



DEVILS LAKE PLAN

by

Devils Lake Water Improvement District

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EXECUTIVE SUMMARY

Devils Lake is a shallow, 680 acre coastal lake that has long suffered from the effects of inputs of excess nutrients. Most prominent of these effects was the domination of the lake by nuisance aquatic plants in the 1980's. Aquatic weed infestations largely choked the lake covering over 60% of the surface. Recreation was greatly impacted, and property values were in decline. In 1984, a local government entity, Devils Lake Water Improvement District (DLWID), was formed with the purpose of improving water quality, improving the environment for fish and wildlife, and generally reestablishing beneficial uses, including safe navigation and public access.

Current concerns in the watershed are ongoing inputs of nitrogen and phosphorus, increasing sedimentation, erosion, stormwater, annual cyanobacteria blooms, and the threat of the return of nuisance aquatic plants to the lake. The Devils Lake Plan has been developed to help guide lake management, to address these concerns, and to achieve the District's short term and long term goals. The document itself is intended to be adaptable and updatable, demonstrating improvements made in the watershed year to year.

Issues with excess nutrients became most pronounced in the 1980's when nuisance aquatic plants effectively took over the lake. An EPA funded Clear Lakes Program led to the introduction of Chinese Grass Carp (*Ctenopharyngodon idella*) to suppress non-native plants which had all but destroyed the beneficial recreational use of the lake for most users. Success of the program was measurable. Over time recreation returned to Devils Lake and today the lake is enjoyed by thousands of residents and visitors each year. Similarly, property values have increased significantly as investment returned to the watershed.

Unintended consequences though have been observed. In 1994 following a small, but potentially pivotal third stocking of Grass Carp full eradication of all aquatic plants with few exceptions occurred. The intention of the program was not full weed eradication, but the biological control of these invasive species to what was an assumed optimal coverage of twenty percent. With the loss of the aquatic vegetation, periodic Harmful Algal Blooms are arguably more prolific in frequency and intensity, particularly in warmer years. Even with a declining and ageing carp population, these blooms continue today.

The loss of lake vegetation has had impacts to fish populations as well. Beneficially, steep declines in non-native, warm-water fish have been documented in recent years. These introduced fish are thought to compete with and predate upon native fish in the system. Thus their population reductions lessen these impacts to native fish, specifically Coho Salmon. The absence of macrophytes is thought to be the driving force in the decline of these non-native, warm-water fish. Their populations have declined sharply since 1994 corresponding to when most of the vegetative cover was eliminated. Native fish are also dependent on vegetation for habitat, and consequently the resulting impacts may be more of a net-zero effect in terms of populations. Lastly, a “Put and Take” rainbow trout fishery is robust, producing fast growing fish for recreationalists in the biologically productive waters. These fish are largely caught the year they are planted, and thus have less dependence on aquatic vegetation for survival.

With the impacts of nutrients and fish introductions being well documented, the forward direction for Devils Lake is nutrient abatement and nutrient sequestration. As nutrients entrained in the lake are difficult to remove, much of the water quality improvement work needs to focus on the landscape and land-use. Changes to the way people live around the lake have had profound effects on the lake, and thus reversing that dynamic will alleviate much of that stress to the aquatic system. As a result this plan calls for a number of best management tools including septic tank inspections, sewers, establishment of native aquatic vegetation, stormwater improvements, and wetland and riparian zone replanting. Additionally, local policy changes leading to land-use ordinances that will protect the lake from unregulated development are sought. However with any potential ordinance the District might consider for adoption, a formal public hearing process would occur providing the opportunity for broad stakeholder input.

Realistically, even with the external nutrient controls, Devils Lake will continue to be biologically productive for many years. Similarly, without Grass Carp or other control, undesirable non-native aquatic weeds will inevitably return. Addressing this is an important consideration of this integrated lake management plan. Prevention of such an invasion is primary. Boat wash stations and educational outreach are fundamental. Secondly, native plants are needed to keep the opportunistic, non-natives out. However, even with good prevention and established native plant populations, invasive species will continue to threaten Devils Lake. Given that imminent reality the need for invasive species control cannot be overlooked. In fact, maintaining the beneficial uses of navigation, public access and recreation is expected by the overwhelming majority of the District’s constituency. While small scale

invasions may likely be controllable through physical treatments, such as bottom barriers or hand pulling, a larger scale invasion would not. Physical controls at that scale are labor intensive and cost prohibitive. Chemical controls are neither inexpensive, nor publicly acceptable. Thus, in order to maintain the beneficial uses and economic gains achieved in the 1990's, this plan calls for securing the ability to re-introduce sterile Grass Carp as a safe guard against widespread aquatic weed infestation. Grass Carp are an existing, relatively low cost, means of control with a proven record in the watershed. As many legal hurdles and lengthy permitting requirements may be necessary the District has prioritized Grass Carp re-authorization as fundamental for lake management.

Lastly, public communication is vital to stewardship. The Devils Lake Plan emphasizes the ongoing needs of education and outreach. The District actively engages the public through various media, however more is always needed. As a result The Center for Applied Freshwater Ecology, better known as The CAFÉ, is proposed. The CAFÉ will be a research based science center and interpretive center which will serve the community and the lake for generations. The center will not only house the District, but it will be a living museum and resource for the public. The Center for Applied Freshwater Ecology will become the cornerstone of the District, continually demonstrating to the public the needs for ongoing protection and restoration of Devils Lake.

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MISSION AND CURRENT PRIORITIES

The Devils Lake Plan has been designed to serve the Devils Lake Water Improvement District in its restoration efforts over the short and long term. Projects have been identified that meet the District's mission and its current priorities. The District's mission, established in its foundation, seeks to achieve the following:

Mission

- Improve and maintain water quality
- Improve the environment for fish, wildlife and humans
- Increase public access to Devils Lake
- Reestablish safe and efficient navigation

The Devils Lake Plan has been under development for some years. In order to prioritize the District's goals, a public goal setting workshop was held in January 2010. This was followed up with months of categorizing and deliberation which have resulted in the current list of priorities solidified in May of 2010. The current priority section of the plan explains the District's top priorities. Greater detail about these and the other prospective projects are provided in the subsequent chapters.

Current Priorities

1. Develop and implement a strategy for aquatic vegetation management and control.

In order to address Goal #1, the District has been for one developing this plan. In it are complementary strategies for vegetation management and invasive species prevention. These strategies are matched with nutrient reduction targets, such as the ongoing septic tank revitalization program and the Save our Shoreline (SOS) Campaign. Primary in the overall strategy though is the goal of securing the right to replant Grass Carp. As other large-scale vegetation removal means are either cost prohibitive and/or as in the case with herbicides lack public support, securing the right to replant Grass Carp is a vital safe-guard for the lake.

- 2. Finish the septic tank revitalization program creating an ordinance which will provide the data necessary to complete the septic systems database. Use that database to estimate septic tank loading as part of the total watershed nutrient load.**

As the primary mechanism to assure that a septic tank revitalization program is continued, the District has funded a short-term position with specific focus on that issue. The District continues to partner with the City of Lincoln City in this endeavor and has completed the septic database to the greatest extent possible at this time. With the passing of an ordinance and the eventual inspection of all the systems, better estimation can be made as to nutrient loading on the watershed. Additionally, Oregon Department of Environmental Quality may seek to include Devils Lake in the next round of TMDLs (Total Daily Maximum Loads) which through detailed investigation sets limits on pollutants and nutrients such as phosphorus and nitrogen, one source being septic systems.

- 3. Increase District's time spent on the lake to promote communication to property owners, while conducting a lakeshore photographic survey. Also re-evaluate the cyanobacteria postings from the District.**

The District has recently revised, overhauled and expanded its communication mechanisms. Included in that is a new email listserv, social media connectivity, and direct mailers. The District has also been conducting direct outreach to lakefront property owners and lake enthusiasts through one-on-one communication. As a result the District has increased its outreach to hundreds of individuals, which in turn continues to increase its website traffic. As to progress on a shoreline photographic survey, the District has recently contracted for such a survey in conjunction with an erosion study for the shoreline. Additionally, The District has completed the reformatting of the cyanobacteria postings providing greater clarity to the public of any such water contact advisories.

- 4. Determine the source of *E. coli* on Thompson Creek.**

The District has recently invested heavily in the resources to conduct fecal source tracking and has begun sampling. Prior to sampling, a monitoring plan has been developed, a partnership with Oregon State University has been forged for analysis, and property owner alliances have

been made. Recently the analysis from the first round of sampling has been completed, and the District is investigating additional uses of this now verified analytical technique.

5. Determine the methods we can use and those to collaborate with to sewer the rest of the watershed.

Members of the Devils Lake Water Improvement District Board of Directors have taken the lead on sewerage, through the formation of a Local Improvement District, providing a model that may serve other neighborhoods. Extensive research, collaboration and outreach have been conducted for a project which could serve a sizable percentage of the homes currently on septic systems. While economics will certainly be the driving force in any actual projects, the framework for moving forward has already been set.

Other Projects

Beyond the current goals listed and the steps identified, The Devils Lake Water Improvement District is and has been working on a number of other projects not highlighted by this plan. Recently the District completed a Shoreline Planting Guide. This guide, which is already in its second printing, provides homeowners, landscapers, and nurseries detailed information about the native plant communities and their environmental requirements. The guide is of significant help in the expansion of the Save our Shorelines program and the Native Vegetation work the District has initiated.

Currently the District is also developing a database of all existing sample data collected over the last 40 years. This project is being completed with the help of Oregon Department of Environmental Quality and outside contractors and will provide the District and the State of Oregon a solid, interpretable dataset of water quality. It is anticipated that this dataset will become the foundation for targeting nutrient reduction strategies. This would be part of the federally required TMDL (Total Maximum Daily Load) process. This Mass-Balance approach first studies, then determines how to reduce pollutants in the nations' waterways. A TMDL for Devils Lake is forthcoming in which the District will heedfully play a vital role working with other stakeholders. Many of the current and prospective projects detailed by this plan will complement that process.

Most recently, the District has been developing a study of shoreline erosion. This project will provide the District better insight into how lake level management may impact shorelines. The District currently maintains a recreational water right in the summer months and conducts emergency dredging of the D River in the winter months. Research into the role these and other factors may play in shoreline erosion is being considered.

Restoration is a long-term process. Incrementally that process continues. Cumulatively through these projects, past projects, and the many additional ones detailed within this newly revised Devils Lake Plan, the Devils Lake Water Improvement District and its partners have and will continue to make strides in improving Devils Lake.

INTENT AND REASON FOR LAKE MANAGEMENT

Through the history of the Devils Lake Water Improvement District many projects have been conducted to achieve its mission, the largest project being the introduction of the Chinese Grass Carp. Smaller projects such as shoreline bioengineering, dam removal for Coho passage, domestic waterfowl relocation for improved water quality, and terrestrial invasive species eradication have also been part of the District's history. However this current endeavor, to create and implement the Devils Lake Plan, is its most ambitious goal since the 1980's. Through a preliminary planning process, seven primary objectives for lake management have been identified by the Devils Lake Water Improvement District for Devils Lake. They are the following:

Objectives:

1. Reduce Nutrient Loading
2. Reduce Internal Nutrient Cycling
3. Reduce Cyanobacteria Dominance
4. Increase Native Vegetation
5. Prevent Spread of Invasive Species
6. Reduce Toxicants
7. Sustain a Monitoring Plan as a Means of Evaluating Success

Achievement of each of these objectives will come with the collective support of community, non-governmental organizations, and governments other than the District, large and small. The planning process and the creation of the Devils Lake Plan come with strong reliance on outside resources. These stakeholders include not only scientists, property owners, and permitting agencies, but they are indeed the very fabric necessary for the success of the plan to which they are a part.

Stakeholders:

- Residents and property owners in the watershed: residential, agricultural, timber and public lands
- Recreational users of Devils Lake: boaters, fishers, pilots, kayakers, bird watchers, and others
- Tourism industry, including hotel and vacation rental dwelling operators, restaurants and shops, and the marina

- Preservation Association of Devils Lake (PADL)
- City of Lincoln City
- Salmon Drift Creek Watershed Council (SDCWC)
- Lincoln City Chamber of Commerce
- Lincoln City Visitors & Convention Bureau (VCB)
- Confederated Tribes of Siletz Indians of Oregon (CTSI)
- Lincoln County
- Lincoln Soil and Water Conservation District (Lincoln SWCD)
- Mid Coast Watersheds Council
- Master Gardeners, OSU Extension Office
- North Lincoln Fire and Rescue (NLFR)
- Oregon Department of Agriculture (ODA)
- Oregon Department of Environmental Quality (DEQ)
- Oregon Department of Fish & Wildlife (ODFW)
- Oregon Department of Forestry (ODF)
- Oregon Department of State Lands (DSL)
- Oregon Department of Water Resources (WRD)
- Oregon State Marine Board (OSMB)
- Oregon Watershed Enhancement Board (OWEB)
- National Oceanic and Atmospheric Administration (NOAA)
- National Marine Fisheries Service (NMFS)
- Natural Resources Conservation Service (NRCS)
- US Army Corp of Engineers (USACE)
- US Coast Guard Auxiliary
- US Environmental Protection Agency (US EPA)
- US Fish and Wildlife Service (USFWS)

Within many of these entities specific individuals have been identified to represent the interests of the body. With that comes a vast range of expertise and experience. It is anticipated that all such entities will continue to aid in the development and implementation of this plan.

HISTORY OF DEVILS LAKE

Devils Lake was formed nearly 14,000 years ago from upheaval of marine sediments from the sea floor. This geologic action created a lake system not unlike many reservoirs today, where tributaries in the basin were blocked off and backed up creating the fingers or arms seen in Devils Lake's irregular morphology. Eventually the uplifted sediment gave way to erosion and the inland water broke through the sandstone blockage creating an outlet for the lake. This "Outlet" was to later be called the D River, which at a mere 120 feet (36.6 meters) claims to be the "World's Shortest".

Known to be rich in fish and mollusks, Devils Lake has been used by early inhabitants for centuries, and has been the site of many traditional ceremonies. Native Americans celebrated the lake's bounty in annual "Moon of Abundance" ceremonies. At one such festival, a tragedy occurred which would later spawn the lake's current name. According to legend, young men would paddle the lake to impress upon young women seeking their affection. While doing so it is said that terrible loss of life occurred. From an excerpt of a statement given by Chief William Depoe, "the lake churned and bubbled...like a giant snake, it can raise up and pull beneath its surface whatever might be traveling across." Continuing, Chief Depoe said, "The Indian people would offer valuables to the lake before crossing it. In that way they showed respect to the power that it possesses." European settlers coming later to the lake which they had initially dubbed "Indian Bay" for its strong American Indian presence eventually renamed the waterbody "Devils Lake" in reference to the dark history the oral traditions relayed.

With Oregon's harsh winter climate and high erosive forces at play, little if any evidence remains of the activities of the earliest settlers. This is also likely due to the limited footprint these people had on the environment. Not true of the European settlers that followed.

In the eighteenth century a second wave of settlers came to the Oregon Coast, the first of which were honeymooners on horseback. From the Willamette Valley it was a four day trip, yet tourism was then and remains today the reason most people come to what is now known as Lincoln City.

Officially opened up to European settlers from the east in 1895, and with the formation of Lincoln County two years prior, the area around Devils Lake soon became populated with cottages and homesteads. With names like Oceanlake, DeLake, and Neotsu, these communities grew quickly as did their impact on Devils Lake. Accustomed to fishing for bass and bluegill rather than the silvery native

Coho Salmon and Cutthroat Trout, these settlers prompted the Oregon Game Commission to plant a variety of warmwater fish into Devils Lake. In 1932, 25,000 bass, crappie, bluegill and catfish were planted in the lake. Done with no malicious intent according to statements by Frank B. Wise head of the Oregon State Fish & Game Commission recorded in the local press these introductions decimated the trout fishery at least by February of 1939 (Anders, 1990).

Further with the broadening impact of automotive travel, Devils Lake and the region saw an auto park at the “Outlet” and East Devils Lake Road was deemed a public highway by 1936. In part cutting right across the wetlands at the lower end of Rock Creek (Devils Lake’s largest tributary) this highway fueled more settlement. By the 1940’s much of the footprint seen today had been stamped out.

Effects from this intensive settlement were almost immediate. Concentrated sewer disposal from the town of Oceanlake into Devils Lake spawned criticism of the D River being heavily polluted. Fecal matter was not the only problem as nutrients from domestic waste fed aquatic plants which proliferated in the lake. Boaters used to reaching World Record speeds (13 were set in 1961 alone) were soon dragged to a halt by the weeds. In 1963 investigations began to remedy the weed infestation, and later with the formation of the Devils Lake Association in 1968, the presence of fecal coliforms were readily being documented around the lake.

Additional impacts from fish introductions were also seen. In 1959, Clothier and Breuser described the nuisance fish eradication program that was attempted by the Oregon Game Commission. Rotenone was used in attempt to remove all the common carp from the lake. On June 16, 1959 a second attempt using a powerful toxicant (Fish-Tox) was used as it was noted that the previous Rotenone treatment flavored the milk from dairy cattle in the basin. Fish stockings were also conducted in which Silver Salmon, Steelhead, Rainbow Trout, Channel Catfish and Cutthroat Trout were planted by the thousands between 1956 – 1960 (Wagner, editor 1994).

In 1970 with the passing of federal legislation, namely the Clean Water Act, residents of the recently incorporated City of Lincoln City discontinued their effluent discharge into Devils Lake in favor of a common treatment plant which discharges into Schooner Creek a few watersheds away. Certainly a key nutrient management step forward, discontinuance of the Oceanlake sewer plant did not however fully alleviate the ecological stresses on Devils Lake. Increasing settlement in and out of the incorporated areas has added pressure to the lake system. Many of the home sites on the northern, eastern and even the western shores developed without a sanitary sewer. Most of those that did

develop remain today on septic systems of varying integrity, and constructed to varying levels of building codes

While many of the impacts to Devils Lake did and continue to come from those directly living in the watershed, more amorphous forms of impacts are known from forestry practices. Large-scale clear cutting in the private timber holdings and the national forest in the basin have left their mark on water quality, fish resources and sedimentation. Oakley, describing interviews held with residents in the Thompson Creek watershed (Devils Lake's second largest tributary), reported that there was anecdotal evidence of Coho salmon carcasses' densities sufficient to serve as fertilizer for the Benedict homestead (1962). Eilers *et al.*, have shown through radiometric work that there has been increased sedimentation correlating to the clear-cutting done in the watershed (2005). Agriculture too has had its impact. In particular, a dairy farm in the Rock Creek drainage formerly contributed large quantities of fecal matter and resulting nutrients to the system. Further research noted that the dairy, along with septic systems and the abandoned wastewater treatment plant were the cause of the algae and weed problems Devils Lake was suffering (McHugh, 1972).

With the ongoing documentation and characterization of Devils Lake (Kavanagh, 1973; Meyerhoff, 1977; McHugh 1979) solutions to the weed and algae problems identified were sought. In 1980 an Environmental Protection Agency funded Clean Lakes study began. Local support in seeking solutions to the problems faced by Devils Lake was evident by March 11, 1980. A resolution passed unanimously by Lincoln City's City Council in support of the application to attract the federal funding. The Preservation Association of Devils Lake (PADL) was formed shortly thereafter in 1982, a formative action group instrumental in pressing forward lake clean up objectives.

Analytical work commenced swiftly. By 1981, Bierly and Associates had completed the Devils Lake Watershed Analysis and in 1983 the Devils Lake Diagnostic and Feasibility Study by Kramer, Chin & Mayo (KCM Consulting) was printed and being distributed. Outlined in the 245 page document were eight cures for "lake ills". Stemming from results of a qualitative and quantitative approach, a matrix was eventually devised to assess restoration alternatives. The recommendations of vegetation harvesting, land use controls, herbicides, and limited dredging topped the list.

Not an official recommended alternative at the time, but later surfacing as a potential viable solution to the macrophyte problem was the introduction of the herbivorous Chinese Grass Carp (*Ctenopharyngodon idella*). Support from agencies including the EPA whelmed around the bio-control

alternative, and in 1985 the Oregon Department of Fish & Wildlife Commission approved the use of sterile Chinese Grass Carp. Ten thousand fish were introduced in 1986, and another 17,050 in 1987.

The objective from the outset was the reduction, not elimination of macrophytes, and yet the progress was notably slow. Lakes initially tend to react slowly to intervention. This is true for biological manipulation, such as Grass Carp, as well as with nutrient reduction strategies. For decades the lake had been dominated by invasive aquatic weeds, and thus this established, “Stable State” was slow to give way to another “Stable State” for some time. Recreation though was increasing and a renewed sense of community pride was evident in the annual Grass Carp Festivals organized by PADL and DLWID.

By 1993, the beneficial use goals of the Grass Carp introductions were still yet to be realized. As a result a third introduction of 5,000 more Grass Carp was made. By 1994 however a tipping point was passed as the Grass Carp overwhelmed the system. This promulgated the full eradication of macrophytes from the bed of Devils Lake, an undesired outcome.

With the loss of macrophytes ecological niches were exploited by cyanobacteria and an “Alternate Stable State” of cyanobacteria dominance was initiated. With the grazing pressures from the Grass Carp in full effect, the previously slow process away from macrophyte dominance moved rapidly towards cyanobacteria dominance resulting in what was deemed the worst blue-green algae bloom to date. This delayed, but then swift progression to another “Stable State” is known as the hysteresis effect. This lag period is also exhibited in lakes following nutrient reduction strategies as the benefits of improvements may not be realized for substantial periods of time.

While previously present in the lake, cyanobacteria have become a dominant part of the current lake ecology. Eilers *et al.*, in 1996 and again in 2005 detailed the population trends of certain cyanobacteria over recent centuries using radiometric dating of sediment cores. What was shown in the 2005 report was an exponential growth of free floating cyanobacteria beginning in 1994. Lost were many of the epiphytic algal forms in favor of planktonic cyanobacteria and diatoms. To reverse this trend Eilers *et al.*, recommendation in 2005 was to allow vegetation to return to Devils Lake.

What is known today is that primary production in Devils Lake is dominated by algae and cyanobacteria. Routine sampling done by the Devils Lake Water Improvement District and analyzed by Water Environmental Services, Inc., has demonstrated the presence of potential toxigenic

cyanobacteria at certain times of the year, primarily late summer (Gibbons, 2003-2009). The presence of such toxigenic species in high densities has caused the posting of area beaches and public spaces in recent years. In 2010, however a significant bloom was not observed during the sampling season, and no advisories were made.

The Lincoln City area is dependent on tourism for its financial viability, and Devils Lake is one of the natural resources that provides a local and regional economic driver. Recreational use and access to the lake is thus of great importance. The private marina in the NW arm of Devils Lake is directly affected by access to the lake. The marina, like other area businesses and real property owners, benefits economically from a healthy ecosystem. As part of the Diagnostic and Feasibility Study of 1983, an economic resource evaluation tied to Devils Lake was conducted. At the time lake front property was less desirable. This was due to the mats of aquatic vegetation that would wash ashore and rot creating foul odor and an undesirable lakeshore experience. Effectively there was an economic exodus of property investment from lake front and lake view parcels. Through the economic study, it was established that not only was Devils Lake an economic engine for north Lincoln County, that in fact Devils Lake could if restored again become a vital part of the community and regional resource in the state. Evidence of this claim has been shown with the rapid increase of property values around the lake following the reduction of nuisance aquatic vegetation. Property values and investment have soared around the lake, generally outpacing in valuation all but the oceanfront properties in the area. While economics of the day dictate property values, toxigenic cyanobacteria and the potential return of nuisance aquatic vegetation can greatly threaten financial prosperity as well.

Through its relatively short recorded history, significant change has come to Devils Lake. In less than 150 years, large swaths of the watershed have been clear cut, development has encroached on much of the shoreline, and invasive aquatic weeds have invaded and subsequently been eradicated by introduced fish. Similarly, cyanobacteria populations have increased substantially, and fish and wildlife resources are in flux. Devils Lake though continues to be a valuable natural resources, one that is seeking a new ecological balance.

STATE OF DEVILS LAKE

Devils Lake is a shallow 680 acre coastal lake in Oregon. Located in Lincoln County, Devils Lake is bordered to the east by the foothills of the Coast Range and to the west and south by Lincoln City. The Devils Lake watershed covers 12.1 square miles (18 km²). With its outlet to the Pacific Ocean, the D River, the basin is a concise model of the hydrological cycle. A watershed map has been provided in the appendix.

The basin is made up of a mix of private and public timber land, limited agriculture, and single family dwelling units (See Land Use in Appendix). The City of Lincoln City, coupled with the densely populated community of Neotsu on the northern shores, and the unincorporated eastside of the lake, create an urbanized landscape around Devils Lake. Overall, heavy settlement pressures since the 1900's have stressed the lake's ecology. With these development pressures has come the eutrophication of Devils Lake. The following seeks to delineate some of these pressures on the lake as well as outline some of the other attributes in the watershed that currently define the lake.

Water Quality: Devils Lake is a 303_(d) listed waterbody identified for impairment by excess chlorophyll and high pH. Water quality is deemed limited by the proliferation of algae and cyanobacteria. Thompson Creek, a major tributary of the lake, is also listed on the 303_(d). Fecal coliforms levels which fail state and federal standards are consistently found on this system.

Recreational water quality then for Devils Lake is measured by two major parameters: abundance of *E. coli* and concentration of microcystin, a toxin created by cyanobacteria. These parameters are measured in the peak recreational use period of the lake, Memorial Day to Labor Day. During that time the lake has seen periodic cyanoblooms which have lead to microcystin concentrations failing state guidelines. The District also monitors for the presence of *E. coli*, an indicator of fecal contamination. All the lake's public beach access points consistently pass these state standards. Issues are however seen in tributaries and at the terminal end of the lake where the D River flows into the Pacific Ocean.

Increased sedimentation is also prevalent in Devils Lake. The sedimentation accumulation rate currently exceeds 1 kg/m²/yr) a rate that has been increasing steadily over the last century (Eilers, *et. al*, 2005. Historic inputs from poor forestry practices and more recently urban development have hastened the

infilling of the lake over its natural pace. Plant biomass is also linked to the voluminous amounts of unconsolidated, organic matter that dominates the lake's upper substrate.

Aquatic Vegetation and Grass Carp: Vegetation growth in Devils Lake largely continues to be suppressed by the few remaining Chinese Grass Carp. For most of the last 16 years, the lake bottom has largely been devoid of macrophytes. This trend though is beginning to show signs of changing, as aquatic plants are taking root in previously denuded areas. With an ageing population of Grass Carp, macrophyte suppression is showing signs of being reversed. While herbivore grazing is apparent, small aquatic plants are beginning to be seen in some of the shallow waters of the lake. With the last planting of the sterile Grass Carp being 1993, a certain decline in their population is assured. Without further suppression the return of macrophytes by introduction or re-colonization is probable.

The typical life expectancy of a Grass Carp is 10-12 years; however, evidence shows the Chinese Grass Carp can live to be as old as 25 years. This has been shown to be the case with the sterile (triploid) fish as well. A citizen science experiment conducted in September 2006 at roughly about 40 docks lake wide demonstrated the presence of between 195 - 300 fish. Given the tameness of the fish and their proven attraction to feed, the five instantaneous counts provided a record as to a declining population since the last stocking. Anecdotal evidence has shown that hundreds of fish in years past would school at any one particular dock when prompted by feed. This is further rationale for suggesting that a significant reduction has occurred from the 33,050 fish stocked over the years. It is estimated that somewhere between 300-1,000 fish remain.

Wetlands and Riparian Zones: The Devils Lake Watershed has a declining number of highly functioning wetlands and has lost significant amounts of its riparian zone in the 20th Century. In 1996, a wetland inventory was conducted which identified and prioritized wetland and riparian zones (See Wetland & Riparian Zone Map in the Appendix). While wetlands make up a small fraction of the overall watershed, they play a significant role in nutrient abatement, sediment storage and are valuable habitat for fish and wildlife. Wetland loss has come from two primary development pressures, home site establishment and agricultural use. While the former may only be the cause of small marginal wetlands being lost, the cumulative effect may be significant. Many wetlands have recently been

encroached on by fill projects near the lake's edge. Although work in wetlands immediately adjacent to the lake is restricted, other in the watershed are not as protected. Removal or fill in wetlands that are adjacent to the lake, those deemed Essential Salmon Habitat (ESH), are fully restricted without a permit. In non-adjacent wetlands however not deemed Essential Salmon Habitat a 50 cubic yard allowance per year is permitted. As a result ongoing destruction of wetlands in and around Devils Lake still occurs.

Riparian habitat also continues to be lost to development pressures. As part of a statewide planning process in the 1990's, significant riparian zones and significant wetlands were identified in the watershed (See Addendix). Special protection for these areas has been assigned and a natural resource planning overlay was created with maps detailing those designations. However, the actualization of those protections may not be being realized in the watershed.

For the Devils Lake Basin agricultural land conversion has been the largest means of wetland loss. The bottomlands of the major tributaries of Devils Lake have been largely utilized for agricultural means. Rock Creek, once the home of a large dairy operation, is now a horse boarding facility. Additionally, a small herd of cattle remain on the landscape further upstream of the horses on a separate parcel. This historic land use has reduced the sinuosity of Rock Creek and through a series of dikes and ditches has restricted the periodic flooding of the alluvial plain that makes up the bottomland. The Rock Creek wetland and its functionality are further hampered by the road built in the 1930's that bisects the wetland. East Devils Lake Road is a major impediment to the natural laminar flows of water within the wetland. Efforts and partnerships with Oregon Department of Fish and Wildlife and US Fish and Wildlife's Coastal Program may one day resolve the flooding and resulting salmon impacts.

With the building of the road, Rock Creek was necessarily channelized to and under a bridge. Years later due to sedimentation on the lakeward side of the road this downstream channel has largely become blocked. To combat the deposition dredging has been done over the years. Aerial photography from the 1970's shows a dredged channel downstream of the road through the lower wetlands to the lake. This dredged channel may have been more important during the peak agricultural use of the upstream properties as drainage of those upstream wetlands would have afforded additional grazing opportunities for cattle. Property ownership on the lakeward side of the road is now in the hands of the Oregon Parks and Recreation Department and dredging the canal is no longer a practice in the wetland. Wetland functionality thus has increased in the terminal end of Rock Creek as it enters the lake.

Forestry: Forestry and logging practices continue to have a presence in the watershed. However, since there are established designated management agencies associated with forestry, actionable items are not addressed by this plan. Early logging practices did have extremely detrimental effects to fish and wildlife and were linked to heavy sedimentation of the lake. Log booms sent careening down valleys would have destroyed much of the natural banks, causing undue erosion. Cut banks in the stream, coupled with the resulting loss of rainfall interception and evapotranspiration from the clearcuts, would have provided significant downstream sediment transport. Eilers *et al.*, documented the sedimentation rates through sediment core sampling in 1995 and 2005 with evidence of high periods of deposition occurring in the early 20th century corresponding to historical periods of intense logging.

Forestry practices today are largely improved. Buffer zones are left between the stream and the cut forest. Fish passage issues are considered when roads are built or are maintained. The Forest Practices Act passed in 1990 also requires replanting within a short timeframe, to protect soils from additional erosion. That being said logging can still have significant impacts, and commercial logging continues in the watershed. The Oregon Department of Forestry oversees these activities on state and private lands, and is thus the designated management agency in much of the active forestry in the watershed. Forests on federal lands are also highly managed in this case by the US Forest Service. Federal lands are currently managed for late succession and thus are not being actively harvested. In the 1970's however these forests too were clear-cut, and policy changes may occur in which additional logging may again eventually be seen in the watershed.

Agriculture: Although it is largely diminished in relative size, agriculture continues to have a footprint in the watershed. Formerly a large dairy operation existed in the watershed, but that has long been displaced by an equestrian boarding facility. Other small herds of cattle do though graze in the watershed to date and the presence and thus potential impacts from cows, horses or other livestock are ongoing. As a result there are still needs for improved management practices in the watershed. This will largely be dependent on the private land holders and their willing cooperation with non-regulatory agencies such as the Lincoln Soil and Water Conservation District and the Natural Resources Conservation Service, as well compliance with the Oregon Department of Agriculture who are the Designated Management Agency and regulatory agency for agriculture in the Mid Coast Watershed (Mid Coast Agricultural Water Quality Management Area Plan, 2004). Many programs currently exist for such partnership, and some have been initiated and completed in the watershed. These local, state and

federal entities will continue to be the best resource for the agriculture community, and thus specific action items are not part of this plan.

Fish and Wildlife: Devils Lake is home to a myriad of native and exotic fish and wildlife species as documented by US Army Corps of Engineers in 1974 (See Appendix). Additionally threatened or endangered species, such as the Marbled Murrelet (*Brachyramphus marmoratus*), not recognized by this initial survey, but identified by the US Fish and Wildlife Service may also exist, or have ranges that overlap with the watershed. A complete list of endangered, threatened, candidate and recovery species for Lincoln County is provided in the appendix. Additionally, NOAA Fisheries recognizes a number of Species of Concern, of which Steelhead Trout (*Oncorhynchus mykiss*) are listed, and the Oregon Department of Fish and Wildlife hold their own statewide lists which rank the endemic Oregon Coastal Coho Salmon (*Oncorhynchus kisutch*) as threatened, and the Bald Eagle (*Haliaeetus leucocephalus*) as threatened. The Confederated Tribes of Siletz Indians of Oregon recognize culturally and ecologically important species such as the Pacific Lamprey (*Lampetra tridentata*), which is known in Oregon's coastal streams (Palacios, 2000) and have been found in the Devils Lake Watershed (US Army Corps of Engineers, 1974). As a result many fish and wildlife species have specific recovery plans in place which the Devils Lake Plan may complement.

As to specifics, fish populations in Devils Lake have seen significant flux. As identified in the chapter on history, large-scale introductions of non-native fish have occurred which have greatly impacted native fisheries. While not as closely monitored as would be today, these impacts were likely similar to reductions in Coho in similar coastal lakes. In 1973, following the well documented introduction of non-native game fish to Tenmile Lake, Coho declined sharply and are yet to recover (R. Buckman, pers. Comm., 2010-10-26). This marked decline may have also occurred in Siltcoos Lake and Tahkenitch, but like Devils Lake these non-native introductions were in the 1930's and would have received much less scrutiny and documentation. For Devils Lake though habitat lost with the introduction of Grass Carp has greatly deflated the non-native fish populations. While predation alone cannot explain Coho population dynamics, with the reduction in non-native piscivorous fish predatory impacts in Devils Lake may logically be less than in previous years. Other fishery considerations also exist in the system. Currently Oregon Department of Fish and Wildlife stock Devils Lake with approximately 20,000 hatchery grown rainbow trout. These fish generally grow from 8" to 16" in the year they are stocked.

Wildlife issues as they relate to the lake are less well understood. Although aquatic habitat loss has been shown to impact migratory bird populations, it has not been known to adversely affect a nesting pair of Bald Eagles (Wagner, 1994). Terrestrial impacts are likely more pronounced as shoreline development has encroached heavily on the breeding and resting grounds for many birds. Likewise development has significant impacts to mammalian populations, which is often a driver in population declines.

Recreation: Swimming and boating are the most popular recreational activities along with fishing and water sports such as wake boarding. Popular public beaches include Regatta Grounds and Sand Point which see swarms of visitors particularly in the summer months. Additionally there are three improved and two unimproved boat launches around the lake which offer free access to the public and one private marina which rents boats. A map of recreational opportunities including camping, hiking, fishing, swimming and boating has been provided in the appendix.

Motorized watercrafts dominate the recreational aspect on the lake. Wind and paddle powered vessels are used to a much lesser degree on the lake although kayaking and canoeing are becoming more popular. Oregon State Parks and Recreation Department runs a kayak program in the summer, and thus more and more people are being introduced to this form of recreation. The City of Lincoln City is also developing a kayak and sailing program, which will again increase these forms of recreation. Overall the lake is enjoyed by thousands of resident and visitors alike.

TOOLS FOR LAKE MANAGEMENT

The arsenal of tools at the disposal of a lake manager has grown readily. This is largely due to the increased interest in water quality spurred on by the Clean Water Act, coupled with the desire to eradicate aquatic invasive species that have choked America's waterways. From that, depending on the objectives of a lake association or management agency, numerous opportunities for lake management exist to choose from. As an example, Devils Lake was the implementation site of a strategy for vegetation control, the herbivorous Chinese Grass Carp. This management strategy, chosen to reduce the impacts from aquatic weeds, was selected after a series of studies and recommendations were done as part of the Diagnostic and Feasibility Study completed in 1983 by Kramer, Chin and Mayo, Inc.

From the report eight fixes to "lake ills" were identified. The "lake ills" identified included excess available nutrients, excess macrophyte growth, and increasing algal and cyanobacteria growth. The "fixes" were prioritized and included vegetation harvesting, land use controls, herbicides and limited dredging. It is partially from this process that many of the current strategies for lake management have been identified.

Since the Eighties other more relevant lake management tools have surfaced. In 2006 and 2007 the Devils Lake Water Improvement District explored some 25 strategies for vegetation management and cyanobacteria dominance reduction. These strategies were largely taken from the Center for Lakes and Reservoirs publication entitled, "Guide for Developing Integrated Aquatic Vegetation Management Plans in Oregon" and from listings on the State of Washington's Department of Ecology's Water Quality Website. Only those strategies deemed most viable by the District have been included in this plan.

External Controls

Primary to the reduction of macrophytic growth as identified by Kramer, Chin & Mayo, Inc. in 1983 and holding true today is reducing the amount of nutrients entering the watershed. This then continues to be a primary objective for the District. Within generally accepted practices, today known as Best Management Practices (BMPs), the following list of external controls are being considered for Devils Lake and will be addressed individually. Other management activities related to forestry and

agriculture are addressed by much larger government entities, and thus are not part of the Devils Lake Water Improvement District's Plan.

The following items that are part of the Devils Lake Plan are given in no particular order. The District does though have its current list of priorities detailed in a previous section. Upon fulfillment of those priorities, additional projects will be developed from items identified in this plan.

1. Septic Tank Revitalization
2. Stormwater Management
3. Wetland Preservation, Establishment, Enhancement and Restoration
4. Shoreline & Riparian Vegetation
5. Erosion Prevention and Sediment Control
6. Sanitary Sewer
7. Phosphorus & Nitrogen Reduction
8. Low Impact Development
9. Toxicant Reduction & Abatement
10. Invasive Species Prevention

Septic Tank Revitalization: The watershed surrounding Devils Lake has been thickly settled in the last 100 years. With that settlement has come the creation of hundreds of septic tanks which individually seek to treat the wastes from the respective homes they serve. While under working order, septic tanks with notable exceptions of nitrogen abatement are generally considered a reasonable tool for treating domestic wastewater. This is not however true with failed systems. Aging and poorly maintained septic tanks and drainfields can be a major contributor of additional nutrients and undesirable pathogens to the watershed.

Currently there are 685 developed properties using septic systems in the watershed. Through research conducted by the Devils Lake Water Improvement District, for 217 properties there are no records of installation or repair of their septic systems. Oregon began requiring permits for septic systems in 1974, and thus likely nearly one-third of all septic systems in the watershed are at least 36 years old, many likely much older. Given the life expectancy of the various types of septic systems, many other properties are also likely at risk of failure. In fact, further analysis of Lincoln County's septic tank

records revealed that 55% of all systems are at or beyond the age that failures are likely. Identification and revitalization of all such systems thus is a priority in the Devils Lake Plan.

The Devils Lake Water Improvement District is working with the City of Lincoln City on developing a mandatory septic tank inspection requirement for all properties receiving municipal water in the watershed. The City of Lincoln City identifies Devils Lake as a major natural resource worthy of protection and is thus a willing participant and driver of this proposal. The plan would require mandatory, certified inspections of all septic systems within the watershed every ten years. While EPA recommends that system be inspected more regularly (on a 3-5 year rotation), a ten year rotation has been selected as a compromise between the economic cost of having inspections and the ecological costs of unidentified failed systems in the watershed. Failure to comply with the proposed municipal ordinance would be cause for the water service to be shut off or fines assessed. This requirement would only be for the inspection, not for a repair. Property owners would only have to provide an inspection report to maintain their water service or avoid fines from the City of Lincoln City.

Having the tools to identify failing or failed septic systems is just one step in the Septic Tank Revitalization. The key to improving the watershed is through the actual repair or replacement of the system, or if feasible the connection to municipal sewer. For systems that are found to be faulty, the Lincoln County Planning Department has and continues to partner with the District in permitting and enforcement through its usual channels as needed. In no way is this enforcement tied to water service, which again only is proposed for requiring an inspection. The County has a long demonstrated history of working with landowners to bring them into compliance, a partnership which extends today.

While sewers ultimately in many ways are more favorable to septic systems, the reality is that much of the watershed remains without access to a unified sewer. The District is championing an alternative sewer system, which is dealt with later on in this chapter, but the reality is that sewers are not the economically favorable choice for many property owners in the watershed. As a result the vast majority of the 685 systems in use today will likely remain to be in use beyond the ten year horizon that this inspection program would establish. Therefore it is fundamental that septic inspections and any needed subsequent repairs take place.

Stormwater Management: Given the reduction in point source pollution nationally, stormwater has become the number one source of pollutants of waterways. This is true in the Devils

Lake watershed as much as it is in other parts of the state and nation. Because stormwater carries a myriad of chemicals many of which are considered pollutants, a reduction in stormwater through direct infiltration and increase permeability is preferential. However as large conduits of stormwater already exist in the watershed, the treatment of stormwater through the use of Raingardens, bioswales and other pollutant reduction BMPs is also sought.

In order to reduce stormwater, natural systems must be reestablished. Runoff from rooftops, driveways, parking lots, roads and other impervious surfaces greatly increase the volume of water discharged into the lake during rain events. This occurs largely without the buffering and cleansing afforded by native vegetation and soils. It is this native buffer then that needs to be reestablished which will reduce the ecological footprint of existing housing and infrastructure.

Methods of bioremediation through vegetative buffers are being created and evolving readily with the need for restoration. One key is the disconnection and day-lighting of the stormwater system into smaller more manageable parts. If water that has been channelized or piped can be allowed to again interface with vegetation, sunlight, and soils, a large amount of water treatment can take place. Additionally, infiltration provides the water molecules a longer life on the landscape before eventually making its way to the lake and eventually to the sea. It is because of this very plain and simple fact that we through partnerships with the city, the county and private property owners must develop and implement biofiltration and other stormwater management mechanisms as a primary means of nutrient abatement.

Wetland Preservation, Establishment, Enhancement, and Restoration: Wetlands serve many functions, part of which is improving water quality. Wetland plant species and wetland processes remove nutrients that would otherwise reach Devils Lake. Wetlands also serve as physical catchments for sediment and stabilize shorelines. Biologically, wetlands serve vital functions as well, including providing habitat for fish and wildlife.

With the increased development pressures of the 20th century, the preservation of wetlands was not a priority. It was only beginning in the 1970's that wetlands began to be recognized for the functions they serve. This however has not stopped the filling of wetlands and still today wetlands can be legally filled and destroyed with the correct permits and compensatory mitigation as appropriate.

Functional wetlands are difficult to replicate, and thus wetland preservation needs to be the primary objective. An inventory done in 1996 by Shapiro and Associates (See Appendix) detailed and allowed the prioritization of existing wetlands in the watershed. Generally wetlands were deemed significant which served larger drainage basins and that were functionally intact. The Significant Wetland determination was meant to provide additional protection from development at the state and local levels, however the enforcement of such needs to be insured. Wetlands not receiving that designation were also cataloged. Many of these wetlands may have already been impacted by development and were deemed less important through this initial review for protection. These wetlands however provide in some ways the greatest opportunities for wetland enhancement or wetland reestablishment where wetland functions have either been reduced or lost entirely.

The largest wetland creation and enhancement opportunities exist primarily in the Rock Creek basin. For example, large tracts of land converted to pastureland could be restored to a high level of wetland functionality. Other opportunities also exist particularly in the Neotsu and Thompson Creek watersheds as large tracts in those basins have also been converted to agricultural. Lastly, with the nature of the topography around the lake and the many small drainages that exist, small wetlands can be created or recreated from outputs which have in many ways been converted and channeled into stormwater conveyances. To achieve these goals and to develop working relationships with conservation groups with overlapping goals, the District seeks to partner with entities, such as Ducks Unlimited, the Nature Conservancy, and the Oregon Wildlife Heritage.

Shoreline and Riparian Vegetation: The shoreline is the critical interface between the lake and the watershed. Recently, USEPA conducted a National Lakes Assessment and determined that lake health was largely correlated with shoreline integrity. Lakes with the greatest vegetated buffer typically were the better in terms of biological diversity and water quality. Thus for the benefit of Devils Lake, a public outreach campaign must be initiated to educate and promote healthy "lakescapes" and riparian vegetation. Efforts must be made to challenge current popular aesthetics of lakeshore environments, namely lawns that stretch all the ways to the lake's edge. Primarily this is the small, private landholder with a single family residence that needs to be targeted. A "Lawns aren't for Lakes" campaign has been initiated in other communities, and should be developed here locally as well. Education can alter the property owners' decision from intensive mowing and fertilizing and the care for non-native grass to a more harmonious vegetated landscape.

Such improvements are self sustaining, promote a healthy ecosystem, prevent wave erosion, stabilize the shoreline, which helps improve water quality.

Riparian vegetation naturally extends up stream corridors as well. A similar outreach program should be developed for riparian landowners along the many tributaries of Devils Lake. Riparian vegetation prevents erosion, utilizes nutrients, provides habitat, and serves to keep the streams cool enough for native fish. As the Forestry Practices Act governs much of the activities in the timberlands of the upper watershed, opportunities for riparian improvements largely lay in the bottomlands of the various tributaries of Devils Lake. Small residential parcels and agriculture dominate this part of the landscape. The Oregon Department of Agriculture, Lincoln Soil and Water Conservation District, and the Natural Resources Conservation Service are the best resources to address riparian issues on these properties. The District can, has, and will continue to play a vital role in connecting such agencies with property owners and to partner in restoration of the riparian corridors as appropriate.

To facilitate and to help prioritize restoration, stream inventories complete with stream conditions are needed. For Rock Creek data has already been compiled through the Limiting Factors Assessment and Restoration Plan, Rock Creek, 2003. For the other tributaries this type of information may be reasonably extracted or inferred from digital aerials and from compiling local knowledge. With these tools a rapid assessment could readily be developed as a GIS layer indicating relative stream fitness and where riparian zones were intact or where improvements would be warranted.

As to the lakefront, the concept of “Save our Shorelines” or SOS is currently being developed and promoted as a way of improving the watershed one parcel at a time. The SOS program speaks to not only maintaining a healthy vegetated shoreline for oneself and the fish and wildlife that rely on land and water interface, but for the viewscape of each other’s neighbors as well. Developing a unique Devils Lake aesthetic that truly balances the needs of the property owner with the needs of the lake is critical in maintaining a healthy shoreline.

Erosion Prevention and Sediment Control: Disruption of soils in the watershed is a primary cause of increased sedimentation and nutrient enrichment in Devils Lake. During construction, newly exposed soils are more vulnerable to the natural forces of erosion and sediment transport. To prevent or at least reduce these impacts, Best Management Practices are critical before, during, and after land disruption. Agriculture is another potential source of erosion. Overgrazing and

the lack of adequate riparian vegetation are impacts that can lead to increased erosion. At the state level, the Oregon Department of Agriculture as the Designated Management Agency is charged with regulating erosion from agriculture and other rural lands (OAR 603-095-2240).

At the local level, in 1997, following many years of input, the City of Lincoln City passed a grading ordinance which prohibits land disturbing activities of a certain scope without an approved sediment and erosion prevention plan. The Devils Lake Water Improvement District was a key stakeholder in developing this ordinance. Through an intergovernmental agreement this ordinance extends to the Urban Growth Boundary, which includes the eastside of the lake. In order to insure ongoing compliance and continuing education the City of Lincoln City and the Devils Lake Water Improvement District jointly sponsor an Erosion Prevention and Sediment Control Workshop each year. This workshop provides necessary training in Best Management Practices, and with the expansion of the SOS program, future seminars may include trainings on shoreline erosion as well. To coincide with the onset of the rainy season, the event is held in the fall, and September is named Erosion Prevention and Sediment Control Awareness Month. Continuance of these practices and insurance of the regular and fair enforcement of the ordinance will continue to reduce the impact development has on the watershed.

Sanitary Sewer: Many of the homes around Devils Lake are not on a unified sanitary sewer, and thus domestic waste treatment is managed by hundreds of individual property owners. Sewering Devils Lake has many favorable aspects when viewed from a means of strictly pollution abatement. However, with the availability of a sanitary sewer comes development. With development often comes increased stormwater runoff, laden with the chemicals and pollutants of modern living and transportation. Thus the balance between nutrient abatement through sewerage and nutrient introduction through increased stormwater must be addressed.

Support of a sewer around Devils Lake must come from a number of stakeholders, namely the residents and the City of Lincoln City. Support from the Devils Lake Water Improvement District is also primary to the success of such a project and would come with the provision for land use controls that would protect the lake from unabated development. Development should include substantial native vegetative buffers between the built space and the lake with the homeowner maintaining a long-term healthy “lakescape”. Without these provisions sewerage the lake could have the affect of a net

increase in nutrients entering the lake, and thus such provisions are critical to have in place before a lake-wide sewer should move forward. That being said, the use of new technologies for getting existing, developed parcels off of septic systems can be beneficial and is called for in this plan. Currently one such neighborhood sewer is being proposed that can serve as a model for other already highly urbanized parts of the lake.

A recently developed alternative to a traditional gravity sewer is a pressurized sewer system. Instead of a deep, large receiving pipe, sewage is pumped from individual properties into a relative shallow, small diameter pipe which leads to a traditional sewer pump station. Systems such as these tend to be much lower in cost, and can serve traditionally difficult to serve areas. Local residents can petition for the creation of a local improvement district that would then allow homeowners to pay for the system over a longer period of time. Such an application is currently moving forward for an area near Regatta Grounds, demonstrating the promise of such technology for other areas.

While alternative sewers may work in some areas where the existing infrastructure downstream is able to absorb the capacity, larger systems may not. For instance, for an area such as Neotsu to be sewerred entirely, that additional flow may require upgrades in any number of pump stations and sewer pipes along the way to the sewer treatment plant. In areas currently not served by pump stations such as the east side of the lake, sewer pump station may need to be built outright to accommodate flows. All of these costs accumulate and can make the economics of a project much more complex. Such additional costs has caused property owners previously committed to such sewer improvements to later reject the project leaving significant design costs to be paid by the general public. None-the-less sewer continues to be a nutrient abatement strategy in the Devils Lake Plan. It is recognized though as being a formidable and thus slow process, with the risk of leaving failed septic tanks potentially unaddressed for decades.

Phosphorus & Nitrogen Reduction: Phosphorus and nitrogen are primary nutrients in lake ecology, but too much of them can lead to lake eutrophication as has been the case for Devils Lake. Naturally occurring elements, we can not possibly remove them entirely from the watershed, but we can reduce the anthropogenic or human induced applications. Simple reduction techniques can be done that do not reduce the homeowner's use of their property, yet provide significant reductions in nutrients entering the watershed. For example often homeowners might apply fertilizers needless to

their land when a simple soil test can determine if external fertilizer might be needed at all. More and more awareness has been generated around the use of phosphorus free products. Recently the State of Oregon passed legislation restricting the content of phosphorus in dishwashing detergent. Phosphate for decades has been restricted in laundry detergents as well. In an effort to curb the use of phosphate in fertilizers, the District has and will continue to partner with area merchants in the use of non-phosphate fertilizers. Wide scale voluntary adherence to such principles however has not taken root in the watershed and mandatory compliance may be warranted.

Large-scale phosphorus and nitrogen use must also be addressed. Parks, timberlands, agriculture and the golf course are all users of fertilizers. Fertilizer use in government owned parks should be restricted and turf grass phased out in favor of native plantings. Soil tests for agriculture and for forested lands must become the norm, and the golf course should seek to reduce its use of fertilizers through best management practices, including irrigation methods. Recently the District supported the development of an additional Point of Diversion of an existing water right held by the City of Lincoln City which could serve the irrigation needs of the golf course. Approval of this new water access point will provided for significant reductions in the amount of fertilizer used on the golf course, as nutrient rich waters from Devils Lake would replace the existing practice of using nearly pure and chlorinated tap water for irrigation. Not only would less fertilizer be required on the greens and fairways, but nutrients would be physically removed from the lake bed as water was extracted. Other best management practices such as reducing the golf course footprint, providing for native species, and allowing for higher settings on mowers can also be developed and encouraged particularly as the course expands as is planned.

Low Impact Development: Low Impact Development or LID is a means of developing properties in a way that has little or limited impact on the natural systems that support life. Development has historically been based on clearing the land, grading and leveling, putting in the roads and infrastructure, followed by homes, and lastly, adding a cover landscape. Low Impact Development inverts that process in which the landscape is preserved, the house and infrastructure are built with sensitivity to the environment, and stormwater is treated onsite. The resulting property functions more or less from a runoff perspective as it did prior to development.

BMPs include the use of permeable pavers, rainwater capture, tree preservation, wetland preservation, and clustered development. A little preplanning goes a long way in saving the natural system that supports wildlife and provides the natural filter for rain water. The District staff has attended Low Impact Development seminars as well as ones on the creation of rain gardens for stormwater treatment in years past. The District should continue to become educated in this regard and to support the use of Low Impact Development in the entire watershed. The District must work with the City and the County planning departments to further expand LIDs and should work to create development requirements that provide protection to the lake and the watershed.

Toxicant Reduction & Abatement: Toxicants are chemicals that have an adverse affect on living organisms. One class of toxicants is the suite of manmade chemicals derived to kill what are deemed nuisance biota. Collectively known as pesticides, chemicals in this class include herbicides, insecticides and fungicides. While often formulated to target specific organisms, pesticides and/or their degradation by-products, can often have adverse affects on other parts of the food chain. Regulation of pesticide use and pesticide applicators is the jurisdiction of the Oregon Department of Agriculture, yet there are many voluntary measures that can be taken to reduce and eventually eliminate these toxicants from the watershed.

Many of the common pesticides used in the watershed are sold to promote the growth of non-native grass (i.e. lawns) around the watershed. Moving to a natively vegetated watershed would alleviate the need for many of these chemicals outright. Native vegetation is disease resistant and thus can combat the infestations internally without the need of chemical treatments. In order to educate the public and help implement the return of native vegetation to the watershed, the enlistment of the Lincoln County Master Gardeners from Oregon State University Extension Office is sought.

A first step to being toxicant free in the watershed has been taken by the City of Lincoln City whose parks are pesticide free. Secondly, Oregon Department of Transportation has agreed to not use herbicides on right of ways in Lincoln City. A similar agreement with the Lincoln County Road Department exists for county roads in Lincoln City. This could be expanded to the entire watershed. Likewise agreements with entities such as Oregon Department of Parks and Recreation need to be struck in order to reduce the introduction of these toxicants, many of which have unforeseen or unknown consequences in the environment.

At the private property owner level, a program needs to be developed which would restrict the use of pesticides. Allowance for the use of toxicant for home preservation from the likes of termites would be exempted, but the wholesale spraying of lawns, driveways, and other areas would be restricted. Reliance on voluntary adherence to such BMPs would be favorable, but without the fabric of community and a culture of support for such BMPs, mandatory compliance is likely required.

Another class of toxicants is heavy metals. Heavy metals can be particularly toxic and when they enter the ecosystem tend to bio-accumulate and even bio-magnify through the food chain. Lead is in this family of toxicants as is mercury and cadmium. Longtime known to be a toxicant, lead was banned from paint, gasoline, and pencils, yet it is readily available and marketed for use as fishing supply. Other heavy metals are common place in appliances, batteries, and fluorescent lighting. While many of these chemicals are necessary for modern life, others do have very reasonable replacements. This is certainly true for leaded fishing weights. For those toxicants that are necessary for modern society, recycling programs need to be utilized with a strict ban of disposal into landfills. The District needs to partner with Oregon Department of Fish and Wildlife to ban the use of lead in fishing tackle statewide. In 2006, in order to raise awareness locally the Devils Lake Water Improvement District initiated a lead-free weight promotional give-away and is developing a “Get the Lead Out” public service announcement.

Even with diligent work fighting the introduction of toxicants into the watershed, unforeseen spills may occur. For Devils Lake this may come in the form of a tractor trailer accident near a drainage basin or a motorboat sinking and spilling gas and oil into the lake. House fires and the requisite fire suppression is another mechanism of acute pollution. Storm drains receiving runoff from firefighting can be an efficient conduit of unwanted solutes into the waterway. As a result an effective means of dealing with such incidents must be developed. A good start would be a hazardous materials team which would be trained in first response and containment of such pollutants. Potential partners include North Lincoln Fire and Rescue and the US Coast Guard Auxiliary.

Invasive Species Prevention: The prevention of the spread of invasive species to and from Devils Lake is an ominous task. Thousands of individuals visit the lake every year, each of whom can become a carrier or a vector for invasive species. Boats and boat trailers are obvious vectors, but for some invasive species the transport can take place on a smaller scale.

While no invasive species prevention strategy alone will keep invaders from taking over the lake or its shoreline, multiple strategies molded together can greatly reduce the likelihood of transport. Steps the District has already made in the prevention of the spread of these invasives are many fold and focus generally on raising awareness. Devils Lake was recently featured in the statewide campaign most famously highlighted by the production and airing of an Oregon Public Broadcasting Special: *The Silent Invasion*. This hour long program has run at multiple times since its original airing. The video has even found its way into higher level curriculum, specifically being part of coursework at the University of Oregon in recent months. Additionally, Devils Lake Water Improvement District has recently collaborated with Oregon Sea Grant in establishing the Devils Lake Radio, a low watt radio station broadcasting invasive species messages at the two primary boat launches on the lake. These are just two of the educational mechanisms in place to date, many other approaches are necessary however. Potential partners for spreading information about invasive species include the North Lincoln Fire and Rescue's Water Rescue Division and the US Coast Guard Auxiliary.

Invasive species are a much larger problem than that of the confines of Devils Lake. The State of Oregon also has a role to play as do many federal agencies. Recently the Oregon legislature passed a requirement of all vessels, motor powered, wind powered or paddle powered over 10' in length to have an invasive species permit. Kayakers and canoe enthusiasts are included, and all must have their own permits. The permit requires that the operator will keep their vessel and gear free of invasive species and costs \$7. The revenues are used by the state to provide inspection stations and provide education.

Controlling invasive species also takes physical action. "Never Launch a Dirty Boat" is the newest campaign from the Oregon State Marine Board. Stop Aquatic Invaders is a similar one, but messaging is never enough. Providing an easy means for people to act on the message is a large step toward prevention. The Preservation Association of Devils Lake has been conducting fundraisers to help build a watercraft rinse station at Regatta Grounds. The Devils Lake Water Improvement District has augmented their fundraising efforts with a grant of \$2,500. Given the fact that there are three free, improved public boat launches and other pair of lesser improved launches many thousands more may be needed, but the goal of providing easy access for boaters to clean their vessels both before and after visiting the lake is obtainable and called for in this plan.

In Lake Treatments

Much of the focus over the first 25 years of the District has been on in lake treatment of noxious weeds. The Chinese Grass Carp introduction, initially in 1986, and again in 1987 and 1993, was aimed at the symptoms of lake degradation. Similarly many in lake treatments known today also treat the symptoms of eutrophication, (often noxious weeds and/or harmful algal blooms) rather than getting at the root cause of these symptoms, nutrients. Treatments prescribed for lakes include dredging, mechanical harvesting, herbicides, alum, and biocontrols. In 2006 and 2007 the Devils Lake Water Improvement District conducted an evaluation of over 25 of these various mechanisms. As many of the treatments are only temporary, may be prohibitively expensive, and/or politically and socially unacceptable, only those In Lake Treatments currently being considered by the Devils Lake Water Improvement District are included.

Native Vegetation: The Devils Lake Water Improvement District has over the course of the last few years been developing methods for enhancing native vegetation on the lake bottom. The development of the Shoreline Planting Guide is a direct result of this work. Planning, development and application to the state for planting native vegetation on the lake bottom has occurred, but was withdrawn by a decision of the Board until a more supportable plan in the eyes of the regulatory agencies could be made. In order for native plants to survive, fish exclosures would have to be built to protect the plants from herbivorous fish. Oregon Department of Fish and Wildlife has also required that these exclosures would also have to limit the access to the planting areas by piscivorous fish. This is being required to protect native Coho Salmon being predated upon by ambush predators such as bass. Sophisticated monitoring of the exclosures by electro-shocking the areas frequently would be required to ensure that the Coho/bass predation issue would be resolved indefinitely. Projects within the purview of Native Vegetation then have been funded up to \$25,000 in the current budget.

Invasive Species Management: While encouraging native vegetation is important, the control of non-natives is also vital. The District will need to monitor the growth of natives and non-natives alike. Routine lake surveys need to be performed to map the existing plant life on the lake bed. Proper plant identification is critical. Many plants look similar and thus specialist knowledge must be

applied. Given the identification of noxious species, steps to control the species must be undertaken. Local or spot control is favorable to large scale control methods, and should thus be implemented first. Such methods include hand pulling, raking, and diver assisted suction dredging. This is compared to large scale non-specific methods such as dredging, rotovation, weed harvesting or biological control which may not only be costly, but can be highly disruptive. The District needs to create an implementation plan that would allow for the quick response to invasive species at a time when their population is the lowest. This will take coordination with capable contractors and outside agencies for permitting. Given a situation where localized control is not possible, larger scaled control options may be necessary. Of those evaluated, including dredging, herbicides, mechanical harvesting and rotovation, the reintroduction of Chinese Grass Carp is the most cost effective, long-lasting, and thus favorable option.

Chinese Grass Carp: The connection between Chinese Grass Carp (*Ctenopharyngodon idella*) and Devils Lake goes back to the beginnings of the District. In fact, the District's first responsibilities were centered on implementing and monitoring the Grass Carp plantings. Grass Carp have been stocked three times in the lake with the initial plantings in 1986 and 1987, and finally 1993. As a result of these stockings the recreational value and real market economic values of properties have surged (CH2M Hill, 1993). While consequences to these stockings have been seen, when compared to other vegetation management treatments such as herbicides, dredging, or mechanical harvesting Grass Carp remain a cost effective, long-lasting, largely publicly accepted in lake treatment.

The use of Grass Carp however is limited in the State of Oregon currently. Only waterbodies of less than 10 acres held entirely on private land are eligible. All water bodies that the Grass Carp are planted in must now be restricted from public access and have no inputs or outputs to other waterbodies with limited exception. This for most practical purposes limits their use to irrigation ditches and small private ponds. Further, public government bodies, such as the Devils Lake Water Improvement District, are forbidden from the application process altogether. These are some of the major hurdles that the reintroduction of Grass Carp must thus overcome. Grass Carp though have a proven record in Devils Lake which may make it a good candidate for an exemption. Specifically, Devils Lake was identified in the 1980's as a test case for Grass Carp; the watershed is unique in that it discharges directly in to saltwater; the bio-control continues to be an In-Lake treatment for the lake; beneficial

uses as a result of the Grass Carp introduction are marked; and like no other waterbody in the state there is a special government designated specifically for the lake to provide oversight.

Because however current rules prohibit the use of Grass Carp in Devils Lake, the only way of approving the restocking is through a variance of the rules by the Oregon Department of Fish and Wildlife Commission. To initiate that process, in 2008 the District applied for the carp knowing that its application would be denied. This denial is then available for a formal and detailed appeal, which is the District's intent. While the specifics of how a reintroduction of Grass Carp would take place are beyond the scope of this document, the reality of the potential return of exotic aquatic plants species to Devils Lake requires that the District be pro-active in obtaining this variance. The allowance would provide the District the insurance of having a known, effective lake management tool at its disposal. The District recognizes though that invasive weeds are only a symptom of a culturally impacted lake. In recognition of this, the District is and will continue to actively reduce nutrients coming into the lake as well as seek to prevent the spread of invasive species. It is with a watershed wide approach then that Grass Carp fit into the management strategy for Devils Lake.

Even with the District's object of a renewing its Grass Carp permit, complete aquatic plant eradication is not, nor has it been the goal. Native vegetation is a vital and natural part of any lake ecosystem and shall be encouraged. In researching the feeding preferences of Grass Carp it is apparent there is some disagreement about what these fish will eat first. Grass Carp are known as a general herbivore in that they will eat most anything eventually, but they do have favorites and those plants that they will not consume. A few published studies do provide some overlap and concurrence for some species while offering differing reports for other species. At some level this knowledge enables the District to strategically plant those natives that are less affected such as the emergent species, Cat Tail (*Typha latifolia*), and at the same time target prevention and removal strategies for the invasive plants that are not readily consumed, such as Eurasian watermilfoil (*Myriophyllum spicatum*).

Invasive species prevention strategies are fundamental and shall include the use of an ongoing public outreach campaign, watercraft rinse stations, and signage. Regular aquatic plant surveys will necessarily be conducted to identify possible introductions. Targeted, small-scale removal and prevention strategies developed including the use of bottom barriers, hand pulling, and diver assisted suction dredging. A larger-scale introduction or resurgence not responding to the smaller-scale removal strategies will require more direct action. Grass Carp are a proven, relatively low cost method

for removing large infestations of invasives species and will continue to be sought as a management strategy for such invasions.

Research, Education & Outreach

The Devils Lake Water Improvement District has for decades worked to raise awareness among lake users and lake front property owners about the lake and influences that affect it. In the 1980's and 1990's many publications were created for focusing on native vegetation, phosphorus reduction, and septic system maintenance. While these efforts were significant, more work continually needs to be done. To that end, The Devils Lake Water Improvement District recently created a communication plan. Contained in the plan are the tools the District uses to communicate to the general public, to state and federal agencies, and to other entities. Such tools include the District's website, a listserv, public kiosks, radio, television, print, and other media.

The CAFÉ: Key to the ongoing health and vitality of Devils Lake is an ongoing, robust education program. Facilitating such education is greatly enhanced with kiosks and exhibits demonstrating such information. One answer to the needs of ongoing education is development of permanent educational and research center, effectively a science center focused on limnology and living in the watershed. Devils Lake Water Improvement District in 2006 developed a slideshow presentation detailing the idea. This slideshow was presented to numerous groups including the Lincoln City Chamber, Kiwanis Club of Lincoln City, Lincoln City Urban Renewal, and the City of Lincoln City. Positive feedback was received on all accounts, suggesting the community would embrace the development of such a facility.

This proposal thus calls for the formation of the Center for Applied Freshwater Ecology better known by the name and acronym of "The CAFÉ". Not only would The CAFÉ serve as an educational resource by being a science center, the center would include provisions for research as well. Lab space and temporary living quarters for researchers may eventually be afforded. The CAFÉ would evolve into an economic resource for north Lincoln County, providing jobs and creating skill sets required by today's environmental professionals.

One primary research objective would be cyanobacteria. Devils Lake Water Improvement District has recently acquired the means for cyano-toxin analysis which would be expanded upon in a new lab environment. The CAFÉ would develop into a regional resource for such cyano-toxin monitoring, a growing need in nearby lakes in coastal Lane and Clatsop Counties. Other research priorities would be charted from current research objectives within partnering organizations. Already identified as an interested participant in The CAFÉ, is the Center for Lakes and Reservoirs (CLR) as well as its hosting institution, Portland State University. Dr. Mark Sytsma, the director of CLR and a professor at PSU sees Devils Lake as the perfect research grounds for students and professionals alike and seeks to grow a partnership that would eventually see a regional resource established on the shores of Devils Lake.

Likewise, the Aquarium Science Program at Oregon Coast Community College is another potential partner. Notably, a previous student of the program has served as a Water Quality and Geographic Information System Intern for DLWID. While not specifically part of that student's curriculum, the educational link between aquarium science and practical work experience afforded by the operation of an aquatic science center would serve the program's requirement for an internship.

Lastly, The CAFÉ can serve the needs beyond ecology. Given an appropriate site access, recreational and informational programs could be developed that would serve the District's constituents as well as the District's Mission Statement. Kayak based educational trips might be one example. Such programs could be developed with the Lincoln City Parks and Recreation Department or sailing clubs. Water safety and boater safety education are also ongoing needs. Partnerships with the US Coast Auxiliary and North Lincoln Fire and Rescue's Water Rescue Division could be developed to serve these needs in the community making The CAFÉ a one-stop port for all things related to Devils Lake.

Volunteerism: Education and outreach opportunities of a smaller scale are also incorporated into the plan. Currently the Devils Lake Water Improvement District sponsors a lake cleanup event with SOLV (Stop Oregon Litter and Vandalism). The Down by the Lakeside brings volunteers together for an annual clean up project in and around the lake. Teams of snorkelers have retrieved dozens of tires from the lake bed. Combined with other debris, over two tons of materials have been removed from Devils Lake in the three years the program has been in operation. Additionally the District provides opportunities for volunteers to contribute to shoreline plantings through the SOS

program. Volunteerism is another vital aspect tying the community to the lake and instilling long-term stewardship of the resource.

Monitoring and Measuring Success

The Devils Lake Water Improvement District currently has a number of monitoring programs it maintains. Foremost is the recreational water quality monitoring program which includes the Bacteria Monitoring, the Cyano-Watch and the Physical and Chemical Monitoring Programs. Sampling and Analysis Plans exist for each program as well as an overall Quality Assurance Project Plan, Water quality for these programs is tested in the peak recreational use period of the lake from Memorial Day to Labor Day.

The Bacteria Monitoring Program utilizes *E. coli* as an indicator species of contamination. Weekly samples are taken during the summer and reported through multiple means. Bacteria postings are updated weekly at each of the prominent sampling sites, are made available online, and through a weekly water quality email. The Cyano-Watch Program follows the potential bloom of cyanobacteria in the lake. Cell enumerations and microcystin concentration determinations are made during active blooms. Data are compared to guidelines established by Oregon's Department of Health and Human Services, and water contact advisories are made as appropriate. The Physical and Chemical Sampling and Analysis Plan calls for the collection of data on parameters such as dissolved oxygen, temperature, conductivity, turbidity and nutrients. Collectively these three programs feed a database of knowledge that can be used to assess not only the current conditions of the lake and watershed, but also trends in water quality.

Success can be measured in many ways. For bacteria or cyanotoxin concentrations meeting the recreational use standards are used. Physical parameters such as temperature and dissolved oxygen can be compared to the biological requirements of native fish populations. Other parameters though are less clearly defined as state or national standards may not exist or may not be applied universally. One example would be clarity, which can be monitored in a number of ways including through turbidity or Secchi depth measurements. While general expectations might suitably point to increasing clarity, what is not known is at what point is that reasonably achieved. For parameters such as these, the District needs to develop its own set of determinants for judging its success.

One highly useful means of determining success is through the use of a trophic state model. Variables such as nitrogen and phosphorus concentrations are plugged into the model and the resulting trophic state is estimated. The District has much of the data necessary to develop such a model making it an achievable objective; missing data could be supplemented through augmenting existing monitoring programs. Nutrient reduction targets can be determined through the model which then can transpire into prioritizing on the ground projects such as Septic Tank Revitalization to meet those targets. This is a similar methodology of a Total Maximum Daily Load (TMDL) process that DEQ and EPA use to reduce impacts to impaired water bodies. Development and utilization of such a model then will help the District prioritize projects which ultimately will lead to a healthier ecosystem in a shorter period of time than possibly achieved through a non-targeted approach. With the recent development of a database of all the existing data about the lake and watershed, the District is well positioned to incorporate these data into such a model in the future.

FUNDING OPPORTUNITIES

The primary funding for the District is its existing tax base. The District receives funding from properties in the watershed at a rate of 0.2499 per thousand dollars of assessed value. For properties outside the watershed, but in Lincoln City the rate is 0.1280 per thousand. This funding stream is available to the District annually. In fiscal year 2010-2011, the District anticipates to receive \$177,336. In 2014-2015 this tax base will expand by approximately \$25,000 annually with the sun-setting of Urban Renewal, a special taxing assessment within the boundaries of the DLWID.

Another funding opportunity resides within the District, that of reserve funds. The District has some \$348,000 in its Improvement Fund. Uses of these funds include vegetation management, watershed protection, capitol improvements, water quality improvements, cyanobacteria control, and other improvements seen necessary by the Devils Lake Water Improvement District Board of Directors. Currently the District is funding the SOS program and the Septic Tank Revitalization Program from this reserve fund.

As a special District, DLWID is also eligible for many public and private funding opportunities. Federal grants can be researched at Grants.gov for a wide range of applications appropriate to the mission and vision for Devils Lake. Private foundation grants are researchable through similar queries. The District was a recent recipient of an EPA 319 Grant for the development of a database and has received or implemented grants from the Oregon Watershed Enhancement Board and the Special Districts Association of Oregon. Other grants exist for which the District may not be directly eligible for, but may be applied for through a partner, such as the Salmon Drift Creek Watershed Council, or Oregon Department of Fish and Wildlife. The District can and has previously offered matching support, both cash and In-kind, for these types of grants. These outside sources of funding can largely supplement the District, making otherwise unaffordable projects obtainable.

Funding opportunities are available through Grants.gov, some specific ones are listed below:

- NRCS: Wetland Reserves and CREP Program
- US EPA: Wetland Grant Program
- USFWS: Coastal Program

IMPLEMENTATION & TIMELINE

Action Plan for Septic Tank Revitalization

GOAL: To create a septic system inspection program that protects Devils Lake from undetected failed systems.

Item = 0.55 FTE	Status & Timeline
1. Create a priority list of watershed properties that are less likely to have functional septic systems.	Completed
2. Work to create a Lincoln City Ordinance requiring regular septic tank and leach field inspections for all properties using city water as a condition of use.	Final Stages
3. Investigate current real estate transaction requirements for providing a working and serviced septic system.	Pending, may not be necessary.

Accomplishments to date: The Devils Lake Water Improvement District provided matching grant funding for a RARE program participant in FY 2009-2010. Fifty percent of the work plan for this position was allocated towards the septic program. As a result great strides in the Septic tank Revitalization Program have been made, including a survey of all of the County's records for properties in the watershed, creation of a septic system GIS database, receipt of public input at multiple occasions, and collaboration with the City of Lincoln City in the drafting of a Septic Tank Inspection Ordinance. The District has continued its commitment to the Project in 2010-2011 by funding a Project Management Specialist to work on the finalization of this project.

Action Plan for Stormwater Management

GOAL: To decrease the amount of stormwater entering Devils Lake and to better treat the stormwater that does reach the lake.

Item = 0.91 FTE	Status & Timeline
1. In cooperation with the City of Lincoln City, establish a GIS layer of all stormwater drainage and conveyance systems.	Partially completed by Lincoln City GIS
2. Import layer into Devils Lake Water Improvement District's GIS system.	
3. Determine opportunities for bioswale and bio-retention facilities.	
4. Create standard designs that can be easily replicated throughout the watershed.	
5. Access funding mechanisms for implementation.	
6. Build bio-retention facilities.	Demo project built
7. Maintain facilities.	
8. Develop training opportunities for other contractors.	
9. Create a watershed wide ordinance requiring onsite stormwater treatment.	

Accomplishments to date: The District has participated in a number of trainings on stormwater best management practices. The City of Lincoln City is actively updating their stormwater master plan and encouraging better stormwater practices. The City of Lincoln City, the Preservation Association of Devils Lake, the Lincoln Soil and Water Conservation District, and the Devils Lake Water Improvement District have collaborated on a demonstration rain garden near the Taft 7-12 School.

Action Plan for Wetland Preservation, Establishment, Enhancement, and Restoration

GOAL: To insure existing wetlands are protected and new wetlands are created which further protect Devils Lake.

Item = 1.30 FTE	Status & Timeline
1. Liaison with Oregon DSL to maintain compliance with and enforcement of existing laws.	Ongoing
2. Be a resource for property owners, developers, and logging companies regarding wetland conservation.	Ongoing
3. Research and recommend conservation easement opportunities to Lincoln Land Legacy Program.	2010 Winter
4. Research and recommend properties for Open Space Acquisition through the City of Lincoln City.	2010 Winter
5. Use existing and updated wetland and riparian inventories to promote and establish a wetland mitigation bank through Oregon DSL or private means, leaning on the expert help of the US Army Corps of Engineers.	
6. Provide comments on wetland removal/fill applications in the watershed.	Ongoing
7. Identify opportunities to establish new wetlands.	
8. Develop list of suitable, native wetland species.	Completed
9. Contract with experts to establish wetlands where appropriate.	
10. Contract with experts to enhance existing wetlands.	
11. Seek opportunities to partner with national, state and local conservation, recreational groups, companies and consultants to promote and expand the District's objectives around wetlands.	

Accomplishments to date: DLWID has collaborated with the USACE and Oregon DSL in a wetland brochure specific to Devils Lake. This brochure was mailed to every property owner in the watershed with an identified wetland on their property. DLWID has also been a strong advocate for consistent enforcement of existing regulations. The City of Lincoln City has and continues to acquire wetlands as open space. Those in the watershed include the D River Open Space, Spring Lake, Friends of the Wildwoods, and the Seid Creek Open Space. The Devils Lake Water Improvement District Lake Manager sits on an advisory board for the Lincoln Land Legacy Program which recommends expenditures for conservation easements. This program has also been used in grant matching for wetland purchases. DLWID has provided funding for such purchases including the D River Open Space.

Action Plan for Shoreline and Riparian Vegetation

GOAL: To increase shoreline and riparian vegetation for water quality benefits, to protect soils from erosion, and to provide resources for fish and wildlife.

Item = 1.05 FTE	Status & Timeline
1. Evaluate existing laws protecting riparian vegetation.	2011 Spring
2. Educate property owners of existing ordinances and laws.	2011 Spring
3. Educate property owners about the benefits of riparian vegetation.	2011 Spring
4. Create a public campaign around SOS or “Save our Shorelines”	2010 – Spring 2011
5. Create a public campaign around “Lawns aren’t for Lakes”.	2009 – Spring 2011
6. Conduct a rapid assessment GIS layer of stream fitness and intact riparian buffers using existing data, aerials, and local knowledge.	
7. Work with partners to address non-residential and non-developmental parcels for shoreline and riparian improvements.	
8. Where existing laws fail to protect riparian vegetation, work with local planning authorities and public officials to implement laws that do.	

Accomplishments to date: The Devils Lake Water Improvement District provided matching grant funding for a RARE program participant in FY 2009-2010. Twenty percent of the work plan for this position was dedicate to the SOS program. As a result the program has been initiated and three demonstration projects have been done. Plans for expanding the program exist and the District has funded a full time position through June 2010 which will focus primarily on this program. Additionally in an effort to address impacts on water quality, the District is targeting an outreach campaign to riparian property owners up Thompson Creek. This is a result of some preliminary findings from a DNA based fecal source tracking project the District began in summer 2010.

Action Plan for Erosion Prevention and Sediment Control

GOAL: To reduce the sedimentation of Devils Lake through best management practices.

Item = 0.61 FTE	Status & Timeline
1. Create an educational flyer for erosion prevention and sediment control.	Completed
2. Hold annual erosion and sediment control seminars with the City of Lincoln City.	10 years
3. Ensure laws governing the transport of sediment are being enforced at the state and local levels.	
4. Work with developers and be a resource for erosion prevention and sediment control techniques.	
5. Create a webpage highlighting Best Management Practices.	
6. Work with and provide additional training to excavator operators and contractors to prevent unnecessary erosion and soil compaction.	
7. Work with partners to identify and address non-residential and non-developmental sources of erosion and sediment transport.	
8. Continue a public outreach campaign to target new developers, property owners and contractors in the area.	

Accomplishments to date: The Devils Lake Water Improvement District and the City of Lincoln City have held ten seminars on Erosion Prevention and Sediment Control. The District has organized vendors that supply BMP materials to participate in these workshops. The District has also encouraged the local market to respond to the needs of construction to provide a ready source of BMP supplies. The District has also been instrumental in keeping the focus on existing laws and seeking enforcement.

Action Plan for Sanitary Sewer

GOAL: To reduce nutrient loading in Devils Lake from onsite septic systems without enabling detrimental development.

Item = 0.85 FTE	Status & Timeline
1. Establish a stakeholder list.	2011 Spring
2. Collect past documents created about sewerage the lake.	2011 Spring
3. Meet with the City of Lincoln City regarding past efforts at sewerage.	2011 Spring
4. Meet with the Lincoln County Planning Department.	2011 Spring
5. Determine objectives and obstacles to the process.	2011 Spring
6. Research alternatives to sewers.	2011 Spring
7. Work with existing jurisdictions to establish a planning overlay to protect Devils Lake from unregulated development.	2011 Spring
8. Contract to determine the costs of a new system to serve areas on septic.	2010 Pilot Project
9. Investigate funding opportunities for sewer infrastructure	2011 Spring
10. Apply for funding.	As needed
11. Implement construction.	

Accomplishments to date: Currently a large-scale pilot project is being developed using a novel type of sewer infrastructure. A grinder pump technology has been evaluated and expensed by two of the Directors of the Devils Lake Water Improvement District, Brian Green and Randy Weldon. Potentially 50 plus homes currently in the city limits but only served by septic systems may be added to sewer.

Action Plan for Phosphorus & Nitrogen Reduction

GOAL: To reduce the amount of phosphorus and nitrogen entering the watershed which feed cyanobacteria blooms and become available for non-native aquatic plant species.

Item = 0.45 FTE	Status & Timeline
1. Create a public outreach campaign identifying phosphorus in dishwasher detergent as reduction target.	Statewide Ban 2010
2. Create a public outreach campaign educating landowners of phosphorus fertilizers.	2011 Spring
3. Create a public outreach campaign identifying use of native plants verse lawns for lakescaping.	2011 Spring
4. Evaluate current forestry practices.	
5. Continue to support the Siletz Point of Diversion for Lincoln City's Rock Creek water right.	2010 Winter
6. Partner with Chinook Winds Casino and Golf Resort on BMPs.	

Accomplishments to date: The State of Oregon recently passed new legislation regulating the amount of phosphorus in dishwashing detergents. This is a significant step which at the state level can and should abate a large amount of phosphorus into septic tanks which can migrate to the lake. DLWID has worked with local hardware stores to offer phosphate free fertilizer and is beginning its SOS program to educate property owners about native plantings and how that can reduce nutrients from entering the lake. DLWID has also played a critical role in moving forward a proposal of irrigation of the golf course in the watershed which promises to greatly reduce the amount of fertilizer used on the course.

Action Plan for Low Impact Development

GOAL: To provide for development that protects the watershed of Devils Lake which at the same is aesthetic and economically feasible.

Item = 0.46 FTE	Status & Timeline
1. Research LID strategies for the Oregon Coast.	
2. Attend workshops in LID.	
3. Provide outreach for LID in the form of workshops and websites.	
4. Collaborate with local planning departments in the creation of an LID ordinance.	

Accomplishments to date: The Devils Lake Water Improvement District, Lake Manager created a presentation entitled *Safeguarding the Lake: Smart Development & Reasoning for Exceptional Erosion Prevention & Control*. This slideshow was presented to a group of 40-50 local builders and developers at the 2006 Erosion Seminar. District staff has also attended trainings on LID and Raingardens.

Action Plan for Pesticide Reduction

GOAL: To eliminate the use of petrochemical based pesticides and herbicides in the watershed.

Item = 0.69 FTE	Status & Timeline
1. Create list of large landowners that are using pesticides.	
2. Create a list of commonly used or available pesticides in the watershed and research degradation byproducts.	
3. Create a list of alternatives to pesticide use.	
4. Create a list of suppliers and providers of alternatives to pesticides.	
5. Work with OSU Master Gardeners to create an Integrated Pest Management Strategy for the basin.	
6. Create a pesticide-free overlay with local planning authorities.	
7. Create a "Pesticide Free" logo and sign.	Completed 2010
8. Create a webpage with pesticide information.	
9. Create a brochure with pesticide information.	

Accomplishments to date: Lincoln City Green Drinks established a "Pesticide Free" logo and have made up signs which have been handed out at Earth Day.

Action Plan for Heavy Metal Reduction

GOAL: To reduce and prevent toxic metal releases which bioaccumulation into plant and animal tissue.

Item = 0.20 FTE	Status & Timeline
1. Implement “Get the Lead Out” campaign including PSAs.	Lead free weights, signage.
2. Educate the public about toxic metals.	
3. Coordinate with the Solid Waste District on Recycling.	

Accomplishments to date: A “Get the Lead Out” campaign has been initiated which provides for education materials and demonstration products during the Free Fishing Day Weekend. Events are held in conjunction with ODFW and Lincoln City Parks and Recreation Department.

Action Plan for Hazardous Materials

GOAL: To provide for a trained, local team capable of quickly cleaning up or containing hazardous materials in the event of spill in the watershed.

Item = 0.97 FTE	Status & Timeline
1. Create a Haz-Mat team for north Lincoln County.	
2. Develop a list of participants.	Largely identified
3. Develop a communication system.	
4. Develop, print, laminate and distribute a resource list.	
5. Develop a drainage basin map for spill containment.	See Stormwater
6. Investigate funding opportunities for training and supplies.	
7. Train 4-5 individuals with a 40 hour HazWopper certification.	
8. Obtain and maintain supplies of hazardous material cleanup tools.	Supplies in storage
9. Hold regular training sessions.	

Accomplishments to date: The Devils Lake Water Improvement District Lake Manager has for the last few years participated in the bi-monthly emergency preparedness meetings. These meetings include the City of Lincoln City, North Lincoln Fire and Rescue, CERT, Samaritan North Lincoln Hospital, and the Lincoln County Sheriffs Office. Spill responses have been coordinated to some degree with Lincoln City Public Works. A small store of materials has been created by the District which has been used for a number of incidents including two sunken boats.

Action Plan for Invasive Species Prevention

GOAL: To protect Devils Lake from invasion of non-native species.

Item = 0.76 FTE	Status & Timeline
1. Inventory all invasive species currently known to be present in Devils Lake.	2011 Spring
2. Survey and map the invasion.	2011 Summer
3. Obtain a list of likely invaders to Devils Lake based on proximity to sources.	2011 Spring
4. Update Devils Lake Radio 1610 AM with informative new messages.	2011 Spring
5. Build a boat wash station at each of the major boat launches.	2011 Fall
6. Maintain signage at each public boat launch about invasive species.	Ongoing
7. Create an invasive species page on the Devils Lake Water Improvement District Website.	2011 Winter
8. Put the OPB Special: <i>The Silent Invasion</i> on local government access television.	2011 Spring
9. Send out literature to educate public about non-native plants in the garden and aquariums.	2011 Spring
10. Partner with Lincoln Soil and Water Conservation for knotweed control.	
11. Partner with Oregon Department of Agriculture on invasive species control.	
12. Encourage people to take the Stop Aquatic Hitchhikers Pledge (www.protectyourwaters.net).	2011 Spring
13. Obtain and disseminate nuisance species watch cards.	2011 Spring
14. Publish invasive species information on the email list serv.	2011 Spring

Accomplishments to date: The Devils Lake Radio has recently been updated and additional public service announcements are being developed. Some funds for a boat wash station have been raised, although many additional dollars are required. A partnership for placement of the facilities has also occurred, with a focus on parcels owned by the City of Lincoln City. DLWID has in the past partnered with the Lincoln Soil and Water Conservation District for knotweed control.

Action Plan for Native Vegetation

GOAL: To revegetate Devils Lake with native plants capable of sequestering nutrients and trapping sediments at the same time as providing habitat for fish and wildlife.

Item = 0.71 FTE	Status & Timeline
1. Create a current inventory of native and non-native aquatic species in the lake.	2011 Summer
2. Map the data with GIS.	2011 Summer
4. Re-apply to DSL and USACE for the permits to install improved design of enclosure.	2011 Winter
5. Contract to build enclosures	2012 Spring
6. Create and implement a monitoring program of the enclosures for fish and non-natives plants.	2012 Spring
7. Evaluate success and create additional enclosures around the perimeter of Devils Lake.	2012 Fall
8. Long-term work with ODFW and NOAA-Fisheries to develop a means of allowing the permanent establishment of natives in the lake.	

Accomplishments to date: The District has contracted with a private company to develop a planting technique that would meet the needs of ODFW for excluding fish. This plan was part of the Shoreline Planting Guide. Further, the District has written a DSL and USACE Removal/Fill application for a similar project which can be used as a template for a new application.

Action Plan for Invasive Species Control

GOAL: To track and have the ability to respond to introductions of non-native invasive aquatic plants in Devils Lake.

Item = 0.63 FTE	Status & Timeline
1. Create a current inventory of native and non-native aquatic species in the lake.	2011 Summer
2. Map the data with GIS.	2011 Summer
3. Through meetings and public outreach evaluate the level of control required.	2011 Spring
4. Determine preferred physical control methodologies for rapid response.	2011 Spring
5. Coordinate with outside agencies for permits to conduct rapid response control methods.	2011 Fall
6. Establish or train contractors to perform work.	
7. Continue to survey and map the vegetation annually.	
8. Activate rapid response as necessary.	
9. Evaluate the effectiveness of control methods.	
10. Determine if larger scale methods area appropriate.	

Accomplishments to date: The Devils Lake Water Improvement District in 2006-2007 created and evaluated a list of vegetation control technologies. These strategies have been considered by the Devils Lake Water Improvement District's Board of Directors and have been made available to the public through the District's meetings and through its website. Staff has provided feedback on various methods providing Pros vs. Cons document for each of the 25 methods identified.

Action Plan for Chinese Grass Carp

GOAL: To provide the assurance and ability to act against the re-colonization of nuisance aquatic vegetation using a known, a relatively cost effective method of biological control, the herbivorous Chinese Grass Carp.

Item = 0.55 FTE	Status & Timeline
1. Attend meetings of the ODFW Commission; provide public input regarding efforts to improve Devils Lake.	2007 & 2008
2. Apply for Grass Carp Permit.	Completed 2008
3. Establish timeline to appeal decision.	2010 Fall
4. Implement Action Plans: Invasive Species Prevention, Native Vegetation, Invasive Species Control, Septic Tank Revitalization, Riparian and Shoreline Vegetation, Stormwater Management, Erosion and Sediment Control, and Wetland Protection.	2010-2020
5. Establish the stocking number required for vegetation control.	2011 Summer
6. Contract with engineer to delineate structures that meet ODFW's requirement for grass carp control.	Winter 2010
7. Appropriate funding for grass carp purchase.	
8. Formally appeal ODFW's decision for stocking Devils Lake with Grass Carp.	2011 Fall
9. Implement educational program on the prohibition of angling for and/or transport of Grass Carp.	2011 Fall
10. Purchase Grass Carp from reputable source and plant under permit.	As required

Accomplishments to Date: The Devils Lake Water Improvement District has made application to ODFW for Grass Carp in 2009. This application was denied as expected. The District has since met with the ODFW Commission on two separate occasions identifying current strategies for lake management. The District has also established a reserve line item in the Improvement Fund for a future expenditure.

Action Plan for The CAFÉ

GOAL: To create The Center for Applied Freshwater Ecology which will serve as an education and research facility for generations to come.

Item = 0.91 FTE	Status & Timeline
1. Form an action group: community leaders, business leaders, & academic professionals	
2. Get the partners: academic, economic & community	PSU & Lincoln City Chamber
3. Develop a business plan for The CAFÉ.	
4. Solicit suitable sites.	
5. Draw up the plans: architectural drawings of the building, exhibits, displays & labs	
6. Develop funding strategy.	
7. Research & write grants.	
8. Secure funding.	
9. Acquire facility or construct.	
10. Open the doors!	

Accomplishments to date: The Center for Applied Freshwater Ecology as a concept has been developed and a preferred site selected. Data has been compiled on the site and adjacent parcel. A presentation exploring the idea has been made which has been given to Lincoln City Chamber and Lincoln City Kiwanis Club which was well received. Contacts have been made in academia, specifically Portland State University who are committed to further development of The CAFÉ concept. Contact has been initiated with US Senator Ron Wyden, former US Senator Gordon Smith, and former US Representative Darlene Hooley for funding advice. Locally meetings have been held with Lincoln City's Mayor, the Visitor and Convention Bureau, Lincoln City Public Works and Lincoln City Parks and Recreation Department. Funding alternatives have also been assessed through USDA Core Grants.

Action Plan for Monitoring & Measuring Success

GOAL: To provide for ongoing monitoring of water quality to meet the objectives of recreational water in the state of Oregon, long-term data acquisition, and effectiveness monitoring of restoration efforts.

Item 0.40FTE	Status & Timeline
1. Maintain training.	2011
2. Maintain lab supplies.	Ongoing
3. Sample weekly Memorial Day to Labor Day for <i>E. coli</i> and physical parameters.	2011 Summer
4. Post results online, with media and on listserv weekly.	2011 Summer
5. Conduct bi-weekly cyanobacteria monitoring during blooms.	2011 Summer
6. Post data online, with media and on listserv.	2011 Summer
7. Develop water quality targets for the watershed.	
8. Develop a nutrient budget based model of the lake to determine trophic state.	
9. Supplement water quality data with additional monitoring as needed.	
10. Prioritize projects based on model.	

Accomplishments to date: The Devils Lake Water Improvement District conducts three monitoring programs currently, the Bacterial Monitoring Program, the Cyano-Watch program, and the Physical and Chemical monitoring program. The District has recently completed a Quality Assurance Project Plan (QAPP) and Sampling and Analysis Plans (SAPs) for these various programs. Additionally in 2010, the District has been developing a fecal source tracking program for Thompson Creek. This program may then be expanded upon to other watersheds.

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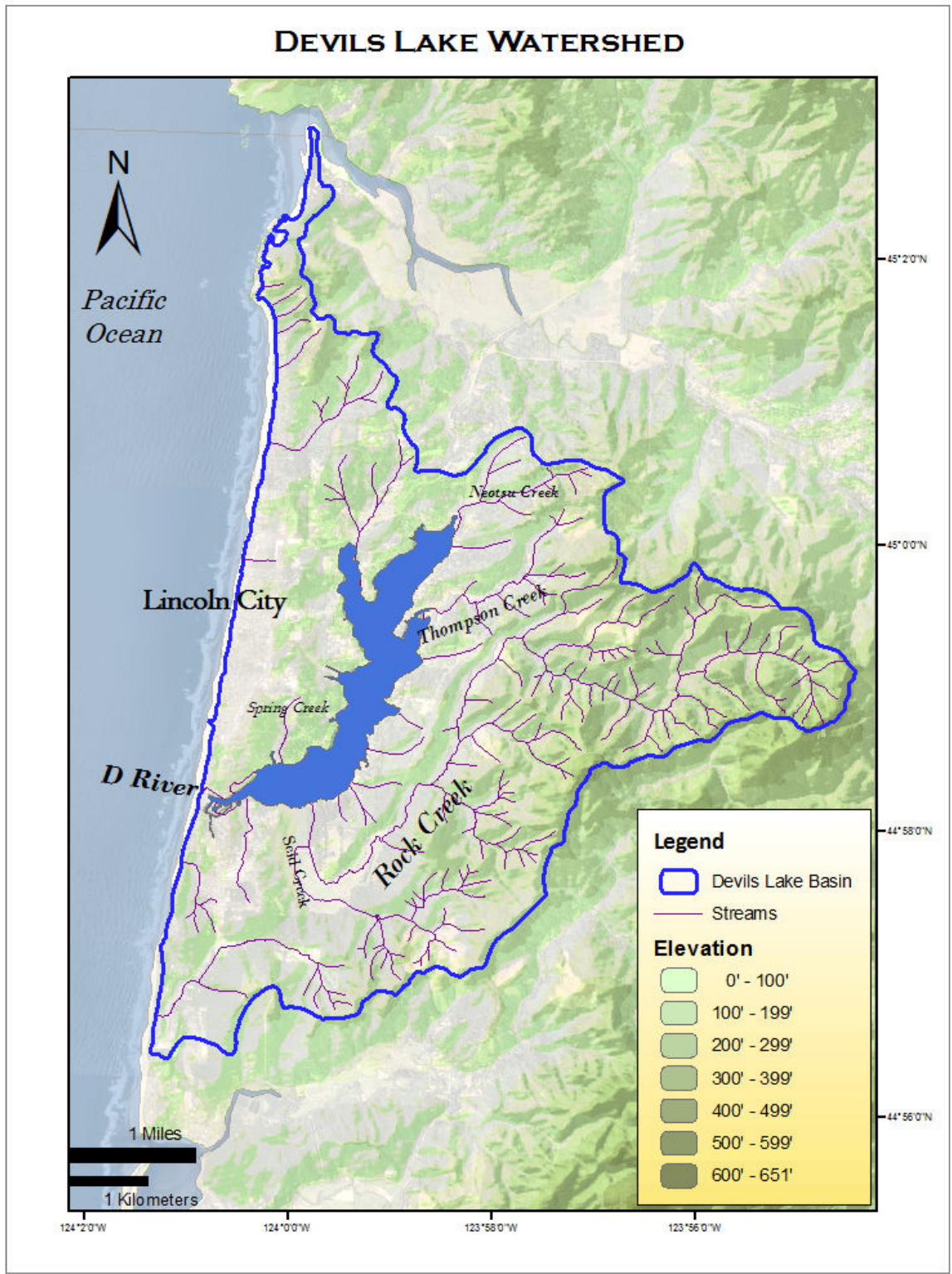
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APPENDIIX

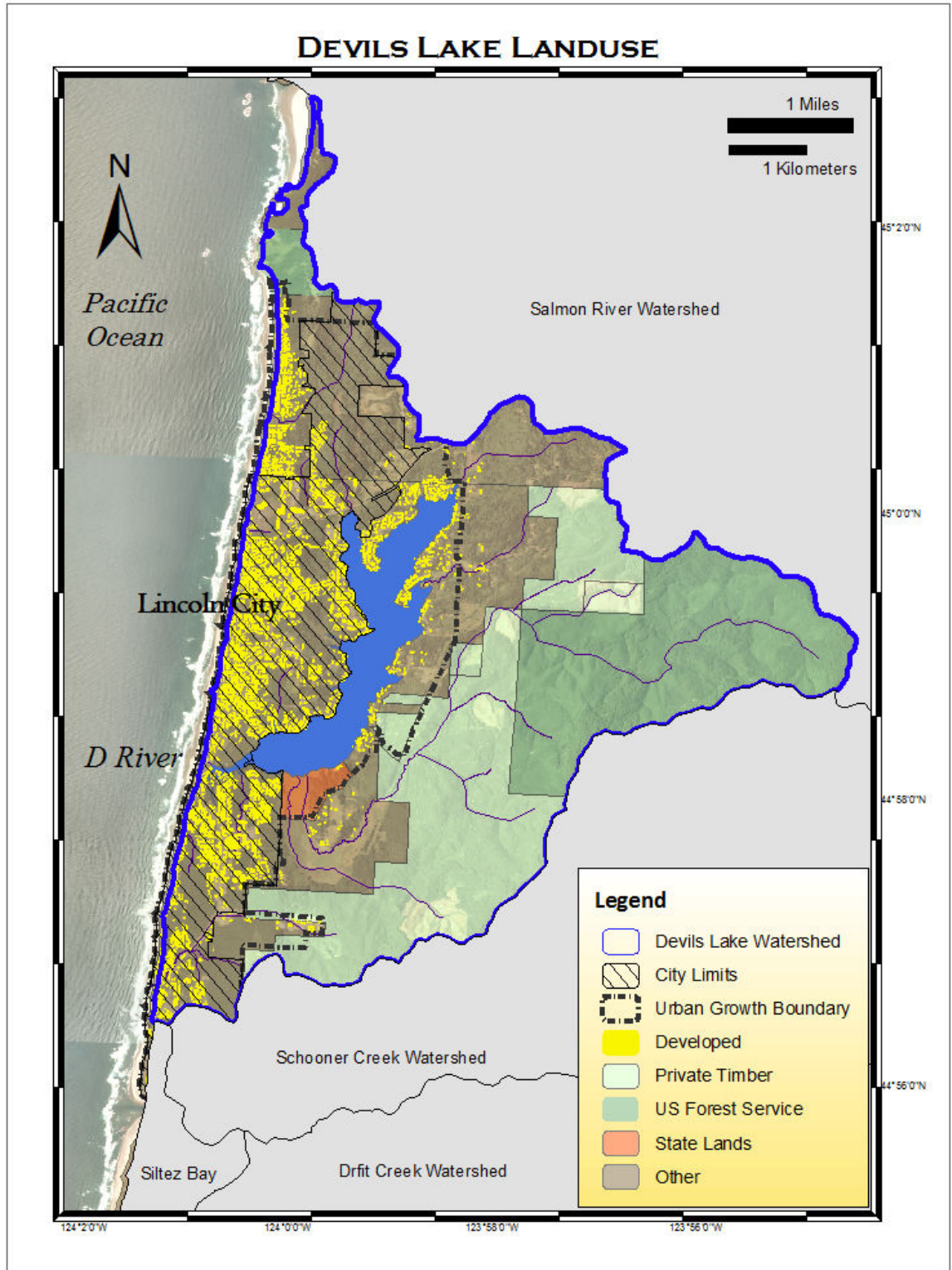
List of Appendices

- Devils Lake Watershed Map
- Devils Lake Land Use Map
- Devils Lake Bathymetric Map
- Devils Lake Wetland & Riparian Zone Map
- Devils Lake Recreation Map
- Devils Lake Species List
- USFWS Species Report

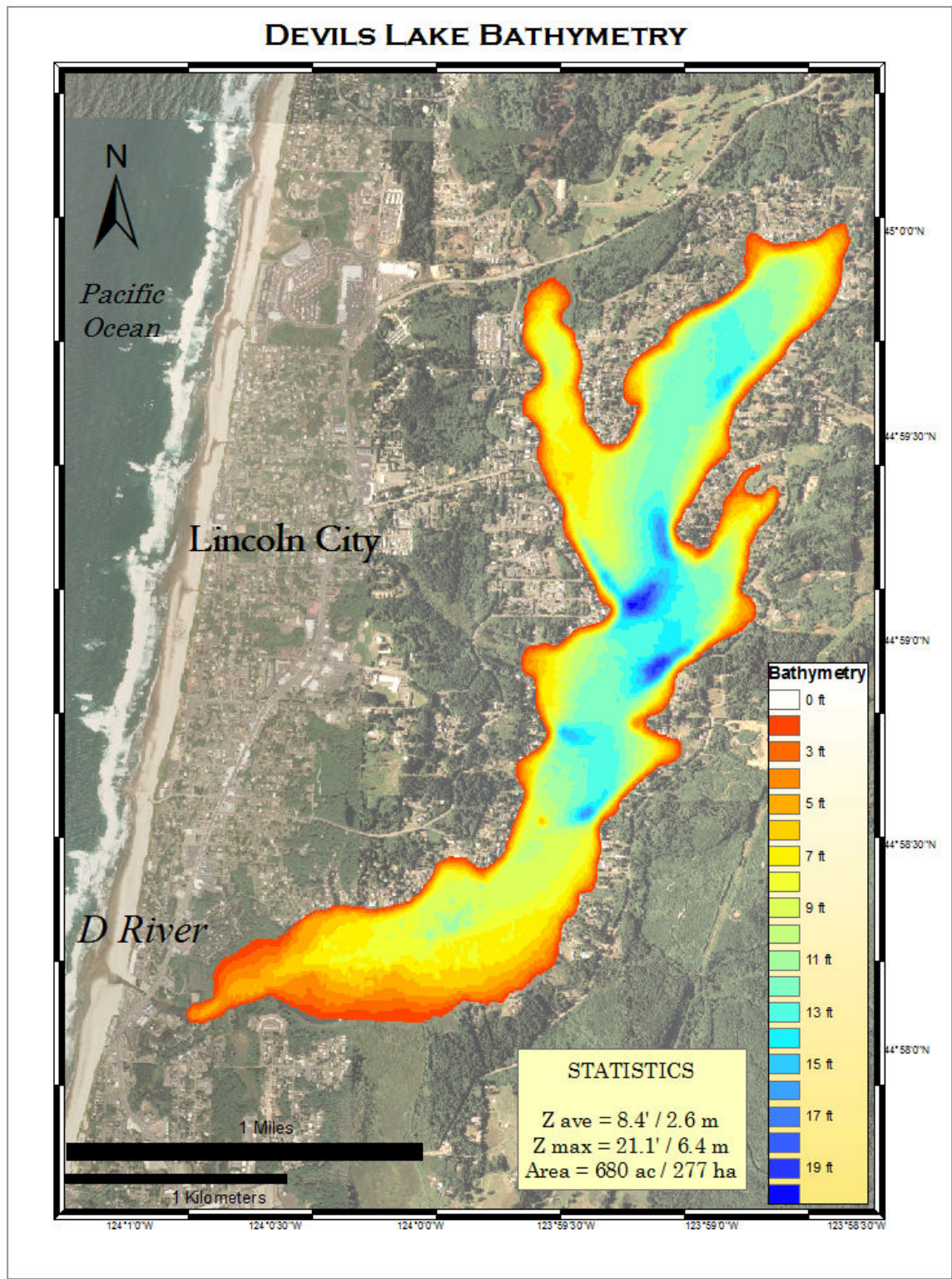
Devils Lake Watershed Map



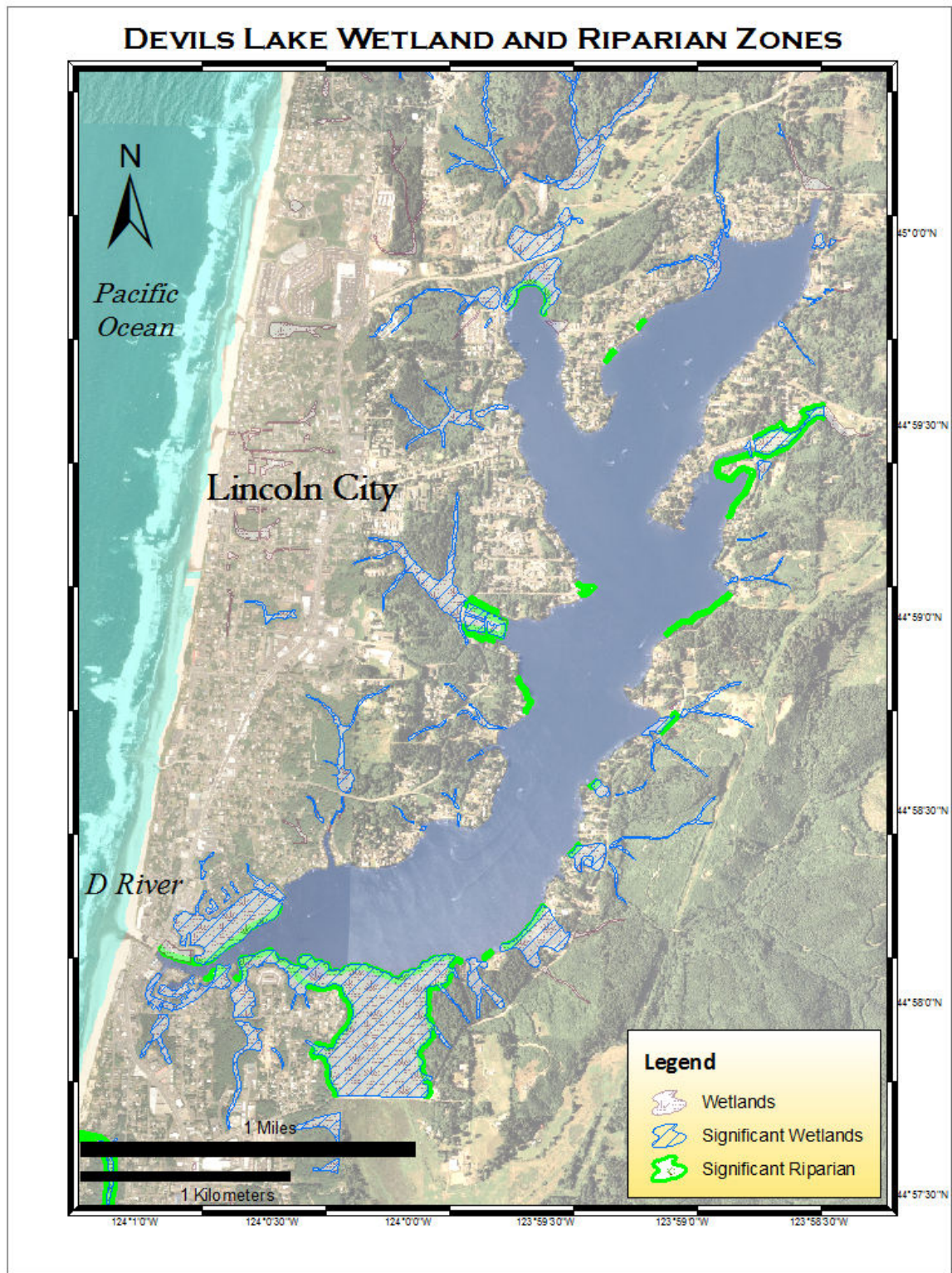
Devils Lake Land Use Map



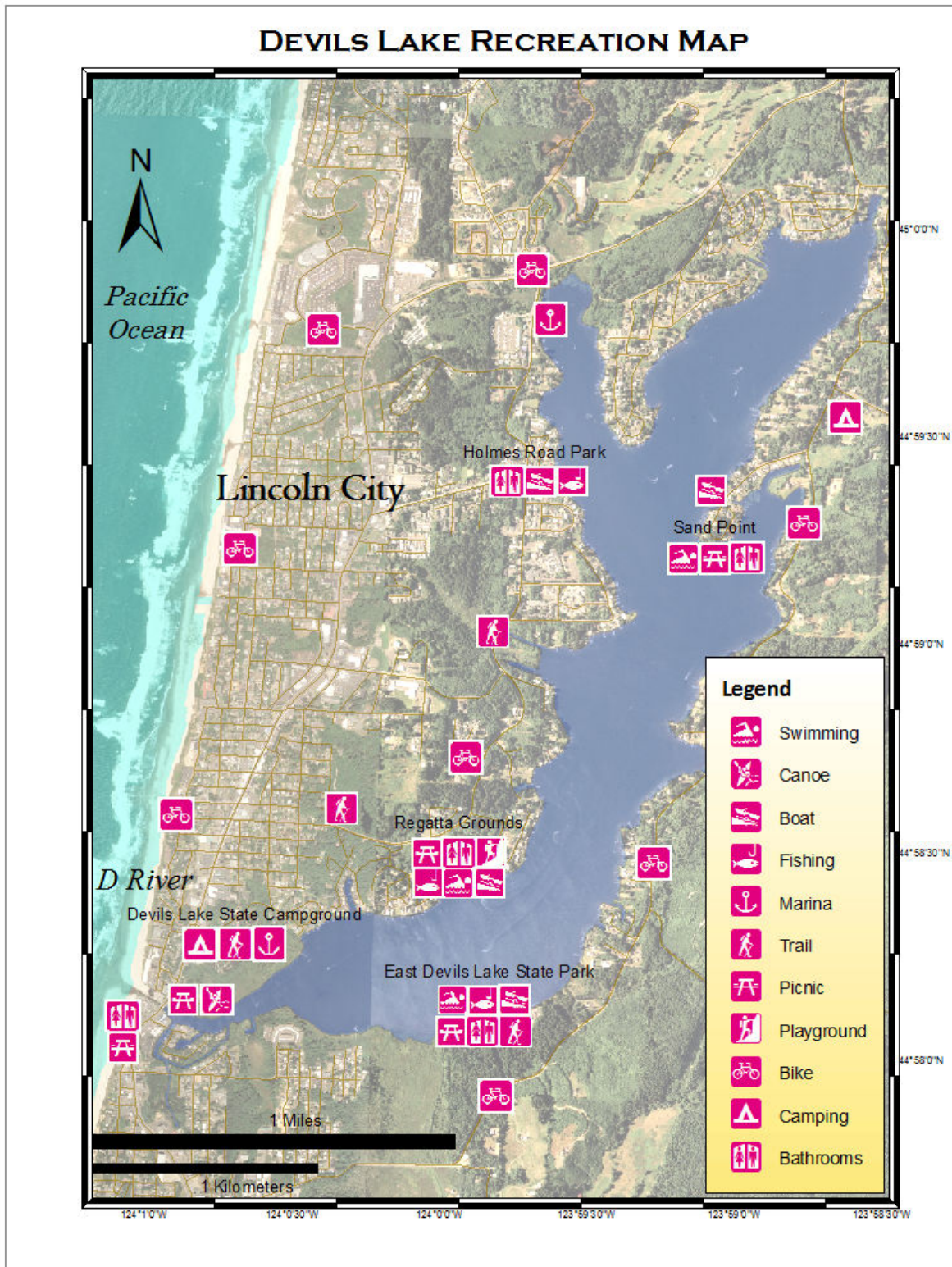
Devils Lake Bathymetric Map



Devils Lake Wetland & Riparian Zone Map



Devils Lake Recreation Map



Devils Lake Species List

*Compiled primarily from "Environmental Assessment Report Devils Lake Flood Control". US Army Corps of Engineers. 1974.

Kingdom Animalia

Phylum Protozoa

- Class Rhizopoda
 - Subclass Amoebina e.g. Amoeba ep.
- Class Flagellata
 - Subclass Phytomastigine
 - Subclass Zoomastigina
- Class Ciliophora
 - Subclass Ciliata e.g. Paramecium sp.
 - Subclass Suctoria e.g. Podophyra sp.

Phylum Platyhelminthes (flatworm.)

- Class Turbellaria e.g. Planaria sp.
- Class Trematoda *Trogloremma salminicola* (Salmon Poison fluke)
- Class Cestoda *Proteocephalus ambloplites* (bass tapeworm)

Phylum Nematoda (roundworm.)

- e.g. *Ascertic* ep.

Phylum Rotifera (rotifers)

- e.g. *Asplanchna* sp., *Keratella* sp.

Phylum Annelida (segmented worm.)

- Class Polychaeta
- Class Oligochaeta
 - Order Limicolae e.g. *Tubifex* sp.
- Class Hirudinea (leeches)

Phylum Arthropoda

- Class Crustacea
 - Subclass Branchiopoda e.g. *Daphnia* sp.
 - Subclass Ostracoda e.g. *Cypris* sp.
 - Subclass Copepoda e.g. *Cyclops* sp., *Diaptomus* ep.
 - Subclass Malacostraca
 - Order Isopoda
 - Order Amphipoda e.g. *Gammarus* ep. (River also)*
 - Order Decapoda e.g. *Pacifastacus* sp. (crayfish)*
- Class Insecta
 - Subclass Apterygota
 - Subclass Pterygota
 - Superorder Exopterygota
 - Order Plecoptera (Stoneflies)
 - Order Ephemeroptera (mayflies., e.g. *Ephemeroptera** ep.)
 - Order Odonata (dragonflies)
 - skimmer dragonfly, *Libellula* sp.
 - blue damselfly, *Enallagma* sp.,
 - Order Hemiptera water strider, *Gerris* sp.
 - Superorder Endopterygota
 - Order Neuroptera (aldenflie.)
 - Order Trichoptera (caddieflies)
 - Order Coleoptera (beetles)
 - Order Diptera (gnats and midgea)

Phylum Mollusca

- Class Gastropoda (snails, limpet, etc.) flat—coil snail,
Family Planorbida.; salmon snail, Coniobasi. *p.,*
- Class Lamellibrenchia (bivalve molluscs)
fresh water mussel, Anodonta* sp.,
pea clam, Family Cyrenidae

Phylum Chordata

Subphylum Vertebrata

Class Pisces

Superorder Teleostei (all observed in area)

- coho (silver) salmon, *Oncorhynchus kisutch*
- steelhead trout, *Salmo gairdneri*~
- searun cutthroat trout, *Salmo clarki*
- largemouth bass, *Micropterus salmoides*
- black crappie, *Pomoxis nigromaculatus*
- white crappie, *Pomoxie anuularie*
- yellow perch, *Perca flavescens*
- sturgeon *Acipeneer* sp.
- rainbow trout, *Salvo gairdneri*
- prickly sculpin, *Cottus asper*
- pacific lamprey, *Entosphenus tridentatus*
- long—finned smelt, *Spirinchus dilatue*
- carp, *Cyprinus carpio*
- brown bullhead, *Ameirus nebulo~us*
- channel catfish, *Ictalurue lacultris*
- three—spied stickleback, *Casterosteus aculeatus*
- grass carp *Ctenopharynogodon idella*

Class Ayes

- | | |
|------------------------|----------------------------------|
| bald eagle | <i>Halaieetus leucocephalus</i> |
| mallard | <i>Anas platyrhynchoS</i> |
| bufflehead | <i>Bucephala albeola</i> |
| ruddy duck | <i>Oxyura jamaicensis</i> |
| pied-billed grebe | <i>Podilymbus podiceps</i> |
| cormorant | <i>Phalacrocora</i> |
| gadwall | <i>Anas strepera</i> |
| canvasback | <i>Aythya valisineria</i> |
| scaup | <i>Aythya spp.</i> |
| ring-necked duck | <i>Aythya collaris</i> |
| western grebe | <i>Aechmophorus occidentalis</i> |
| green-winged teal | <i>Anas crecca</i> |
| Eurasian wigeon | <i>Anas penelope</i> |
| northern shoveler | <i>Anas clypeata</i> |
| northern pintail | <i>Anas acuta</i> |
| wood duck | <i>Aix sponsa</i> |
| redhead | <i>Aythya americana</i> |
| goldeneye | <i>Bucephala Spp.</i> |
| Canada goose | <i>Branta canadensis</i> |
| tundra swan | <i>Olor columnbiaflUs</i> |
| white-winged scoter | <i>Melanitta fusca</i> |
| surf scoter | <i>Melanitta perspicillata</i> |
| eared grebe | <i>Podiceps nigricollis</i> |
| horned grebe | <i>Podiceps auritus</i> |
| red-necked grebe | <i>Podiceps grisegena</i> |
| hooded merganser | <i>Lophodytes cucullatus</i> |
| red-breasted merganser | <i>Mergus serserrator</i> |
| common loon | <i>Gavia immer</i> |

Class Amphibia (all observed in area)

Pacific newt, *Taricha granulosa*
Long-tailed salamander, *Ambystoma macrodactylum*
Northwestern salamander, *A. gracile*
Pacific giant salamander, *Dicamptodon ensatus*
Pacific treefrog, *Hyla regilla*
Bullfrog, *Rana catesbeiana*

Class Reptilia

Garter and "Water" snakes, *Thamnophis* spp. (observed)

Class Mammalia (all observed in area)

Beaver, *Castor canadensis*
Muskrat, *Ondatra zibethica*
Nutria, *Nvodocastor. covvuu*
Raccoon, *Procyon lotor*
Mink, *Lutreola lutreola*
River otter, *Lutra canadensis*
Deer, *Odocoileus bemonue columbianus*

USFWS Species Report

US Fish and Wildlife Service

Species Reports: Lincoln County, Oregon

As of 2011-02-23

Group	Name	Status
Birds	Aleutian Canada goose (<i>Branta canadensis leucopareia</i>)	Recovery
Birds	Short-tailed albatross (<i>Phoebastria (=Diomedea) albatrus</i>)	Endangered
Birds	Arctic peregrine Falcon (<i>Falco peregrinus tundrius</i>)	Recovery
Birds	Western snowy plover (<i>Charadrius alexandrinus nivosus</i>)	Threatened
Birds	Northern spotted owl (<i>Strix occidentalis caurina</i>)	Threatened
Birds	Marbled murrelet (<i>Brachyramphus marmoratus</i>)	Threatened
Insects	Oregon silverspot butterfly (<i>Speyeria zerene hippolyta</i>)	Threatened
Mammals	North American wolverine (<i>Gulo gulo luscus</i>)	Candidate
Reptiles	Leatherback sea turtle (<i>Dermochelys coriacea</i>)	Endangered
Reptiles	Green sea turtle (<i>Chelonia mydas</i>)	Threatened
Reptiles	Loggerhead sea turtle (<i>Caretta caretta</i>)	Threatened