



FINAL REPORT

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LAKE FOREST CONDOMINIUMS STORMWATER SYSTEM UPGRADE AND STREAM DAYLIGHT

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1. EXECUTIVE SUMMARY

Trudell Consulting Engineers (TCE) was obtained by the Lake Forest at Oakledge Condominium Association as the engineering consultant for final design of a water quality improvement project funded through the Lake Champlain Basin Program and NEIWPCC. The Lake Forest Community is a 37-unit condo association in the City of Burlington's south end, located less than 1,000 feet from the edge of Lake Champlain, specifically Blanchard Beach within Oakledge Park. The Lake Forest development was designed with three large ponds which have become heavily sedimented in due to lack of maintenance and access issues. As existing, the ponds are experiencing bank erosion and annual algae blooms. A previous improvement assessment was performed to identify potential water quality improvements for the site and determined that stormwater improvements as well a stream daylight and restoration would not only improve site conditions, but would also reduce phosphorus loading to the phosphorus-impaired Lake Champlain.

The project goal is to improve water quality within the Lake Forest Development with the objective of the current project being the preparation of preliminary and final plans as well as a runoff quality and quantity analysis, summary of permitting requirements, and cost estimating. TCE has collected existing conditions information through a topographic survey, watershed delineation, wetland and stream delineations and phosphorus loading calculations. During the preliminary design process, alternatives were presented to the Lake Forest community and a final design was selected. Final design plans, an opinion of probable cost, summary of necessary permitting and final phosphorus reduction calculations were completed.

The final design proposes to deepen two of the three existing ponds, convert the ponds to pre-treatment sediment forebays, and convert one pond into a Gravel Wetland as well as restore the stream bed. In addition, the final design proposes to reduce bank slopes, increase plantings along pond and stream banks, and improve stormwater conveyance for improved maintenance access. Final phosphorus calculations result in an expected phosphorus removal of 4.89 lbs/yr through proposed stormwater improvements, and 1.62 lbs/yr through the stream restoration. In total, the project is expected to remove 6.51 lbs/yr of phosphorus to Lake Champlain.

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3. PROJECT SYNOPSIS

The project purpose is the development of preliminary and final plans for a water quality improvement project at the Lake Forest at Oakledge Condominium Association in Burlington, VT. The project goal is to improve existing ponds to reduce bank erosion, minimize algae blooms, improve pond maintenance, and increase phosphorus capture throughout the Lake Forest property. The overall project approach is to gather existing conditions information; determine preliminary design alternatives; select a final design; and prepare final plans. A cost estimate and summary of permits is prepared.

Tasks 1-4 were funded under a separate agreement with NEIWPC/LCBP (994-002-001, project code LS-2020-014). Tasks 5-9 were completed in this subaward (995-002-001, project code LS-2022-019).

4. TASKS COMPLETED

The following tasks were completed as identified in the approved project workplan:

i. Obtain Engineering Services and Develop a Quality Assurance Protection Plan *(May – November 2021)*

After TCE was selected by the Lake Forest Association, development of a Quality Assurance Protection Plan (QAPP) began in May of 2021 and a first draft was submitted in June of 2021. Subsequent revisions were made between June and October based on comments from the LCBP and NEIWPC. A final QAPP was approved November 16, 2021.

ii. Project Kickoff *(July 2021)*

A Meeting was held with the Lake Forest stormwater committee to review existing water quality concerns, previous studies, and an overall timeline for proposed work. The project kick-off meeting was held on 07/21/2021 at the Lake Forest property. The kick-off meeting was held after a draft QAPP was submitted, however, prior to the approval of the QAPP to ensure the existing conditions survey would start as soon as the QAPP was approved.

iii. Existing Conditions Survey *(November 2021 – January 2022)*

The Existing Conditions Survey consisted of fieldwork including a wetland delineation, stream assessment, and topographic survey. The wetland delineation and stream assessment were performed on November 18, 2021, and the topographic survey was performed on December 16, 2021 and January 7, 2022. Post-processing of data including mapping wetlands and streams, drafting existing conditions plan and completing wetland data forms was also completed in this timeframe.

iv. Runoff Quantity and Quality Model Analysis *(January – March 2022)*

Watershed delineations within the Lake Forest property as well as the off-site areas draining to the Lake Forest property were performed and mapped as depicted on Stormwater Plan C4-02. Mapping of off-site drainage areas was discussed with and reviewed by the City of Burlington Stormwater Program. Land cover calculations were performed to determine land cover types, site slopes and soils types for preparation of a HydroCAD model to calculate existing peak runoff rates to and from the Lake Forest property. Total phosphorus loading calculations were also performed and all runoff quantity and quality information was summarized in a memorandum, submitted to the Lake Forest Association on March 15, 2022.

v. Preliminary 30% Designs *(February – September 2022)*

A meeting was held on February 15, 2022, to discuss project progress including the findings of the Existing Conditions survey, wetland and stream assessment, and the runoff quantity and quality analysis. During this initial meeting, six theoretical alternatives were presented to the HOA including combinations of various types of stormwater treatment systems (wet ponds, gravel wetlands and shallow surface wetlands) as well as a stream restoration component.

Based on this preliminary meeting, TCE proceeded with a preliminary design for two alternatives. Both alternatives proposed converting existing Ponds 1 and 3 into deepened sediment forebays with the removal of Pond 2 and installation of a Gravel Wetland for stormwater treatment of the Lake Forest runoff. Alternative A proposed the construction of a Wet Pond for treatment of off-site runoff and Alternative B proposed a stream restoration component for off-site runoff. Preliminary site plans for both alternatives were prepared. Due to the treatment of off-site runoff, both alternatives were discussed with the City of Burlington Stormwater Program.

A second meeting was held on April 14, 2022 to discuss preliminary design plans with the Lake Forest Association. James Sherrard from the City of Burlington Stormwater Program was in attendance of this meeting. With interest from the Association on both alternatives, each was further reviewed by TCE with the City of Burlington and Association throughout the summer. Cut and fill calculations were performed and preliminary designs were modified to reduce the need to remove soils from the site. Additionally, illustrative 2D renderings of both preliminary alternatives and preliminary landscaping schedules were created.

Emails summarizing the proposed alternatives were sent to various state agencies including the Wetlands Program, Fish and Wildlife, and Rivers Program for initial comment on August 18, 2021. Responses from the Wetlands Program and Fish and Wildlife both included concern for Alternative A

(stormwater treatment of off-site runoff) as both agencies stated this alternative would have more impact to existing wetlands and streams than Alternative B (stream daylight and restoration component). Additionally, further conversation regarding the City's interest in treatment of off-site runoff was held on August 24, 2022.

A third meeting with the Association was held on September 6, 2022, to discuss the final selection of a preferred alternative for final design.

vi. Final 100% Designs *(October – May 2023)*

Based on discussion with the Association, City and State Agencies, Alternative B involving the Stream Daylight component was selected to be moved forward for final design. While the Association and City were both interested in treating off-site runoff, final design of this alternative would have been outside the scope of current funding. Information regarding treatment of off-site runoff is included in the Final Summary Report should this alternative be moved forward with possible future work.

A detailed Final Design Plan set was prepared including design details, a landscaping plan and landscaping schedule. Final phosphorus removal calculations were performed based on the final design. A Final Summary Report was written to summarize existing conditions including existing water quality concerns, alternatives considered, details of the proposed final design, a summary of permits needed, an opinion of probable cost and discussion of next steps.

A final meeting was held with the Association on May 30, 2022, to review final design details and next steps for the project.

vii. Permitting *(May 2023)*

A Vermont Wetland Permit Application, Vermont Construction General Permit 3-9020 Application, Vermont Stormwater General Permit 3-9050 Application and City of Burlington Zoning Permit Applications were filled out for the proposed final design. As there is no current planned construction for this project, these permit applications have not been submitted.

viii. Cost Estimate *(May 2023)*

An Opinion of Probable Cost was prepared for the total construction phase cost of the proposed final design. As permit applications have not yet been submitted, permit application costs were included in the opinion for a complete summary of the cost to finalize the proposed project. Expected costs are based on 2023 estimates for similar projects within Chittenden County, Vermont.

ix. Quarterly Report Submittal and Approved Final Report (May 2023)

Quarterly reports were submitted for this project on-time throughout the duration of the two grant contracts. Quarterly reports were written by Andrea Poulos, Jennifer Desautels and Craig Smith of Lake Forest. Quarterly reports were submitted throughout the project by Craig Smith of the Lake Forest Association.

A final report was submitted with all required deliverables on May 30, 2023.

5. METHODOLOGY

The following methods were used to complete each task:

i. Existing Conditions Survey

Existing topography, stormwater infrastructure, and utilities were located and verified by the survey crew. The survey crew utilized a CR2+ Carlson Robotic Total Station and a Carlson BRx7 GNSS Receiver (GPS), which are designed and calibrated to capture precise X, Y, and Z coordinates for each collected point to one tenth of a foot. The total station is equipped with an on-board computer that collects and stores survey data.

Surveyed data was then transferred to TCE's computers for incorporation into engineering designs. The survey crew followed the standards of the 2021 Vermont Survey Law and used standard surveying methodologies. All survey data was reviewed by Vermont Licensed land Surveyor, Gerald Stockman.

Andrea Poulos, PE (formerly Dotolo) identified, GPS located, and mapped wetland boundaries as well as stream top of bank and centerline. The wetland delineation was performed in accordance with the standards of the 1987 US Army Corp of Engineers Wetland Delineation Manual and the 2012 Northeast and Northcentral Regional Supplement. The stream assessment was performed in accordance with the Vermont Agency of Natural Resources Stream Geomorphic Assessment protocols. Wetland boundaries were flagged using pink "wetland delineation" tape.

Both wetland boundaries and stream geomorphic features were mapped with a GPS Trimble Geo XH Unit (sub-meter accuracy). This data was transferred to TCE's computers for correction using GPS Pathfinder Office and was then mapped in ArcGIS and incorporated into engineering AutoCAD files. The wetland delineation boundary was reviewed and approved by State Wetland Ecologist, Tina Heath.

ii. Runoff Quantity and Quality Model Analysis

Hydrologic and hydraulic modeling for runoff quantity and quality analysis was completed in HydroCAD, a computer aided design tool. The VT DEC STP

Calculator was used to assess total phosphorus (TP) loading. Inputs to the HydroCAD model and STP Calculator utilized available public data from the following sources: USDA Natural Resources Conservation Service (NRCS) soil data; surveyed topography data and 1' LiDAR contours from the Vermont Center for Geographic Information; watershed drainage areas created by TCE in AutoCAD Map 3D 2021 using standard procedures as described in the 1991 Method for the Comparative Evaluation of Nontidal Wetlands in New Hampshire; National Oceanographic and Atmospheric Administration (NOAA) Atlas 14 precipitation data for Chittenden County, VT; and satellite and/or aerial imagery along with on-site observations of land cover types.

iii. Preliminary 30% Designs

HydroCAD modeling was used to determine preliminary designs. Preliminary designs were drafted by Andrea Poulos, PE and reviewed by Jennifer Desautels, PE. Preliminary landscaping was designed by Lucy Thayer, PLA.

iv. Final 100% Designs

HydroCAD modeling was used to determine final design details. All stormwater treatment and conveyance was designed in accordance with the 2017 Vermont Stormwater Management Manual. Final designs were drafted by Andrea Poulos, PE and reviewed by Jennifer Desautels, PE. Final landscaping was designed by Lucy Thayer, PLA.

6. QUALITY ASSURANCE TASKS COMPLETED

All quality control tasks as required by the QAPP were followed throughout the data collection and design phases of the project. Data collection, analysis, and design processes followed the methods outlined in the QAPP. All collected data was validated for usability per the QAPP. All instruments and technology used for data collection and analysis were tested, inspected and maintained as outlined in the QAPP. Only qualified personnel outlined in the QAPP performed tasks. All tasks were prepared and/or reviewed by licensed professionals including Andrea Dotolo, PE; Jennifer Desautels, PE; Lucy Thayer, PLA; and, Gerald Stockman, LS. All files were saved electronically and backed-up daily within the TCE office in Williston.

Quarterly reports were written by Andrea Poulos, Jennifer Desautels and Craig Smith of Lake Forest. Quarterly reports were submitted throughout the project by Craig Smith of the Lake Forest Association.

7. DELIVERABLES COMPLETED

The following deliverables were completed:

i. Existing Conditions Plans

Existing conditions plans were prepared based on the topographic survey to provide detailed information of existing site conditions. Existing Conditions plans also includes an Existing Conditions Stormwater Plan showing on-site and off-site watershed delineations. Existing Condition Plans are included in the appendices.

ii. Wetland/Stream Delineation Map & Wetland Data Forms

A map detailing existing wetland boundaries and associated jurisdictional wetland buffers as well as the delineated stream location was created. Army Corp of Engineer Wetland Data Forms for an upland and wetland data point associated with the delineation of the Class II wetland have been filled. The Wetland/Stream Map and Data Forms are included in the appendices.

iii. Runoff Quantity and Quality Model Analysis Memo

A memorandum was prepared summarizing existing runoff quantity and quality, including peak discharge rates to and from the Lake Forest property as well as phosphorus loading calculations. The memorandum is included in the appendices.

iv. Preliminary Plans & Alternatives Schematics

During the preliminary plans phase, sketch plans and illustrative schematics were prepared for two alternative designs. All sketch plans and alternatives information are included in the appendices.

v. Final Design Plans

A plan set was created including site plans, erosion control plans, wetland impact plans and detail sheets with all required information for permitting and construction. Final Design Plans are included in the appendices.

vi. Hydrologic Modeling

A HydroCAD Model was prepared to model proposed final conditions of the site. The project was designed to ensure peak discharge rates were not increased as a result of site changes. A PDF print out of HydroCAD modeling is included in the appendices.

vii. Phosphorus Removal Calculations

Calculations were performed to determine the expected phosphorus reduction of the proposed stormwater improvements and stream restoration. As detailed in the attached calculations, the stormwater improvements are expected to reduce phosphorus loading to Lake Champlain by 4.89 lbs/yr, and stream daylight and restoration improvements are expected to reduce phosphorus loading by 1.62 lbs/yr. In total, the project is expected to remove 6.51 lbs/yr of total phosphorus to the phosphorus-impaired Lake Champlain. Phosphorus removal calculations are included in the appendices.

viii. Permit Applications

Various State and Local permit applications were prepared based on the final design including a 3-9050 Stormwater General Permit Application, a 3-9020 Construction General Permit Application, a 3-9026 Wetlands General Permit, a City of Burlington Zoning Permit and a City of Burlington Water Resources Preliminary Review Form. Filled applications are included in the appendices.

ix. Opinion of Probable Cost

The Opinion of Probable Cost was prepared to determine an expected cost of the next phase of the project, final permitting and implementation. As detailed within the Opinion of Probable Cost, the project is estimated to cost approximately \$400,000 to complete construction. The Opinion of Probable Cost is included in the appendices.

x. Summary Report

The Summary Report was prepared to provide a narrative overview of the project initiation, findings and next steps. This Summary Report provides a detailed overview of all aspects of the project to be used for future project planning, including a summary of permits required. The Summary Report is included in the appendices.

8. CONCLUSIONS

Overall the project was successful in determining a final preferred alternative and producing a final design plan set with supporting information necessary for construction. The project took longer than expected and required an extension due to staffing difficulties as well as additional time needed during the preliminary plan phase. The biggest lesson learned is that a streamlined preliminary and final plan project should start with the project owners being comfortable with a proposed design. During the preliminary plan phase, it was quickly apparent that the Association was not settled with the result of the previous scoping work and needed additional review of potential design alternatives. When reviewing preliminary alternatives, a larger project involving the treatment of off-site runoff was identified. While this was the preferred alternative by some Association members, it was ultimately determined that moving forward with this alternative was not feasible under current funding. Future work may involve the construction phase of the final design or additional final design of the alternative involving treatment of off-site runoff.

9. REFERENCES

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10. APPENDICES

1. Existing Stormwater Permits
2. Existing Conditions Plans
3. Wetland/Stream Delineation Map & Data Forms
4. Runoff Quantity and Quality Memorandum
5. Preliminary Plans & Alternatives Schematic
6. Preliminary Design Correspondence
7. Final Design Plans
8. Design Form & Hydrologic Modeling
9. Phosphorus Removal Calculations
10. Permit Applications
11. Opinion of Probable Cost
12. Lake Forest Summary Report

Electronic Data:

All Electronic Data has been emailed to the Project Officer.