Hydraulic Analysis Addendum for the Amendment to the Drainage Master Plan for the Trails Units 1, 2 and 3

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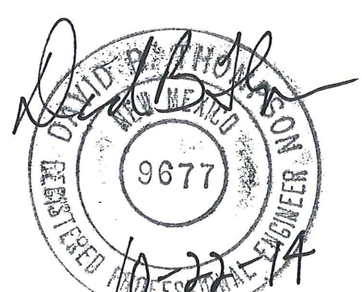

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Introduction and Background

The Amendment to The Drainage Master Plan (DMP) for the Trails Units 1, 2, and 3 was completed by Thompson Engineering Consultants (TEC) in April 2014 and approved by the City Hydrologist in May 2014. The hydrologic analysis for the Trails watershed was modeled using AHYMO_97. For detailed watershed maps and background on the DMP please refer to the document that was approved by the City Hydrologist in May 2014. This Addendum to the Amendment focuses on the area from Rainbow Boulevard on the west to Universe Boulevard on the east and Paseo Del Norte on the north to the Trails boundary on the south. Please refer to Plate 1.

Purpose

The purpose of this analysis was to confine the footprint of Pond D within the open space area tract (Tract OS-3) without exceeding the outfall discharge limit of 62 cfs from the Trails Units 1, 2 and 3 at the intersection of Universe Boulevard and Avenida de Jaimito or without increasing the required volume of any other proposed pond in the Trails. All of the Trails surge/detention ponds were based on conservative assumptions when modeled initially by AHYMO.

By performing more intensive and precise hydraulic modeling using XPSWMM software, the inefficiencies of the original system are iteratively investigated and the conservative “slack” created within the AHYMO model can be carefully utilized to maximize the efficiency of the system while decreasing the size of this particular pond.

Methodology

XPSWMM is a dynamic hydraulic modeling software similar to USEPA’s Storm Water Management Model (EPA SWMM). For storm drain and pond analysis, XPSWMM solves the complete St. Venant (Dynamic Flow) equations for gradually varied, one dimensional, unsteady flow throughout the drainage network. Using the Dynamic Wave option, XP SWMM can account for backwater, surcharging, and reverse flow situations, which neither AHYMO nor HEC-HMS are able to model. XP SWMM has a stronger user interface than EPA SWMM, and is effective at importing and exporting hydrographs, and AutoCAD and ArcGIS drawing files.

EPA SWMM has been used in the City of Albuquerque for many projects involving complex pressurized flow in storm drains and especially where surge ponds are integral to the drainage system. Examples are the Broadway storm drain system in the southeast valley and the recent Mid Valley DMP modeled by Smith Engineering for the City of Albuquerque. XPSWMM has recently been used in Bernalillo County’s south valley for analysis of the system draining to the Sanchez Farm Detention Pond.

Hydrographs were imported from the TEC Trails DMP AHYMO_97 Hydrological model and added directly at key locations within the study area. The location and the AHYMO_97 hydrograph ID numbers are shown on **Plate 1**. All elevation area data for the ponds were imported directly from the TEC Amendment to The Trails Drainage Master Plan. Record drawings were used to obtain information regarding storm drain size, material, length, slope, and manhole invert and rim elevations. Digital copies of the as-built drawings are included in **Appendix A**. All elevations are based on NAVD 1929 datum. Excel files containing hydrographs and elevation area data for the model are included in **Appendix B**. **Appendix C** contains the electronic input file for the XPSWMM model that can be viewed using the XPSWMM Viewer. Instructions are included in **Appendix C.**

<u>Base Model</u>

The TEC Addendum (April 2014) modeled the developed conditions for storm drains and surge/detention ponds. This model and report determined the sizes for the future installation of ponds and orifice plates. The storm drain system and many of the ponds have already been built.

A base XPSWMM model (Base.xp) matching the infrastructure as modeled in TEC's AHYMO_97 model was constructed. Many of the ponds in this system are inline structures that allow stormwater to surge into the ponds only if the storm drain develops significant head where the Hydraulic Grade line (HGL) exceeds the pond bottom. Otherwise the low flows from the smaller storms bypass the pond. **Figure 1** shows how a typical surge pond works. As outlined above XP SWMM is equipped to more accurately model this system. The results of this base XP SWMM model and the previous AHYMO_97 model are consistent. Refer to **Table 1** for a comparison between TEC's AHYMO_97 and the XPSWMM base model results.

<u>Proposed Conditions Model</u>

The base model was then iteratively altered to make system changes to pond volumes, storm drain sizes, and orifice plate sizes to determine the optimum scenario for Pond D.

Under the final scenario (S1.xp), the footprint for Pond D was reduced to fit within Tract OS-3 without adding any additional storm drain. The final model configuration is shown graphically on **Plate 1** and results are summarized in **Tables 2** and **3**.

The modified elevation-area-storage data for all ponds is included in **Appendix B** and the conceptual grading plan is shown on **Plate 1**.

Table 3 summarizes the changes made to orifice plates at the various ponds and which Tract would be responsible for the developments in the future. This table is intended to be a replacement for Table 4 in the April 2014 TEC Trails DMP.

Results

After several iterations, it was determined that the size of Pond D could be reduced to a design capacity of 2.7 ac-ft. The existing 24 inch outfall that runs south in Rio Galisteo Place will remain. Furthermore, the orifice plate sizes of all the ponds were changed while Ponds D and F5 were modeled without any flow restriction devices. **Table 1** indicates that Pond G does not store much water during the 100-yr, 24hr design storm. Based on the base scenario, there was also an indication that Pond H was operating at maximum capacity. As a result, the configuration of orifice plates was altered throughout the system to optimize pond storage and freeboard in all of the ponds.

Conclusion

The capacity of existing Pond D was reduced to 2.7 ac-ft. Pond D will be reconstructed to have 3H:1V side slopes. The pond bottom will be at elevation 5427.5 ft., while the top of pond will be at elevation 5433.5 ft. (**Plate 1**)

Pond D will continue to function as a surge pond, however, there will be no orifice plate required to control discharge. During the 100-yr-24hr storm the pond will store 1.99 ac-ft. of water while maintaining 1.3 ft. of freeboard.

By changing the sizes of the orifice plates at Ponds F and G, the storage volumes and freeboard between the ponds balance out more evenly.

These changes were made in the model without exceeding the downstream flow constraint of 62 cfs or exceeding the design pond volumes of any of the other proposed ponds simulated in the TEC Trails DMP.

TABLE 1 Base Model Results

XPSWMM Pond Output Summary													AHYMO_97			
Pond	Design Storage At Emergency Spillway	100 Yr-24 Hr Peak Storage	100 Yr-24 Hr Peak Storage	Elevation of Pond Bottom (NAVD 1929)	Elevation of Emergency Spillway (NAVD 1929)	Elevation of Top of Pond (NAVD 1929)	100 Yr-24Hr Peak Water Surface Elevation	Pond Depth	Depth of Water From Pond Bottom	100 Yr-24Hr Freeboard to Emergency Spillway	Peak Outflow	Outlow Restricted by Downstream Orifice	100 Yr-24 Hr Peak Storage [a]	Peak Water Surface Elevation [a]	Peak Outflow [a]	
	ac-ft	ft^3	ac-ft	ft	ft	ft	ft	ft	ft	ft	cfs		ac-ft	ft	cfs	
Pond D	6.24	122165	2.80	5430.00	5436.85	5438.00	5433.90	8.00	3.9	2.9	15.7	Y	4.04	5435.03	19.7	
POND F	11.76	344445	7.91	5415.08	5424.33	5425.00	5422.14	9.92	7.1	2.2	14.8	Y	10.4	5423.56	23.8	
POND F5	1.40	22189	0.51	5421.00	5426.00	5427.00	5423.75	6.00	2.7	2.3	21.8	Y	1.38	5425.97	19.8	
POND G	7.21	81108	1.86	5415.67	5422.50	5424.00	5419.05	8.33	3.4	3.4	17.6	Y	2.96	5419.84	24.6	
POND H	3.02	134124	3.08	5418.65	5422.00	5423.00	5422.00	4.35	3.4	0.0	23.4	Y	2.87	5421.89	26.8	
POND J	7.94	172482	3.960	5414.00	5417.00	5418.00	5416.08	4.00	2.1	0.9	26.7	Y	3.77	5415.66	32.4	
POND K	14.84	357301	8.20	5404.85	5409.00	5410.00	5407.78	5.15	2.9	1.2	60.1	Y	8.39	5407.79	60.7	

[a] Values based on the Ammendment to the Trails Drainage Master Plan

TABLE 2 Proposed Scenario 1 Results

Scenario S1 XPSWMM Pond Output Summary													AHYMO_97			
Pond	Design Capacity At Emergency Spillway	100 Yr-24 Hr Peak Storage	100 Yr-24 Hr Peak Storage	Elevation of Pond Bottom (NAVD 1929)	Elevation of Emergency Spillway (NAVD 1929)	Elevation of Top of Pond (NAVD 1929)	100 Yr-24Hr Peak Water Surface Elevation	Pond Depth	Depth of Water From Pond Bottom	100 Yr-24Hr Freeboard to Emergency Spillway	Peak Outflow	Outlow Restricted by Downstream Orifice	100 Yr-24 Hr Peak Storage [a]	Peak Water Surface Elevation [a]	Peak Outflow [a]	Future Improvements
	ac-ft	ft^3	ac-ft	ft	ft	ft	ft	ft	ft	ft	cfs		ac-ft	ft	cfs	
Pond D	2.7	86472	1.99	5427.50	5433.50	5433.50	5432.24	6	4.7	1.3	28.9	N	4.04	5435.03	19.7	Pond size reduced from 6.26 ac-ft to 2.75 ac-ft, orifice plate removed
POND F	11.76	396013	9.09	5415.08	5424.33	5425.00	5422.83	9.92	7.8	1.5	12.9	Y	10.4	5423.56	23.8	Orifice Area Increased from 1.63 to 2 ft^2
POND F5	1.83	32949	0.76	5421	5427	5427	5424.46	6	3.5	2.5	58.5	N	1.38	5425.97	19.8	Pond Spillway assumed at 5427
POND G	7.21	176891	4.06	5415.67	5422.50	5424.00	5420.62	8.33	4.9	1.9	12.0	Y	2.96	5419.84	24.6	Orifice Area reduced from 1.75 to 1 ft^2
POND H	3.02	130000	2.98	5418.65	5422.00	5423.00	5422.00	4.35	3.4	0.0	21.6	Y	2.87	5421.89	26.8	Orifice area = 1.14 ft^2 Per Bohannan Huston's plans
POND J	7.94	163081	3.74	5414.00	5417.00	5418.00	5416.00	4	2.0	1.0	30.1	Y	3.77	5415.66	32.39	Orifice area increased from 3.05 to 3.5 ft^2
POND K	14.84	280338	6.44	5404.85	5409.00	5410.00	5407.39	5.15	2.5	1.6	60.7	Y	8.39	5407.79	60.7	Orifice area 4.96ft^2 (No Change)

* The first tract developed will be responsible for improvements to the pond
[a] Values based on the Ammendment to the Trails Drainage Master Plan

Table 3				
Responsible Tracts for Facility Improvements				
Facility	Tract Responsible for Future Improvements	Flow Characteristics (cfs)	Future Improvements	Modifications to Orifice Plates
Pond D	Tract 1, Unit 2 (North of Pond D)	Qin = 102.5 Qout = 28.9	Regrading Pond D	Modeled without Orifice plate
Pond F**	Tract 9, Unit 3A or, Tract 2, Unit 2 orTract 3, Unit 2*	Qin =144.3 Qout = 12.9	Inlet and outlet improvements, Overflow inlets	Orifice Area Increased from 1.63 to 2 ft^2
Pond F-5	*Future Pond*	*Qin = 78.5 Qout = 58.5*	*Pond to be constructed in the future*	*Pond Spillway assumed at 5427 based on existing grade*
Pond G **	Tract 9, Unit 3A or, Tract 2, Unit 2 ,Tract 3, Unit 2 or Tract 1 Unit 2*	Qin = 84.3 Qout = 12.0	Inlet and outlet improvements, Overflow inlets	Orifice Area reduced from 1.75 to 1 ft^2
Pond H **	Tract 8, Unit 2	Qin = 110.6 Qout = 27.4	Inlet and outlet improvements, Overflow inlets	Orifice area 1.14 ft^2. per BHI plans
Pond J	Tracts 1-4, Unit 4	Qin = 112.4 Qout = 30.1	Inlet and outlet improvements	Orifice area increased from 3.05 to 3.5 ft^2
Pond K	Tracts 1-4, Unit 4	Qin = 126.1 Qout = 60.7	Inlet and outlet improvements	Orifice area 4.96 ft^2

* The first tract developed will be responsible for pond improvements

** Any pond which requires an outlet or orifice restriction which is less then 24 inch diameter equivalent area will require a sluice gate type restriction plate or similar movable restriction to facilitate cleaning if orifice becomes blocked

Figure 1 - Definition Sketch for an In-Line Surge Pond