in the numerous conventions used in data reporting, and to provide additional information within the database on the objectives of the study for which the data was collected.

The analysis of nutrient criteria and agricultural land use carried out for PEI is promising. Although considerable variability still exists in the relationships presented, it is likely that this could be significantly reduced if the type of agricultural land use was taken into account. For example, run off of nutrients to coastal waters would be expected to be much less for forage crops than for crops such as potatoes. Additional factors that should also be considered to establish stronger relationships are changes that have occurred in agricultural land use over time[8] and the physical characteristics of the receiving water bodies. We recommend that this type of information be collected and further analyses carried out to establish a more comprehensive basis for the development of nutrient guidelines.

[7] This error was corrected prior to carrying out the analysis of the relationship between nutrient over-enrichment parameters and agricultural activity.

[8] The nutrient database use in the analyses spanned a period of nearly 30 years and no attempt was made to account for temporal changes in land use over this period.

This analyses carried out in this study are quite preliminary but provide an important first step. It is recommended that the analyses be repeated once the main database is verified for accuracy and expanded to include a more proportional representation of Canadian coastal waters.

6. References

Bricker, S.B., C.G. Clement, D.E. Pirhalla, S.P. Orlando and D.R.G. Farrow. 1999. National estuarine eutrophication assessment effects of nutrient enrichment in the nation's estuaries. NOAA, National Ocean Service, Special Projects Office and the National Centers for Coastal Ocean Science. Silver Spring, MD: 71p.

7. Acknowledgements

We would like to thank Cynthia Crane of the PEI Department of Environment, Energy and Forestry and Bill Glen of the PEI Department of Agriculture, Fisheries and Aquaculture for providing us with the information on land use within PEI watersheds.

APPENDIX I

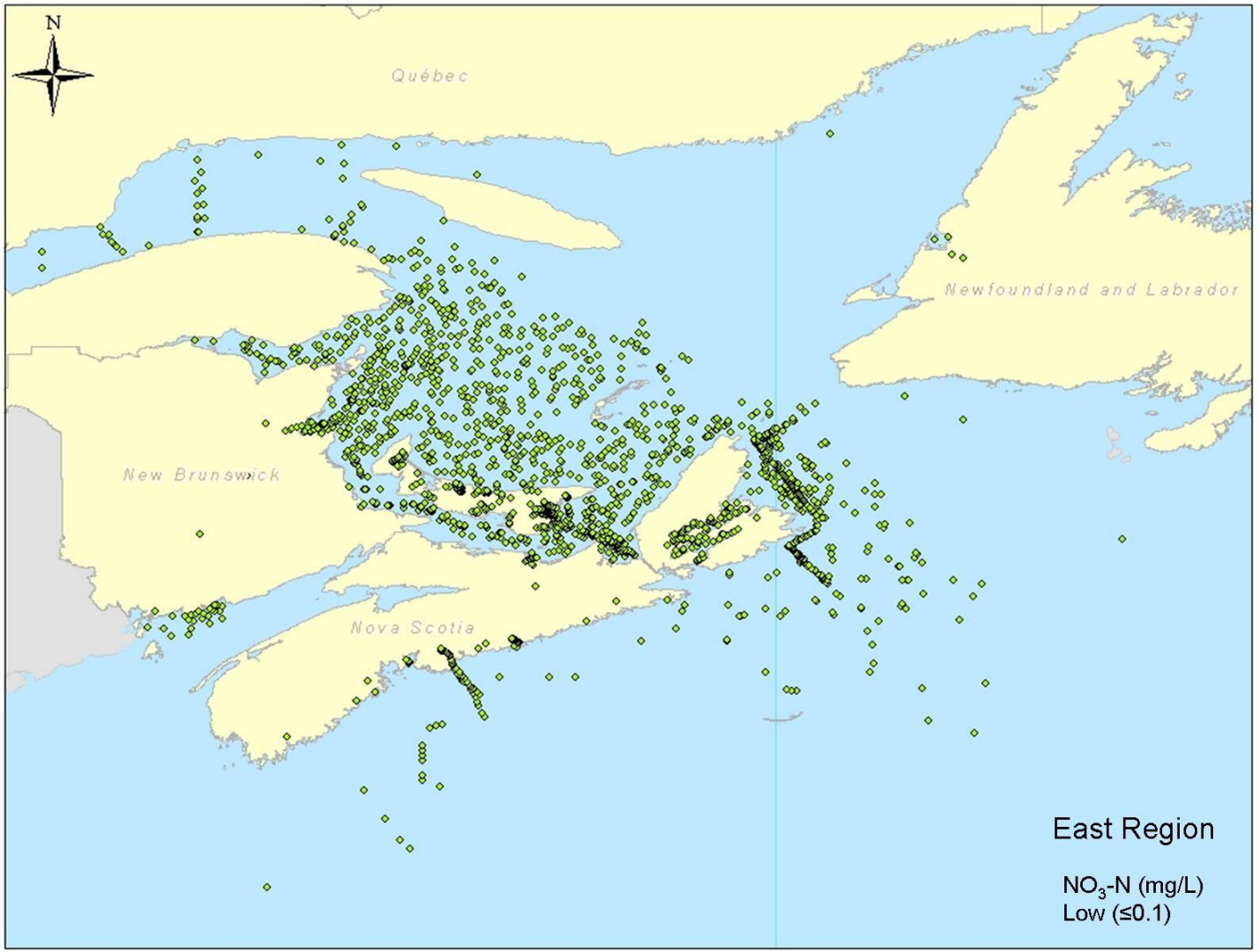
Maps Illustrating Levels of Each Nutrient Criteria Parameter for Each Region

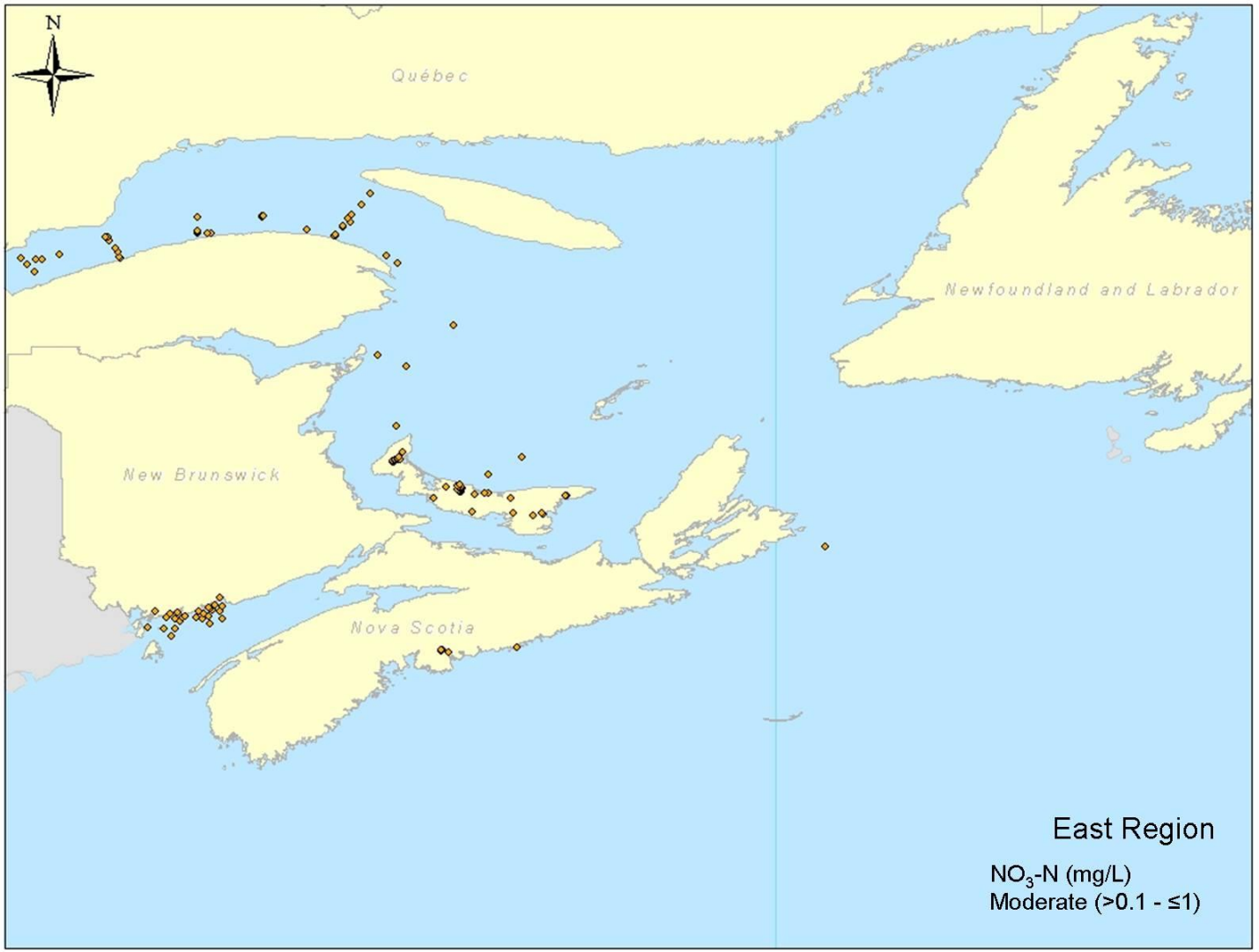
The following maps were omitted as there were no values falling into the respective categories:

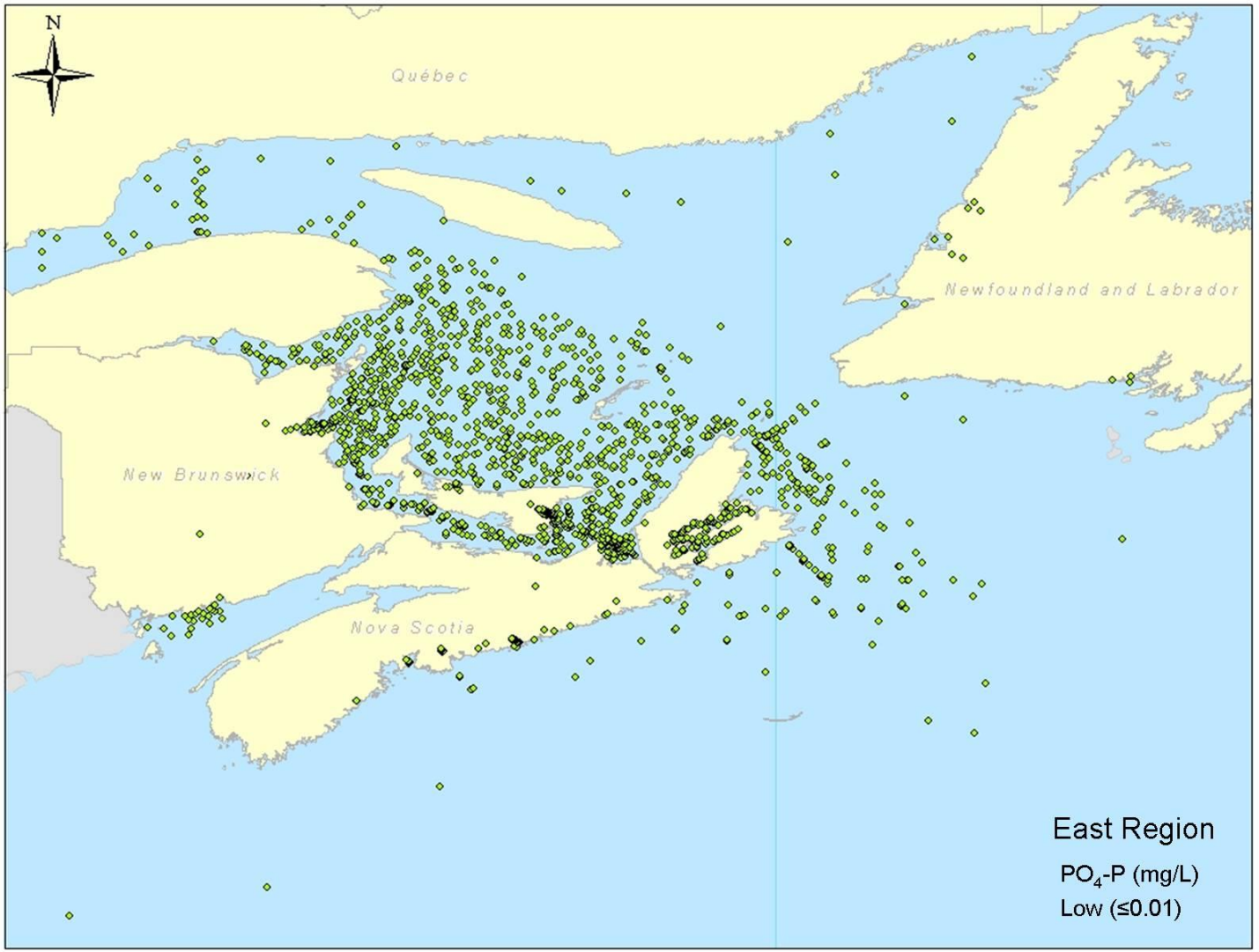
East Region – High Nitrate
Northeast Region – High Nitrate
Northeast Region – High Phosphate
Northeast Region – Low Dissolved Oxygen
Northeast Region – High Chlorophyll *a*
Northwest Region – High Nitrate
Northwest Region – High Phosphate
Northwest Region – Moderate Chlorophyll *a*
Northwest Region – High Chlorophyll *a*

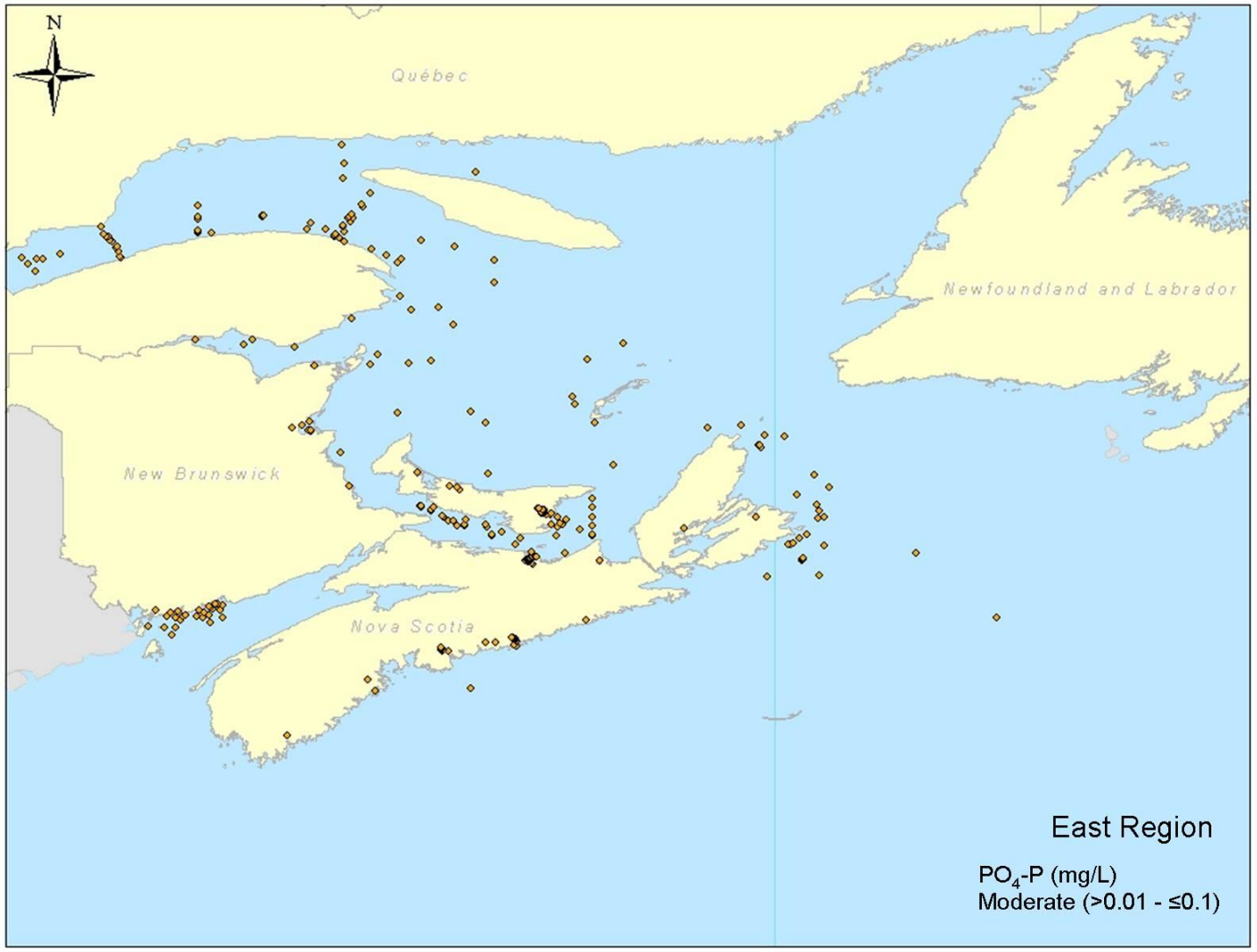
The following maps were omitted as no data was available:

West Region – Chlorophyll *a*

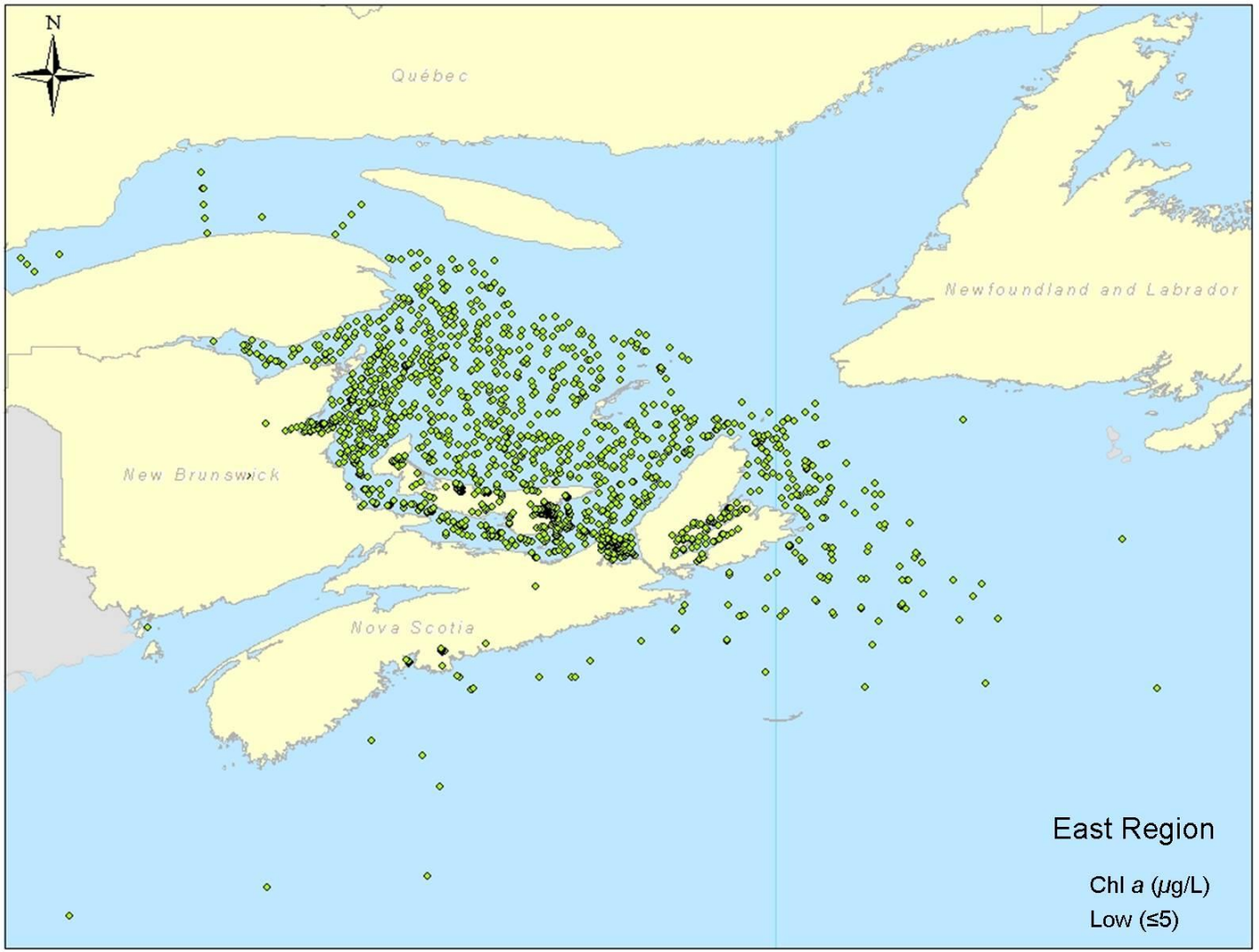

N
Québec
Newfoundland and Labrador
New Brunswick
Nova Scotia
East Region
NO_3-N (mg/L)
Low (≤0.1)

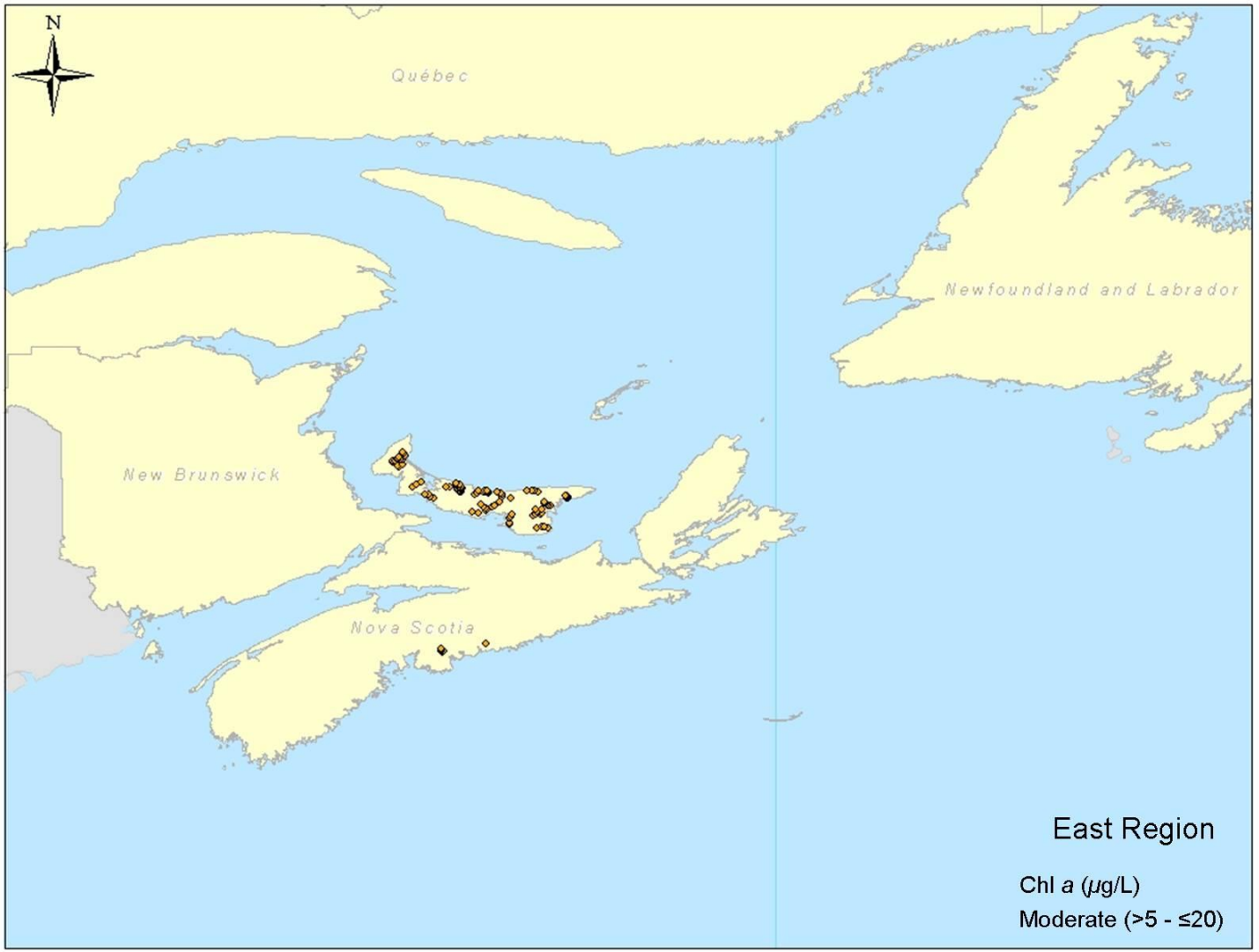

N
Québec
Newfoundland and Labrador
New Brunswick
Nova Scotia
East Region
NO3-N (mg/L)
Moderate (>0.1 - ≤1)

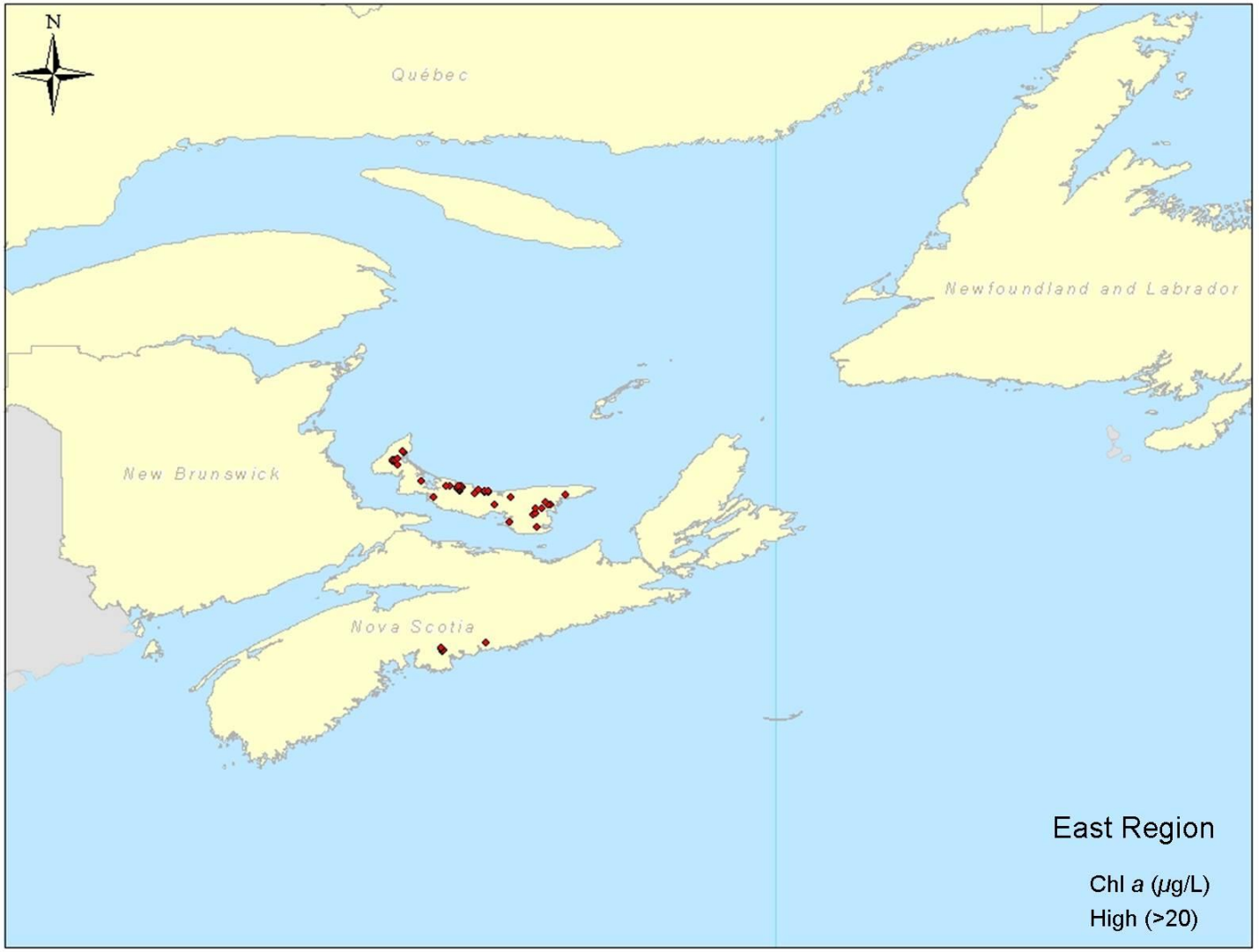

N
Québec
Newfoundland and Labrador
New Brunswick
Nova Scotia
East Region
PO4-P (mg/L)
Low (≤0.01)


N
Québec
Newfoundland and Labrador
New Brunswick
Nova Scotia
East Region
PO4-P (mg/L)
Moderate (>0.01 - ≤0.1)


N
Québec
Newfoundland and Labrador
New Brunswick
Nova Scotia
East Region
PO4-P (mg/L)
High (>0.1)


N
Québec
Newfoundland and Labrador
New Brunswick
Nova Scotia
East Region
Chl a (µg/L)
Low (≤5)

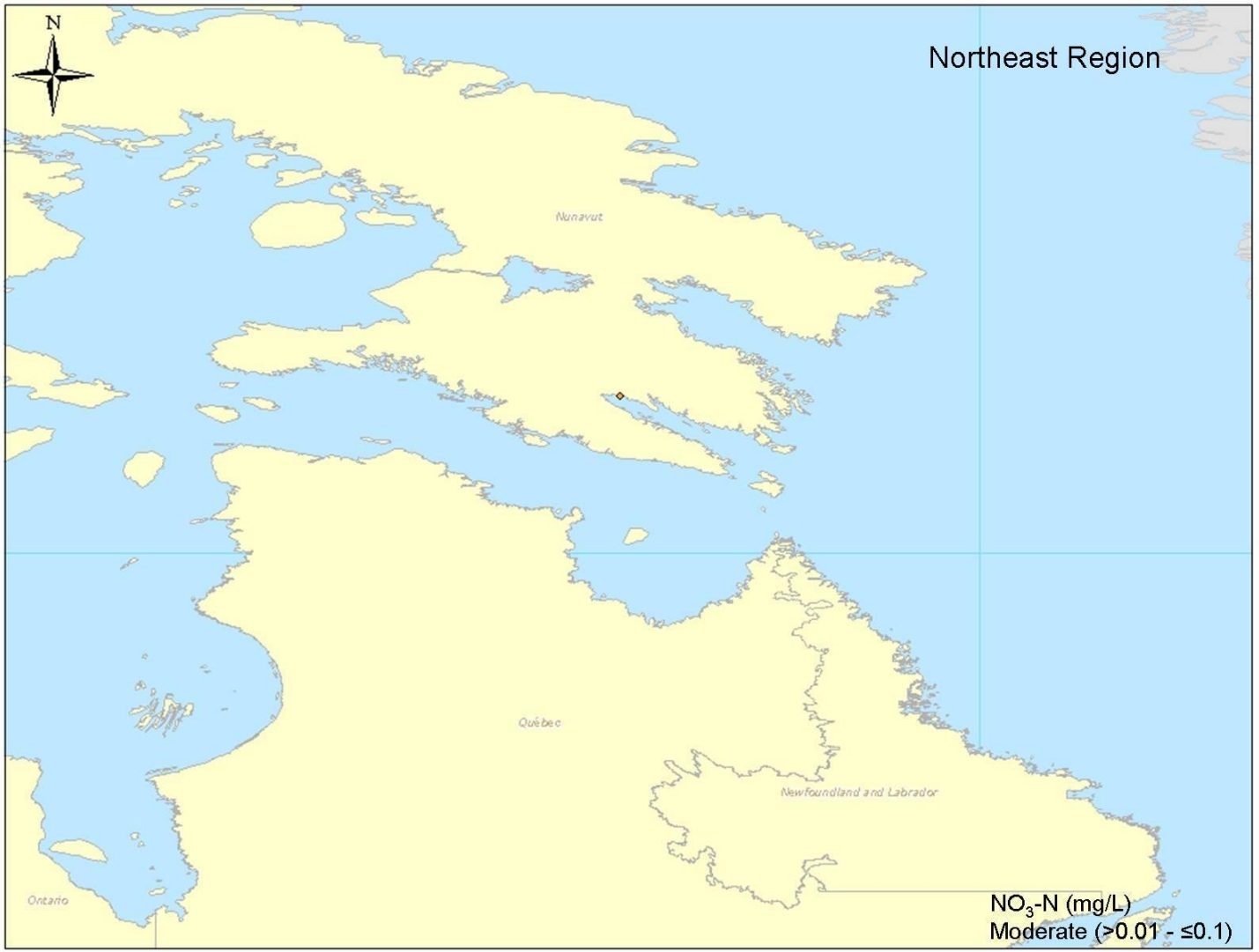

N
Québec
Newfoundland and Labrador
New Brunswick
Nova Scotia
East Region
Chl a (µg/L)
Moderate (>5 - ≤20)

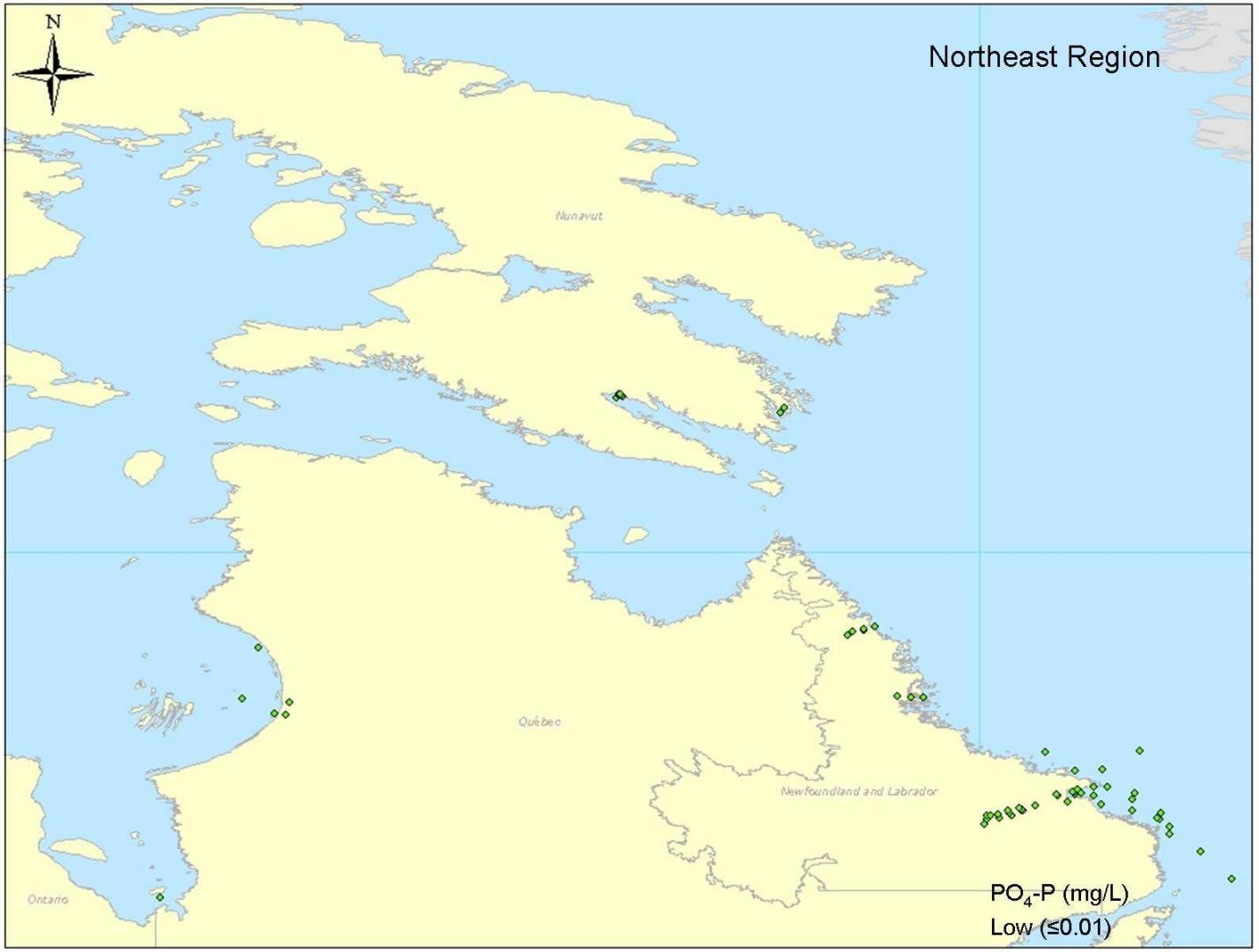

N
Québec
Newfoundland and Labrador
New Brunswick
Nova Scotia
East Region
Chl a (µg/L)
High (>20)

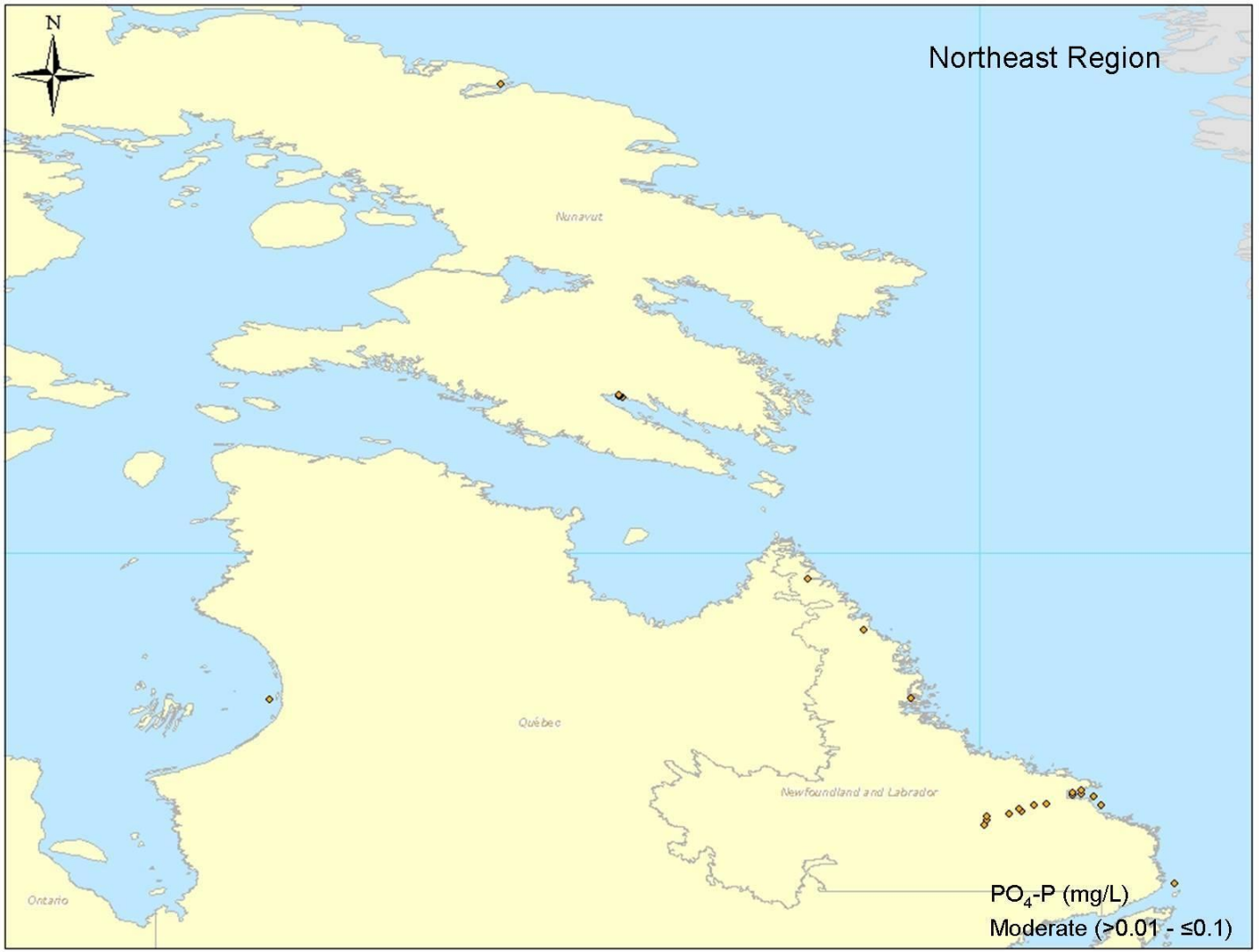

N
Québec
Newfoundland and Labrador
New Brunswick
Nova Scotia
East Region
DO (mg/L)
Low (≤4)

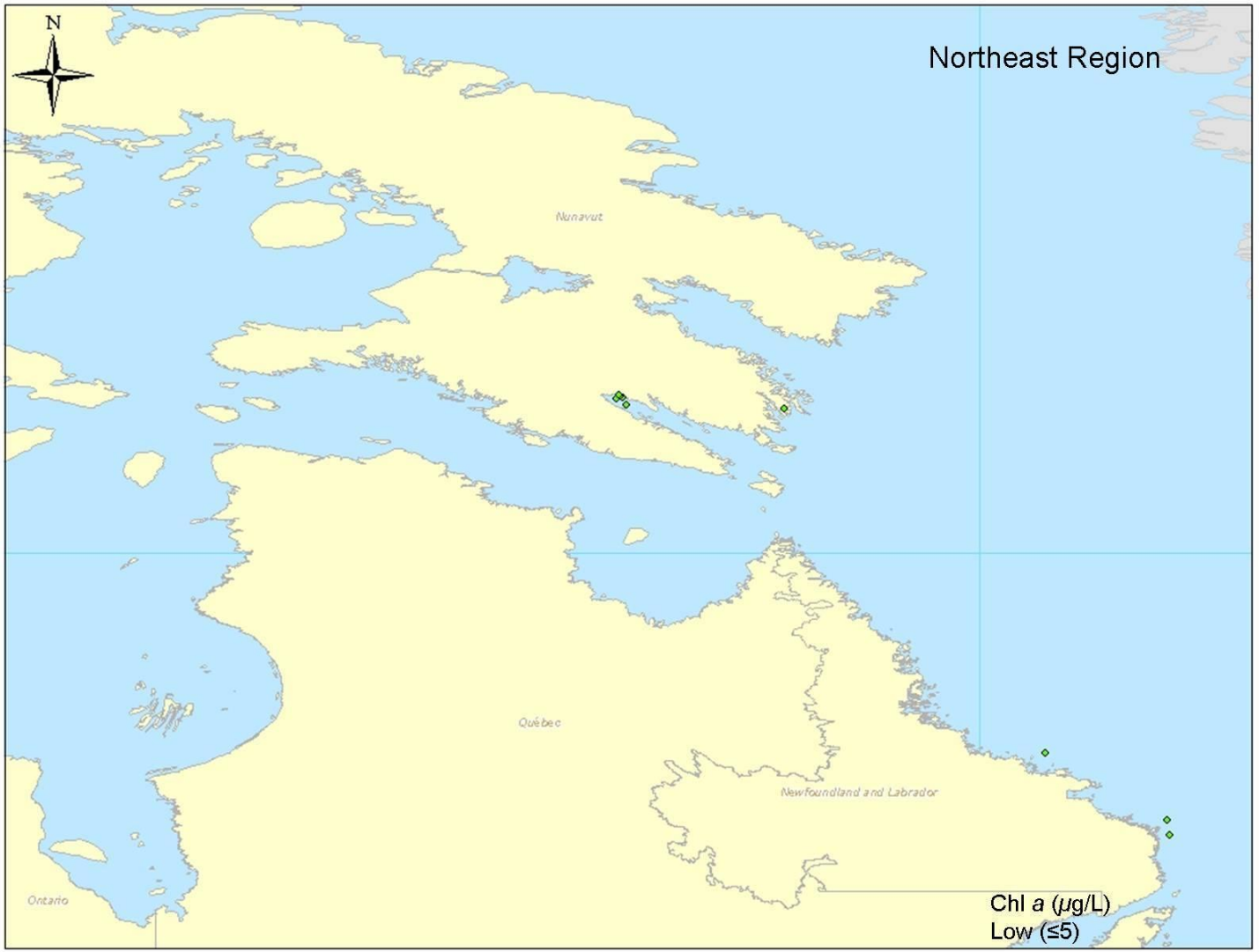

N
Québec
Newfoundland and Labrador
New Brunswick
Nova Scotia
East Region
DO (mg/L)
High (>4)

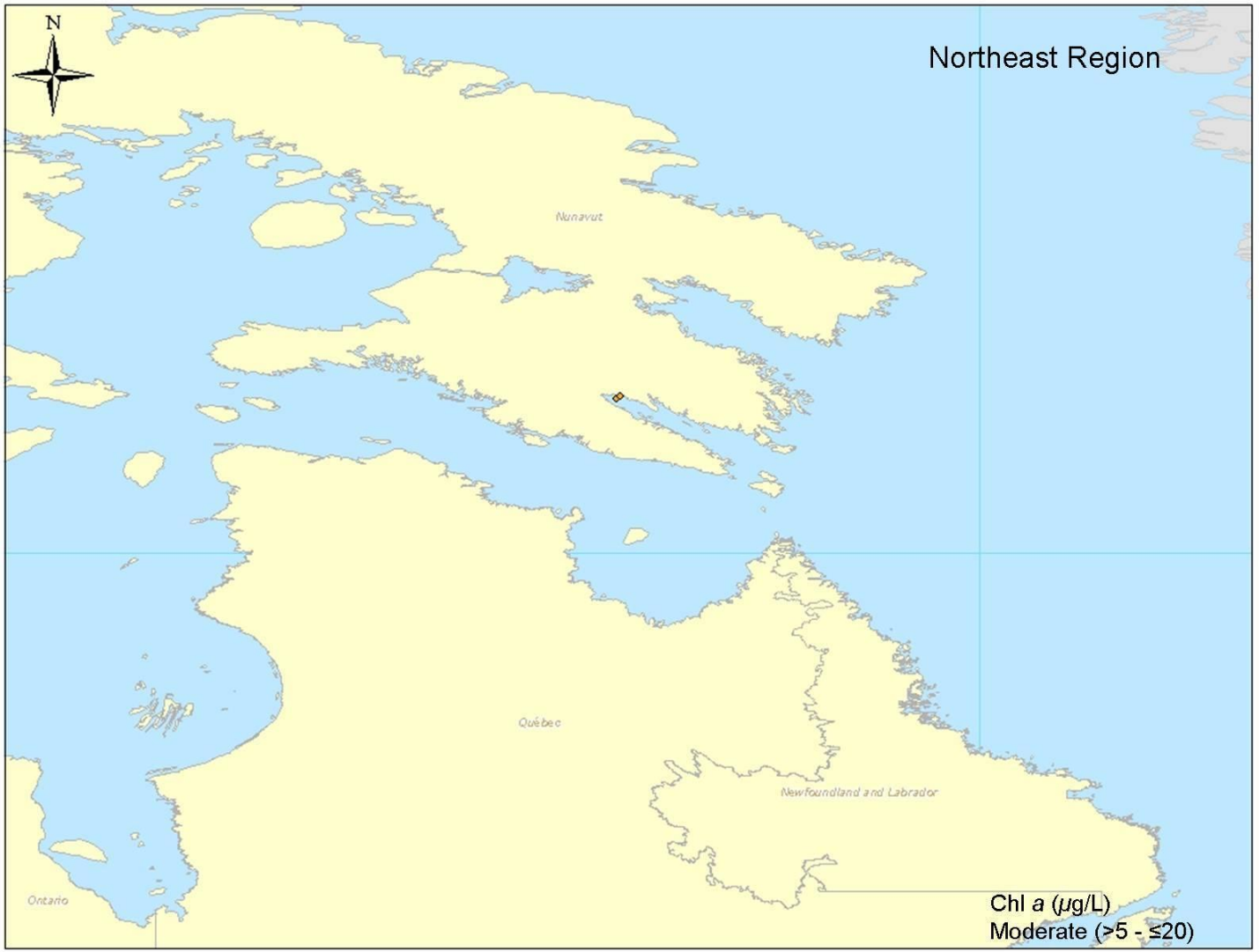

N
Northeast Region
Nunavut
Québec
Newfoundland and Labrador
Ontario
NO_3-N (mg/L)
Low (≤0.1)

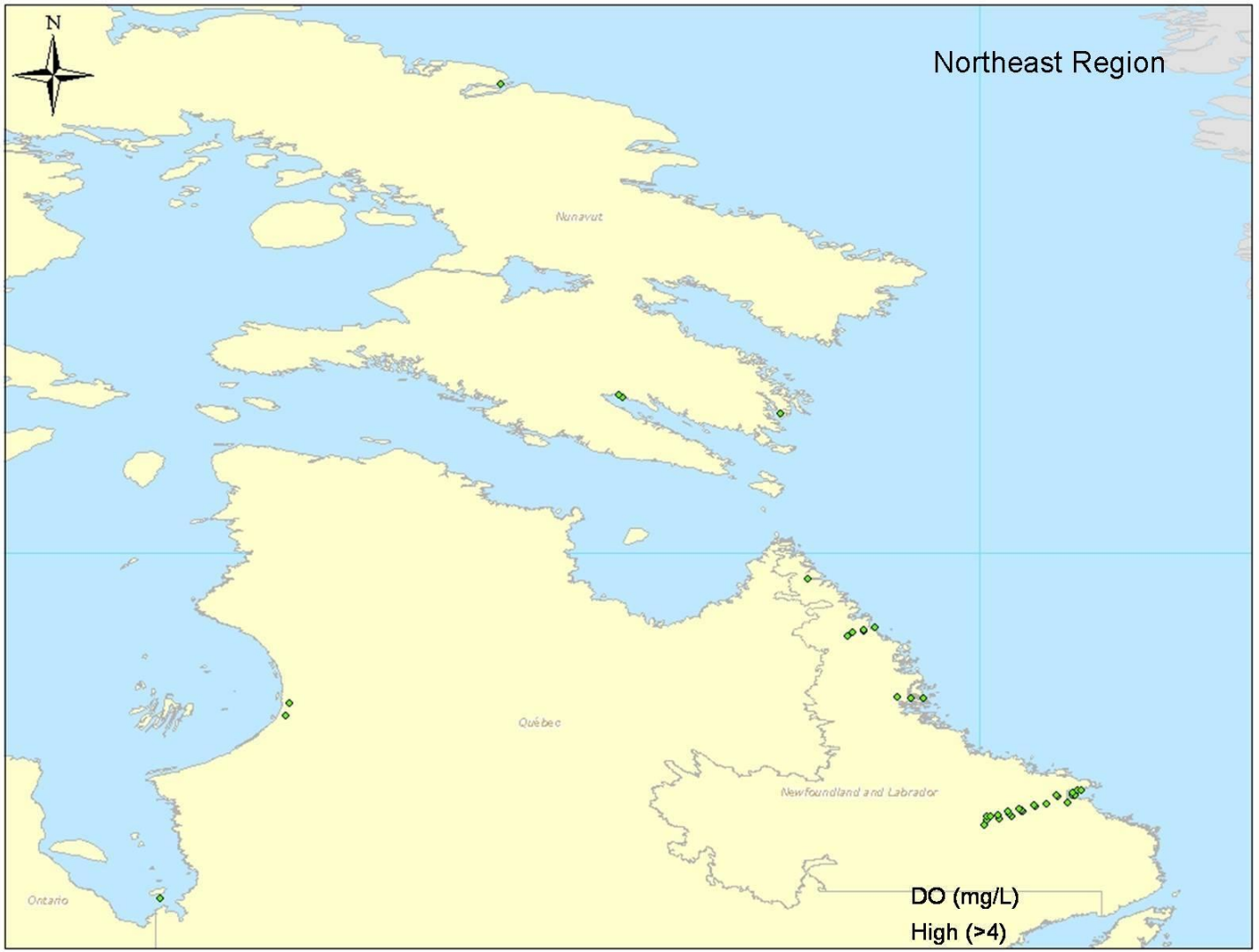

N
Northeast Region
Nunavut
Québec
Newfoundland and Labrador
Ontario
NO_3-N (mg/L)
Moderate (>0.01 - ≤0.1)

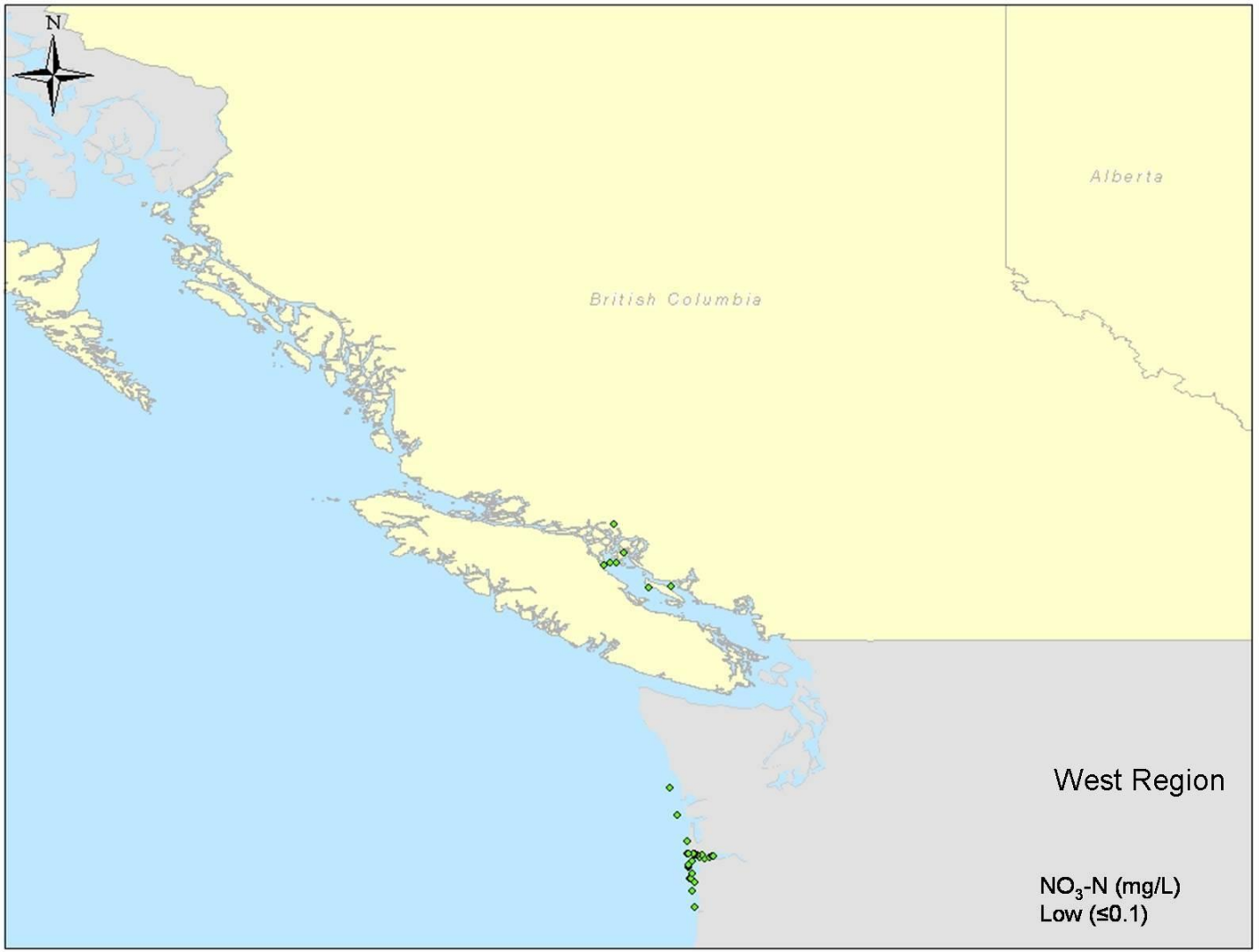

N
Northeast Region
Nunavut
Québec
Newfoundland and Labrador
Ontario
PO4-P (mg/L)
Low (≤0.01)

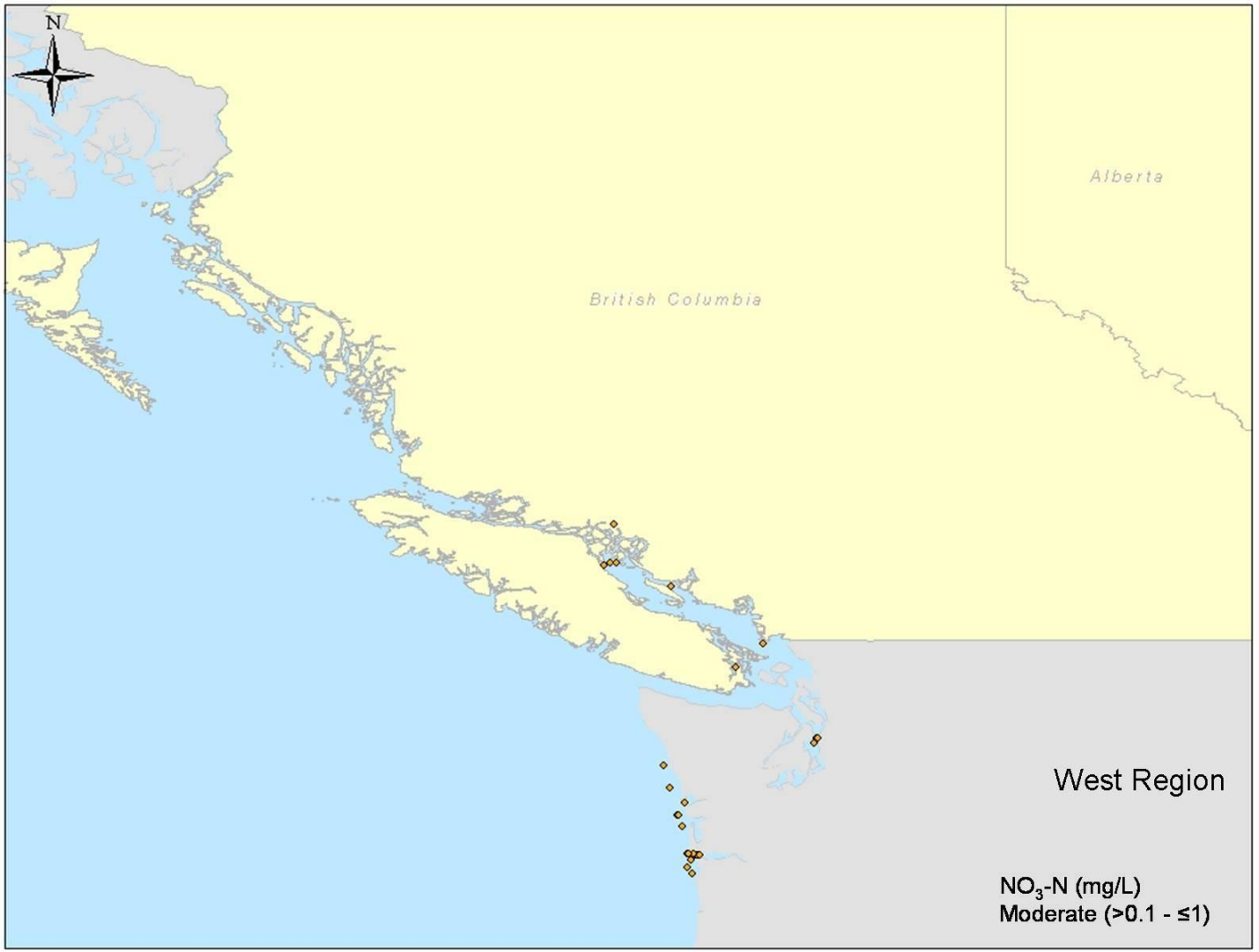

N
Northeast Region
Nunavut
Québec
Newfoundland and Labrador
Ontario
PO4-P (mg/L)
Moderate (>0.01 - ≤0.1)

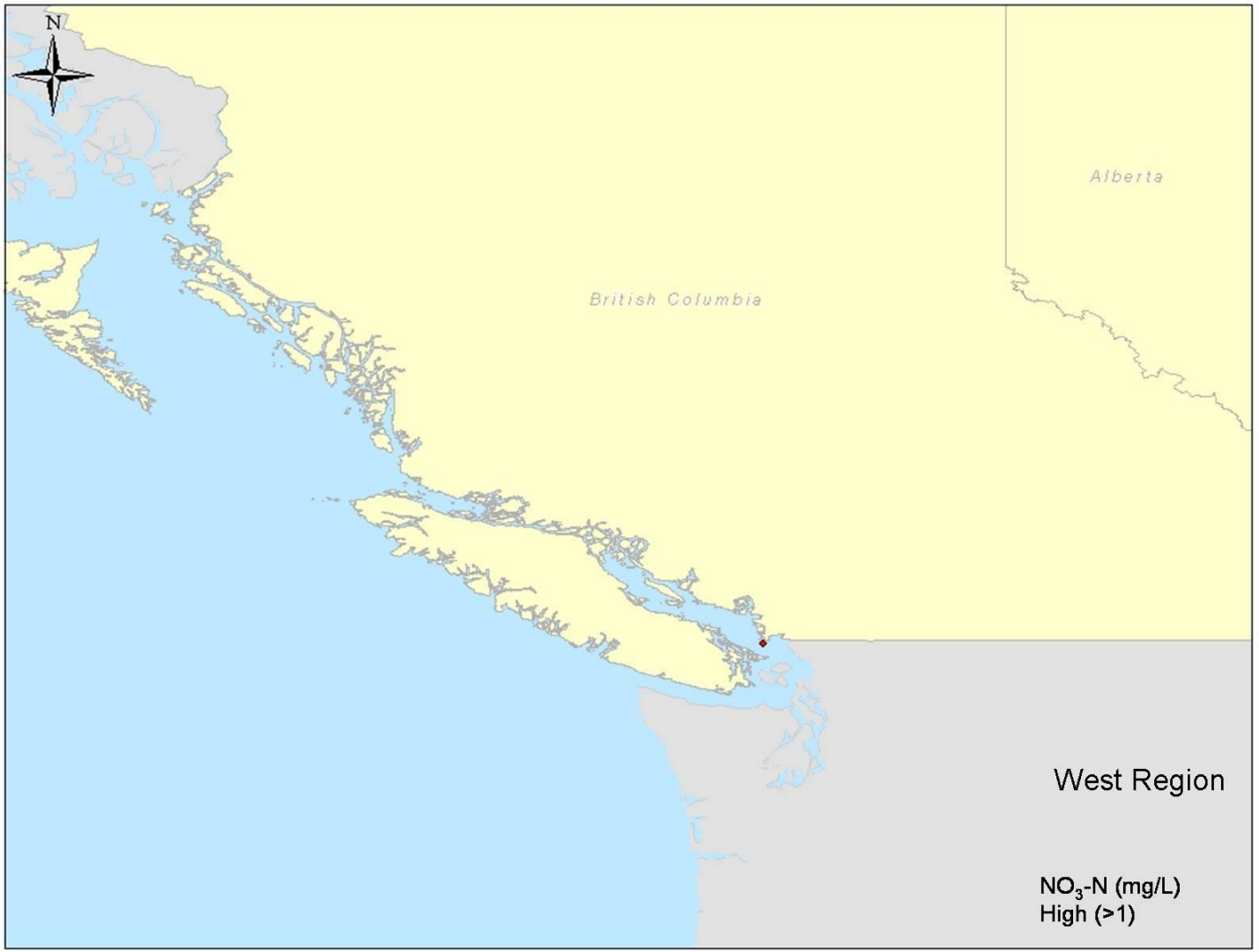

N
Northeast Region
Nunavut
Québec
Newfoundland and Labrador
Ontario
Chl a (µg/L)
Low (≤5)

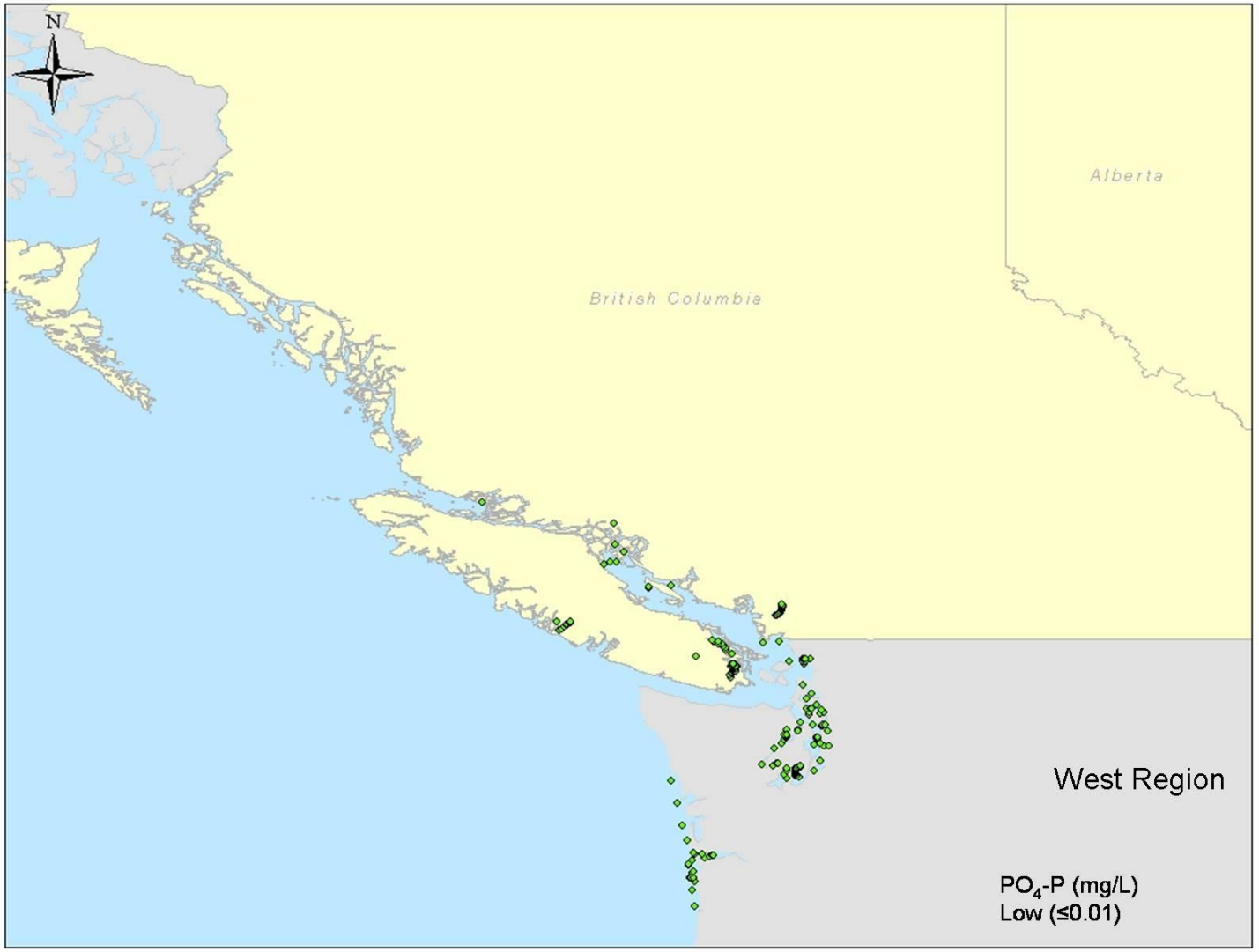

N
Northeast Region
Nunavut
Québec
Newfoundland and Labrador
Ontario
Chl a (µg/L)
Moderate (>5 - ≤20)

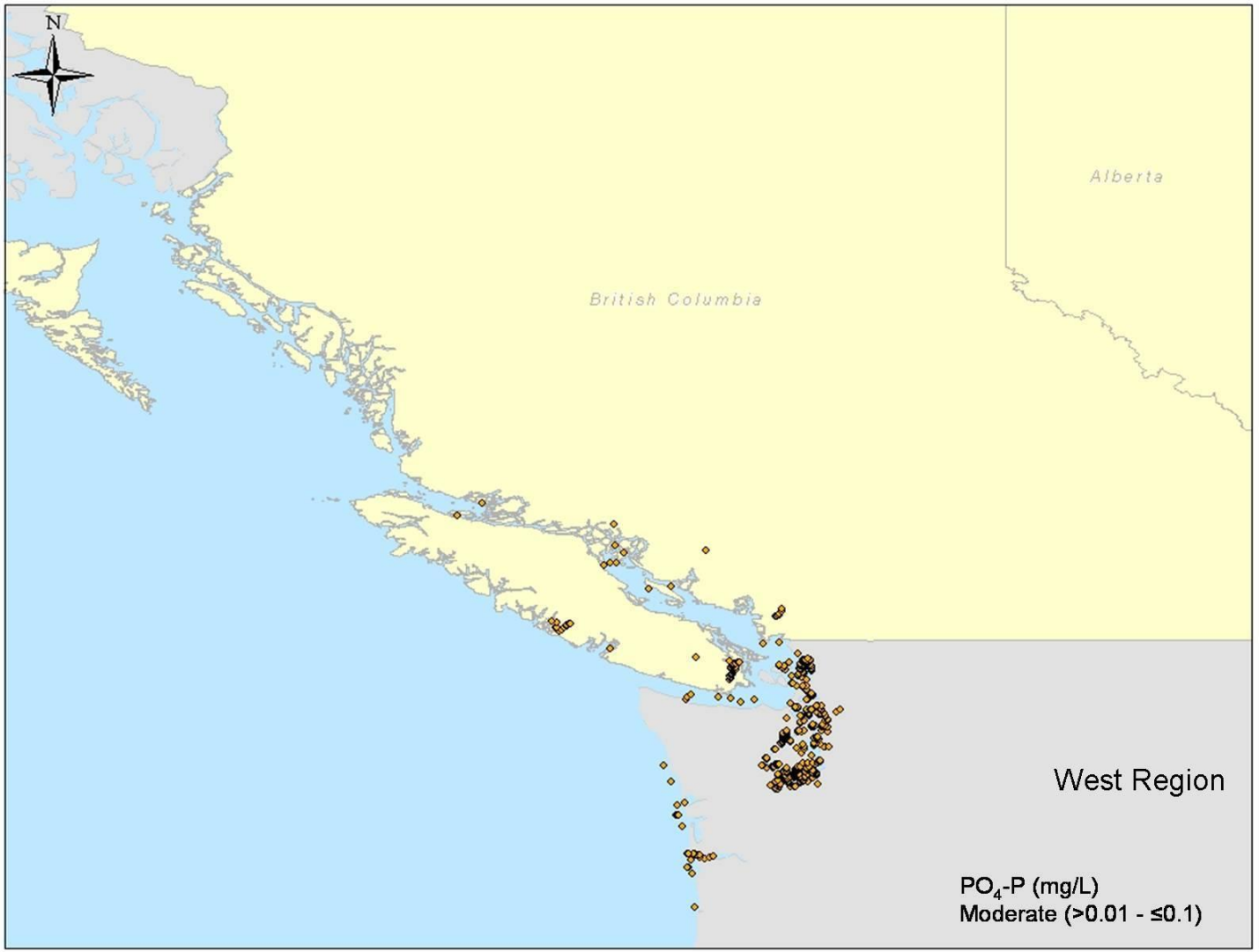

N
Northeast Region
Nunavut
Québec
Newfoundland and Labrador
Ontario
DO (mg/L)
High (>4)

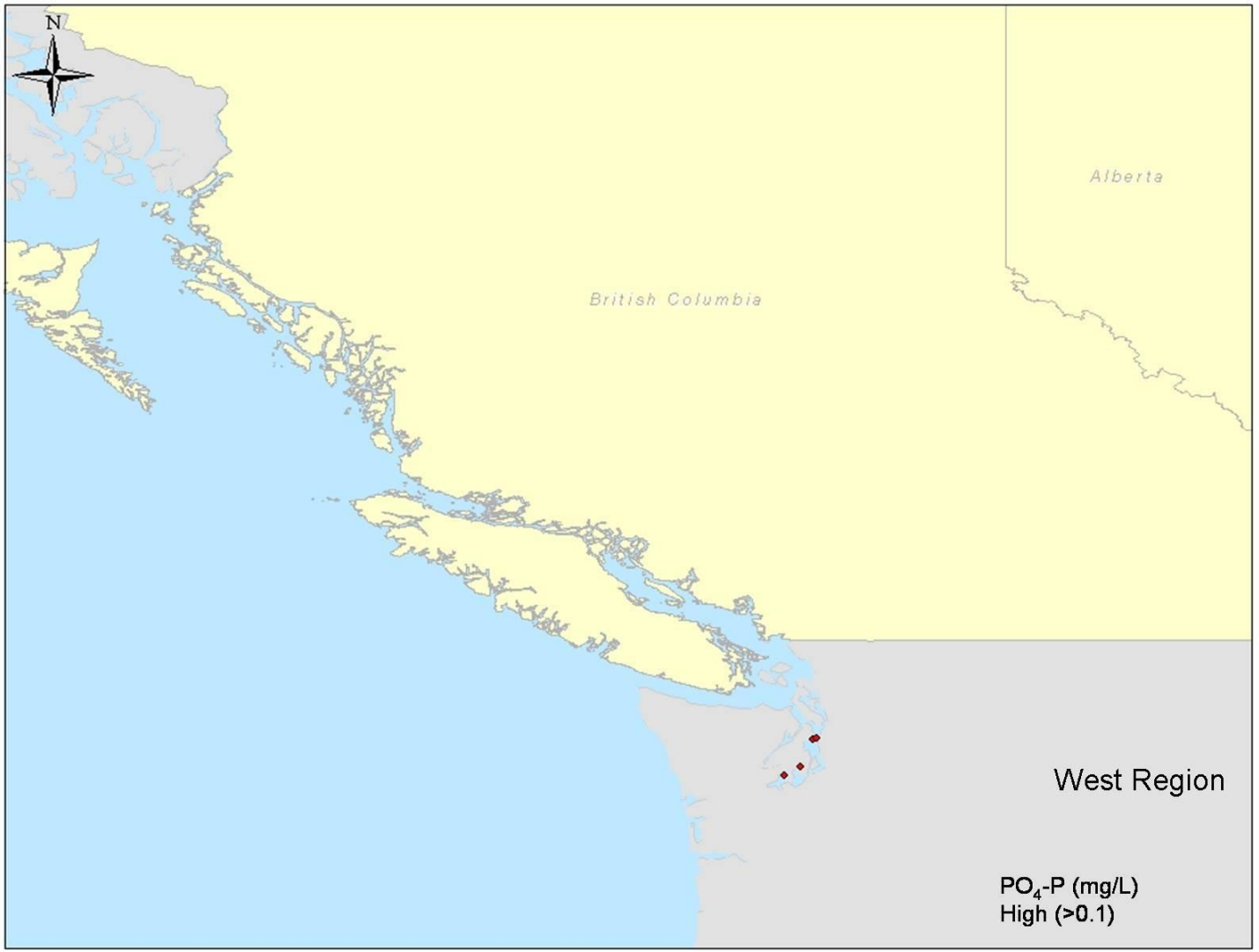

N
Alberta
British Columbia
West Region
NO_3-N (mg/L)
Low (≤0.1)

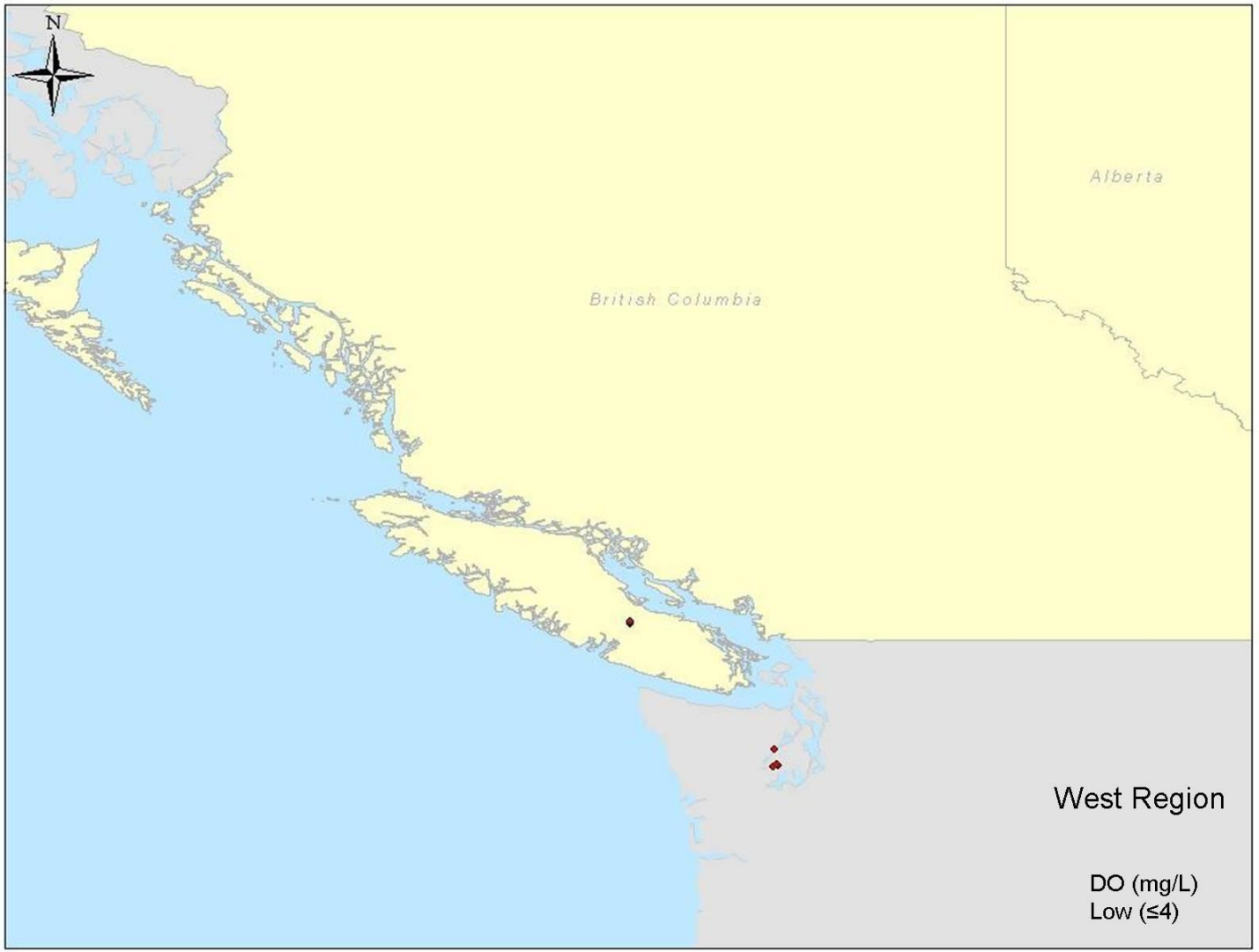

N
Alberta
British Columbia
West Region
NO_3-N (mg/L)
Moderate (>0.1 - ≤1)

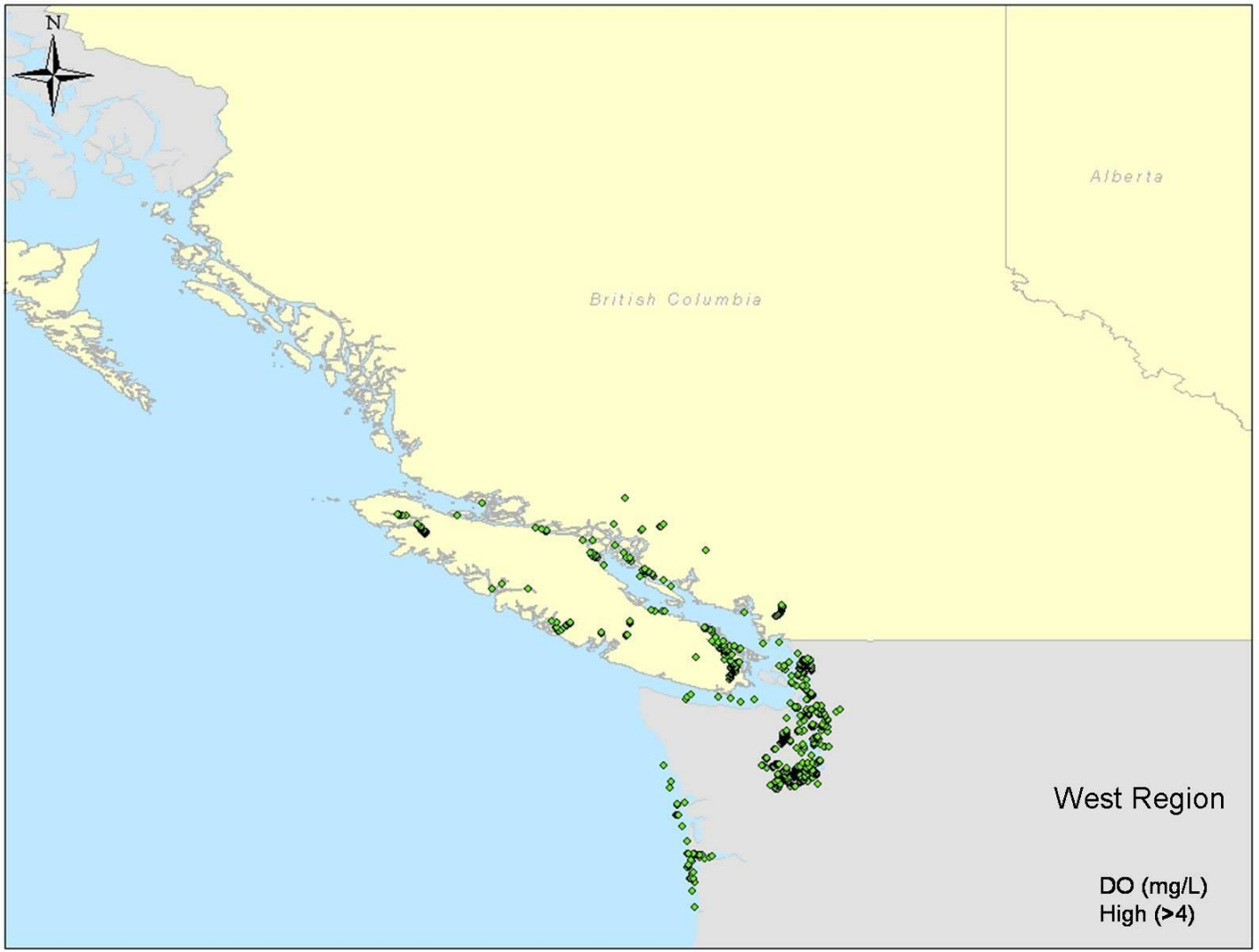

N
Alberta
British Columbia
West Region
NO_3-N (mg/L)
High (>1)


N
Alberta
British Columbia
West Region
PO4-P (mg/L)
Low (≤0.01)


N
Alberta
British Columbia
West Region
PO4-P (mg/L)
Moderate (>0.01 - ≤0.1)


N
Alberta
British Columbia
West Region
PO4-P (mg/L)
High (>0.1)


N
Alberta
British Columbia
West Region
DO (mg/L)
Low (≤4)


N
Alberta
British Columbia
West Region
DO (mg/L)
High (>4)


N
YT
NT
NU
BC
AB
SK
MB
ON
QC
Northwest Region
NO3-N (mg/L)
Low (≤0.1)


N
YT
NT
NU
BC
AB
SK
MB
ON
QC
Northwest Region
NO_3-N (mg/L)
Moderate (>0.1 - ≤1)


N
YT
NT
NU
BC
AB
SK
MB
ON
QC
Northwest Region
PO4-P (mg/L)
Low (≤0.01)

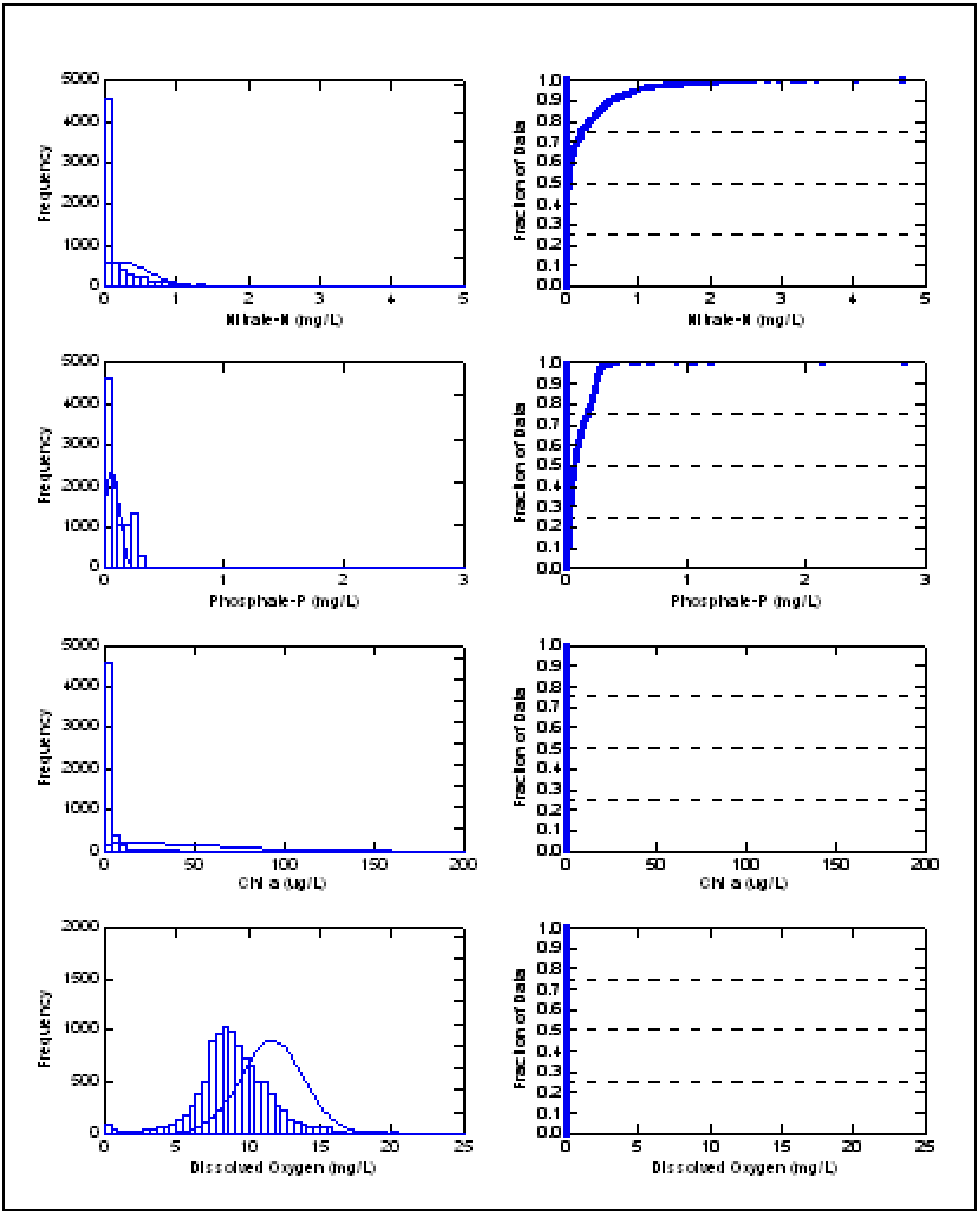

N
YT
NT
NU
BC
AB
SK
MB
ON
QC
Northwest Region
PO4-P (mg/L)
Moderate (>0.01 - ≤0.1)


N
YT
NT
NU
BC
AB
SK
MB
ON
QC
Northwest Region
Chl a (µg/L)
Low (≤5)

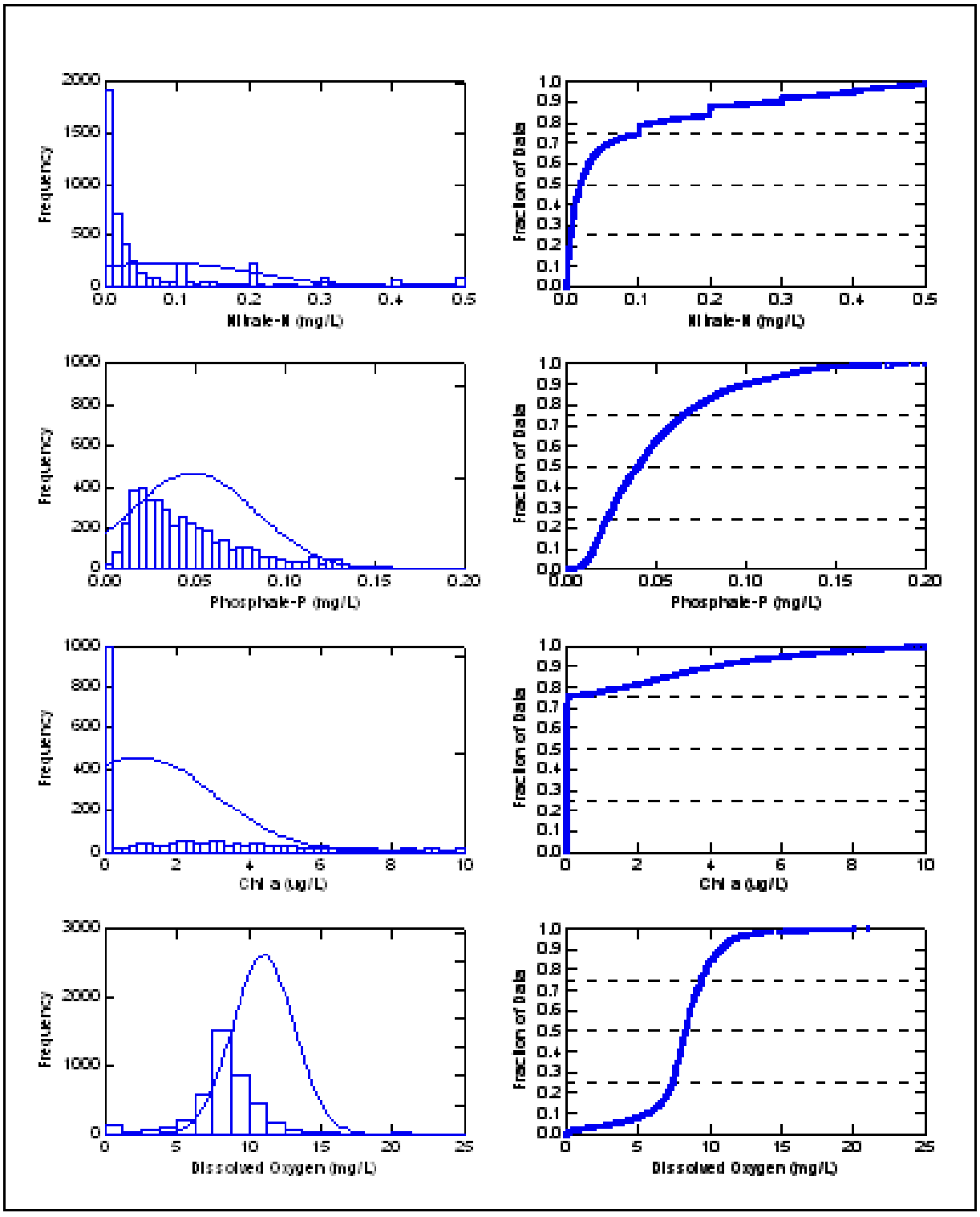

N
YT
NT
NU
BC
AB
SK
MB
ON
QC
Northwest Region
DO (mg/L)
Low (≤4)


N
YT
NT
NU
BC
AB
SK
MB
ON
QC
Northwest Region
DO (mg/L)
High (>4)

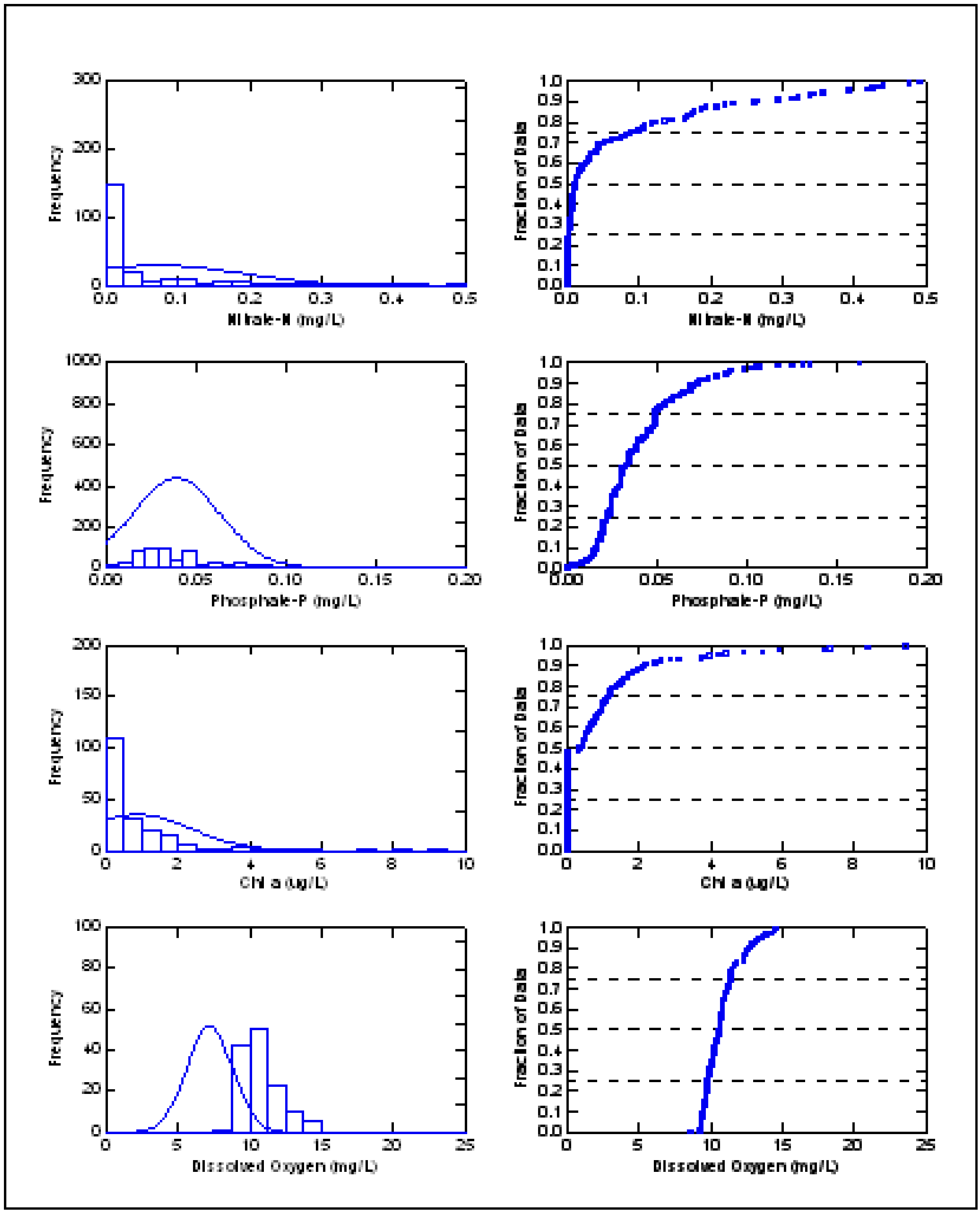
APPENDIX II
Quantile Plots


Frequency
Nitrate-N (mg/L)
Fraction of Data
Nitrate-N (mg/L)
Frequency
Phosphate-P (mg/L)
Fraction of Data
Phosphate-P (mg/L)
Frequency
Chl a (ug/L)
Fraction of Data
Chl a (ug/L)
Frequency
Dissolved Oxygen (mg/L)
Fraction of Data
Dissolved Oxygen (mg/L)

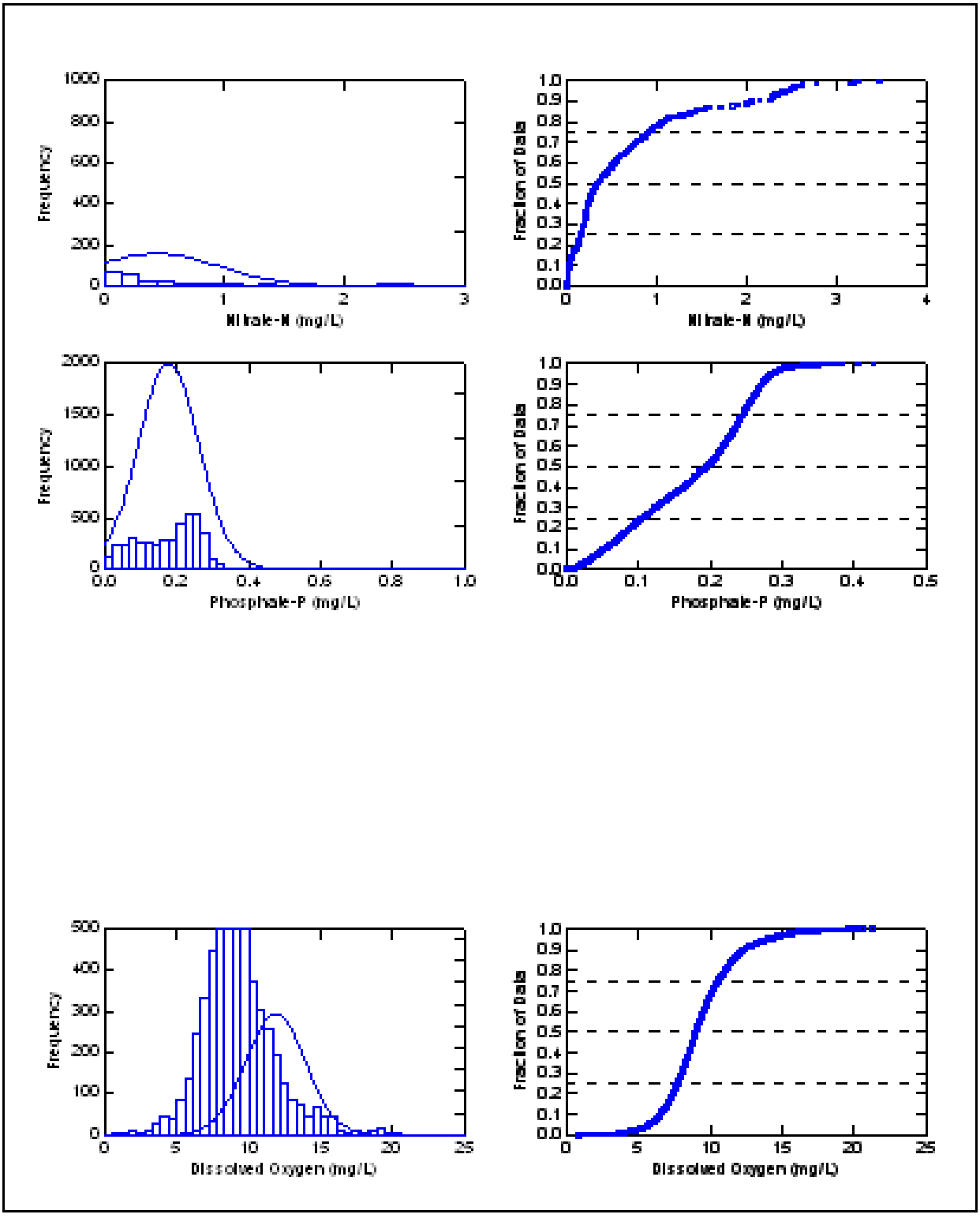
ALL REGIONS


Frequency
Nitrate-N (mg/L)
Fraction of Data
Nitrate-N (mg/L)
Frequency
Phosphate-P (mg/L)
Fraction of Data
Phosphate-P (mg/L)
Frequency
Chl a (ug/L)
Fraction of Data
Chl a (ug/L)
Frequency
Dissolved Oxygen (mg/L)
Fraction of Data
Dissolved Oxygen (mg/L)

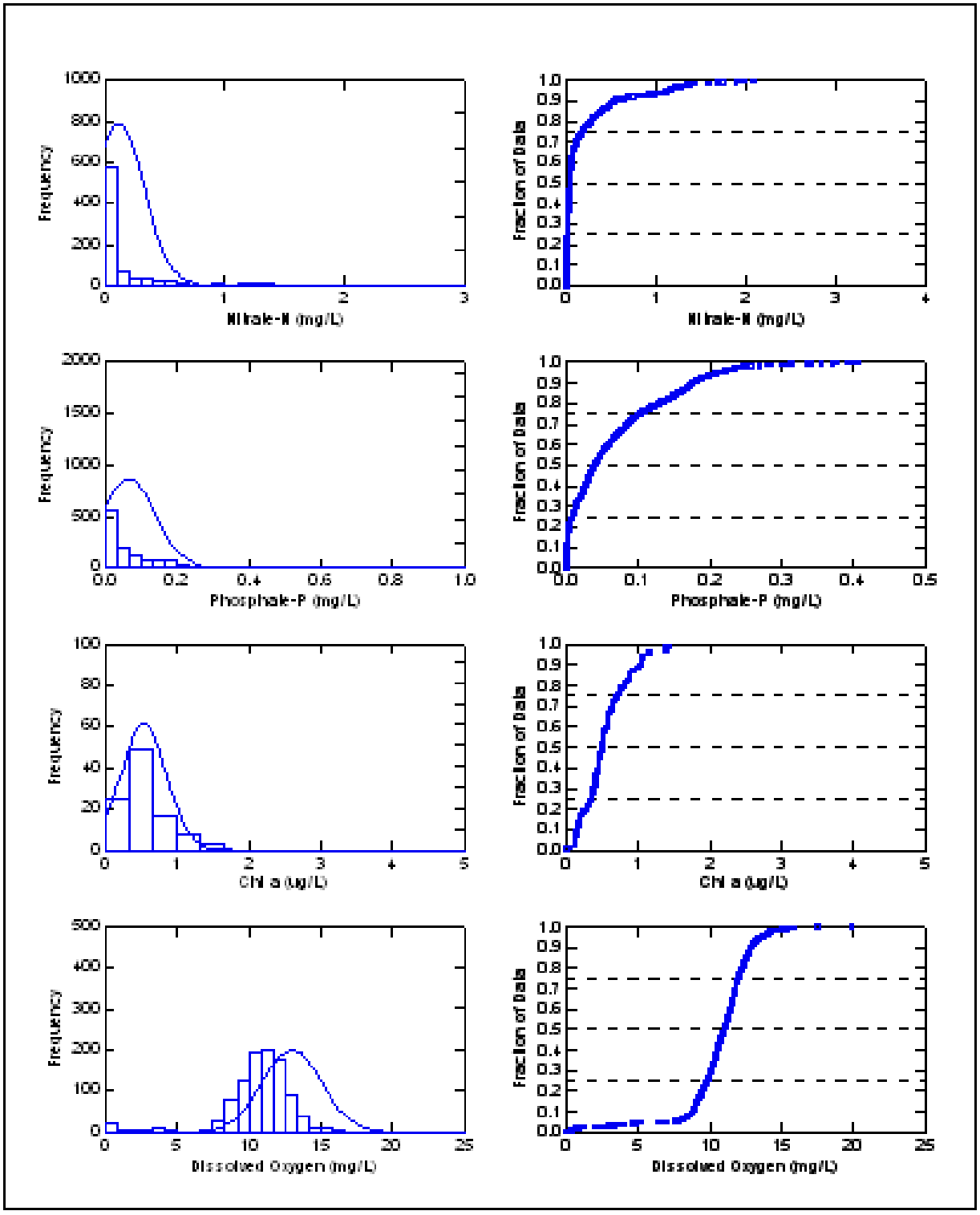
EAST REGION



NORTHEAST REGION


Frequency
Nitrate-N (mg/L)
Fraction of Data
Nitrate-N (mg/L)
Frequency
Phosphate-P (mg/L)
Fraction of Data
Phosphate-P (mg/L)
Frequency
Dissolved Oxygen (mg/L)
Fraction of Data
Dissolved Oxygen (mg/L)

WEST REGION



NORTHWEST REGION

Appendix III
Watershed Land Use and Areas

Appendix III - Watershed Land Use and Areas

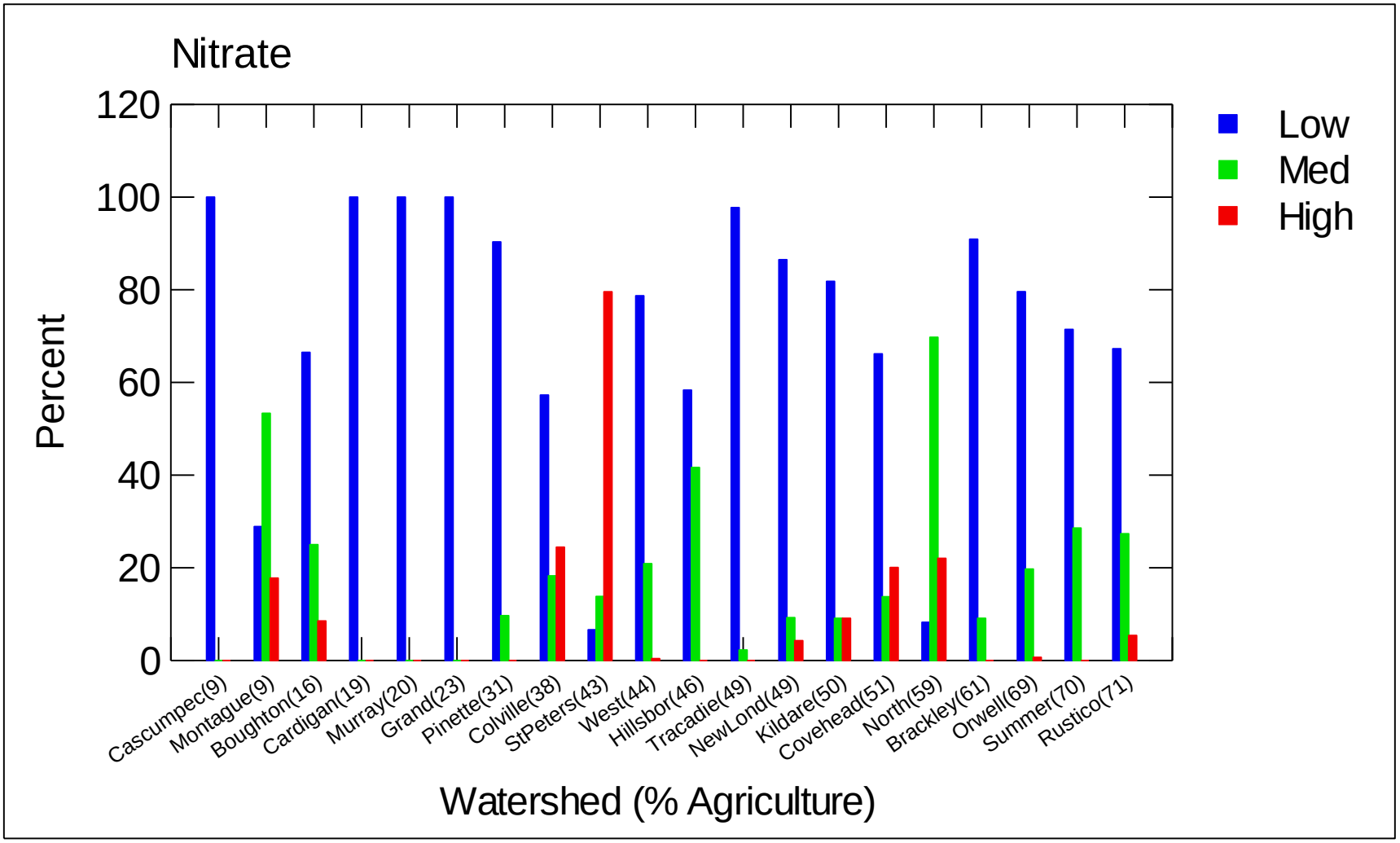
Main Watershed	Sub-Watershed	Agriculture	Commercial	Forest	Industrial	Institutional	No evident use	Recreation	Residential	Transportation	Urban	Wetlands	Total hectares	% Agriculture
Boughton River	BLACKETTS CREEK27	180.84	0.00	757.99	1.23	0.80	15.46	0.00	13.71	15.87	0.00	127.13	1113.03	**16.2**
	BOUGHTON RIVER29	1887.77	3.34	2426.91	14.28	1.91	119.81	4.38	48.11	108.82	12.06	490.16	5117.55	**36.9**
	GRAYSTONE CREEK101	304.04	0.35	418.19	0.00	0.33	18.61	0.00	4.45	11.14	0.00	41.90	799.01	**38.1**
	MORRISON POND165	70.35	0.00	499.55	0.00	0.00	12.32	0.00	10.45	11.32	0.00	32.51	636.50	**11.1**
	NARROWS CREEK169	292.38	0.52	1272.53	0.14	3.20	9.89	0.00	12.94	23.11	0.00	115.07	1729.78	**16.9**
	POPLAR POINT191	263.71	0.00	556.53	0.00	0.00	22.45	1.19	26.17	28.25	0.00	54.62	952.92	**27.7**
Brackley Bay	BLACK RIVER25	1277.19	5.91	609.93	0.57	0.44	33.46	15.66	57.76	37.42	0.00	47.32	2085.66	**61.2**
	McCALLUM CREEK154	448.82	28.68	485.07	11.27	0.69	49.66	24.10	108.63	41.70	0.00	362.93	1561.55	**28.7**
	BRUDENELL RIVER36	2329.22	33.19	2316.78	62.60	1.69	140.63	213.74	120.95	140.43	6.70	160.28	5526.21	**42.1**
Cardigan Bay	BYRNES CREEK37	160.76	0.00	596.35	5.58	0.00	10.52	0.00	6.67	9.18	0.00	18.73	807.79	**19.9**
	CARDIGAN RIVER45	1158.71	10.99	2655.44	34.10	1.71	98.31	6.31	112.36	161.79	24.04	192.03	4455.79	**26.0**
	LAUNCHING129	328.41	0.00	963.80	1.40	0.00	50.82	0.00	37.22	36.47	0.00	129.28	1547.40	**21.2**
	MITCHELL RIVER162	65.52	0.00	1071.28	0.00	0.00	12.42	0.00	10.70	27.28	0.00	74.75	1261.95	**5.2**
	SEAL RIVER (CARDIGAN)215	496.91	0.00	1350.06	0.76	0.47	44.04	0.00	27.56	49.71	0.00	125.42	2094.93	**23.7**
Cascumpec Bay	FOXLEY RIVER83	383.10	0.00	2636.81	148.46	2.13	72.09	1.96	32.98	55.99	0.00	906.02	4239.54	**9.0**
	TROUT RIVER (ROXBURY)244	4274.93	2.94	4877.42	51.23	11.62	359.51	9.57	113.38	199.95	77.62	729.69	10707.86	**39.9**
Colville Bay	SOURIS RIVER224	2037.12	2.27	2488.61	25.66	14.47	195.01	2.24	122.99	145.53	86.02	189.62	5309.54	**38.4**
Covehead Bay	BELLS CREEK15	2194.63	13.41	1437.00	18.94	5.43	119.17	79.90	174.04	71.91	79.27	130.04	4323.74	**50.8**
	BLACK RIVER25	1277.19	5.91	609.93	0.57	0.44	33.46	15.66	57.76	37.42	0.00	47.32	2085.66	**61.2**
	McCALLUM CREEK154	448.82	28.68	485.07	11.27	0.69	49.66	24.10	108.63	41.70	0.00	362.93	1561.55	**28.7**
Grand River	GRAND RIVER99	1162.41	1.82	3175.55	32.44	5.91	173.30	6.69	78.20	116.08	37.36	356.23	5145.99	**22.6**
	LITTLE TROUT RIVER137	635.24	3.71	1258.67	25.60	0.00	46.78	0.66	27.73	51.85	0.00	78.83	2129.07	**29.8**
	NEBRASKA CREEK171	1155.26	0.89	868.35	5.05	0.00	77.58	0.00	39.98	49.22	0.00	205.45	2401.78	**48.1**

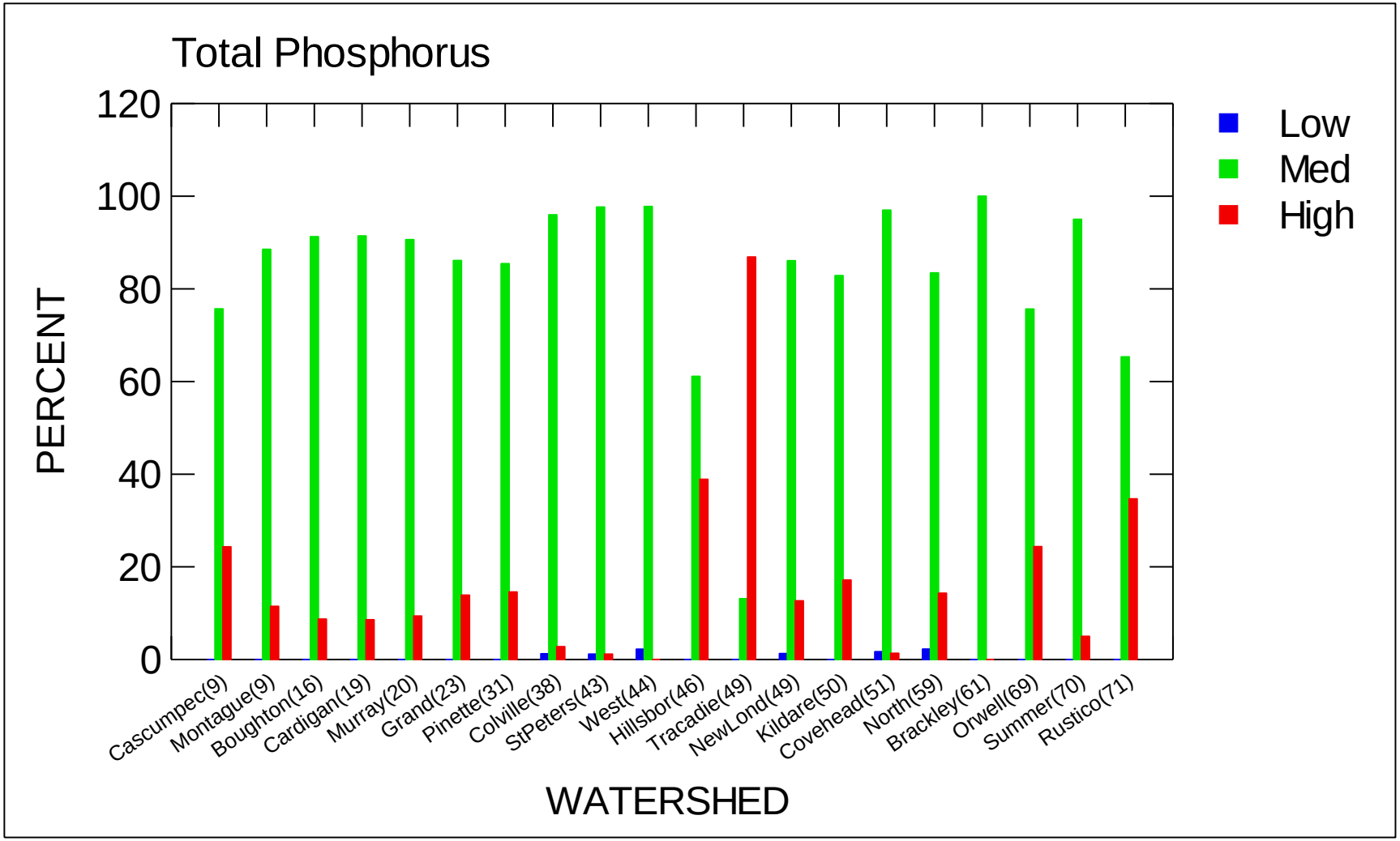
	ROCHFORD POND203	228.49	0.79	73.42	0.00	0.27	35.00	0.00	6.05	9.14	0.00	83.96	437.12	**52.3**
	SHIPYARD CREEK221	1480.70	6.05	692.73	5.85	0.00	108.49	1.40	29.19	72.31	0.00	61.52	2458.24	**60.2**
Hillsborough River	APPLETREE CREEK5	203.48	0.00	49.06	0.00	0.00	1.62	0.00	11.88	5.51	0.00	10.40	281.95	**72.2**
Hillsborough River	BLACK BROOK21	197.86	0.23	298.10	0.97	0.00	13.25	0.00	12.48	22.15	0.00	42.78	587.82	**33.7**
	CHEESE FACTORY CREEK51	781.52	1.39	521.63	6.22	5.50	35.71	3.00	26.58	26.77	0.00	99.98	1508.30	**51.8**
	CLARKS BROOK55	1510.59	0.00	2396.72	13.28	0.00	54.56	0.00	40.56	107.17	0.00	507.19	4630.07	**32.6**
	FULLERTONS CREEK86	1698.70	1.55	639.13	16.62	4.21	183.55	2.35	206.67	85.70	22.08	185.09	3045.65	**55.8**
	GLENFINNAN RIVER92	1051.87	0.00	1686.43	9.73	5.94	63.21	2.35	42.68	52.36	0.00	412.80	3327.37	**31.6**
	HILLSBOROUGH RIVER110	1663.47	3.20	2923.01	6.48	8.09	131.97	0.85	45.86	118.71	6.88	401.44	5309.96	**31.3**
	HORNES CREEK1114	842.63	1.18	209.09	3.65	1.65	19.09	23.39	57.28	26.84	0.00	17.76	1202.56	**70.1**
	HORNES CREEK2115	772.91	5.59	156.91	8.20	0.00	29.58	0.00	38.33	31.16	15.57	33.63	1091.88	**70.8**
	JOHNSTONS RIVER124	1999.81	0.00	1211.21	9.39	1.13	100.91	0.01	80.98	58.71	0.00	465.48	3927.63	**50.9**
	MILLERS CREEK159	781.13	0.37	710.93	11.77	0.83	38.83	0.00	33.88	45.04	0.00	169.98	1792.76	**43.6**
	PISQUID RIVER187	1573.99	0.61	2524.09	10.16	0.00	80.75	0.00	47.09	120.18	10.87	386.83	4754.57	**33.1**
	RIVERSIDE202	47.27	0.24	19.97	3.56	43.33	7.83	75.84	0.75	39.37	536.89	13.97	789.02	**6.0**
	ROSEBANK207	115.66	11.00	64.21	23.98	13.61	115.62	82.03	25.81	31.04	311.61	10.33	804.90	**14.4**
	SCOTCHFORT212	381.72	0.58	308.62	2.58	0.00	20.91	1.25	25.21	30.94	3.76	121.64	897.21	**42.5**
	SCOTTS CREEK213	390.64	2.34	98.57	15.15	1.04	20.93	0.63	32.95	9.80	0.00	17.86	589.91	**66.2**
	WRIGHTS CREEK260	398.40	0.00	56.28	9.16	13.67	97.57	4.80	43.57	74.10	211.08	39.23	947.86	**42.0**
Kildare River	DOCK RIVER70	909.65	1.86	493.85	6.97	5.10	58.07	10.51	42.66	63.87	157.31	79.05	1828.90	**49.7**
	HUNTLEY RIVER119	1655.84	1.10	906.81	39.21	1.91	60.09	0.72	68.88	86.43	16.42	48.02	2885.43	**57.4**
	KILDAIRE RIVER127	1657.21	1.13	922.02	7.64	0.05	33.05	0.00	62.87	63.89	0.00	140.90	2888.76	**57.4**
Mill River	HILLS RIVER109	995.75	0.00	239.74	11.11	8.24	16.10	1.34	67.30	31.65	0.00	24.22	1395.45	**71.4**
	MILL RIVER158	4665.38	11.08	5274.46	45.66	23.75	237.05	145.64	204.01	226.13	0.00	414.59	11247.75	**41.5**
Montague River	LOWER MONTAGUE141	26.97	3.59	213.76	0.00	0.00	4.50	0.00	19.34	9.20	8.90	7.93	294.19	**9.2**
	MONTAGUE-VALLEYFIELD163	6925.02	17.69	10749.89	275.12	19.76	295.82	6.44	360.84	412.43	229.75	373.01	19665.77	**35.2**
Murray River	MURRAY RIVER166	1424.07	6.56	4768.09	55.69	3.66	94.47	29.08	103.42	160.32	83.82	361.63	7090.81	**20.1**
New London Bay	BAYVIEW11	550.85	3.91	445.54	3.80	0.96	31.70	23.57	23.28	17.19	0.00	14.49	1115.29	**49.4**
	CAMPBELLS POND40	725.80	0.00	176.73	0.00	0.00	23.28	0.01	20.57	15.49	0.00	54.14	1016.02	**71.4**
	DURANT CREEK72	516.91	0.00	115.16	0.54	0.00	8.78	0.00	13.46	10.48	0.00	11.05	676.38	**76.4**
	FOUNDS RIVER81	974.96	9.17	204.54	3.30	0.00	34.16	2.39	71.99	33.33	0.00	21.92	1355.76	**71.9**
	FRENCH RIVER85	421.97	0.00	113.66	0.75	0.00	23.46	53.36	44.69	21.90	0.00	6.90	686.69	**61.4**

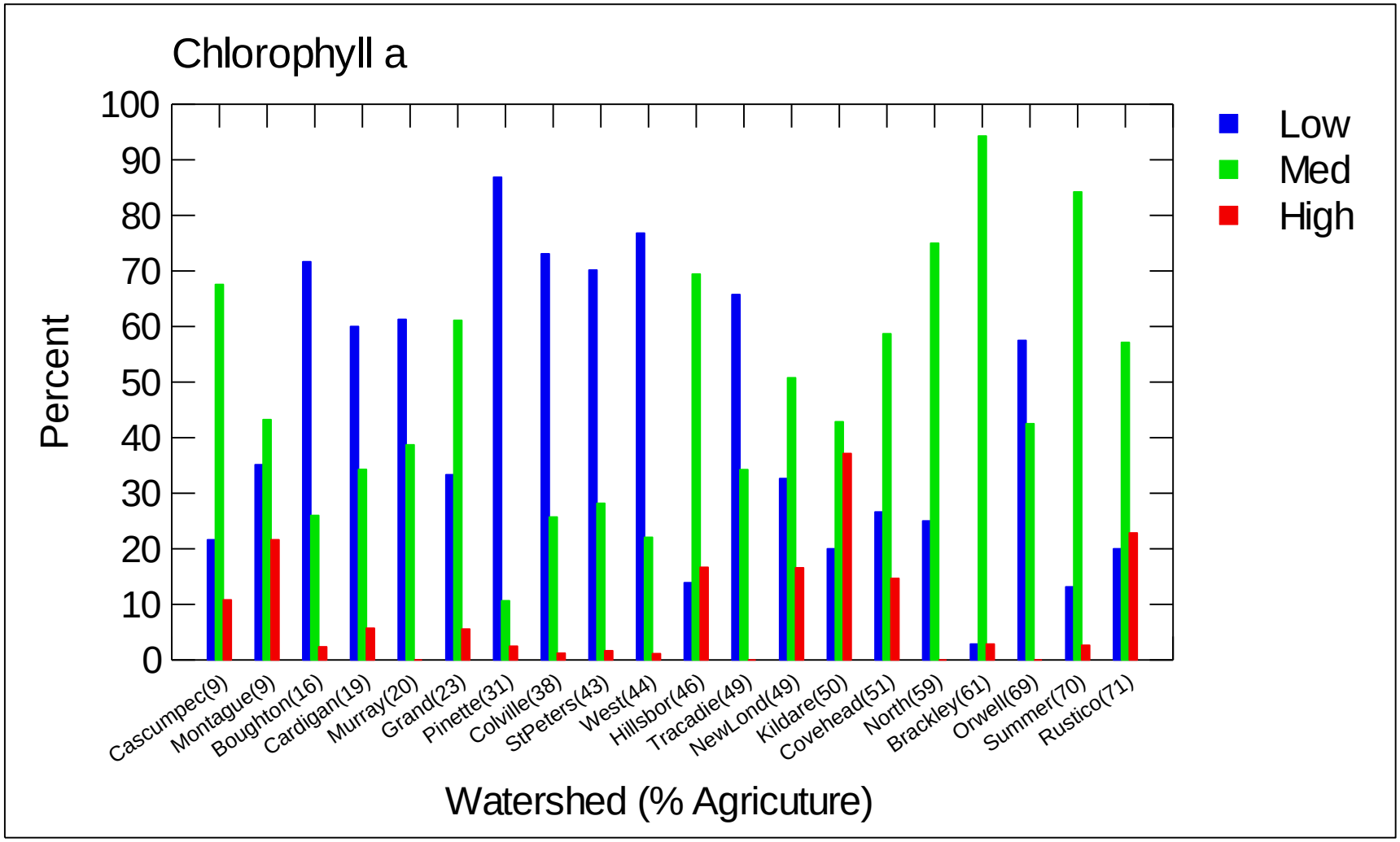
	GRAHAMS CREEK97	218.99	10.23	146.59	0.00	1.18	46.20	40.81	17.83	7.66	0.00	101.45	590.94	**37.1**
	GRANVILLE CREEK100	1374.89	0.00	1050.07	1.05	1.09	58.92	0.00	47.48	36.76	0.00	30.17	2600.43	**52.9**
	HARDING CREEK105	662.61	0.00	118.53	7.73	0.00	26.01	31.24	38.32	18.59	0.00	16.70	919.73	**72.0**
	HOPE RIVER113	992.69	0.00	804.15	10.57	3.38	50.24	0.00	40.19	51.08	0.00	9.81	1962.11	**50.6**
	LONG RIVER140	534.35	0.00	155.92	1.69	0.00	4.57	0.00	27.65	20.13	0.00	5.60	749.91	**71.3**
	MACINTYRES CREEK145	531.52	0.00	64.26	2.69	0.90	18.05	0.00	42.40	17.11	7.97	8.92	693.82	**76.6**
	MACKIES POND147	314.30	0.83	92.28	2.62	0.25	5.20	0.00	30.39	6.90	0.00	18.31	471.08	**66.7**
	PAYNTERS CREEK183	741.78	5.76	176.39	2.03	2.04	8.33	0.00	20.27	23.78	0.00	13.96	994.34	**74.6**
	SOUTHWEST RIVER227	1785.15	18.81	371.48	0.84	1.33	39.81	3.13	77.53	52.35	0.00	65.52	2415.95	**73.9**
	SUTHERLAND CREEK239	275.14	0.00	74.67	0.39	0.00	16.15	0.00	10.31	6.14	0.00	6.39	389.19	**70.7**
	TROUT RIVER (MILLVALE)243	2251.05	4.72	2608.40	15.89	0.91	127.61	8.96	138.20	132.16	4.68	36.99	5329.57	**42.2**
	TUPLIN CREEK247	561.83	0.00	62.15	6.18	7.50	19.62	0.00	36.91	13.04	13.27	29.50	750.00	**74.9**
North River	NORTH RIVER176	5855.84	114.84	1518.79	72.95	54.97	372.78	10.48	322.49	333.26	909.09	332.27	9897.76	**59.2**
Orwell Bay	EARNSCLIFFE73	1874.32	0.52	450.32	7.64	1.15	124.22	0.00	52.36	55.52	0.00	143.95	2710.00	**69.2**
	ORWELL COVE178	259.05	0.00	31.50	0.04	0.00	46.72	0.00	11.70	6.82	0.00	52.56	408.39	**63.4**
	ORWELL RIVER179	1616.64	0.00	1023.44	5.17	0.84	99.98	0.69	46.64	73.70	0.00	85.34	2952.44	**54.8**
	SEAL RIVER (VERNON)216	1451.54	1.10	581.27	8.05	1.23	85.44	0.00	32.79	48.18	0.00	129.97	2339.57	**62.0**
	VERNON RIVER248	2938.86	2.28	2987.77	7.58	6.78	175.07	66.94	97.21	170.02	0.00	462.49	6915.00	**42.5**
Pinette River	PINETTE RIVER185	1672.70	3.66	3413.34	19.05	6.14	55.44	15.12	116.83	90.94	0.00	62.08	5455.30	**30.7**
Rustico	CHAPEL CREEK49	790.46	1.14	165.91	0.64	4.55	57.86	0.00	48.00	21.14	0.00	26.22	1115.92	**70.8**
	CYMBRIA65	156.51	6.20	66.12	1.69	0.00	8.53	52.75	64.06	7.57	0.00	9.67	373.10	**41.9**
	HORNES CREEK1114		842.63	1.18	209.09	3.65	1.65	19.09	23.39	57.28	26.84	0.00	17.76	**0.0**
	HORNES CREEK2115		772.91	5.59	156.91	8.20	0.00	29.58	0.00	38.33	31.16	15.57	33.63	**0.0**
	LUKES CREEK143	159.39	1.63	16.67	0.00	1.33	19.12	0.00	24.07	8.22	0.00	11.40	241.83	**65.9**
	OYSTER BED BRIDGE181	42.55	0.00	8.20	0.00	0.00	7.59	7.09	10.37	5.17	1.48	3.43	85.88	**49.5**
	WHEATLEY RIVER255	4236.86	2.36	1149.74	6.53	2.48	105.08	0.00	140.51	99.87	0.00	55.61	5799.04	**73.1**
St. Peters Bay	MARIE RIVER153	1249.48	0.00	1312.99	4.55	0.27	34.66	0.00	19.55	64.57	0.00	243.53	2929.60	**42.7**
	MIDGELL RIVER156	1263.07	0.00	4243.62	3.41	1.82	64.19	0.00	32.02	87.30	0.00	682.19	6377.62	**19.8**
	MORELL RIVER164	4811.71	4.48	9864.01	53.49	4.15	490.87	66.89	197.81	343.70	36.25	1182.53	17055.89	**28.2**
	ST. PETERS HARBOUR231	74.57	0.00	30.11	0.00	0.00	16.38	0.00	30.25	6.01	0.00	67.06	224.38	**33.2**
	ST. PETERS RIVER233	1547.78	4.27	2085.10	18.16	7.12	248.39	21.76	72.18	130.27	22.59	280.51	4438.13	**34.9**
Summerside	BRADSHAW RIVER30	3245.89	5.16	783.31	13.14	6.18	94.22	6.02	95.03	172.10	35.97	146.57	4603.59	**70.5**

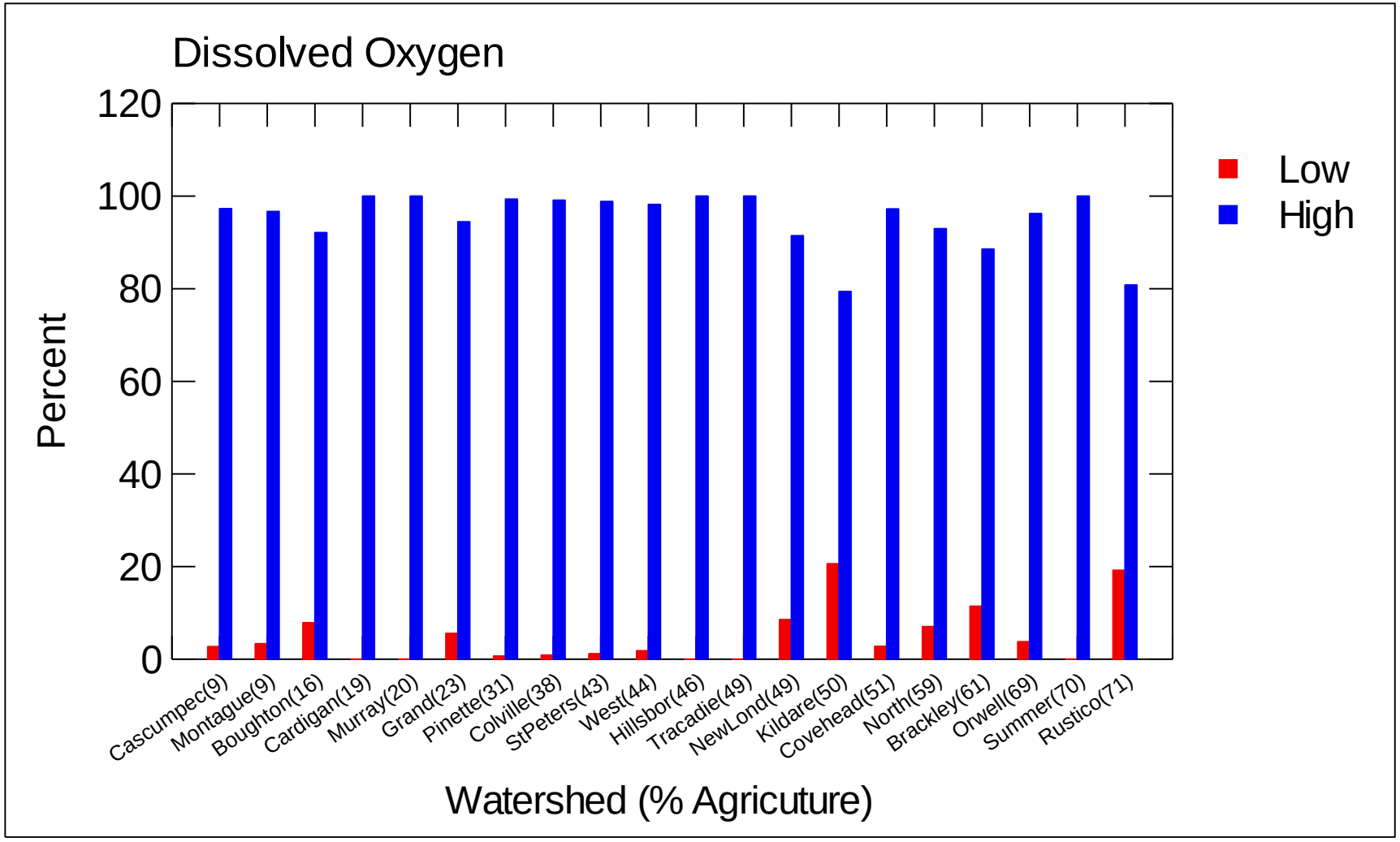
Harbour	DUNK RIVER71	11066.15	31.81	4081.74	43.00	10.06	247.68	1.07	303.37	406.92	52.48	323.53	16567.81	**66.8**
	SCHURMANS POINT211	95.89	0.04	13.94	0.00	0.00	0.00	0.00	30.27	3.16	0.00	0.00	143.30	**66.9**
	SEVEN MILE BAY218	2196.28	4.42	1058.21	47.51	2.44	163.01	3.28	208.73	116.33	140.95	253.45	4194.61	**52.4**
	SUNBURY COVE237	1907.20	128.55	4724.06	88.04	27.35	378.67	93.26	162.72	235.57	405.78	884.73	9035.93	**21.1**
	WILMOT RIVER258	6473.58	28.35	943.34	32.02	5.77	126.09	2.53	171.65	189.99	143.52	222.16	8339.00	**77.6**
Tracadie Bay	BLACK RIVER (DONALDSTON)26	472.42	0.00	356.86	2.74	0.00	23.81	0.00	21.52	15.11	0.00	75.28	967.74	**48.8**
	DEROCHE POND68	627.70	0.23	1471.51	1.60	0.00	41.00	0.00	11.42	40.13	0.00	648.72	2842.31	**22.1**
	KELLYS POINT126	25.73	0.00	36.29	0.00	0.00	7.36	0.00	18.90	4.01	0.00	0.00	92.29	**27.9**
	PIPERS CREEK186	607.89	1.39	1210.96	4.54	5.06	36.28	2.02	67.84	41.96	0.00	150.36	2128.30	**28.6**
	WINTER RIVER259	2882.63	7.73	2903.42	79.81	4.93	228.85	5.56	297.88	305.30	7.90	230.95	6954.96	**41.4**
West River	CHURCHILL54	387.12	1.20	349.14	9.84	1.22	41.84	20.38	21.65	21.75	0.00	28.83	882.97	**43.8**
	CLYDE RIVER56	2892.07	3.18	740.80	27.06	7.65	124.23	49.59	160.90	78.49	0.00	83.49	4167.46	**69.4**
	FAIRVIEW76	1109.90	1.60	404.03	4.65	0.97	80.43	53.90	117.76	45.77	0.00	51.64	1870.65	**59.3**
	HYDE CREEK120	1296.15	0.75	295.52	1.14	11.56	57.38	22.54	85.57	44.48	160.35	50.72	2026.16	**64.0**
	LONG CREEK139	580.13	2.53	159.30	0.75	0.98	15.69	0.00	36.83	16.00	0.00	41.95	854.16	**67.9**
	MACFAYDENS CREEK144	123.75	0.00	250.49	0.59	0.00	19.10	0.00	3.90	3.64	0.00	8.77	410.24	**30.2**
	MACLAUGHLINS CREEK149	222.57	0.00	199.88	1.11	0.00	8.37	0.00	9.12	5.86	0.00	2.50	449.41	**49.5**
	MACLEODS CREEK151	128.43	0.00	14.66	0.07	0.00	6.68	0.00	17.49	5.34	0.00	1.85	174.52	**73.6**
	MCPHEE CREEK155	108.69	3.70	105.22	9.66	0.37	15.61	3.23	37.49	10.20	0.00	3.87	298.04	**36.5**
	WEST RIVER253	4693.20	12.16	5803.53	16.21	6.81	290.27	68.06	170.77	241.69	0.00	110.17	11412.87	**41.1**

Appendix IV
Bar Plots of Nutrient Criteria and Percent Agricultural Land Use


Nitrate
120
100
80
60
40
20
0
Percent
Low
Med
High
Cascumpec(9)
Montague(9)
Boughton(16)
Cardigan(19)
Murray(20)
Grand(23)
Pinette(31)
Colville(38)
StPeters(43)
West(44)
Hillsbor(46)
Tracadie(49)
NewLond(49)
Kildare(50)
Covehead(51)
North(59)
Brackley(61)
Orwell(69)
Summer(70)
Rustico(71)
Watershed (% Agriculture)


Total Phosphorus
PERCENT
120
100
80
60
40
20
0
Low
Med
High
Cascumpec(9)
Montague(9)
Boughton(16)
Cardigan(19)
Murray(20)
Grand(23)
Pinette(31)
Colville(38)
StPeters(43)
West(44)
Hillsbor(46)
Tracadie(49)
NewLond(49)
Kildare(50)
Covehead(51)
North(59)
Brackley(61)
Orwell(69)
Summer(70)
Rustico(71)
WATERSHED


Chlorophyll a
Percent
100
90
80
70
60
50
40
30
20
10
0
Low
Med
High
Cascumpec(9)
Montague(9)
Boughton(16)
Cardigan(19)
Murray(20)
Grand(23)
Pinette(31)
Colville(38)
StPeters(43)
West(44)
Hillsbor(46)
Tracadie(49)
NewLond(49)
Kildare(50)
Covehead(51)
North(59)
Brackley(61)
Orwell(69)
Summer(70)
Rustico(71)
Watershed (% Agricuture)


Dissolved Oxygen
Percent
120
100
80
60
40
20
0
Low
High
Cascumpec(9)
Montague(9)
Boughton(16)
Cardigan(19)
Murray(20)
Grand(23)
Pinette(31)
Colville(38)
StPeters(43)
West(44)
Hillsbor(46)
Tracadie(49)
NewLond(49)
Kildare(50)
Covehead(51)
North(59)
Brackley(61)
Orwell(69)
Summer(70)
Rustico(71)
Watershed (% Agricuture)