Wabagishik Rapids
Vermilion River
Heavy Metal Contamination

Severe Heavy Metal Contamination

* Over 100 years of mining, milling & smelting
  - Nickel
  - Copper
  - Gold
  - Zinc
  - Iron
* One of most contaminated regions on the planet
  - Careless disposal/storage of tailings, waste & slag
  - Air & effluent emissions
  - Roast Yards
* Mining is still booming
  - Vale
  - Victoria Mine
  - Totten Mine
  - Vermilion Mine
  - Errington Mine

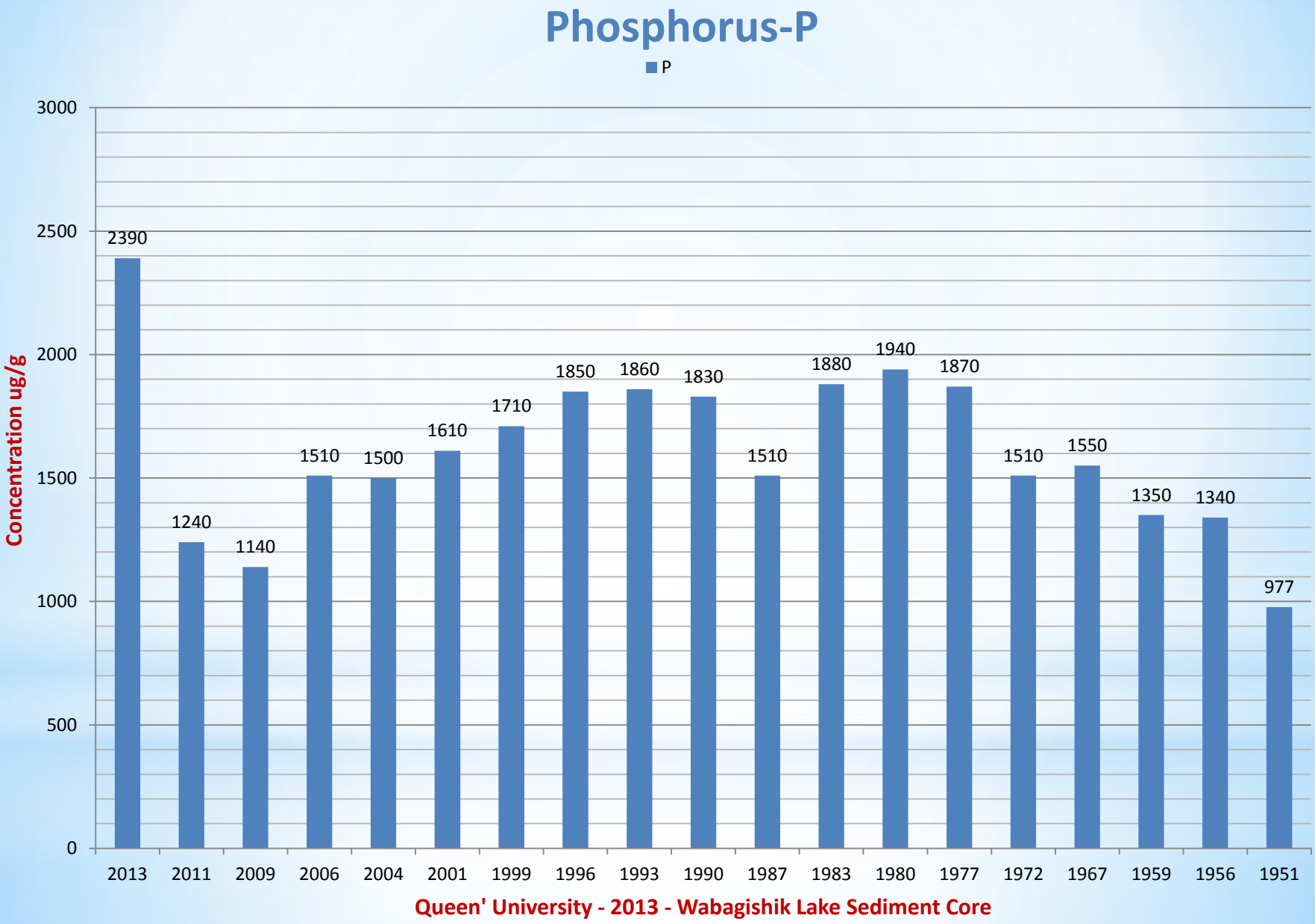
Wabagishik Sediment Core Sampling

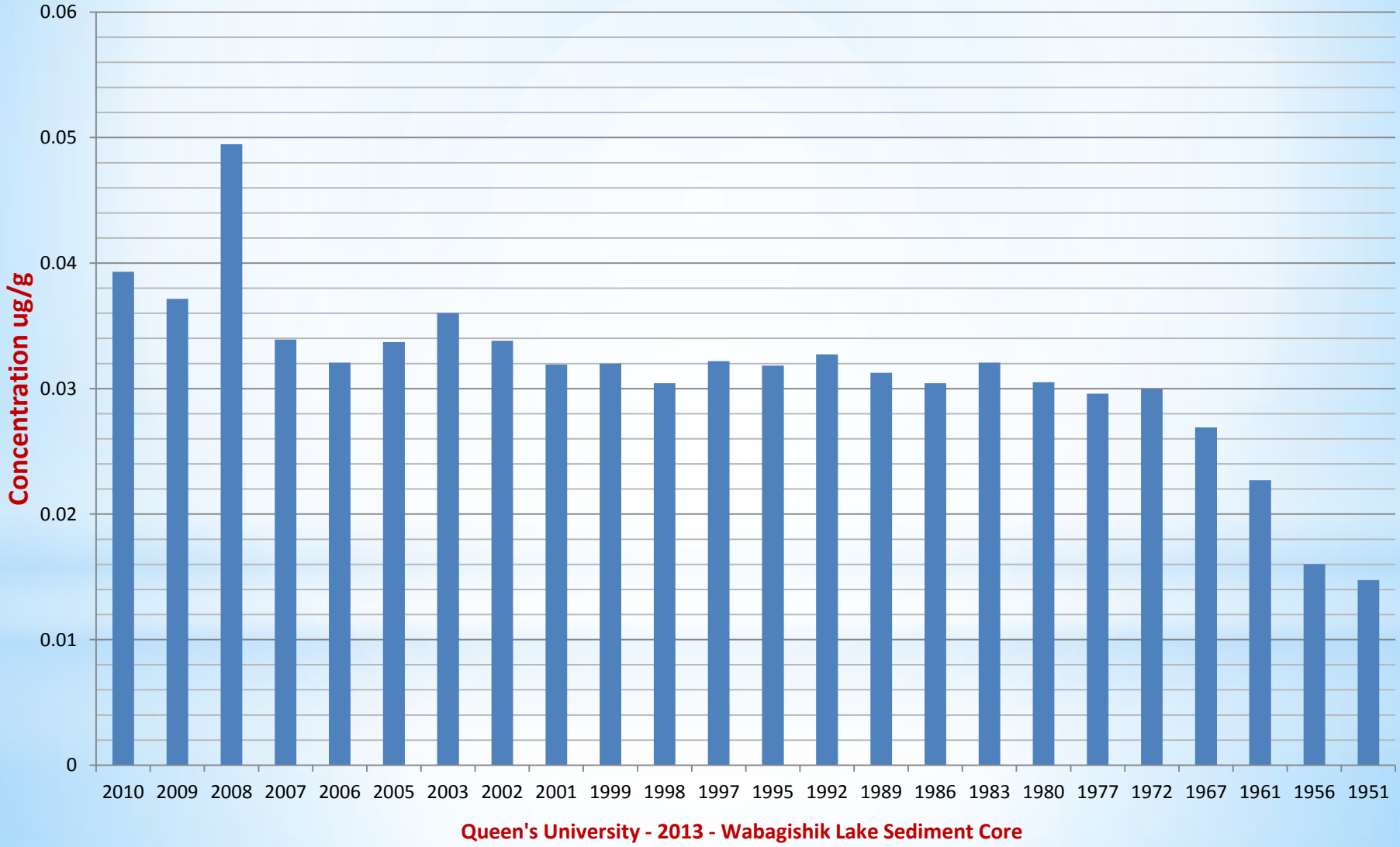
* 1986 – MOE Wabagishik Sediment Chemistry
* 2013 – Queen's University Sediment Core
  - 4th year Thesis
  - 37 cm core sample
  - 1951 to 2013
  - High sedimentation rate was unexpected

* Sudbury Soil Study
* Roast Yard Sediment Study
* Vermilion Lake Sediment Study
* Drought Induced Release of Metals – Szkokan-Emilson
  - Elevated metal & sulphur content of sediments & soils in Sudbury area
  - Drying and rewetting of soils & sediments
  - Results in acidification & release of stored metals
* Xeneca refused to do a sediment study
  - Inadequate cumulative effects assessment
  - Inadequate planning or mitigation measures

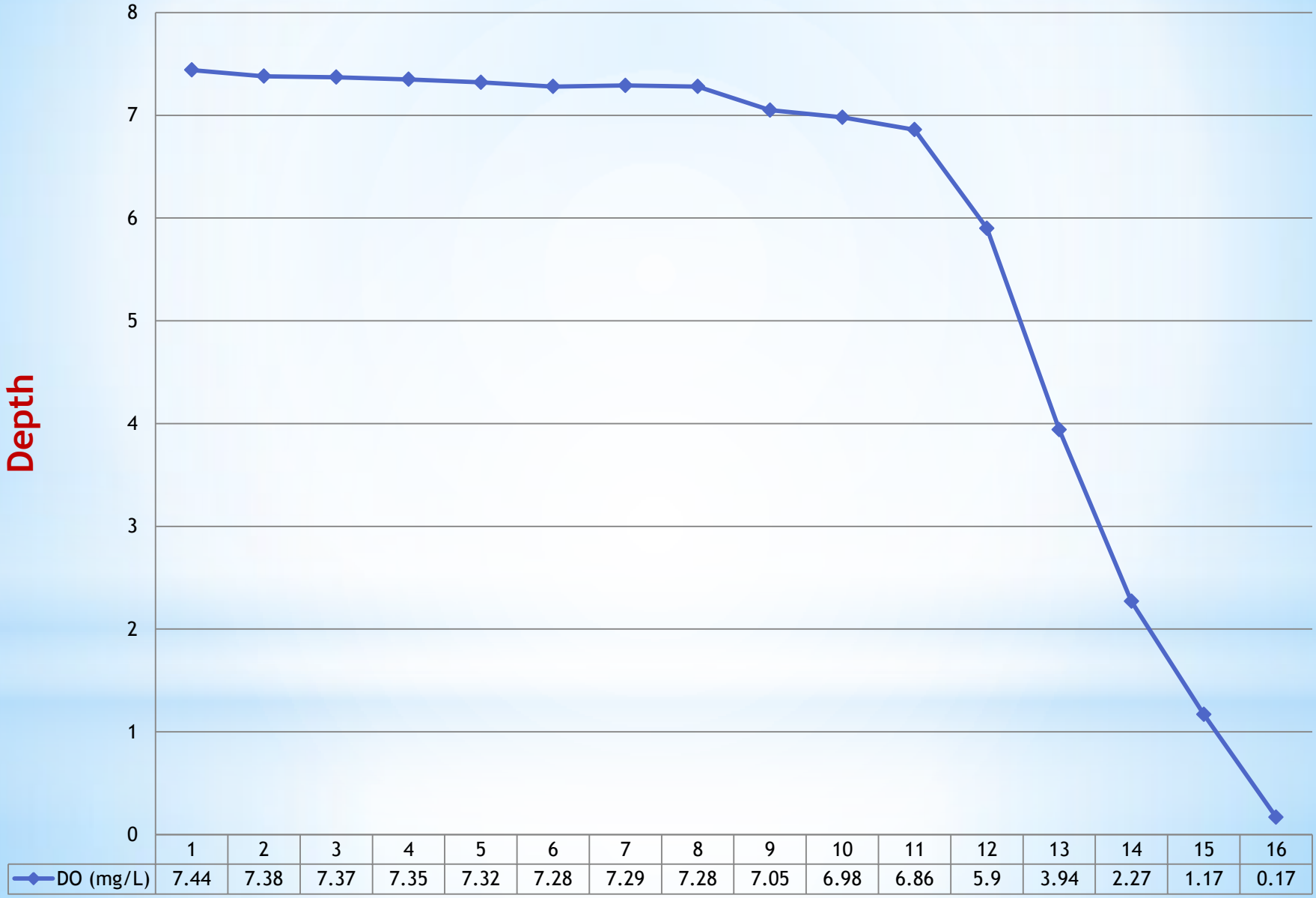
Other Challenges

- Climate Change - extremes
- Downstream of 9 WWTF
  - 2006 - 4th highest in Ontario for WW bypasses
  - 2009 – 5th highest in Ontario for WW bypasses
- Vermilion River – main drain of watershed
- Cumulative Effects
- Declining Water Quality
- Invasive Species
- Fish Consumption Restrictions
- Contaminated Sediment
- Blue-green Algae
  - 2011 – Blooms on 32 Ontario Lakes – 9 in Sudbury
  - 2011 - Entire Lower arm of Vermilion River
  - 2012 & 2013 - Ella Lake - November to April
  - Ella Lake is immediately above Wabagishik Lake
  - Ella Lake is the headpond for Lorne Falls GS


Phosphorus-P
P
Concentration ug/g
3000
2500
2000
1500
1000
500
0
2390
1240
1140
1510
1500
1610
1710
1850
1860
1830
1510
1880
1940
1870
1510
1550
1350
1340
977
2013
2011
2009
2006
2004
2001
1999
1996
1993
1990
1987
1983
1980
1977
1972
1967
1959
1956
1951
Queen' University - 2013 - Wabagishik Lake Sediment Core


Chlorphyll a
VRS-Inferred chlorophyll a (mg/ g dry wt)
Concentration ug/g
0.06
0.05
0.04
0.03
0.02
0.01
0
2010 2009 2008 2007 2006 2005 2003 2002 2001 1999 1998 1997 1995 1992 1989 1986 1983 1980 1977 1972 1967 1961 1956 1951
Queen's University - 2013 - Wabagishik Lake Sediment Core

DO (mg/L)

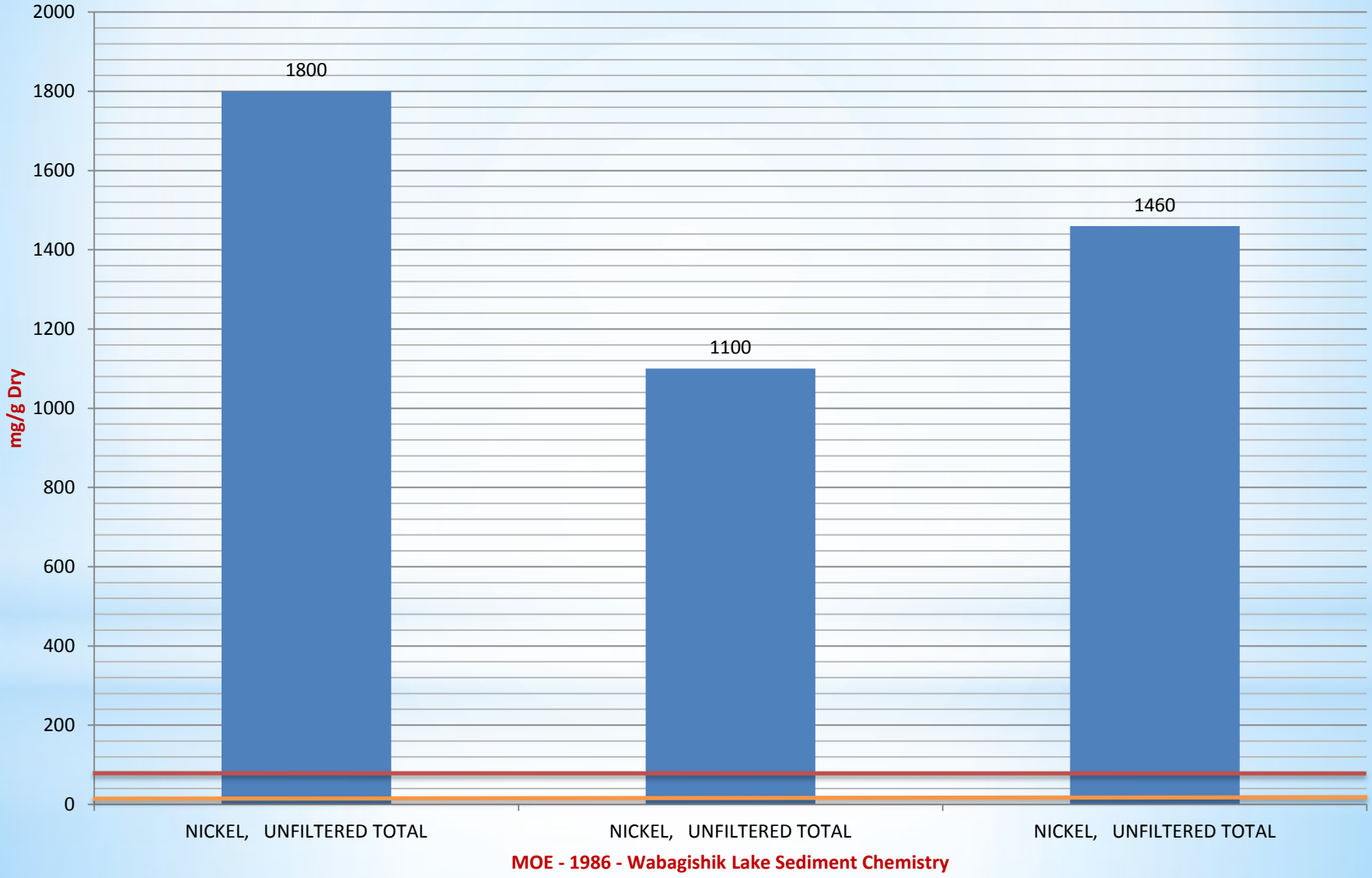


	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
DO (mg/L)	7.44	7.38	7.37	7.35	7.32	7.28	7.29	7.28	7.05	6.98	6.86	5.9	3.94	2.27	1.17	0.17

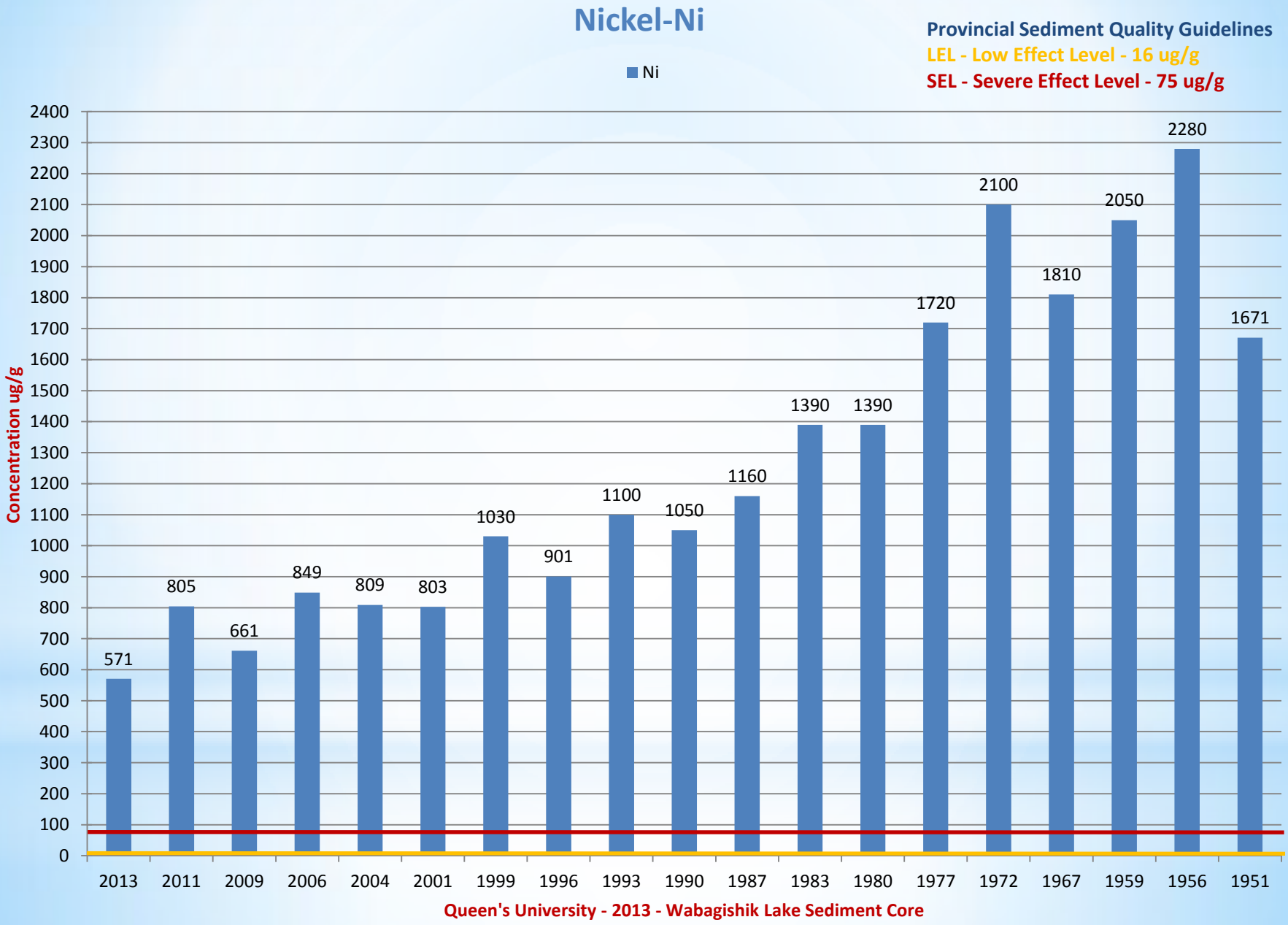
* Wabagishik Lake – Core Sample site

Nickel

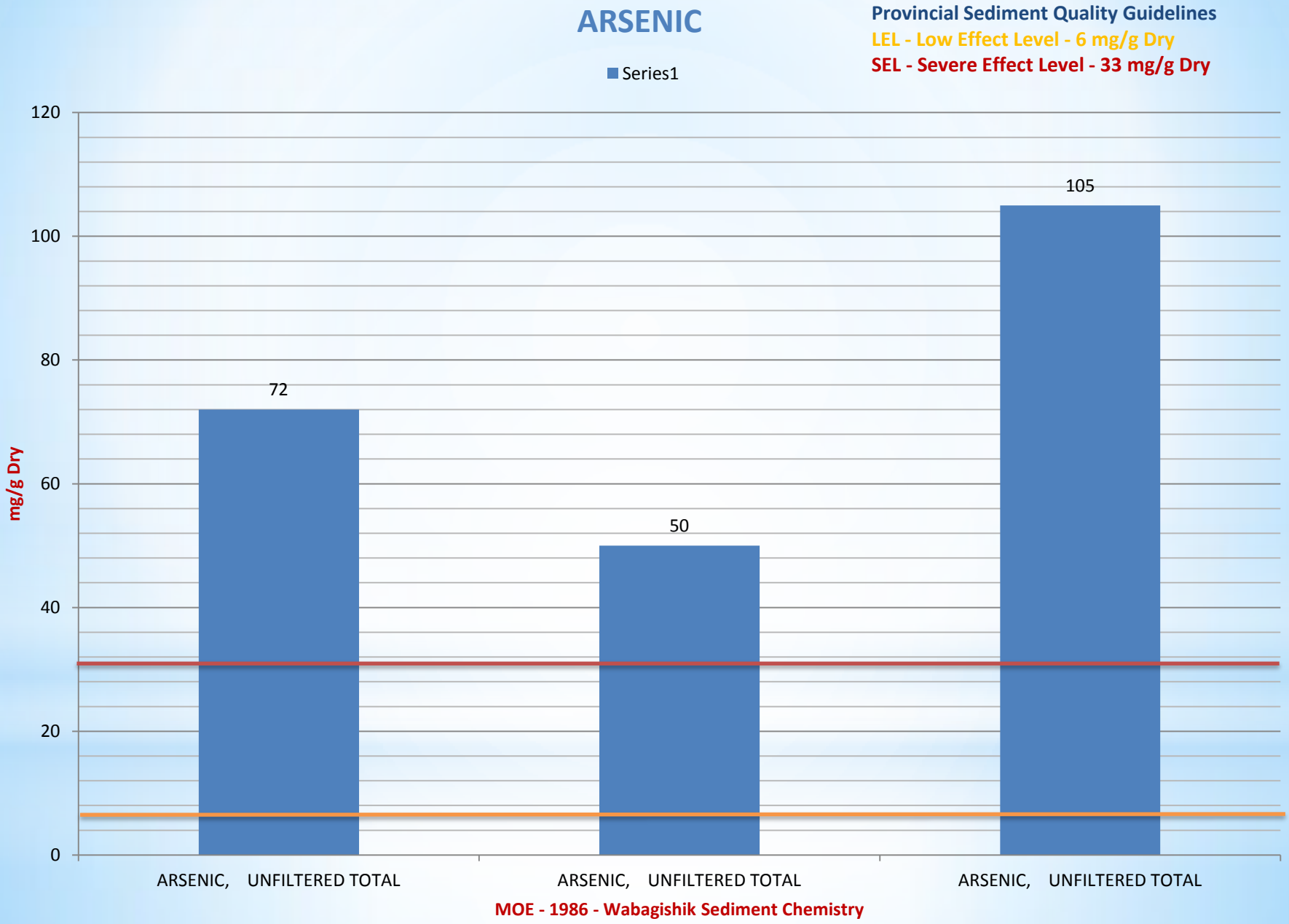
Provincial Sediment Quality Guidelines
LEL - Low Effect Level - 16 mg/g Dry
SEL - Severe Effect Level - 75 mg/g Dry

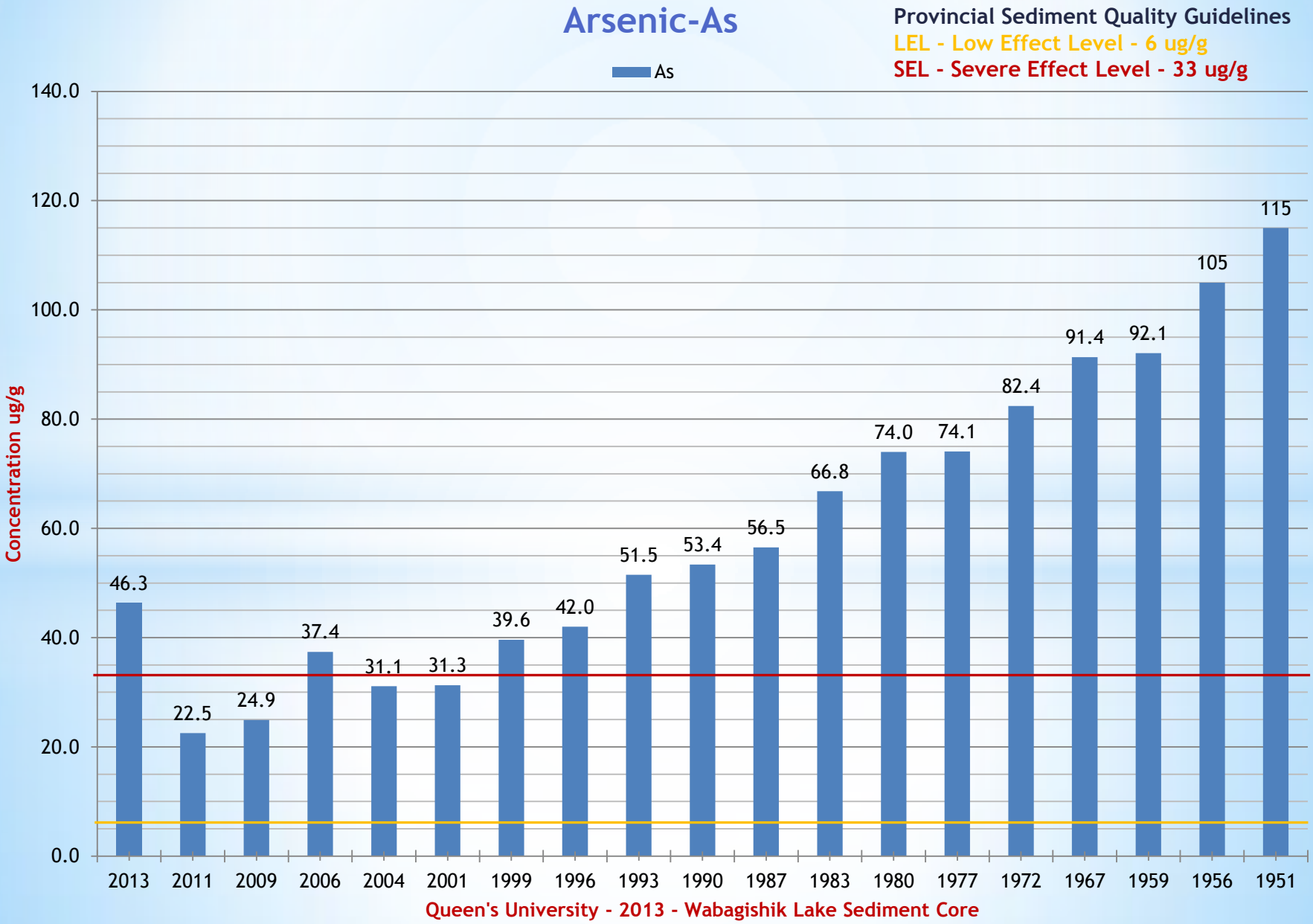


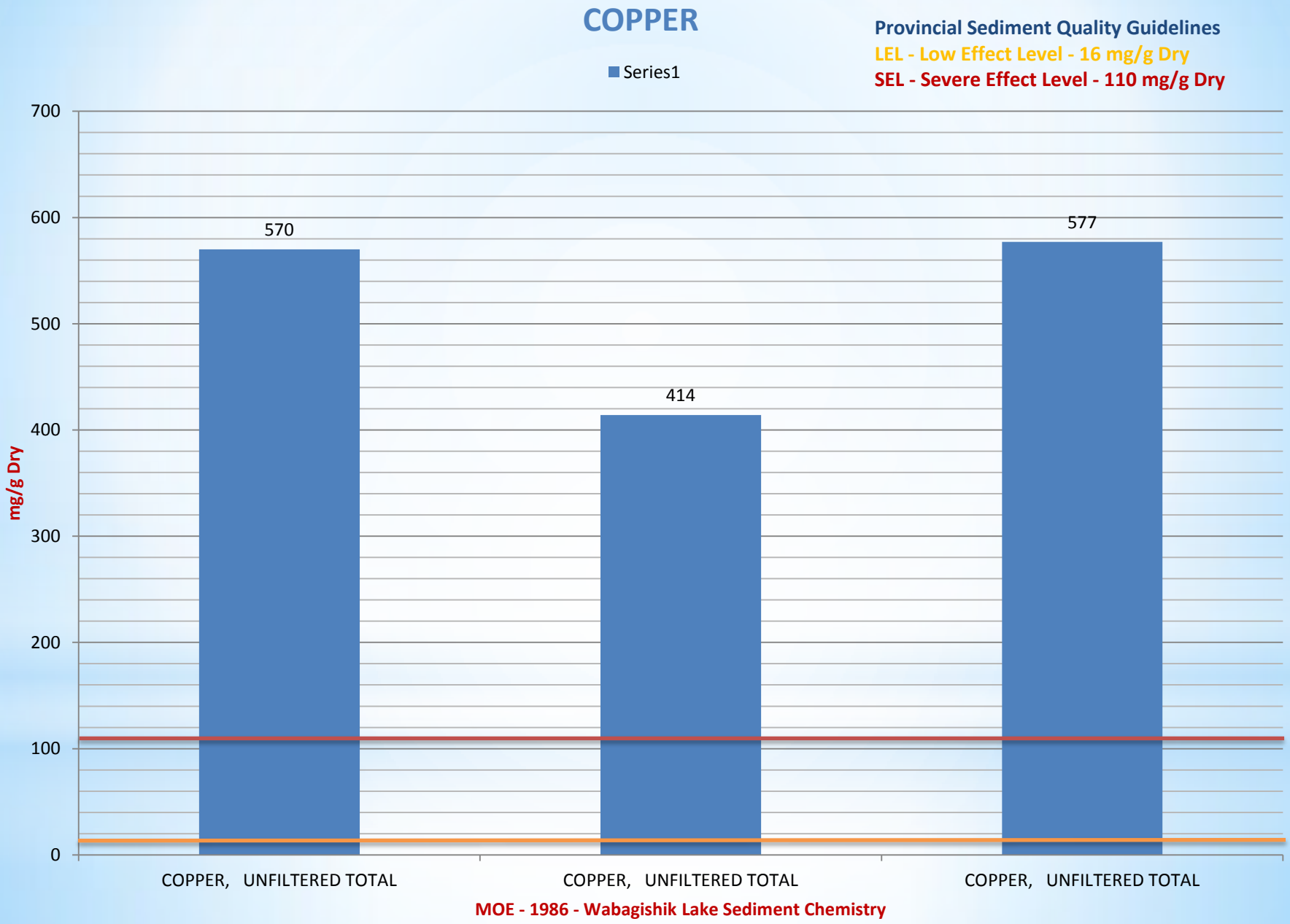
MOE - 1986 - Wabagishik Lake Sediment Chemistry

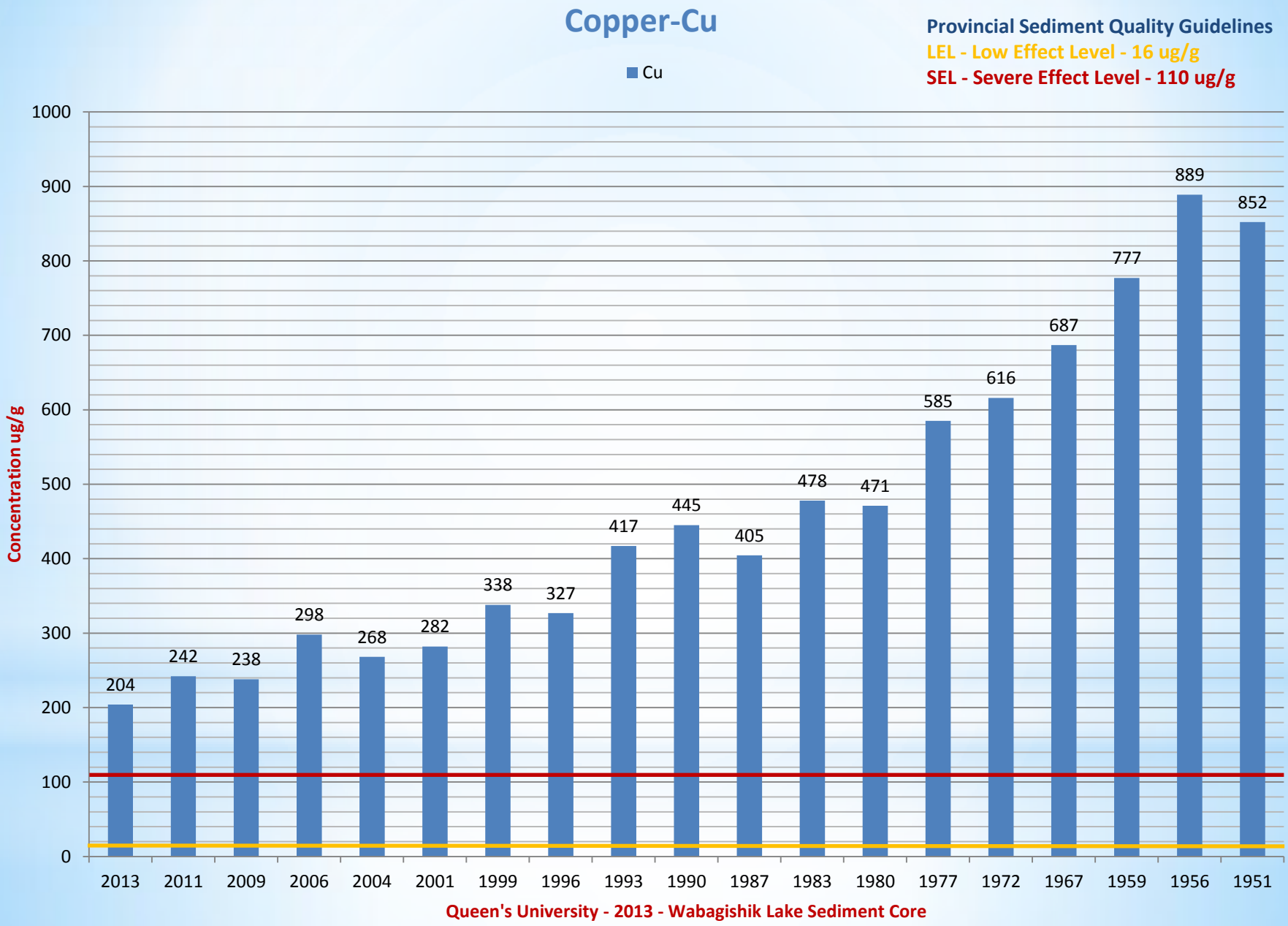

Nickel-Ni
Ni
Provincial Sediment Quality Guidelines
LEL - Low Effect Level - 16 ug/g
SEL - Severe Effect Level - 75 ug/g
Concentration ug/g
2400
2300
2200
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
571
805
661
849
809
803
1030
901
1100
1050
1160
1390
1390
1720
2100
1810
2050
2280
1671
2013
2011
2009
2006
2004
2001
1999
1996
1993
1990
1987
1983
1980
1977
1972
1967
1959
1956
1951
Queen's University - 2013 - Wabagishik Lake Sediment Core

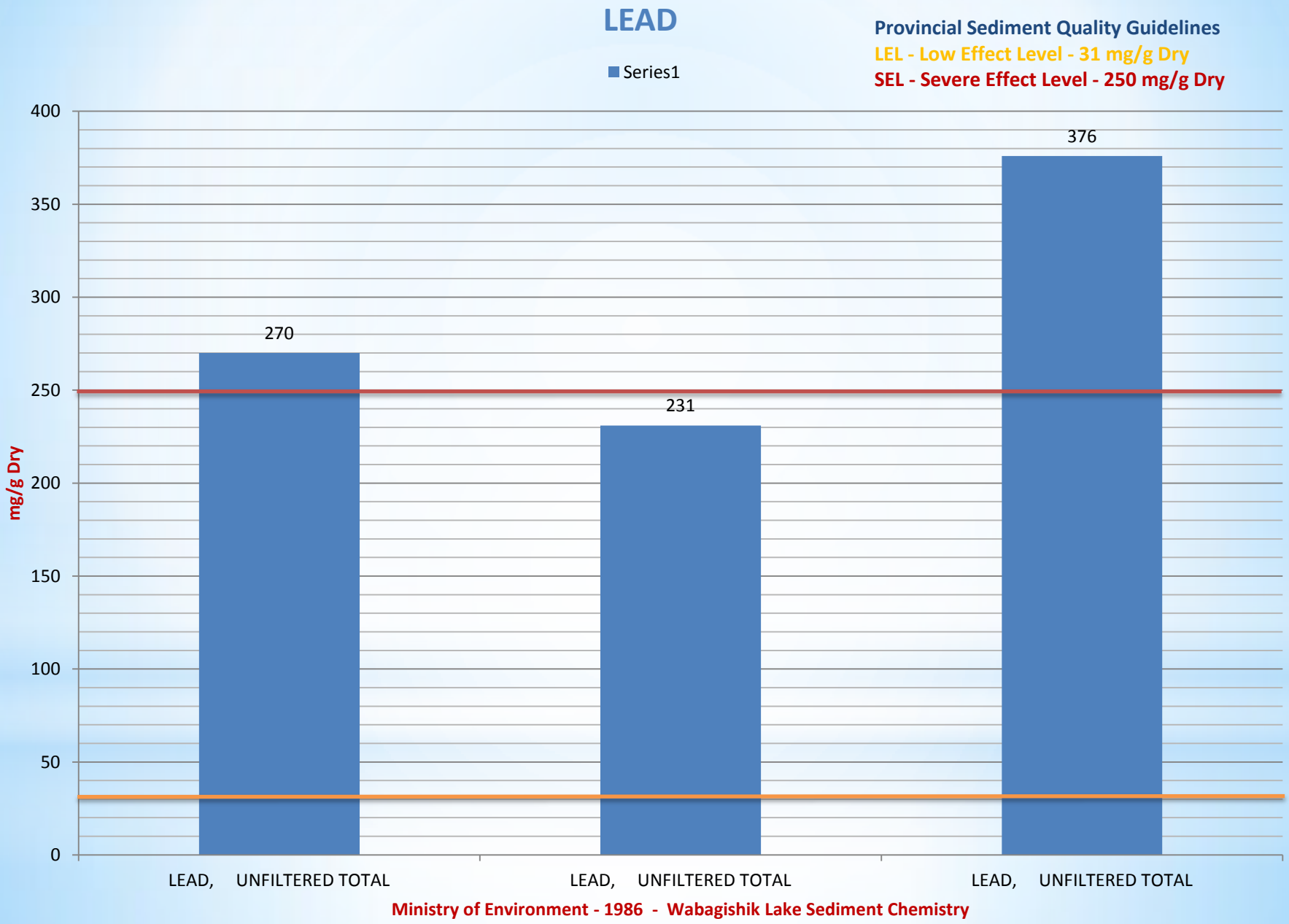
ARSENIC

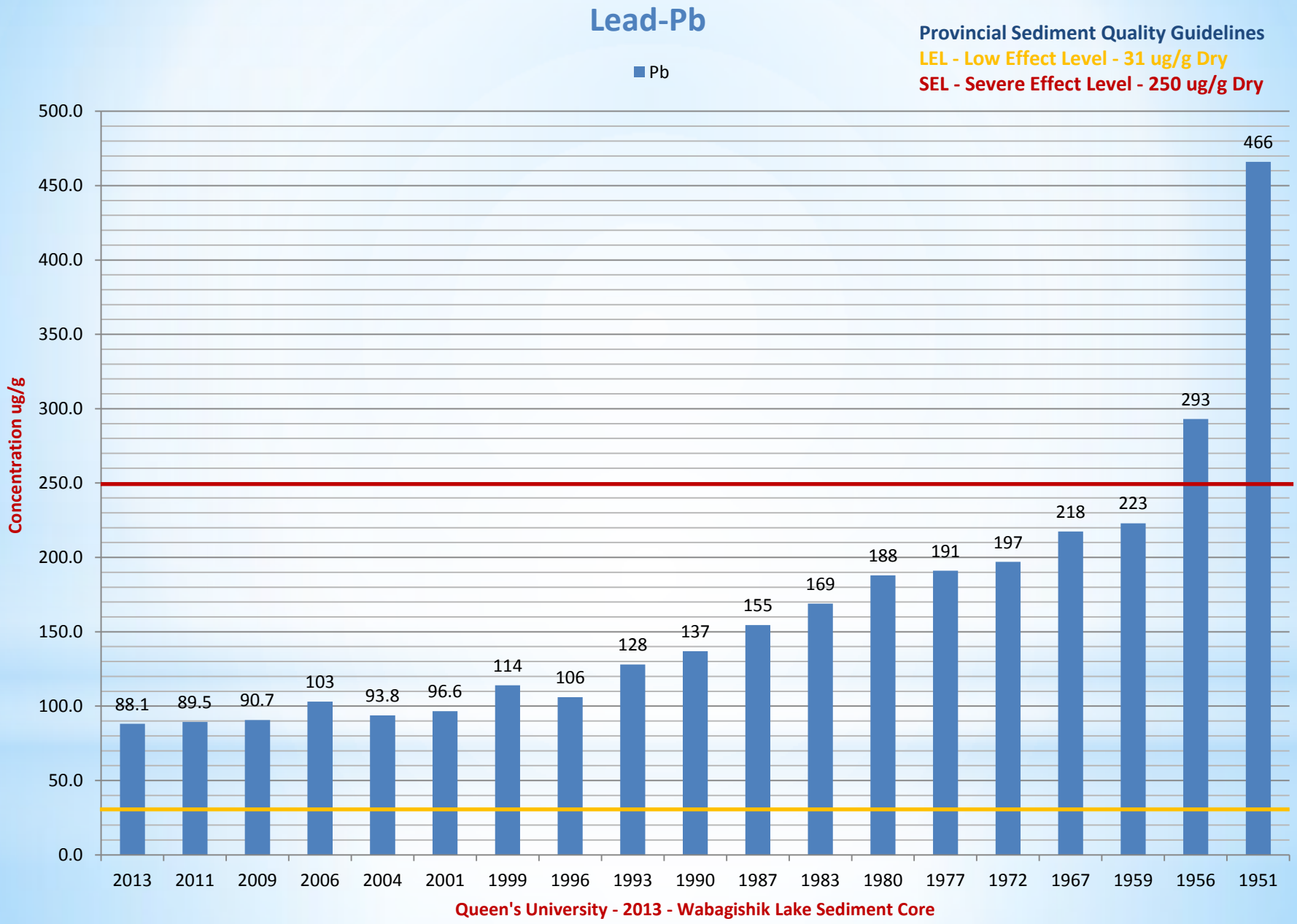

Provincial Sediment Quality Guidelines
LEL - Low Effect Level - 6 mg/g Dry
SEL - Severe Effect Level - 33 mg/g Dry
Series1
120
100
80
60
40
20
0
mg/g Dry
72
50
105
ARSENIC, UNFILTERED TOTAL
ARSENIC, UNFILTERED TOTAL
ARSENIC, UNFILTERED TOTAL
MOE - 1986 - Wabagishik Sediment Chemistry

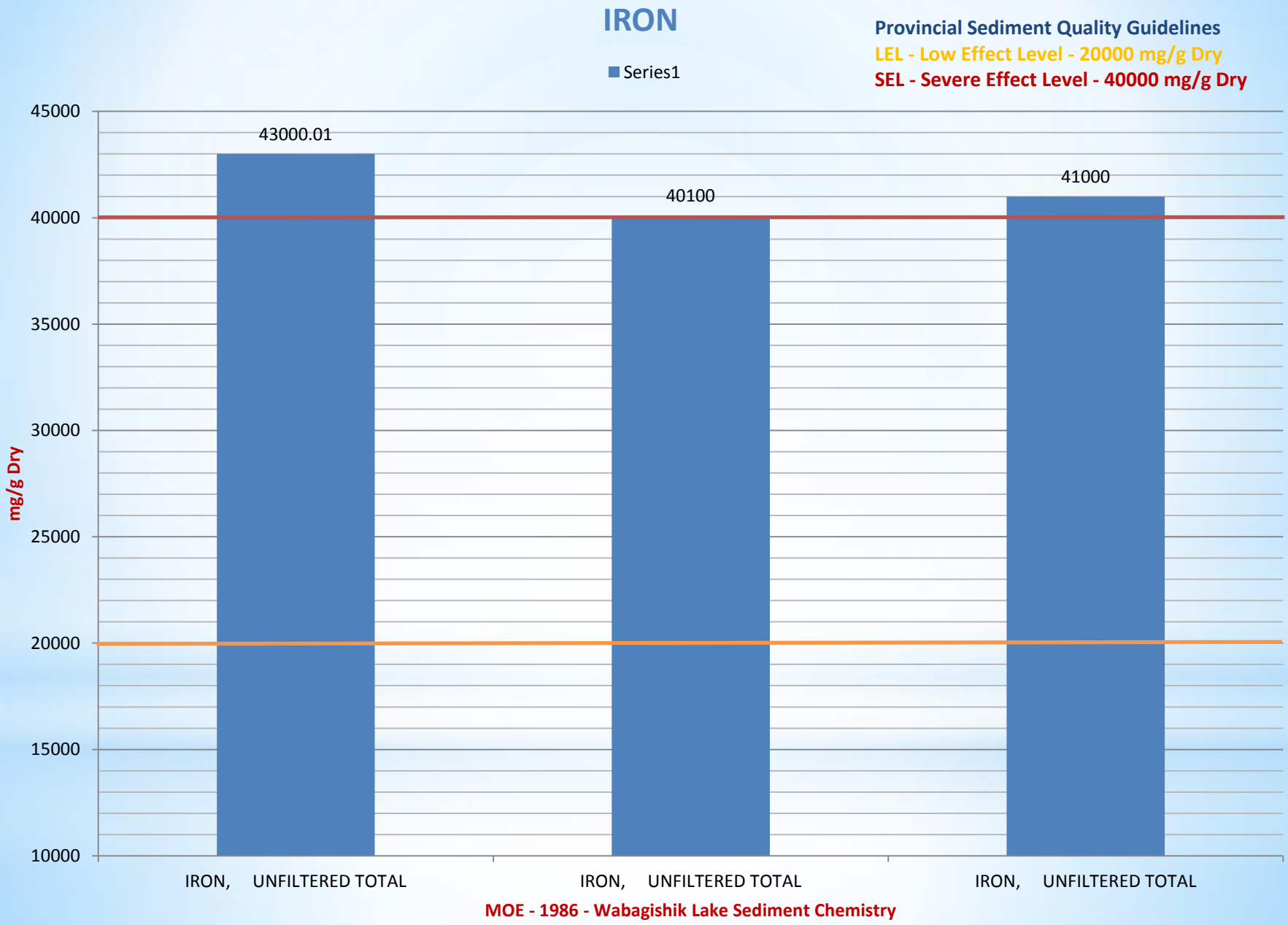

Arsenic-As
As
Provincial Sediment Quality Guidelines
LEL - Low Effect Level - 6 ug/g
SEL - Severe Effect Level - 33 ug/g
Concentration ug/g
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
46.3
22.5
24.9
37.4
31.1
31.3
39.6
42.0
51.5
53.4
56.5
66.8
74.0
74.1
82.4
91.4
92.1
105
115
2013
2011
2009
2006
2004
2001
1999
1996
1993
1990
1987
1983
1980
1977
1972
1967
1959
1956
1951
Queen's University - 2013 - Wabagishik Lake Sediment Core

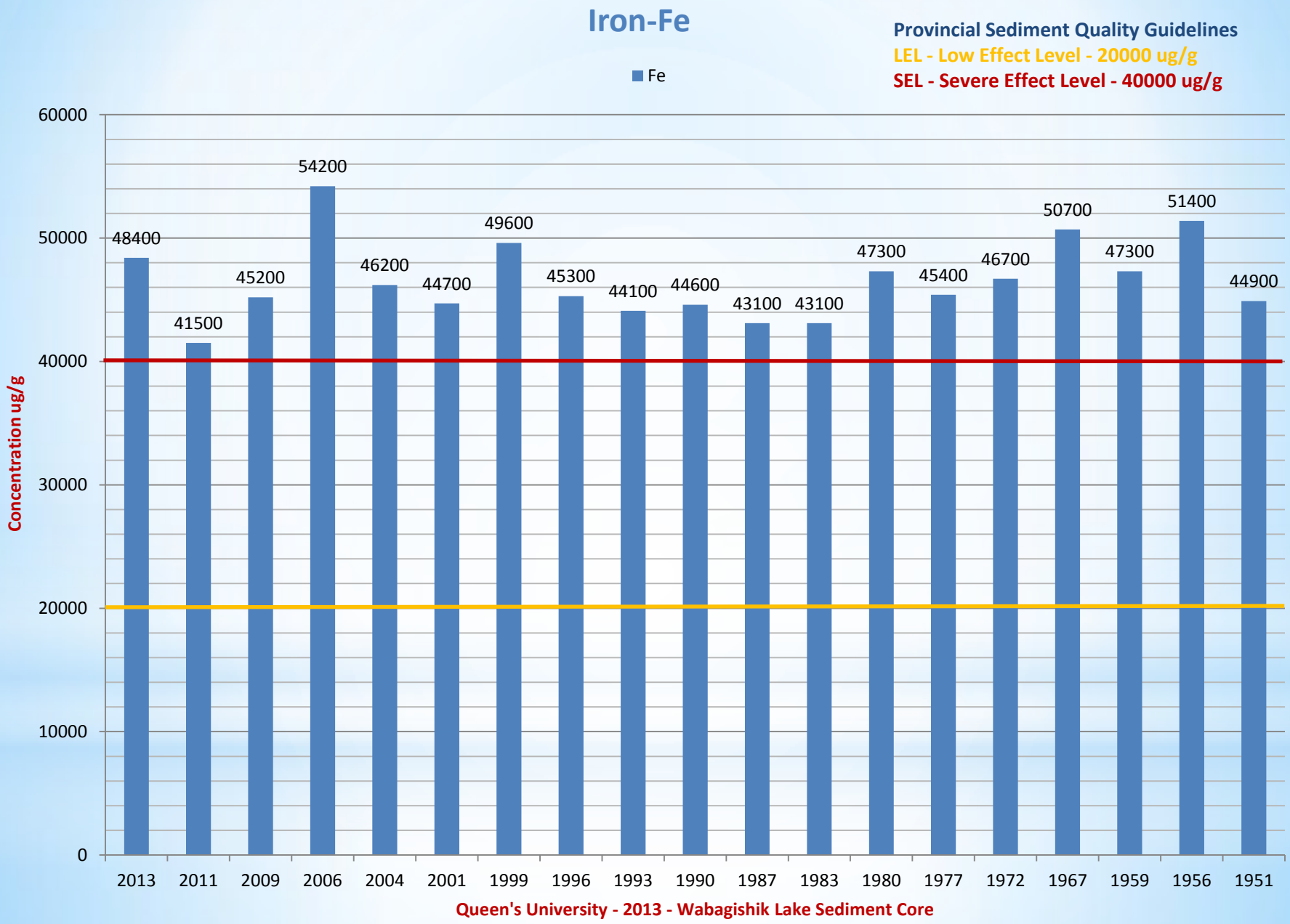

COPPER
Series1
Provincial Sediment Quality Guidelines
LEL - Low Effect Level - 16 mg/g Dry
SEL - Severe Effect Level - 110 mg/g Dry
700
600
500
400
300
200
100
0
mg/g Dry
570
414
577
COPPER, UNFILTERED TOTAL
COPPER, UNFILTERED TOTAL
COPPER, UNFILTERED TOTAL
MOE - 1986 - Wabagishik Lake Sediment Chemistry


Copper-Cu
Cu
Provincial Sediment Quality Guidelines
LEL - Low Effect Level - 16 ug/g
SEL - Severe Effect Level - 110 ug/g
Concentration ug/g
1000
900
800
700
600
500
400
300
200
100
0
204
242
238
298
268
282
338
327
417
445
405
478
471
585
616
687
777
889
852
2013
2011
2009
2006
2004
2001
1999
1996
1993
1990
1987
1983
1980
1977
1972
1967
1959
1956
1951
Queen's University - 2013 - Wabagishik Lake Sediment Core

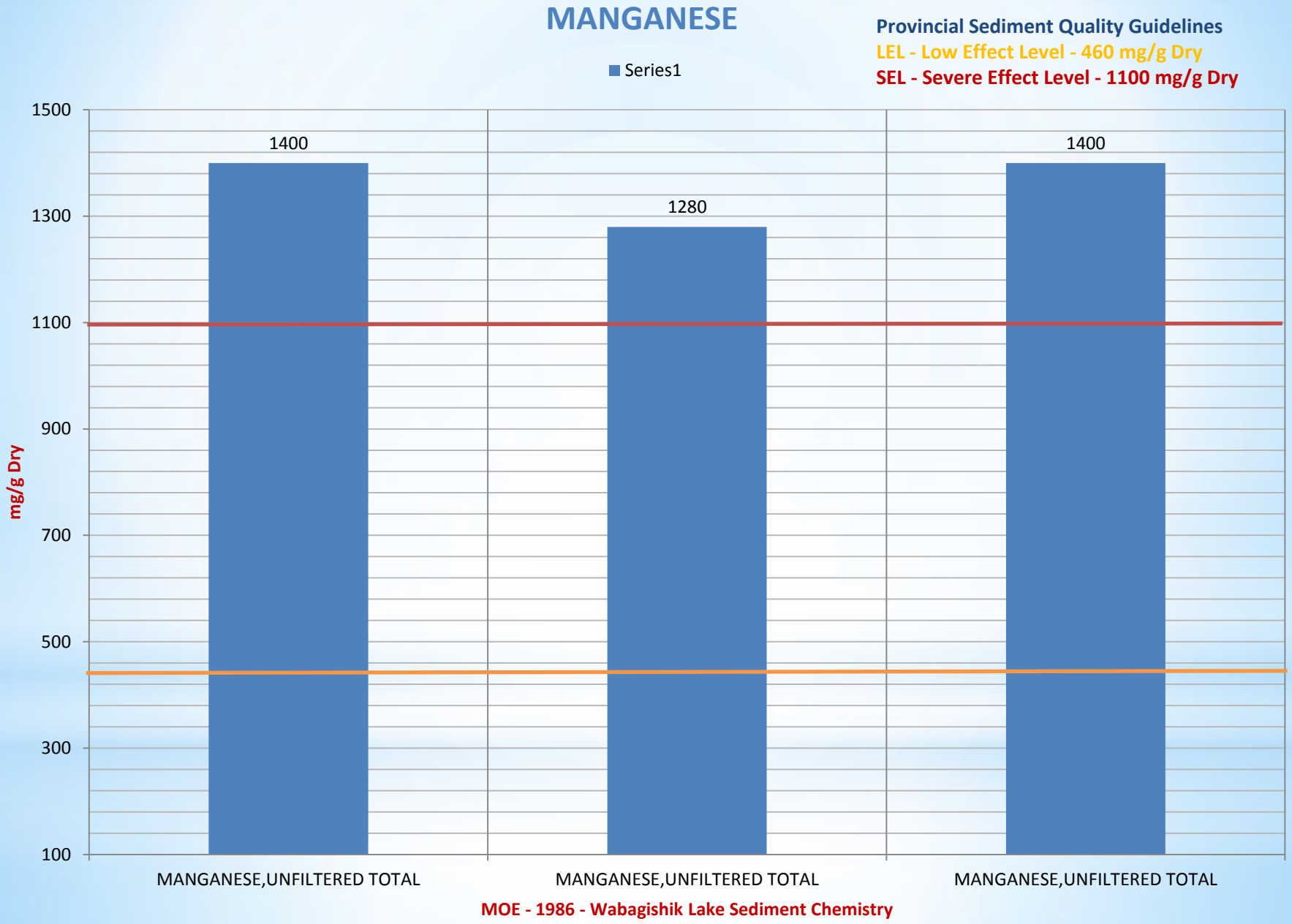

LEAD
Series1
Provincial Sediment Quality Guidelines
LEL - Low Effect Level - 31 mg/g Dry
SEL - Severe Effect Level - 250 mg/g Dry
400
350
300
250
200
150
100
50
0
mg/g Dry
270
231
376
LEAD, UNFILTERED TOTAL
LEAD, UNFILTERED TOTAL
LEAD, UNFILTERED TOTAL
Ministry of Environment - 1986 - Wabagishik Lake Sediment Chemistry

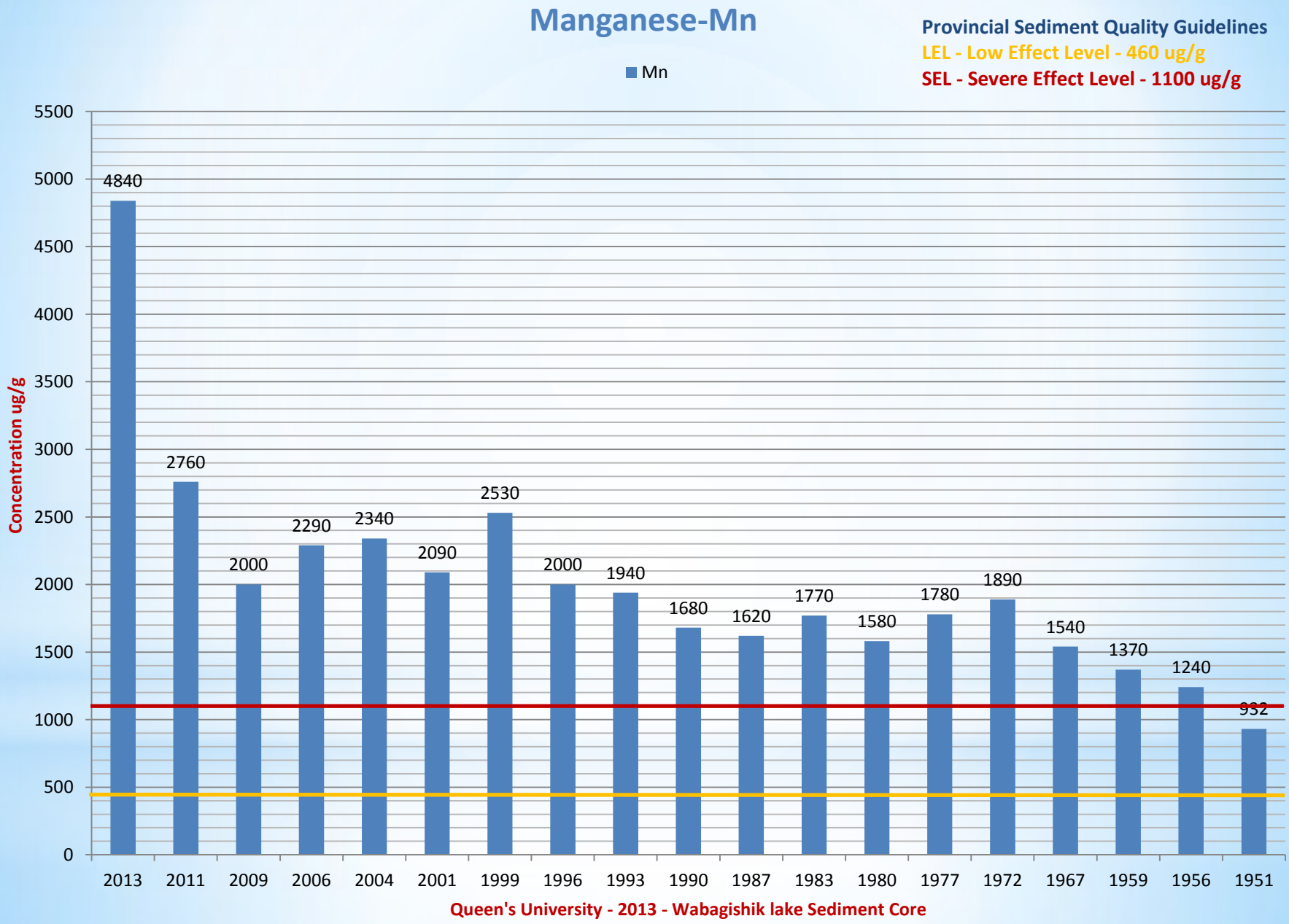

Lead-Pb
Pb
Provincial Sediment Quality Guidelines
LEL - Low Effect Level - 31 ug/g Dry
SEL - Severe Effect Level - 250 ug/g Dry
Concentration ug/g
500.0
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
88.1
89.5
90.7
103
93.8
96.6
114
106
128
137
155
169
188
191
197
218
223
293
466
2013
2011
2009
2006
2004
2001
1999
1996
1993
1990
1987
1983
1980
1977
1972
1967
1959
1956
1951
Queen's University - 2013 - Wabagishik Lake Sediment Core


IRON
Series1
Provincial Sediment Quality Guidelines
LEL - Low Effect Level - 20000 mg/g Dry
SEL - Severe Effect Level - 40000 mg/g Dry
45000
40000
35000
30000
25000
20000
15000
10000
mg/g Dry
43000.01
40100
41000
IRON, UNFILTERED TOTAL
IRON, UNFILTERED TOTAL
IRON, UNFILTERED TOTAL
MOE - 1986 - Wabagishik Lake Sediment Chemistry


Iron-Fe
Fe
Provincial Sediment Quality Guidelines
LEL - Low Effect Level - 20000 ug/g
SEL - Severe Effect Level - 40000 ug/g
Concentration ug/g
60000
50000
40000
30000
20000
10000
0
48400
41500
45200
54200
46200
44700
49600
45300
44100
44600
43100
43100
47300
45400
46700
50700
47300
51400
44900
2013
2011
2009
2006
2004
2001
1999
1996
1993
1990
1987
1983
1980
1977
1972
1967
1959
1956
1951
Queen's University - 2013 - Wabagishik Lake Sediment Core

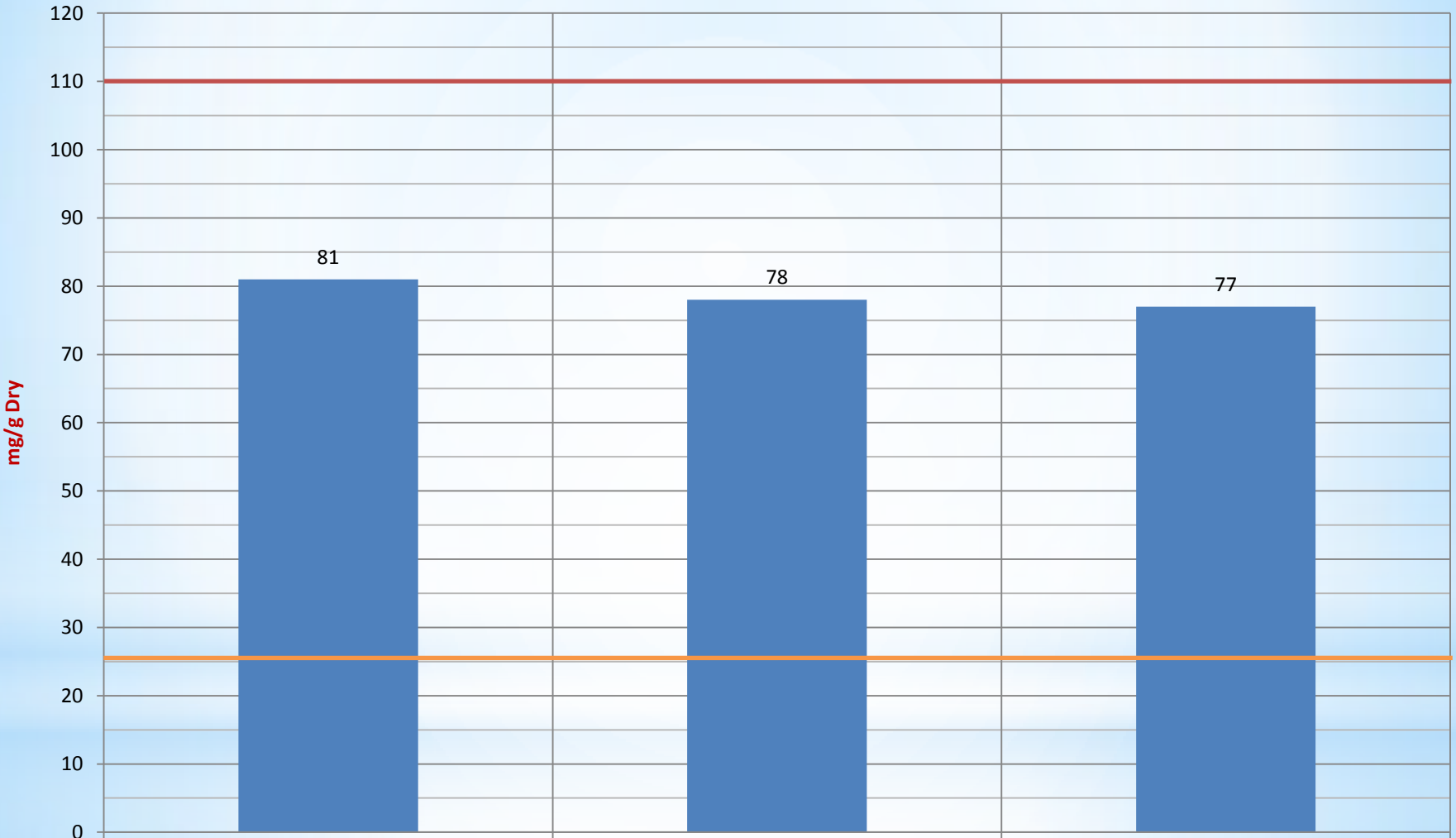
MANGANESE


Series1
Provincial Sediment Quality Guidelines
LEL - Low Effect Level - 460 mg/g Dry
SEL - Severe Effect Level - 1100 mg/g Dry
1500
1300
1100
900
700
500
300
100
mg/g Dry
1400
1280
1400
MANGANESE,UNFILTERED TOTAL
MANGANESE,UNFILTERED TOTAL
MANGANESE,UNFILTERED TOTAL
MOE - 1986 - Wabagishik Lake Sediment Chemistry

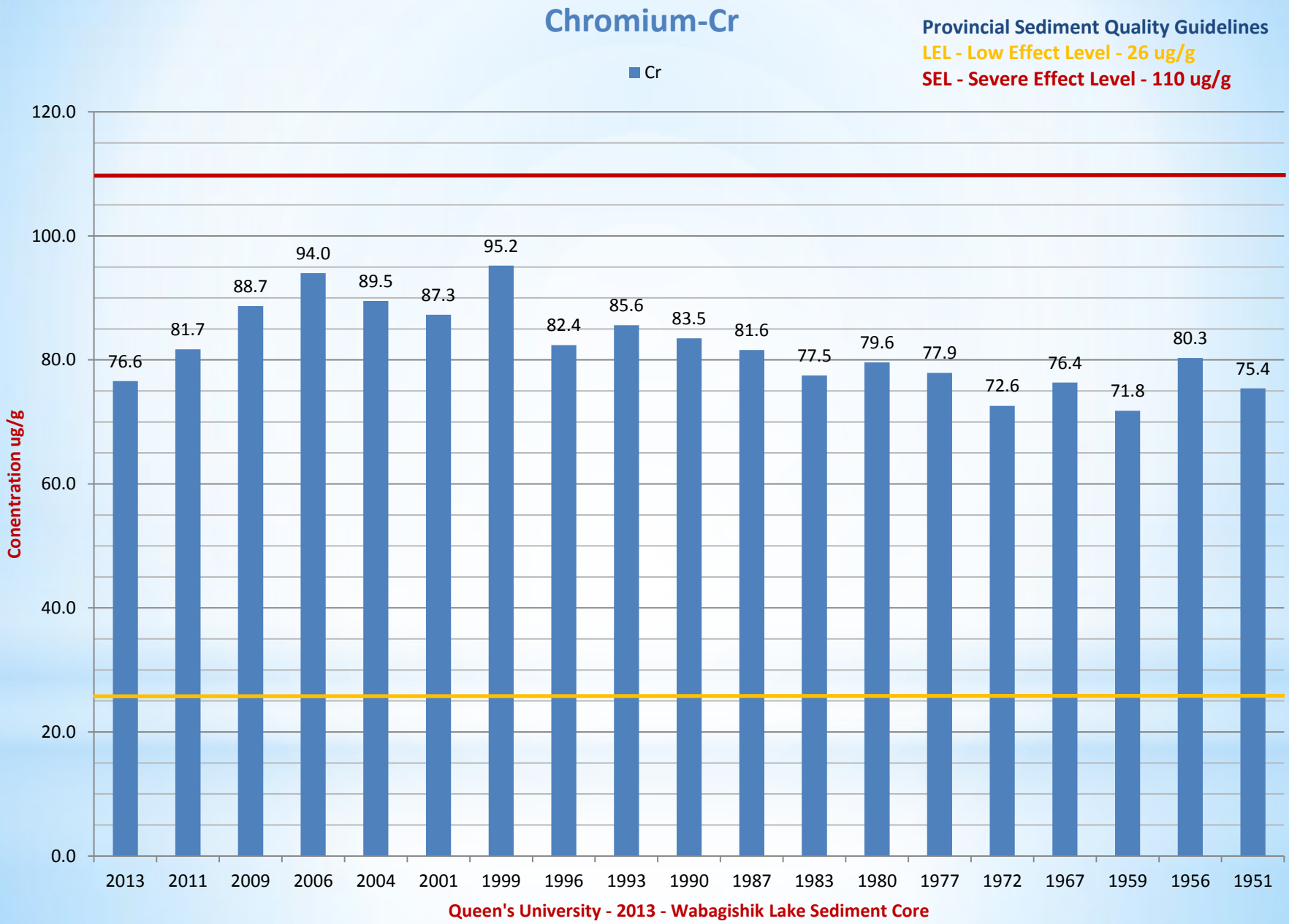

Manganese-Mn
Mn
Provincial Sediment Quality Guidelines
LEL - Low Effect Level - 460 ug/g
SEL - Severe Effect Level - 1100 ug/g
Concentration ug/g
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
4840
2760
2000
2290
2340
2090
2530
2000
1940
1680
1620
1770
1580
1780
1890
1540
1370
1240
932
2013
2011
2009
2006
2004
2001
1999
1996
1993
1990
1987
1983
1980
1977
1972
1967
1959
1956
1951
Queen's University - 2013 - Wabagishik lake Sediment Core

CHROMIUM

Provincial Sediment Quality Guidelines
LEL - Low Effect Level - 26 mg/g Dry
SEL - Severe Effect Level - 110 mg/g Dry



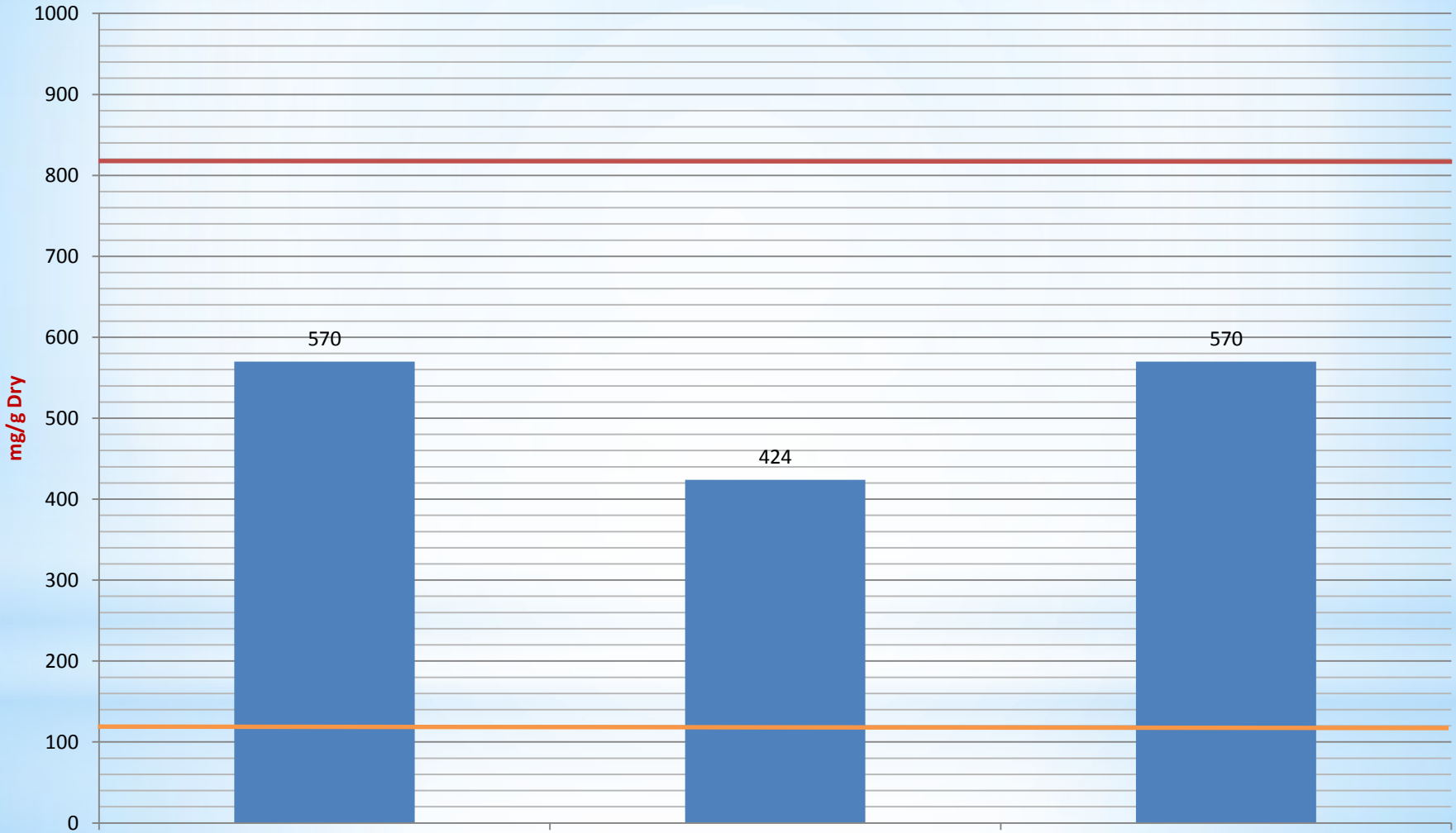
MOE - 1986 - Wabagishik Lake Sediment Chemistry


Chromium-Cr
Cr
Provincial Sediment Quality Guidelines
LEL - Low Effect Level - 26 ug/g
SEL - Severe Effect Level - 110 ug/g
Conentration ug/g
120.0
100.0
80.0
60.0
40.0
20.0
0.0
76.6
81.7
88.7
94.0
89.5
87.3
95.2
82.4
85.6
83.5
81.6
77.5
79.6
77.9
72.6
76.4
71.8
80.3
75.4
2013
2011
2009
2006
2004
2001
1999
1996
1993
1990
1987
1983
1980
1977
1972
1967
1959
1956
1951
Queen's University - 2013 - Wabagishik Lake Sediment Core

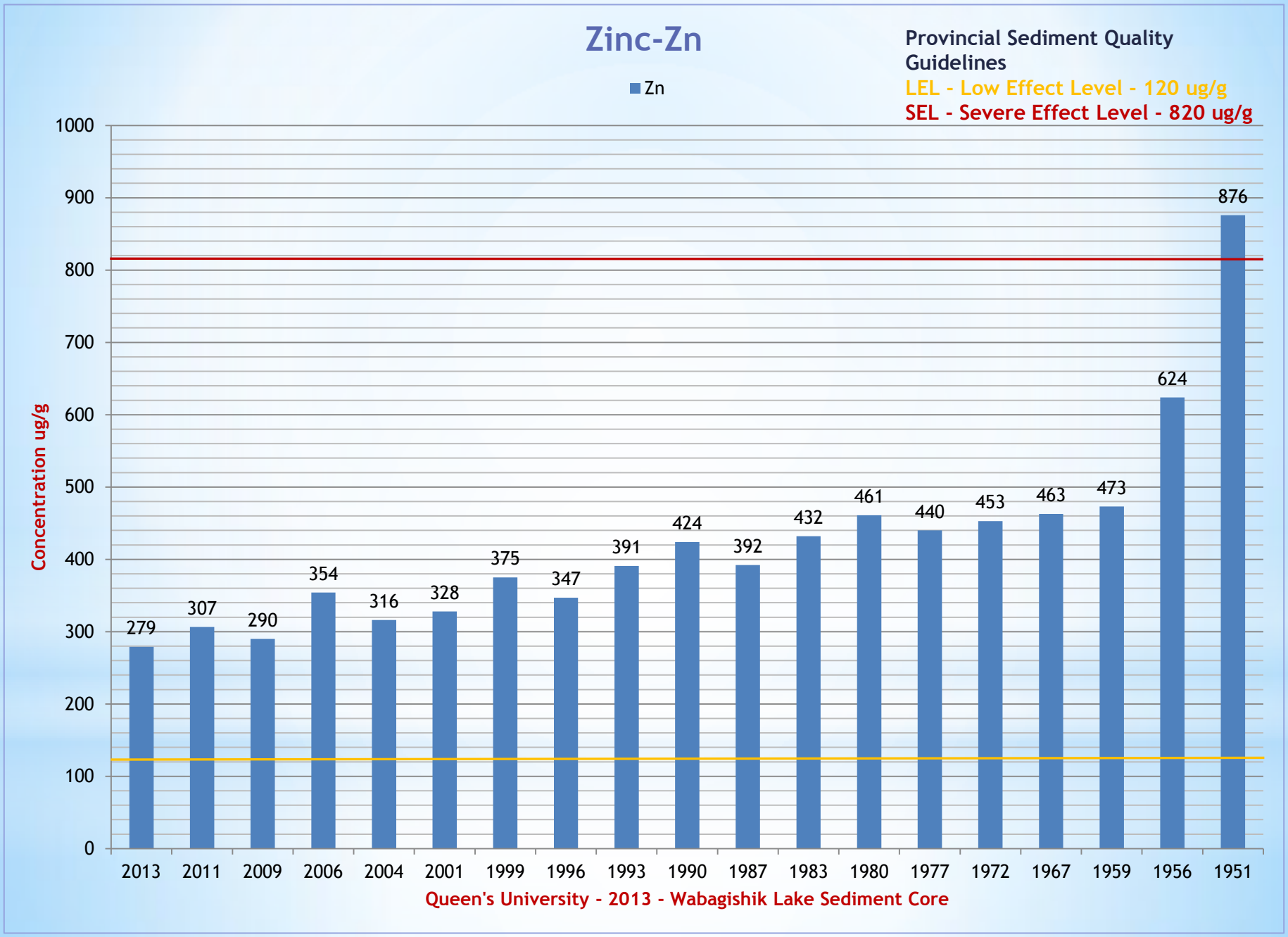
Zinc

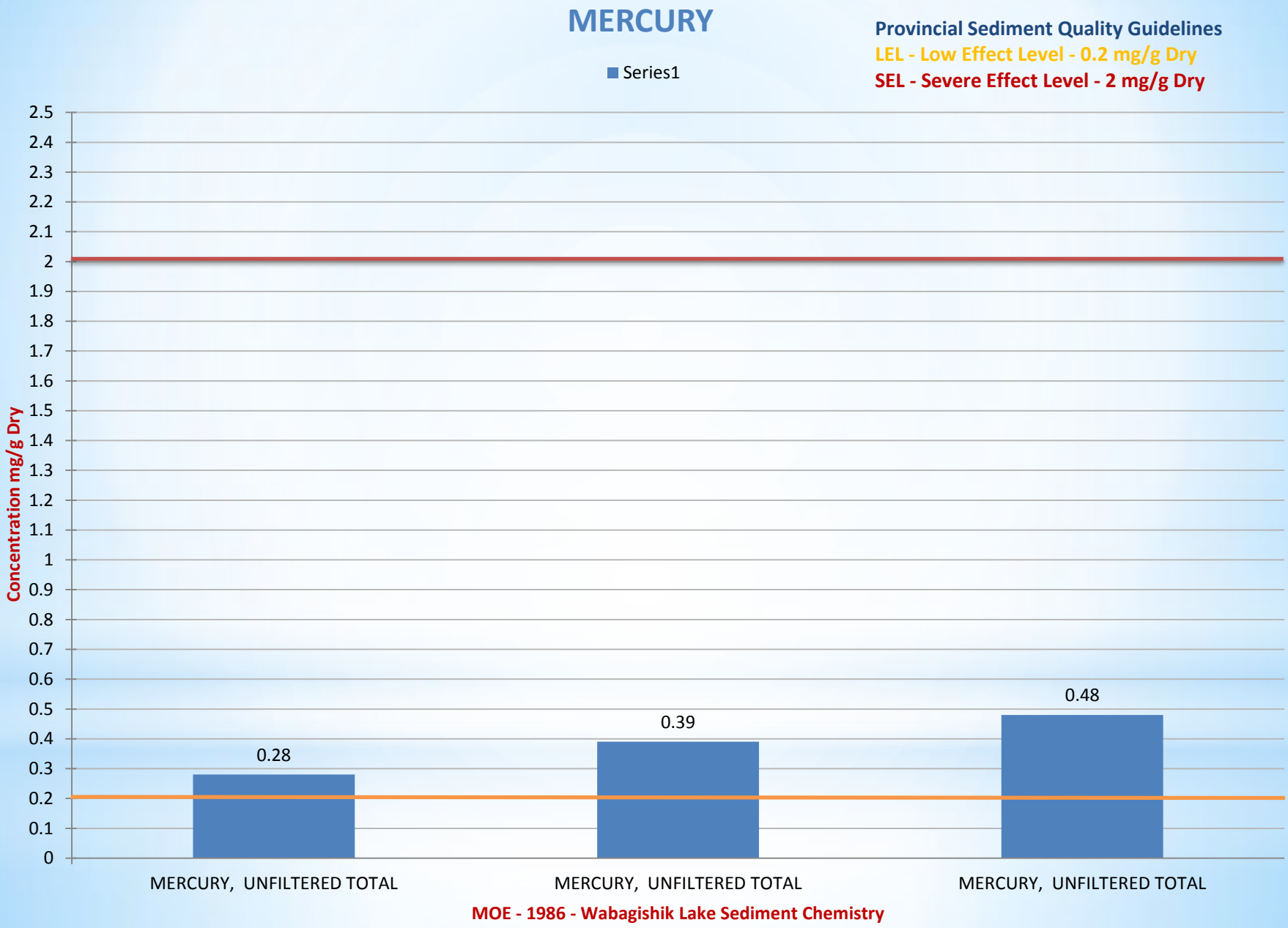
Unfiltered Total

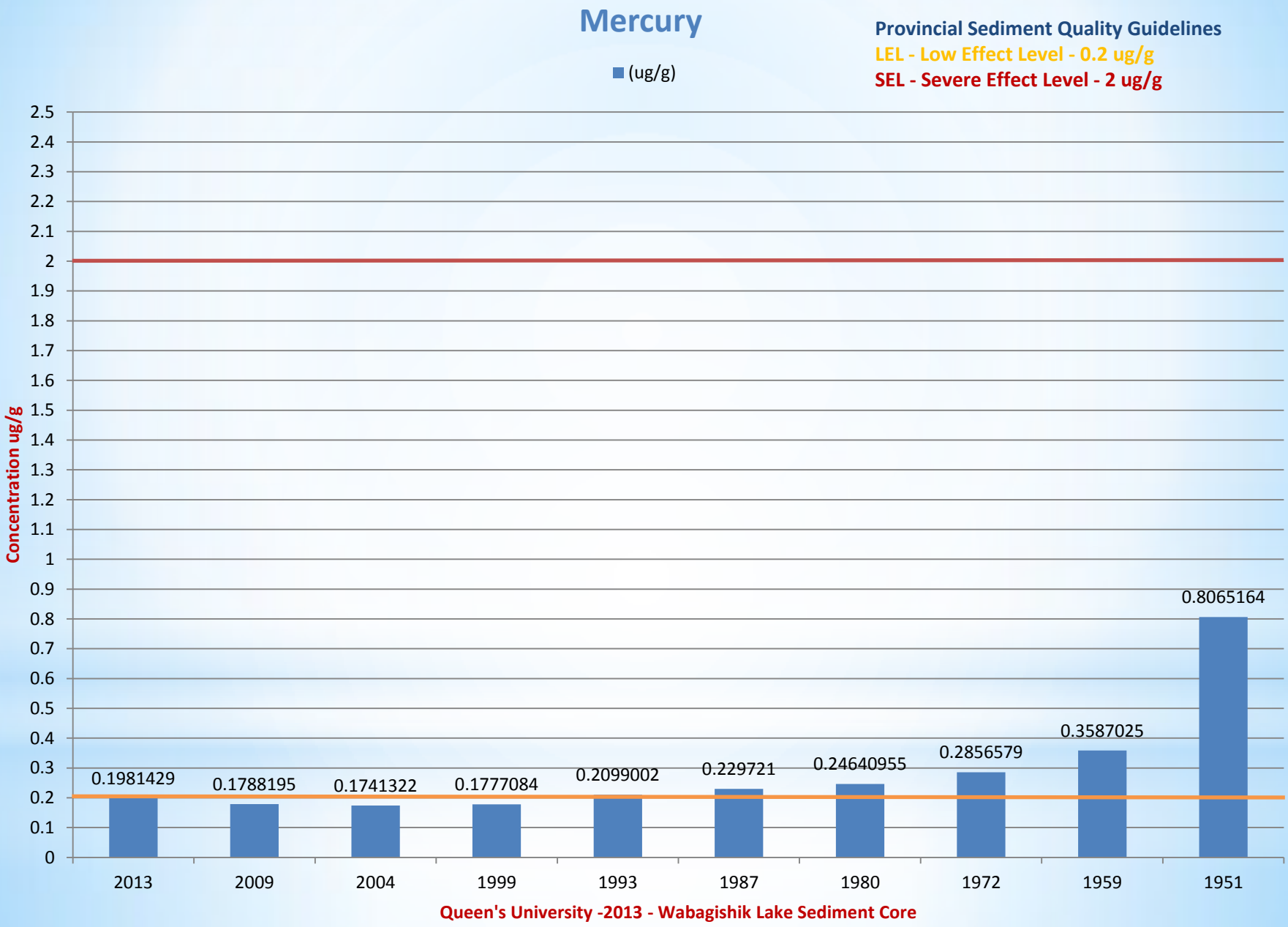
Provincial Sediment Quality Guidelines
LEL - Low Effect Level - 120 mg/g Dry
SEL - Severe Effect Level - 820 mg/g Dry



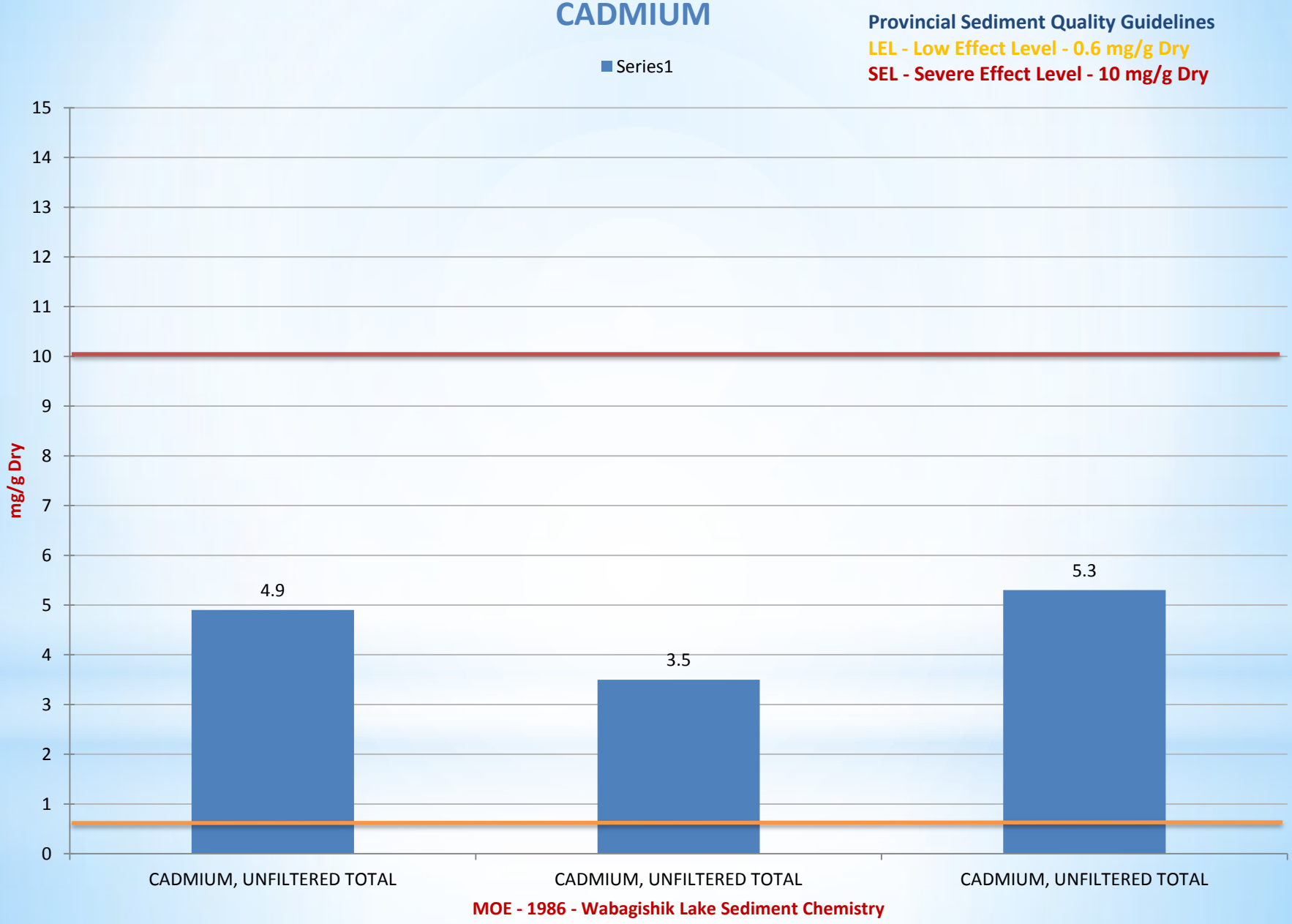
MOE - 1986 - Wabagishik Lake Sediment Chemistry


Zinc-Zn
Zn
Provincial Sediment Quality Guidelines
LEL - Low Effect Level - 120 ug/g
SEL - Severe Effect Level - 820 ug/g
Concentration ug/g
1000
900
800
700
600
500
400
300
200
100
0
279
307
290
354
316
328
375
347
391
424
392
432
461
440
453
463
473
624
876
2013
2011
2009
2006
2004
2001
1999
1996
1993
1990
1987
1983
1980
1977
1972
1967
1959
1956
1951
Queen's University - 2013 - Wabagishik Lake Sediment Core

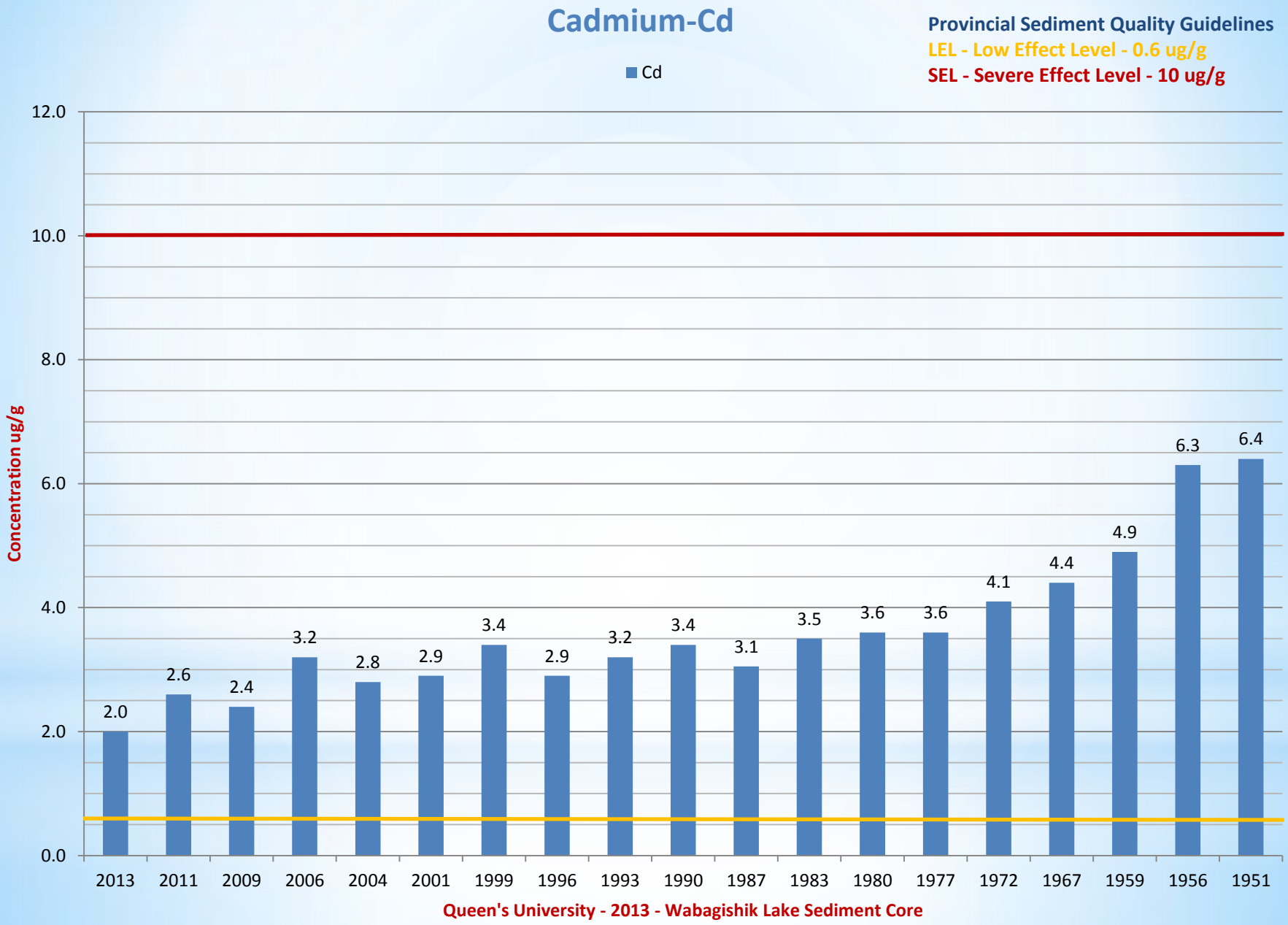

MERCURY
Series1
Provincial Sediment Quality Guidelines
LEL - Low Effect Level - 0.2 mg/g Dry
SEL - Severe Effect Level - 2 mg/g Dry
Concentration mg/g Dry
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.28
0.39
0.48
MERCURY, UNFILTERED TOTAL
MERCURY, UNFILTERED TOTAL
MERCURY, UNFILTERED TOTAL
MOE - 1986 - Wabagishik Lake Sediment Chemistry


Mercury
(ug/g)
Provincial Sediment Quality Guidelines
LEL - Low Effect Level - 0.2 ug/g
SEL - Severe Effect Level - 2 ug/g
Concentration ug/g
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.1981429
0.1788195
0.1741322
0.1777084
0.2099002
0.229721
0.24640955
0.2856579
0.3587025
0.8065164
2013
2009
2004
1999
1993
1987
1980
1972
1959
1951
Queen's University -2013 - Wabagishik Lake Sediment Core

CADMIUM



MOE - 1986 - Wabagishik Lake Sediment Chemistry


Cadmium-Cd
Cd
Provincial Sediment Quality Guidelines
LEL - Low Effect Level - 0.6 ug/g
SEL - Severe Effect Level - 10 ug/g
Concentration ug/g
12.0
10.0
8.0
6.0
4.0
2.0
0.0
2.0
2.6
2.4
3.2
2.8
2.9
3.4
2.9
3.2
3.4
3.1
3.5
3.6
3.6
4.1
4.4
4.9
6.3
6.4
2013
2011
2009
2006
2004
2001
1999
1996
1993
1990
1987
1983
1980
1977
1972
1967
1959
1956
1951
Queen's University - 2013 - Wabagishik Lake Sediment Core

Vermilion River - Bay Area

Class EA for Waterpower

- Class EA requires predictable, repeatable & mitigable projects
- Peaking & cycling projects do not meet this criteria
- Wabagishik Rapids ER does not meet this criteria
  - Wabagishik Lake - ZOI - not studied
  - Vermilion River - upstream of Wabagishik Lake - not studied
  - Wetlands were not mapped or studied around Wabagishik Lake
  - Very deep sediments downstream of rapids in bay area – not sampled
  - Lake and downstream sediments should have been studied
- Proponent led process is not working
  - Erosion of trust and confidence
  - Not studying entire ZOI
  - Not cooperating with MOE or MNR
- Request a strong message that all standards must be met
- Request Minister issue a Part II Order to elevate to an Individual EA!

*Wabagishik Rapids

FRESHWATER THAT IS SWIMMABLE, DRINKABLE & FISHABLE