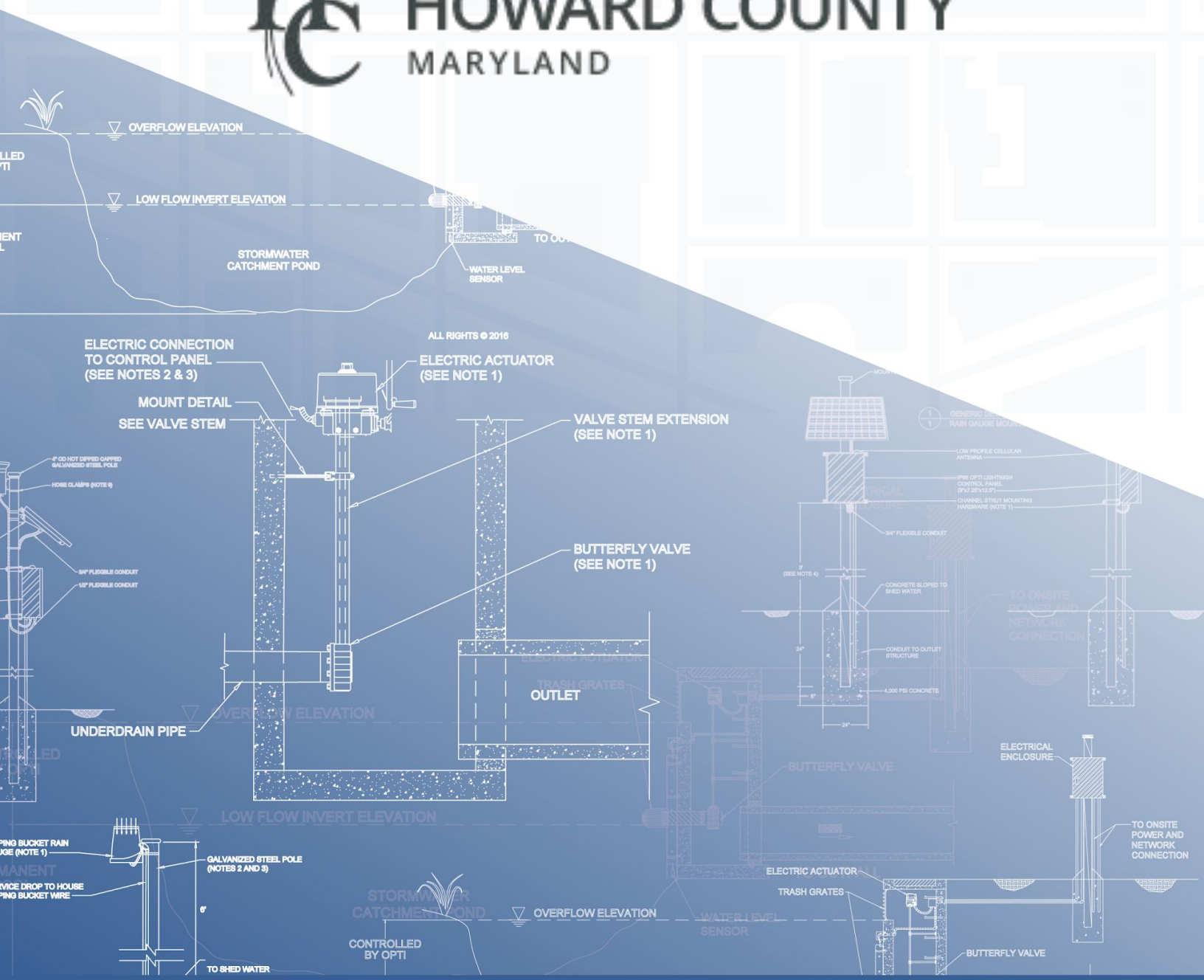
Continuous Monitoring and Adaptive Control for Enhanced Flood Control in Howard County, Maryland

Prepared for

HOWARD COUNTY
MARYLAND



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Objective

The objective of this document is to estimate the expected volume of quantity control and water quality benefit achieved through the installation of continuous monitoring and adaptive control (CMAC) on six stormwater management ponds in Howard County, Maryland ("the County"). The ponds evaluated as part of this document were chosen based on using the CMAC Retrofit Score developed by Opti and detailed in the "Prioritization Methodology for Continuous Monitoring and Adaptive Control (CMAC) Projects in Howard County, MD" memorandum provided to the County (May 1, 2019). Three stormwater management ponds were chosen for further evaluation based on the CMAC retrofit score and through conversations with the County. Three additional alternative ponds were evaluated as part of this analysis (totaling six). Sites were selected based on their ability to mitigate flood risk through water quantity control using CMAC to enable Howard County to become more resilient to flooding and stormwater hazards.

Background

The CMAC Retrofit score for each site was used to determine stormwater management ponds with the highest potential for flood reduction benefits through implementation of CMAC. Multi-criteria decision analysis (MCDA) was used to assign a CMAC Retrofit Score to each of the 1,422 ponds in the County. Parameters, such as drainage area, impervious area, pond type, watershed, dam safety rating, proximity to floodplain, and ownership were considered as part of the CMAC Retrofit Score determination. Of the 1,422 stormwater management facilities evaluated, 168 facilities were determined to have "high" CMAC Retrofit scores. Further conversations with the County helped prioritize ponds to be evaluated as part of this study.

Overall, six (6) facilities were evaluated to estimate the expected volume of quantity control and water quality benefit through the implementation of CMAC (Table 1). Three of the ponds presented are expected to move forward to conceptual design (Sites 1-3). These sites were selected based on input from the County on the location of specific flood prone areas. The remaining three sites are alternatives (Alternative 1-3) in the event the County decides to replace another CMAC site presented, or move forward with additional conceptual designs.

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Table 1: Facilities evaluated for quantity control and quality benefit through CMAC.

Site Number	Location	Type	CMAC Score	Ranking (compared to other CMAC Scores)
1	8390 Autumn Rust Rd., Ellicott City, MD	Wet Pond	52.9	3
2	11244 Chase St., Fulton, MD	Wet Extended Detention Pond	45.9	9
3	8056 Hillsborough Rd., Ellicott City, MD	Wet Pond	35.9	38
Alternative 1	9527 Valley Mede Ct., Ellicott City, MD	Wet Pond	50.4	6
Alternative 2	7769 Water St., Fulton, MD	Wet Extended Detention Pond	43.0	12
Alternative 3	8587 Eastern Morning Run, Laurel, MD	Wet Extended Detention Pond	40.9	17

Other sites with high CMAC scores were not chosen for evaluation due to conversations with the County or concerns with dam hazard classification.

Evaluation Methodology

The CMAC retrofit at each facility would involve installing an actuated valve on the existing pond drain and allowing the permanent pool in each wet pond to be drawn-down in advance of a rain event. A water level sensor would be installed at the outlet structure of each pond for real-time volume estimation. The valve and level sensor would be connected through a solar powered control panel which provides communication with Opti cloud-based software. The Opti cloud-based software uses the National Weather Service (NWS) forecast to predict the volume of runoff to each pond and controls the actuated valve based on the amount of runoff predicted. This approach provides added flood storage at existing wet ponds without the creation of new storage through grading or excavation.

The six ponds selected for evaluation were analyzed using available as-builts, design plans, and stormwater reports that detailed the current condition of each pond. Each pond has an existing

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pond drain that remains closed in existing conditions to hold a permanent pool between the pond bottom and the next passive outflow point. Specifically, the adaptive storage volume provided by a CMAC retrofit and the impact on hydraulics at each pond were evaluated. The following methodology was used to evaluate each pond:

- Evaluate the stage-storage relationship of the existing pond
- Identify the invert elevation of the existing pond drain
- Determine the volume available between the existing pond drain and the next passive outflow point to be drawn-down in each pond in advance of a rain event ("adaptive storage volume")
- Model each pond to compare hydraulic performance of existing conditions and proposed conditions with CMAC (assumes the adaptive volume is controlled through the existing pond drain)

Each pond was modeled using both existing conditions and the CMAC drawdown condition to compare peak discharge rates for each. Hydraulic modeling was performed using the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 rainfall depths along with the NOAA Type "C" synthetic rainfall distribution for the 1-year (2.66"), 2-year (3.21"), 10-year (4.93"), and 100-year (8.52"), 24-hour duration events.

Adaptive storage volume was evaluated for each pond based on the available design information and the required drawdown rate. Wet pools would be drawn-down in advance of a specific volume of rainfall (this is a configurable setting using CMAC software) and drain for a maximum period of 48-hours prior to a forecasted rainfall event based on the NWS forecast. The Maryland Department of the Environment (MDE) has indicated that the maximum rate of drawdown for a wet pool is 12" per day. Therefore, the volume and rate of drawing down a wet pool in advance of a rainfall event is limited to no more than two (2) feet for the purposes of creating adaptable storage.

Maryland Department of the Environment requires that 50% of the water quality volume (WQv) for wet ponds be held in the permanent pool of a facility. Drawing-down the permanent pool in advance of a rainfall event reduces what is considered the permanent pool of a pond and thus reduces creditable volume. To mitigate any perceived reduction in water quality benefit, CMAC control settings at each pond would be configured to drawdown only when a rainfall event greater than a specific volume is in the forecast. For example, if a pond has an adaptive storage volume to capture 1.5" of runoff from a watershed without wet weather discharge, a minimum rainfall volume of 1.5" could be set using CMAC software. Runoff would be stored in the pond below typical point of passive overflow. This would allow drawdown only for forecasted rainfall events greater than 1.5", which limits the number of pre-event drawdowns for a pond and increases overall retention time of water in a pond. Wet weather discharge is water that is discharged from a pond during a rainfall event, potentially contributing to erosive or damaging flow rates downstream. The volume of rainfall that can be captured without wet weather discharge is referred to as the "CMAC Event" in this evaluation.

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Water quality volume (WQv) and impervious area treated (IAT) was estimated for each pond. The main goal of the proposed work is to identify facilities most capable of reducing flood risk through water quantity control to enable the County to become more resilient to future impacts caused by flooding and stormwater hazards. Water quality crediting was viewed as a secondary benefit of this study and there are several instances where the creditable WQv and IAT could decrease as a result of increasing adaptive flood control and resilience through CMAC. Adaptive storage volume could be decreased to limit water quality credit at impacted ponds. The maximum adaptive storage volume (based on current regulations) for each pond was evaluated, regardless of impact to water quality credit for all ponds evaluated. It should be noted that drawdown of the adaptive storage volume would be limited to rainfall events with volume greater than the CMAC Event. This results in a limited number of drawdowns per year based on the occurrence of these larger rainfall events. Nonetheless, estimated WQv and IAT credits are provided for each facility as well as the corresponding adaptable storage volume for pond.

Summary of Results

Site 1: 8390 Autumn Rust Road Pond

The wet pond at 8390 Autumn Rust Road in Ellicott City has a drainage area of approximately 58.9 acres and a contributing impervious area of 14.7 acres. This site is located in the Tiber-Hudson watershed, upstream of downtown Ellicott City in the greater Patapsco River watershed (Figure 1). Site work at the pond is currently in design to replace the existing control structure and provide additional water quality treatment at the pond.

Additional flood capacity would be added by drawing-down the permanent pool of the pond prior to rainfall events greater than 1.1” using CMAC. The permanent pool would be lowered approximately 1.7 feet (the vertical distance between the permanent pool elevation and the invert elevation of the pond drain) to create 0.82 ac-ft of capacity for flood control storage. Drawdown would only occur prior to rainfall events in the forecast greater than the CMAC Event (Table 3). Since the adaptive storage volume (0.82 ac-ft) accounts for less than half of total existing wet pool volume (2.00 ac-ft), the WQv and IAT from the facility would remain unchanged.

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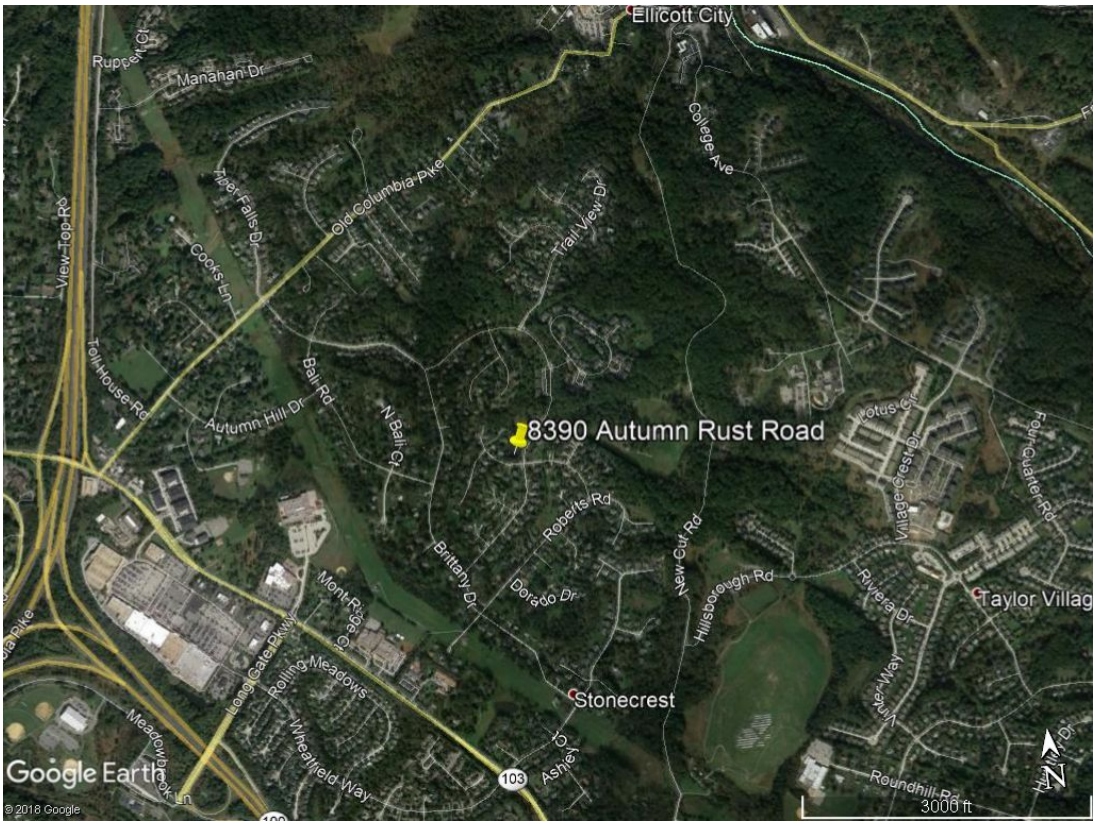

Figure 1: Aerial location of 8390 Autumn Rust Road wet pond (Google Earth).

Table 2: Summary of existing and proposed water quality and flood control benefits for the 8390 Autumn Rust Rd. pond.

	Existing	**Proposed**
Drainage Area (ac)	58.9	
Impervious Area (ac)	14.7	
Pool Elevation (less than CMAC event, ft)	363.8	
Pool Elevation (greater than CMAC event, ft)	363.8	362.1
Adaptive Storage (ac-ft)	0	0.82
Creditable WQv (in)	1.48	
Creditable IAT (acres)	16.5	

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The increased flood control capacity from CMAC would result in decreases in peak discharges for the 1-, 2-, and 10-year events. Peak discharge for the 100-year rainfall event was similar in both the existing and proposed CMAC conditions (Table 3). While the peak discharges were similar for the 100-year event, the volume released downstream of the facility would be reduced by 0.82 ac-ft due to the CMAC adaptive storage. Further, using CMAC for adaptive flood storage would result in no wet weather discharge from the modeled 1.1" rainfall event (CMAC Event). The CMAC Event represents the rainfall event that can be fully captured in the adaptive storage without discharge during the rain event.

Table 3: Comparison of peak discharges between existing conditions and proposed conditions with CMAC for the 8390 Autumn Rust Rd. pond.

Rainfall Event	Existing Peak Flow (cfs)	CMAC Peak Flow (cfs)	Peak Flow Reduction (%)
CMAC Event (1.1")	1.6	0*	100
1-year	22.4	19.4	13
2-year	28.9	26.5	8
10-year	103.7	91.7	12
100-year	226.5	226.5	0

*No outflow during wet weather. Runoff would be discharged prior to the subsequent forecasted rainfall event with a volume greater than the CMAC event.

Peak flow reductions were partially dependent on the elevations of openings in the control structure and the size of each opening. Event slight decreases in water surface elevation can cause large reductions in peak flow rate, as seen with the 10-year rainfall event for 8390 Autumn Rust Road.

Site 2: 11244 Chase Street Pond

The wet pond at 11244 Chase Street in Fulton has a drainage area of approximately 42.5 acres and a contributing impervious area of 21.0 acres. This site is located in the Little Patuxent River watershed, just southwest of the Applied Physics Laboratory (APL) campus off Johns Hopkins Road (Figure 2).

Additional flood capacity would be added by drawing-down the permanent pool of the pond prior to rainfall events greater than 1.3" using CMAC. The permanent pool would be lowered approximately 2.0 feet (based on maximum 12" per day drawdown and the 48-hour forecast) to

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create 1.04 ac-ft of capacity for flood control storage. Drawdown would only occur prior to rainfall events in the forecast greater than the CMAC Event (Table 5). The water quality WQv and IAT from the facility would remain unchanged since the volume in the adaptive storage volume (1.04 ac-ft) is less than 50% of the existing permanent pool volume (2.36 ac-ft).

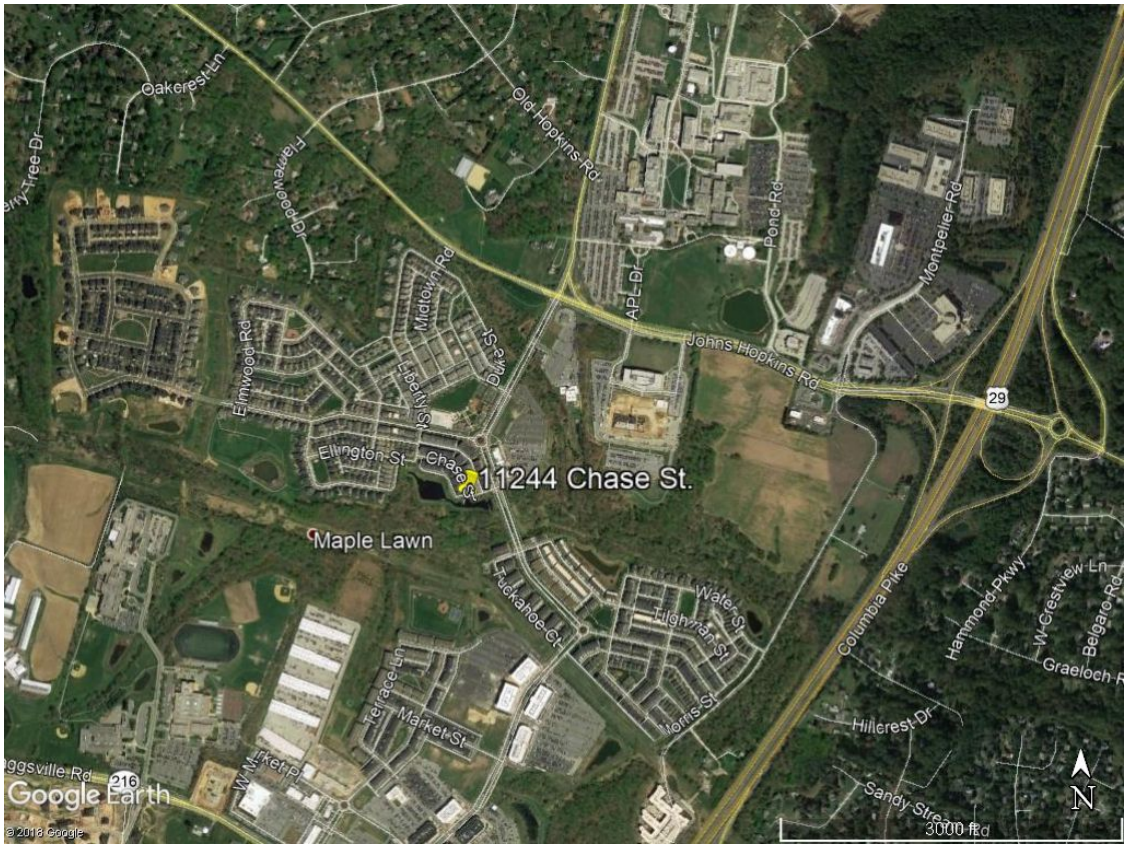

Figure 2: Aerial location of 11244 Chase Street wet pond (Google Earth).

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Table 4: Summary of existing and proposed water quality and flood control benefits for 11244 Chase Street pond

	Existing	Proposed
Drainage Area (ac)	42.5	
Impervious Area (ac)	21.0	
Pool Elevation (less than CMAC event, ft)	374.7	
Pool Elevation (greater than CMAC event, ft)	374.7	372.7
Adaptive Storage (ac-ft)	0	1.04
Creditable WQv (in)	1.35	
Creditable IAT (acres)	22.9	

The increased flood control capacity from CMAC would result in decreases in peak discharges for the 1-, 2-, and 10-year events. Peak discharge for the 100-year rainfall event is similar in both the existing and proposed CMAC conditions. While the peak discharges are similar for the larger 100-year event, the volume released downstream of the facility would be reduced by 1.04 ac-ft due to the CMAC adaptive storage. Further, using CMAC for adaptive flood storage would result in no wet weather discharge from the modeled 1.3” rainfall event (CMAC Event).

Table 5: Comparison of peak discharges between existing conditions and proposed conditions with CMAC for the 11244 Chase Street pond.

Rainfall Event	Existing Peak Flow (cfs)	CMAC Peak Flow (cfs)	Peak Flow Reduction (%)
CMAC Event (1.3”)	1.7	0*	100
1-year	6.5	5.6	15
2-year	8.1	7.6	6
10-year	105.5	99.5	6
100-year	261.7	261.6	0

*No outflow during wet weather. Runoff would be discharged prior to the subsequent forecasted rainfall event with a volume greater than the CMAC event.

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Site 3: 8056 Hillsborough Road Pond

The wet pond at 8056 Hillsborough Road in Ellicott City has a drainage area of approximately 25.9 acres and a contributing impervious area of 9.1 acres. This site is located in the Tiber-Hudson watershed, upstream of downtown Ellicott City in the greater Patapsco River watershed (Figure 3).

Additional flood capacity would be added by drawing-down the permanent pool of the pond prior to rainfall events greater than 1.7" using CMAC. The permanent pool would be lowered approximately 2.0 feet (based on maximum 12" per day drawdown and the 48-hour forecast) to create 0.52 ac-ft of capacity for flood control storage. Drawdown would only occur prior to rainfall events in the forecast greater than the CMAC Event (Table 7). Based on current regulations, the WQv and IAT would be reduced as a result of draining greater than 50% (0.52 ac-ft) of the existing permanent pool (0.80 ac-ft) prior to rainfall events with greater volume than the CMAC event.

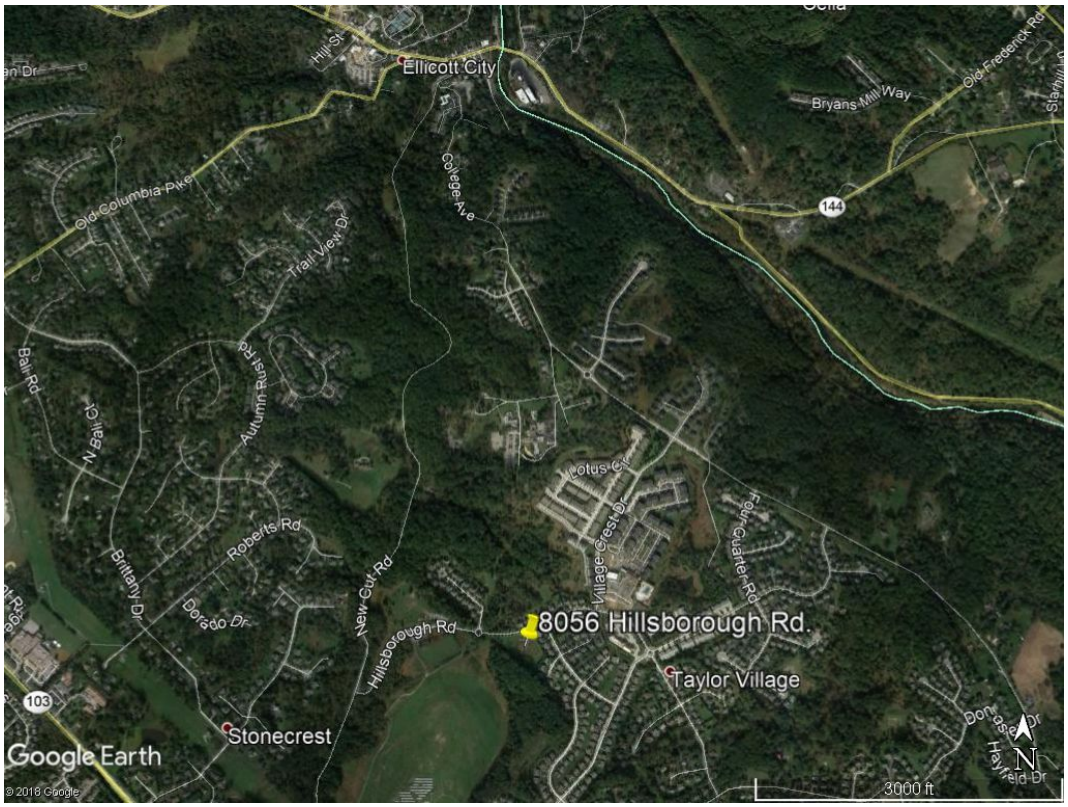

Figure 3: Aerial location of 8056 Hillsborough Road. wet pond (Google Earth).

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Table 6: Summary of existing and proposed water quality and flood control benefits for 8056 Hillsborough Road

	Existing	Proposed
Drainage Area (ac)	25.9	
Impervious Area (ac)	9.1	
Pool Elevation (less than CMAC event, ft)	396.0	
Pool Elevation (greater than CMAC event, ft)	396.0	394.0
Adaptive Storage (ac-ft)	0	0.52
Creditable WQv (in)	1.05	0.74
Creditable IAT (acres)	9.23	6.73

The increased flood control capacity from CMAC would result in decreases in peak discharges for the 1-, 2-, and 10-year events. Peak discharge for the 100-year rainfall event was similar in both the existing and proposed CMAC conditions. While the peak discharges are similar for the larger 100-year event, the volume released downstream of the facility would be reduced by 0.52 ac-ft due to the CMAC adaptive storage. Further, using CMAC for adaptive flood storage would result in no wet weather discharge from the modeled 1.7” rainfall event (CMAC Event).

Table 7: Comparison of peak discharges between existing conditions and proposed conditions with CMAC for the 8056 Hillsborough Road pond.

Rainfall Event	Existing Peak Flow (cfs)	CMAC Peak Flow (cfs)	Peak Flow Reduction (%)
CMAC Event (1.7”)	3.5	0*	100
1-year	18.8	4.5	76
2-year	24.4	20.2	17
10-year	46.7	45.0	4
100-year	80.1	79.3	1

*No outflow during wet weather. Runoff would be discharged prior to the subsequent forecasted rainfall event with a volume greater than the CMAC event.

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Alternative Site 1: 9527 Valley Mede Court Pond

The wet pond at 9527 Valley Mede Court in Ellicott City has a drainage area of approximately 25.5 acres and a contributing impervious area of 5.7 acres. This site is located in the Plumtree watershed, in the greater Patapsco River watershed (Figure 4).

Additional flood capacity would be added by drawing-down the permanent pool of the pond prior to rainfall events greater than 1.5" using CMAC. The permanent pool would be lowered approximately 1.3 feet (the vertical distance between the permanent pool elevation and the bottom of the pond) to create 0.16 ac-ft of capacity for flood control storage. Drawdown would only occur prior to rainfall events in the forecast greater than the CMAC Event (Table 9). The WQv and IAT would be reduced by 50% as a result of completely draining the permanent pool prior to a rainfall event. However, Opti is currently conducting a monitoring study to provide full WQv and IAT credit to CMAC facilities with no permanent pool.

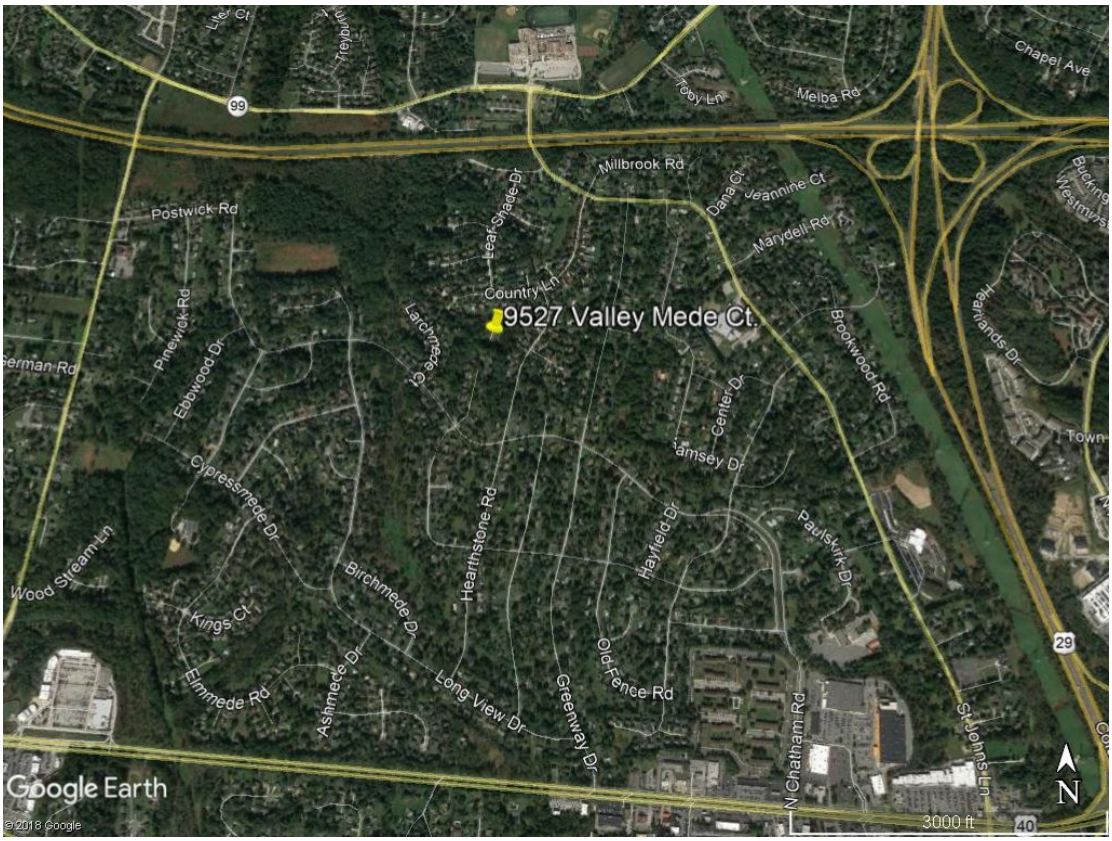

Figure 4: Aerial location of 9527 Valley Mede Court wet pond (Google Earth).

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Table 8: Summary of existing and proposed water quality and flood control benefits for 9527 Valley Mede Court.

	Existing	**Proposed**
Drainage Area (ac)	25.5	
Impervious Area (ac)	5.7	
Pool Elevation (less than CMAC event, ft)	406.9	
Pool Elevation (greater than CMAC event, ft)	406.9	405.6 (bottom of pond)
Adaptive Storage (ac-ft)	0	0.16
Creditable WQv (in)	0.34	0.17
Creditable IAT (acres)	1.92	0.96

The increased flood control capacity from CMAC would result in decreases in peak discharges for the 1-, 2-, and 10-year events. Peak discharge for the 100-year rainfall event is similar in both the existing and proposed CMAC conditions. While the peak discharges are similar for the larger 100-year event, the volume released downstream of the facility would be reduced by 0.16 ac-ft due to the CMAC adaptive storage. Further, using CMAC for adaptive flood storage would result in no wet weather discharge from the modeled 1.5” rainfall event (CMAC Event).

Table 9: Comparison of peak discharges between existing conditions and proposed conditions with CMAC for the 9527 Valley Mede Court pond.

Rainfall Event	**Existing Peak Flow (cfs)**	**CMAC Peak Flow (cfs)**	**Peak Flow Reduction (%)**
CMAC Event (1.5”)	0.2	0*	100
1-year	2.4	1.3	46
2-year	5.2	4.3	17
10-year	22.9	20.4	11
100-year	110.4	109.2	1

*No outflow during wet weather. Runoff would be discharged prior to the subsequent forecasted rainfall event with a volume greater than the CMAC event.

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Alternative Site 2: 7769 Water Street Pond

The wet pond at 7769 Water St. in Fulton has a drainage area of approximately 27.3 acres and a contributing impervious area of 13.2 acres. This site is located in the Little Patuxent River watershed, just southwest of the Applied Physics Laboratory (APL) campus off Johns Hopkins Rd. (Figure 5).

Additional flood capacity would be added by drawing-down the permanent pool of the pond prior to rainfall events greater than 1.3" using CMAC. The permanent pool would be lowered approximately 2.0 feet (based on maximum 12" per day drawdown and the 48-hour forecast) to create 0.89 ac-ft of capacity for flood control storage. Drawdown would only occur prior to rainfall events in the forecast greater than the CMAC Event (Table 11). The water quality WQv and IAT from the facility would be reduced since adaptive storage volume (0.89 ac-ft) is greater than 50% of the existing permanent pool volume (1.00 ac-ft)

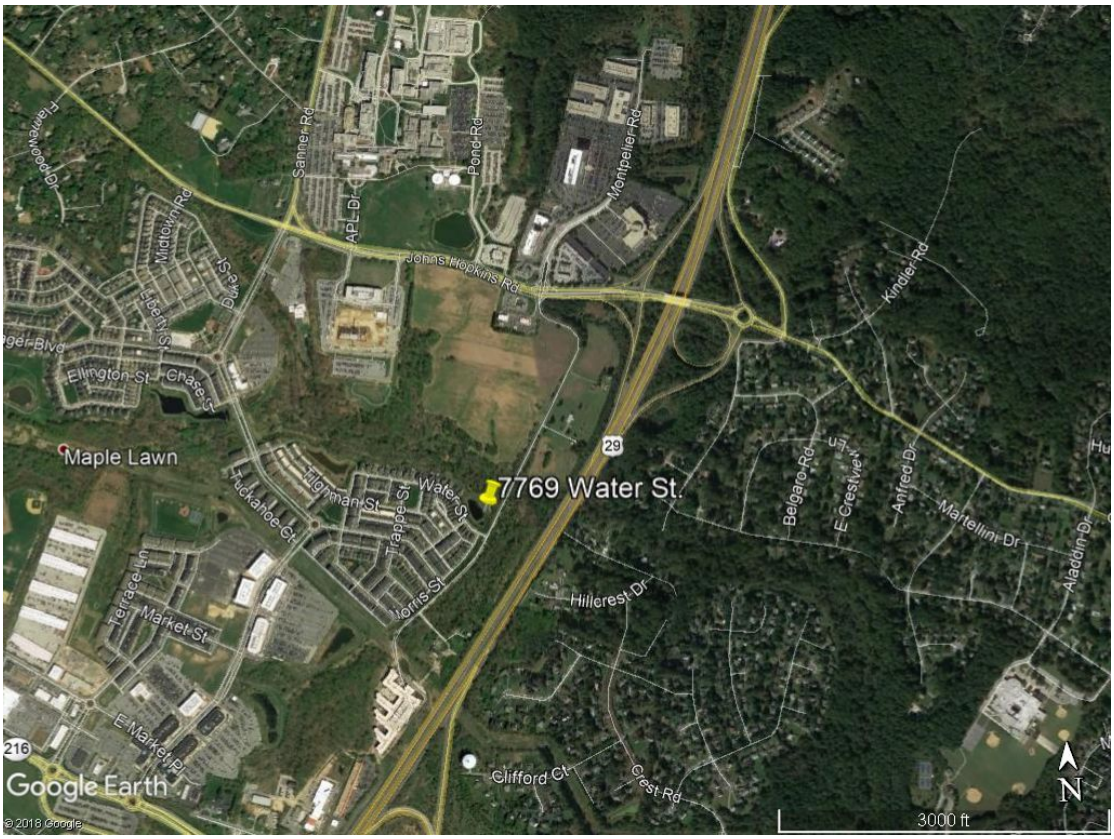

Figure 5: Aerial location of 7769 Water Street wet pond (Google Earth).

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Table 10: Summary of existing and proposed water quality and flood control benefits for 7769 Water Street pond

	Existing	Proposed
Drainage Area (ac)	27.3	
Impervious Area (ac)	13.2	
Pool Elevation (less than CMAC event, ft)	357.0	
Pool Elevation (greater than CMAC event, ft)	357.0	355.0
Adaptive Storage (ac-ft)	0	0.89
Creditable WQv (in)	1.10	0.58
Creditable IAT (acres)	13.5	7.8

The increased flood control capacity from CMAC would result in decreases in peak discharges for the 1-, 2-, and 10-year events. Peak discharge for the 100-year rainfall event decreases by approximately 3% due to adaptive storage. While the peak discharges are similar for the 100-year event, the volume released downstream of the facility would be reduced by 0.89 ac-ft due to the CMAC adaptive storage. Further, using CMAC for adaptive flood storage would result in no wet weather discharge from the modeled 1.3” rainfall event (CMAC Event).

Table 11: Comparison of peak discharges between existing conditions and proposed conditions with CMAC for the 7769 Water Street pond.

Rainfall Event	Existing Peak Flow (cfs)	CMAC Peak Flow (cfs)	Peak Flow Reduction (%)
CMAC Event (1.3”)	0.9	0*	100
1-year	2.2	1.7	22
2-year	2.5	2.2	13
10-year	83.6	55.4	34
100-year	166.5	162.3	3

*No outflow during wet weather. Runoff would be discharged prior to the subsequent forecasted rainfall event with a volume greater than the CMAC event.

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Peak flow reductions were partially dependent on the elevations of openings in the control structure and the size of each opening. Event slight decreases in water surface elevation can cause large reductions in peak flow rate, as seen with the 10-year rainfall event for 7769 Water Street.

Alternative Site 3: 8587 Eastern Morning Run Road Pond

The wet pond at 8587 Eastern Morning Run Road in Laurel has a drainage area of approximately 17.3 acres and a contributing impervious area of 7.2 acres. This site is located in the Little Patuxent River watershed (Figure 6).

Additional flood capacity would be added by drawing-down the permanent pool of the pond prior to rainfall events greater than 1.4" using CMAC. The permanent pool would be lowered approximately 2.0 feet (based on maximum 12" per day drawdown and the 48-hour forecast) to create 0.31 ac-ft of capacity for flood control storage. Drawdown would only occur prior to rainfall events in the forecast greater than the CMAC Event (Table 13). The water quality WQv and IAT from the facility would be slightly reduced based on the CMAC adaptive volume.

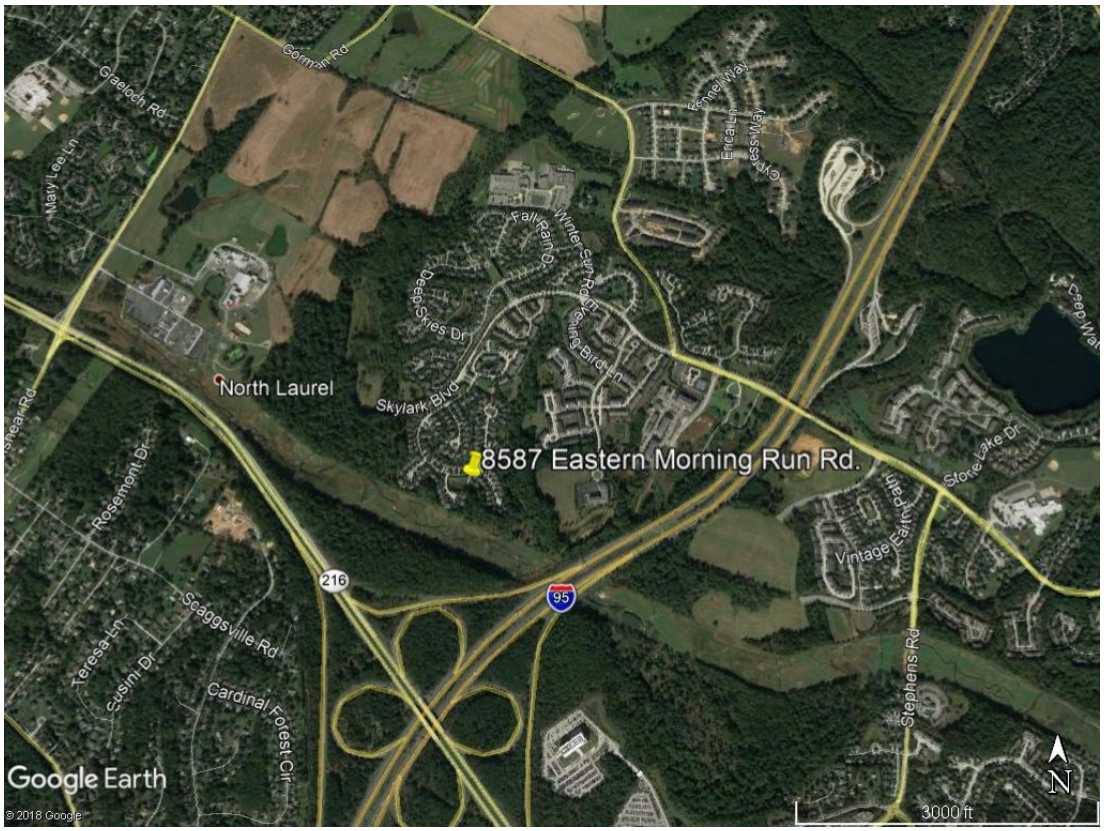

Figure 6: Aerial location of 8587 Eastern Morning Run Road wet pond (Google Earth).

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Table 12: Summary of existing and proposed water quality and flood control benefits for 8587 Eastern Morning Run Road pond

	Existing	**Proposed**
Drainage Area (ac)	17.3	
Impervious Area (ac)	7.2	
Pool Elevation (less than CMAC event, ft)	306.8	
Pool Elevation (greater than CMAC event, ft)	306.8	304.8
Adaptive Storage (ac-ft)	0	0.31
Creditable WQv (in)	1.32	1.22
Creditable IAT (acres)	7.8	7.6

The increased flood control capacity from CMAC would result in decreases in peak discharges for the 1-, 2-, and 10-year events. Peak discharge for the 100-year rainfall event would be slightly decreased due to the CMAC adaptive storage. While the peak discharges are similar for the larger 100-year event, the volume released downstream of the facility would be reduced by 0.31 ac-ft due to the CMAC adaptive storage. Further, using CMAC for adaptive flood storage would result in no wet weather discharge from the modeled 1.4” rainfall event (CMAC Event).

Table 13: Comparison of peak discharges between existing conditions and proposed conditions with CMAC for the 8587 Eastern Morning Run Road pond.

Rainfall Event	**Existing Peak Flow (cfs)**	**CMAC Peak Flow (cfs)**	**Peak Flow Reduction (%)**
CMAC Event (1.4”)	0.2	0*	100
1-year	0.7	0.6	13
2-year	6.2	2.4	62
10-year	58.7	52.3	34
100-year	100.1	100.0	0

*No outflow during wet weather. Runoff would be discharged prior to the subsequent forecasted rainfall event with a volume greater than the CMAC event.

Conclusions

Evaluation of ponds in Howard County illustrates the impact of using CMAC to create adaptive storage in existing stormwater ponds. The goal of the proposed work was to enable the County to become more resilient to future impacts caused by flooding and stormwater hazards by identifying ponds most capable of reducing flood-risk through CMAC adaptive storage. Using CMAC to drawdown existing permanent pools in advance of rainfall resulted in a total of 3.74 ac-ft of adaptive storage for flood control from the six identified facilities. This represents new flood control storage not currently available through the use of CMAC on existing ponds. A full summary table of ponds analyzed is provided in Appendix A.

Table 14: Summary of proposed adaptive storage using CMAC

Site Number	Location	Watershed	Adaptive Storage (ac-ft)
1	8390 Autumn Rust Road, Ellicott City, MD	Tiber-Hudson	0.82
2	11244 Chase Street, Fulton, MD	Little Patuxent	1.04
3	8056 Hillsborough Road, Ellicott City, MD	Tiber-Hudson	0.52
Alternative 1	9527 Valley Mede Court, Ellicott City, MD	Plumtree	0.16
Alternative 2	7769 Water Street, Fulton, MD	Little Patuxent	0.89
Alternative 3	8587 Eastern Morning Run Road, Laurel, MD	Little Patuxent	0.31
		Total (ac-ft)	**3.74**

The increase in adaptive storage through CMAC resulted in decreases in peak flow rates for the 1-, 2-, and 10-year rainfall events (between 6% and 76% decreases). Decreases in peak discharge from the 100-year event were small (between 0% and 3%) due to the existing flood storage capacity of each facility. Each pond with CMAC adaptive storage showed the ability to capture smaller rainfall events (between 1.1” and 1.7”) with no wet weather discharge.

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Conceptual designs for the ponds at 8390 Autumn Rust Road, 11244 Chase Street, and 8056 Hillsborough Road will be completed based on the results of this analysis and conversations with the County. The three alternative sites identified as part of this evaluation could be used as a replacement to any of the three previously mentioned sites, or as an additional conceptual design. The conceptual designs will be completed as part of Task 5 (“Create Conceptual Designs”) of this project.

Funding Statement

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Appendix A: Summary Table of Ponds Analyzed

Site Number	Location	Watershed	Drainage Area (ac)	Impervious Area (ac)	Current WQv (in)	Proposed WQv (in)	Proposed Adaptive Storage (ac-ft)	Existing IAT (acres)	Proposed IAT (acres)	Change in IAT (acres)
1	8390 Autumn Rust Road, Ellicott City, MD	Tiber-Hudson	58.9	14.7	1.48	1.48	0.82	16.5	16.5	0.00
2	11244 Chase Street, Fulton, MD	Little Patuxent	42.5	21.0	1.35	1.35	1.04	22.9	22.9	0.00
3	8056 Hillsborough Road, Ellicott City, MD	Tiber-Hudson	25.9	9.10	1.05	0.74	0.52	9.23	6.73	2.50
Alternative 1	9527 Valley Mede Court, Ellicott City, MD	Plumtree	25.5	5.70	0.34	0.17	0.16	1.92	0.96	0.96
Alternative 2	7769 Water Street, Fulton, MD	Little Patuxent	27.3	13.2	1.10	0.58	0.89	13.5	7.80	5.70
Alternative 3	8587 Eastern Morning Run Road, Laurel, MD	Little Patuxent	17.3	7.20	1.32	1.22	0.31	7.80	7.60	0.20