Stormwater Management Report for The Meadows Development

This stormwater management report has been prepared for submission to the RM of East St. Paul, Manitoba Transportation & Infrastructure, and Manitoba Environment & Climate Change

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Revision Record

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Acronyms / Abbreviations

Acronym / Abbreviation	Full Name
ha	Hectares
Hwy	Highway
Hr	Hour
m	Meters
mm	Millimeters
min	Minutes
m/s	Meters per Second
m^3/s	Cubic Meters per Second
SWM	Stormwater Management
NWL	Normal Water Level
HWL	High Water Level

1 Overview

This brief has been prepared for submission to the RM of East St. Paul, Manitoba Transportation & Infrastructure, and Manitoba Environment & Climate Change as a requirement for the development review and subsequent approval on behalf of the developers 10089844 Manitoba Inc and 10215032 Manitoba Ltd.

The total analysis area for this report is approximately 76.02 ha, comprising approximately 74.29 ha of land owned by 10089844 Manitoba Inc./10215032 Manitoba Ltd. and 1.73 ha of Manitoba Hydro transmission right-of-way traversing through the planned development area.

The development is located in the RM of East St. Paul, bounded by Manitoba Highways maintenance yard and private properties to the north, Lagimodiere Boulevard and McGregor Farm Road to the west, private properties fronting onto McGregor Farm Road to the south and McGregor Farm Road and Wenzel Street to the east.

This report addresses the design and modelling of the proposed subdivision's retention pond drainage system.

2 Predevelopment Flow

The Meadows development area is split into two catchment areas (East and West). The east catchment is approximately 40.26 ha and it currently drains east to an existing ditch located on the west side of Wenzel Street and McGregor Farm Road. The west catchment is approximately 35.76 ha and it currently drains west to an existing ditch located on the east side of McGregor Farm Road. The catchment is shown on Figure 1.

Predevelopment runoff rates were determined by rational method, using Kinematic Wave Equation for sheet flow, and Equation (3-4) for the FHWA HEC 22 Urban Drainage Design Manual for shallow concentrated flow. A runoff coefficient of C=0.22 was used for the landscaped area (former golf course). Rainfall intensity was based on 2011 Environment Canada IDF data for Winnipeg corresponding to an event with 20% probability of exceedance (5 year storm). The results of the pre-development flow calculations are shown in the table below.

Table 1. Pre-development Flow Calculations

Catchment	Area	Total Length	Slope	Sheet Flow			Shallow Concentrated Flow				TOC	Runoff		
	(ha)	(m)	(%)	n	L (m)	Tt (min)	K	L (m)	V (m/s)	Tt (min)	(min)	I (mm/hr)	C	Q (m^3/s)
WEST	35.76	893	0.13	0.15	30	35.22	0.213	863	0.078	184.47	219.7	13.4	0.22	0.293
EAST	40.26	956	0.08	0.15	30	43.29	0.213	926	0.060	256.17	299.47	10.4	0.22	0.257
TOTAL														**0.550**

Based on the table above, the permitted peak flow to the existing McGregor Farm Road ditch is 0.550 m^3/s.

3 Post Development Drainage Plan

The proposed Meadows development will contain six (6) naturalized retention ponds with a combined normal water level area of 3.700 ha, as illustrated in Figure 2.0. These retention ponds will store and attenuate runoff from the proposed Meadows Development and ultimately discharge to the McGregor Farm Road ditch on the west side of development. The total catchment area for the Meadows Development retention pond system is 76.02 ha.

The proposed retention ponds will drain through series of interconnecting pipes to a 450 mm control outlet culvert located approximately 30m east of the existing McGregor Farm Road ditch. The invert of this control outlet culvert will maintain the normal water level elevation of 231.50m and control the discharge from the pond system to the existing ditch west of the Development.

The post development drainage plan is shown Figure 2.0.

3.1 Analysis

Manitoba Environment & Climate Change design criteria require that retention ponds with outlet pipes limit the 25-year post-development peak flow to the 5-year pre-development peak, while also providing storage for the 100-year post-development event. The Province of Manitoba Drainage Policy further requires that outlet pipes that affect drains through provincial trunk highways are to be designed to restrict the 50-year post-development peak flow to the 5-year pre-development peak. These two criteria together form the basis for the stormwater management design for this subdivision.

A Stormwater Management (SWM) model for this subdivision was developed. The controlled discharge system (retention pond, discharge pipes, retention pond inlet pipes, surface storage) was modelled using SWMM 5.1.

The post development catchment boundaries, retention pond inlet pipes, and outlet pipe is shown in Figure 2.0.

3.1.1 Design Criteria and Assumptions

Design rainfall events for retention pond modelling.

- 5 year Storm (MacLaren 1974)
- 25 year Storm (MacLaren 1974)
- 50 year Storm (M.I.T.)
- 100 year Storm (Acres 1978)

Sub catchments were modelled using the following assumption.

- Catchment ‘A’ = 69% Impervious

- Catchment ‘B’, ‘C’, ‘D’, ‘E’ and ‘F’ = 61% Impervious
- Manning’s roughness coefficient for runoff
    - Impervious n=0.015
    - Pervious n=0.25
- Depression Storage
    - Impervious = 3 mm
    - Pervious = 6 mm
- Horton Infiltration Parameters (for pervious surfaces)
    - Fo = 75 mm/hr
    - Fc = 3 mm/hr
    - K = 4.14 hr^{-1}
- Roughness Coefficients
    - LDS Pipes (PVC & Concrete) n = 0.013
    - Culverts (CSP) n = 0.024

3.1.2 Results

3.1.2.1 Retention Pond Responses

The results of the SWM modelling for the retention pond responses to the design storms are presented in Table 2. – 7. below and the detailed plots of the retention pond levels are shown in Figure 3.

Table 2. Retention Pond Responses: Retention Pond #1 (NWL =231.500m)

Storm	High Water Level (m)	Rise Above NWL (m)	Volume Stored (m^3)
5 Year Storm	232.071	0.571	6,630
50 Year Storm	232.365	0.865	10,557
100 Year Storm	232.558	1.058	13,319

Table 3 Retention Pond Responses: Retention Pond #2 (NWL =231.500m)

Storm	High Water Level (m)	Rise Above NWL (m)	Volume Stored (m^3)
5 Year Storm	232.073	0.573	1,611
50 Year Storm	232.413	0.913	2,875
100 Year Storm	232.636	1.136	3,831

Table 4. Retention Pond Responses: Retention Pond #3 (NWL =231.500m)

Storm	High Water Level (m)	Rise Above NWL (m)	Volume Stored (m^3)
5 Year Storm	232.011	0.511	4,968
50 Year Storm	232.266	0.766	7,742
100 Year Storm	232.456	0.956	9,938

Table 5. Retention Pond Responses: Retention Pond #4 (NWL =231.500m)

Storm	High Water Level (m)	Rise Above NWL (m)	Volume Stored (m^3)
5 Year Storm	232.011	0.511	2,905
50 Year Storm	232.266	0.766	4,630
100 Year Storm	232.456	0.956	6,036

Table 6. Retention Pond Responses: Retention Pond #5 (NWL =231.500m)

Storm	High Water Level (m)	Rise Above NWL (m)	Volume Stored (m^3)
5 Year Storm	232.002	0.502	2,307
50 Year Storm	232.246	0.746	3,660
100 Year Storm	232.428	0.928	4,767

Table 7. Retention Pond Responses: Retention Pond #6 (NWL =231.500m)

Storm	High Water Level (m)	Rise Above NWL (m)	Volume Stored (m^3)
5 Year Storm	232.002	0.502	3,615
50 Year Storm	232.246	0.746	5,656
100 Year Storm	232.429	0.929	7,298

As shown in the above tables, the maximum rise for the Meadows Development Ponds is seen in pond #2 during the 100-year storm. The maximum calculated High-Water Level (HWL) is 232.636 m. This represents a rise of 1.136 m above NWL. The flood protection level for this development will be set at 233.236 m, which is 0.60m above the retention pond 100-year HWL.

3.1.2.2 Controlled Runoff

The max discharge for the design storms from the proposed development is summarized in Table 8. below and the detailed plots of the discharge curves are provided in Figure 4.

Table 8. Retention Pond Max Discharge

Storm	Max Discharge (m^3/s)
5 Year Storm	0.242
50 Year Storm	0.355
100 Year Storm	0.411

3.1.2.3 Uncontrolled Runoff

The post-development area contributing to uncontrolled runoff is approximately 1.27 ha. At this stage of the analysis, this portion of the site is assumed to drain directly into the Wenzel Street and McGregor Farm Road ditch. The total uncontrolled surface runoff for post-development conditions under the 50-year storm event is summarized in Table 9.

Table 9. Pre-development Uncontrolled Runoff Calculations

Catchment	Area	Total Length	Slope	Sheet Flow			TOC	Runoff		
	(ha)	(m)	(%)	n	L (m)	Tt (min)	(min)	I (mm/hr)	C	Q (m^3/s)
UNCONTROLLED	1.27	26	2.5	0.24	26	14.19	14.19	131.5	0.15	0.070

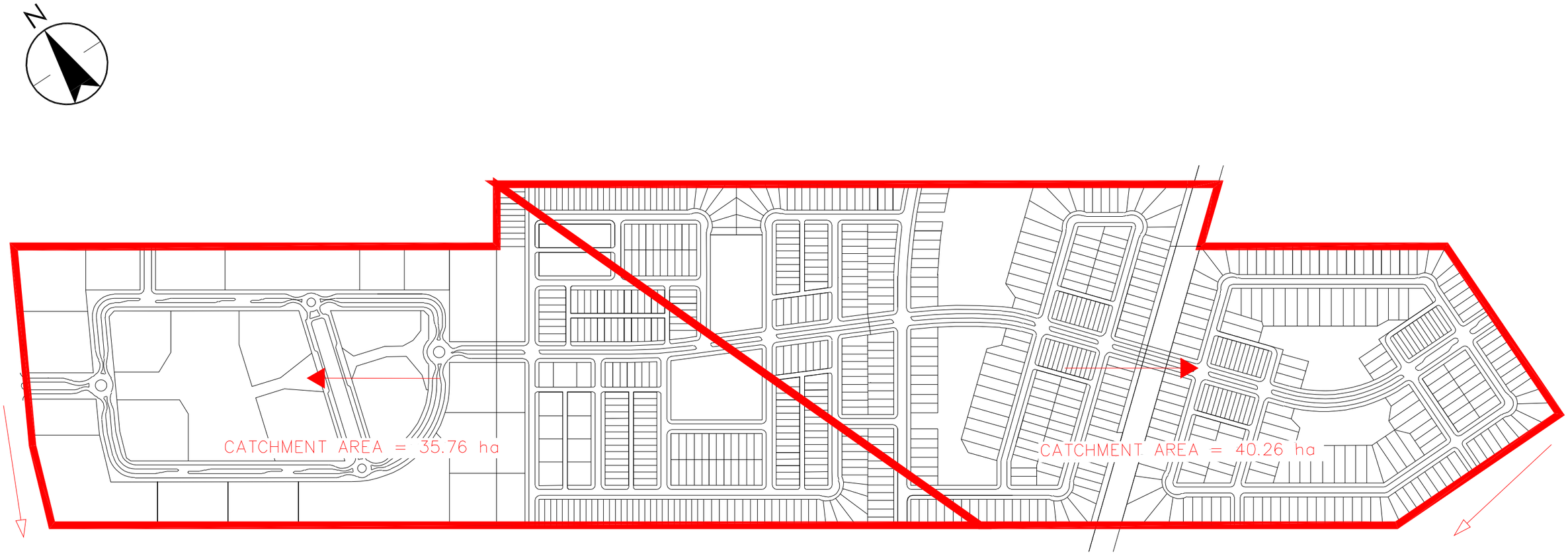
4 Conclusion

The calculated controlled 50 year post development peak flow rate to the existing ditch located directly adjacent to the west end of the site is 0.355 m^3/s and the calculated uncontrolled 50 year post development peak flow rate to the existing ditch is 0.070 m^3/s. The total post development peak flow is 0.425 m^3/s which is 0.125 m^3/s less than the calculated 5 year pre-development peak flow of 0.550 m^3/s.

The retention pond system has capacity to store the runoff generated from the 100 year post development design storm with an expected HWL elevation of 232.636m. The flood protection level for this development will be set at 233.236m (HWL + 0.60m).

Based on our analysis we can conclude that the drainage from this proposed subdivision will not have a negative impact on the rural ditch system, since the post development runoff will be restricted to below the pre-development runoff rate.

FIGURES



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PRE-DEVELOPMENT CATCHMENTS

Notes

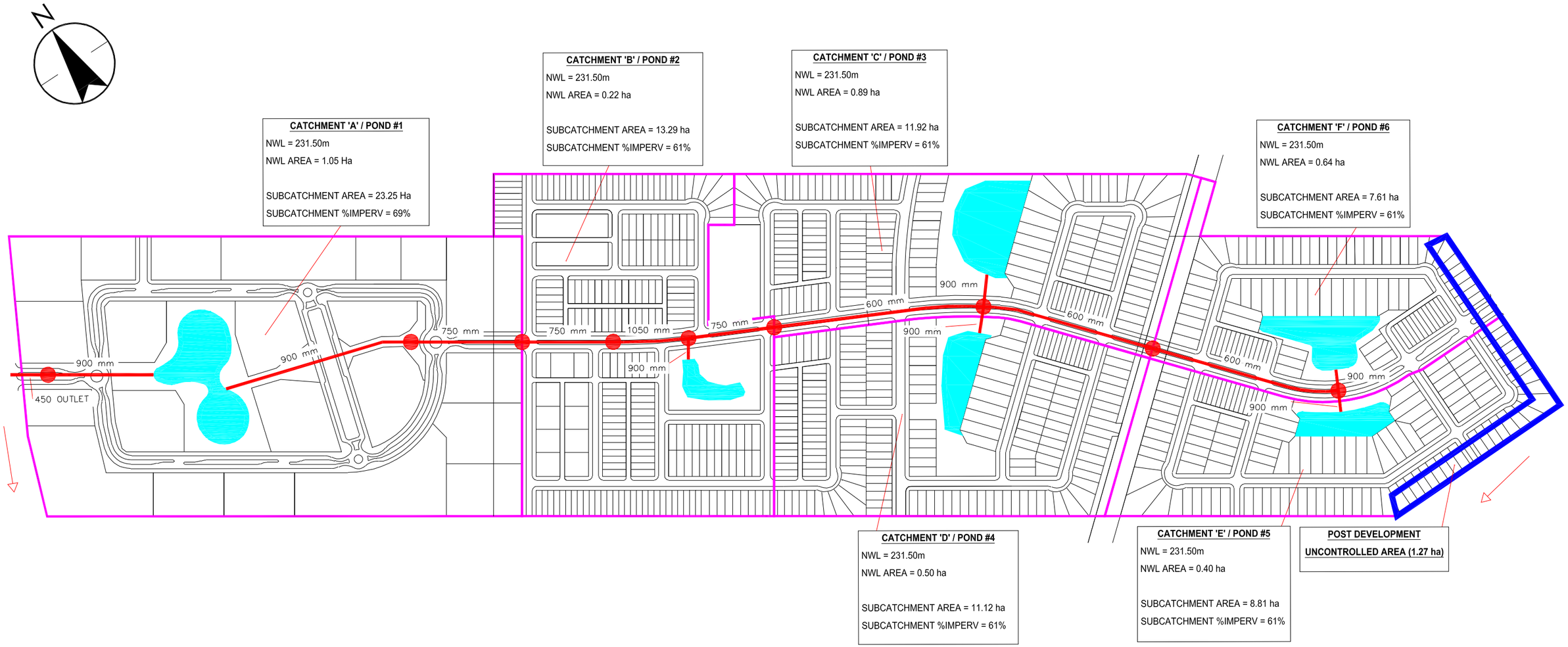
EXISTING DITCH FLOW DIRECTION

CATCHMENT FLOW DIRECTION

Client/Project
10089844 Manitoba Inc. and 10215032 Manitoba Ltd.
The Meadows Development

Figure No.
1.0

Title
Pre-development Flow Patterns



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RETENTION POND CATCHMENTS

UNCONTROLLED AREA

Notes

EXISTING DITCH FLOW DIRECTION

PROPOSED INTERCONNECTING PIPE

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The Meadows Development

Figure No.
2.0

Title
Post-development Catchments,
Outlet Pipe and Inteconnecting Pipes

Figure 3.1 - Retention Pond Rises During 5-Year Storm

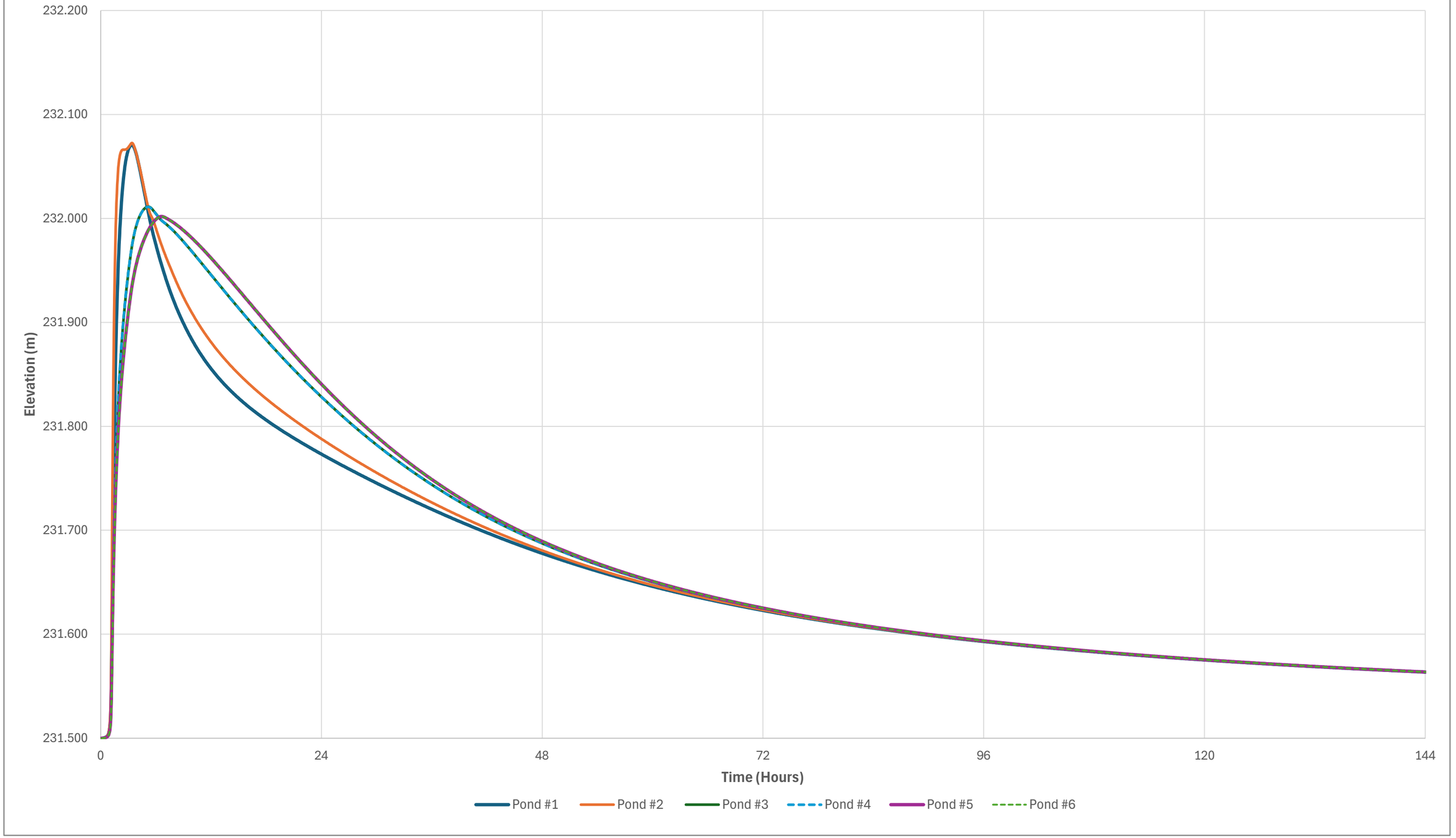


Figure 3.2 - Retention Pond Rises During 50-Year Storm

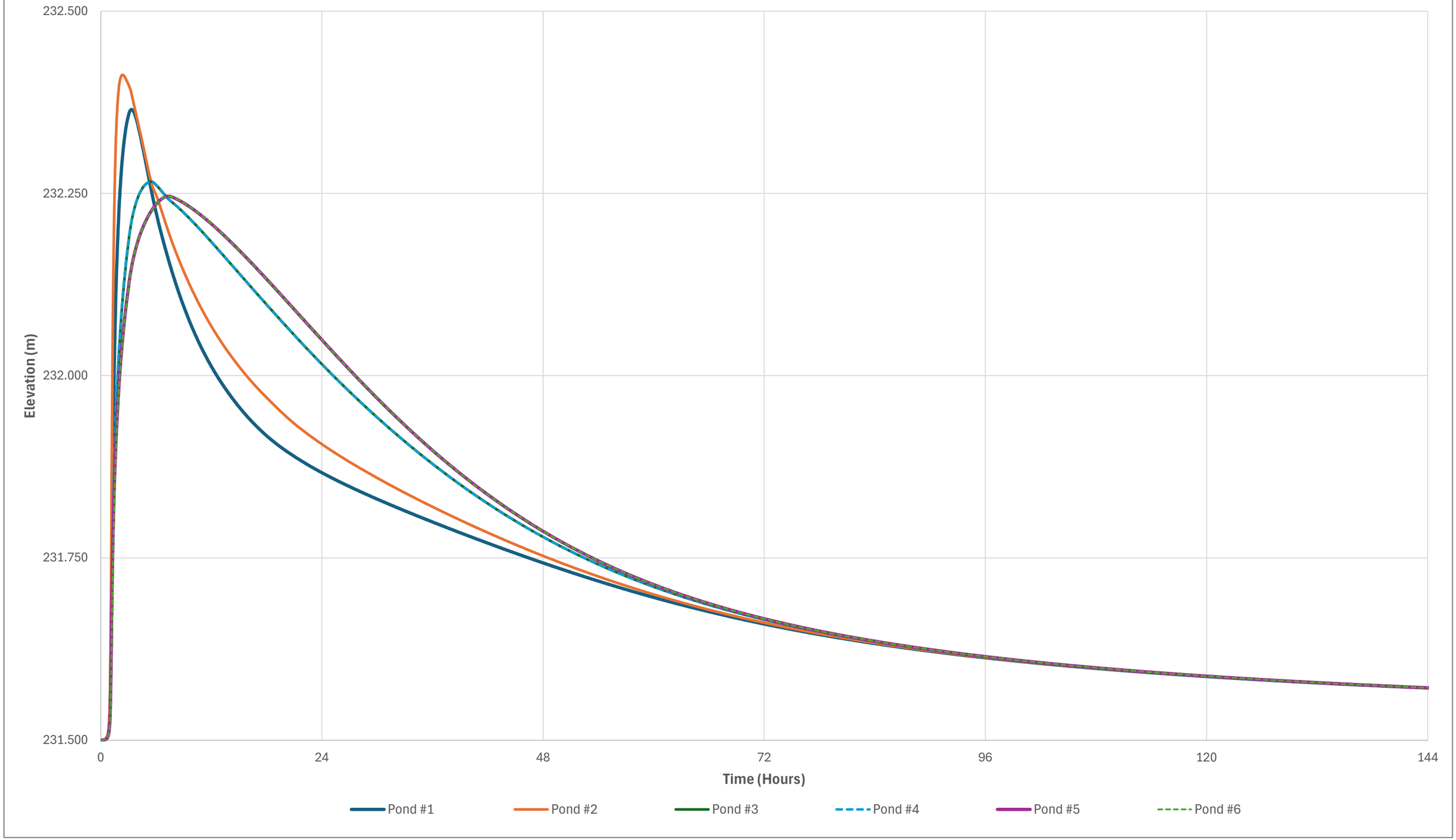


Figure 3.3 - Retention Pond Rises During 100-Year Storm

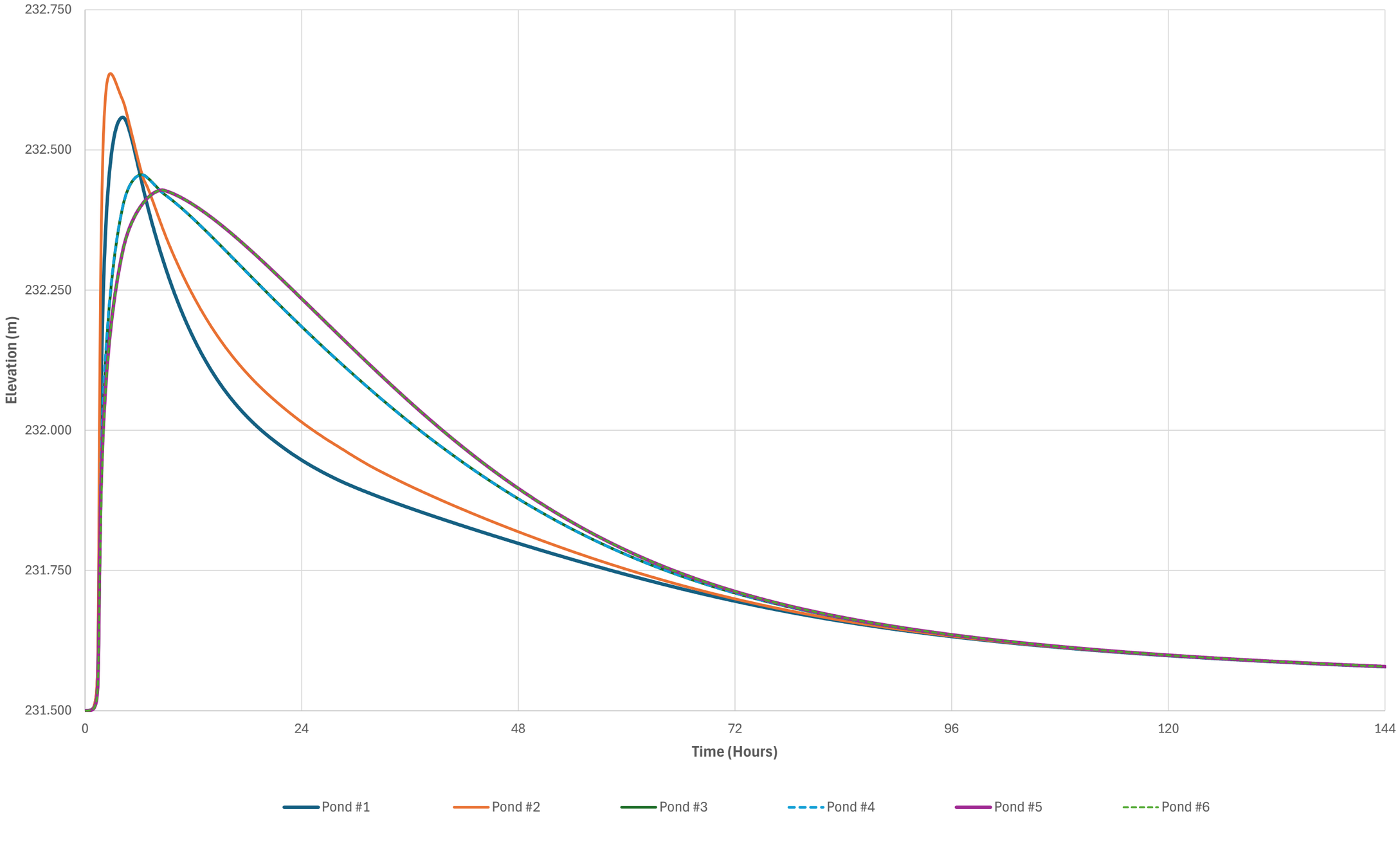
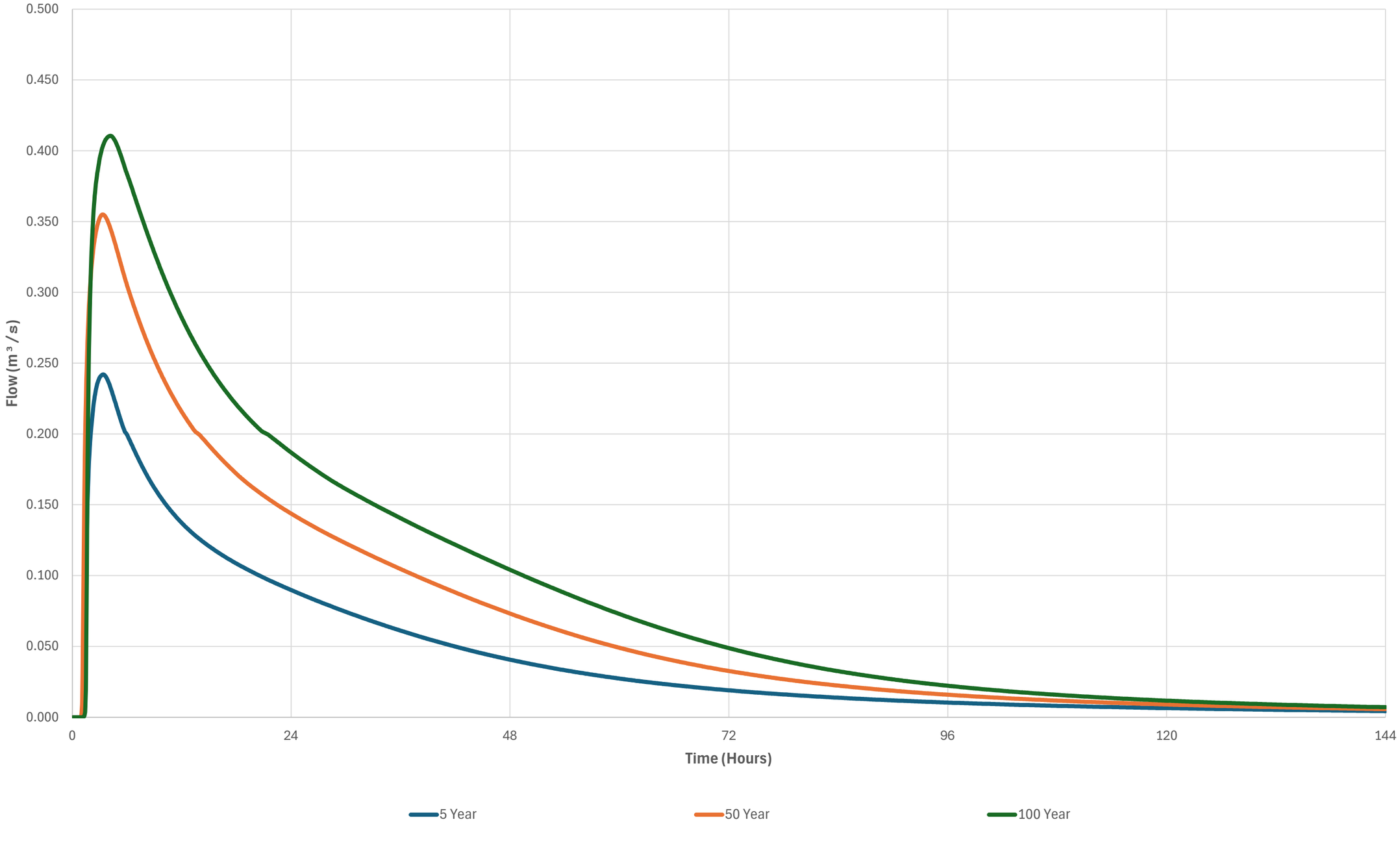


Figure 4 - Discharge Rate at Outlet



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