Wetland Resource Evaluation & Stormwater Impact Analysis

Park Central

0 Turnpike Road
Southborough, Massachusetts
DEP File # 290-0981

Submitted to:
Southborough Conservation Commission
Southborough Town Hall
17 Common Street
Southborough, MA 01772

Prepared for:
Park Central, LLC
259 Turnpike Road, Suite 100
Southborough, MA 01772

Prepared by:
Goddard Consulting, LLC
291 Main Street, Suite 8
Northborough, MA 01532

In Association with:
Waterman Design Associates, Inc.
31 East Main Street
Westborough, MA 01581

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Appendices:

1.0 Introduction and Purpose

Goddard Consulting, LLC is pleased to submit this wetland resource evaluation and stormwater impact analysis on behalf of the applicant, Capital Group Properties, LLC and owner, Park Central, LLC, for the proposed mixed residential development project ("Park Central") located at 0 Turnpike Road in Southborough, MA (Maps 33, 41, 24, 25; Lots 4, 4.A, 3, 5).

The purpose of this analysis is to demonstrate that the proposed utilization of certain resource areas for stormwater management associated with the Park Central mixed residential project will not have an adverse impact to these resource areas and will be in compliance with the applicable provision 310 CMR 10.06(k) under the Wetlands Protection Act (see Appendix H for a copy of this provision). The resource areas are Bordering Vegetated Wetlands (BVW), Bank, and Land under Water (LUW) of ponds, and will be referred to as "subject resource areas" or "basins" in this analysis. Through an evaluation of the subject resource areas, a comparison of the peak water elevation and duration of drawdown between the 1983 stormwater design and the proposed design, and supporting literature research, we have concluded that the following values and functions of the subject resource areas listed under M.G.L. c. 131, § 40 will remain protected:

- Public water supply
- Private water supply (not applicable)
- Ground water supply
- Flood control
- Prevention of storm damage
- Prevention of pollution
- Land containing shellfish (not applicable)
- Fisheries
- Wildlife habitat

2.0 Project Overview

The proposed project consists of a mixed residential development project with portions containing a 40B apartment complex, condominium units, a wastewater treatment facility, and a roadway extension. The proposed project will utilize an existing stormwater management system permitted and constructed in 1983 within wetland resource areas. The subject resource areas have been labeled A, B, D, H, and I. A, D and I are BVWs, B is a constructed pond (under the original Order of Conditions), and H is a natural pond (see Appendix A for a GIS view of each area). The design will incorporate specific improvements to meet the most current Massachusetts Stormwater Management Standards (SMS) and effectively protect the values and functions of the subject resource areas post-development.

2.1 Existing Stormwater Management System

The existing permitted stormwater management infrastructure represents partial completion of what was originally designed and permitted, which consisted of grading (including construction

of Pond B), installation of reinforced concrete pipes, drainage inlets, water control devices, and a commercial development to be serviced by the infrastructure. The development, however, was not constructed due to economic conditions. Therefore, the subject resource areas have not received runoff from the built-out development but have received rainfall from the site directly, as well as runoff from Route 495.

We estimate that portions of the boundaries of the subject resource areas were likely temporarily impacted from the installation of pipes, inlets, and culverts in 1983. However, the subject resource areas currently appear healthy with a diverse plant community and presence of wildlife (e.g. deer, water birds, fish, songbirds, small mammals; see Appendix B and C for more details).

2.2 Proposed Stormwater Management System

The proposed system will utilize what currently exists but with a number of improvements that meet the most current Massachusetts Stormwater Management Standards in order to effectively protect the functions of the subject resource areas. These improvements include:

- Water quality measures that remove a minimum of 80% Total Suspended Solids (TSS) through deep-sump, hooded catch basins, proprietary water quality structures, infiltration systems, and/or a combination of these.
- A minimum of 44% pretreatment to infiltration systems.
- Treatment of one (1.0) inch of rainwater before exiting the system.
- Addition of drainage manholes or (DMH) to allow for maintenance, and outlet control structures for control of water flow.
- Addition of vegetated "swale-like" areas adjacent to wetlands for further water treatment through plant root systems.

With all applicable provisions of the SMS being met (see Appendix D for more details), there is one difference in the proposed system, in that the peak (i.e. not sustained but a rise and fall pattern) duration of water compared to 1983 will be slightly longer by 60 hours (2.5 days, so a total of 6 days) for a 100-year storm for Basins A and B but will remain the same for Basins D, H, and I. This is largely because of compact C and D soils that slow down the recharge rate. However, we find that the slightly longer draw down time will not have an adverse impact to these resource areas.

3.0 Methods

We based our analysis on three methodologies: First, we evaluated each subject resource area separately to document the plant community, soil characteristics, hydrology, and specific wildlife habitat characteristics that exist post-construction of the 1983 stormwater system. The evaluation was in accordance to the "Massachusetts Wildlife Habitat Protection Guidance for Inland Wetlands" manual by MassDEP. Completed wildlife habitat evaluation data forms and a description of each resource area are included in Appendix B and C).

Second, we compared the estimated peak water elevation and duration of drawdown time, calculated by Waterman Design Associates (WDA), for a 100-year storm between the proposed and 1983 design conditions (see Appendix F). We note that data for the 1983 design conditions for a 2-year and 10-year storm event are not available so our comparison to the proposed conditions is kept to a 100-year storm. Additional elevation and drawdown data for a 2-year and 10-year storm event are included in Appendix E and G.

We also note that calculations made back in 1983 were completed under localized conditions, and therefore, discharge from Route 495 was not included in the original study. For this reason, a direct comparison between the proposed conditions with Route 495 to those in 1983 was not possible. Lastly, we conducted literature research on the impacts of flooding on vegetation, as well as the efficacy of utilizing wetlands and ponds as infiltration systems.

4.0 Findings

4.1 No Adverse Impact to Public, Private, or Groundwater Supply

The subject resource areas are tributary to a public water supply, the Sudbury River (Outstanding Resource Water or ORW), so additional measures have been incorporated to protect water quality as required in Standard 6 of the SMS. A description of how the system complies with this standard is included in Appendix D.

The subject resource areas are not tributary to a private supply, so this interest will remain unaffected by the system. The system will be in compliance with Standard 3 of the SMS for groundwater recharge as this applies to protection of groundwater supply. A description of how the system complies with this standard is included in Appendix D.

Because the proposed system will be in compliance with Standards 6 and 3 which apply to protection of public water supply and groundwater supply, respectively, we find that the proposed system will not have an adverse impact to these protected interests.

4.2 Flood Control and Storm Damage Prevention

Peak flow rates will be controlled by outlet control structures in each basin to manage the flow of water during storm events. Peak runoff rates and elevations will remain as close as possible to the 1983 design conditions in each basin in order to prevent flooding and storm damage. The system has been designed so that post-development peak discharge rates do not exceed those of pre-development rates, as required in Standard 2 of the SMS. A description of how the system complies with this standard is included in Appendix D.

Because the proposed system will be in compliance with Standard 2 which is set to control flooding and prevent storm damage, we find that the proposed system will not have an adverse impact to these protected interests.

4.3 Prevention of Pollution

The stormwater collection system has been designed so that all runoff from the site will be treated through a treatment train prior to entering the basins, as required in Standard 1 of the SMS. Compliance with this standard is included in Appendix D.

Water quality measures have been incorporated in the system as required in Standard 4 of the SMS which aim to prevent water pollution as well. Compliance with this standard is included in Appendix D.

Because the proposed project is not considered a land use with higher pollutant loads, Standard 5 of the SMS is not applicable. A Stormwater Pollution Prevention Plan (SWPPP) is required for this project and will be provided during the permitting process, as required in Standard 8 of the SMS. An Illicit Discharge Compliance Statement will also be provided as required in Standard 10 to prevent illicit discharges.

The design will comply with Standards 1, 4, 8 and 10 which are intended to prevent pollution of water. Therefore, we find that the design will not cause an adverse impact to this protected interest.

4.4 No Adverse Impact to Fisheries and Land containing Shellfish

Wetlands A, D, and I are not tributary to fisheries or land containing shellfish so these interests will remain unaffected by the system. There are no proposed changes (i.e. decreasing the water level or removing vegetation/substrate) in ponds B or H for the stormwater management system that would adversely alter the availability of food, cover, shelter, or breeding requirements for fish. Therefore, there will no adverse impacts to this interest.

4.5 No Adverse Impact to Wildlife Habitat

There are no proposed changes or alterations of vegetation or wildlife habitat characteristics (i.e. removal of places for cover and shelter or food) within the subject resource areas so these protected interests will be unaffected.

The slightly longer duration of peak water elevation (by 60 hours) within wetland A during a 100-year storm event (compared to the 1983 design) will not have an impact on wetland A for the following reasons:

- By its nature, this basin is a wetland and is designed to hold water for periods of time.
- The presence of hydric soils, drainage patterns, and wetland vegetation indicate that it is subject to periods of inundation.
- The dominant wetland vegetation within is flood tolerant (red maple, ash, cinnamon fern, eastern poison ivy, northern arrowwood in A, and wild grape, cinnamon fern, and speckled alder on the banks of B) and can adapt to flooding events that can last a few months.

Pond B is already inundated so the slight increase in peak water elevation will have little effect.

5.0 Research and Discussion

There has been ongoing research on wetlands and ponds as stormwater management systems as well as the molecular and physical effects of flooding on plants. This research is particularly useful as it relates to the protected values and functions of the subject resource areas utilized for the proposed stormwater management system.

5.1 Increased Biodiversity and Reduction of Nutrients

Margaret Greenway, an Associate Professor and Wetland Ecologist whose research focuses on the efficacy of wetlands and ponds for stormwater treatment, finds that both wetlands and ponds used for stormwater treatment are effective at enhancing biodiversity and habitat while reducing various nutrients (Greenway 2010). Macrophytes, which play a key role in the biodiversity and function of wetlands, can increase species richness up to 86 taxa. Nutrients such as NO_3-N and PO_4-P can be reduced by 78% and 86%, respectively. Additionally, waterbirds frequent these wetlands and ponds, which suggests the presence of supportive resources within (Greenway 2010).

With the existing stormwater system occurring in both wetlands and ponds as referenced in the research, and with the proposed improvements that will comply with the SMS, we conclude that the overall system will not have an adverse impact on the subject resource areas. Moreover, as studies of these systems have shown, they will likely help to reduce nutrients and increase biodiversity and wildlife habitat.

5.2 Adaptations to Periods of Flooding by Wetland Plants

The difference between the original system and the proposed system is the duration of water within wetland A and pond B during a storm event, which causes them to be temporarily flooded (above soil surface inundation) or waterlogged (inundation up to the soil surface) for a peak number of days (e.g. the water does not sustain but rises and falls) depending on the calculated 2, 10, and 100-year storm event (although B is already a pond so this will make little difference).

In general, inundation creates an environment in the soil that lacks oxygen as the water fills in the air spaces (Kreuzwieser and Rennenberg 2014), which creates hypoxic or anaerobic conditions over time. Studies show that flooded or waterlogged soils have a different effect on plants depending on the plant's tolerance level to hypoxic conditions. For instance, *Acer pseudoplatanus,* which typically grows in well-drained upland soils may not be tolerant versus *Quercus robur,* which grows in wet soils subject to flooding (Kreuzwieser and Rennenberg 2014).

Typically, wetlands are naturally subject to flooding at times and the plants within contain the adaptations necessary for surviving hypoxic conditions, which can last for months without visible damage (Kreuzwieser and Rennenberg 2014). These adaptations include hypertrophied lenticels, adventitious roots, and the formation of aerenchyma (Kreuzwieser and Rennenberg 2014; Armstrong *et al*. 1994; Garssen *et al*. 2015). These mechanisms, collectively, work to increase gas exchange in the roots and allow for oxygen uptake during times of inundation. Metabolically, survival during anoxic conditions among tolerant species depends on the ability to control energy metabolism, abundant energy resources, and protection against injury (Armstrong *et al*. 1994).

Differences among tolerant and intolerant plants when experiencing flooding can be witnessed rather easily. For example, *Salix caprea*, a plant favoring well-drained soils, shows leaf discoloration, brittleness, and abscission within four weeks of flooding, and eventually ceases growing. Whereas *Salix cinerea,* a plant occurring in wet soils or adjacent to water, does not have visible damage, produces adventitious roots, and remains alive (Talbot *et al*. 1987). These findings are consistent with previous findings that tolerant species of plants contain the adaptations necessary for survival during periods of flooding versus intolerant species (Talbot *et al*. 1987).

Interestingly, survival among tolerant plants during periods of flooding varies in relation to contact with air and sunlight above the water's surface. For instance, seedlings that are drowned by water do not survive because they are unable to access oxygen and sunlight from the air. Plants above the water's surface with access to air, however, are able to survive (Kreuzwieser and Rennenberg 2014).

Duration of flooding and its effect on plants varies among species as well. For instance, the maximum duration without damage can be as low as 9 days for *Fagus sylvatica* (favors well drained, slightly acidic soils), and as high as 170 days for *Salix alba* (thrives in a variety of soil types with ample water) (Kreuzwieser and Rennenberg 2014). Further, some plants show an increase in their root prosperity as the duration of flooding increases (Garssen *et al*. 2015). As permanent flooding (i.e. ponding) becomes long-term, such as 15-16 years, there is generally a reduction in the abundance and distribution of species, which is supported by a number of previous studies (Van der Valk and Welling 1994).

In relation to the proposed stormwater management system, recall that the duration will only be longer for the A and B series, while all others will remain within the same range as existing conditions. In the A and B series, duration of flooding will be within 4.5, 5.5, and 6 days for a 2, 10, and 100-year storm, respectively. This will consist of a rise and fall pattern and will not be sustained at the highest elevation. This duration falls well below the threshold of tolerance (i.e. 9 days) even for species not accustomed to saturated soils. Moreover, the dominant plants within the A and B series are all flood tolerant (Table 1), and as studies have shown, flood tolerant species can withstand inundated conditions for months at a time through a series of adaptations.

6.0 Conclusion

We conclude that the proposed stormwater management system will not have an adverse impact to the subject resource areas as the proposed conditions are nearly identical to the approved 1983 conditions. Measures will be taken to go above and beyond in order to protect the quality of water and prevent adverse impacts to public, private and ground water supply, wildlife habitat and fisheries. The longer duration in peak water elevation for wetland A and pond B will have little difference on these areas as A is naturally designed for periods of flooding and its vegetation can adapt, and B is already ponded with vegetation along the bank that can also adapt.

In addition to proposed improvements on the system to meet the SMS, research supports the finding that wetlands and ponds on existing stormwater management features increase biodiversity and reduce nutrients in the water, while also serving as habitat for both large and small organisms. Further, plants (such as those typically found in wetland soil conditions) that have the adaptations for tolerating intermittent flooding events are shown to withstand these conditions for months at a time with no visible damage. These facts, collectively, lead us to conclude that the proposed stormwater management system will not have an adverse impact to the resource areas.

Thank you for taking the time to review this report. Please feel free to contact us if you have any questions.

Very truly yours,

Scott Goddard,
Principal & PWS

Cc: Capital Group Properties, LLC, 259 Turnpike Road, Suite 100, Southborough, MA 01772
MassDEP CERO, 8 New Bond Street, Worcester, MA 01606
Waterman Design Associates, Inc., 31 East Main Street, Westborough, MA 01581
Lucas Environmental, 67 Coddington Street, Suite 204, Quincy, MA 02169
Fuss & O'Neill, 78 Interstate Drive, West Springfield, MA 01089

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