Protecting Limnological Jewels* : The Lakes of the Cowichan Valley

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For the Cowichan Watershed Board 7 Feb 2013

*some of the jewels need polishing?!?!?

Why are lakes important?

* Lakes are important in the global and local scale
* Need to be considered as an integral part of the watershed with streams, groundwater and the terrestrial catchment area
* The value of water in general is greatly undervalued – what if water licenses were put out to bid? Waterfront real estate example?
* The value of lakes is not only in the water itself but in the intangible worth of aesthetics, spiritual and artistic contributions that lakes provide.

Lakes (with groundwater) are one of the neglected siblings of the water management family. Much longer data records exist for hydrology and climate (temp and precip).

* Data needs for all of the lakes are numerous and in some cases expensive so need to be priorized
* For Cowichan Lake this need is much more acute than for Somenos and Quamichan
* For Cowichan: Lake biological inventory (fisheries, plankton, benthos), inflow stream WQ and flows, lake water balance (especially evaporation)
* Checking (and expansion) of water quality objectives
* Protectionof riparian
* Enhancement and support of Stewardship

Basic Lake Characterization

* Bathymetry (map, volumes etc), watershed (soils, vegetation, slope, development), hydrology (stream flow), evaporation etc
* What is the stratification regime (how long, how deep) what are the temperature and oxygen profiles
* Basic water chemistry: phosphorus, nitrogen, carbon, TDS, color – quantification and trends
* Basic health related microbiology (bacterial and protozoan)
* Basic biology: phytoplankton, zooplankton, benthos, aquatic plants and fish. This needs to be quantitative.
* Special issues: eg contaminants (metals, biocides)

The Three Lakes

	Quamichan	Somenos	Cowichan
Surface area Watershed Area	313 ha 1630 ha	64	6204 122700? 47000?
Depths (m) Max Mean	 9.1 5.0	 7.0 4.7	 152 50
Nutrients Phosphorus Nitrogen	 30-60 400	 64	 3 70
Water Clarity (m)	1.5	1.3	8.7
Water Exchange Time	1 year		2.2?


VANCOUVER ISLAND
(at map centre)
COWICHAN LAKE
MT WHYMPER
MT BRENTON
DUNCAN
SALTAIR
LADYSMITH
NANAIMO
COWICHAN RIVER
CHEMAINUS RIVER
GORDON RIVER
SAN JUAN RIVER
PORT RENFREW
N
W
E
S


June 2003
Photo by Don Fan

Lake Risks from Human Activities

* Climate Change
* Watershed development
* Species Introductions

Climate Change effects on lakes

* Evidence strong – good data from other lakes that this is one of the factors in the present problems
* Cowichan Lake is not functioning in a natural way (wier, lake level control, withdrawals) and this is being exacerbated by climate change. Potential issues:

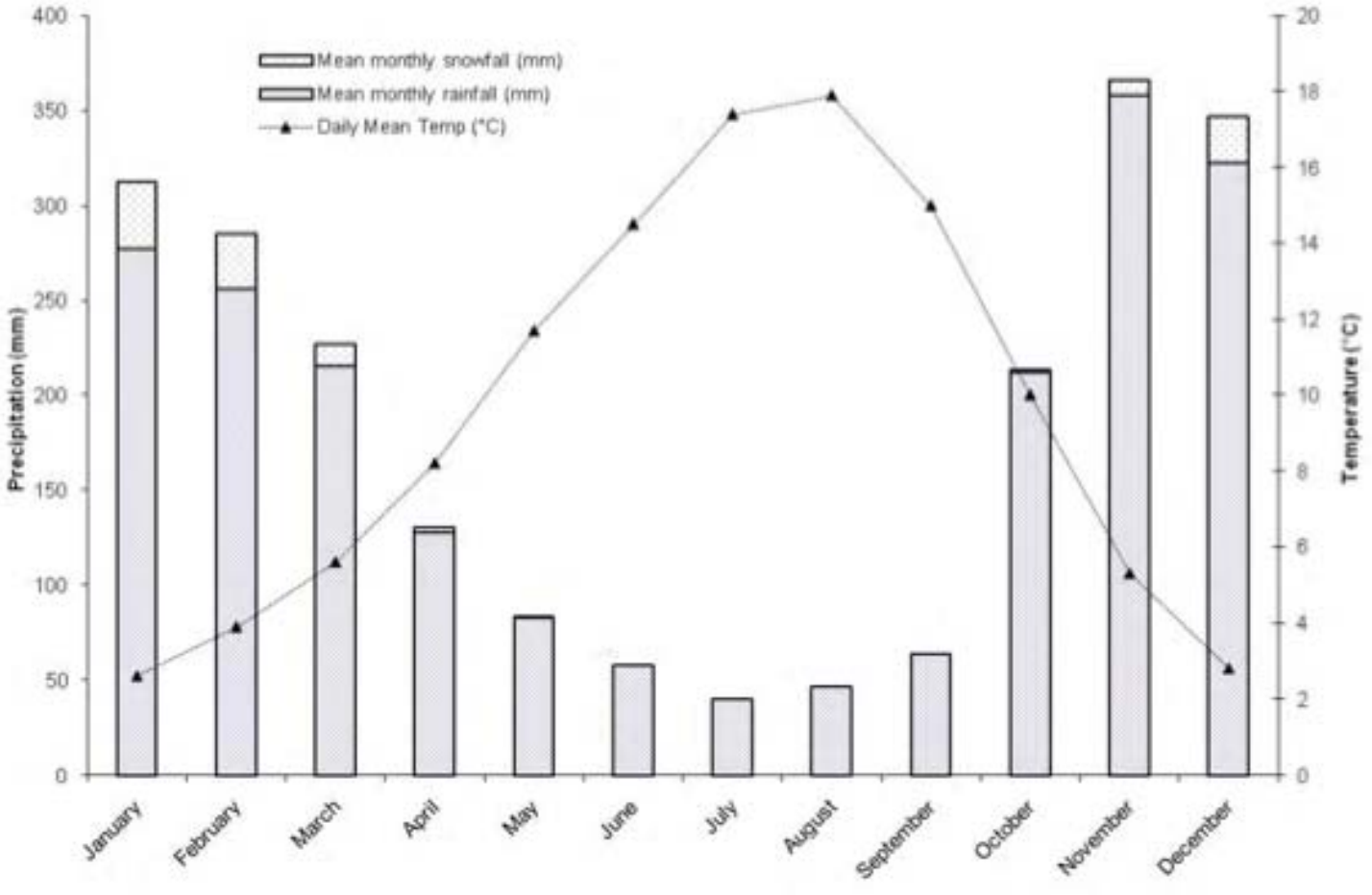
Changes in heat budgets,

Change in thermal stratification depth and length of stratification,

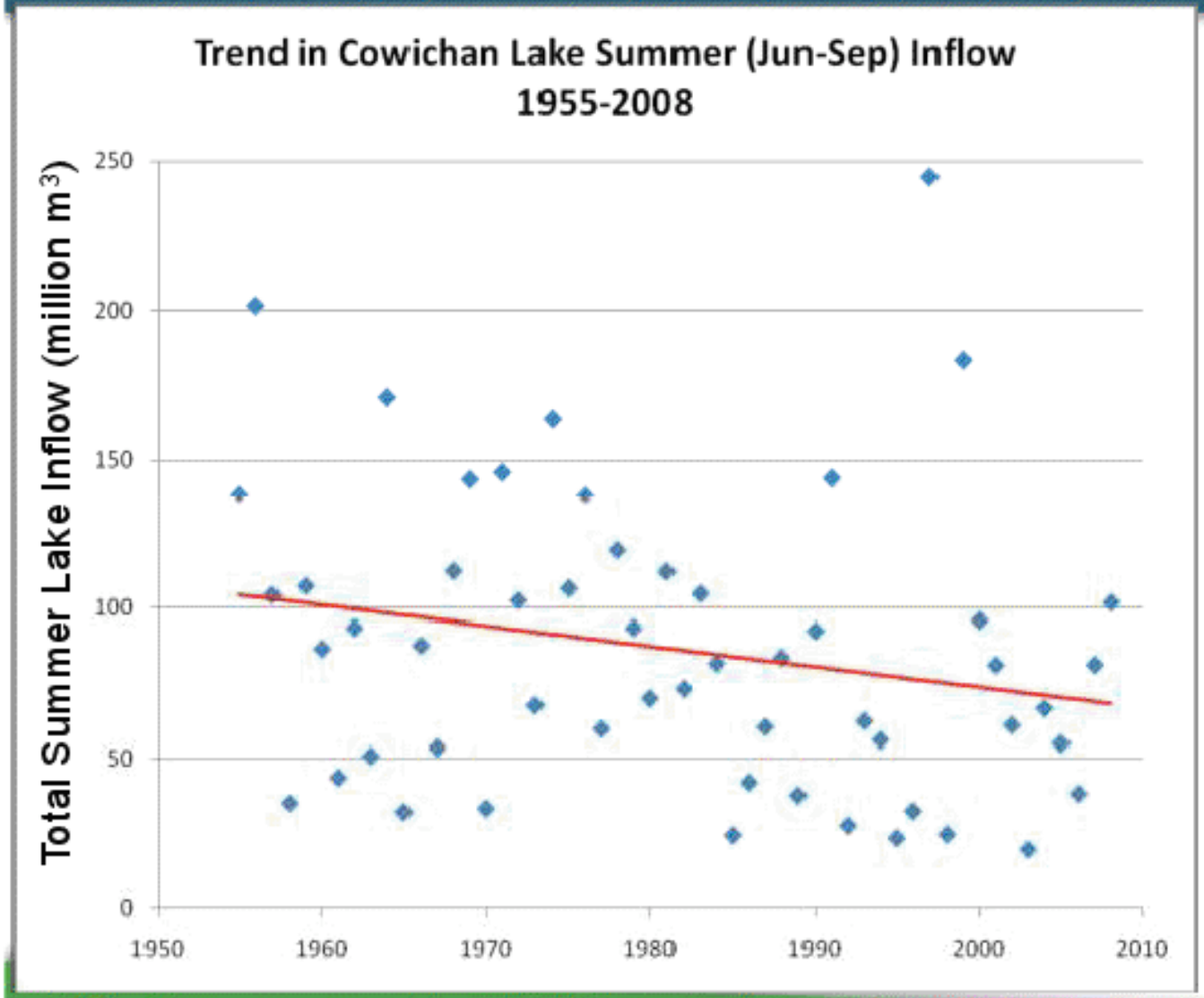
Increased Hypolimnetic Oxygen Demand (not yet serious but a sensitive indicator), increased evaporation (very serious),

Longer water exchange times, change in the periodicity of phytoplankton and zooplankton, shift in fish species (which may be related to decreases in fishery productivity?)

Precipitation and temperature



Changes in Lake Inflow



Late 1950's, avg. summer inflow

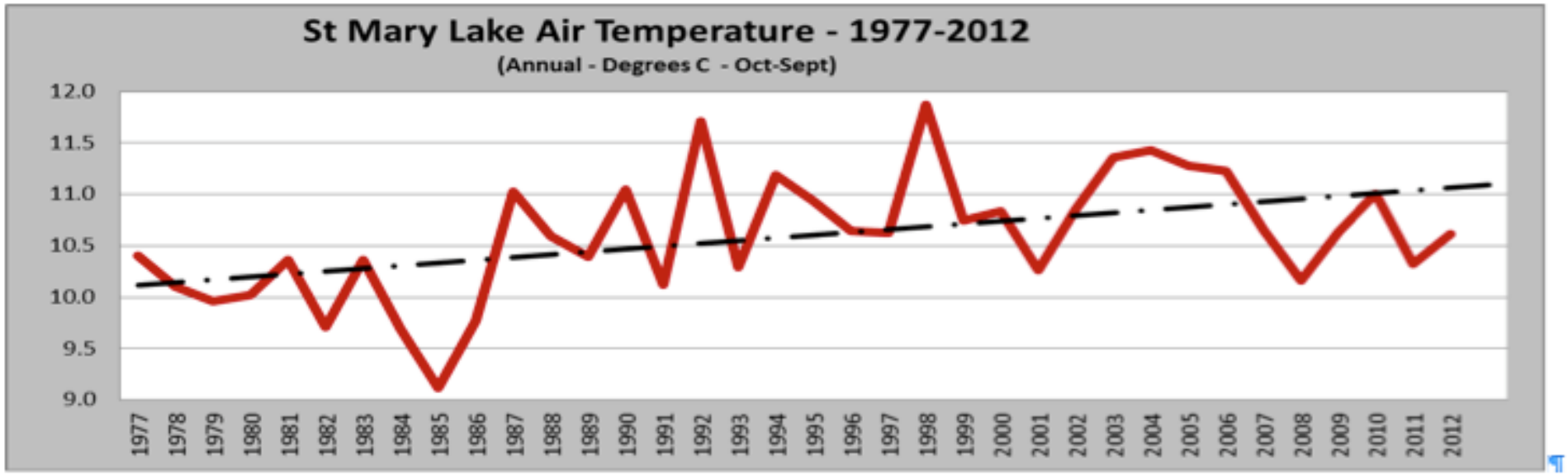
~ 104 million m^3

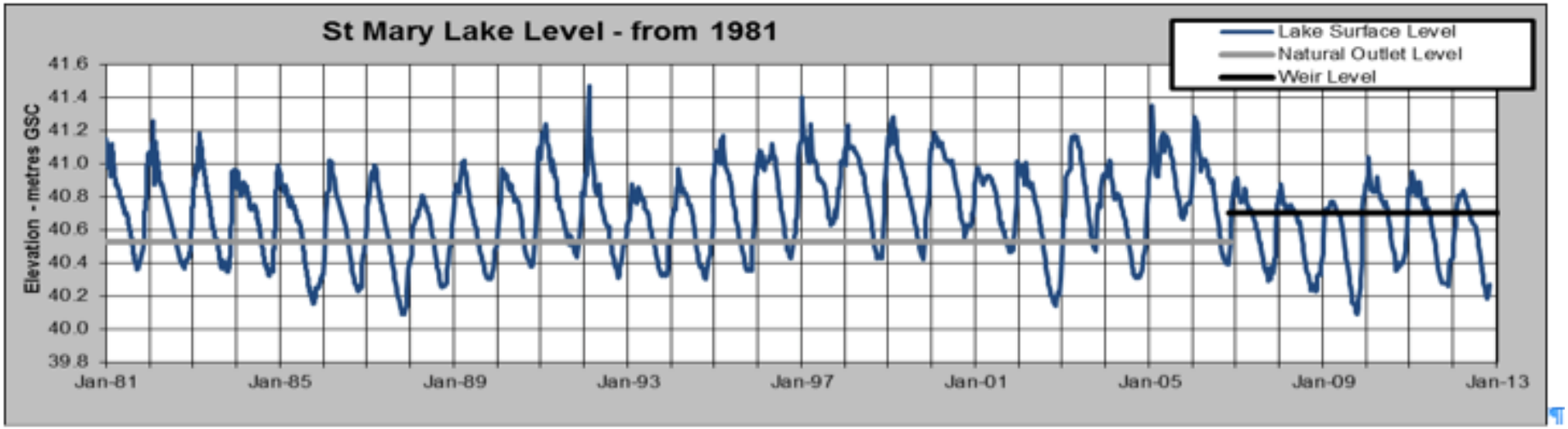
By 2008, avg. summer inflow

~ 68 million m^3

35% reduction

Source (A. Chapman, 2010)


St Mary Lake Air Temperature - 1977-2012
(Annual - Degrees C - Oct-Sept)
12.0
11.5
11.0
10.5
10.0
9.5
9.0
1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012


St Mary Lake Level - from 1981
Lake Surface Level
Natural Outlet Level
Weir Level
Elevation - metres GSC
41.6
41.4
41.2
41.0
40.8
40.6
40.4
40.2
40.0
39.8
Jan-81
Jan-85
Jan-89
Jan-93
Jan-97
Jan-01
Jan-05
Jan-09
Jan-13

Forest harvesting and /or land development and lake functioning

* Issues:
  * Hydrologic changes (patterns, inflow / evaporation balance)
  * Suspended sediment increases (habitat, drinking water)
  * Nutrient export and loss of forest productivity
  * Most research and case studies on these topic area are on stream ecosystems
  * Loss of fishery productivity (in lake and habitat – esp for Kokanee?)
  * Loss of aesthetics (landscape appearance, respect for land)

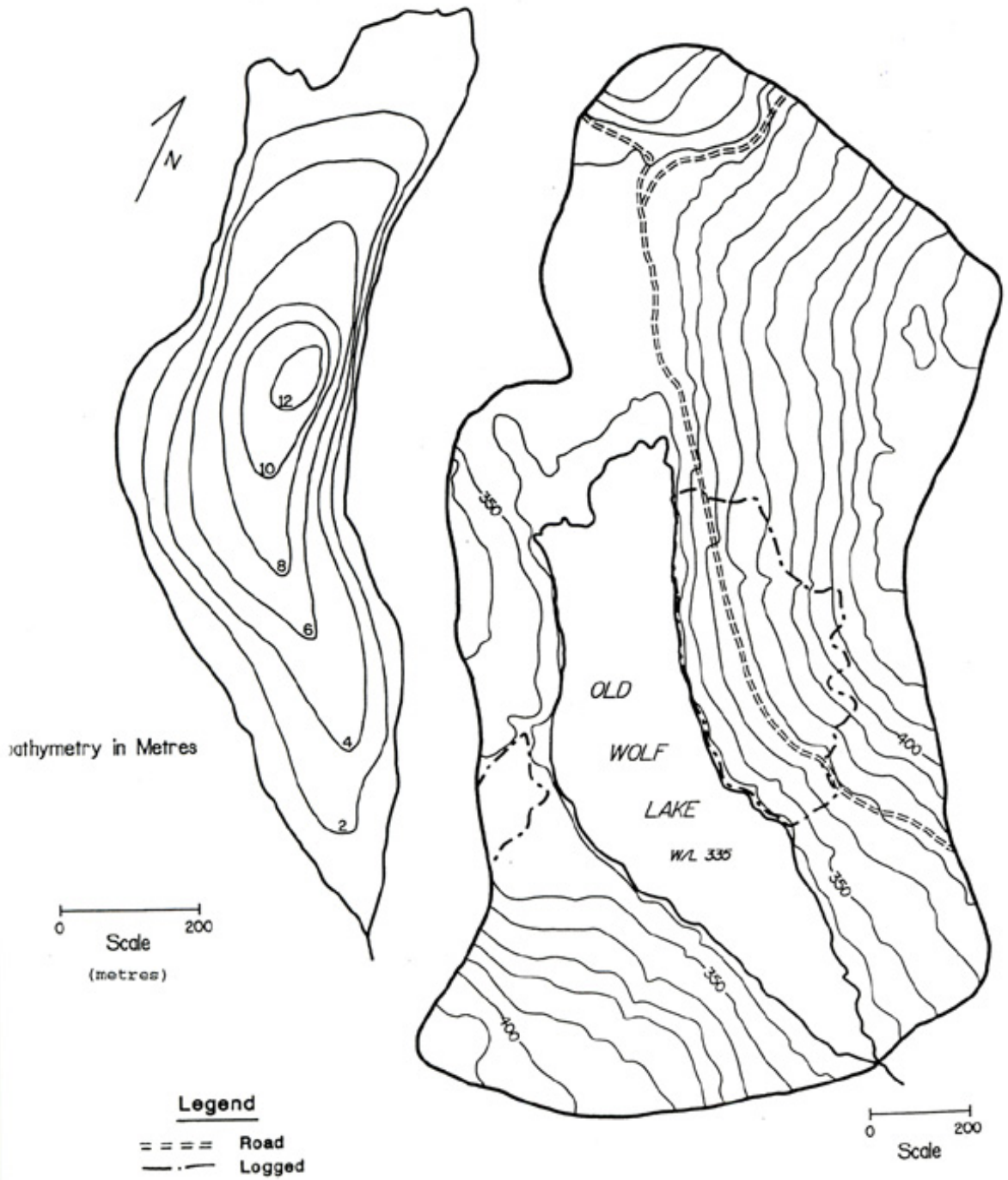

BOMAG


PACIFIC


GREATER VICTORIA WATER SUPPLY AREA
RESTRICTED ACCESS
WATERSHED LANDS ARE CLOSED TO THE PUBLIC
NO HIKING – NO CAMPING – NO BIKING
NO HUNTING OR FISHING
NO MOTORCYCLES OR OFF–ROAD VEHICLES
NO SALAL, MUSHROOM OR WOOD CUTTING & REMOVAL
NO TRESPASSING
BYLAW #2804
CAPITAL REGIONAL DISTRICT WATER DEPARTMENT

Study and timelines

* Monthly sampling 1984-1994
* Annual sampling (spring only) 1995-2003
* Area 1 logged 1986 (15 ha, 11% of WS)
* Area 2 logged 1988 (1.6 ha, 1% of WS)

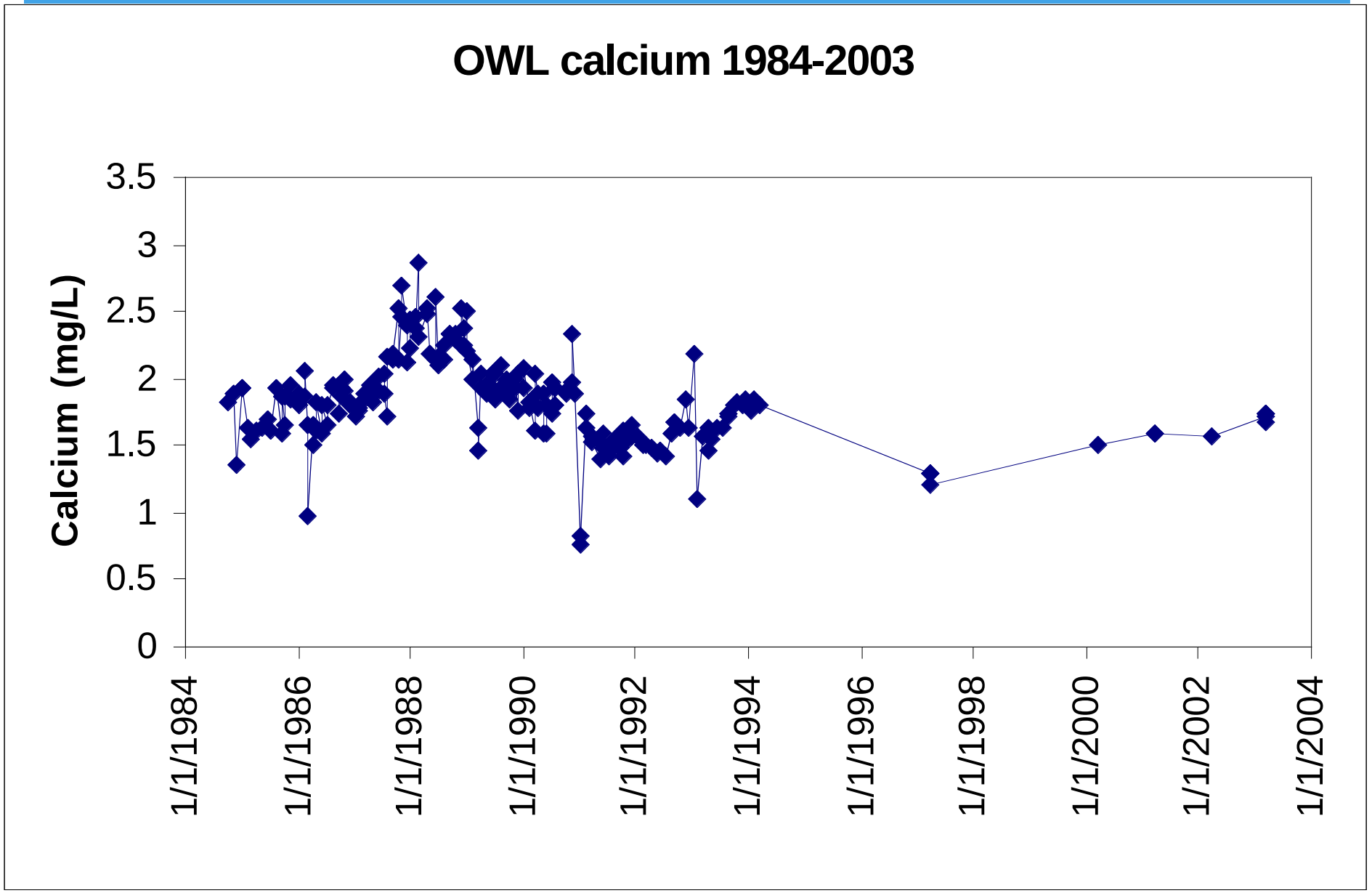

N
12
10
8
6
4
2
athymetry in Metres
0
200
Scale
(metres)
OLD
WOLF
LAKE
W/L 335
350
400
350
400
Legend
Road
Logged
0
200
Scale

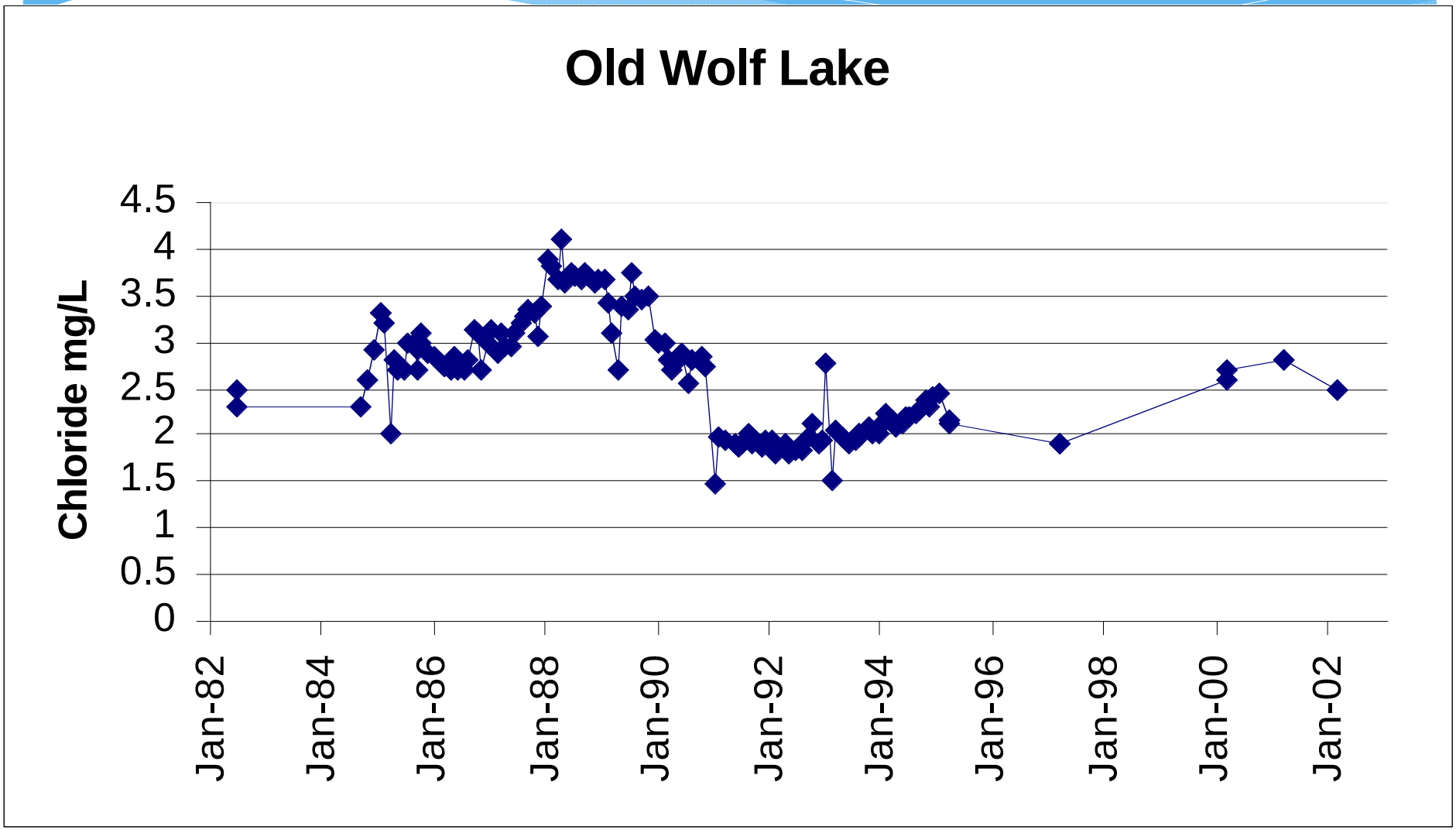
Old Wolf Lake morphometry

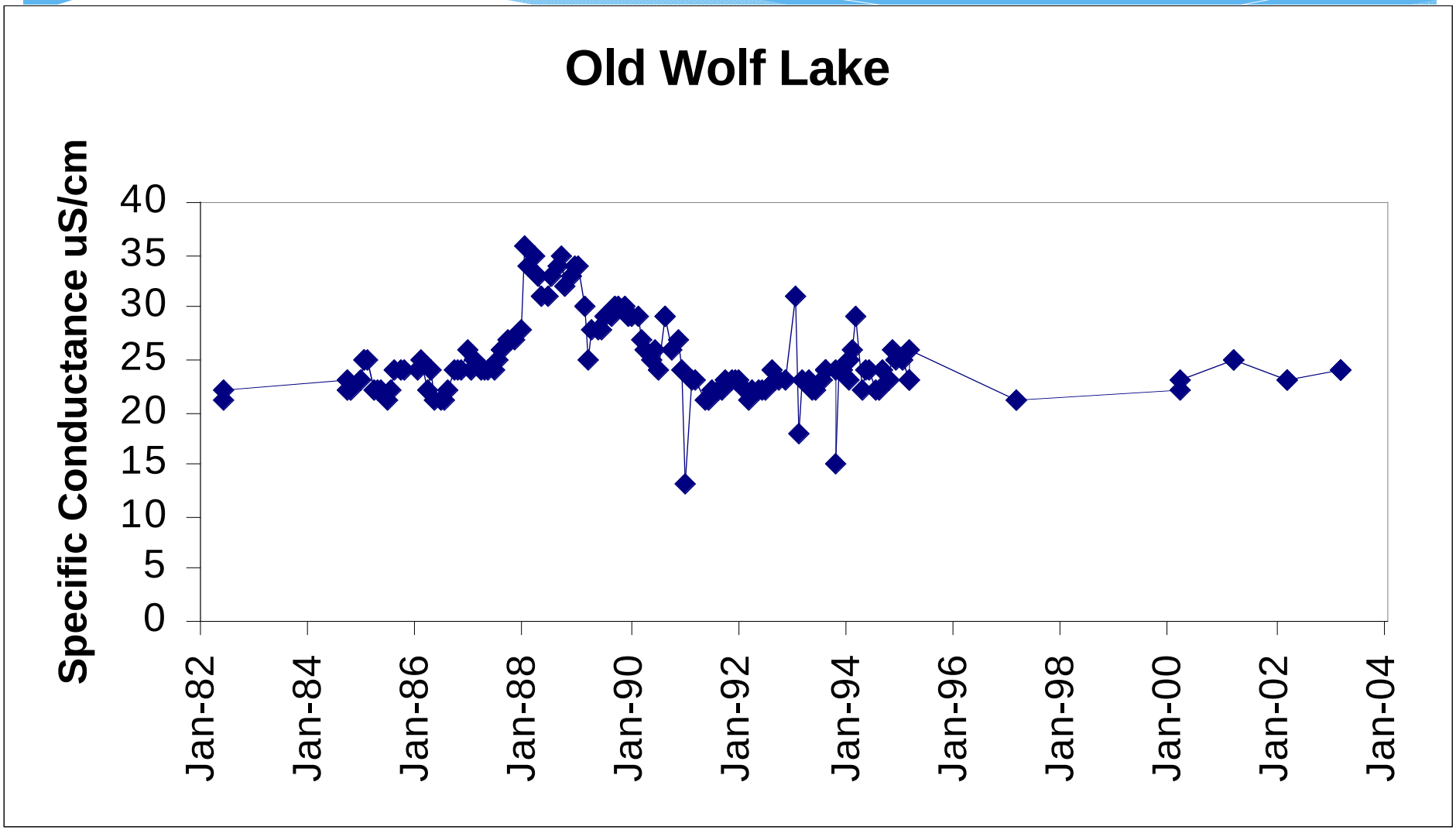
* lake surface area 24.9 ha
* mean depth 4.4 m
* maximum depth 13 m
* volume 1050 dam3
* watershed area 175 ha
* watershed area to lake surface area ratio 6:1
* watershed elevation 335 to 447 m
* lake water residence time 0.625 year (exchange rate 1.6/yr)

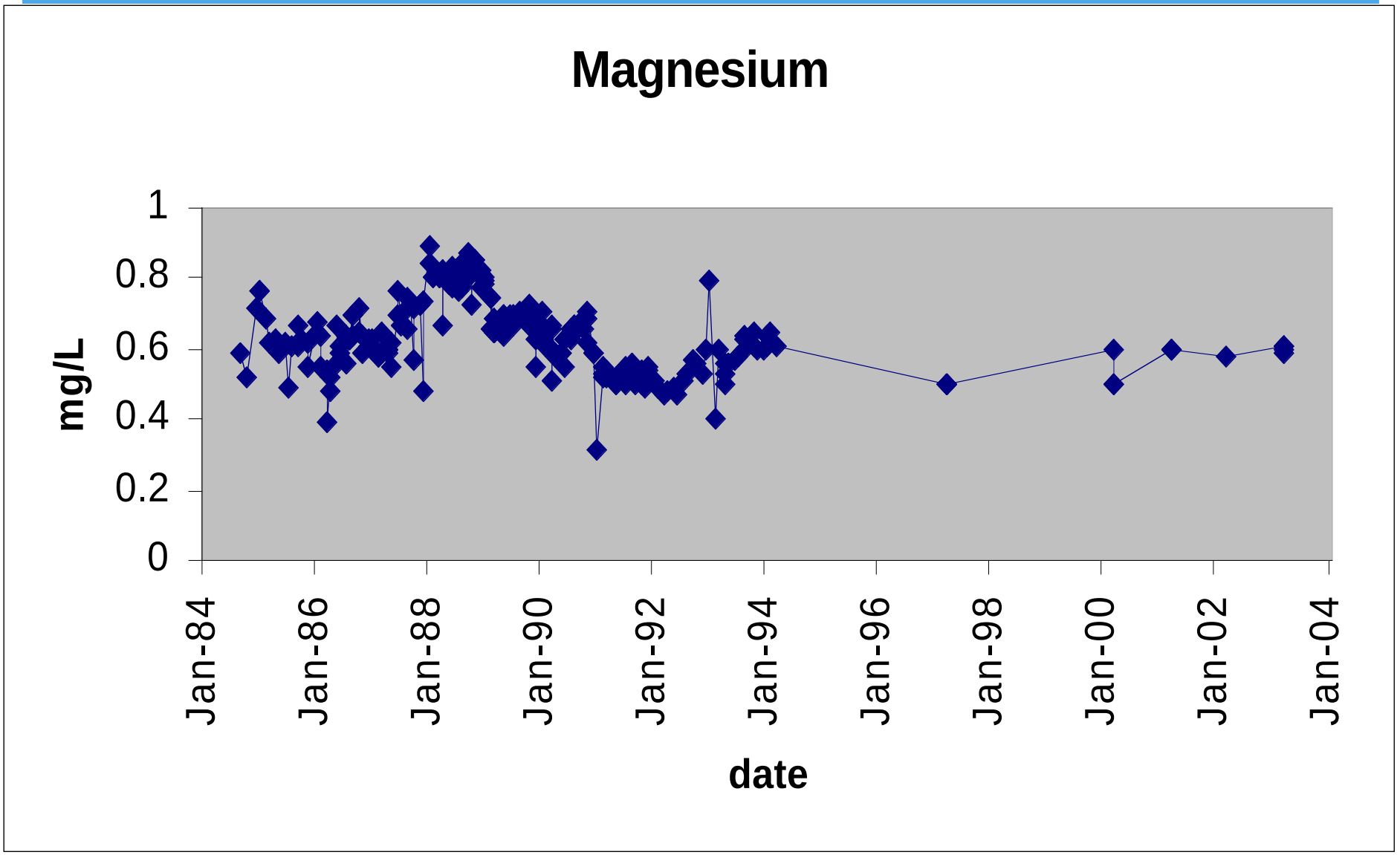
The estimated export coefficients for the watershed before logging and at the peak of the lake concentration.

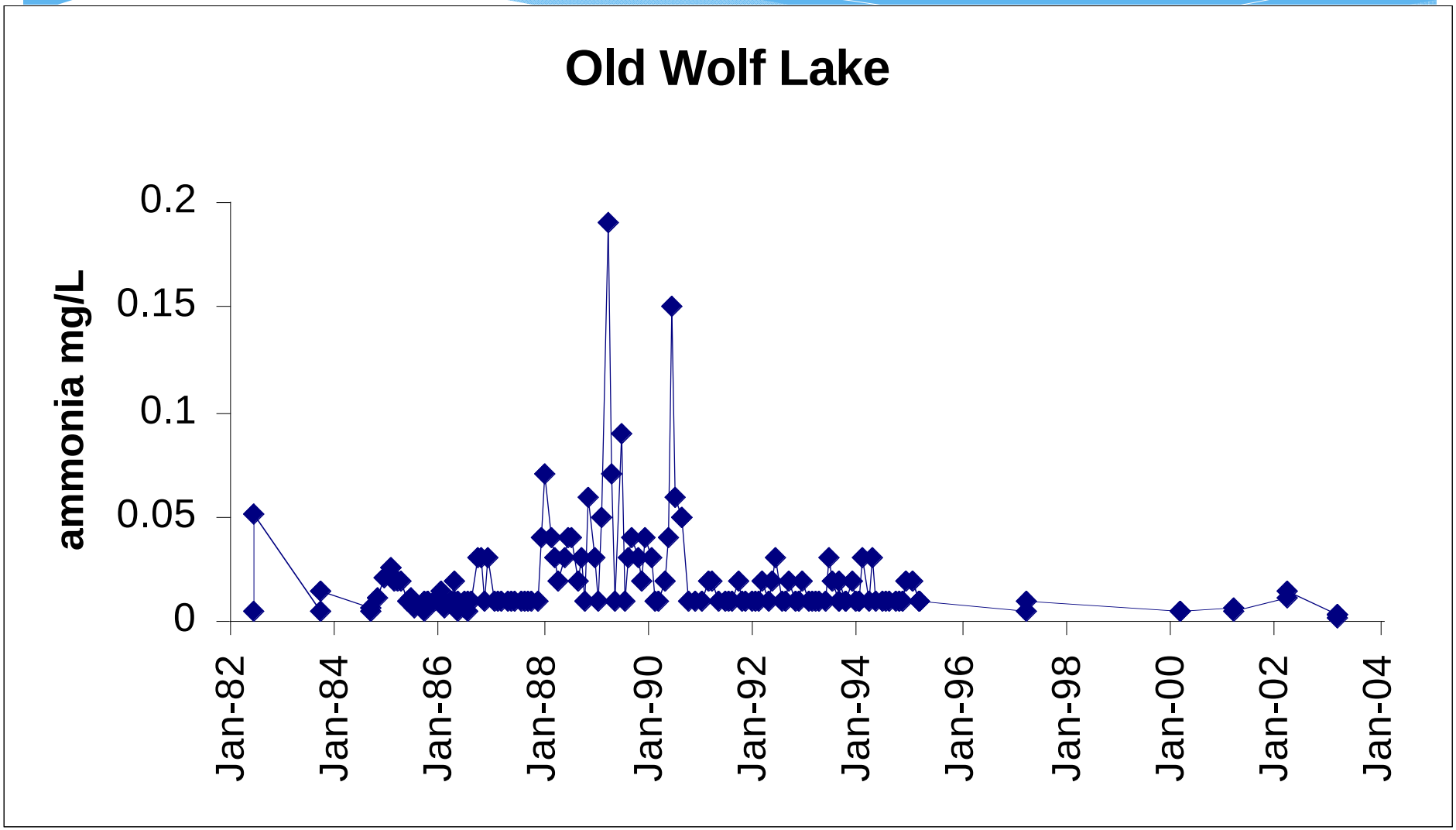
* The increase in export was considered to originate from the logged area and was calculated on that basis.
* Constituent background concentration in lake background export kg/ha/yr peak lake concentration mg/L export for logged area kg/ha/yr increase -


OWL calcium 1984-2003
Calcium (mg/L)
3.5
3
2.5
2
1.5
1
0.5
0
1/1/1984
1/1/1986
1/1/1988
1/1/1990
1/1/1992
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004

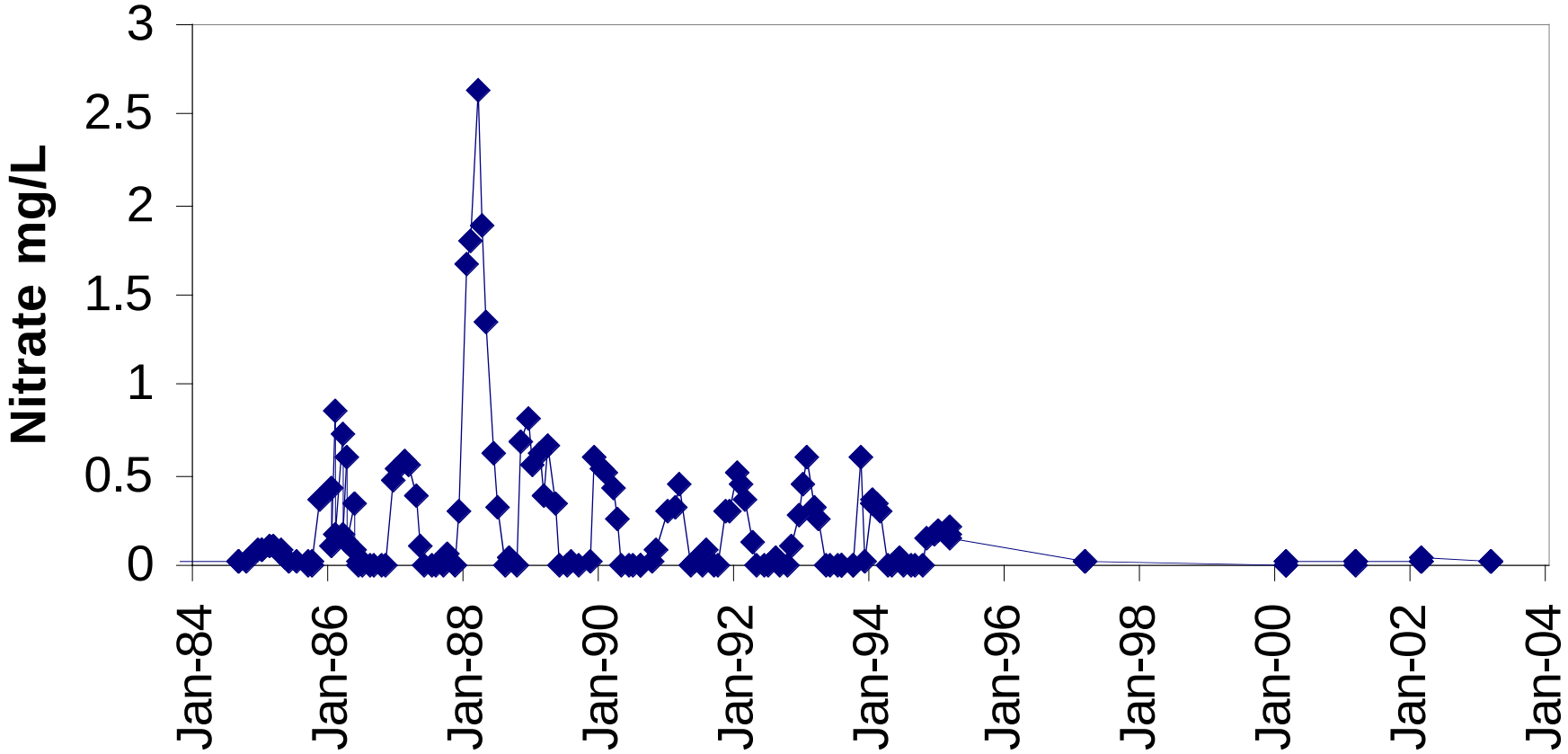

Old Wolf Lake
Chloride mg/L
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02

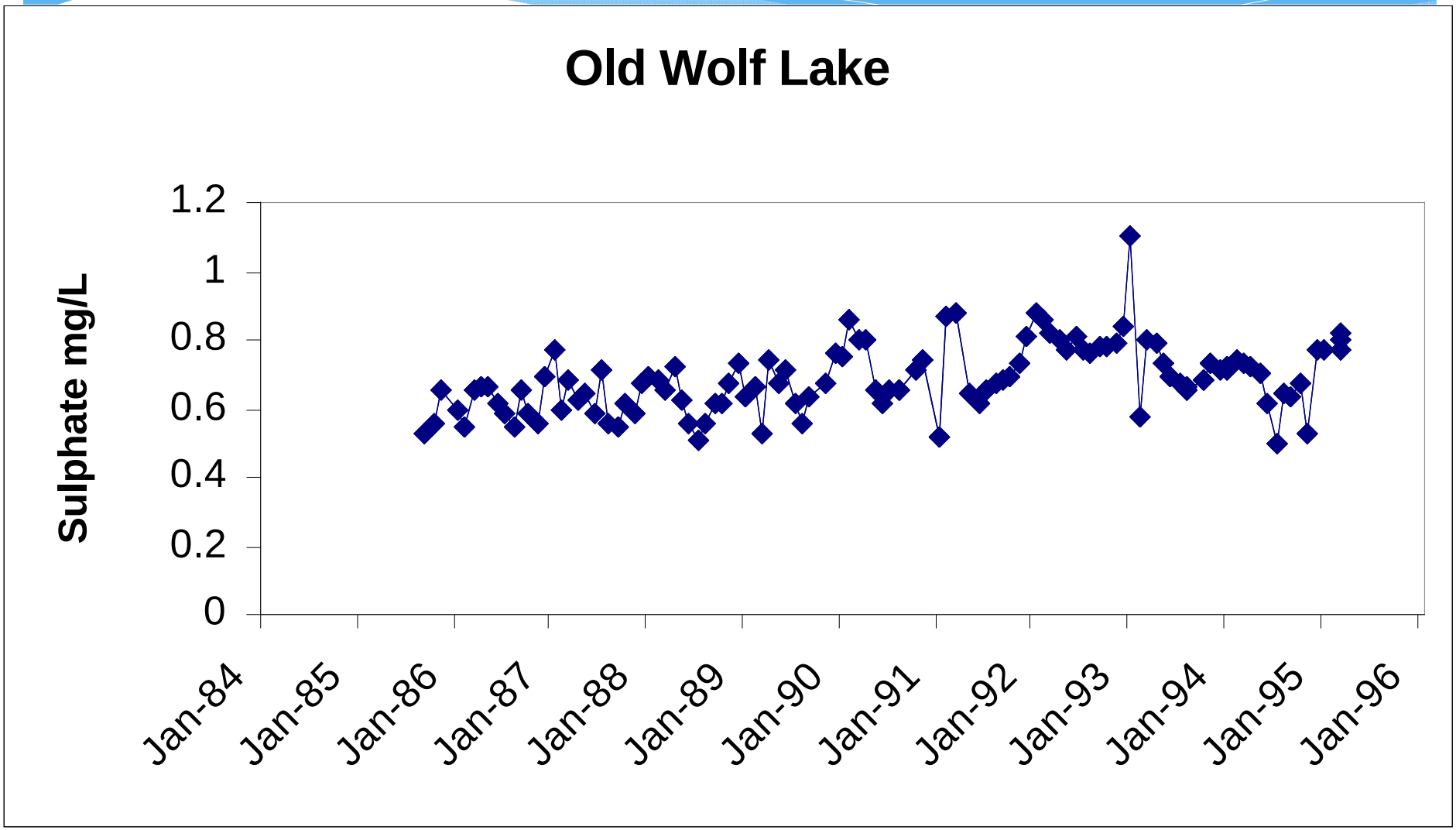

Old Wolf Lake
Specific Conductance uS/cm
40
35
30
25
20
15
10
5
0
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04


Magnesium
mg/L
1
0.8
0.6
0.4
0.2
0
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
date


Old Wolf Lake
ammonia mg/L
0.2
0.15
0.1
0.05
0
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04

Old Wolf Lake




Old Wolf Lake
Sulphate mg/L
1.2
1
0.8
0.6
0.4
0.2
0
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96

Ion export estimates

	Lake Conc	**Export** Kg/ha/yr	**Peak Conc**	**Logged area Export**	**Increase**	
Calcium	1.7	17.0	2.5	93.6	5.5x	
Chloride	3.0	30.1	4.0	117	3.9	
Sodium	1.8	18.0	2.5	81.9	4.5	
TDS	23	230.6	35	1403	6.1	
Nitrate	100	1.00	0.7	70.2	70	
Ammonia	30	0.3	0.15	14.1	47	

Study Conclusions

* Lakes are an effective monitor for watershed disturbance - several advantages over streams
* Ion loss may be a useful indicator of watershed change
* Forest harvesting in this case results in an increase in export particularly of nitrogen

Cowichan Lake Opportunities

* UVic Simpson Property – fantastic facility – under-utilised? – perhaps more interest from VIU?
* Ministry of Forest Research Station – outstanding facility but seems to to have much more and wider potential use?
* Lake education and awareness (eg lamprey)
* Lake use leads to more awareness and increases value Open water swim race? Tour de Cowichan?)
* Stewardship

Path Forward?

* Many of the challenges are administrative, jurisdictional, organizational not necessarily scientific?
* Use the experiences of others as example – keep and eye on St Mary Lake (analagous to Quamichan and Somenos?) look to other management schemes – Like the Okanagan Basin Water Board?
* Public education and awareness and participation are powerful tools and can accomplish a great deal.
* Make use of the resources that are available from ordinary citizens (stewardship) - they are eager to help - they need encouragement and direction.