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MEMORANDUM

TO:	Tabitha Biehl Land & Water Natural Areas Manager Polk County Parks & Natural Resources Division
FROM:	Lance Lumbard, MS, MBA; Tiffany Davies, PE
DATE:	July 17, 2024
RE:	FINAL Preliminary Results for Task 2 – Groundwater Seepage Screening, Polk County Water Quality Assessments, and Improvements Project
WSP PROJECT NO.:	600527X3.1.1G

1.0 BACKGROUND

WSP (formerly Wood Environment & Infrastructure Solutions, Inc.) was contracted by Polk County (the County) to conduct a water quality assessment and provide recommendations on improvements for select lakes within the County. As part of the overall project, WSP is currently conducting a feasibility study to understand groundwater connectivity and potential seepage into six lakes in the County. A screening-level assessment of groundwater seepage as a pollutant source is currently underway. Four groundwater seepage meters were installed in Lakes Clinch, Crooked , Deeson, and Hamilton, ; three meters were installed in Lake Lulu; and five meters were installed in Lake Pierce (**Figure 1.1**). Meters were sampled six time (every two months) between July 2021 and May 2022. to evaluate seepage pollutant loading. WSP measure monthly volume at each seepage meter and, using the surface area of the seepage meter, determined the seepage flow rate. WSP also collected water quality samples to determine total nitrogen (TN) and total phosphorus (TP) concentrations which were used with flow rates to estimate seepage pollutant loading at each seepage meter. Data analysis and interpretation is ongoing, with preliminary results (average loads) summarized below.

2.0 PRELIMINARY RESULTS

Preliminary average loading (mg/m^2) results are displayed in **Figure 2.1** through **Figure 2.12**. Square symbols represent groundwater loading at each station for each lake. Circles on the figures represent the average loading for all 24 stations included in the study placed into ten bins shown in each legend representing a range of low to high loadings. The maps allow for visual comparison and interpretation of each station's average nutrient load (squares) and which nutrient load bin it falls in across the entire study (circle). As such, a station average load might be considered high for that lake, but the value may be low within the context of the range of loads observed across all lakes. This helps to identify priority sites across the study area. Potential nutrient loading sources (e.g., septic tank locations, wastewater facilities, land application sites and residual application sites) are also shown on the figures.

In Lake Clinch, the average daily TN groundwater load (Figure 2.1) was highest at LC-04 followed by LC-01. These stations represent some of the highest TN groundwater loads compared to the other seepage stationss. The average daily TP groundwater loads (Figure 2.2) were also highest at LC-01 and LC-04. LC-04 had the highest TP groundwater load of any seepage meter. Several wastewater facilities are located upgradient of LC-04 a shown in Figures 2.1 and 2.2.

In Crooked Lake, the average daily TN groundwater load (Figure 2.3) and TP groundwater load (Figure 2.4) were highest at CL-01 and CL-02. Compared to other lakes in this study, TN groundwater load was also relatively high at CL-01 and CL-02. TP groundwater loads were relatively low in Crooked Lake compared to the other study lakes. Wastewater facilities, septic tanks, and percolation ponds are all potential nutrient sources located adjacent to Crooked Lake.

Average daily TN groundwater load in Lake Deeson (Figure 2.5) was highest at LD-01 while loads were relatively low at the remaining stations. LD-01 also had the highest average TN groundwater load of all seepage stations in the study. The average daily TP groundwater load (Figure 2.6) was highest at LD-01. TP groundwater loading was generally low in Lake Deeson seepage meters compared to seepage meters in other study lakes. Potential nutrient sources surrounding Lake Deeson include septic tanks and stormwater infrastructure.

In Lake Hamilton, the average daily TN groundwater load (Figure 2.7) was highest at LH-01 and LH-04. TN groundwater loading in Lake Hamilton seepage meters was moderate compared to other study lakes. All seepage meters in Lake Hamilton had comparatively low TP groundwater loading (Figure 2.8) and LH-01, LH-02, and LH-04 had slightly higher TP loading than LH-03. Septic tanks, wastewater facilities and percolation ponds are some of the potential nutrient sources located around Lake Hamilton.

Of the six lakes included in the study, TN (Figure 2.9) and TP groundwater loads were lowest in Lake Lulu (Figure 2.10). Station LL-02 had the lowest TN and TP groundwater loads out of all stations monitored as part of the study. Within Lake Lulu, the highest TN and TP groundwater loads were observed at LL-03.

Average daily TN groundwater load in Lake Pierce (Figure 2.11) was highest at LP-02 and LP-05. The highest average daily TP groundwater load (Figure 2.12) was at LP-01 and LP-04. These stations had relatively moderate to high groundwater loads compared to stations in the other study lakes. Septic tanks and wastewater facilities are present along the western side of Lake Pierce.

3.0 SUMMARY AND RECOMMENDATIONS

Seepage meters with higher groundwater loading may indicate that there is an upgradient pollutant source which may contribute to surface water nutrient concentrations. Based on preliminary results from this study, groundwater seepage may be a significant source of nutrients to several of the studied lakes. Total seepage pollutant loading should be estimated for each lake to evaluate the impact to the overall lake nutrient budget. Within Polk County, potential nutrient sources include, but are not limited to, septic tanks, land and residual application sites, and wastewater facilities.

Based on the seepage meter data collected in this assessment, the following lakes and pollutants should be prioritized: Lake Clinch (TN and TP), Crooked Lake (TN), Lake Deeson (TN), and Lake Pierce (TP). Full-scale groundwater seepage studies with refined (additional) seepage meter locations are recommended to provide lakewide seepage nutrient loading. Although groundwater nutrient loads were lower in Lake Hamilton than in the priority study lakes, there are several potential nutrient sources located near the shoreline. A full-scale groundwater seepage study is recommended for Lake Hamilton, but it is not considered a priority lake. A full-scale groundwater seepage study is not necessary for Lake Lulu at this time because groundwater nutrient loads are low and there are limited potential upgradient nutrient sources.

A full-scale groundwater seepage study typically includes installation of additional seepage meters to determine the quality and quantity of shallow groundwater seepage entering the lake. Prior to meter installation, available data should be reviewed and site reconnaissance should be performed. This may include the sampling of temporary push-point wells to determine groundwater flow direction. Legacy land uses, (e.g., mining, citrus, and other agricultural land uses) should also be evaluated to assess the potential for legacy effects on groundwater resources. These meter locations are selected based on groundwater flow direction and location of potential sources likely to contribute to nutrients found in groundwater (i.e., septic tanks, fertilized areas, and wastewater application sites). If possible, seepage meters should be installed in areas with and without septic tanks in an attempt to identify possible contributions from septic tank areas, if relevant. Routine monitoring should take place for a period of at least one year with samples collected approximately every two months. During each sample collection event, the quantity of seepage collected in each seepage meter is measured and samples of water collected from the seepage meters are submitted to a laboratory for TP and TN analysis. Additional wastewater tracer (e.g., sucralose, pharmaceuticals, etc.), isotopic analysis, and herbicide/pesticide parameters may also be included with the analyte list for select seepage meters.

Data from a full-scale seepage study may be used to develop a lakewide seepage loading estimate and provide a management tool for water quality improvement. While the conceptual projects depend on the pollutant source and site-specific conditions, example projects that can be implemented to reduce nutrient contamination in groundwater include septic-to-sewer conversion and improvements to wastewater facilities. Low impact development (LID) best management practices (BMPs) can also be implemented to improve the quality of stormwater that infiltrates to groundwater. The overall goals of LID are to “slow, spread, and soak” preventing excess stormwater runoff by creating upgradient storage volumes. This reduces the volume of stormwater runoff by increasing the amount of pervious area, allowing stored water to infiltrate into the groundwater, and treating stored water (for nutrient removal) with vegetation or biosorption activated filter media before infiltration or discharge. LID BMPs include bioretention/bioinfiltration basins (commonly referred to as rain gardens), stormwater ponds, treatment wetland, and bioswales. Some LID BMPs can be enhanced with biosorption activated media (BAM) to enhance nutrient removal prior to infiltration. Stormwater infiltration generally increases the amount of seepage to a lake. Therefore, BAM enhancements are critical for binding TP and controlling the movement of nutrients within the groundwater.

Figure 1.1 – Monitored Lakes

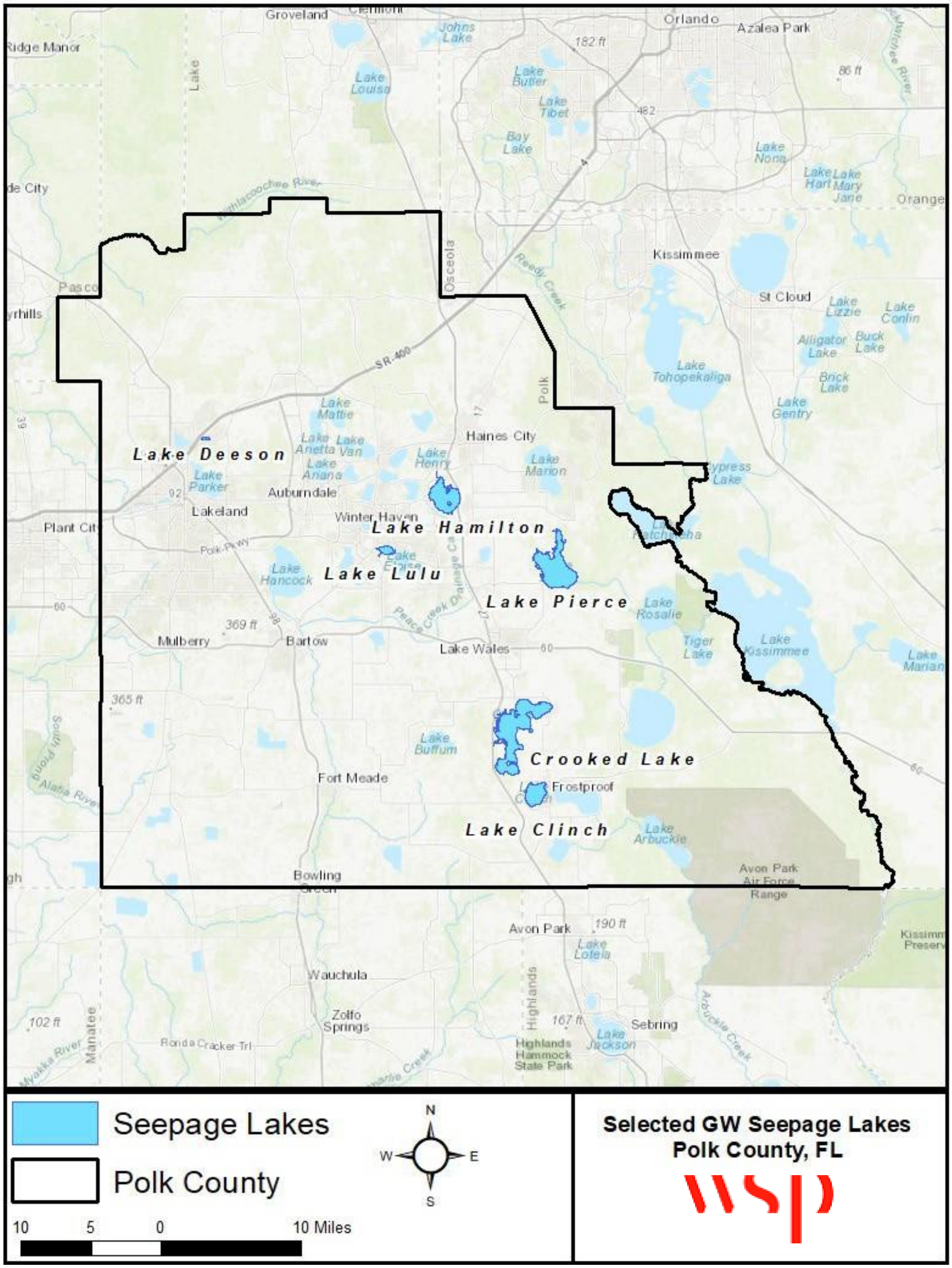

Figure 2.1 – Average Daily Seepage Meter TN Loading at Lake Clinch

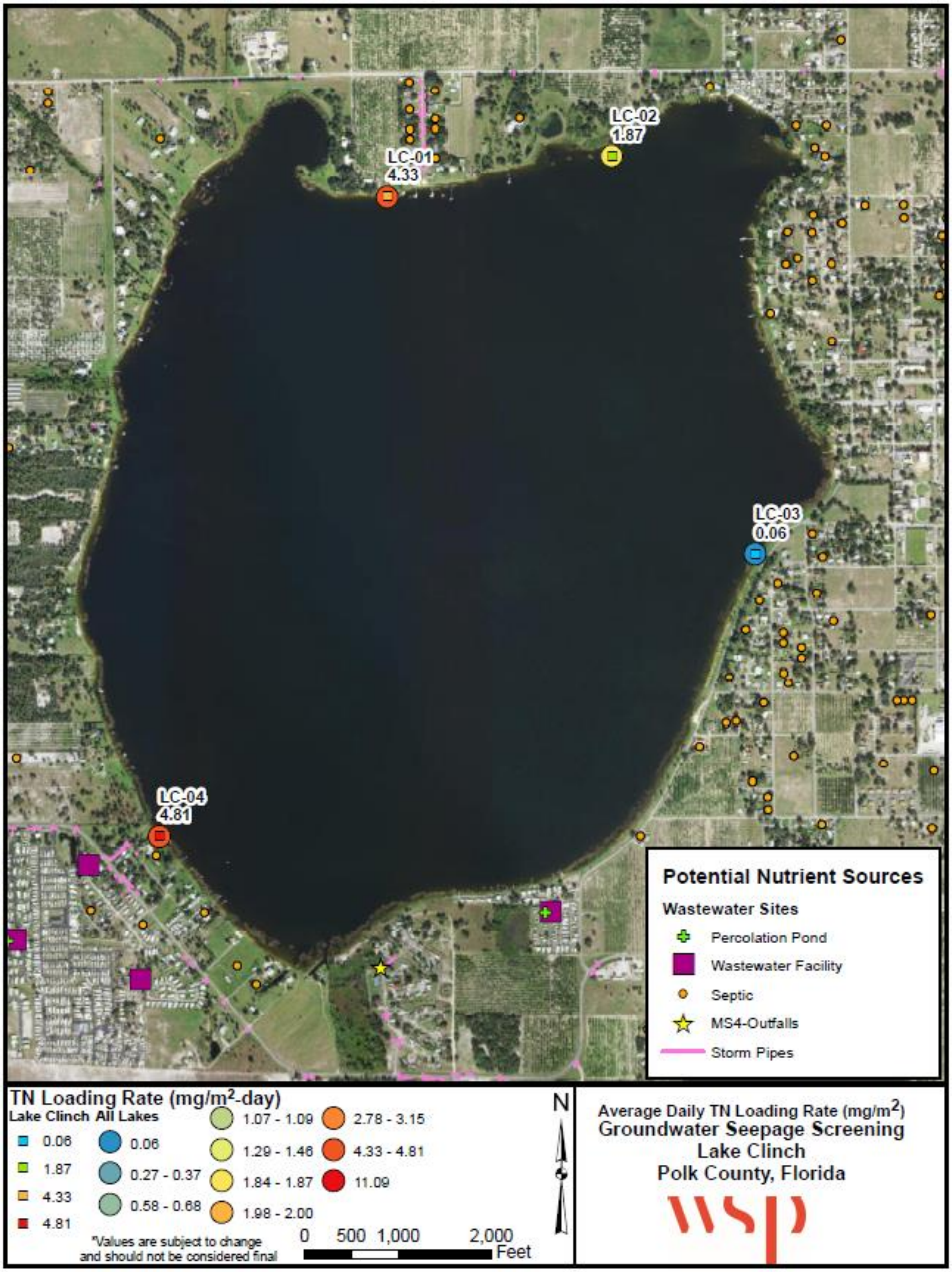

Figure 2.2 – Average Daily Seepage Meter TP Loading at Lake Clinch

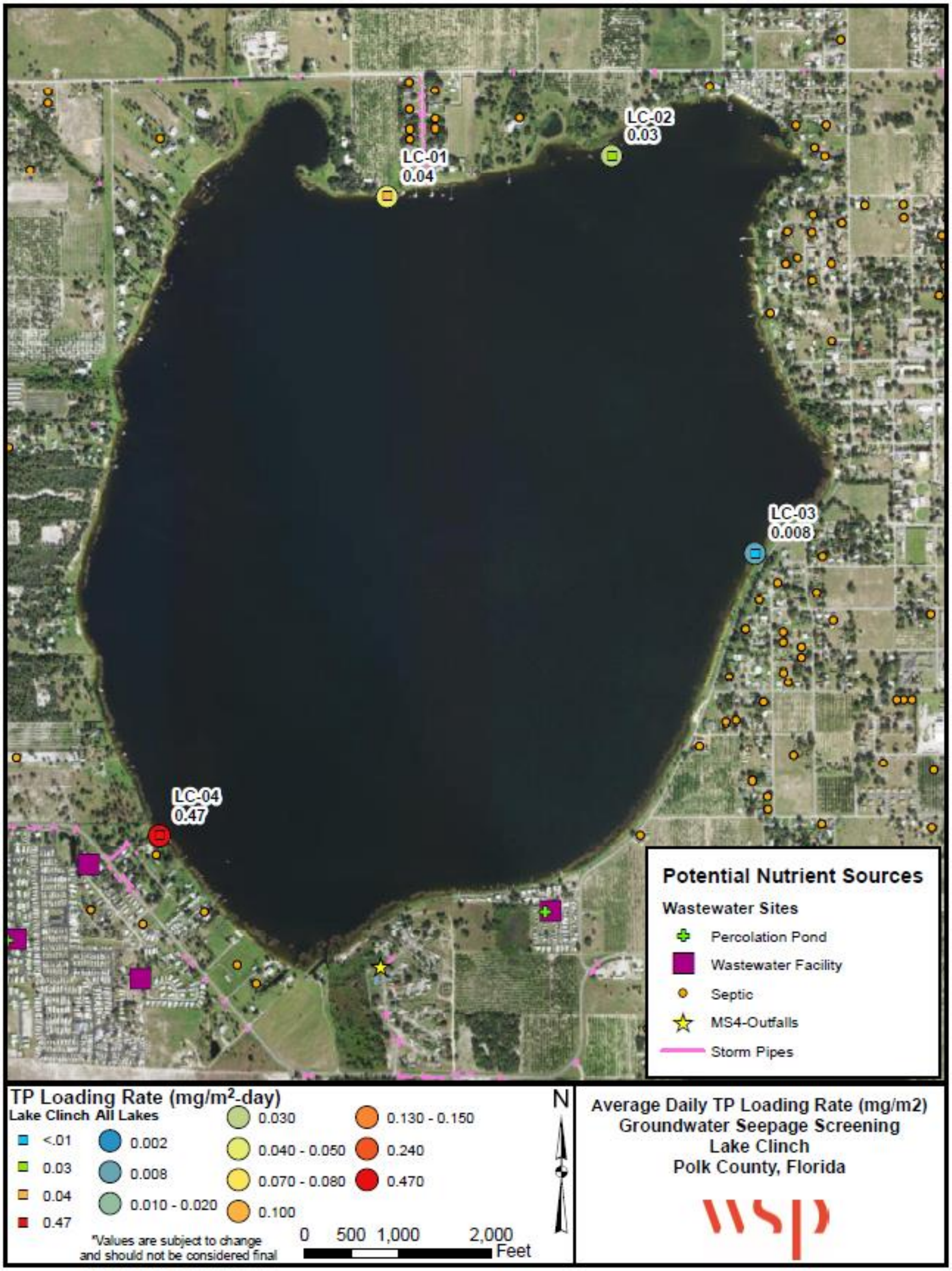

Figure 2.3 – Average Daily Seepage Meter TN Loading at Crooked Lake

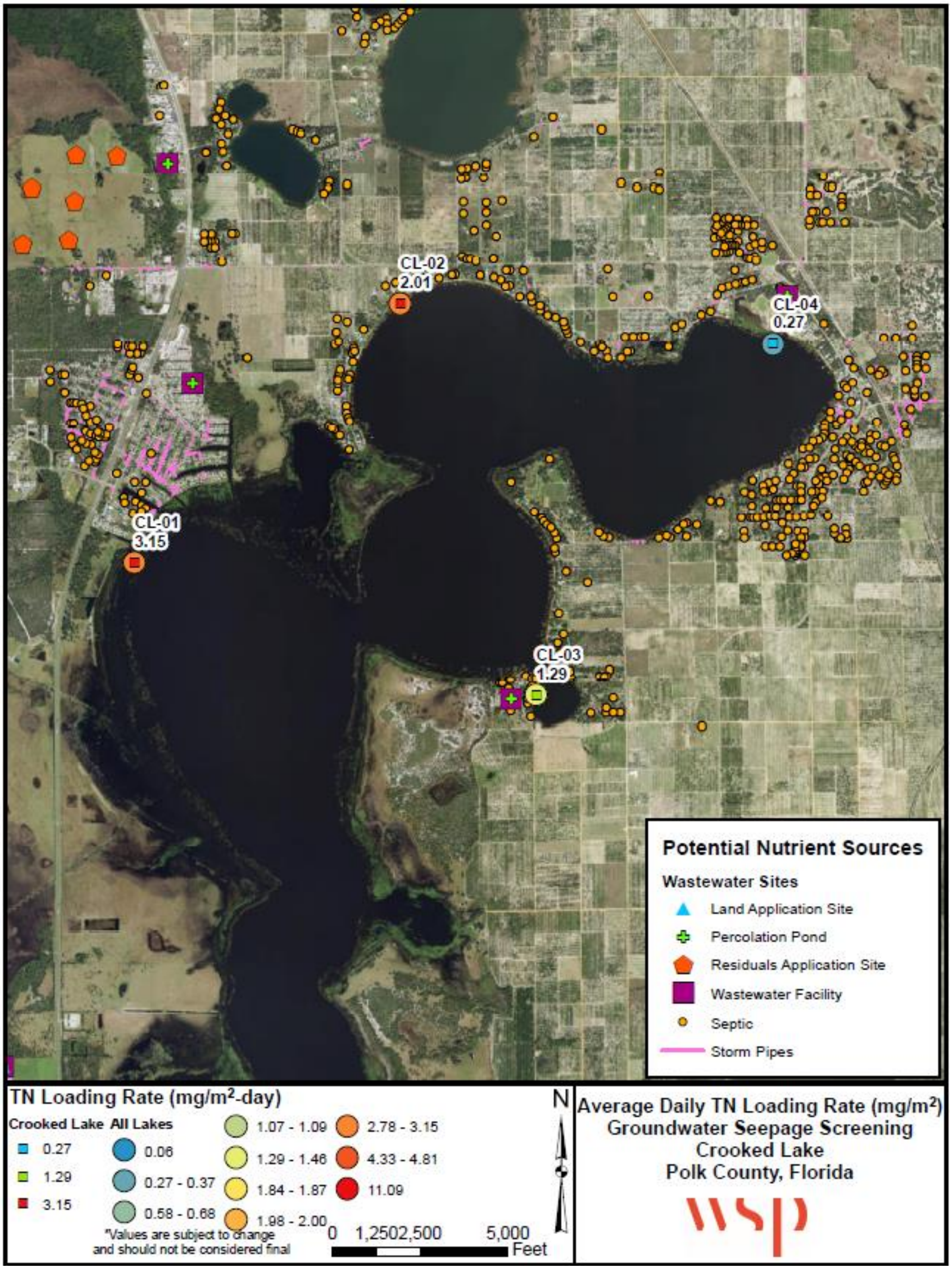

Figure 2.4 – Average Daily Seepage Meter TP Loading at Crooked Lake

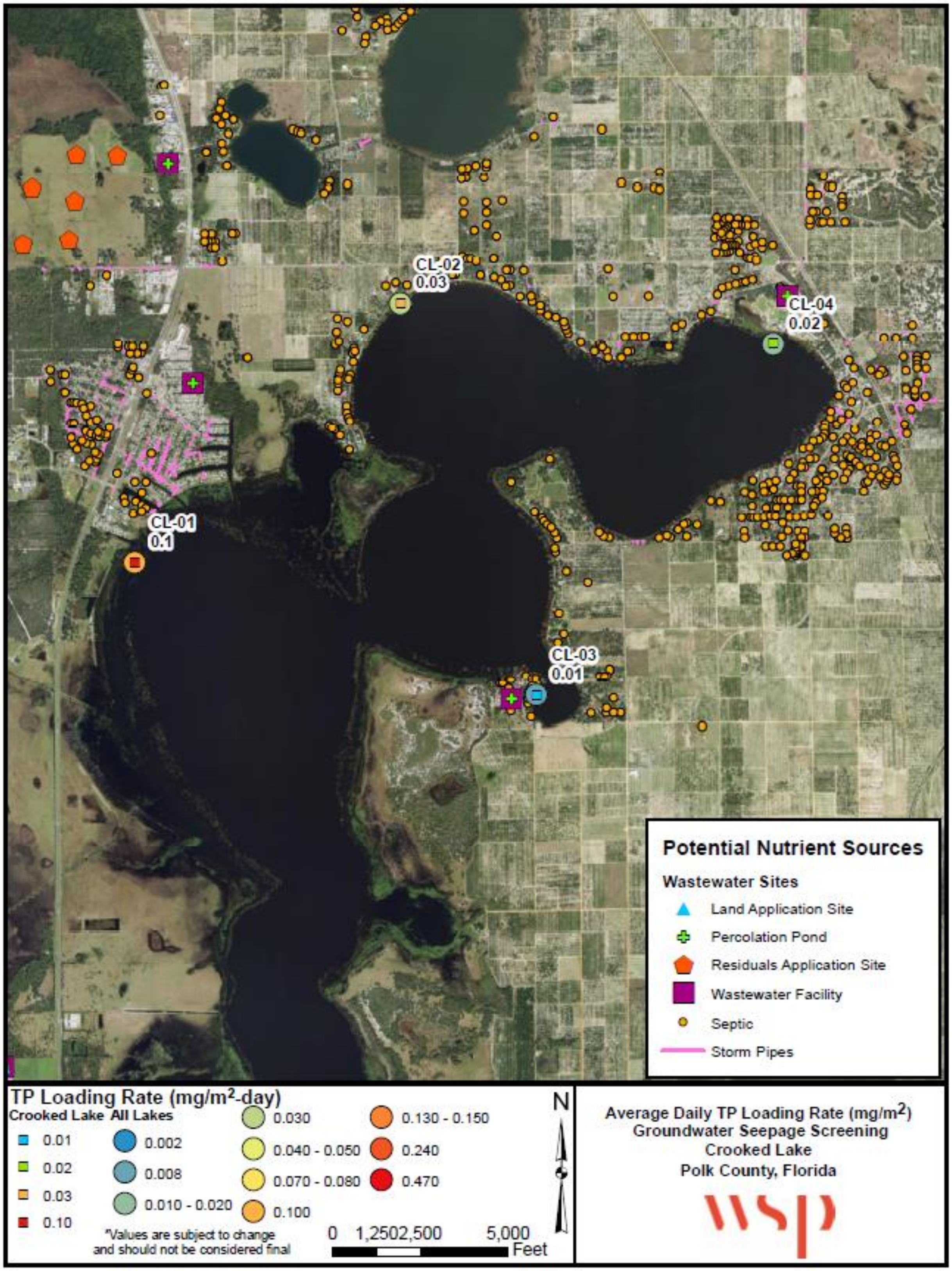

Figure 2.5 – Average Daily TN Seepage Meter Loading at Lake Deeson

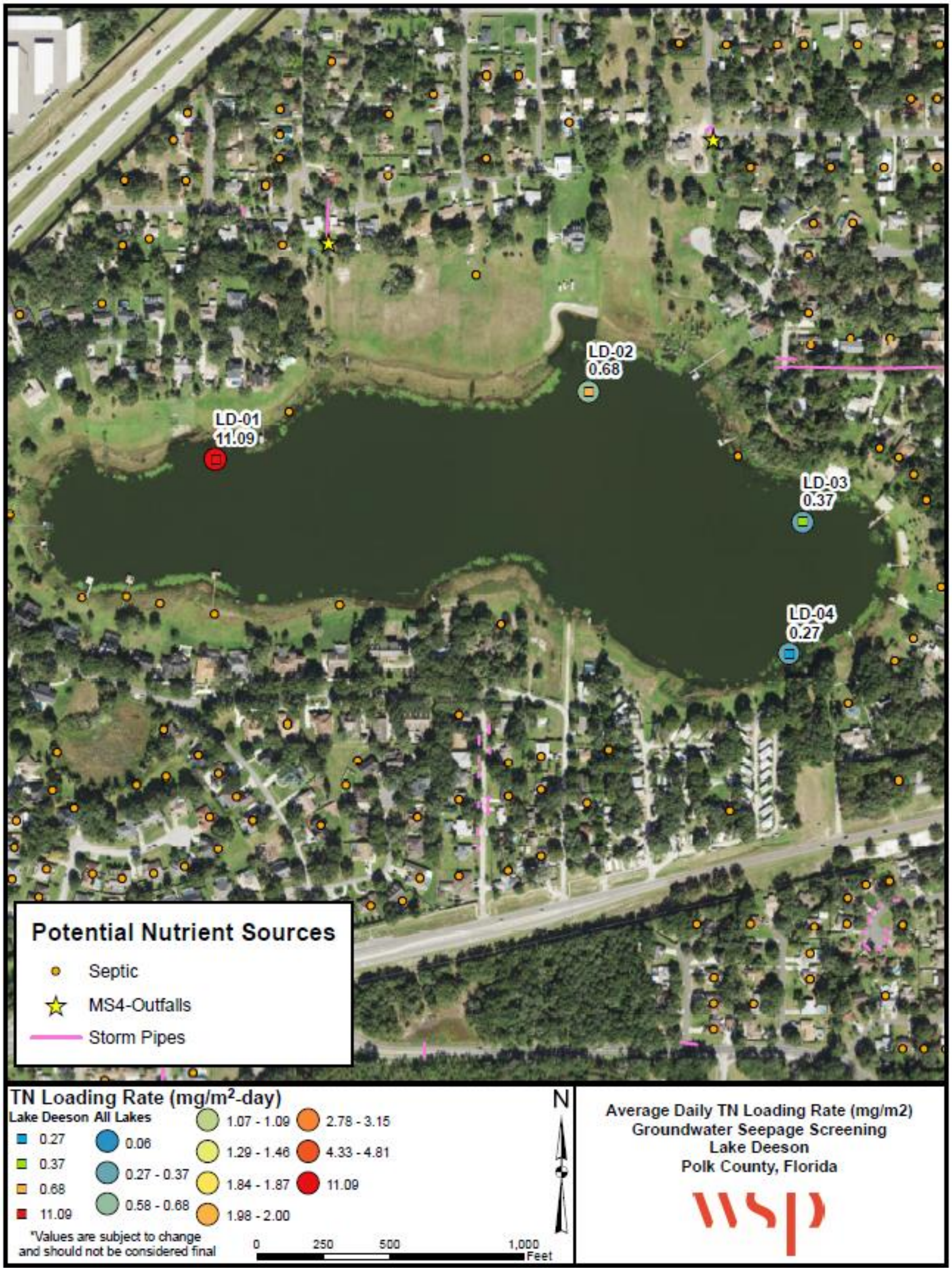

Figure 2.6 – Average Daily Seepage Meter TP Loading at Lake Deeson

Figure 2.7 – Average Daily Seepage Meter TN Loading at Lake Hamilton

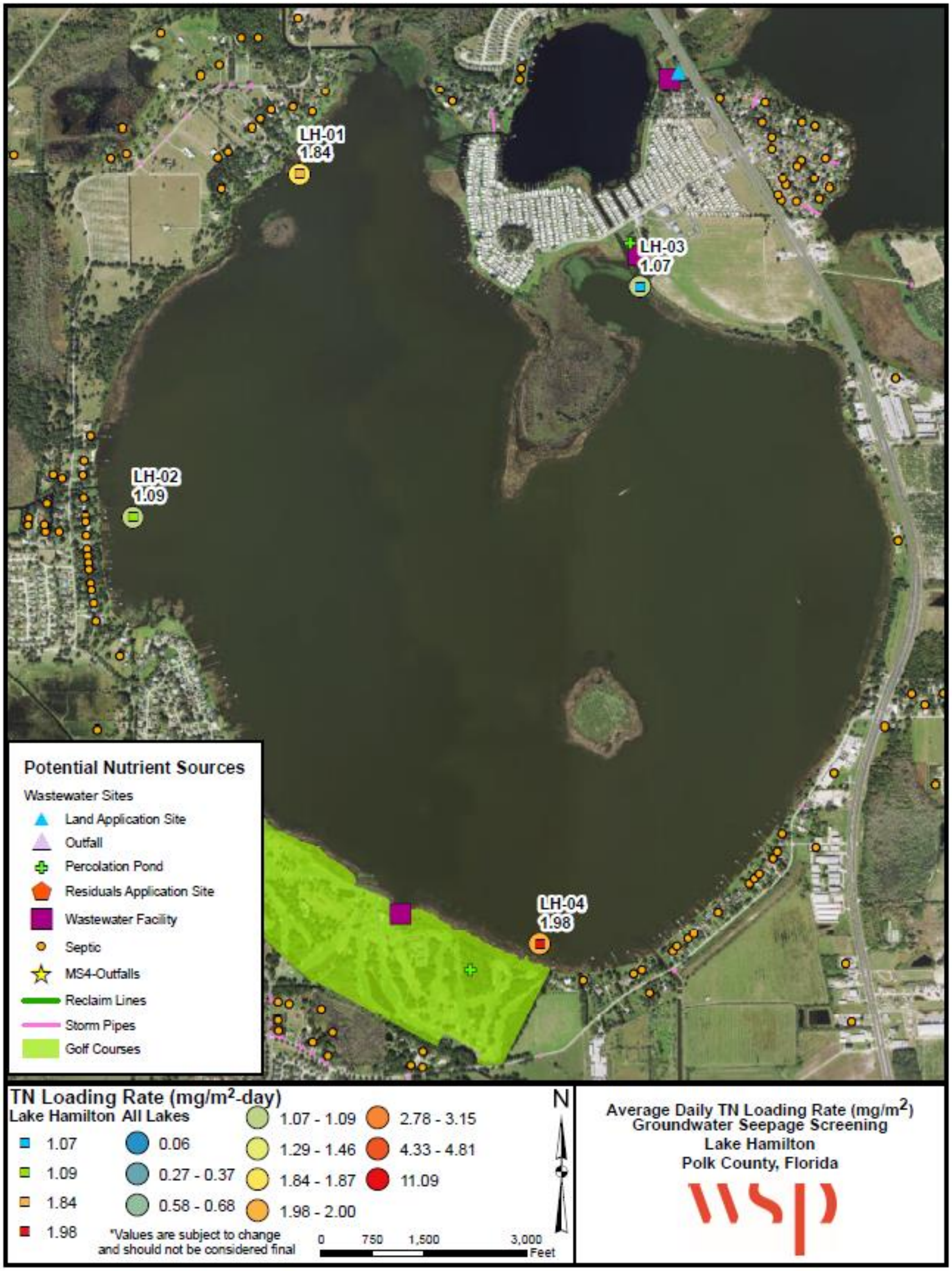

Figure 2.8 – Average Daily Seepage Meter TP Loading at Lake Hamilton

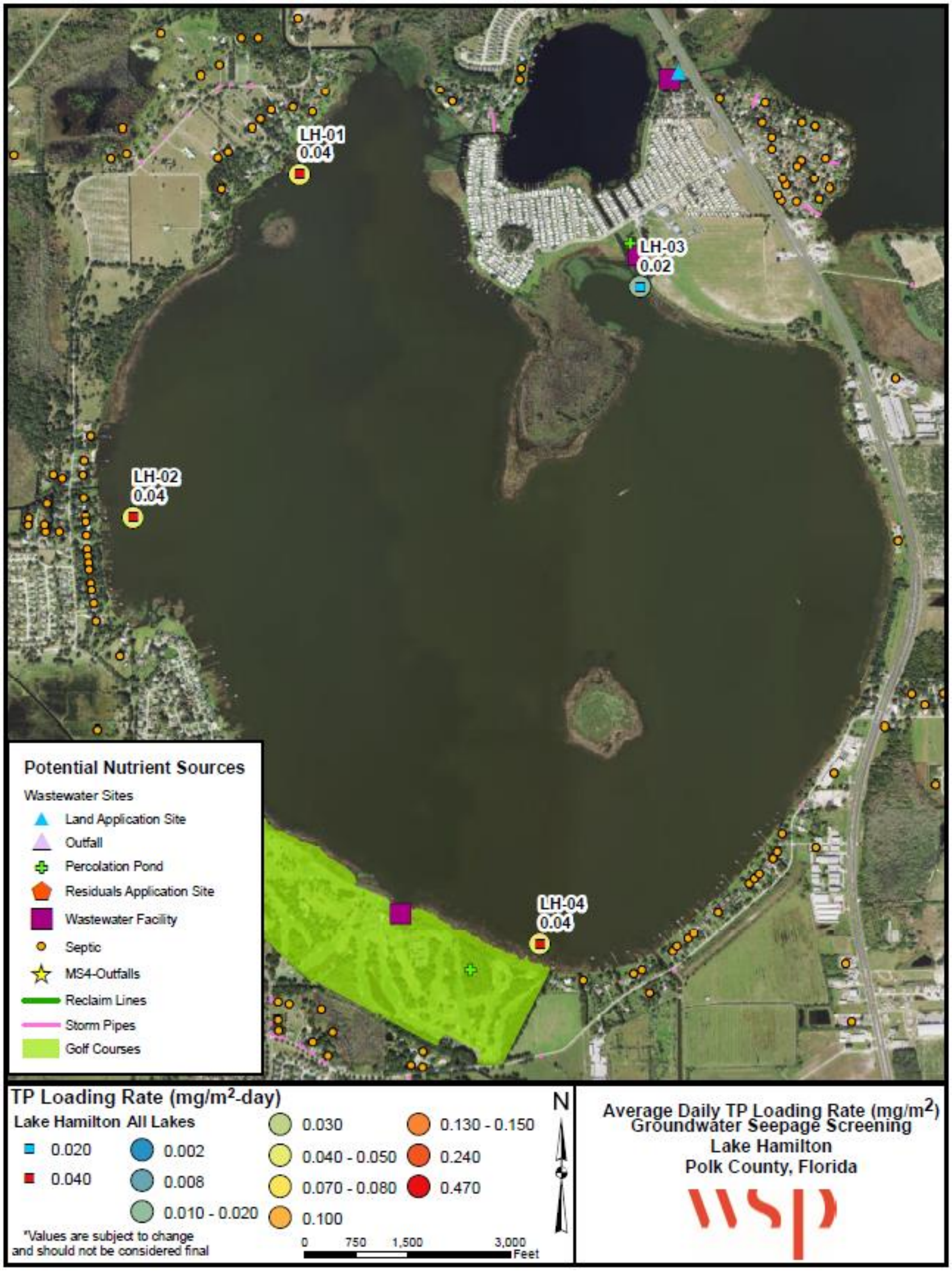

Figure 2.9 – Average Daily Seepage Meter TN Loading at Lake Lulu

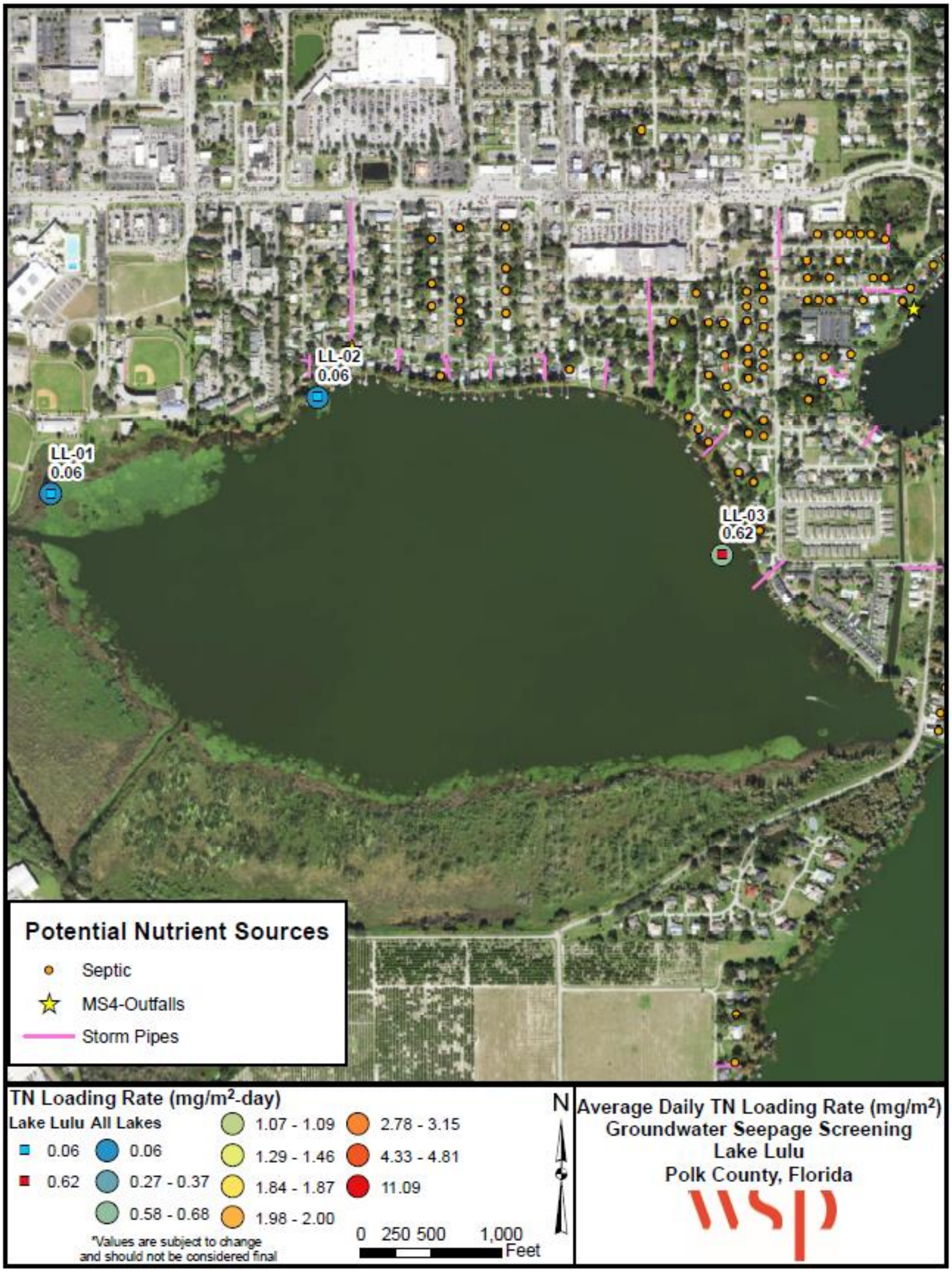

Figure 2.10 – Average Daily Seepage Meter TP Loading at Lake Lulu

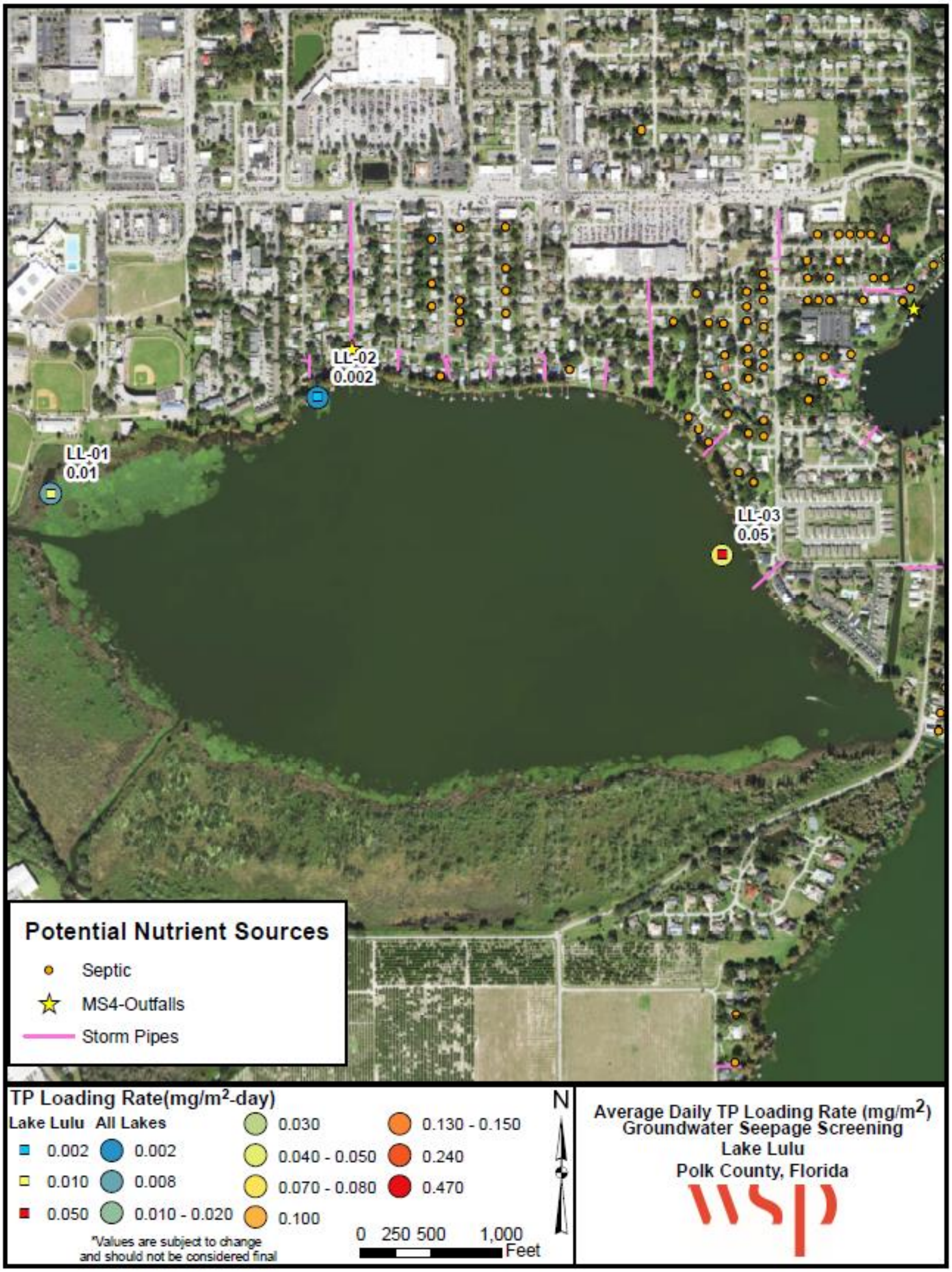

Figure 2.11 – Average Daily Seepage Meter TN Loading at Lake Pierce

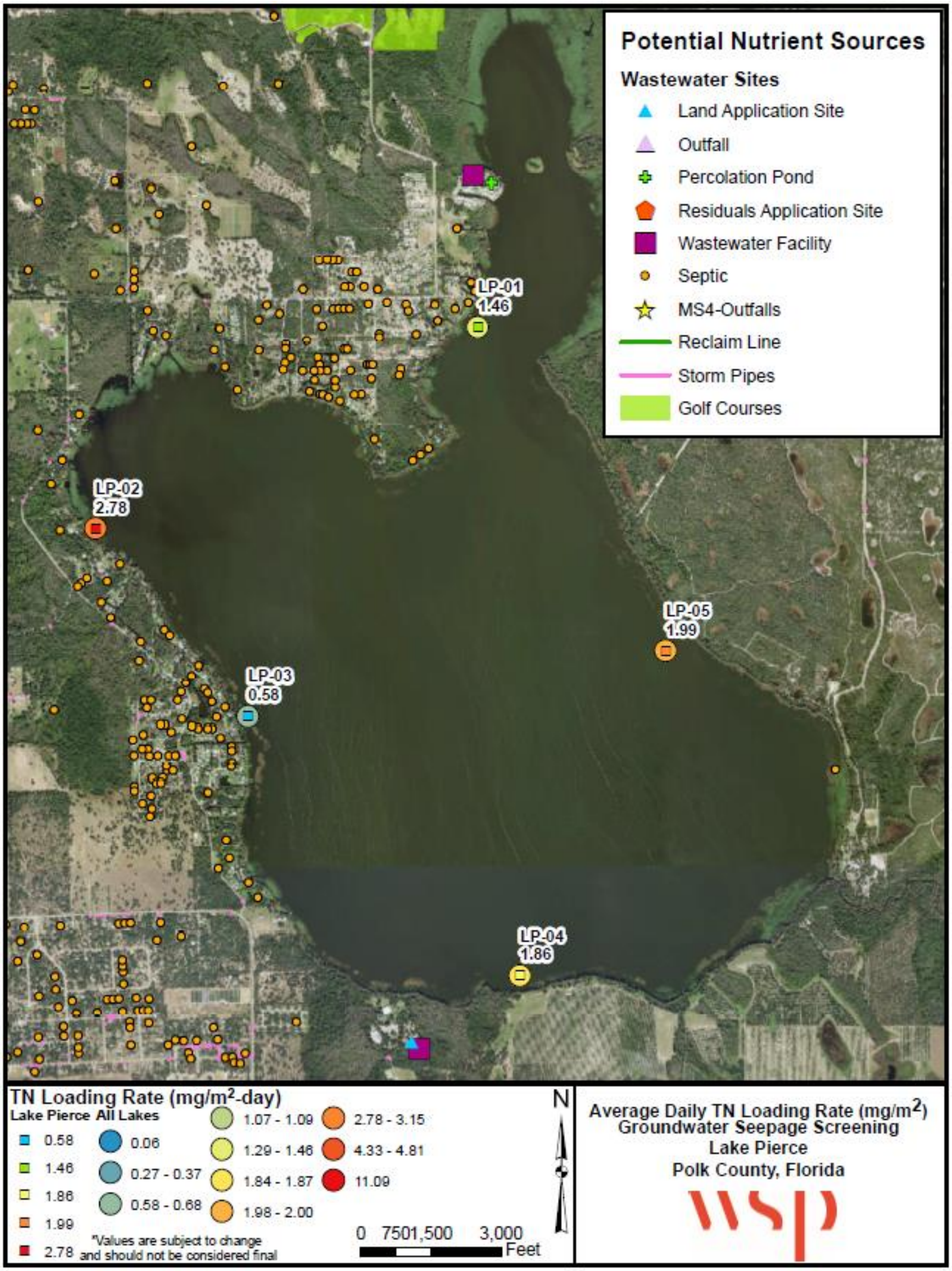

Figure 2.12 – Average Daily Seepage Meter TP Loading at Lake Pierce