

# Water Quality Monitoring and Analysis:

An Investigation of the Eutrophication and Undesirable Algae,  
and Degradation of Aesthetics Beneficial Use Impairments  
in the Canadian St. Marys River Area of Concern (2013-2015)



Environment  
Canada

Environnement  
Canada



**Algoma**  
UNIVERSITY

Carrie Ginou, Field Technician  
September 22, 2016

# St. Marys River Area of Concern

- Freshwater ecosystem where impairment of beneficial uses has occurred due to human activities





# Remedial Action Plan

- Restoration of beneficial uses, leading to the recovery of the St. Marys River Area of Concern



# Project Purpose

- Provide scientific information to allow for a re-assessment of the Eutrophication and Undesirable Algae, and Degradation of Aesthetics beneficial use impairments





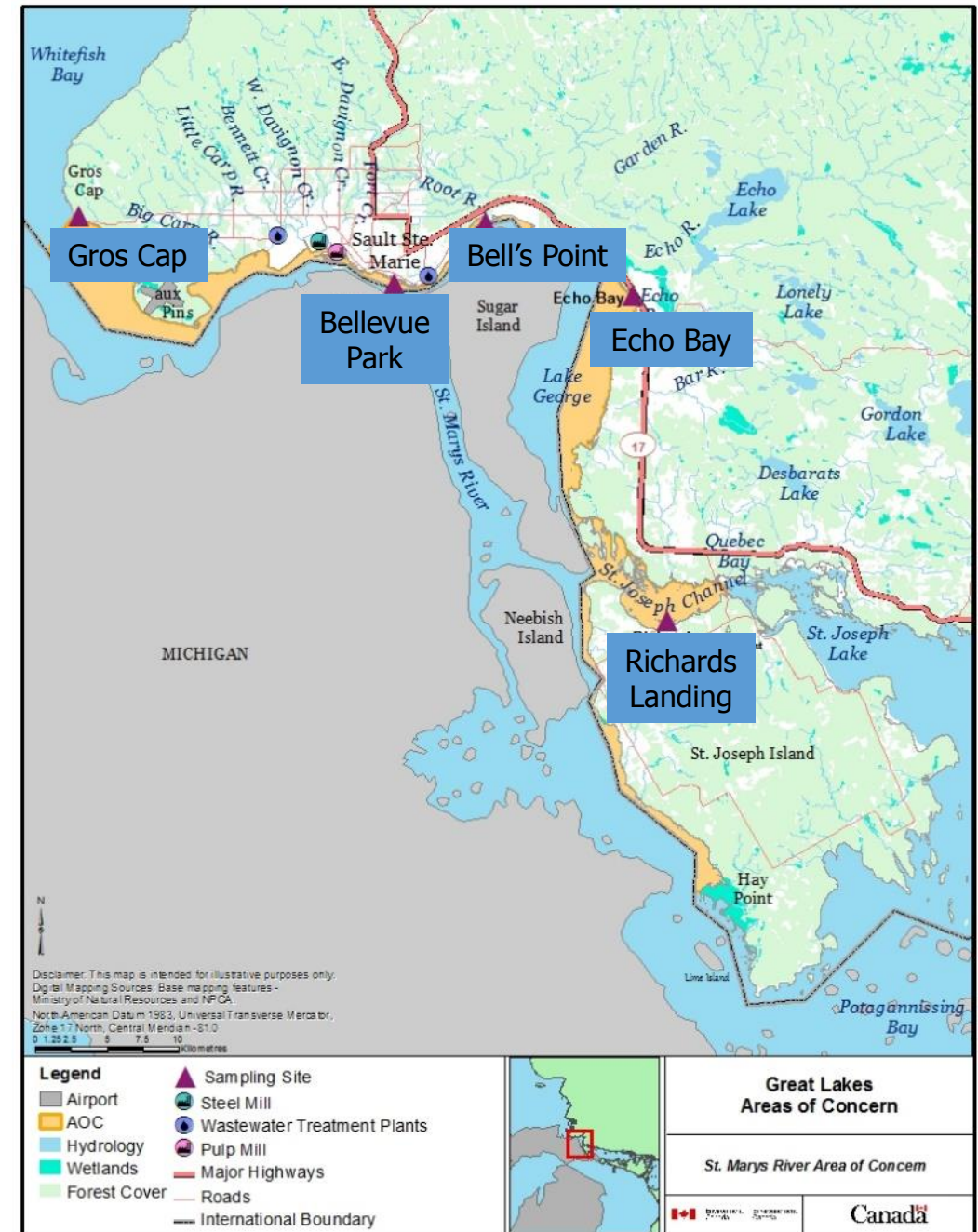
# Methods

- Observations, field measurements, and water samples



# Monitoring Sites

1. Gros Cap
2. Bellevue Park
3. Bell's Point
4. Echo Bay
5. Richards Landing



Map: Environment and Climate Change Canada



# Monitoring Dates

- November 2013 (1)
- May to October 2014 (11)
- May to October 2015 (11)
- Total: 23 events



# Data Collected

- Monitoring site characteristics
- Aesthetic parameters
- Physical parameters
- Chemical parameters





# Monitoring Site Characteristics

## Air temperature

- 7.0-27.7 °C

## Weather

- Sun, rain, cloud, wind

## Waterfowl

- All sites

## Substrate and Shoreline

- Rocky to sandy

## Human Uses

- Recreational



# Visual Water Clarity

## Results:

- Clear to moderately turbid
- Secchi depth: 40-50 cm
- Turbidity tube: 23-60 cm

## Discussion:

- *Free of unnatural turbidity*<sup>1</sup>



<sup>1</sup> St. Marys River Remedial Action Plan Implementation Annex (2015)



# Total Suspended Solids

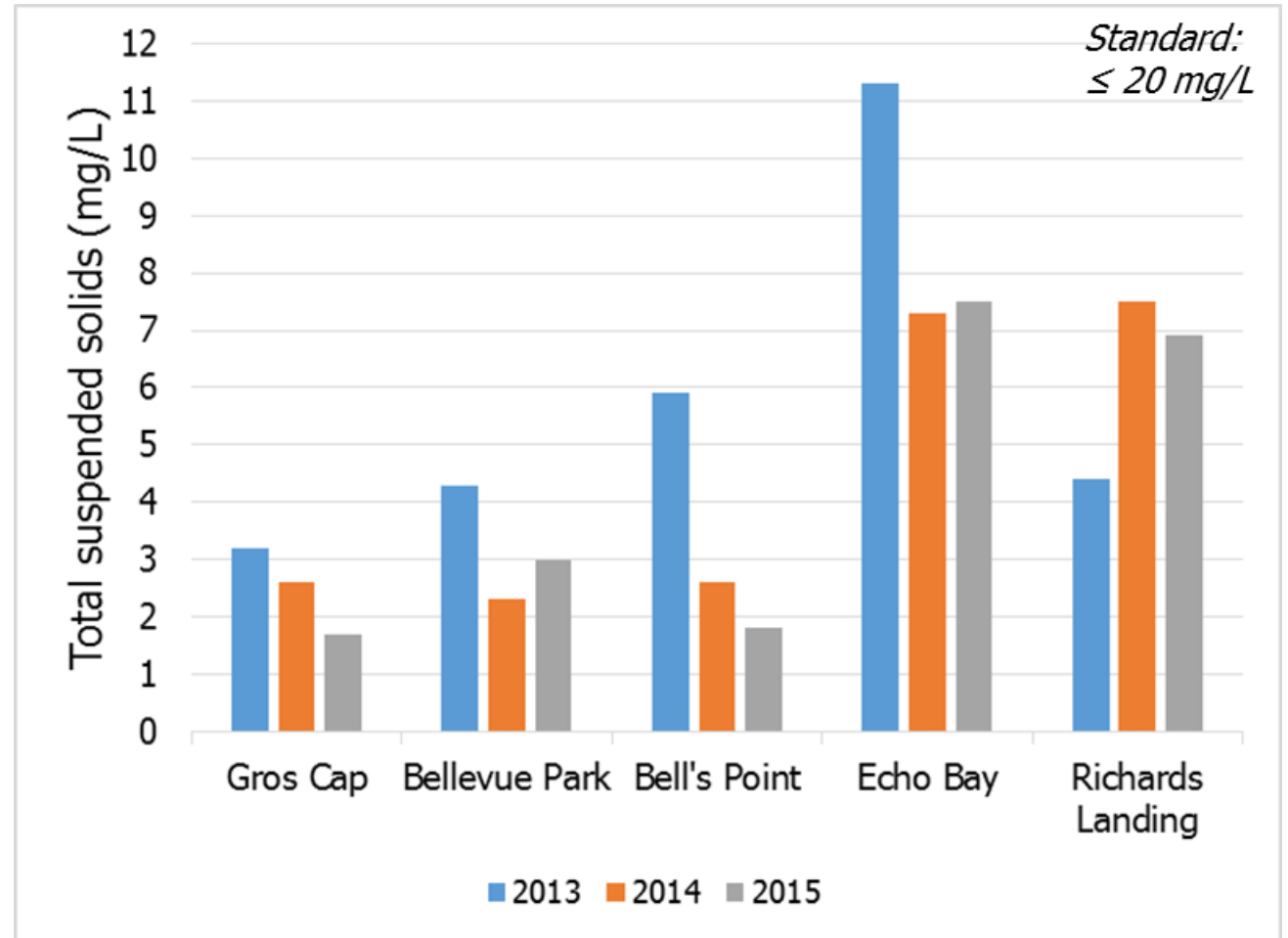
## Results:

- Range: <0.7-44.0 mg/L
- Mean: 1.7-11.3 mg/L

## Discussion:

- $\leq 20 \text{ mg/L}$ <sup>2</sup>

Bars represent mean values



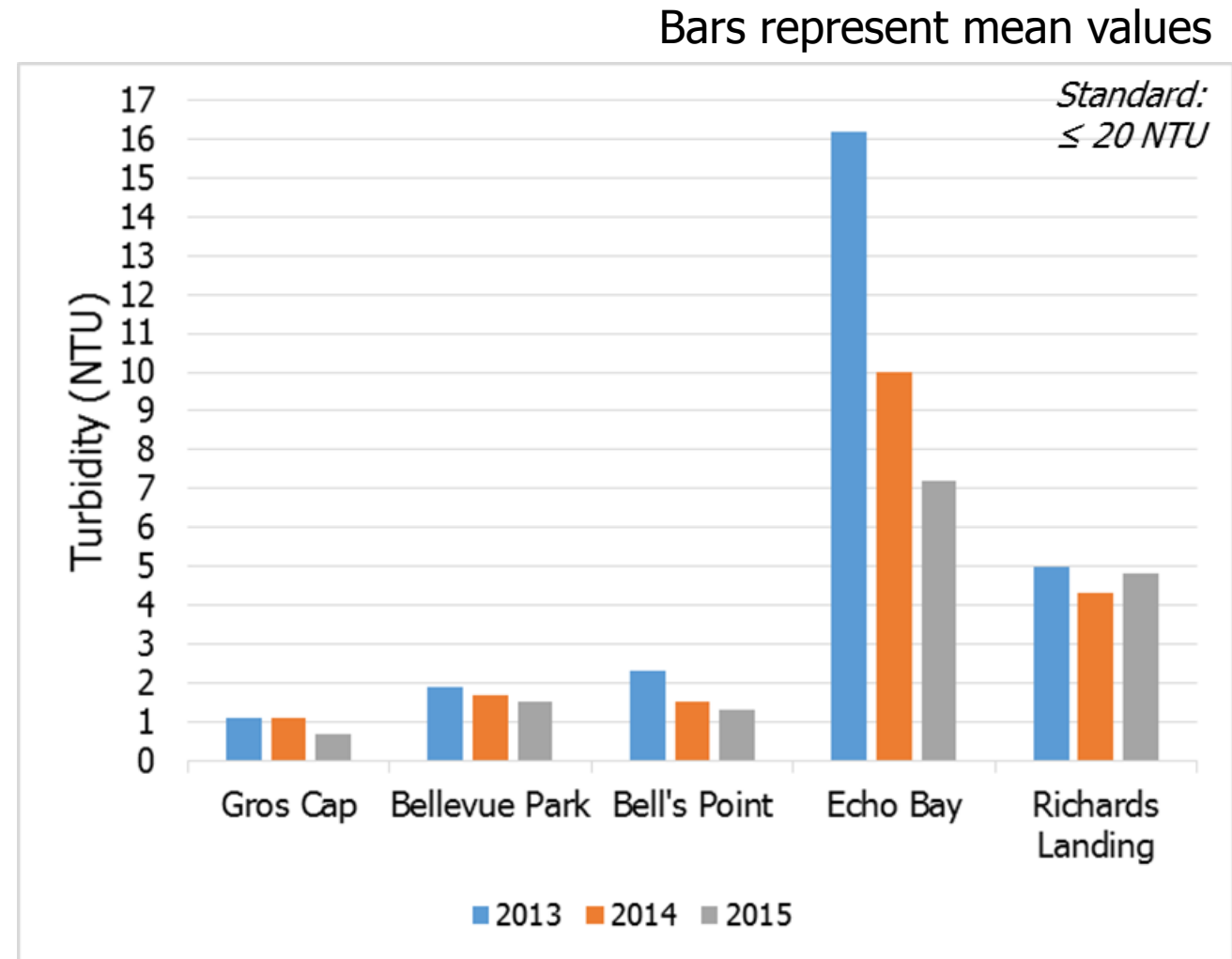
# Turbidity

## Results:

- Range: 0.3-23.5 NTU
- Mean: 0.7-16.2 NTU

## Discussion:

- Weather, human activities, shoreline and substrate characteristics, water flow, and tributary inputs
- $\leq 20 \text{ NTU}$ <sup>3</sup>



<sup>3</sup> Canadian Water Quality Guidelines for the Protection of Aquatic Life: Total Particulate Matter (2002)



# Water Colour

## Results:

- Clear to light yellow-brown

## Discussion:

- Plant debris, plankton, suspended sediments, and dissolved organic matter
- *Free of unnatural colour*<sup>4</sup>



<sup>4</sup> St. Marys River Remedial Action Plan Implementation Annex (2015)

# Water Odour

## Results:

- One incidence (2013)

## Discussion:

- *Free of a persistent unnatural odour*<sup>5</sup>



<sup>5</sup> St. Marys River Remedial Action Plan Implementation Annex (2015)



# Algae

## Results:

- All sites (2014)
- Not Richards Landing (2015)

## Discussion:

- Attachment sites
- *Free of persistent or recurring large blooms*<sup>6</sup>



<sup>6</sup> St. Marys River Remedial Action Plan Implementation Annex (2015)

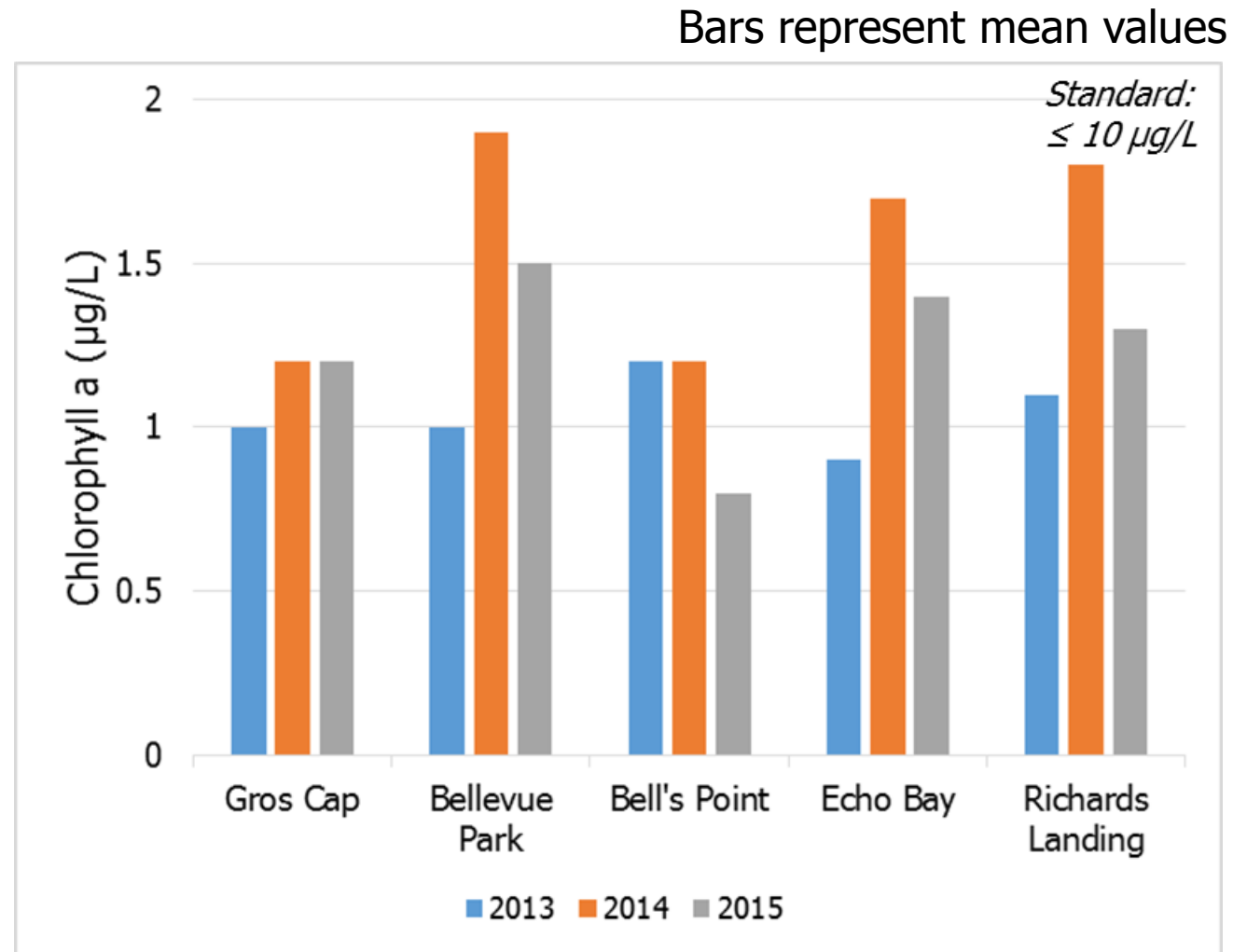
# Chlorophyll a

## Results:

- Range: <0.5-8.3 µg/L
- Mean: 0.8-1.9 µg/L

## Discussion:

- Wave action, nutrients, and microscopic algae
- $\leq 10 \mu\text{g/L}$ <sup>7</sup>



<sup>7</sup> St. Marys River Remedial Action Plan (2002)



# Visible Debris

## Results:

- All natural ; no sheens, oil, grease, solids, or scums

## Discussion:

- *Free of objectionable deposits<sup>8</sup>*
- *Oil and grease below levels that can be detected as a film or sheen; no visible petrochemical deposits<sup>9</sup>*



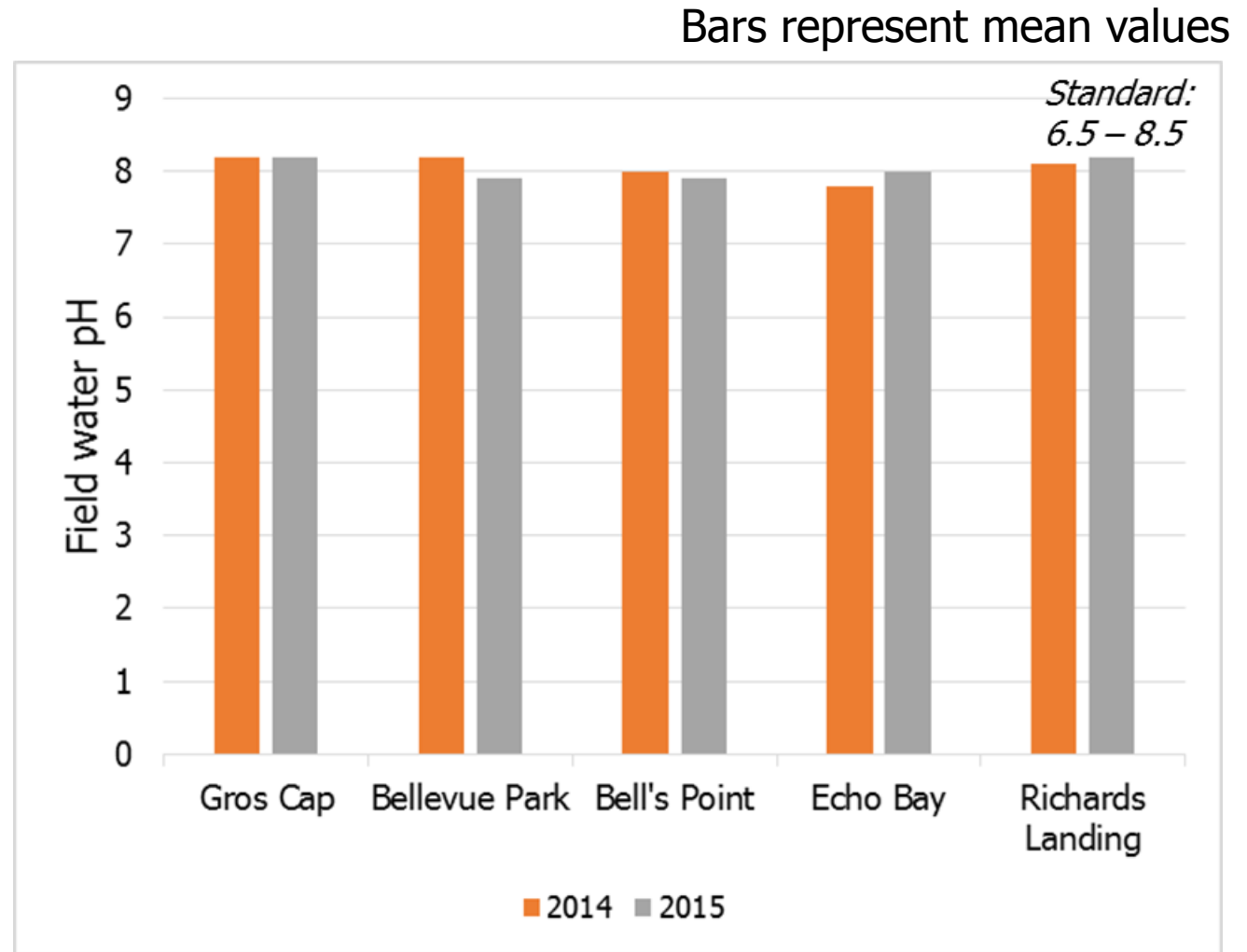
# Field Water pH

## Results:

- Range: 7.3-8.8
- Mean: 7.8-8.2

## Discussion:

- *6.5-8.5*<sup>10</sup>
- *6.5-9.0*<sup>11</sup>



# Field Water Temperature

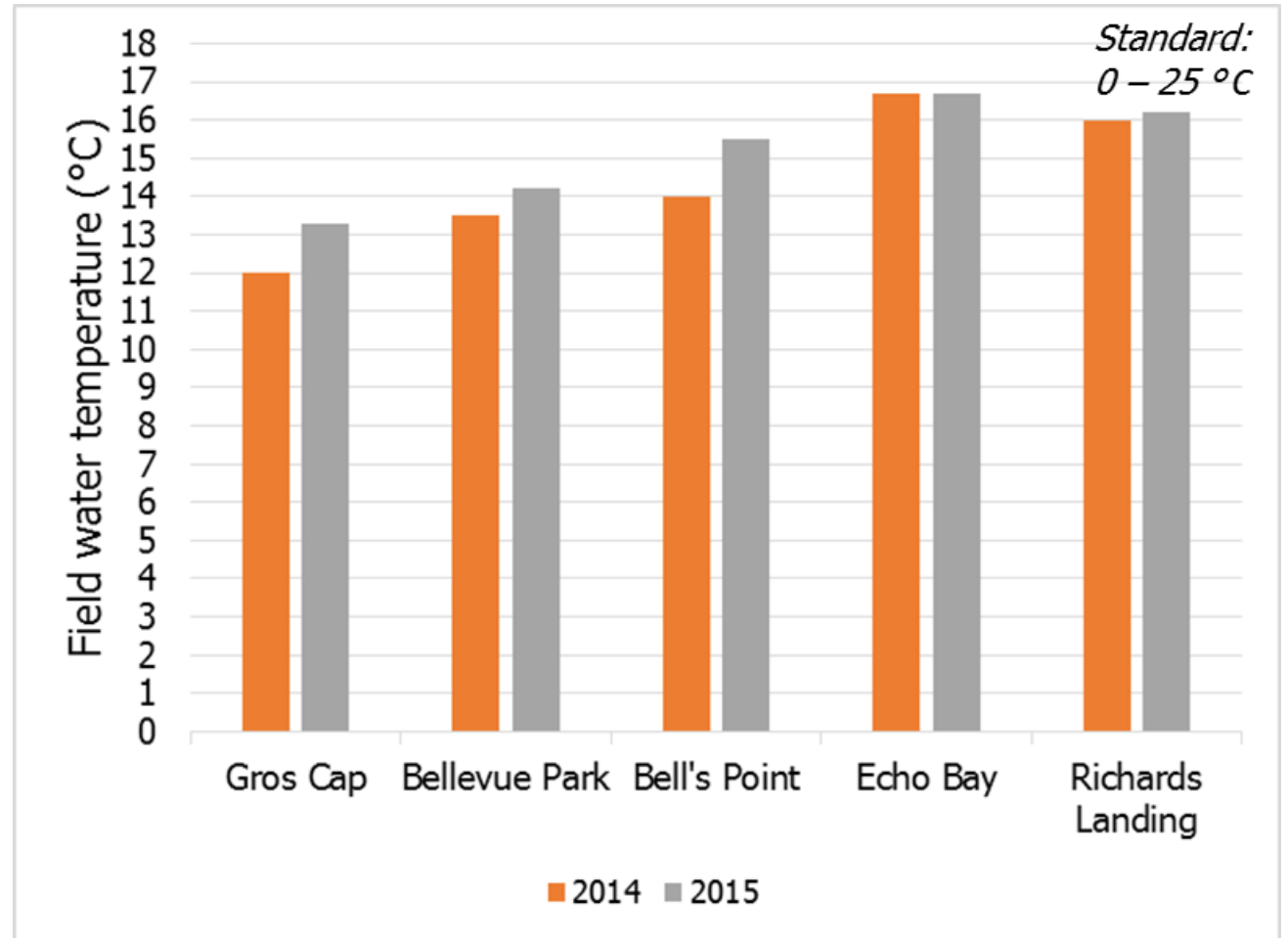
## Results:

- Range: 2.8-23.4°C
- Mean: 12.0-16.7°C

## Discussion:

- *0-25 °C*<sup>12</sup>
- *Natural thermal regime*<sup>13</sup>

Bars represent mean values



<sup>12</sup> Literature values for the St. Marys River; <sup>13</sup> PWQO (1999)



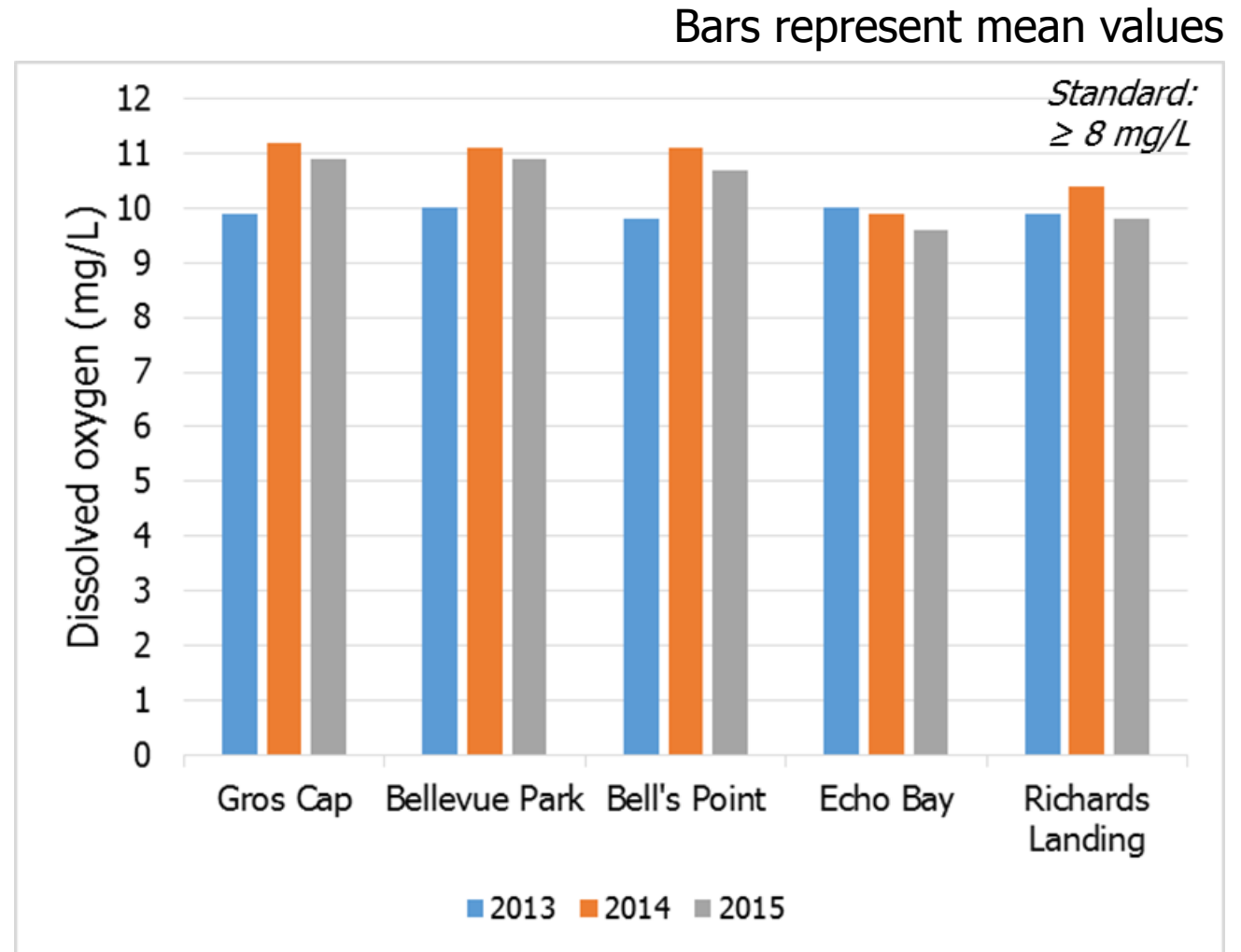
# Dissolved Oxygen

## Results:

- Range: 8.2-13.9 mg/L
- Mean: 9.6-11.2 mg/L

## Discussion:

- Temperature, turbulence, and biological activity
- $\geq 8 \text{ mg/L}$  <sup>14</sup>
- *Free of oxygen stress* <sup>15</sup>



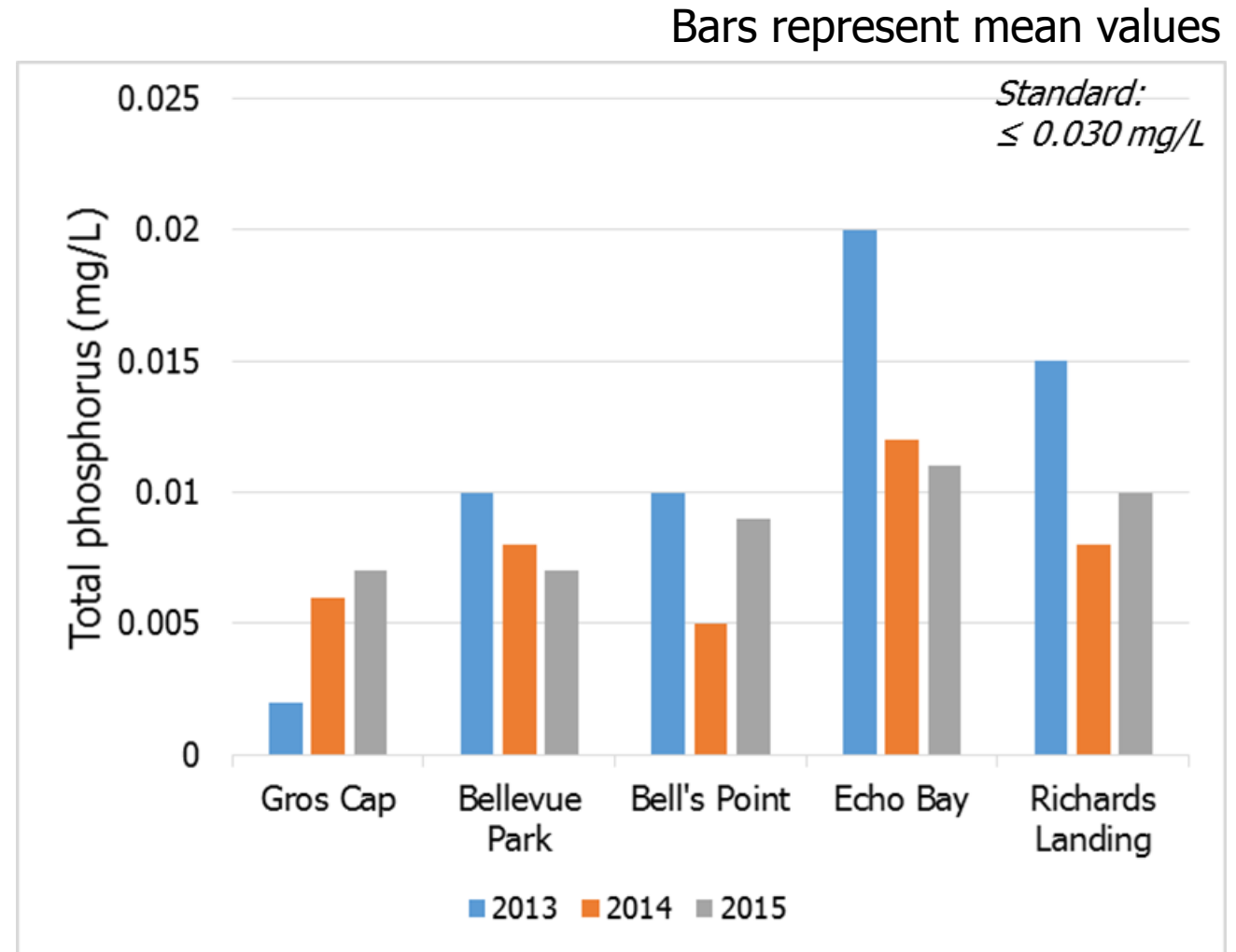
# Total Phosphorus

## Results:

- Range: <0.002-0.058 mg/L
- Mean: 0.002-0.020 mg/L

## Discussion:

- Nearshore habitat, tributary inputs, and runoff
- $\leq 0.030 \text{ mg/L}$  <sup>16</sup>



# Dissolved Organic Carbon

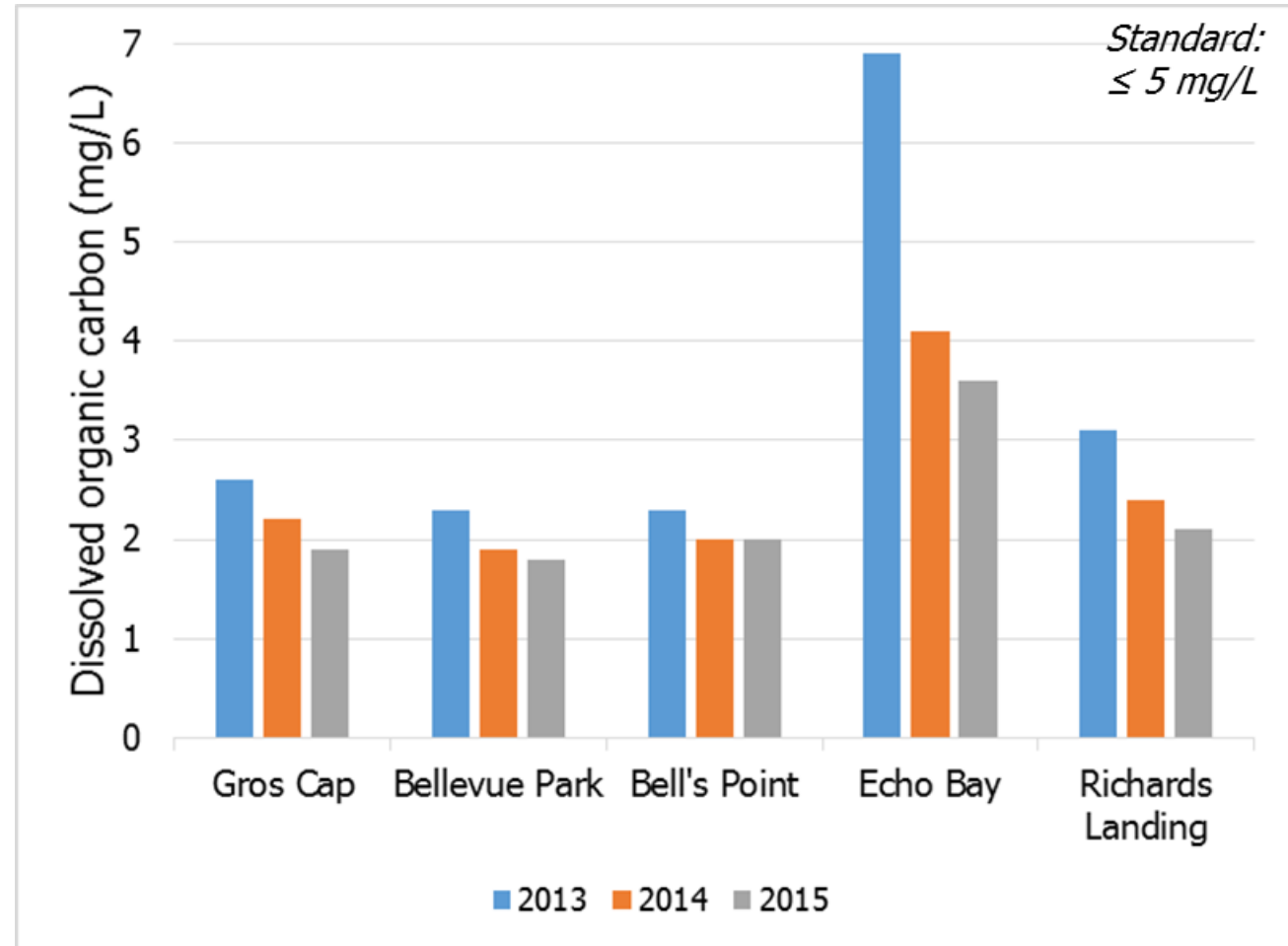
## Results:

- Range: 1.5-10.8 mg/L
- Mean: 1.8-6.9 mg/L

## Discussion:

- Runoff, re-suspension, plants, and phytoplankton
- $\leq 5 \text{ mg/L}$  <sup>17</sup>

Bars represent mean values





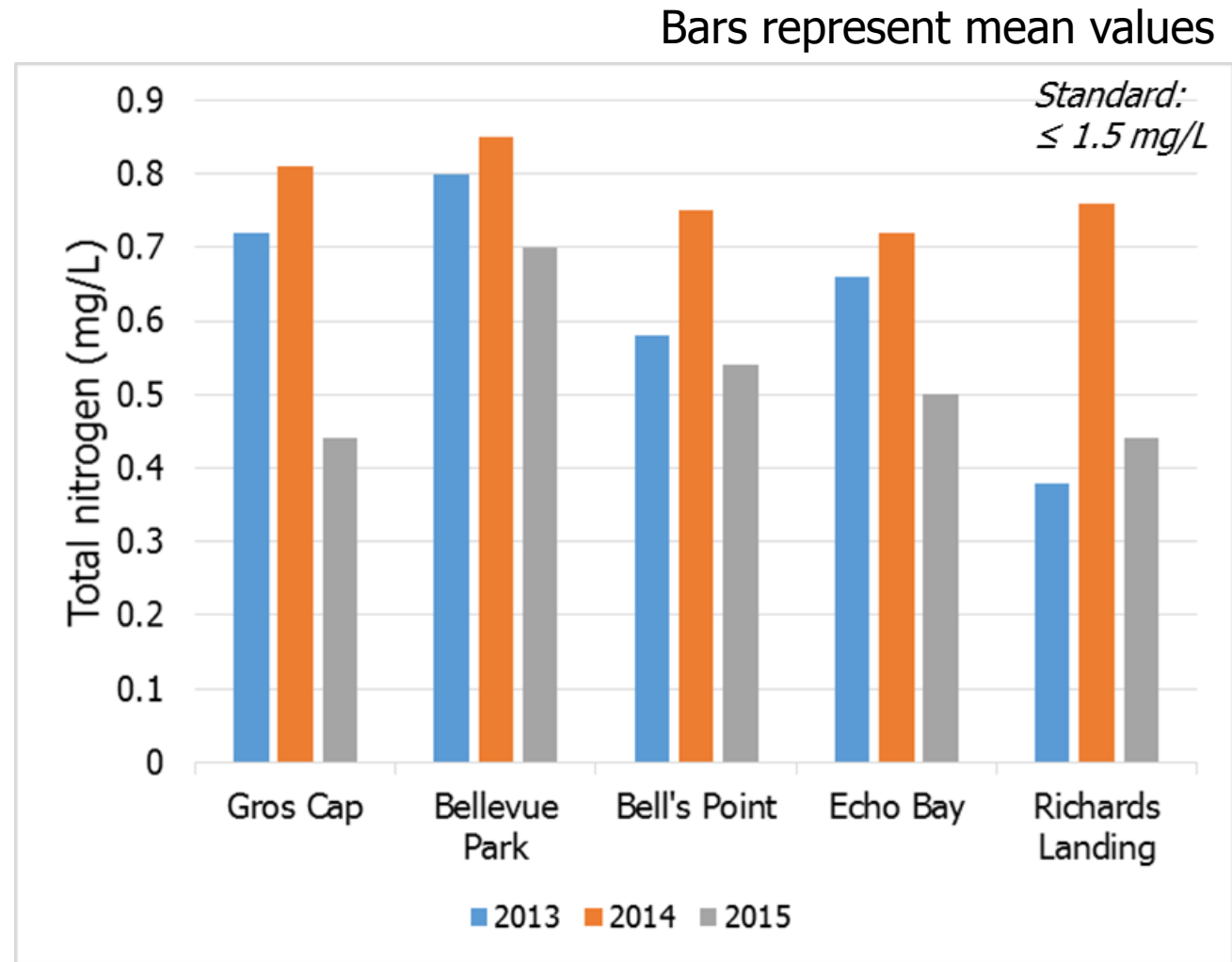
# Total Nitrogen

## Results:

- Range: 0.19-1.63 mg/L
- Mean: 0.38-0.85 mg/L

## Discussion:

- Organic, nitrates, ammonia
- $\leq 1.5 \text{ mg/L}$  <sup>18</sup>



# Conclusion

- Measurements were generally more favourable than historical values for the St. Marys River, comparable to literature results, and within the range of environmental standards
- There were no observations of objectionable deposits



# Eutrophication and Undesirable Algae

## Delisting criterion:

*"This beneficial use will no longer be impaired when comprehensive tests of the Area of Concern's water quality demonstrate the river is free from persistent or reoccurring problems associated with oxygen stress (eutrophication) and large algal blooms, as determined through a comparison to established guidelines for the relevant physical and chemical parameters".*

Results: No oxygen stress present, large algal blooms and high concentrations of chlorophyll a absent, and the majority of nutrient measurements within standards and/or indicative of oligotrophic or mesotrophic waters.

*Recommendation: Not impaired*



# Degradation of Aesthetics

## Delisting criterion:

*"This beneficial use will no longer be impaired when comprehensive tests of the Area of Concern's water quality demonstrate that the river is devoid of any substances that produce a persistent objectionable deposit, unnatural colour or turbidity, or unnatural odour, and is free from persistent or reoccurring problems associated with degraded aesthetics."*

Results: No evidence of objectionable deposits, unnatural colour, unnatural turbidity, and/or unnatural odour.

*Recommendation: Not impaired*

# Questions

Thank you for your support. Please ask questions.

