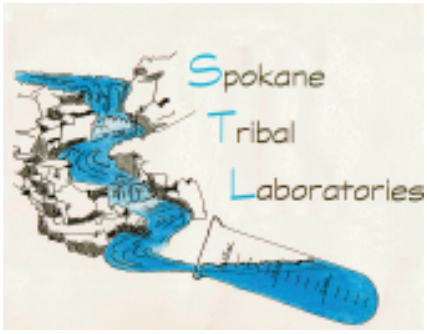

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November 21, 2005

Deer Lake Property Owners Association
Mr. Mike Phillips <skipper@omnicast.net>
PO Box 250
Loon Lake WA 99148

RE: Deer Lake 2005 Water Quality Study Report

Dear Mike and DLPOA Board:

We are writing to present you with the completion report for the above referenced project. Included are descriptions of monitoring methods and 2005 water quality condition, collected data and comparisons with previously collected data. All collected data are presented in ATTACHMENT B.

Following receipt of a request for assistance from the Deer Lake Property Owners Association (DLPOA), Spokane Tribal Labs, Darren Lantzer, Manager, and David Lamb, Lake Ecologist, prepared a proposal for a limited water quality study and comparisons between 2005 data and previously collected information to be performed. This proposal was approved by the DLPOA Board and signed effective 4/28/05. The scope-of-work for this project is presented below.

BACKGROUND: Deer Lake is located in southern Stevens County within the Colville River watershed. The lake drainage area is 18.2 square miles and is mostly forested. The lake surface area is 1,100 acres, the mean depth is 52 feet and the estimated volume of the lake is 57,000 acre-feet (Bortleson et al. 1976).

Deer Lake water quality has been studied several times in the past. The first sampling took place in 1911 by Kemmerer et al. (1924) who found the lake thermally stratified with an algal community comprised of diatoms and blue-green algae. Bishop (1973) found blue-green algae predominant in 1971 and 1972. Bortleson et al. (1976) also monitored the lake in 1972 and found good water clarity, low levels of algae and healthy oxygen conditions. Bortleson also looked at aquatic vegetation along the lakeshore and indicated that up to 50% of the near shore (littoral zone) areas supported vegetation, although no species were listed.

Shoemaker (1976) was the first to attempt to identify sources and quantities of phosphorus entering Deer Lake. Shoemaker estimated the annual phosphorus loading and suggested that

approximately 75% came from septic tank leachate. He also found that surface runoff, while intermittent, accounted for 55 % of the annual inflow to the lake with precipitation accounting for the rest. Underground seepage was the largest loss of water from the lake.

Singleton et al. (1980) classified Deer Lake as having a moderate productivity ("mesotrophic") and found similar levels of nutrients and algae in 1978 as were observed by Bishop in 1971 and 1972. However, Scholz et al. (1988) found increased nutrient concentrations and blue-green algal populations and decreased water clarity in 1985.

The most recent water quality study was performed by Soltero et al. (1991) in 1989 and 1990. This study was prompted by lake resident concerns over the apparent increase in the frequency of algae blooms and increasing submersed plant growth. Soltero et al.'s investigation included a shoreline wastewater survey, lake and inlet/outlet testing and monitoring of groundwater inflow and outflow. The findings of this study again documented the trend of declining deep-water oxygen levels and increasing phosphorus levels and algae growth. Recommendations following from this study concerned the control of phosphorus entering the lake from the area referred to as the 'Northeast Meadows'.

The Deer Lake residents concern over the apparent declining water quality led to several significant management efforts. The first was the purchase of 20 acres of near-shore habitat in the Northeast Meadows area to prevent cattle grazing near the lake. The second effort was the sewering of the developed areas around the lake. The sewer was designed and constructed under the auspices of the local Public Utility District. Completed in 1991 this system carries wastewater to the Loon Lake treatment facility which is outside the Deer Lake watershed.

The third, and perhaps, most important to the immediate protection of water quality in the lake was the purchase of the Northeast Meadows area in 1996-1997 by the USDA Natural Resource Conservation Service and US Fish and Wildlife Service. This former heavily grazed area is now actively maintained as a wetland wildlife habitat and has seen various stream channel restoration, revegetation and pond construction efforts in recent years.

The Northeast Meadows work, in particular, is believed to be the cause of observed improved water quality conditions in recent years. However, the residents are still concerned about nutrient additions from their fish rearing net pen operations and about the long term effects of near drought conditions which have prevented there being any surface water outflow since the 1997 high water year (Mike Phillips, personal communication 2005). Thus the current study was requested.

2005 MONITORING PROJECT PLAN

STL proposed to provide the following professional services to DLPOA relative to the Deer Lake 2005 Water Quality Study. Specifically, this study was a two-day sampling effort with field monitoring to take place in May and August.

Task 1 Project Planning: STL was to develop a sampling program which would include field and laboratory analyses.

Task 2. Water Quality Monitoring: STL was to perform routine water monitoring and sample collection on two lake sites (the 'Deep' and 'Narrows' sites used for previous studies, **see Figure 1**) and two major inlets into the lake during May and August only. Field methods were to include flow at two major inlets and collection of samples and in-situ analysis at two lake sites using a Secchi disk for water transparency and a Hydrolab multi-parameter analyzer for physical characteristics. The Hydrolab would measure dissolved oxygen, pH, temperature, turbidity and conductivity.

Laboratory analyses for the May sampling were to include nitrite and nitrate nitrogen, dissolved ('ortho') phosphorus, total phosphorus, total Kjeldahl nitrogen, ammonia nitrogen, total hardness, alkalinity, sulfate, chloride, and fecal coliform bacteria. Laboratory analysis for the August sampling were to include nitrite and nitrate nitrogen, ortho-phosphorus, total phosphorus, total Kjeldahl nitrogen, ammonia nitrogen and fecal coliform bacteria.

Task 3. Data Analysis / Interpretation: STL was to tabulate and review field and laboratory analysis data for the purpose of summarizing the current water quality conditions. STL would also review pertinent published reports, primarily Soltero et al. 1991, to obtain past data and make comparisons with the 2005 measurements.

Task 4. Report Preparation: STL would prepare a summary letter report detailing the findings of this project and include all collected data for presentation to the Property Owners Association.

2005 WATER QUALITY MONITORING METHODS

Water samples and field measurements were taken during May and August 2005. Sampling occurred at two in-lake stations (referred to as 'Narrows' and 'South') as Shown in Figure 1. Field analyses were performed at the water surface and every meter of depth using a Hydrolab DataSonde 4A multi-parameter probe. Field analyses consisted of temperature (measured in degrees Celsius, °C), dissolved oxygen (measured in milligrams per liter, mg/L, approximately the same as parts per million), conductivity (a measure of the electrical conductance of the water, in units of micro-mhos per centimeter, μmhos/cm), pH (a measure of the acidity or alkalinity of the water) and turbidity (a measure of the clarity or lack of clarity of the water, in Nephelometric Turbidity Units, NTUs).

Apparent water clarity was also measured at each site using a 20 centimeter (8 inch) Secchi disk. There is an inverse relationship between Secchi clarity and turbidity. Secchi represents the cumulative clarity of the water between the surface and the depth where the disk disappears from view, while turbidity is, in effect, a measurement of how particles in the water block the passage of light at specific depths. Thus a higher number of particles (which could be suspended silt or algae) would yield a higher turbidity value and a lower clarity.

Water samples were collected at the surface and 2-meter (6.56 foot) depth intervals at the 'Narrows' and 'South' sites (see lake map, **Figure 1**). These samples were taken on ice to Spokane Tribal Laboratories Spokane facility to be analyzed for the parameters listed in the

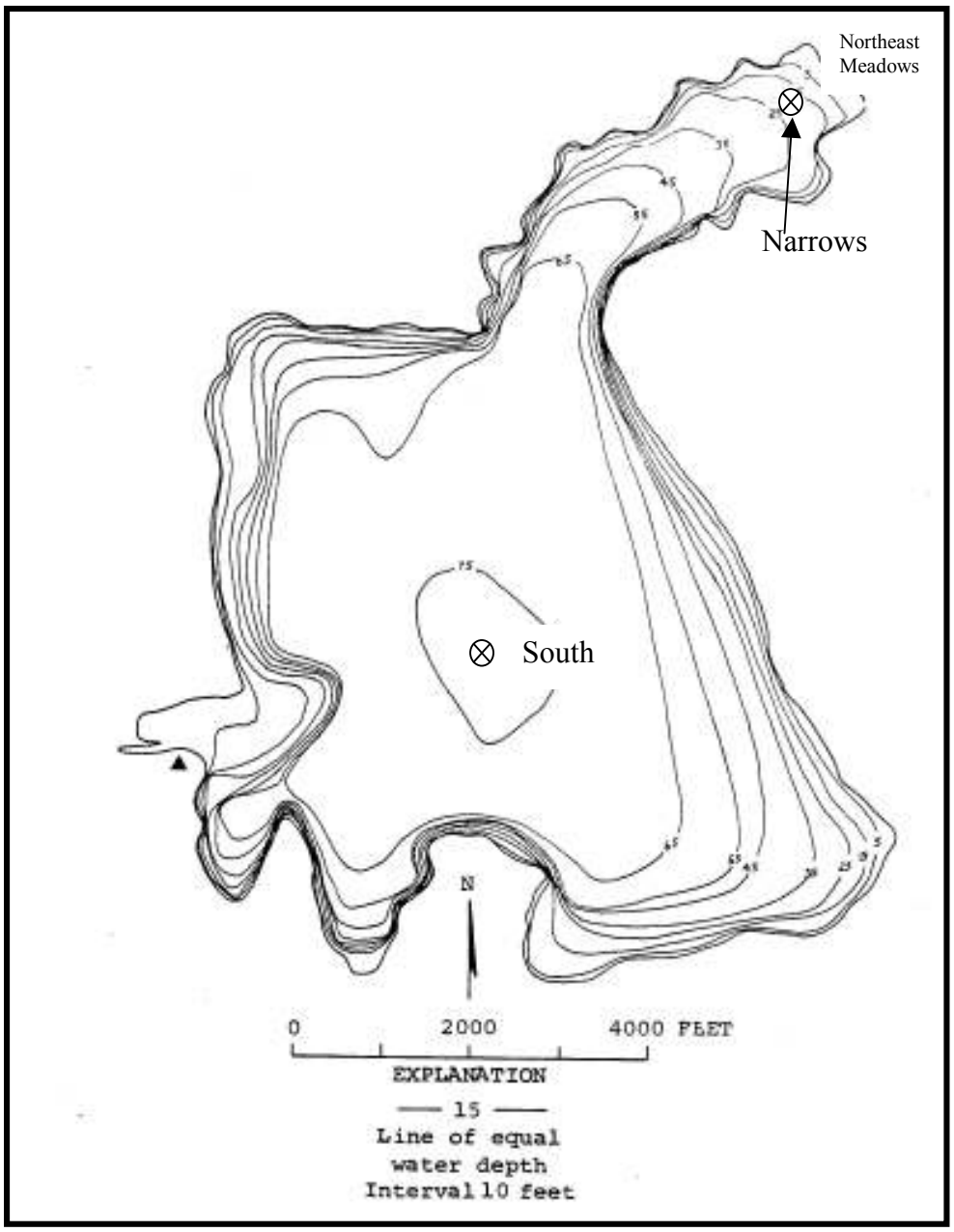

Figure 1. Map of Deer Lake, WA, showing depth contours and 2005 sampling sites (from Dion et al. 1976).

proposal. *Standard Methods for the Examination of Water and Wastewater* (APHA, 1995) methods and US EPA-approved methods (http://www.epa.gov/OGWDW/methods/inch_tbl.html) were used for all analyses following the lab's State Certification for non-potable water analyses.

Phosphorus is essential to the growth of organisms and can be the nutrient that limits the primary productivity of a body of water. Most lakes in this area are phosphorus limited. Total phosphorus

includes all phosphorus fractions in the water (includes dissolved forms). Dissolved (also called "ortho" phosphorus) is the form of phosphorus that is available for uptake by plants and algae.

Total Kjeldahl nitrogen (TKN) is a measure of nitrogen in organic forms and includes ammonia. Organic nitrogen includes such natural materials as proteins, peptides, nucleic acids, and urea. Typical organic nitrogen concentrations vary from a few hundred micrograms per liter in some lakes to more than 20mg/L in raw sewage. TKN does not include nitrate (NO_3) or nitrite (NO_2).

The major springs where they enter the northeast meadows were also sampled in May and August with all parameters (except Secchi disk) being measured. Flows were measured in May and August using a Marsh-McBirney Model 2000 Flow Mate flow meter.

SUMMARY OF 2005 WATER DATA

Tabulated data from this study is presented in ATTACHMENT B. Quality assurance and quality control information relative to this data is maintained on file at STL and is available upon request.

Lake Physical Parameters (Tables B-1 and B-2)

On May 23, 2005 the STL crew performed field analyses and collected water samples at the South and Narrows sites. At the South site analyses were performed at the surface, two-meter intervals from 2.0 to 20.0 meters and just off the bottom (22 meters). At the Narrows analyses were performed at the surface, 2.0, 4.0 and 5.0 meter depths, with 5.0 meters being just off the bottom.

On May 23rd, temperature ranged from 14.57 °C to 5.71 °C at South and 14.98 °C to 14.26 °C at the Narrows. No stratification was seen at the Narrows but a pronounced thermocline (metalimnion) was seen between the 6 meter and 8 meter depths at South indicating that the lake was beginning to stratify. At this same time dissolved oxygen ranged between 10.65 mg/L at the South surface to 4.94 mg/L at the South bottom. At the Narrows site dissolved oxygen ranged between 10.17 mg/L at the surface and 9.82 mg/L near the bottom. Conductivity at the South site was 72.6 µmhos/cm at the surface and dropped steadily to a low of 68.9 µmhos/cm at the 20 meter depth. The conductivity reading at 22 meters was 72.9 µmhos/cm. At the Narrows conductivity was 72.3 µmhos/cm at the surface and 72.9 µmhos/cm above the bottom.
The pH of the Deer Lake waters was between 6.68 and 7.85 at the South and 7.53 and 7.77 at the Narrows. At both sites the low pH was found at the surface and the high at 6 meters and 4 meters at South and Narrows, respectively. Turbidity at the South ranged between 0.6 NTU at the surface and 2.1 NTU just above the bottom, and at the Narrows between 0 at the surface and 1.1 NTU near the bottom. Secchi disk water clarity was 5.6 meters at the South site and 5.1 meters (on the bottom) at the Narrows.

On August 22, 2005 the STL crew performed field analyses and collected water samples at the South and Narrows sites. At the South site analyses were performed at the surface, two-meter intervals from 2.0 to 20.0 meters and just off the bottom (22 meters). At the Narrows analyses were performed at the surface, 2.0 and 4.0 meter depths.

At the time of the August sampling, temperature ranged from 21.32 °C to 5.86 °C at South and 21.13 °C to 20.78 °C at the Narrows. Again, no stratification was seen at the Narrows but a pronounced thermocline was seen, this time between the 8 meter and 10 meter depths, at the South site. At this same time dissolved oxygen ranged between 10.46 mg/L at the South 10 meter depth (just below the thermocline, which is not usual) to 0.12 mg/L at the South bottom. DO was fairly consistent from the South surface to the 6 meter depth (8.25 to 8.41 mg/L) but dropped steadily below the 10 meter depth. DO was below 1 mg/L below the 16 meter depth. At the Narrows site dissolved oxygen ranged between 8.28 mg/L (at 4 meters) to 7.77 mg/L (at 2 meters). Conductivity at the South site was fairly consistent between the surface and the 18 meter depth at 72.4 to 80.1 μmhos/cm. At the bottom of the South site (20 and 22 meter depths) conductivity was somewhat elevated, to 95.2 - 96.9 μmhos/cm likely indicating the presence of higher levels of dissolved ions or suspended materials in this low-oxygen area. At the Narrows conductivity was close to 80 μmhos/cm at the three depths sampled.

The pH was between 8.09 and 6.84 at the South and 8.15 and 8.12 at the Narrows. The pH at South site dropped steadily from surface to bottom, likely in response to dropping oxygen concentrations. Turbidity at the South was not detectable (0 NTU) between the surface and the 18 meter depth, and below this rose to 1.5 NTU at the bottom. All turbidity measurements were 0 NTU at the Narrows site. Secchi disk water clarity was 6.6 meters at the South site and 5.4 meters (on the bottom) at the Narrows.

Inlets Physical Parameters (Tables B-1 and B-2)

Surface tributaries in the Northeast Meadows area of the lake were sampled in May and August although this effort was deemed to provide little useful information due to the uncertainty as to where the primary inlet could be accessed to represent the majority of inflowing waters. In May two streams were sampled (designated 'Inlet 1' and 'Inlet 2') where they crossed the Deer Lake North Shore Road leading from the lake into the Northeast Meadows area. However, in August these two streams had no flow so a sample was collected at a third channel ('Inlet 3') located approximately 200 yards past locked gate. This stream appeared to be a larger primary channel leading to the lake. Unfortunately none of these sites were close to the lake so it is not known if they are representative of the water reaching the lake. With this caveat, the following describes the physical characteristics of the sampled waters.

In May Inlet 1 had a Flow of 0.15 cfs (cubic feet per second), Temperature of 11.6 °C, a Dissolved Oxygen (DO) of 8.76 mg/l, Conductivity of 78.2 μmhos/cm, pH of 7.16 and Turbidity of 6.8 NTU. At that time Inlet 2 had a Flow of 0.01 cfs, Temperature of 14.65 °C, DO of 7.77 mg/l, Conductivity of 106.9 μmhos/cm, pH of 6.79 and Turbidity of 9.2 NTU. Thus these two streams have apparently difference sources and subsequent qualities. In August Inlet 3 had a Flow of 0.134 cfs, Temperature of 14.85 °C, a DO of 8.57 mg/l, Conductivity of 114.2 μmhos/cm, pH of 7.8 and Turbidity of 0 NTU. From this data it would appear that all three inlets drain different sub-watersheds.

Lake Chemical Parameters (Tables B-3, B-4 and B-5)

At the time of the May 2005 sampling total phosphorus (TP) at the South site ranged from a high of 0.016 mg/L to a low of 0.005 mg/L. While the highest concentration of TP was at the 22 meter depth, there were other high values at 14 meters (0.015 mg/L), 12 meters (0.014 mg/L) and at the surface (0.012 mg/L). The low value of 0.005 was found just below the thermocline, at the 8 meter depth. At this time dissolved, 'ortho' phosphorus (OP) was fairly consistent throughout the water column at 0.006 - 0.008 mg/L. Nitrogen forms measured at the South site in May included total Kjeldahl nitrogen (TKN) between 0.44 and 0.028 mg/L, with the high at 14 meters and the low at the surface. Ammonia nitrogen was generally below the analytical detection limit (0.01 mg/L) except for a high value of 0.02 mg/L at the 4 meter depth and 0.01 mg/L at the 16, 18 and 22 meter depths. Nitrate and nitrite nitrogen was below detection in all samples collected at this time.

Also measured at the South site in May 2005 was alkalinity, which was either 39 or 41 mg/L, hardness, which ranged from a high of 74 mg/L at the 20 meter depth to a low of 40 mg/L at 12 meters and sulfate, which was between 2.51 mg/L and 2.38 mg/L. Bromide was below detection in all samples, chloride was between 1.14 mg/L at 2 meters and 1.03 at 8 meters and fluoride was consistently 0.08 - 0.09 mg/L.

At the Narrows site in May TP was between 0.018 and 0.010 mg/L and OP was 0.005 to 0.007 mg/L. TKN was between 0.46 and 0.37 mg/L while ammonia, nitrate and nitrite were essentially all at or below the detection limit of 0.01 mg/L. Also at the Narrows site alkalinity was consistently 41 mg/L, hardness was between 68 mg/L (at the surface) and 36 mg/L (at the 4 and 5 meter depths), sulfate was between 2.40 and 2.36 mg/L, bromide was again below detection, chloride was between 1.31 mg/L (at the surface) and 1.09 mg/L (at 2 and 4 meters) and fluoride was 0.07 - 0.08 mg/L.

Due to the lower water depth in August there were no samples collected at 22 meters at the South site. Collectors did not want to take the chance of disturbing the bottom sediment and collecting a non-representative sample. In August at the South site TP was between a high of 0.058 mg/L (at the bottom) and 0.015 mg/L (at the 2 and 12 meter depths) while OP was between 0.041 mg/L (at the bottom) and 0.011 mg/L (at 8 meters). The high phosphorus concentrations near the lake bottom at this time are undoubtedly the result of chemical release from the sediments with the low oxygen conditions present. TKN and ammonia were also highest near the bottom at this time (0.53 mg/L ad 0.19 mg/L respectively). Otherwise TKN was between 0.14 and 0.26 mg/L at the surface to16 meter depths and ammonia was below detection. Nitrate and nitrite were, again, consistently below detection in all samples.

At the Narrows site August TP was between 0.015 and 0.011 mg/L, OP was between 0.011 and 0.009, TKN was 0.22 to 0.24 mg/L and ammonia, nitrate and nitrite were all below detection.

Inlets Chemical Parameters (Tables B-3, B-4 and B-5)

At the time of the May sampling Inlet 1 had a Total Phosphorus concentration of 0.040 mg/L and ortho phosphorus of 0.033 mg/L. Similarly, Inlet 2 had a TP of 0.051 mg/L and OP of 0.043

mg/L. This would indicate that most of the phosphorus is in the dissolved state which is the state most available for algal growth.

Nitrogen was found essentially only in the particulate or organic state (i.e. the Total Kjeldahl Nitrogen analysis). TKN values were 0.20 mg/L and 0.45 mg/L in Inlet 1 and Inlet 2, respectively. Ammonia, nitrate and nitrite were at or below the detection limit.

Other chemical analyses were Alkalinity, 45.1 mg/L and 59.4 mg/L in Inlets 1 & 2, and Hardness 50 mg/L and 54 mg/L in Inlets 1 & 2. These are both intermediate values for other lakes in this region. Sulfate, Bromide, Chloride and Fluoride were all below detection in these inlet samples.

In August, at a different inlet site, water chemistry was very similar to the May results: TP 0.045 mg/L, OP 0.041 mg/L, TKN 0.11 mg/L and Ammonia, Nitrate and Nitrite below detection. The similarities in the chemical parameters contrast with the physical parameter results which showed different watershed effects.

Lake and Inlet Bacteriological Analyses (Tables B-4 and B-5)

Testing for fecal coliform bacteria was performed on samples from the lake surface and each sampled inlet on both sampling dates. The South site sample result was less than one colony forming unit (<1 CFU) per 100 mL of water during the August sampling. A May South site sample was not collected due to a collection error with the sampling crew. The Narrows site had 32 and 34 CFU/100mls for May and August, respectively. The inlet samples ranged from <1 to 21 CFU/100mls during the two sampling periods. For comparison, the Washington Drinking Water standards include a 50 CFU/100 mL criteria for the "Extraordinary Primary Contact Recreation" category of designated uses.

COMPARISONS BETWEEN 2005 AND PREVIOUS DATA

In order to evaluate the water quality data collected in 2005, selected available past data is also presented in this report (see ATTACHMENT C). In particular, physical results from the South site in May and August of 1990 (from Soltero et al, 1991), May and august of 1992 (WDOE, 1994) and June and September 1999 (WDOE unpublished data) are reproduced in Table C-1 along with the current data. In addition, Table C-2 presents Secchi disk water transparency, epilimnion and hypolimnion total phosphorus and epilimnion and hypolimnion total nitrogen concentrations calculated form data collected in 1972, 1978, 1980, 1982,1999 and 2005.

The review of the physical data in Table C-1 does not indicate any significant differences between the years presented, in fact the parameters presented are very similar over these years. DO values are seen to drop to below 1.0 mg/L near the bottom in the August samples of all years although this effect extends farther above the bottom in 2005. Low DO and subsequent higher levels of dissolved ions near the bottom is likely the reason for the higher conductivities seen there (although accidental disturbing of bottom sediment materials can also cause this). The conductivity seen in May 2005 is noticeably lower than in previous years, as is the pH value at the surface but, again, this does not appear to be significant.

Table C-2 presents summary data that is more pertinent to the overall productivity (i.e. "trophic state") of Deer Lake over the years. In this table, except for 1972 and 1999, total phosphorus (TP) and total nitrogen (TN, the sum of data for nitrate, nitrite, ammonia and Total Kjeldahl Nitrogen) concentrations were calculated from raw data from the 2, 4 and 6 meter depths ("Epilimnion") and 14, 16 and 18 meter depths ("Hypolimnion"). In 1972 there was a single sample taken at the 3 and 69 foot depths. So, it can be seen that TP was the highest of all times presented in August of 2005, but only in the hypolimnion. TP values presented in 1999 are notably higher overall, however. While TP data from May 2005 were not higher than previous times, the August results may warrant that future monitoring efforts be performed in the near, rather than far, future. TN, on the other hand, was highest in the hypolimnion during August 1972 although the May 2005 TN values were slightly higher than previous May results. Secchi disk data appear unchanged throughout the 1972 – 2005 sampling periods although the high of 32.4 feet in June 1999 is notable.

CONCLUSIONS

The results of water quality monitoring performed in May and August 2005 provided a good view of physical, chemical and biological characteristics of Deer Lake waters. Data from inlets to the lake were not particularly insightful due to the lack of a monitoring site close to the lake that would catch the various sub-watershed tributaries. However, the Northeast Meadow appears to be decreasing the nutrient loading into the lake due to the higher nutrient levels detected in the inlets. No parameter measured in 2005 indicated the presence of a water quality problem or health related issue.

Comparison of 2005 data with various previous study results did not indicate any significant change in any parameter. However, the apparent slight elevation in total phosphorus levels in August of 2005 warrants that future monitoring efforts be conducted in the two to four year time frame.

We hope that this report provides you with a good understanding of our assessment of the 2005 water quality in Deer Lake. We are pleased to have had the opportunity to work with you on this project.

Sincerely,

Darren Lantzer
Laboratory Manager

David S. Lamb
Lake Management Specialist

Attachments: References cited
Tabulated water data
Summary of past data

ATTACHMENT A. REFERENCES CITED

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ATTACHMENT B. 2005 Water Quality Data

Table B-1. Deer Lake, Stevens County, WA, physical data from May 23, 2005.

5/23/05	Temperature	Dissolved Oxygen	Conductivity	pH	Turbidity	Flow	Secchi
units	Celcius	mg/L	umhos/cm		NTUs	CFS	feet
South - Depth (m)							
Surface	14.57	10.65	72.6	6.68	0.6		18.5
2.0	13.86	10.37	72.1	7.63	0.9		
4.0	13.76	10.09	72.2	7.75	0.8		
6.0	13.32	10.81	72.2	7.85	0.9		
8.0	9.81	11.46	70.7	7.72	1.0		
10.0	8.43	11.57	70.2	7.61	1.1		
12.0	7.66	11.02	69.9	7.51	1.1		
14.0	6.77	10.18	69.3	7.38	0.6		
16.0	6.45	9.67	69.1	7.32	0.8		
18.0	6.24	9.48	69.1	7.47	0.7		
20.0	5.96	9.02	68.9	7.33	0.7		
22.0 (bottom)	5.71	4.94	72.9	7.21	2.1		
Narrows							
Surface	14.98	10.17	72.3	7.53	0		16.8
2.0	14.92	9.66	72.6	7.68	0.9		
4.0	14.34	9.45	72.2	7.77	1.0		
5.0	14.26	9.82	72.9	7.71	1.1		
Inlet 1(24 culvert)	11.6	8.76	78.2	7.16	6.8	0.15	
Inlet 2(12 culvert)	14.65	7.77	106.9	6.79	9.2	0.011	

Table B-2. Deer Lake, Stevens County, WA physical data from August 22, 2005.

8/22/05	Temperature	Dissolved Oxygen	Conductivity	pH	Turbidity	Flow	Secchi
units	Celcius	mg/L	umhos/cm		NTUs	CFS	feet
South Depth (m)							
Surface	21.32	8.38	80.1	8.06	0		21.6
2.0	21.33	8.37	80.0	8.09	0		
4.0	21.08	8.25	79.9	8.07	0		
6.0	20.58	8.41	79.4	8.02	0		
8.0	18.83	9.03	77.8	7.87	0		
10.0	12.84	10.46	74.2	7.68	0		
12.0	9.04	9.31	72.8	7.5	0		
14.0	7.66	7.34	72.6	7.36	0		
16.0	6.92	5.35	72.4	7.23	0		
18.0	6.25	0.47	76.2	7.06	0.4		
20.0	5.88	0.19	95.2	6.81	0.7		
22.0 (bottom)	5.86	0.12	96.9	6.84	1.5		
Narrows							
Surface	21.13	8.02	80.3	8.12	0		17.6
2.0	20.9	7.77	80.2	8.12	0		
4.0	20.78	8.28	79.9	8.15	0		
5.0							
Inlet 3	14.85	8.57	114.2	7.8	0	0.134	
~200 yds past gate							

Table B-3. Deer Lake, Stevens County, WA chemical data (Part 1) from May 23, 2005.

5/23/05	Total Phosphorus	Ortho Phosphorus	Total Kjeldahl Nitrogen	Ammonia	Nitrate	Nitrite
units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
South - Depth (m)						
Surface	0.012	0.007	0.28	<0.01	<0.01	<0.01
2.0	0.009	0.007	0.33	<0.01	<0.01	<0.01
4.0	0.008	0.008	0.39	0.02	<0.01	<0.01
6.0	0.009	0.008	0.36	<0.01	<0.01	<0.01
8.0	0.005	0.006	0.41	<0.01	<0.01	<0.01
10.0	0.008	0.006	0.35	<0.01	<0.01	<0.01
12.0	0.014	0.006	0.44	<0.01	<0.01	<0.01
14.0	0.015	0.006	0.37	<0.01	<0.01	<0.01
16.0	0.012	0.006	0.36	0.01	<0.01	<0.01
18.0	0.009	0.007	0.34	0.01	<0.01	<0.01
20.0	0.009	0.006	0.32	<0.01	<0.01	<0.01
22.0	0.016	0.006	0.39	0.01	<0.01	<0.01
Narrows						
Surface	0.012	0.005	0.38	<0.01	<0.01	<0.01
2.0	0.018	0.006	0.42	<0.01	<0.01	<0.01
4.0	0.010	0.007	0.37	<0.01	<0.01	<0.01
5.0	0.014	0.006	0.46	0.01	<0.01	<0.01
Inlet 1	0.040	0.033	0.20	0.01	<0.01	<0.01
Inlet 2	0.051	0.043	0.45	0.01	<0.01	<0.01

Table B-4. Deer Lake, Stevens County, WA chemical data (Part 2) from May 23, 2005.

5/23/05	Fecal coliforms	Alkalinity	Hardness	Sulfate	Bromide	Chloride	Fluoride
units	CFU/100 ml	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
South - Depth (m)							
Surface		41	42	2.48	<0.05	1.08	0.09
2.0		41	50	2.38	<0.05	1.14	0.08
4.0		39	56	2.38	<0.05	1.09	0.08
6.0		41	70	2.46	<0.05	1.10	0.08
8.0		41	48	2.38	<0.05	1.03	0.08
10.0		39	52	2.43	<0.05	1.10	0.08
12.0		41	40	2.50	<0.05	1.10	0.08
14.0		39	70	2.41	<0.05	1.10	0.08
16.0		41	52	2.42	<0.05	1.10	0.08
18.0		41	72	2.51	<0.05	1.10	0.08
20.0		39	74	2.53	<0.05	1.11	0.08
22.0		41	40	2.47	<0.05	1.10	0.08
Narrows							
Surface	34	41	68	2.40	<0.05	1.311	0.08
2.0		41	38	2.38	<0.05	1.09	0.08
4.0		41	36	2.36	<0.05	1.09	0.08
5.0		41	36	2.38	<0.05	1.10	0.07
Inlet 1	18	45.1	50	<0.05	<0.05	<0.05	<0.05
Inlet 2	<1	59.4	54	<0.05	<0.05	<0.05	<0.05

Table B-5. Deer Lake, Stevens County, WA chemical data from August 22, 2005.

8/22/05	Total Phosphorus	Ortho Phosphorus	Total Kjeldahl Nitrogen	Ammonia	Nitrate	Nitrite	Fecal coliforms
units ->	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	CFU/100 ml
South - Depth (m)							
Surface	0.018	0.022	0.2	<0.01	<0.01	<0.01	<1
2.0	0.015	0.017	0.22	<0.01	<0.01	<0.01	
4.0	0.017	0.016	0.18	<0.01	<0.01	<0.01	
6.0	0.021	0.014	0.26	<0.01	<0.01	<0.01	
8.0	0.018	0.015	0.14	<0.01	<0.01	<0.01	
10.0	0.016	0.013	0.22	<0.01	<0.01	<0.01	
12.0	0.015	0.011	0.22	<0.01	<0.01	<0.01	
14.0	0.023	0.015	0.21	<0.01	<0.01	<0.01	
16.0	0.020	0.013	0.24	<0.01	<0.01	<0.01	
18.0	0.045	0.019	0.34	0.01	<0.01	<0.01	
20.0	0.058	0.041	0.53	0.19	<0.01	<0.01	
Narrows							
Surface	0.011	0.011	0.22	<0.01	<0.01	<0.01	32
2.0	0.015	0.011	0.24	<0.01	<0.01	<0.01	
4.0	0.011	0.009	0.23	<0.01	<0.01	<0.01	
Inlet 3	0.045	0.041	0.11	0.01	<0.01	<0.01	21

ATTACHMENT C. Water Quality Comparison Data

Table C-1. Deer Lake early and late season physical data from the South sampling site from various studies (1990 from Soltero et al. 1991, 1992 from WDOE 1994, 1999 from WDOE unpublished and 2005 from STL 2005).

Parameter ->	Temp.	DO	Cond.	pH	**Parameter ->**	Temp.	DO	Cond.	pH	**Parameter ->**	Temp.	DO	Cond.	pH	**Parameter ->**	Temp.	DO	Cond.	pH
units ->	Deg. C	mg/L	umhos/cm		units ->	Deg. C	mg/L	umhos/cm		units ->	Deg. C	mg/L	umhos/cm		units ->	Deg. C	mg/L	umhos/cm	
5/14/90					**5/12/92**					**6/14/99**					**5/23/05**				
Depth (m)					**Depth (m)**					**Depth (m)**					**Depth (m)**				
Surface	11.7	10.1	79	8.0	Surface	14.3	9.8	81	7.6	Surface	16.2	9.5	78.5	7.8	Surface	14.6	10.7	72.6	6.7
2.0	11.6	10.1	79	8.0	2.0	12.9	10.0	82	7.6	2.0	15.8	9.5	78.5	7.9	2.0	13.9	10.4	72.1	7.6
4.0	11.5	10.1	80	7.9	4.0	12.7	10.0	81	7.7	4.0	15.3	9.6	78.2	7.9	4.0	13.8	10.1	72.2	7.8
6.0	11.1	10.2	80	7.8	6.0	12.7	10.0	81	7.8	6.0	13.9	9.8	78.2	7.9	6.0	13.3	10.8	72.2	7.9
8.0	9.2	10.4	79	7.7	8.0	11.7	10.5	82	7.8	8.0	9.6	11.2	76.4	7.9	8.0	9.8	11.5	70.7	7.7
10.0	7.7	10.6	78	7.6	10.0	9.2	11.0	81	7.8	10.0	7.9	10.5	76.3	7.7	10.0	8.4	11.6	70.2	7.6
12.0	6.5	10.7	78	7.6	12.0	7.8	10.7	81	7.7	12.0	7.0	10.4	75.8	7.7	12.0	7.7	11.0	69.9	7.5
14.0	5.8	10.2	77	7.6	14.0	7.2	10.6	80	7.7	14.0	6.3	10.1	75.8	7.6	14.0	6.8	10.2	69.3	7.4
16.0	5.4	9.5	77	7.6	16.0	6.7	10.0	80	7.7	16.0	5.6	9.5	75.5	7.5	16.0	6.5	9.7	69.1	7.3
18.0	5.0	9.3	78	7.7	18.0	6.4	9.5	80	7.6	18.0	5.2	8.8	75.3	7.4	18.0	6.2	9.5	69.1	7.5
20.0	4.9	8.8	78	7.7	20.0	6.1	9.0	79	7.5	20.0	4.9	8.2	75.4	7.4	20.0	6.0	9.0	68.9	7.3
22.0	4.8	8.1	78	7.8	22.0					22.0	4.6	6.7	76.2	7.3	22.0 (bottom)	5.7	4.9	72.9	7.2
8/27/90					**8/25/92**					**9/13/99**					**8/22/05**				
Depth (m)					**Depth (m)**					**Depth (m)**					**Depth (m)**				
Surface	19.7	8.4	80	7.9	Surface	20.1	8.6	84	8.0	Surface	16.9	8.9	76.4	8.0	Surface	21.3	8.4	80.1	8.1
2.0	19.2	8.5	80	7.9	2.0	19.7	8.5	84	8.0	2.0	16.9	8.8	76.5	8.1	2.0	21.3	8.4	80.0	8.1
4.0	19.1	8.5	80	7.8	4.0	19.5	8.5	84	8.0	4.0	16.9	8.8	76.5	8.1	4.0	21.1	8.3	79.9	8.1
6.0	18.8	8.8	79	7.7	6.0	19.5	8.6	84	8.1	6.0	16.9	8.8	76.4	8.1	6.0	20.6	8.4	79.4	8.0
8.0	14.7	10.7	76	7.5	8.0	18.5	9.5	83	8.1	8.0	16.7	8.8	76.3	8.0	8.0	18.8	9.0	77.8	7.9
10.0	10.7	9.6	77	7.4	10.0	14.1	11.7	81	8.3	10.0	12.6	9.3	74.0	7.6	10.0	12.8	10.5	74.2	7.7
12.0	8.2	8.7	77	7.4	12.0	15.5	9.8	80	8.1	12.0	8.3	8.3	72.6	7.4	12.0	9.0	9.3	72.8	7.5
14.0	6.9	8.0	6	7.4	14.0	8.7	7.6	80	7.9	14.0	7.0	7.3	72.9	7.2	14.0	7.7	7.3	72.6	7.4
16.0	6.0	5.9	76	7.4	16.0	8.0	7.5	79	7.9	16.0	6.1	6.2	72.8	7.1	16.0	6.9	5.4	72.4	7.2
18.0	5.6	4.0	78	7.4	18.0	7.3	5.5	79	7.9	18.0	5.5	4.7	72.8	7.0	18.0	6.3	0.5	76.2	7.1
20.0	5.3	0.8	78	7.4	20.0	6.7	2.6	80	7.8	20.0	5.2	2.5	74.6	6.9	20.0	5.9	0.2	95.2	6.8
22.0	5.1	0.2	97	7.3	22.0	6.2	0.0	105	7.7	22.0	4.8	0.3	98.7	6.8	22.0 (bottom)	5.9	0.1	96.9	6.8

Table C-2. Selected Deer Lake Water Quality Data from 1972 to 2005 including Secchi disk transparency and epilimnetic total phosphorus and total nitrogen, and hypolimnetic total phosphorus and total nitrogen.

Date -->	**Aug-72**	**Aug-78**	**May-90**	**Aug-90**	**May-92**	**Aug-92**	**Jun-99**	**Aug-99**	**May-05**	**Aug-05**
Source -->	Dion et al.	Singleton et al.	Soltero et al.	Soltero et al.	WDOE	WDOE	WDOE	WDOE	STL	STL
	1976	1980	1991	1991	1994	1994	unpublished	unpublished	2005	2005
Parameter										
Secchi (ft)	22.0	23.6	19.4	18.3	19.6	26.0	32.4	22.3	18.5	21.6
Epi* TP (mg/L)	0.010	0.015	0.011	0.013	0.007	0.008	0.024	0.023	0.009	0.018
Hypo** TP (mg/L)	0.012	0.015	0.007	0.01	0.01	0.015	0.027	0.022	0.012	0.029
Epi* TN (mg/L)	0.41	0.28	0.22	0.51	0.29	0.33	0.25	0.29	0.36	0.22
Hypo** TN (mg/L)	0.89	0.36	0.27	0.42	0.30	0.33	0.24	0.26	0.36	0.27

* Epi (epilimnion) average values calculated using results from 2, 4 and 6 meter depths.
**Hypo (hypolimnion) average values calculated using results form 14, 16 and 18 meter depths.
Totoal Nitrogen (TN) is sum of nitrogen measured as nitrate, nitrite, ammonia and total Kjeldahl Nitrogen.