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

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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 PCSWMM 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 footprint of Pond D.

Methodology

PCSWMM is a dynamic hydraulic modeling software similar to USEPA's Storm Water Management Model (EPA SWMM). For storm drain and pond analysis, PCSWMM solves the complete St. Venant (Dynamic Flow) equations for gradually varied, one dimensional, unsteady flow throughout the drainage network. Using the Dynamic Wave option, PCSWMM can account for backwater, surcharging, and reverse flow situations, which neither AHYMO nor HEC-HMS are able to model. PCSWMM has a stronger user interface than EPA SWMM, and is effective at importing and exporting hydrographs, and AutoCAD and ArcGIS drawing files. PCSWMM can be easily viewed using EPA SWMM software, which is available for free online, and uses the EPA SWMM software as a solving engine so that no conversion is necessary.

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 and PCSWMM is currently being used to update those models.

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. PCSWMM is equipped to accurately model this system. PCSWMM is fully compatible with EPA SWMM without any conversions being necessary.

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**. **Plates 1 & 2** dated 2-26-15 are located in **Appendix D** and show all of the basins related to the model. These exhibits are for basin information only. All elevation area data for the ponds were imported directly from the TEC Amendment to The Trails Drainage Master Plan, except the hydrograph from Pond D.1, which has been modified to allow a larger flow rate into the Heritage Subdivision storm drain system and consequentially increases the peak flow rate coming to Pond D. This modification was made to allow the original maximum flow rate from the western subdivisions which had been restricted in the Amendment. Record drawings were used to obtain information regarding storm drain size, material, length, slope, and manhole invert and rim elevations for existing storm drain. However, a survey performed by Surv-Tek conflicted with some of the data in the record as-builts. In cases where there was a discrepancy, the data from the survey was used. As-built drawings and Surv-Tek's survey are included in **Appendix A**. All elevations are based on NAVD 1929 datum. Elevation area data for the ponds in the model are included in **Appendix B**. **Appendix C** contains the electronic input files for the PCSWMM model that can be viewed using EPA SWMM software available for free online. A summary of inputs and outputs is also included in Appendix C. A rendering of the model is shown on Plate 1.

AHYMO Modifications

A couple of changes were made to the AHYMO model in order to more accurately reflect proposed and future conditions. The hydrograph (AHYMO ID 73) entering at Node163 was altered to reflect a peak discharge from Pond D1 of 52 cfs instead of 13.4 cfs. This was done to correct a restricted flow rate from the western subdivisions that was imposed in the Amendment, but was not necessary. Secondly, due to changes to the proposed Tract 1 Subdivision layout, the entire property now discharges into Pond F5. Therefore, runoff from Tract 1 (52.5 cfs) was removed from the hydrograph entering Pond D and added to the hydrograph entering Pond F5. The input and summary files are included in **Appendix F**.

PCSWMM Proposed Conditions

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.

The PCSWMM model was iteratively altered by making changes to pond volumes and orifice plate sizes to determine the optimum scenario for the Trails storm drain system. The footprint for Pond D was reduced to fit within Tract OS 3 without adding any additional storm drain and Pond F5 was expanded in order to maximize capacity for its location. The modified elevation-area-storage data for all ponds is included in **Appendix B**. Details for the proposed ported risers at Ponds D and F5 are included in **Appendix B** as well. Orifice plates were added at the outflow of Ponds D and F5. **Table 1** summarizes the proposed configurations of the orifice plates at the various ponds as well as a comparison between the Proposed PCSWMM model and the AHYMO_97 model. **Table 6** summarizes Pond improvements and which Tract(s) are responsible for the modifications as they develop in the future. This table is intended to be a replacement for Table 4 in the April 2014 TEC Trails DMP and is intended to be a tool for the City Hydrologist to assign improvements to each Tract and accurately track improvements. **Table 7** provides a summary of the AHYMO hydrographs included in the PCSWMM model.

Results

After several iterations, it was determined that the footprint of Pond D could be moved to fit fully on the OS-3 Tract and accommodate a design capacity of 6.44 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 and ported risers were added at Ponds D and F5. The configuration of orifice plates was altered throughout the system to optimize pond storage and freeboard in all of the ponds. Furthermore, Ponds J and K located on the east side of Universe Boulevard remain unaffected by the proposed changes.

Tables 2 thru **5** provide a summary of the Node, Link, Storage, and Orifice results from the PCSWMM model. All tables are on **Plate 1** and the intent is that all summary model data and the accompanying graphics are displayed together on **Plate 1** to facilitate review and future reference. This exhibit also displays **Tables 1, 6, and 7**.

Conclusion

The configuration of existing Pond D has been modified to fit fully in Tract OS-3. Pond D will be reconstructed to have 3H:1V side slopes. The pond bottom will be at elevation 5423.3 ft, while the top of pond will be at elevation 5432.3 ft with an emergency spillway elevation of 5431.3 ft (**Plate 1).** Pond D will be modified to function as a detention pond and will require a ported riser to control discharge. During the 100-yr, 24-hr storm the pond will store 6.44 ac ft of water while maintaining 1 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.

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