EXECUTIVE SUMMARY
DRAINAGE CALCULATIONS AND
STORMWATER MANAGEMENT REPORT

For:

PROPOSED RESIDENTIAL DEVELOPMENT

Located at:

DYER STREET
ASSESSOR'S MAP 34, LOTS 83, 84, 87, 88, 89 & 90
ROCKLAND, MA 02370

Submitted to:

TOWN OF ROCKLAND

Prepared For:

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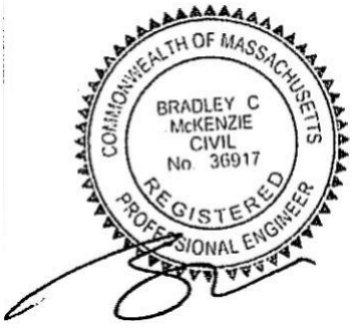

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OCTOBER 23, 2020
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Drainage Calculations and Stormwater Management Report
Proposed Residential Development
Dyer Street
Rockland, Massachusetts

Project Summary

The project proponent, Gaspar Investment Inc. proposes to develop four existing parcels totaling 1.83 acres (The Site) (current Assessor's Parcel Numbers: 34-83-0, 034-84-0, 34-87-0, 34-88-0, 34-89-0, 34-90-0 & portion of Dyer Street right-of-way) located off Dyer Street to be constructed as a residential development consisting of two multi-family buildings and two duplexes. The two existing parcels located at the end of Dyer Street totaling to approximate 1.29 acres (recently combined by ANR Plan into two parcels; current Assessor's Parcel Numbers: 34-84-0, 34-87-0, 34-88-0, 34-89-0 & portion of Dyer Street right-of-way) are proposed to be constructed as two multi-family buildings, and are located within the Town of Rockland's Business B-1 Zoning District. The two remaining parcels located off Dyer Street totaling to 0.54 acres (Assessor's Parcel Numbers: 34-83-0 & 34-90-0) will be developed as two duplexes, and are located within the Town of Rockland's Residential R-2 Zoning District. The proposed development will consist of four (4) buildings totaling sixteen (16) units with related site improvements including asphalt parking area and access driveways, landscaping, stormwater management facilities, utility connections and other relevant infrastructure. The site is not located within a DEP Zone 2 or Town of Rockland Aquifer Protection Zone. Refer to Figure 1- USGS Locus Map for the location of the parcel.

This report contains stormwater runoff calculations for the pre-development and post-development conditions and includes the sizing of the proposed stormwater best management practices (BMPs). The proposed and existing site conditions are illustrated on the project *site plans* entitled "Site Development Plan, Assessor's Map 34, Lots 83, 84, 87, 88, 89 & 90, Dyer Street, Rockland, Massachusetts", prepared by McKenzie Engineering Group, Inc. dated October 23, 2020 and revised hereafter.

Pre-Development Condition

The site is currently comprised of undeveloped woodland and located at the end of Dyer Street, an existing private way. The property has frontage on Dyer Street and is bordered by developed residential property to the north, east and west. The site is bordered by bordering vegetated wetlands directly to the east, located adjacent to the eastern property line. The topography of the site ranges in elevation from approximately 150 ft. (NAVD 1988) at the center of the site (Assessor's Parcel Number 34-84-0) to approximately 138 ft. (NAVD 1988) at the wetland directly east of the site. Runoff from a portion of the site generally flows east towards the bordering vegetated wetlands. The limit of bordering vegetated wetland resource area on the site was delineated by Environmental Consulting & Restoration, LLC in September of 2019.

The site is located within the Zone X of the Flood Insurance Rate Map, as shown on the current FEMA Flood Insurance Rate Map Panel No. 25025C0091J with an effective date of July 17, 2012. Refer to Figure 2 – FEMA Flood Map.

The soil types as identified by the Soil Survey, Plymouth County, MA prepared by the NRCS Soil Conservation Service (NRCS) are classified as 427A-Newfields Fine Sandy

Loam, 0-3% slopes, extremely stony with hydrologic soil group (HSG) B and 49A-Norwell Mucky Fine Sandy Loam, 0-3% slopes, extremely stony with HSG D. Soil testing conducted by McKenzie Engineering Group, Inc. (MEG) on February 4, 2021 identified the soils to be comprised generally of sandy-loam subsoil, underlain by shallow bedrock. Refer to Figure 3 - Soil Map for the NRCS delineation of soil types. Refer to Appendix E for Soil Testing Results.

In the pre- and post- development stormwater analysis, the watershed area analyzed was approximately 2.10 acres consisting of the subject parcels to be developed. The watershed consists of five (5) sub-catchments. Refer to Pre-Development Watershed Delineation Plan WS-1 in Appendix A for a delineation of drainage subareas for the pre-development design condition.

The SCS Technical Release 20 (TR-20) and Technical Release 55 (TR-55) method-based program "HydroCAD" was employed to develop pre- and post-development peak flows. Drainage calculations were prepared for the pre-development condition for the 2, 10, 25 and 100-year, Type III storm events. Refer to Appendix A for computer results, soil characteristics, cover descriptions and times of concentrations for all subareas.

Post-Development Condition

The proposed development will comprise the four existing lots and will consist of two multi-family buildings with varying irregular footprints, and two duplexes, totaling sixteen units. The project will incorporate a bituminous concrete access roadway, parking areas and driveways, landscaping, stormwater management system and associated infrastructure. The project will access existing utilities located on Dyer Street and South Douglas Street to the west, including water, sewer, gas, electric, telephone and cable. The project will utilize a stormwater management system, consisting of a proposed closed drainage system and subsurface infiltration systems to treat, detain and regulate runoff from the proposed parking areas, roadway, landscaped areas and buildings to ensure contaminated water will not drain into the bordering vegetated wetland. The stormwater management system will be designed to fully comply with all standards of the Department of Environment Protection's Stormwater Management Regulations.

In both the pre-development and post-development condition, an approximate watershed area of 2.10 acres was analyzed. Watershed areas were analyzed in the post-development condition to design low impact stormwater management facilities to mitigate impacts resulting from developing the property. The objective in designing the proposed drainage facilities for the project was to maintain existing drainage patterns to the extent practicable and to ensure that the post-development rates of runoff are less than pre-development rates at the design points. Refer to Proposed Watershed Delineation Plan WS-2 in Appendix B for a delineation of the post-development drainage subareas. The design points for the post-development design conditions correspond to those analyzed for the pre-development design condition. All design points are shown on Plan No. WS-2.

The proposed stormwater management system utilizes a treatment stream consisting of deep sump hooded catch basins, proprietary pre-treatment unit and subsurface infiltration systems. The subsurface infiltration systems were designed to accommodate peak flows and volumes generated by all storms up to the 100-year storm event, and will outlet stormwater into the adjacent bordering vegetated wetlands located east of the site at a regulated rate. All BMPs shall be supported by a comprehensive Construction

Phase Pollution Prevention and Erosion Control Plan and Post-Development BMP Operation and Maintenance Plan.

Subsurface Infiltration System

Runoff from subcatchments 1S & 2S-A, consisting of the roadway, driveways and landscaped areas will be captured in subsurface infiltration chamber systems shown as Ponds 1P & 2P on Plan No. WS-2. Runoff within the limit of pavement will be directed to catch basins and treated by the proprietary pretreatment units, then conveyed into the subsurface infiltration systems where it will infiltrate into the surrounding soils. The subsurface infiltration chamber systems will outlet stormwater directed at the bordering vegetated wetlands located east of the site at a regulated rate. The subsurface infiltration chamber systems were designed to accommodate peak flow generated by all storms up and including to the 100-year storm event. Refer to the site plans for the drainage system design. All BMPs shall be supported by a comprehensive Construction Phase Pollution Prevention Plan and Erosion Control Plan and Post-Development BMP Operation and Maintenance Plan.

Stormwater Best Management Practices (BMP's)

Treatment stream for the new development shall consist of deep sump hooded catch basins, proprietary pre-treatment unit and subsurface infiltration systems to achieve the required removal of at least 80% of the total suspended solids (TSS) and mitigate the anticipated pollutant loading.

Refer to the TSS Removal Worksheets in Appendix D for TSS removal rates.

Erosion and Sedimentation Controls

Compost filter tube (Silt sock) erosion control barriers will be placed at the limit of work as indicated on the plan prior to the commencement of any construction activity. The integrity of the silt sock will be maintained by periodic inspection and replacement as necessary. The silt sock will remain in place until the first course of pavement has been placed and all side slopes have been loamed and seeded and vegetation has been established. Refer to the Erosion Control details on the Site Development Plans and BMP Operation and Maintenance Plan for proposed erosion control measures to be employed for the project.

Compliance with Stormwater Management Standards

Standard 1 – No New Untreated Discharges

The proposed development will not introduce any new untreated discharges to a wetland area or waters of the Commonwealth of Massachusetts. All discharges from the site will be treated through proposed deep sump hooded catch basins, proprietary pre-treatment unit and the subsurface infiltration systems including the establishment of proper maintenance procedures.

To ensure scouring will not occur, Flared-End Sections and Sediment Traps shown on the plan were sized in accordance with the criteria shown on Sheet D-4, Typical Sediment Trap Detail.

Standard 2 – Peak Rate Attenuation

The SCS Technical Release 20 (TR-20) and Technical Release 55 (TR-55) method-based program "HydroCAD" was employed to develop pre- and post-development peak flows. Drainage calculations were prepared for the pre-development condition for the 2, 10, 25 and 100-year, Type III storm events. Refer to Appendices A and B for computer results, soil characteristics, cover descriptions and times of concentrations for all subareas. All drainage structures will be designed employing the Rational Method and the Mass. DPW Design Manual to accommodate peak flows generated by a minimum of a 25-year storm event or a 100-year storm event where applicable. The stormwater management systems were designed to accommodate peak flows generated by a 100-year storm event.

In the pre-development and post-development stormwater analysis, the watershed area analyzed was approximately 2.10 acres consisting of the subject parcels to be developed within the limit of work. Refer to Existing Watershed Delineation Plan WS-1 for a delineation of drainage subareas for the pre-development design condition and refer to Post-Development Watershed Delineation Plan WS-2 for a delineation of drainage subareas for the post-development design condition.

The peak rates of runoff are as follows:

Pre-Development vs. Post-Development Peak Rates of Runoff

Design Point	2 Year Storm **(3.20 Inches)**		10 Year Storm **(4.70 Inches)**		25 Year Storm **(5.50 Inches)**		100 Year Storm **(6.70 Inches)**	
	Exist. (CFS)	**Prop. (CFS)**	**Exist. (CFS)**	**Prop. (CFS)**	**Exist. (CFS)**	**Prop. (CFS)**	**Exist. (CFS)**	**Prop. (CFS)**
Design Point 1	*0.13*	0.13	*0.85*	0.70	*1.42*	1.08	*2.43*	1.73
Design Point 2	*0.06*	0.06	*0.35*	0.24	*0.58*	0.36	*0.99*	0.55
Design Point 3	*0.02*	0.02	*0.11*	0.08	*0.18*	0.12	*0.31*	0.18
Design Point 4	*0.00*	0.00	*0.00*	0.00	*0.01*	0.01	*0.01*	0.01
Design Point 5	*0.11*	0.07	*0.22*	0.15	*0.28*	0.19	*0.38*	0.26

Pre-Development vs. Post-Development Peak Volumes of Runoff

Design Point	2 Year Storm **(3.20 Inches)**		10 Year Storm **(4.70 Inches)**		25 Year Storm **(5.50 Inches)**		100 Year Storm **(6.70 Inches)**	
	Exist. (AC-FT)	**Prop. (AC-FT)**	**Exist. (AC-FT)**	**Prop. (AC-FT)**	**Exist. (AC-FT)**	**Prop. (AC-FT)**	**Exist. (AC-FT)**	**Prop. (AC-FT)**
Design Point 1	*0.026*	0.020	*0.088*	0.060	*0.130*	0.104	*0.203*	0.201
Design Point 2	*0.012*	0.007	*0.041*	0.020	*0.061*	0.028	*0.096*	0.041
Design Point 3	*0.003*	0.002	*0.011*	0.006	*0.017*	0.009	*0.026*	0.013
Design Point 4	*0.000*	0.000	*0.000*	0.000	*0.001*	0.001	*0.001*	0.001
Design Point 5	*0.008*	0.005	*0.016*	0.011	*0.020*	0.014	*0.028*	0.019

A comparison of the pre-development and post-development peak rates of runoff and volumes indicates that the peak rates of runoff and volumes for the post-development condition will be less than or equal to the pre-development condition for all storm events.

Standard 3 – Groundwater Recharge

The soil types as identified by the Soil Survey, Plymouth County, MA prepared by the NRCS Soil Conservation Service (NRCS) are classified as 427A-Newfields Fine Sandy Loam, 0-3% slopes, extremely stony with hydrologic soil group (HSG) B and 49A-Norwell Mucky Fine Sandy Loam, 0-3% slopes, extremely stony with HSG D. An analysis of Soil Tests indicates that the site is comprised of sandy-loam subsoil, underlain by shallow bedrock. The pre-development conditions indicate that the site's topsoil consists almost entirely of dense woodland, providing little if any groundwater recharge. The proposed development will provide significant landscaped areas, consisting of loam and seed to promote infiltration. A calculation of the required recharge volume using the static method indicates that the Site requires a recharge volume of 1,063 C.F., based on a total proposed impervious area of 36,429 S.F. and Hydrologic Soil Group (HSG), B soils (Target Depth Factor = 0.35).

Refer to Figure 3 - Soil Map for the NRCS delineation of soil types and Appendix E – Soil Testing Results for supporting data.

Groundwater Recharge Volume

Stormwater System	Soil Type	Target Depth Factor (F) (in)	Total Impervious Area (sf)	Required Recharge Volume (cf)[1]	Provided Recharge Volume (cf)[2]
	B	0.35	36,429	1,063	
1P (Subsurface Infil. #1)	B				3,518
2P (Subsurface Infil. #2)	B				5,442
				1,063	**8,960**

1. Required Recharge Volume = Target Depth Factor X Impervious Area (d+Kt) [Simple dynamic method]
2. Provided Recharge Volume = Volume Provided from Bottom of System to peak elevation

The subsurface infiltration system will provide both water quality and recharge. Per Standard 4, Water Quality, the BMP must be sized to treat or hold the Target Volume, the larger of the required Water Quality Volume and the Required Recharge Volume. Both the Required Water Quality Volume and Required Recharge Volume are based on the one-half inch of runoff; therefore the Target Volume is the Required Water Quality Volume of 1,467 C.F.

The subsurface infiltration chamber systems will provide Required Recharge Volume. The Required Recharge Volume of 1,063 cubic feet is based on 0.35-inches (Soil Type

B). Groundwater recharge volume will be achieved by the proposed subsurface infiltration systems by providing storage volume up to the invert elevation. The subsurface infiltration systems will provide a total of 8,960 C.F., exceeding the Required Recharge Volume by 7,897 C.F. Refer to Appendix D supplemental calculations.

The subsurface infiltration systems and outlet control structures have been designed to completely drain within 72 hours. Refer to the peak rates of runoff and volumes table for the post-development condition for groundwater recharge of 2, 10 & 25-year storms.

Standard 4 – Water Quality

The stormwater management system was designed to be in full compliance with the DEP Stormwater Management Policy. A treatment stream consisting of deep-sump catch basins with hooded outlets, First Defense proprietary separators (FD-4HC) and subsurface infiltration systems will be employed in the design of drainage facilities for the project to achieve the required removal of 80% total suspended solids. The proposed treatment streams will renovate the stormwater and improve the water quality by promoting the settlement of sediments and pollutants before runoff is released.

First Defense proprietary separators were sized to accommodate and treat all tributary impervious areas within the watershed using the half-inch rule of precipitation during the 100-year storm event. Refer to the TSS Removal Worksheets, and Water Quality Calculations in Appendix D for TSS removal rates and water quality calculations. The water quality treatment volume is provided within the storm water management facilities as follows:

Water Quality Treatment Volume

Design Point	Required WQ Volume (cf)	Proposed WQ Volume (cf)	
Pond 1P	721	3,518	Subsurface Infil. #1 (FD-4HC)
Pond 2P	747	5,442	Subsurface Infil. #2 (FD-4HC)
	1,467	8,960	

Standard 5 – Land Use with Higher Potential Pollutant Loads (LUHPPL)

The proposed project does not include land uses with higher potential pollutant loads. Not Applicable.

Standard 6 – Critical Areas

The proposed project does not discharge to any critical areas. Not Applicable.

Standard 7 - Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

The proposed project is not a redevelopment project. Not Applicable.

Standard 8 – Construction Period Pollution Prevention and Erosion and Sedimentation Control

The project will require a NPDES Construction General Permit and the preparation of a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP will be submitted prior to any proposed construction. A Construction Phase BMP Operation and Maintenance Plan is provided in Appendix F.

Standard 9 – Operation and Maintenance Plan

The Post Construction Operation and Maintenance Plan is provided in Appendix F.

Standard 10 – Prohibition of Illicit Discharges

No illicit discharges are anticipated on site. An Illicit Discharge Compliance Statement will be submitted prior to the discharge of any stormwater to the post-construction best management practices. Measures to prevent illicit discharges will be included in the Long-Term Pollution Prevention Plan.

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Dyer Street
Rockland, MA

6/24/2021

WATER QUALITY VOLUME ANALYSIS

POND	IMPERVIOUS AREA (SF) CN=98	PRECIPITATION (IN)	WATER QUALITY VOLUME REQUIRED (CF)	TREATMENT VOLUME PROVIDED (CF) UP TO INVERT ELEVATION	NET TREATMENT VOLUME PROVIDED (CF)
Subsurface Infil. #1	17,296	0.50	721	3,518	2,797
Subsurface Infil. #2	17,922	0.50	747	5,442	4,695
TOTAL	**35,218**		**1,467**	**8,960**	**7,493**

WATER QUALITY VOLUME ANALYSIS - PROPRIETARY STORMWATER TREATMENTS UNITS (FIRST DEFENSE UNITS)

WATERSHED	IMPERVIOUS AREA (SF) CN=98	PRECIPITATION (IN)	qu (Fig 4) Tc 6 min. (CSM/IN)	AREA (SM)	WATER QUALITY REQUIRED (CFS)
Subsurface Infil. #1	17,296	0.50	774	6.204E-04	0.240
Subsurface Infil. #2	17,922	0.50	774	6.429E-04	0.249

*Use 4' Diameter First Defense Units

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DRAWDOWN WITHIN 72 HOURS ANALYSIS

POND	RAWLS RATE (IN/HR)	STORAGE VOLUME PROVIDED (CF)	BOTTOM AREA (FT2)	DRAWDOWN (HR)
Subsurface Infil. #1	1.02	7,670	3,020	30
Subsurface Infil. #2	1.02	12,004	4,726	30

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REQUIRED RECHARGE VOLUME (CF) *"STATIC METHOD"*

WATERSHED #	IMPERVIOUS AREA (SF)	TARGET DEPTH FACTOR (F) A SOIL	IMPERVIOUS AREA (SF)	TARGET DEPTH FACTOR (F) B SOIL	IMPERVIOUS AREA (SF)	TARGET DEPTH FACTOR (F) C SOIL	IMPERVIOUS AREA (SF)	TARGET DEPTH FACTOR (F) D SOIL		REQUIRED RECHARGE VOLUME (CF)
Subsurface Infil. #1		0.60	17,296	0.35		0.25		0.10		504
Subsurface Infil. #2		0.60	17,922	0.35		0.25		0.10		523
		0.60		0.35		0.25		0.10		
							TOTAL			**1,027**

CAPTURE ADJUSTMENT

WATERSHED #	TOTAL IMPERVIOUS AREA (SF)	TOTAL IMPERVIOUS COLLECTED	% DIRECTED TOWARDS INFILTRATION SYSTEM	STANDARD NO. 3 <100% - > 65% CAPTURED	CAPTURE ADJUSTMENT	ADJUSTED REQUIRED RECHARGE VOLUME (CF)
TOTAL SITE	36,429	35,218	96.68%	**CAPTURE ADJUSTMENT REQUIRED**	1.03	1,063

PROVIDED RECHARGE VOLUME (CF)
BELOW LOWEST INVERT

	REQUIRED RECHARGE VOLUME (CF)	POND	STORAGE VOLUME PROVIDED UP TO INVERT ELEVATION (CF)	NET STORAGE VOLUME PROVIDED (CF)
	522	Subsurface Infil. #1	3,518	2,996
	541	Subsurface Infil. #2	5,442	4,901
TOTAL	**1,063**		**8,960**	**7,897**