# STERLING RANCH MDDP AMENDMENT NO. 2 \& PRELIMINARY DRAINAGE REPORT FOR <br> STERLING RANCH EAST PRELIMINARY PLAN NO. 1 

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CONSULTING

## STERLING RANCH MDDP AMENDMENT NO. 2 \& PRELIM. DRAINAGE REPORT FOR STERLING RANCH EAST PRELIMINARY PLAN NO. 1

## ENGINEER'S STATEMENT:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the applicable master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

Marc A. Whorton Colorado P.E. \#37155
Date

## OWNER'S/DEVELOPER'S STATEMENT:

I, the owner/developer, have read and will comply with all of the requirements specified in this drainage report and plan.

Business Name: CLASSIC SRJ LAND, LLC

By :

Title:

Address:
2138 Flying Horse Club Drive

Colorado Springs, CO 80921

## EL PASO COUNTY:

Filed in accordance with the requirements of the Drainage Criteria Manual, Volumes 1 and 2, El Paso County Engineering Criteria Manual and Land Development Code as amended.

For County Engineer, / ECM Administrator

## Date

Conditions:

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## STERLING RANCH MDDP AMENDMENT NO. 2 \& PRELIM. DRAINAGE REPORT FOR STERLING RANCH EAST PRELIMINARY PLAN NO. 1

## PURPOSE

The purpose of this Sterling Ranch MDDP Amendment No. 2 \& Preliminary Drainage Report is to address on-site and off-site drainage quantities and patterns for the proposed development, compare to approved MDDP and identify general drainage improvements and facilities required to minimize impacts to the adjacent properties. The MDDP Amendment No. 2 portion of the report only addresses adjustments proposed to help reduce the East Fork Basin transfer and the combining of ponds FSD-16A and FSD-16B into one single facility. All other overall basin hydrology and pond locations remain the same at this time.

## GENERAL DESCRIPTION

Classic SRJ Land, LLC (Classic Homes) has recently purchased the remaining portion of the Sterling Ranch property east of Sand Creek from the Jim Morley. This initial development proposal east of Sand Creek in to be known as Sterling Ranch East Preliminary Plan No. 1. This initial Preliminary Plan consists of 3 distinct development areas east of Sand Creek separated by the proposed roadway plats, prepared by JR Engineering, for Briargate Pkwy. and Sterling Ranch Road. The area north of Briargate Pkwy. is 84.74 acres ( 280 lots). The area south of Briargate Pkwy. but north of Sterling Ranch Road is 161.90 acres ( 294 lots); and the area south of Sterling Ranch Road is 74.73 acres (187 lots). The total Preliminary Plan area is then 321.37 acres located in portions sections $27,48,33$ and 34 , township 12 south, range 65 west of the sixth principal meridian. The site is bounded on the north by the Retreat at TimberRidge development, to the east by future Sterling Ranch East property (zoned for future urban development), to the west by Sand Creek and existing Sterling Ranch residential development and to the south by existing rural residential development zoned RR-5. The site is in the upper portion of both the Sand Creek and Sand Creek East Fork Drainage Basins. Urban single family residential development totaling $\mathbf{7 6 1}$ lots, along with two future District 20 school sites and several park areas are proposed within this Sterling Ranch East Preliminary Plan No. 1.

The average soil condition reflects Hydrologic Group " $A$ " (Blakeland loamy sand and Columbine gravelly sandy loam) with also some presence of Hydrologic Group "B" (Pring coarse sandy loam) as determined by the "Web Soil Survey of El Paso County Area," prepared by the Natural Resources Conservation Service (see map in Appendix).

## EXISTING DRAINAGE CONDITIONS

The Sterling Ranch East Preliminary Plan No. 1 property is located in the upper portion of the Sand Creek drainage basin on the south edge of Black Forest. However, some easterly portions of the site lie within the East Fork tributary of Sand Creek. (See MDDP Amendment portion of this report for further discussion) Nearly the entire site, other than the Sand Creek corridor, is mainly covered with native grasses with few or no trees. Some minor disturbance due to utility installation has also taken place within the utility esmt. corridors traversing the site for the future Briargate Pkwy. Other land disturbance including some grading operations by the previous land owner has also taken place just north of the future Briargate Pkwy. alignment and within the parcel south of Briargate Pkwy. and northwest of Sterling Ranch Road. The Sand Creek channel exists along the extreme westerly edge of the property. All required improvements to the Sand Creek channel adjacent to this property are described in a separate report prepared by JR Engineering, "Final Design Report for Sand Creek Restoration", dated October 21, 202\%. Please reference this report for all adjacent creek improvement requirements and assoclated wetland mitigation plans and permitting within jurisdictional waters.

## Update as <br> applicable

The adjacent Sand Creek portions of this site have been previously studied in the "Sand Creek Drainage Basin Planning Study" (DBPS) prepared by Kiowa Engineering Corporation, March 1996 and more recently in the above-mentioned Sand Creek Restoration Report by JR Engineering, LLC. CORE Consultants is the wetland consultant working with JR Engineering, LLC on this stretch of Sand Creek. They are coordinating the effort with the Corps. of Eng. for the required 404 permitting for all the proposed channel improvements. Two public roadway crossings of Sand Creek are also proposed to serve as direct access for the Sterling Ranch East

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Preliminary Plan No. 1 development areas. These crossings are currently covered under a 404 permit (Action No. SPA-2015-00428-SCO) with the previous land owner dated February 2016. JR Engineering, LLC is also coordinating a CLOMR/LOMR for this stretch of Sand Creek that is adjacent to the site and defined as Reach SC-8 (south of Briargate Pkwy.) and SC-9 north of Briargate Pkwy.). This entre site was also studied as a part of the "Master Development Drainage Plan for Sterling Ranch", prepared by M\&S Civil Consultants, approved November 2018 which includes modeling of this property as well as the large acreage north up to the top of the Sand Creek Basin. The MDDP proposes developed flows within Sand Creek that are significantly lower than both the DBPS and FEMA currently show. These flows are as follows: At Arroya Lane crossing (North of the TimberRidge Development) $Q_{10}=430 \mathrm{cfs} Q_{100}=1487 \mathrm{cfs}$ and Sterling Ranch south property line $Q_{10}=713 \mathrm{cfs} Q_{100}=1911 \mathrm{cfs}$. However, the focus of this report is not on Sand Creek, but the adjacent residential development proposed. As mentioned earlier, eastern portions of this site lie within the East Fork of Sand Creek. The following descriptions represent the pre-development flow design points for the property consistent with the approved MDDP for Sterling Ranch, yet differentiate Sand Creek main tributary basins verses the East Fork basins. The nomenclature is similar to the MDDP for easy comparison:

## Sand Creek Main

The Retreat at TimberRidge development exists at the northwest portion of the Sterling Ranch East property. Retreat at TimberRidge Filing No. 2 was recently approved by County Staff and proposes several temporary sediment basins and drainage swales adjacent to this property. These facilities will be removed upon construction from this proposed development in these areas. The following basins are off-site basins (outside the proposed Preliminary Plan area but within the overall Sterling Ranch East ownership) accounted for in the Retreat at TimberRidge development and are not tributary to the proposed development:

Basin TR-12 ( $\left.\mathbf{Q}_{5}=\mathbf{2} \mathbf{~ c f s}, \mathrm{Q}_{100}=\mathbf{9} \mathbf{~ c f s}\right)$ consists of future large lot residential area that currently is undeveloped and sheet flows in a southwesterly direction off-site into the future Retreat at TimberRidge development. These flows were anticipated and accounted for within that
development and future downstream storm facilities. Basin TR-20 ( $\left.\mathbf{Q}_{\mathbf{5}}=\mathbf{1 0} \mathbf{~ c f s ,} \mathbf{Q}_{\mathbf{1 0 0}}=\mathbf{3 2} \mathbf{~ c f s}\right)$ consists of future large lot residential area that currently is undeveloped and sheet flows in a southwesterly direction off-site directly into an existing stock pond within the future Retreat at TimberRidge development. These flows were anticipated and accounted for within that development and downstream storm facilities. Basin TR-4 ( $\mathbf{Q}_{5}=\mathbf{2 ~ c f s , ~} \mathrm{Q}_{100}=\mathbf{9} \mathbf{~ c f s}$ ) consists of future urban residential area that currently is undeveloped and sheet flows in a southwesterly direction off-site into the future Retreat at TimberRidge development. These flows were anticipated and accounted for within that development and downstream storm facilities.

Basin TR-5 ( $\left.Q_{5}=\mathbf{5 c f s}, Q_{100}=\mathbf{1 7} \mathbf{c f s}\right)$ consists of future urban residential area that currently is undeveloped and sheet flows in a southwesterly direction directly into a temporary sediment basin constructed with the Retreat at TimberRidge Filing No. 2 project. These flows were anticipated and accounted for within that development and downstream storm facilities.

Basin TR-6 ( $Q_{5}=1 \mathrm{cfs}, \mathrm{Q}_{100}=\mathbf{4 c s}$ ) consists of a small future urban residential area that currently is undeveloped and sheet flows in a southwesterly direction off-site into the Retreat at TimberRidge development. These flows were anticipated and accounted for within that development and downstream storm facilities. Basin TR-7 ( $\mathbf{Q}_{5}=1 \mathrm{cfs}, \mathrm{Q}_{\mathbf{1 0 0}}=\mathbf{5 c f s}$ ) consists of a basin that sheet flows towards the Retreat property but then captured by a temporary swale and routed to the west into another temporary sediment basin constructed by the Retreat development.

The following basins are within the proposed Preliminary Plan area and also within the Sand Creek main basin boundary:

Basin EX-4A ( $\mathbf{Q}_{\mathbf{5}}=\mathbf{1 9} \mathbf{~ c f s ,} \mathbf{Q}_{\mathbf{1 0 0}}=\mathbf{5 0} \mathbf{~ c f s}$ ) consists of the smaller portion of the property (44.2 acres) south of the Briargate Pkwy. crossing that currently sheet flows in a southwesterly direction directly into the Sand Creek main channel. These sheet flows are then conveyed downstream as channel flow towards the south property boundary. This basin differs from the MDDP as it only represents the on-site existing flows from the east side of the channel as defined by the current ownership boundary and does not include the off-site flows from the

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development along the west side of the channel or the significant existing off-site channel flow itself.

Basin EX-5 ( $\left.\mathbf{Q}_{\mathbf{5}}=\mathbf{1 2} \mathbf{~ c f s , ~} \mathbf{Q}_{\mathbf{1 0 0}}=\mathbf{3 2} \mathbf{~ c f s}\right)$ also consists of the smaller portion of the property (26.2 acres) north of the Briargate Pkwy. crossing that currently sheet flows in a southwesterly direction directly into the Sand Creek main channel. These sheet flows are then conveyed downstream as channel flow towards the proposed Briargate Pkwy. roadway crossing. This basin differs from the MDDP as it only represents the on-site existing flows from the east side of the channel as defined by the proposed platted boundary from the Homestead North at Sterling Ranch development and does not include the off-site flows from the west side of the channel or the significant existing off-site channel flow itself.

Basin EX-7 ( $\mathbf{Q}_{\mathbf{5}}=\mathbf{4 7} \mathbf{~ c f s ,} \mathbf{Q}_{\mathbf{1 0 0}}=\mathbf{1 0 7} \mathbf{~ c f s}$ ) consists of approximately 155.2 acres of property that sheet flows in a southerly direction. This basin is similar to the MDDP and the east basin line defines the westerly edge of the East Fork basin. The sheet flows become more concentrated towards the south end of the basin as the topography becomes steeper and more defined south of the proposed Sterling Ranch Road crossing. The existing flows exit the property along the south boundary at Design Point 4. Given the difference in hydrologic modeling (SWMM 5.1 vs. HEC-HMS) these flows are fairly consistent with the flows determined by the MDDP ( $\mathrm{Q}_{5}=22$ cfs, $\left.Q_{100}=107 \mathrm{cfs}\right)$.

## Sand Creek East Fork

Basin EX-9 ( $\left.\mathbf{Q}_{\mathbf{5}}=\mathbf{5 7} \mathbf{c f s}, \mathbf{Q}_{\mathbf{1 0 0}}=\mathbf{1 2 4} \mathbf{c f s}\right)$ consists of approximately 178.1 acres of property that sheet flows in a southerly direction. This basin is similar to the MDDP and the west basin line defines the westerly edge of the East Fork basin. This basin incorporates both the MDDP basins EX-8 and EX-9. Unlike the previous basin, the flows seem to remain as sheet flows as they exit the property along the south boundary at Design Point 6. Again, these flows seem consistent with the flows determined by the $\operatorname{MDDP}\left(\mathrm{Q}_{5}=24 \mathrm{cfs}, \mathrm{Q}_{100}=125 \mathrm{cfs}\right)$.

Basin EX-10 ( $\left.\mathbf{Q}_{\mathbf{5}}=\mathbf{1 0 5} \mathbf{c f s}, \mathbf{Q}_{\mathbf{1 0 0}}=\mathbf{2 2 2} \mathbf{~ c f s}\right)$ consists of approximately 265.9 acres of property at the extreme top of the Sand Creek East Fork Basin. The off-site northern portion of this basin is within the Black Forest, heavily treed area. The off-site eastern portion of the basin contains existing 5 ac . lot development (Indian Wells Subd. Filing 1). The flows from this large basin sheet flow in a southerly direction across the northern portion of the Sterling Ranch property and enter Basin EX-10A.

Basin EX-10A ( $\left.\mathbf{Q}_{\mathbf{5}}=\mathbf{5 2} \mathbf{~ c f s}, \mathbf{Q}_{\mathbf{1 0 0}}=\mathbf{1 1 7} \mathbf{~ c f s}\right)$ consists of approximately 175.4 acres of property that sheet flows in a southerly direction through the Sterling Ranch property. The combined flows from both basins seem to remain as sheet flow traveling in a southerly direction towards Design Point 7. $\left(Q_{5}=\mathbf{1 1 4} \mathbf{c f s}, Q_{100}=\mathbf{2 5 9} \mathbf{c f s}\right)$ At this location the flows exit the property along the south boundary. Again, these flows are fairly rencictent with the flowic determined hiv the Did not see a corresponding DP in the MDDP MDDP at this location ( $Q_{5}=57 \mathrm{cfs}, Q_{100}=278 \mathrm{cfs}$ ). map to compare with DP 7 or verify flows noted. See additional comments on drainage map.
Basin EX-13 $\left(\mathbf{Q}_{\mathbf{5}}=\mathbf{3 6} \mathbf{c f s}, \mathbf{Q}_{\mathbf{1 0 0}} \mathbf{=} \mathbf{8 5} \mathbf{c f s}\right)$ consists of approximately 94.8 acres ot property at the extreme eastern edge of the Sterling Ranch property. The off-site northern portion of this basin contains existing 5 ac . lot development (Indian Wells Subd. Filing 1). The flows from this basin sheet flow in a southeasterly direction towards the eastern boundary of the Sterling Ranch property. To be consistent with the MDDP, the flows then seem to run along the eastern property boundary and enter Basin EX-11 near the Southeast corner of the property.

Basin EX-11 ( $\left.\mathbf{Q}_{\mathbf{5}}=\mathbf{5 4} \mathbf{c f s}, \mathbf{Q}_{\mathbf{1 0 0}}=\mathbf{1 2 9} \mathbf{c f s}\right)$ consists of approximately 214.34 acres of property that sheet flows across the southeastern corner of the Sterling Ranch property. The combined flows from both basins seem to remain as sheet flow traveling in a southerly direction towards Design Point 56. ( $\left.Q_{5}=\mathbf{6 0} \mathbf{c f s}, Q_{100}=\mathbf{1 6 0} \mathbf{c f s}\right)$ At this location the flows exit the property along the south boundary. Again, these flows are fairly consistent with the flows determined by the MDDP at this location ( $\mathrm{Q}_{5}=43 \mathrm{cfs}, \mathrm{Q}_{100}=203 \mathrm{cfs}$ ). Did not see a corresponding DP in the MDDP map to compare with DP 56 or verify flows noted. See additional comments on drainage map.

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## STERLING RANCH MDDP AMENDMENT NO. 2

 PURPOSEThis portion of the report represents the second amendment to the Sterling Ranch MDDP, originally prepared by M\&S Civil Consultants, Inc., approved June 2018. Amendment No. 1 was prepared by JR Engineering, LLC, dated October, 2021. All existing basin hydrology, concept routing and pond locations remain the same except for the following proposed changes:

1. As described in the Sterling Ranch MDDP Amendment No. 1, Ponds FSD-16A and FSD-16B are proposed to be combined into one full-spectrum facility $\downarrow$ ocated at the northeast corner of Briargate Pkwy. and Sterling Ranch Road.
2. Rather than divert significant surface routed flows from the East Fork Sand Creek basin to the Sand Creek main basin, this report proposes to continue to release surface flows into the East Fork Sand Creek basin matching as close to predevelopment conditions as possible.
3. Small portions of original MDDP basins SCE-7 and SCE-10 are now proposed to be tributary to Pond FSD-14B with the outfall in a southerly direction instead of towards Pond W3.

## DETAILED DESCRIPTION

The original MDDP basins SC3-16A and SC3-16B had total acreages of 168.1 Ac . and 50.7 Ac ., respectively for a total of 218.8 Ac . The following proposed basins represent this same area tributary to the single Pond FSD-16, including the tributary basins from Briargate Pkwy.:

| P1-A | 12.7 Ac. | P1-B | 35.5 Ac. | P1-C | 10.7 Ac. |
| :--- | :--- | :--- | :--- | :--- | :--- |
| P1-D | 31.4 Ac. | P1-E | 52.2 Ac. | P1-F | 76.7 Ac. |
| TR-W | 1.4 Ac. | TR-V | 2.1 Ac. | P1-A1 | 5.0 Ac. |


| P1-A2 6.4 Ac. | P1-A3 1.8 Ac. | P1-A4 2.0 Ac. |
| :--- | :--- | :--- |
| P1-A5 | 4.3 Ac. | P1-A6 2.8 Ac. |

This single proposed full spectrum facility is planned to be designed as a pond and useable park (play fields in the base). Based on construction phasing of the Preliminary Plan, the facility may also be built in phases with associated orifice plates to be switched out based on development. The anticipated first phase of development tributary to this facility is the Briargate Pkwy. improvements (reference "Drainage Letter for Sterling Ranch Road and Briargate Pkwy. Interim Plan", prepared by JR Engineering, LLC, dated December 2021 and "Sterling Ranch Road and Briargate Pkwy. Street Plans", prepared by JR Engineering, LLC, dated October 2021 for inlegt and pipe sizes through this corridor) along with a small portion of the Sterling Ranch East Preliminary Plan No. 1 north of Briargate ( 42 lots) and the Sterling Ranch East Preliminary Plan/PUD No. 2 development. The outfall for this facility will continue to be the planned 48 RCP storm system as designed by JR Engineering, LLC as described in the plans mentioned above. Include where this system outfalls to.

The original MDDP as approved in 2018 proposed for a fairly significant inter-basin transfer of approximately 267 acres from East Fork Sand Creek into Sand Creek main basin. (See Excerpt below) While this transfer was still kept within the overall Sand Creek basin, there was concern of surface water rights for the immediate downstream properties just south of Sterling Ranch with this approved concept. In an effort to address this concern, this MDDP Amendment proposes to continue to release surface flows as close to pre-development condition as possible within the same historic basin location. (See Basin Exhibit below) These flows will either be treated in a formal full spectrum facility or provide WQCV runoff reduction prior to being released. Also, given the size of the historic basins and natural sheet flow characteristics at these outfall locations, this MDDP Amendment proposes a level spreader design at these locations. These facilities will help better disburse the developed flows in a historic sheet flow manner. Pre-development Design Point 6 that is currently within the East Fork basin would be the location for one of these planned facilities. Upon future Sterling Ranch East residential

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## (Excerpt from 2018 Sterling Ranch MDDP, M\&S Civil Consultants, Inc.)

Step 2 Implement BMPs that provide a water quality capture volume with slow release. - Using Full Spectrum Detention Facilities which will incorporate water quality capture volumes that are intended to slowly drain in 40 hours and excess urban runoff volumes that are intended to drain within 72 hours. All storage facilities will be designed to meet State Statue SB15-212/ §37-92-602(8).

Step 3 Stabilize streams. - With the full spectrum detention facility in place, the runoff from the developments will be reduced to predevelopment conditions. The developed discharge from the sites will be less than existing and therefore is not anticipated to have negative effects on downstream drainage ways.

Step 4
Consider need for Industrial and Commercial BMPs. - No industrial land uses are proposed with this development. The proposed commercial development area will implement a Stormwater Management Plan (SWMP) incorporation proper housekeeping procedures. Onsite drainage will be routed through private Full Spectrum Detention (FSD) basins to minimize introduction of contaminates to the county's public drainage systems.

## INTERBASIN TRANSFER EAST FORK SAND CREEK TO MAIN STEM SAND CREEK

It should be noted that the proposed development plan for the $\sim 1444$ acre of Sterling Ranch redistributes a small percentage of the historic watershed between the Sand Creek and East Fork of Sand Creek watershed.

Based upon the survey and contour mapping, prior to development approximately 682 acres of Sterling Ranch runoff was collected by the Sand Creek watershed with the remaining 762 acres was directed to the East Fork of Sand Creek,

After development approximately 267 acres will be redirected from the East Fork Sand Creek into the Sand Creek Basin, resulting in 949 acres of Sterling Ranch directed to the Sand Creek Basin with the remaining 495 acres directed to East Fork Sand Creek.

This modification is driven primarily by maximizing the area of land that can be delivered to the sanitary sewer lift station. It should be noted that the East Fork of Sand Creek is still tributary to the Main Branch of Sand Creek, and thus this transfer is between minor watersheds, not major watershed, and that the development as planned will still function to limit discharged runoff into Sand Creek and East Tributary to the historic flow rates. An exhibit was added to the appendix, which also accompanies the deviation request that shows this basin diversion.

It should be noted that the Developed Conditions Map (provided in the appendix) illustrated the diverted acreage based upon the DPBS mapped boundary(as mapped within the SCDBPS) and diversion based upon the actual field contour data.

## Drainage Basin Descriptions

Developed Sand Creek (Main Stem) Basin Flows
Basin SC3-82 $(\mathrm{Q} 5=33.2 \mathrm{cfs}, \mathrm{Q} 100=132.3 \mathrm{cfs})$ which is located north of Sterling Ranch and Burgess Road to the east Basin SC3-81, assumes that the 117.8 is primarily undeveloped, pine forested land. In this undeveloped condition runoff from the basin continues south overland into Basin SC3-74.

Basin SC3-74 (Q5 $=36.5 \mathrm{cfs}, \mathrm{Q} 100=140.7 \mathrm{cfs})$ is a 119.7 acre area of 5 and 10 -acre lots covered with a mixture of native prairie grasses and pine trees land located north of Sterling Ranch and south of Burgess Road to the west and north of Basins SC3-73 and SC3-75. Runoff from Basins SC3-74 and SC3-82, combine at DP-74 (Q5 $=65.3 \mathrm{cfs}, \mathrm{Q} 100=262.8 \mathrm{cfs}$ ), which is equivalent to the anticipated existing modeled flow rates of $\mathrm{Q} 5=65.3 \mathrm{cfs}, \mathrm{Q} 100=262.8 \mathrm{cfs}$.

Basin SC3-73 (Q5 $=26.4 \mathrm{cfs}, \mathrm{Q} 100=102.0 \mathrm{cfs})$ is a 90.0 acre area of 5 to 40 acres lots covered with a mixture of native prairie grasses and pine trees land located north of Sterling Ranch to the northeast of Vollmer Road. Runoff from the Basin SC3-73 will combine with runoff from DP-74 and will continue overland towards DP-75.

Basin SC3-81 (Q5 $=70.2 \mathrm{cfs}, \mathrm{Q} 100=275.7 \mathrm{cfs})$ which is located north of Sterling Ranch (approx 1 mile) between Shoup and Burgess Roads, assumes that the 262.9 acre area of primarily undeveloped, pine forested, land. In this undeveloped condition runoff from the basin continues south overland into Basin SC3-75.

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[^0]development further to the east within Basin EX10A, additional level spreader facilities will also be planned. Indicate possible location of Future level spreader on developed drainage plan

Villages at Sterling Ranch? Include county project \#.

The original MDDP as approved in 2018 proposed Basin SC3-14B to be 34.7 Ac . The proposed Sterling Ranch East Preliminary Plan/PUD No. 3 (submitted concurrently but separate submittal) development area encompasses additional property further to the east than originally depicted as Basin SC3-14B. The proposed basins that better represent the total tributary area for Pond FSD-14B are the proposed basins found in this report as P4-A (25.8 Ac.) and P4-B (37.3 Ac.). Thus, the total area is 63.1 Ac . Future basins SCE-7 and SCE-10 will be reduced by this same amount. The proposed Pond FSD-14B has been upsized accordingly to handle this additional developed flow. The outfall for this facility was originally planned to connect directly to the 48 " RCP storm system within Sterling Ranch Road with an ultimate outfall location into Pond W3 and direct release into Sand Creek main channel. As mentioned in the previous paragraph, the outfall for this facility is now planned to head towards the south property line within a future pipe system. Ultimately, upon full build-out of this Preliminary Plan, a level spreader facility will be installed along the south property line as shown on the drainage map. In the interim, until full build-out, a temporary plunge pool may be installed just south of the pond to help dissipate these released treated flows. The release quantity from Pond FSD-14B will approximate the pre-developed flows for this original Basin EX-9.
Include discussion on Ponds
FSD-11 \& FSD-14A

## PROPOSED DRAINAGE CONDITIONS

As described in the General Description of the report, this proposed Preliminary Plan development contains 321+ acres that is geographically separated by two major roadways that are being final platted and constructed separately (Briargate Pkwy. and Sterling Ranch Rd.). Multiple full spectrum detention (FSD) facilities are planned with this overall Sterling Ranch East Preliminary Plan No. 1 development. They will be designed to handle these proposed lots, future adjacent development and the two other Sterling Ranch East Preliminary Plan/PUD Development Plans No. 2 and No. 3. (Submitted concurrently but under separate County file
numbers) Development of these urban lots proposed will consist of overlot grading and utility installation for the planned roadways and lots. Per the El Paso County ECM, Section I.7.1.B, all urban lots are required to provide Water Quality Capture Volume (WQCV). Thus, the proposed FSD facilities within this development will provide WQCV along with an Excess Urban Runoff Volume (EURV) in the lower portion of the facility storage volume with an outlet control device. Frequent and infrequent inflows are released at rates approximating undeveloped conditions. This concept provides some mitigation of increased runoff volume by releasing a portion of the increased runoff at a low rate over an extended period of time, up to 72 hours. This means that frequent storms, smaller than the 2-year event, will be reduced to very low flows near or below the sediment carrying threshold value for downstream drainage ways. Also, by incorporating an outlet structure that limits the 100-year runoff to the undeveloped condition rate, the discharge hydrograph for storms between the 2 year and the 100 -year event will approximate the hydrograph for the undeveloped conditions and will help effectively mitigate the effects of development. As reasonably possible, WQCV will be provided for all new roads and urban lots.

This report will generally describe overall anticipated developed basins tributary to each of the proposed FSD facilities. Each of these developed basins will then be detailed further in final drainage reports prepared and submitted along with Final Plats and CD's. This final design will include sizing of all inlets, storm systems and finalized FSD facilities including all required appurtenances. It is anticipated that Type-R at-grade and sump inlets ranging from 5' to $15^{\prime}$ will be utilized in all street drainage and HGL's will be provided for all RCP storm system design.

The following developed basin descriptions will start at the north end of the project and move south and describe how this development proposes to handle both the off-site and on-site drainage conditions both from an interim standpoint based on construction phasing and the ultimate buildout scenario of the entire Sterling Ranch East ownership:

## The following represent the basins and design points north of Briargate Pkwy.:

As described earlier, these first several basins are all at the north end of the Sterling Ranch East overall property and are tributary to the adjacent Retreat at TimberRidge development and are consistent with what that approved report anticipated. (Reference "Final Drainage Report for Retreat at TimberRidge Filing No. 1", prepared by CCES, approved November 2020 and "Final Drainage Report for Retreat at TimberRidge Filing No. 2", prepared by CCES, dated March 2022)

The following basins are all contained within basin SC3-16A as presented in the MDDP for Sterling Ranch, prepared by M\&S Civil Consultants, approved in 2018:

Basin TR-V ( $\mathbf{Q}_{5}=\mathbf{2 c f s}, \mathbf{Q}_{100}=\mathbf{6} \mathbf{c s}$ ) consists of rear yards of the adjacent Retreat at TimberRidge

List what bas Indicate that and treated v development into Sand Cr

Include are each basin discussion Filing No. 2 development. These flows are currently captured in a natural swale along the common property line and routed south and then west towards a temporary sediment basin at the end of Bison Valley Trail that was constructed with the TimberRidge development. With the development of this portion of the proposed Sterling Ranch East Preliminary Plan No. 1, these flows will likely remain being captured by the natural swale along the westerly property line but then be directed into Basin P1-F ( $\left.\mathbf{Q}_{\mathbf{5}}=\mathbf{1 1 1} \mathbf{c f s}, \mathbf{Q}_{\mathbf{1 0 0}}=\mathbf{2 1 5} \mathbf{c f s}\right)$. This basin represents the anticipated future urban residential basin tributary to a future downstream storm system within the northerly extension of Sterling Ranch Road. Design Point 1 ( $\mathbf{Q}_{5}=\mathbf{1 1 2} \mathbf{c f s}, \mathrm{Q}_{100}=\mathbf{2 1 9}$ cfs) represents the anticipated total developed flow at this location upon full build-out. In the interim, before development within this basin, the historic flow patterns may be captured in a temporary sediment basin located just east of Design Point 1. This facility will help mitigate the historic flows from the large upstream basin (EX-10) prior to and during the construction of the extension of Sterling Ranch Road, Pond FSD-16 and the northerly portion of this proposed Preliminary Plan area. The final drainage report(s) for this portion of $t$ If both basins TR-V \& TR-W will continue to use the existing swale th describe any temporary sediment basins and collection points for thes for safe routing further downstream. directs both towards the temporary sedimentation pond, how does 1 enc up in Basins P1-F and the other in P1-E?

Basin TR-W ( $\mathbf{Q}_{5}=\mathbf{3} \mathbf{c f s}, \mathbf{Q}_{100}=\mathbf{5 c f s}$ ) consists of rear yards and a small portion of the Bison Valley Trail roadway within the adjacent Retreat at TimberRidge Filing No. 2 development.

These flows are currently captured in a natural swale along the common property line and routed westerly towards a temporary sediment basin at the end of Bison Valley Trail that was constructed with the TimberRidge development. With the development of the proposed Sterling Ranch East - Phase 1, these temporary facilities will be removed and allowed to flow directly into Basin P1-E. Basin P1-E ( $\left.\mathrm{Q}_{\mathbf{5}}=\mathbf{8 3} \mathbf{c f s}, \mathrm{Q}_{\mathbf{1 0 0}}=\mathbf{1 6 1} \mathrm{cfs}\right)$ consists of the proposed urban residential at the north end of this Preliminary Plan, just east of Sand Creek and tributary to a proposed downstream storm system within the northerly extension of Sterling Ranch Road. Design Points $\mathbf{2 \& 3}\left(\mathbf{Q}_{5}=\mathbf{4 2} \mathbf{~ c f s}, Q_{100}=\mathbf{8 1} \mathbf{c f s}\right)$ represent the anticipated split of flows from this large developed basin. The total developed flow will then combine with the upstream

If flows are spl DP 2 \& 3 sepa developed flows from Design Point 1 and be routed in a large diameter storm system further south within Sterling Ranch Road.

Basin P1-C ( $\left.\mathbf{Q}_{5}=\mathbf{2 1} \mathbf{c f s}, \mathrm{Q}_{100}=\mathbf{4 3} \mathbf{c f s}\right)$ consists of the anticipated tributary area for the Sterling Ranch Road ROW extension north of Briargate Pkwy. and adjacent development. These proposed developed flows will be collected in various at-grade inlets within the roadway, combine with the upstream pipe flows described above and then routed towards the proposed Pond FSD-16. The total developed flow at this pipe outlet location into Pond FSD-16 is represented by Design Point 4 ( $\mathrm{Q}_{\mathbf{5}}=\mathbf{1 8 6} \mathbf{c f s}, \mathrm{Q}_{100}=\mathbf{3 7 4} \mathbf{c f s}$ ). The design of the required concrete forebay, impact structure and trickle channel at this outfall will be provided with the Final Drainage Report.

## Foursquare project?

Basin P1-D ( $\left.Q_{5}=53 \mathrm{cfs}, \mathrm{Q}_{100}=\mathbf{1 0 2} \mathbf{c f s}\right)$ represents the urban residential basin that is made up of the entire Sterling Ranch East Preliminary Plan/PUD No. 2 area and a small portion of this proposed Preliminary Plan area just east of Sand Creek, north of Briargate Pkwy. This basin is tributary to Design Point $\mathbf{5}\left(\mathrm{Q}_{\mathbf{5}}=\mathbf{5 3} \mathbf{c f s}, \mathrm{Q}_{\mathbf{1 0 0}}=\mathbf{1 0 2} \mathbf{c f s}\right)$ and a public storm system stub will be provided to connect to the system within Sterling Ranch Road.

Basins P1-A1 ( $\left.Q_{5}=11 \mathrm{cfs}, \mathrm{Q}_{100}=21 \mathrm{cfs}\right)$, Basin P1-A2 ( $\left.\mathrm{Q}_{5}=12 \mathrm{cfs}, \mathrm{Q}_{100}=23 \mathrm{cfs}\right)$, Basin P1-A3 $\left(Q_{5}=\mathbf{5 c f}, Q_{100}=\mathbf{9} \mathbf{c f s}\right)$ and Basin P1-A4 ( $\left.Q_{5}=\mathbf{5 c f s}, Q_{100}=\mathbf{1 0} \mathbf{c f s}\right)$ all represent tributary area
within the Briargate Pkwy. roadway extension between Vollmer and Sterling Ranch Road. These basins have been studied in the "Drainage Letter for Sterling Ranch Road and Briargate Pkwy. Interim Plan", prepared by JR Engineering, LLC, dated December 2021. Reference this report as well as the "Sterling Ranch Road and Briargate Pkwy. Street Plans", prepared by JR Engineering, LLC, dated October 2021 for inlet and pipe sizes through this corridor. These final designed facilities are shown and labeled on the drainage map. However, the designed storm outfall alignment into the Pond FSD-16 will need to be adjusted as the intent of this report is to combine these flows with the previously described Design Point 5 developed flows along the proposed low point in Briargate Pkwy. just east of Sterling Ranch Road into one single outfall into Pond FSD-16 and represented by Design Point 7.

Design Point $6\left(Q_{5}=17 \mathrm{cfs}, \mathrm{Q}_{100}=\mathbf{3 3} \mathbf{c f s}\right)$ is the location of the proposed low-point in Briargate Pkwy. just east of Sterling Ranch Road, with the following two basins being tributary to this sump condition. The emergency overflow release is planned to be around the corner and south down Sterling Ranch Road. Basin P1-A5 ( $\mathbf{Q}_{5}=10 \mathrm{cfs}, \mathrm{Q}_{100}=19 \mathrm{cfs}$ ) and Basin P1-A6 ( $\mathrm{Q}_{5}=\mathbf{7 c f s}$, $\mathbf{Q}_{100}=\mathbf{1 4} \mathbf{c f s}$ ) consist of the anticipated area within the ROW tributary to this low- point. The collected flows will then be routed via a storm system and combine with the previously described basins further west in Briargate Pkwy. and Design Point 5.

Design Point $\mathbf{7}\left(Q_{5}=\mathbf{1 1 7} \mathbf{c f s}, Q_{100}=\mathbf{2 2 9} \mathbf{c f s}\right)$ represents the total developed flows at this pipe outlet location into Pond FSD-16. The design of the required concrete forebay, impact structure and trickle channel at this outfall will be provided with the Final Drainage Report.

The following basins are all contained within basin SC3-16B as presented in the MDDP for Sterling Ranch, prepared by M\&S Civil Consultants, approved in 2018:

Basin P1-B ( $\left.Q_{5}=\mathbf{5 5} \mathbf{c f s}, \mathrm{Q}_{100}=\mathbf{1 0 8} \mathbf{c f s}\right)$ consists of the anticipated tributary area for the future Sterling Ranch East urban residential area outside of this proposed Preliminary Plan. These anticipated future developed flows will be routed towards a downstream storm system. The total developed flow at this pipe system outlet location into Pond FSD-16 is represented by

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Design Point $8\left(Q_{5}=55 \mathrm{cfs}, \mathrm{Q}_{100}=\mathbf{1 0 8} \mathbf{c f s}\right)$. The design of the required concrete forebay, impact structure and trickle channel at this outfall will be provided with the Final Drainage Report. In the interim, before development within this basin, the historic flow patterns and quantities will continue to sheet flow in a southerly direction towards the proposed pond and Briargate Pkwy. The final drainage report(s) will describe any temporary sediment basins and collection points for these pre-development flows for safe routing around the development area and further downstream.

Basin P1-A ( $\mathrm{Q}_{5} \mathbf{= 6} \mathbf{c f s}, \mathrm{Q}_{100}=\mathbf{1 9} \mathbf{c f s}$ ) consists of the anticipated tributary area from the adjacent future residential lots (rear yards only) along with the actual pond area itself. The developed sheet flows from this basin will sheet flow directly into the adjacent FSD-16 Pond where they will be formally treated.

As described in the MDDP Amendment portion of this report, the two FSD ponds planned in the 2018 MDDP (FSD16A and FSD16B) are now proposed to be combined into one facility (FSD-16) northeast of the intersection of Briargate Pkwy. and Sterling Ranch Road. The total anticipated developed flows entering this facility are as follows. (See Appendix for MHFD-Detention pond design sheets):

## Detention Pond FSD-16 (Full Spectrum EDB)

Total Tributary Acreage: 245.0 ac.

### 4.822 Ac.-ft. WQCV required

11.124 Ac.-ft. EURV required with 4:1 max. slopes
10.310 Ac.-ft. 100-yr. Storage
26.256 Ac.-ft. Total

Total Peak In-flow

$$
\begin{aligned}
& Q_{5}=271 \mathrm{cfs}, \quad Q_{100}=590 \mathrm{cfs} \\
& Q_{5}=24 \mathrm{cfs}, \quad Q_{100}=157 \mathrm{cfs}
\end{aligned}
$$

Pond Peak Design Release:
Pre-development Release: $\quad Q_{5}=52 \mathrm{cfs}, \mathrm{Q}_{100}=244 \mathrm{cfs}$

## (Ownership and maintenance by the Sterling Ranch East Metro District)

This facility will release into a large diameter downstream storm system within Briargate Pkwy. just east of the Sterling Ranch Road intersection. Please reference the "Drainage Letter for Sterling Ranch Road and Briargate Pkwy. Interim Plan", prepared by JR Engineering, LLC, dated December 2021 and the "Sterling Ranch Road and Briargate Pkwy. Storm Plans", prepared by JR Engineering, LLC, dated December 2021. These referenced design plans provide a $48^{\prime \prime}$ RCP outfall pipe at this location with an allowable release rate of ( $\left.Q_{5}=9.2 \mathrm{cfs}, Q_{100}=156.6 \mathrm{cfs}\right)$. The 2018 MDDP presents a combined total release rate for the originally planned two ponds (FSD16A and FSD16B) of ( $Q_{5}=8.8 \mathrm{cfs}, \mathrm{Q}_{100}=174.9 \mathrm{cfs}$ ). As designed on the JR Engineering storm plans, this storm system will run in a southeasterly direction within the Sterling Ranch Roadway towards the crossing of Sand Creek. At this location, the pipe system will outfall into the planned Detention Pond W3. Reference the "Final Design Report for Sand Creek Restoration", prepared by JR Engineering, LLC, dated October 21, 2021 for these design documents.

Basin SC-4 ( $\left.Q_{5}=\mathbf{8 c f s}, Q_{100}=\mathbf{2 7} \mathbf{c f s}\right)$ consists of the anticipated rear yards of the lots adjacent to the creek that will continue to sheet flows directly towards the Sand Creek corridor. At this time, these rear yards are not able to be captured and routed to a formal stormwater quality facility. However, given the minimal unconnected impervious area and sizeable receiving pervious are within this basin, the WQCV reduction $=100 \%$ with 0 untreated WQCV. (See Appendix)

The following represent the basins and design points south of Briargate Pkwy. and west of Sterling Ranch Road all contained within basin SC3-14A as presented in the MDDP for Sterling Ranch, prepared by M\&S Civil Consultants, approved in 2018:

Basin P2-S1 ( $\left.Q_{5}=\mathbf{6 8} \mathbf{c f s}, Q_{100}=\mathbf{1 3 3} \mathbf{c f s}\right)$ consists of the anticipated basin for the proposed middle school site. These developed flows will be routed internally within the school site
property towards Design Point 9 where a storm stub will be provided. This storm stub will then outfall into the proposed downstream storm system within Sterling Ranch Road. State which pond this flow ultimately releases to.

Basin P2-B ( $\left.\mathbf{Q}_{5}=\mathbf{9 0} \mathbf{c f s}, \mathrm{Q}_{100}=\mathbf{1 7 6} \mathbf{c f s}\right)$ consists of the anticipated basin for this large urban residential area. These developed flows will be captured in multiple public storm systems onsite and routed towards the two storm stubs provided as shown at Design Points 10 and 11. Design Points 10\&11 ( $\left.Q_{5}=45 \mathrm{cfs}, \mathrm{Q}_{100}=88 \mathrm{cfs}\right)$ represent the anticipated split of flows from this basin. The total developed flow will then combine with the upstream developed flows from Design Point 9 and be routed in a large diameter storm system further south/west within Sterling Ranch Road.

Basin P2-A ( $Q_{5}=\mathbf{1 0} \mathbf{c f s}, Q_{100}=\mathbf{3 3} \mathbf{c f s}$ ) consists of the better portion of the proposed park area. The developed sheet flows from this area are anticipated to sheet flow directly into the adjacent FSD-14A Pond where they will be formally treated.

Basin SC-3 ( $\left.Q_{5}=\mathbf{1 4} \mathbf{c f s}, Q_{100}=\mathbf{3 2} \mathbf{c f s}\right)$ consists of portions of the proposed linear park/open space along with the anticipated rear yards of the lots adjacent to the creek. This area will continue to sheet flow directly towards the Sand Creek corridor. At this time, these rear yards are anticipated to not be captured and routed to a formal stormwater quality facility. However, given the minimal unconnected impervious area and sizeable receiving pervious are within this basin, the WQCV reduction $=100 \%$ with 0 untreated WQCV. (See Appendix)

[^1]Road and Briargate Pkwy. Interim Plan", prepared by JR Engineering, LLC, dated December 2021. Please reference this report along with the "Sterling Ranch Road and Briargate Pkwy. Storm Plans", prepared by JR Engineering, LLC, dated December 2021 and the "Sterling Ranch Road and Briargate Pkwy. Street Plans", prepared by JR Engineering, LLC, dated October 2021. These referenced design plans provide for separate storm outfalls from each of the at-grade inlet locations within Sterling Ranch Road to daylight into a temporary graded channel on the north side of the roadway. This channel then routes the developed roadway flows towards FSD-14A Pond. The ultimate design proposed to handle these roadway flows along with the adjacent development of Basins PS-S1, P2-A and P2-B (as described above) will be a large diameter storm sewer located behind the curb within a proposed open space tract along the north side of Sterling Ranch Road. (See Drainage Map) All the designed curb inlets within this stretch of Sterling Ranch Road will then connect into this proposed storm system.

The original MDDP basin SC3-14A included the entire Sand Creek channel including both the inline stock pond and the proposed Detention Pond W3. Thus, there is about a 30+ acre difference in area from this original basin vs. the actual development area tributary to the proposed FSD-14A Pond. The total anticipated developed flows entering this facility are as follows. (See Appendix for MHFD-Detention pond design sheets):

## Detention Pond FSD-14A (Full Spectrum EDB)

## Total Tributary Acreage: 130.8 ac.

### 2.770 Ac.-ft. WQCV required

6.512 Ac.-ft. EURV required with 4:1 max. slopes
5.636 Ac.-ft. 100-yr. Storage

### 14.918 Ac.-ft. Total <br> Total Peak In-flow: <br> $Q_{5}=163 \mathrm{cfs}, \quad Q_{100}=345 \mathrm{cfs}$ <br> Pond Peak Design Release: <br> $Q_{5}=19 \mathrm{cfs}, \quad Q_{100}=129 \mathrm{cfs}$ <br> Pre-development Release: <br> $Q_{5}=29 \mathrm{cfs}, \quad Q_{100}=135 \mathrm{cfs}$

## (Ownership and maintenance by the Sterling Ranch East Metro District)

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The allowable release rate from this facility per the 2018 MDDP equals $Q_{5}=7.5 \mathrm{cfs}, \mathrm{Q}_{100}=$ 142.4 cfs). This facility is planned to release directly into the adjacent in-line Pond W3. Please reference "Final Design Report for Sand Creek Restoration", prepared by JR Engineering, LLC, dated October 21, 2021 for this pond design along with the adjacent Sand Creek improvements proposed in this area.

The following represent the basins and design points south of Briargate Pkwy. and east of Sterling Ranch Road contained within basins SC3-14B, SCE-7 and SCE-10 as presented in the MDDP for Sterling Ranch, prepared by M\&S Civil Consultants, approved in 2018:

Basin P4-B ( $\left.Q_{5}=\mathbf{6 3} \mathbf{c f s}, Q_{100}=\mathbf{1 2 3} \mathbf{c f s}\right)$ consists of the anticipated basin for the proposed Villages at Sterling Ranch East PUD site. These developed flows will be collected via a public storm system on-site and then routed towards Design Point 14 at the south edge of the site where a $48^{\prime \prime}$ RCP storm stub will be provided. This storm stub will then outfall in a southerly direction through future Sterling Ranch residential development towards Pond FSD-14B.

Basin P4-A ( $\left.Q_{5}=\mathbf{4 1} \mathbf{c f s}, Q_{100}=\mathbf{8 0} \mathbf{c f s}\right)$ consists of the anticipated tributary area for the future Sterling Ranch East urban residential area outside of this proposed Preliminary Plan. These anticipated future developed flows will be routed towards a downstream storm system represented by Design Point 15. These future developed flows then combine with the previously described developed flows from Design Point 14 and are routed into Pond FSD-14B. Design Point 16 ( $Q_{5}=\mathbf{9 7} \mathrm{cfs}, \mathrm{Q}_{100}=\mathbf{1 8 9} \mathbf{c f s}$ ) represents the total anticipated developed flows into Pond FSD-14B. The design of the required concrete forebay, impact structure and trickle channel at this outfall will be provided with the Final Drainage Report. In the interim, before development within this future basin P4-A, the developed flows from the Villages site may be routed via a temporary channel towards Pond FSD-14B. The final drainage report(s) will further describe any temporary conveyance facilities for these developed flows.

The original MDDP basin SC3-14B only included 34.7 acres tributary to Pond FSD-14B. The entire proposed Villages at Sterling Ranch East PUD site along with the planned future residential area due south is now proposed to be tributary to Pond FSD14-B. This total acreage equals 63.1 acres. The planned outfall for this facility as presented in the 2018 MDDP was to the west and into the previously mentioned $48^{\prime \prime}$ RCP outfall within Sterling Ranch Road from Pond FSD-16. However, based on this proposed MDDP Amendment, the ultimate outfall for this facility is now planned to be a $42^{\prime \prime}-48^{\prime \prime}$ RCP storm system routed in a southerly direction towards the south property line of the overall Sterling Ranch East ownership. At this location, a level spreader is proposed to evenly allow the developed, treated flows to exit the property within the Pre-development Basin EX-9 at DP6. The allowed release from Pond FSD-14B and the spreader facility will be equal to or less than the pre-developed flows at this location of ( $\mathrm{Q}_{5}=57 \mathrm{cfs}, \mathrm{Q}_{100}=124 \mathrm{cfs}$ ).

The total anticipated developed flows entering this facility are as follows. (See Appendix for MHFD-Detention pond design sheets):

(Ownership and maintenance by the Sterling Ranch East Metro District)

The following represent the basins and design points south of Sterling Ranch Road contained within basin SC3-11B as presented in the MDDP for Sterling Ranch, prepared by M\&S Civil Consultants, approved in 2018:

Basin P3-A ( $\left.Q_{5}=\mathbf{8 2} \mathbf{c f s}, Q_{100}=\mathbf{1 6 0} \mathbf{c f s}\right)$ consists of the anticipated basin for the proposed urban residential at the south end of the overall Sterling Ranch East project. These developed flows will be collected via a public storm system on-site and then routed towards Design Point 17 at the southwest edge of the site where a $48 "-54$ " RCP storm stub will be provided. This storm stub will then outfall directly into the proposed Pond FSD-11B. The Sterling Ranch East Phase 1 Preliminary Plan in this area proposes RR-5 zoning adjacent to the south overall boundary. The lots presented in this area are all at least $1 / 2$ ac. in size and typically $100^{\prime}$ wide and $225^{\prime}$ deep. Basin EF-A ( $\mathbf{Q}_{5}=\mathbf{7 c f s}, \mathrm{Q}_{100} \mathbf{= 2 0} \mathbf{c f s}$ ) consists of rear portion of these proposed large lots along with a 75'+ wide buffer/utility corridor immediately adjacent to the south property line. This basin will be allowed to continue to sheet flow in a southerly direction off-site. At this time, these rear yards and buffer corridor are anticipated to not be captured and routed to a formal stormwater quality facility. However, given the minimal unconnected impervious area and sizeable receiving pervious are within this basin, the WQCV reduction $=100 \%$ with 0 untreated WQCV. (See Appendix) Basin P3-C ( $\left.\mathbf{Q}_{\mathbf{5}}=\mathbf{1} \mathbf{c f s}, \mathbf{Q}_{\mathbf{1 0 0}}=\mathbf{5} \mathbf{c f s}\right)$ consists of a small portion of the $75^{\prime}+$ wide buffer/utility corridor immediately adjacent to the south property line. This basin will be allowed to continue to sheet flow in a southerly direction off-site. No impervious development is anticipated within this basin and thus no formal stormwater quality feature is required for this small basin.

Basin P3-S2 ( $\left.\mathbf{Q}_{\mathbf{5}}=\mathbf{2 5} \mathbf{c f s}, \mathbf{Q}_{\mathbf{1 0 0}}=\mathbf{5 0} \mathbf{~ c f s}\right)$ consists of the anticipated basin for the proposed elementary school site. These developed flows will be routed internally within the school site property towards Design Point 18 where a $36^{\prime \prime}$ RCP storm stub will be provided. This storm stub will then also outfall directly into the proposed Pond FSD-11B.

Basin SC-1 ( $\left.Q_{5}=\mathbf{2 c f s}, Q_{100}=\mathbf{6 c f s}\right)$ is a small basin due west of the elementary school site that consists of mainly the eastern slope of the Sand Creek channel. No impervious development is
proposed other than the required maintenance access road/trail as presented on the Sand Creek channel plans. At this time, this area is not anticipated to be captured and routed to a formal stormwater quality facility. However, given the minimal unconnected impervious area and sizeable receiving pervious are within this basin, the WQCV reduction $=100 \%$ with 0 untreated WQCV. (See Appendix)

The 2018 MDDP presented a total inflow to this facility of ( $\mathrm{Q}_{5}=81.3 \mathrm{cfs}, \mathrm{Q}_{100}=213.7 \mathrm{cfs}$ ) and an allowable release rate of $\left(Q_{5}=4.5 \mathrm{cfs}, \mathrm{Q}_{100}=69.6 \mathrm{cfs}\right)$. The outlet pipe for this pond will outfall directly into Sand Creek just south of the Sterling Ranch Road crossing. Reference the "Final Design Report for Sand Creek Restoration", prepared by JR Engineering, LLC, dated October 21, 2021 for the Sand Creek channel design documents. The total anticipated developed flows entering this facility are as follows. (See Appendix for MHFD-Detention pond design sheets):

## Detention Pond FSD-11B (Full Spectrum EDB)

 Total Tributary Acreage: 64.5 ac .1.387 Ac.-ft. WQCV required
3.266 Ac.-ft. EURV required with 4:1 max. slopes
2.792 Ac.-ft. 100-yr. Storage

### 7.445 Ac.-ft. Total

Total Peak In-flow: $\quad \mathrm{Q}_{5}=98 \mathrm{cfs}, \mathrm{Q}_{100}=201 \mathrm{cfs}$
Pond Peak Design Release: $\quad Q_{5}=8 \mathrm{cfs}, \mathrm{Q}_{100}=68 \mathrm{cfs}$
Pre-development Release: $\quad Q_{5}=18 \mathrm{cfs}, \mathrm{Q}_{100}=80 \mathrm{cfs}$

## (Ownership and maintenance by the Sterling Ranch East Metro District)

## DETENTION / STORMWATER QUALITY FACILITES

As required, storm water quality measures will be utilized in order to reduce the amount of sediment, debris and pollutants that are allowed to enter Sand Creek. These features include but are not limited to Full Spectrum Detention Basins and temporary sediment basins. Site Planning and design techniques for urban areas that require detention will provide a Water

Quality Capture Volume (WQCV) and Excess Urban Runoff Volume (EURV) in the lower portion of the facility storage volume that will release the more frequent storms at a slower rate to help minimize the effects of development of the property. The proposed detention/SWQ facilities are to be private facilities with ownership and maintenance by the Sterling Ranch Metropolitan District.

## SAND CREEK CHANNEL IMPROVEMENTS

As mentioned previously, the Sand Creek channel exists along the extreme westerly edge of this property. All required improvements to the Sand Creek channel adjacent to this property are described in a separate report prepared by JR Engineering, "Final Design Report for Sand Creek Restoration", dated October 21, 2021. Please reference this report for all adjacent creek improvement requirements and associated wetland mitigation plans and permitting within jurisdictional waters. CORE Consultants is the wetland consultant working with JR Engineering, LLC on this stretch of Sand Creek. They are coordinating the effort with the Corps. of Eng. for the required 404 permitting for all the proposed channel improvements. The two public roadway crossings of Sand Creek (Briargate Pkwy. and Sterling Ranch Road) are currently covered under a 404 permit (Action No. SPA-2015-00428-SCO) with the previous land owner dated February 2016. JR Engineering, LLC is also coordinating a CLOMR/LOMR for this stretch of Sand Creek that is adjacent to the site and defined as Reach SC-8 (south of Briargate Pkwy.) and SC-9 north of Briargate Pkwy.).

## DRAINAGE CRITERIA

Hydrologic calculations were performed using the City of Colorado Springs/El Paso County Drainage Criteria Manual, as revised in November 1991 and October 1994 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage Criteria Manual as revised in May 2014. General on-site and off-site basin design used for detention/SWQ basin sizing was calculated using the EPA Storm Water Management Model
method (SWMM) Ver. 5.1. Rain Gage inputs based on City of Colorado Springs 2-hr. design storm distributions. Basin imperviousness of the particular land uses in accordance with Table 6-6. The Horton infiltration method used in basin modeling. Mile High Flood District (MHFD)Detention spreadsheet Ver. 4.05 used for Preliminary Detention/SWQ design. (See Appendix)

The City of Colorado Springs/EI Paso County DCM requires the Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainage ways, and implementing long-term source controls. The Four Step Process pertains to management of smaller, frequently occurring storm events, as opposed to larger storms for which drainage and flood control infrastructure are sized. Implementation of these four steps helps to achieve storm water permit requirements.

At this point (MDDP level design), this site generally adheres to this Four Step Process as follows:

1. Employ Runoff Reduction Practices: Proposed urban lot impervious area (roof tops, patios, etc.) will sheet flow across landscape areas (yards) and open space areas to slow runoff and increase time of concentration prior to being conveyed to the proposed public streets or detention facilities. This will minimize directly connected impervious areas within the project site. Water quality reduction will be employed for specific areas that are anticipated not able to be captured and routed to SWQ facilities.
2. Stabilize Drainageways: After developed flows utilize the runoff reduction practices through the front and rear yards, developed flows will travel via curb and gutter within the public streets of the development and eventually public storm systems. These collected flows are then routed directly to multiple extended detention basins (fullspectrum facilities). Sand Creek improvements and restoration plans are being proposed for this entire reach as described in "Final Design Report for Sand Creek Restoration", prepared by JR Engineering, LLC, dated October 21, 2021.
3. Provide Water Quality Capture Volume (WQCV): Runoff from this development will be treated through capture and slow release of the WQCV and excess urban runoff volume (EURV) in the proposed Full-Spectrum permanent Extended Detention Basins designed per current El Paso County drainage criteria.
4. Consider need for Industrial and Commercial BMPs: No industrial uses are proposed within this development. A site-specific storm water quality and erosion control plan and narrative will be submitted along with the grading and erosion control plan. Details such as site-specific sediment and erosion control construction BMP's as well as temporary and permanent BMP's were detailed in this plan and narrative to protect receiving waters. BMP's will be constructed and maintained as the development has been graded and erosion control methods employed.
Include discussion on downstream facilities, at each DP where flows exit site, and their ability to accept and handle developed flows.

## FLOODPLAIN STATEMENT

Portions of this site are located within a floodplain as determined by the Flood Insurance Rate Maps (F.I.R.M.) Map Numbers 08041C 0533G and 08041C 0535G with effective dates of December 7, 2018 and the previously mentioned LOMR 08-08-0541P with an effective date of July 23, 2009. (See Appendix). JR Engineering, LLC is coordinating a CLOMR/LOMR for this stretch of Sand Creek that is adjacent to the site and defined as Reach SC-8 (south of Briargate Pkwy.) and SC-9 north of Briargate Pkwy.).

## DRAINAGE AND BRIDGE FEES

This site lies entirely within the Sand Creek Drainage Basin boundaries.
Fees are calculated using the following impervious acreage method approved by El Paso County. The final fee estimate will be included in the Final Drainage Report(s), however, the following represent fee estimates based on the Sterling Ranch East Preliminary Plan No. 1 submittal with a total area of 321.37 acres with the following different land uses proposed:

Development Parcel North of Briargate Blvd.
11.98 Ac. Sand Creek Corridor
8.83 Ac. Open Space
63.93 Ac. 0.20 Ac. avg. lot size
84.74 Ac. Total

Development Parcel South of Briargate Blvd. / North of Sterling Ranch Rd.
28.99 Ac. Sand Creek Corridor
34.40 Ac. Open Space / Park / Pond
59.96 Ac. $\quad 0.18$ Ac. avg. lot size
38.55 Ac. School Site
161.90 Ac. Total

Development Parcel South of Sterling Ranch Rd.
3.48 Ac. Sand Creek Corridor
$9.63 \quad$ Open Space / Pond
39.83 Ac. 0.24 Ac. avg. lot size
9.93 AC. 1/2 AC. Lot size
11.86 Ac. School Site
74.73 Ac. Total

The percent imperviousness for this subdivision is calculated as follows:

## Fees for Sand Creek Drainage Corridor

(Per El Paso County Percent Impervious Chart: 2\%)
44.45 Ac. x $2 \%=0.89$ Impervious Ac.

## Fees for Detention Facilities \& Park

(Per El Paso County Percent Impervious Chart: 7\%)
52.86 Ac. x 7\% = 3.70 Impervious Ac.

## Fees for 0.18 Ac. Avg. lots

(Per El Paso County Percent Impervious Chart: 46\%)
59.96 Ac. x $46 \%=27.58$ Impervious Ac.

## Fees for 0.20 Ac. Avg. lots

(Per El Paso County Percent Impervious Chart: 43\%)
63.93 Ac. x 43\% = 27.49 Impervious Ac.

## Fees for 0.24 Ac. Avg. lots

(Per El Paso County Percent Impervious Chart: 41\%)
39.83 Ac. x 41\% = 16.33 Impervious Ac.

## Fees for 1/2 Ac. Avg. lots

(Per El Paso County Percent Impervious Chart: 25\%)
9.93 Ac. x $25 \%=2.48$ Impervious Ac.

## Fees for School Site

(Per El Paso County Percent Impervious Chart: 70\%)
50.41 Ac. x 70\% = 35.29 Impervious Ac.

## Total Impervious Acreage: <br> 111.28 Imp. Ac.

The following calculations are based on the 2022 Sand Creek drainage/bridge fees:

## ESTIMATED FEE TOTALS:

## Bridge Fees

\$ 8,923.00 x 111.28 Impervious Ac.

Drainage Fees
\$ 21,814.00 x 111.28 Impervious Ac.

$$
=
$$

$\$$ 992,951.44 $=\$ 2,427,461.92$

## SUMMARY

The proposed Sterling Ranch East Preliminary Plan No. 1 is within the Sand Creek Drainage Basin. Recommendations are made within this report concerning necessary improvements that will be required as a result of development of this property. The points of storm water release from the proposed site are required to be at or below the calculated historic flow quantities. The development of the proposed site does not significantly impact any downstream facility or property to an extent greater than that which currently exists in the pre-development conditions. All drainage facilities within this report were sized according to the Drainage Criteria Manuals and the full-spectrum storm water quality requirements.

## PREPARED BY:

## Classic Consulting Engineers \& Surveyors, LLC



Marc A. Whorton, P.E.
Project Manager

## REFERENCES

1. City of Colorado Springs/County of El Paso Drainage Criteria Manual as revised in November 1991 and October 1994 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage Criteria Manual as revised in May 2014.
2. "Urban Storm Drainage Criteria Manual Volume 1, 2 \& 3" Urban Drainage and Flood Control District, dated January 2016.
3. "Sand Creek Drainage Basin Planning Study," Kiowa Engineering Corporation, dated March 1996.
4. "2018 Sterling Ranch MDDP", M\&S Civil Consultants, Inc., June 2018
5. "Final Drainage Report for Retreat at TimberRidge Filing No. 1", Classic Consulting, approved November, 2020.
6. "Final Drainage Report for Retreat at TimberRidge Filing No. 2", Classic Consulting, dated March, 2022
7. "Final Design Report for Sand Creek Restoration", JR Engineering, LLC, dated October 21, 2021
8. "Drainage Letter for Sterling Ranch Road and Briargate Pkwy. Interim Plan", prepared by JR Engineering, LLC, dated December 2021

Include MDDP Amendment by JR Engineering.

APPENDIX

## VICINITY MAP


$38^{\circ} 56^{\prime} 49^{\prime \prime} \mathrm{N}$


## MAP LEGEND

| Area of Interest (AOI) |  |
| :--- | :--- |
|  | Area of Interest (AOI) |
| Soils |  |
| $\square$ | Soil Map Unit Polygons |
| $\square$ | Soil Map Unit Lines |
| $\square$ |  |

Special Point Features
(0) Blowout

B Borrow Pit
澊 Clay Spot
$\diamond$ Closed Depression
Gravel Pit
$\therefore$ Gravelly Spot
(8) Landfill
A. Lava Flow

Marsh or swamp
会 Mine or Quarry
(-) Miscellaneous Water

- Perennial Water
- Rock Outcrop
$\uparrow$ Saline Spot
$\therefore$ Sandy Spot
Severely Eroded Spot
- Sinkhole

3) Slide or Slip
4) Sodic Spot

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)
Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado Survey Area Data: Version 19, Aug 31, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 19, 2018—May 26, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

## Map Unit Legend

| Map Unit Symbol |  | Map Unit Name | Acres in AOI |
| :--- | :--- | ---: | ---: |
| 8 | Blakeland loamy sand, 1 to 9 <br> percent slopes | 171.3 | Percent of AOI |
| 9 | Blakeland-Fluvaquentic <br> Haplaquolls | 1.0 | $5.8 \%$ |
| 19 | Columbine gravelly sandy <br> loam, 0 to 3 percent slopes | 982.6 | $0.0 \%$ |
| 40 | Kettle gravelly loamy sand, 3 <br> to 8 percent slopes | 33.7 | $33.5 \%$ |
| 41 | Kettle gravelly loamy sand, 8 <br> to 40 percent slopes | 135.2 | $1.2 \%$ |
| 71 | Pring coarse sandy loam, 3 to <br> 8 percent slopes | $\mathbf{1 , 6 0 5 . 2}$ | $4.6 \%$ |
| Totals for Area of Interest |  | $\mathbf{2 , 9 2 9 . 0}$ | $54.8 \%$ |

## El Paso County Area, Colorado

## 8-Blakeland loamy sand, 1 to 9 percent slopes

Map Unit Setting<br>National map unit symbol: 369v<br>Elevation: 4,600 to 5,800 feet<br>Mean annual precipitation: 14 to 16 inches<br>Mean annual air temperature: 46 to 48 degrees F<br>Frost-free period: 125 to 145 days<br>Farmland classification: Not prime farmland<br>\section*{Map Unit Composition}<br>Blakeland and similar soils: 98 percent<br>Minor components: 2 percent<br>Estimates are based on observations, descriptions, and transects of the mapunit.<br>\section*{Description of Blakeland}<br>\section*{Setting}<br>Landform: Hills, flats<br>Landform position (three-dimensional): Side slope, talf<br>Down-slope shape: Linear<br>Across-slope shape: Linear<br>Parent material: Alluvium derived from sedimentary rock and/or eolian deposits derived from sedimentary rock<br>\section*{Typical profile}<br>A - 0 to 11 inches: loamy sand<br>AC - 11 to 27 inches: loamy sand<br>C-27 to 60 inches: sand<br>\section*{Properties and qualities}<br>Slope: 1 to 9 percent<br>Depth to restrictive feature: More than 80 inches<br>Drainage class: Somewhat excessively drained<br>Runoff class: Low<br>Capacity of the most limiting layer to transmit water (Ksat): High to very high ( 5.95 to $19.98 \mathrm{in} / \mathrm{hr}$ )<br>Depth to water table: More than 80 inches<br>Frequency of flooding: None<br>Frequency of ponding: None<br>Calcium carbonate, maximum content: 5 percent<br>Available water supply, 0 to 60 inches: Low (about 4.5 inches)<br>\section*{Interpretive groups}<br>Land capability classification (irrigated): 3e<br>Land capability classification (nonirrigated): 6 e<br>Hydrologic Soil Group: A<br>Ecological site: R049XB210CO - Sandy Foothill<br>Hydric soil rating: No

## Minor Components

## Other soils

Percent of map unit: 1 percent
Hydric soil rating: No

## Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

## Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 19, Aug 31, 2021

## El Paso County Area, Colorado

## 19-Columbine gravelly sandy loam, 0 to 3 percent slopes

Map Unit Setting<br>National map unit symbol: 367p<br>Elevation: 6,500 to 7,300 feet<br>Mean annual precipitation: 14 to 16 inches<br>Mean annual air temperature: 46 to 50 degrees F<br>Frost-free period: 125 to 145 days<br>Farmland classification: Not prime farmland<br>\section*{Map Unit Composition}<br>Columbine and similar soils: 97 percent<br>Minor components: 3 percent<br>Estimates are based on observations, descriptions, and transects of the mapunit.<br>\section*{Description of Columbine}<br>\section*{Setting}<br>Landform: Flood plains, fan terraces, fans<br>Down-slope shape: Linear<br>Across-slope shape: Linear<br>Parent material: Alluvium<br>\section*{Typical profile}<br>A - 0 to 14 inches: gravelly sandy loam<br>C-14 to 60 inches: very gravelly loamy sand<br>\section*{Properties and qualities}<br>Slope: 0 to 3 percent<br>Depth to restrictive feature: More than 80 inches<br>Drainage class: Well drained<br>Runoff class: Very low<br>Capacity of the most limiting layer to transmit water (Ksat): High to very high ( 5.95 to $19.98 \mathrm{in} / \mathrm{hr}$ )<br>Depth to water table: More than 80 inches<br>Frequency of flooding: None<br>Frequency of ponding: None<br>Available water supply, 0 to 60 inches: Very low (about 2.5 inches)<br>Interpretive groups<br>Land capability classification (irrigated): 4e<br>Land capability classification (nonirrigated): 6e<br>Hydrologic Soil Group: A<br>Ecological site: R049XY214CO - Gravelly Foothill<br>Hydric soil rating: No<br>\section*{Minor Components}<br>\section*{Fluvaquentic haplaquolls}<br>Percent of map unit: 1 percent

Landform: Swales
Hydric soil rating: Yes
Other soils
Percent of map unit: 1 percent
Hydric soil rating: No

## Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

## Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 19, Aug 31, 2021

## El Paso County Area, Colorado

## 71—Pring coarse sandy loam, 3 to 8 percent slopes

Map Unit SettingNational map unit symbol: 369kElevation: 6,800 to 7,600 feetFarmland classification: Not prime farmland
Map Unit Composition
Pring and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects ofthe mapunit.
Description of Pring
Setting
Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Arkosic alluvium derived from sedimentary rock
Typical profile
A - 0 to 14 inches: coarse sandy loam
C-14 to 60 inches: gravelly sandy loam
Properties and qualities
Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High
( 2.00 to $6.00 \mathrm{in} / \mathrm{hr}$ )
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 6.0 inches)
Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R048AY222CO - Loamy Park
Hydric soil rating: No
Minor Components
Pleasant
Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

## Other soils

Percent of map unit:
Hydric soil rating: No

## Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 19, Aug 31, 2021

## F.E.M.A. MAP / LOMR (08-08-0541P)




# LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED) 

## COMMUNITY INFORMATION

## APPLICABLE NFIP REGULATIONS/COMMUNITY OBLIGATION

We have made this determination pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (P.L. 93-234) and in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, P.L. 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. Pursuant to Section 1361 of the National Flood Insurance Act of 1968, as amended, communities participating in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed NFIP criteria. These criteria, including adoption of the FIS report and FIRM, and the modifications made by this LOMR, are the minimum requirements for continued NFIP participation and do not supersede more stringent State/Commonwealth or local requirements to which the regulations apply.

We provide the floodway designation to your community as a tool to regulate floodplain development. Therefore, the floodway revision we have described in this letter, while acceptable to us, must also be acceptable to your community and adopted by appropriate community action, as specified in Paragraph 60.3(d) of the NFIP regulations.

## COMMUNITY REMINDERS

We based this determination on the 1-percent-annual-chance flood discharges computed in the FIS for your community without considering subsequent changes in watershed characteristics that could increase flood discharges. Future development of projects upstream could cause increased flood discharges, which could cause increased flood hazards. A comprehensive restudy of your community's flood hazards would consider the cumulative effects of development on flood discharges subsequent to the publication of the FIS report for your community and could, therefore, establish greater flood hazards in this area.

Your community must regulate all proposed floodplain development and ensure that permits required by Federal and/or State/Commonwealth law have been obtained. State/Commonwealth or community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction or may limit development in floodplain areas. If your State/Commonwealth or community has adopted more restrictive or comprehensive floodplain management criteria, those criteria take precedence over the minimum NFIP requirements.

We will not print and distribute this LOMR to primary users, such as local insurance agents or mortgage lenders; instead, the community will serve as a repository for the new data. We encourage you to disseminate the information in this LOMR by preparing a news release for publication in your community's newspaper that describes the revision and explains how your community will provide the data and help interpret the NFIP maps. In that way, interested persons, such as property owners, insurance agents, and mortgage lenders, can benefit from the information.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.


David N. Bascom, Program Specialist

## Federal Emergency Management Agency

## LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)

We have designated a Consultation Coordination Officer (CCO) to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Ms. Jeanine D. Petterson<br>Director, Mitigation Division<br>Federal Emergency Management Agency, Region VIII<br>Denver Federal Center, Building 710<br>P.O. Box 25267<br>Denver, CO 80225-0267<br>(303) 235-4830

## STATUS OF THE COMMUNITY NFIP MAPS

We will not physically revise and republish the FIRM and FIS report for your community to reflect the modifications made by this LOMR at this time. When changes to the previously cited FIRM panels) and FIS report warrant physical revision and republication in the future, we will incorporate the modifications made by this LOMR at that time.


| Page 4 of 4 | Issue Date: March 6, 2 |
| :--- | :--- |

## Federal Emergency Management Agency

Washington, D.C. 20472

## LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)



Within 90 days of the second publication in the local newspaper, a citizen may request that we reconsider this determination. Any request for reconsideration must be based on scientific or technical data. Therefore, this letter will be effective only after the 90 -day appeal period has elapsed and we have resolved any appeals that we receive during this appeal period. Until this LOMR is effective, the revised BEs presented in this LOMR may be changed.

A notice of changes will be published in the Federal Register. A short notice also will be published in your local newspaper on or about the dates listed below. Please refer to FEMA's website at https://www.floodmaps.fema.gov/fhm/Scripts/bfe_main.asp for a more detailed description of proposed BFE changes, which will be posted within a week of the date of this letter.

Name: El Paso County News
Dates: 03/18/09 03/25/09


David N. Bascom, Program Specialist


REFERENCE MATERIAL

# MASTER DEVELOPMENT DRAINAGE PLAN FOR STERLING RANCH 

OCTOBER 2018

Prepared for:
Morley-Bentley Investments, LLC
20 Boulder Crescent, $2^{\text {nd }}$ Floor
Colorado Springs, CO 80903
(719) 471-1742

Prepared by:


20 Boulder Crescent, Suite 110
Colorado Springs, CO 80903
(719) 955-5485

Project \#09-002
SKP-18-003
SF-17-024
at DP87 culminating in peak runoff rates within Sand Creek of Q5 $=374.6 \mathrm{cfs}, \mathrm{Q} 100=1905.9 \mathrm{cfs}$.
Basin SC3-16A (Q5 = 120.4 cfs , $\mathrm{Q} 100=351.8 \mathrm{cfs}$ ) consists of a 168.1 acre area located within Sterling Ranch, that is located north of Briargate Parkway and east of Sand Creek Channel. This portion of Sterling Ranch is planned to house residential development that ranges from low density rural lots 1 acres in size to medium density urban residential with lots ranging in size from 0.1 to 0.2 acres. Runoff from the basin shall be collected and conveyed within street and storm sewer systems to a full spectrum detention pond (FSD16A), at the northwest corner of Briargate Parkway and Sterling Ranch Road. The treated detained flows from the pond will discharge to DP22 at peak flow rates of 8.8 cfs and 128.3 cfs in the 5 and 100 year events respectively.

Basin SC3-16B (Q5 = $53.7 \mathrm{cfs}, \mathrm{Q} 100=143.8 \mathrm{cfs})$ consists of a 50.7 acre area located within Sterling Ranch, that is located north of Briargate Parkway and east of Sand Creek Channel. This portion of Sterling Ranch is planned for a low to medium density residential lots ranging in size from 0.1 to 0.2 acres lots and portions of roadways. Runoff from the basin shall be collected and conveyed within street and storm sewer systems to a full spectrum detention pond (FSD16B), at the northeast corner of Briargate Parkway and Sterling Ranch Road. The treated detained flows from the pond will discharge to DP22 at peak flow rates of 0.4 cfs and 28.1 cfs in the 5 and 100 year events respectively. The combined peak flow rates from SC3-16B and FSD14A (DP22, Q5=8.8 cfs and Q100=174.9 cfs) will be conveyed south via storm sewer system to DP21.

Basin SC3-14B (Q5 $=34.3 \mathrm{cfs}, \mathrm{Q} 100=94.1 \mathrm{cfs})$ consists of a 34.7 acre area located within of Sterling. Ranch, that is located between south of Briargate Parkway and east of Sterling Ranch Road, east of Sand Creek. This portion of Sterling Ranch is planned for a low to medium density residential lots ranging in size from 0.1 to 0.33 acres lots and portions of roadways. Runoff from the basin shall be collected and conveyed within street and storm sewer systems to a full spectrum detention pond (FSD14B), at the south end of the basin. The treated detained flows from the pond will discharge to DP21 at peak flow rates of 0.3 cfs and 19.3 cfs in the 5 and 100 year events respectively. The combined peak flow rates from DP22 and FSD14B (DP21, Q5=8.8 cfs and Q100=174.9 cfs) will be conveyed to Pond W3 above the intersection of Sand Creek channel and Sterling Ranch Road.

Basin SC3-14A (Q5 = 175.4 cfs , $\mathrm{Q} 100=466.3 \mathrm{cfs})$ consists of a 164.9 acre area located within of Sterling. Ranch, that is located between south of Briargate Parkway and east of Sterling Ranch Road, east of Sand Creek. This portion of Sterling Ranch is planned for a k-8 school site, several single family residential lots ranging in size from 0.2 to 0.33 acres lots as well as portions of park and open space. Runoff from the basin shall be collected and conveyed within street and storm sewer systems and directed to a full spectrum detention pond (FSD14A), at the southwest corner of the basin. The treated detained flows from the pond will discharge to Pond W3 at peak flow rates of 7.5 cfs and 142.2 cfs in the 5 and 100 year events respectively.

Basin SC3-13 (Q5 = 57.8 cfs, Q100 = 136.9 cfs ) consists of a 41.0 acre area located within of Sterling. Ranch, that is located just the east of the Barbarick Subdivision and north of Sterling Ranch Road. This portion of Sterling Ranch is planned for residential lots ranging in size from 0.1 to 0.2 acres in size. Runoff from the basin shall be collected by storm sewer systems and conveyed to a full spectrum detention pond (FSD13) located in the south end of the basin, adjacent to sand creek. The treated detained flows from the pond will discharge into Sand Creek at peak flow rates of 4.2 cfs and 47.2 cfs in the 5 and 100 year events respectively.

Runoff from DP87, DP21 and from FSD Ponds 13, and 14A will combine within the Sand Creek Channel at proposed Regional Pond Detention Facility W3. The purpose of the regional pond is to reduce the post development flow rates within the Sand Creek Channel at the Southern Sterling Ranch boundary to at or below the existing flow rates calculated by this report. The pond is also necessary due to the drainage basin diversion, as discussed in other parts of this report. The total combined discharge reaching the regional facility (Pond W-3) has been calculated at 374.5 cfs and 2204.1 cfs in the 5 and 100 year events respectively.

As conceptually designed the proposed facility will utilize a check/diversion wall located upstream of the existing stock pond and proposed detention facility that will function to divert base flows within the channel to aid in retaining a fixed water surface within the existing stock pond and in larger storm events diverted flows safely around the amenity to the west side to detention Pond W3. A small controlled outlet structure along with an improved downstream embankment will be added to the existing stock pond to stabilize it and retain a fixed maximum water surface elevation. In the larger detention pond eight (8) small 24 " storm sewer pipe located within a separate embankment will allow for free flow discharge of 2 year runoff and begin to detain flows of 5 years and larger events. Flows exiting the small storm pipes or overtopping the separated embankment will enter a concrete forebay that conveys drainage to two (2) cell $8^{\prime} \mathrm{h} \times 10$ 'w concrete box culvert (CBC) under Proposed Sterling Ranch Road to DP68. As the anticipated flow rate leaving the pond is planned to be less than $1,500 \mathrm{cfs}$, and the proposed culvert crossing is conceptually planned to have an open area of less than 200 ft sq of open area and thus will need to meet the headwater requirements of Table 6-5 of the DCM, which in this concept design is a ratio of about $\sim 1.3$. The total combined discharge calculated to leave the regional facility (Pond $\mathrm{W}-3$ ) has been calculated at 200.3 cfs and $1,350.6 \mathrm{cfs}$ in the 5 and 100 year events respectively, with a maximum 100 year water surface of 7017.3 , a

HW/D ratio of $\sim 1.3$. The peak detained volume has been estimated at 78.2 ac-ft. A low point in Sterling Ranch Road will be designed adjacent to the facility to provide a safe overflow route. An exhibit showing the concept design and its various elements is included in the appendix of this report.

As previously discussed a Condition Letter of Map Revision and Letter of Map Revision (CLOMR/LOMR) will need to be processed through the Federal Emergency Management Agency (FEMA) to revise the hydrology to the Sand Creek Channel and allow for the remapping of the revised floodplains. It should be noted that the DBPS flow rates for Reach SC-8 (Reach 163) adjacent to this location were estimate to be $2,630 \mathrm{cfs}$ and that the effective FEMA 100 year flow rate is $2,600 \mathrm{cfs}$. A comparison table of the various flow rates is provided later in this text and on the accompanying drainage maps.

The final design of the culvert crossing and final determination of approved rates as well as the final pond design will be discussed within the future Sterling Ranch Channel Design Report and Sand Creek CLOMR/LOMR documents. No deviations for this pond and accompanying outlet structure are anticipated at this time.

It is important to note that the planned discharge outlet pipe for the FSD pond located to the west of the pond W3 will need to be extended to the downstream outlet side of the culvert to ensure that the 100 year water surface elevation with W3 does not affect the functionality of the adjacent FSD and its storm sewer systems.

In regards to timing, the need to construction this facility can be tied to the Sand Creek Channel improvements which is discussed within this report and also within the Subdivision Improvements Agreement. In no case should runoff from the East Fork of Sand Creek be diverted to the Main Branch of the Sand Creek Channel prior to the construction and of this facility.

Basin SC3-11A $(Q 5=7.8 \mathrm{cfs}, \mathrm{Q} 100=24.3 \mathrm{cfs})$ consists of a 10.7 acre area located within of Sterling. Ranch, that is south of Sterling Ranch Road, west of Sand Creek. This portion of Sterling Ranch consists of single family residential for lots ranging in size from 0.2 to 0.3 acres in size and open space associated with the Sand Creek Channel. Runoff from the developed portion of the basin shall be collected and conveyed within street and storm sewer systems to a full spectrum detention pond FSD11A. The treated detained flows from the pond will discharge into Sand Creek at peak flow rates of 0.9 cfs and 12.3 cfs in the 5 and 100 year events respectively just upstream of DP-63. It should be noted that this detention facility may not be necessary if grading can be oriented to force surface runoff to the west.

Basin SC3-11B (Q5 = 81.3 cfs , $\mathrm{Q} 100=213.7 \mathrm{cfs})$ consists of a 76.6 acre area located within of Sterling. Ranch, that is south of Sterling Ranch Road, east of Sand Creek. This portion of Sterling Ranch consists of single family residential planned for lots ranging in size from 0.2 to 0.3 acres in size and a portion of a park site and collector roadways. Runoff from the developed portion of the basin shall be collected and conveyed within street and storm sewer systems westward to a full spectrum detention pond FSD11B. The treated detained flows from the pond will discharge into Sand Creek at peak flow rates of 4.5 cfs and 69.5 cfs in the 5 and 100 year events respectively. The runoff from DP68 and from FSD ponds 11 A and 11 B combine at DP63 at peak flow rates of $\mathrm{Q} 5=$ $201.0 \mathrm{cfs}, \mathrm{Q} 100=1385.1$, which is less than the anticipated existing modeled flow rates of Q5 $=430.7 \mathrm{cfs}$, Q100 $=1911.5$ at DP63. Runoff from DP63 continues south within the Sand Creek Channel toward DP61.

Basin SC3-7 $(\mathrm{Q} 5=69.9 \mathrm{cfs}, \mathrm{Q} 100=157.2 \mathrm{cfs})$ consists of a 45.7 acre industrial zoned area, referred to as the Barbarick Subdivision, located outside of Sterling Ranch. Per the Final Drainage Report for Barbarick Subdivision, Portions of Lots 1, 2 and Lots 3and 4 the filing consists of four lots which upon which development will be constructed which will include adding a proposed Extended Detention Basin within Lot 4 . This detention basin will provide water quality treatment for portions of Lots $1 \& 2$, and Lots $3 \& 4$. The EBD will structure will outfall at the south end of Lot 4 at the Barbarick Subdivision/Sterling Ranch property line. Per the report the proposed total outflow from the EDB pond will be Q5 $=0.3 \mathrm{cfs}, \mathrm{Q} 100=45.9^{* *} \mathrm{cfs}(* *$ which includes pass through flows of 29.4 cfs ). A second Sand Filter Basin water quality detention catchment will be provided at the southeast/downstream end of Lot 2 . The SFB will outfall at the southeast corner of the Lot 2 at the Barbarick Subdivision/Sterling Ranch property line. Per the report the proposed total outflow the SFB pond will be $\mathrm{Q} 5=0.1 \mathrm{cfs}, \mathrm{Q} 100=3.6 \mathrm{cfs}$. At the initial writing of this report, neither EDB nor SFB structure has been fully constructed, and thus the assumption was made to utilize the full un-detained untreated runoff from the offsite development for onsite drainage planning purposes. Thus the downstream facilities planned within Sterling Ranch will account for the total un-detained runoff from the parcel of $\mathrm{Q} 5=69.9 \mathrm{cfs}, \mathrm{Q} 100=157.2 \mathrm{cfs}$ and will plan to treat the total runoff onsite facilities. This provides a conservative approach for master planning. Runoff discharged from the property will be collected by proposed storm sewer within Sterling Ranch and routed to DP64. These facilities and their effects on drainage will be re-reviewed with subsequent drainage report and shall be implemented into final design and construction.

Basin SC3-6B (Q5=43.4 cfs, Q100=102.7 cfs) consists of a 30.9 acre area located within of Sterling Ranch, that is north of Sterling

## (Excerpt from 2018 Sterling Ranch MDDP, M\&S Civil Consultants, Inc.)

Step 2 Implement BMPs that provide a water quality capture volume with slow release. - Using Full Spectrum Detention Facilities which will incorporate water quality capture volumes that are intended to slowly drain in 40 hours and excess urban runoff volumes that are intended to drain within 72 hours. All storage facilities will be designed to meet State Statue SB15-212/ §37-92-602(8).

Step 3 Stabilize streams. - With the full spectrum detention facility in place, the runoff from the developments will be reduced to predevelopment conditions. The developed discharge from the sites will be less than existing and therefore is not anticipated to have negative effects on downstream drainage ways.

Step 4 Consider need for Industrial and Commercial BMPs. - No industrial land uses are proposed with this development. The proposed commercial development area will implement a Stormwater Management Plan (SWMP) incorporation proper housekeeping procedures. Onsite drainage will be routed through private Full Spectrum Detention (FSD) basins to minimize introduction of contaminates to the county's public drainage systems.

## INTERBASIN TRANSFER EAST FORK SAND CREEK TO MAIN STEM SAND CREEK

It should be noted that the proposed development plan for the $\sim 1444$ acre of Sterling Ranch redistributes a small percentage of the historic watershed between the Sand Creek and East Fork of Sand Creek watershed.

Based upon the survey and contour mapping, prior to development approximately 682 acres of Sterling Ranch runoff was collected by the Sand Creek watershed with the remaining 762 acres was directed to the East Fork of Sand Creek.

After development approximately 267 acres will be redirected from the East Fork Sand Creek into the Sand Creek Basin, resulting in 949 acres of Sterling Ranch directed to the Sand Creek Basin with the remaining 495 acres directed to East Fork Sand Creek.

This modification is driven primarily by maximizing the area of land that can be delivered to the sanitary sewer lift station. It should be noted that the East Fork of Sand Creek is still tributary to the Main Branch of Sand Creek, and thus this transfer is between minor watersheds, not major watershed, and that the development as planned will still function to limit discharged runoff into Sand Creek and East Tributary to the historic flow rates. An exhibit was added to the appendix, which also accompanies the deviation request that shows this basin diversion.

It should be noted that the Developed Conditions Map (provided in the appendix) illustrated the diverted acreage based upon the DPBS mapped boundary(as mapped within the SCDBPS) and diversion based upon the actual field contour data.

## Drainage Basin Descriptions

Developed Sand Creek (Main Stem) Basin Flows
Basin SC3-82 (Q5 = 33.2 cfs, Q100 = 132.3 cfs ) which is located north of Sterling Ranch and Burgess Road to the east Basin SC3-81, assumes that the 117.8 is primarily undeveloped, pine forested land. In this undeveloped condition runoff from the basin continues south overland into Basin SC3-74.

Basin SC3-74 (Q5 $=36.5 \mathrm{cfs}, \mathrm{Q} 100=140.7 \mathrm{cfs})$ is a 119.7 acre area of 5 and 10 -acre lots covered with a mixture of native prairie grasses and pine trees land located north of Sterling Ranch and south of Burgess Road to the west and north of Basins SC3-73 and SC3-75. Runoff from Basins SC3-74 and SC3-82, combine at DP-74 (Q5 $=65.3 \mathrm{cfs}, \mathrm{Q} 100=262.8 \mathrm{cfs}$ ), which is equivalent to the anticipated existing modeled flow rates of Q5 $=65.3 \mathrm{cfs}, \mathrm{Q} 100=262.8 \mathrm{cfs}$.

Basin SC3-73 (Q5 $=26.4 \mathrm{cfs}, \mathrm{Q} 100=102.0 \mathrm{cfs})$ is a 90.0 acre area of 5 to 40 acres lots covered with a mixture of native prairie grasses and pine trees land located north of Sterling Ranch to the northeast of Vollmer Road. Runoff from the Basin SC3-73 will combine with runoff from DP-74 and will continue overland towards DP-75.

Basin SC3-81 (Q5 = 70.2 cfs, Q100 = 275.7 cfs ) which is located north of Sterling Ranch (approx 1 mile) between Shoup and Burgess Roads, assumes that the 262.9 acre area of primarily undeveloped, pine forested, land. In this undeveloped condition runoff from the basin continues south overland into Basin SC3-75.


## STERLING RANCH DRAINAGE DIVERSION EXHIBIT



# Storm Water Management Model User's Manual Version 5.1 

by<br>Lewis A. Rossman<br>Envronmental Scientist, Emeritus<br>U.S. Environmental Protection Agency

National Risk Management Research Laboratory<br>Office of Research and Development<br>U.S. Environmental Protection Agency<br>26 Martin Luther King Drive<br>Cincinnati, OH 45268

Table 6-5. 2-Hour Design Storm Distributions by Drainage Basin Area (DARF-adjusted fraction of 1-Hour Depth)


5


| City of Colorado Springs DCM | Time Min. | Drainage Basin Area (square miles) |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | 0-1 | >1-5 | >5-10 | >10-15 | >15-20 | >20-40 | >40-60 |
|  | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
|  | 5 | 0.035 | 0.035 | 0.035 | 0.035 | 0.038 | 0.038 | 0.043 |
|  | 10 | 0.116 | 0.111 | 0.103 | 0.103 | 0.106 | 0.106 | 0.101 |
|  | 15 | 0.199 | 0.192 | 0.186 | 0.186 | 0.184 | 0.176 | 0.171 |
|  | 20 | 0.302 | 0.292 | 0.275 | 0.275 | 0.267 | 0.257 | 0.239 |
|  | 25 | 0.451 | 0.444 | 0.426 | 0.423 | 0.411 | 0.396 | 0.370 |
|  | 30 | 0.650 | 0.627 | 0.602 | 0.595 | 0.572 | 0.544 | 0.499 |
| 0-year, 2-hour Storm | 35 | 1.061 | 0.998 | 0.892 | 0.824 | 0.774 | 0.696 | 0.610 |
|  | 40 | 1.794 | 1.651 | 1.409 | 1.247 | 1.129 | 0.960 | 0.794 |
| ulative) | 45 | 2.076 | 1.905 | 1.605 | 1.411 | 1.275 | 1.063 | 0.869 |
|  | 50 | 2.248 | 2.076 | 1.764 | 1.560 | 1.426 | 1.207 | 0.998 |
|  | 55 | 2.356 | 2.182 | 1.865 | 1.658 | 1.515 | 1.290 | 1.079 |
|  | 60 | 2.449 | 2.271 | 1.950 | 1.739 | 1.598 | 1.368 | 1.149 |
|  | 65 | 2.530 | 2.354 | 2.031 | 1.807 | 1.666 | 1.436 | 1.215 |
|  | 70 | 2.565 | 2.389 | 2.069 | 1.845 | 1.709 | 1.484 | 1.263 |
|  | 75 | 2.596 | 2.424 | 2.104 | 1.880 | 1.744 | 1.520 | 1.298 |
|  | 80 | 2.623 | 2.452 | 2.139 | 1.915 | 1.779 | 1.555 | 1.333 |
|  | 85 | 2.651 | 2.480 | 2.175 | 1.950 | 1.814 | 1.590 | 1.368 |
|  | 90 | 2.679 | 2.507 | 2.205 | 1.986 | 1.850 | 1.625 | 1.404 |
|  | 95 | 2.701 | 2.535 | 2.233 | 2.021 | 1.885 | 1.661 | 1.439 |
|  | 100 | 2.727 | 2.563 | 2.258 | 2.049 | 1.920 | 1.696 | 1.474 |
|  | 105 | 2.749 | 2.586 | 2.286 | 2.076 | 1.948 | 1.731 | 1.509 |
|  | 110 | 2.772 | 2.611 | 2.313 | 2.104 | 1.973 | 1.759 | 1.540 |
|  | 115 | 2.795 | 2.633 | 2.341 | 2.132 | 2.001 | 1.787 | 1.567 |
|  | 120 | 2.820 | 2.656 | 2.364 | 2.160 | 2.029 | 1.814 | 1.595 |

7

## 8

Subcatchment Conceptual Model


Subcatchment represented as a sloped, rectangular plane
W = width
L = length
S = slope
A = area

## Percent Impervious

## Estimating/Measuring Percent Impervious:

- If site-specific information is not available, use land use classification
- Sometimes, site-specific impervious GIS layers are available


Source: UDFCD Storm Drainage Criteria Manual

City of Colorado Springs DCM - Manning's n

Table 6-11. Roughness Coefficients (Manning's n) for NRCS Overland Flow

| Surface description | $\mathbf{n}^{1}$ |
| :---: | :---: |
| Smooth surfaces (concrete, asphalt, gravel, bare soil, etc.) | 0.011 |
| Fallow (no residue) | 0.05 |
| Cultivated Soils: |  |
| Residue cover $\leq 20 \%$ | 0.06 |
| Residue cover $>20 \%$ | 0.17 |
| Grass: |  |
| Short grass prairie | 0.15 |
| Dense grasses ${ }^{2}$ | 0.24 |
| Bermuda grass | 0.41 |
| Range (natural) | 0.13 |
| Woods ${ }^{3}$ |  |
| Light underbrush | 0.40 |
| Dense underbrush | 0.80 |

Table 3-1 Impervious area as a percentage of land use.

| Land Use | Percent Impervious Area |
| :--- | :---: |
| Commercial | 56 |
| Industrial | 76 |
| High density residential | 51 |
| Medium density residential | 38 |
| Low density residential | 19 |
| Institutional | 34 |
| Agricultural | 2 |
| Forest | 1.9 |
| Open Urban Land | 11 |

As mentioned earlier, impervious areas in SWMM are hydraulically (directly) connected to the drainage system - called directly connected impervious areas (DCIA). For instance, if rooftops drain onto adjacent pervious lawn areas, they should not be treated as a hydraulically effective impervious area. Such areas are non-effective impervious areas (Doyle and Miller, 1980). On the other hand, if a driveway drains to a street and then to a stormwater inlet, the driveway would be considered hydraulically connected. Rooftops with downspouts connected directly to a sewer are clearly hydraulically connected. An example of careful measurements and statistics on imperviousness may be found in Field et al. (2000), Lee (2003), and Roy and Shuster (2007). Lee and Heaney (2003) provide detailed comparisons of imperviousness computations and their implications for modeling.

Should rooftops be treated as "pervious," the real surrounding pervious area is subject to more incoming water than rainfall alone and thus might produce runoff sooner than if rainfall alone were considered. In the possible event that this effect is important (a judgment based on infiltration parameters) it can be modeled using the overland flow re-routing option discussed earlier in Section 3.7. For example, if disconnected rooftops comprised 25 percent of the total impervious area of a subcatchment (as opposed to the total DCIA) then one could tell SWMM that this percentage of impervious area should be internally routed onto the pervious sub-area of the subcatchment.

Another method of estimating the effective impervious area given measured data is to plot the runoff (in. or mm ) vs. rainfall (in. or mm ) for small storms. The slope of the regression line is a good estimate of the effective impervious area (Doyle and Miller, 1980).

Table 3-5 Estimates of Manning's roughness coefficient for overland flow

| Source | Ground Cover | n | Range |
| :---: | :---: | :---: | :---: |
| Crawford and Linsley (1966) ${ }^{\text {a }}$ | Smooth asphalt | 0.01 |  |
|  | Asphalt of concrete paving | 0.014 |  |
|  | Packed clay | 0.03 |  |
|  | Light turf | 0.20 |  |
|  | Dense turf | 0.35 |  |
|  | Dense shrubbery and forest litter | 0.4 |  |
| Engman (1986) ${ }^{\text {b }}$ | Concrete or asphalt | 0.011 | 0.010-0.013 |
|  | Bare sand | 0.010 | 0.01-0.016 |
|  | Graveled surface | 0.02 | 0.012-0.03 |
|  | Bare clay-loam (eroded) | 0.02 | 0.012-0.033 |
|  | Range (natural) | 0.13 | 0.01-0.32 |
|  | Bluegrass sod | 0.45 | 0.39-0.63 |
|  | Short grass prairie | 0.15 | 0.10-0.20 |
|  | Bermuda grass | 0.41 | 0.30-0.48 |
| Yen (2001) ${ }^{\text {c }}$ | Smooth asphalt pavement | 0.012 | 0.010-0.015 |
|  | Smooth impervious surface | 0.013 | 0.011-0.015 |
|  | Tar and sand pavement | 0.014 | 0.012-0.016 |
|  | Concrete pavement | 0.017 | 0.014-0.020 |
|  | Rough impervious surface | 0.019 | 0.015-0.023 |
|  | Smooth bare packed soil | 0.021 | 0.017-0.025 |
|  | Moderate bare packed soil | 0.030 | 0.025-0.035 |
|  | Rough bare packed soil | 0.038 | 0.032-0.045 |
|  | Gravel soil | 0.032 | 0.025-0.045 |
|  | Mowed poor grass | 0.038 | 0.030-0.045 |
|  | Average grass, closely clipped sod | 0.050 | 0.040-0.060 |
|  | Pasture | 0.055 | 0.040-0.070 |
|  | Timberland | 0.090 | 0.060-0.120 |
|  | Dense grass | 0.090 | 0.060-0.120 |
|  | Shrubs and bushes | 0.120 | 0.080-0.180 |
|  | Business land use | 0.022 | 0.014-0.035 |
|  | Semi-business land use | 0.035 | 0.022-0.050 |
|  | Industrial land use | 0.035 | 0.020-0.050 |
|  | Dense residential land use | 0.040 | 0.025-0.060 |
|  | Suburban residential land use | 0.055 | 0.030-0.080 |
|  | Parks and lawns | 0.075 | 0.040-0.120 |
| ${ }^{\text {a }}$ Obtained by calibration of Stanford Watershed Model. <br> ${ }^{\text {b }}$ Computed by Engman (1986) by kinematic wave and storage analysis of measured rainfall-runoff data. <br> ${ }^{\text {c }}$ Computed on basis of kinematic wave analysis. |  |  |  |

STERLING RANCH EAST PRE-DEVELOPMENT CONDITIONS

Need to provide SWMM Input information. Include calculations for \% impervious, C-values \& time of cocentration.


## STERLING RANCH EAST PRE-DEVELOPMENT CONDITIONS (5yr. Event)

Subcatchment Runoff Summary

| Subcatchment | Total Precip in | Total Runon in | Total Evap in | Total Infil in | Total <br> Runoff in | Total Runoff $10^{\wedge} 6 \mathrm{gal}$ | Peak <br> Runoff <br> CFS | Runoff Coeff |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| EX-10 | 1.68 | 0.00 | 0.00 | 1.50 | 0.18 | 1.28 | 105.15 | 0.106 |
| EX10A | 1.68 | 0.00 | 0.00 | 1.53 | 0.15 | 0.70 | 52.19 | 0.087 |
| EX-11 | 1.68 | 0.00 | 0.00 | 1.54 | 0.14 | 0.80 | 53.86 | 0.082 |
| EX-13 | 1.68 | 0.00 | 0.00 | 1.48 | 0.20 | 0.50 | 35.71 | 0.117 |
| EX-4A | 1.68 | 0.00 | 0.00 | 1.52 | 0.15 | 0.18 | 19.26 | 0.091 |
| EX-5 | 1.68 | 0.00 | 0.00 | 1.52 | 0.16 | 0.11 | 11.51 | 0.093 |
| EX-7 | 1.68 | 0.00 | 0.00 | 1.52 | 0.15 | 0.64 | 46.80 | 0.090 |
| EX-9 | 1.68 | 0.00 | 0.00 | 1.52 | 0.15 | 0.73 | 56.96 | 0.090 |
| TR-12 | 1.68 | 0.00 | 0.00 | 1.43 | 0.25 | 0.03 | 1.88 | 0.148 |
| TR-20 | 1.68 | 0.00 | 0.00 | 1.45 | 0.22 | 0.14 | 10.01 | 0.131 |
| TR-4 | 1.68 | 0.00 | 0.00 | 1.42 | 0.25 | 0.03 | 1.78 | 0.150 |
| TR-5 | 1.68 | 0.00 | 0.00 | 1.48 | 0.20 | 0.07 | 4.56 | 0.116 |
| TR-6 | 1.68 | 0.00 | 0.00 | 1.38 | 0.30 | 0.01 | 0.83 | 0.177 |
| TR-7 | 1.68 | 0.00 | 0.00 | 1.43 | 0.24 | 0.02 | 1.01 | 0.144 |

## STERLING RANCH EAST PRE-DEVELOPMENT CONDITIONS (5yr. Event)

Outfall Loading Summary

| Outfall Node | Flow <br> Freq. Pcnt. | Avg. <br> Flow CFS | Max. <br> Flow CFS | Total Volume $10^{\wedge} 6 \mathrm{gal}$ |
| :---: | :---: | :---: | :---: | :---: |
| DP4 | 91.92 | 4.30 | 46.80 | 0.639 |
| DP56 | 98.59 | 8.23 | 59.57 | 1.311 |
| DP6 | 98.59 | 4.60 | 56.96 | 0.733 |
| DP7 | 98.59 | 12.48 | 114.01 | 1.989 |
| DPEX-4A | 61.64 | 1.84 | 19.26 | 0.183 |
| DPEX-5 | 53.38 | 1.29 | 11.51 | 0.111 |
| Out10 | 36.27 | 0.51 | 1.78 | 0.030 |
| Out11 | 34.38 | 0.22 | 0.83 | 0.012 |
| Out6 | 36.44 | 0.54 | 1.88 | 0.032 |
| Out7 | 48.80 | 1.75 | 10.01 | 0.138 |
| Out8 | 41.34 | 1.09 | 4.56 | 0.073 |
| Out9 | 35.63 | 0.30 | 1.01 | 0.017 |

Include EX-10 \&
EX-13

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
```

```
STERLING RANCH EAST PRE-DEVELOPMENT CONDITIONS
PRELIMINARY DRAINAGE REPORT
PRE-DEVELOPMENT DRAINAGE (5 yr.)
```

*********************************************************
NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.

```
***********************************************************
```

*****************
Analysis Options
*****************
Flow Units ................. CFS
Process Models:
Rainfall/Runoff ......... YES
RDII ....................... NO
Snowmelt .................. NO
Groundwater .............. NO
Flow Routing ............. YES
Ponding Allowed ......... NO
Water Quality ........... NO
Infiltration Method ....... HORTON
Flow Routing Method ....... KINWAVE
Starting Date ............. 04/15/2022 00:00:00
Ending Date ............... 04/15/2022 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step .......... 00:05:00
Wet Time Step ............. 00:01:00
Dry Time Step ............. 01:00:00
Routing Time Step ......... 5.00 sec
**************************

| Volume | Depth |
| ---: | ---: |
| acre-feet | inches |
| ------------ |  |
| 168.488 | 1.679 |
| 0.000 | 0.000 |
| 151.953 | 1.514 |
| 16.119 | 0.161 |
| 0.426 | 0.004 |
| -0.006 |  |


| Flow Routing Continuity | acre-feet | 10^6 gal |
| :---: | :---: | :---: |
| Dry Weather Inflow | 0.000 | 0.000 |
| Wet Weather Inflow | 16.119 | 5.253 |
| Groundwater Inflow | 0.000 | 0.000 |
| RDII Inflow | 0.000 | 0.000 |
| External Inflow | 0.000 | 0.000 |
| External Outflow | 16.166 | 5.268 |
| Flooding Loss | 0.000 | 0.000 |
| Evaporation Loss | 0.000 | 0.000 |
| Exfiltration Loss | 0.000 | 0.000 |
| Initial Stored Volume | 0.000 | 0.000 |
| Final Stored Volume | 0.005 | 0.002 |
| Continuity Error (\%) | -0.324 |  |

## *********************************

Highest Flow Instability Indexes *********************************

All links are stable.

| $* * * * * * * * * * * * * * * * * * * * * * * * * * ~$ |  |  |
| :--- | :--- | :--- |
| Routing Time Step Summary |  |  |
| $* * * * * * * * * * * * * * * * * * * * * * * *$ |  |  |
| Minimum Time Step | $:$ | 5.00 sec |
| Average Time Step | $:$ | 5.00 sec |
| Maximum Time Step | $:$ | 5.00 sec |
| Percent in Steady State | $:$ | 0.00 |
| Average Iterations per Step | 1.00 |  |
| Percent Not Converging | $:$ | 0.00 |

***************************
Subcatchment Runoff Summary ***************************

| Total | Peak | Runoff | Total | Total | Total | Total | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Precip | Runon | Evap | Infil | Runoff |
| Runoff | Runoff | Coeff |  |  | , |  |  |
| Subcatc | chment |  | in | in | in | in | in |
| 10^6 gal | CF | FS |  |  |  |  |  |

----------
EX-7
1.68
0.00
0.00
1.52
0.15

| 0.64 | 46.80 | 0.090 |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| EX-9 |  |  | 1.68 | 0.00 | 0.00 | 1.52 | 0.15 |
| 0.73 | 56.96 | 0.090 |  |  |  |  |  |
| EX10A |  |  | 1.68 | 0.00 | 0.00 | 1.53 | 0.15 |
| 0.70 | 52.19 | 0.087 |  |  |  |  |  |
| EX-11 |  |  | 1.68 | 0.00 | 0.00 | 1.54 | 0.14 |
| 0.80 | 53.86 | 0.082 |  |  |  |  |  |
| EX-13 |  |  | 1.68 | 0.00 | 0.00 | 1.48 | 0.20 |
| 0.50 | 35.71 | 0.117 |  |  |  |  |  |
| EX-10 |  |  | 1.68 | 0.00 | 0.00 | 1.50 | 0.18 |
| 1.28 | 105.15 | 0.106 |  |  |  |  |  |
| TR-7 |  |  | 1.68 | 0.00 | 0.00 | 1.43 | 0.24 |
| 0.02 | 1.01 | 0.144 |  |  |  |  |  |
| TR-6 |  |  | 1.68 | 0.00 | 0.00 | 1.38 | 0.30 |
| 0.01 | 0.83 | 0.177 |  |  |  |  |  |
| TR-5 |  |  | 1.68 | 0.00 | 0.00 | 1.48 | 0.20 |
| 0.07 | 4.56 | 0.116 |  |  |  |  |  |
| TR-4 |  |  | 1.68 | 0.00 | 0.00 | 1.42 | 0.25 |
| 0.03 | 1.78 | 0.150 |  |  |  |  |  |
| TR-12 |  |  | 1.68 | 0.00 | 0.00 | 1.43 | 0.25 |
| 0.03 | 1.88 | 0.148 |  |  |  |  |  |
| TR-20 |  |  | 1.68 | 0.00 | 0.00 | 1.45 | 0.22 |
| 0.14 | 10.01 | 0.131 |  |  |  |  |  |
| EX-4A |  |  | 1.68 | 0.00 | 0.00 | 1.52 | 0.15 |
| 0.18 | 19.26 | 0.091 |  |  |  |  |  |
| EX-5 |  |  | 1.68 | 0.00 | 0.00 | 1.52 | 0.16 |
| 0.11 | 11.51 | 0.093 |  |  |  |  |  |

*******************
Node Depth Summary

```
********************
```

| Node | Type | Average Depth Feet | Maximum Depth Feet | Maximum HGL Feet | Time <br> Occu days | of Max rrence hr :min | Reported Max Depth Feet |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| JEX-10 | JUNCTION | 0.18 | 1.14 | 7149.14 | 0 | 00:45 | 1.14 |
| JEX-13 | JUNCTION | 0.14 | 0.84 | 7070.84 | 0 | 00:45 | 0.84 |
| DP4 | OUTFALL | 0.00 | 0.00 | 6998.00 | 0 | 00:00 | 0.00 |
| DP6 | OUTFALL | 0.00 | 0.00 | 7026.00 | 0 | 00:00 | 0.00 |
| DP7 | OUTFALL | 0.19 | 1.01 | 7017.01 | 0 | 00:47 | 0.98 |
| DP56 | OUTFALL | 0.15 | 0.64 | 7008.64 | 0 | 00:52 | 0.63 |
| Out6 | OUTFALL | 0.00 | 0.00 | 7270.00 | 0 | 00:00 | 0.00 |
| Out7 | OUTFALL | 0.00 | 0.00 | 7246.00 | 0 | 00:00 | 0.00 |
| Out8 | OUTFALL | 0.00 | 0.00 | 7230.00 | 0 | 00:00 | 0.00 |
| Out9 | OUTFALL | 0.00 | 0.00 | 7190.00 | 0 | 00:00 | 0.00 |
| Out10 | OUTFALL | 0.00 | 0.00 | 7250.00 | 0 | 00:00 | 0.00 |
| Out11 | OUTFALL | 0.00 | 0.00 | 7228.00 | 0 | 00:00 | 0.00 |


| DPEX-4A | OUTFALL | 0.00 | 0.00 | 7001.00 | 0 | $00: 00$ | 0.00 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| DPEX-5 | OUTFALL | 0.00 | 0.00 | 7144.00 | 0 | $00: 00$ | 0.00 |

Node Inflow Summary
$* * * * * * * * * * * * * * * * * * *$

| Total | Flow |  | Maximum | Maximum |  | Lateral |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |
|  |  |  | Lateral | Total | Time of Max | Inflow |
| Inflow | Balance |  |  |  |  |  |
|  |  |  | Inflow | Inflow | Occurrence | Volume |
| Volume Node gal | Error |  |  |  |  |  |
|  |  | Type | CFS | CFS | days hr :min | 10^6 gal |
|  | cent |  |  |  |  |  |


| ------------ |  |
| :--- | :--- |
| JEX-10 |  |
| 1.28 | 0.000 |

JUNCTION
105.15
105.15
$0 \quad 00: 45$
1.28

JUNCTION
35.71
35.71

0 00:45
0.505

OUTFALL
46.80
46.80

0 00:45
0.639

OUTFALL
56.96
56.96

0 00:45
0.733

OUTFALL
52.19
114.01
$0 \quad 00: 47$
0.699

OUTFALL
53.86
59.57
$0 \quad 00: 45$
0.797
1.310 .000

Out6 OUTFALL
1.88
1.88
$0 \quad 00: 45$
0.0317
$0.0317 \quad 0.000$ Out7 OUTFALL
10.01
10.01
$0 \quad 00: 45$
0.138
0.138
0.000 Out8
0.0727
0.000

Out9
0.0171
0.000 Out10
0.000 Out11
0.000 DPEX-4A
0.000 DPEX-5
0.111
0.000

```
*********************
```

Node Flooding Summary
*********************

No nodes were flooded.
$* * * * * * * * * * * * * * * * * * * * * * *$
Outfall Loading Summary
$* * * * * * * * * * * * * * * * * * * * * *$

| Outfall Node | Flow Freq Pcnt | Avg Flow CFS | Max Flow CFS | Total Volume |
| :---: | :---: | :---: | :---: | :---: |
| DP4 | 91.92 | 4.30 | 46.80 | 0.639 |
| DP6 | 98.59 | 4.60 | 56.96 | 0.733 |
| DP7 | 98.59 | 12.48 | 114.01 | 1.989 |
| DP56 | 98.59 | 8.23 | 59.57 | 1.311 |
| Out6 | 36.44 | 0.54 | 1.88 | 0.032 |
| Out7 | 48.80 | 1.75 | 10.01 | 0.138 |
| Out8 | 41.34 | 1.09 | 4.56 | 0.073 |
| Out9 | 35.63 | 0.30 | 1.01 | 0.017 |
| Out10 | 36.27 | 0.51 | 1.78 | 0.030 |
| Out11 | 34.38 | 0.22 | 0.83 | 0.012 |
| DPEX-4A | 61.64 | 1.84 | 19.26 | 0.183 |
| DPEX-5 | 53.38 | 1.29 | 11.51 | 0.111 |
| System | 61.30 | 37.15 | 317.58 | 5.268 |



No conduits were surcharged.

Analysis begun on: Wed May 25 09:45:57 2022
Analysis ended on: Wed May 25 09:45:57 2022
Total elapsed time: < 1 sec

## STERLING RANCH EAST PRE-DEVELOPMENT CONDITIONS (100 yr. Event)

Subcatchment Runoff Summary

| Subcatchment | Total Precip in | Total <br> Runon <br> in | Total Evap in | Total Infil in | Total <br> Runoff in | Total Runoff $10^{\wedge} 6 \mathrm{gal}$ | Peak <br> Runoff <br> CFS | Runoff Coeff |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| EX-10 | 2.82 | 0.00 | 0.00 | 2.12 | 0.70 | 5.04 | 221.82 | 0.248 |
| EX10A | 2.82 | 0.00 | 0.00 | 2.16 | 0.65 | 3.10 | 116.83 | 0.231 |
| EX-11 | 2.82 | 0.00 | 0.00 | 2.16 | 0.66 | 3.84 | 129.43 | 0.234 |
| EX-13 | 2.82 | 0.00 | 0.00 | 1.98 | 0.83 | 2.15 | 85.43 | 0.296 |
| EX-4A | 2.82 | 0.00 | 0.00 | 2.01 | 0.80 | 0.96 | 49.54 | 0.285 |
| EX-5 | 2.82 | 0.00 | 0.00 | 1.97 | 0.85 | 0.60 | 31.56 | 0.300 |
| EX-7 | 2.82 | 0.00 | 0.00 | 2.14 | 0.68 | 2.86 | 106.53 | 0.240 |
| EX-9 | 2.82 | 0.00 | 0.00 | 2.17 | 0.65 | 3.13 | 124.02 | 0.230 |
| TR-12 | 2.82 | 0.00 | 0.00 | 1.66 | 1.16 | 0.15 | 9.32 | 0.411 |
| TR-20 | 2.82 | 0.00 | 0.00 | 1.79 | 1.03 | 0.65 | 31.58 | 0.365 |
| TR-4 | 2.82 | 0.00 | 0.00 | 1.65 | 1.16 | 0.14 | 8.91 | 0.413 |
| TR-5 | 2.82 | 0.00 | 0.00 | 1.81 | 1.01 | 0.38 | 17.25 | 0.359 |
| TR-6 | 2.82 | 0.00 | 0.00 | 1.57 | 1.25 | 0.05 | 4.42 | 0.443 |
| TR-7 | 2.82 | 0.00 | 0.00 | 1.67 | 1.14 | 0.08 | 4.90 | 0.405 |

Outfall Loading Summary

|  | Flow <br> Freq. <br> Pcnt. | Avg. <br> Flow <br> CFS | Max. <br> Flow <br> CFS | Total <br> Volume <br> $10 \wedge 6$ gal |
| :--- | ---: | ---: | ---: | ---: |
| DP4 | 92.55 | 19.10 | 106.53 | 2.856 |
| DP56 | 98.59 | 37.64 | 160.10 | 5.996 |
| DP6 | 98.59 | 19.66 | 124.02 | 3.131 |
| DP7 | 98.59 | 51.21 | 258.75 | 8.157 |
| DPEX-4A | 62.08 | 9.61 | 49.54 | 0.964 |
| DPEX-5 | 36.62 | 6.93 | 31.56 | 0.603 |
| Out10 | 34.56 | 2.35 | 8.91 | 0.139 |
| Out11 | 36.90 | 0.91 | 4.42 | 0.051 |
| Out6 | 49.14 | 2.48 | 9.32 | 0.148 |
| Out7 | 42.15 | 5.16 | 31.58 | 0.648 |
| Out8 | 37.27 | 5.53 | 17.25 | 0.376 |
| Out9 |  | 1.34 | 4.90 | 0.081 |

[^2]```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
```

```
STERLING RANCH EAST PRE-DEVELOPMENT CONDITIONS
PRELIMINARY DRAINAGE REPORT
PRE-DEVELOPMENT DRAINAGE (100 yr.)
```

** * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.
*****************
Analysis Options
*****************
Flow Units ................. CFS
Process Models:
Rainfall/Runoff ......... YES
RDII ....................... NO
Snowmelt .................. NO
Groundwater .............. NO
Flow Routing ............. YES
Ponding Allowed ......... NO
Water Quality ........... NO
Infiltration Method ....... HORTON
Flow Routing Method ....... KINWAVE
Starting Date ............. 04/15/2022 00:00:00
Ending Date ............... 04/15/2022 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step .......... 00:05:00
Wet Time Step ............. 00:01:00
Dry Time Step ............. 01:00:00
Routing Time Step ........ 5.00 sec
**************************

| Volume | Depth |
| ---: | ---: |
| acre-feet | inches |
| ------------- | 2.820 |
| 282.987 | 0.000 |
| 0.000 | 2.109 |
| 211.612 | 0.707 |
| 70.972 | 0.004 |
| 0.426 |  |
| -0.008 |  |


| Flow Routing Continuity | acre-feet | 10^6 gal |
| :---: | :---: | :---: |
| Dry Weather Inflow | 0.000 | 0.000 |
| Wet Weather Inflow | 70.972 | 23.127 |
| Groundwater Inflow | 0.000 | 0.000 |
| RDII Inflow | 0.000 | 0.000 |
| External Inflow | 0.000 | 0.000 |
| External Outflow | 71.044 | 23.151 |
| Flooding Loss | 0.000 | 0.000 |
| Evaporation Loss | 0.000 | 0.000 |
| Exfiltration Loss | 0.000 | 0.000 |
| Initial Stored Volume | 0.000 | 0.000 |
| Final Stored Volume | 0.006 | 0.002 |
| Continuity Error (\%) | -0.110 |  |

## $* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * ~$

Highest Flow Instability Indexes *********************************

All links are stable.

| $* * * * * * * * * * * * * * * * * * * * * * * * * * ~$ |  |  |
| :--- | :--- | :--- |
| Routing Time Step Summary <br> $* * * * * * * * * * * * * * * * * * * * * * * *$ |  |  |
| Minimum Time Step | $:$ | 5.00 sec |
| Average Time Step | $:$ | 5.00 sec |
| Maximum Time Step | $:$ | 5.00 sec |
| Percent in Steady State | $:$ | 0.00 |
| Average Iterations per Step | : | 1.01 |
| Percent Not Converging | $:$ | 0.00 |

***************************
Subcatchment Runoff Summary ***************************

| Total | Peak | Runoff | Total | Total | Total | Total | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Precip | Runon | Evap | Infil | Runoff |
| Runoff Subca | Runoff chment | Coeff | in | in | in | in | in |
| 10^6 ga |  | FS |  |  |  |  |  |

EX-7
2.82
0.00
0.00
2.14
0.68

| 2.86 | 106.53 | 0.240 |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| EX-9 |  |  | 2.82 | 0.00 | 0.00 | 2.17 | 0.65 |
| 3.13 | 124.02 | 0.230 |  |  |  |  |  |
| EX10A |  |  | 2.82 | 0.00 | 0.00 | 2.16 | 0.65 |
| 3.10 | 116.83 | 0.231 |  |  |  |  |  |
| EX-11 |  |  | 2.82 | 0.00 | 0.00 | 2.16 | 0.66 |
| 3.84 | 129.43 | 0.234 |  |  |  |  |  |
| EX-13 |  |  | 2.82 | 0.00 | 0.00 | 1.98 | 0.83 |
| 2.15 | 85.43 | 0.296 |  |  |  |  |  |
| EX-10 |  |  | 2.82 | 0.00 | 0.00 | 2.12 | 0.70 |
| 5.04 | 221.82 | 0.248 |  |  |  |  |  |
| TR-7 |  |  | 2.82 | 0.00 | 0.00 | 1.67 | 1.14 |
| 0.08 | 4.90 | 0.405 |  |  |  |  |  |
| TR-6 |  |  | 2.82 | 0.00 | 0.00 | 1.57 | 1.25 |
| 0.05 | 4.42 | 0.443 |  |  |  |  |  |
| TR-5 |  |  | 2.82 | 0.00 | 0.00 | 1.81 | 1.01 |
| 0.38 | 17.25 | 0.359 |  |  |  |  |  |
| TR-4 |  |  | 2.82 | 0.00 | 0.00 | 1.65 | 1.16 |
| 0.14 | 8.91 | 0.413 |  |  |  |  |  |
| TR-12 |  |  | 2.82 | 0.00 | 0.00 | 1.66 | 1.16 |
| 0.15 | 9.32 | 0.411 |  |  |  |  |  |
| TR-20 |  |  | 2.82 | 0.00 | 0.00 | 1.79 | 1.03 |
| 0.65 | 31.58 | 0.365 |  |  |  |  |  |
| EX-4A |  |  | 2.82 | 0.00 | 0.00 | 2.01 | 0.80 |
| 0.96 | 49.54 | 0.285 |  |  |  |  |  |
| EX-5 |  |  | 2.82 | 0.00 | 0.00 | 1.97 | 0.85 |
| 0.60 | 31.56 | 0.300 |  |  |  |  |  |

*******************
Node Depth Summary *******************

| Node | Type | Average Depth Feet | Maximum Depth Feet | Maximum HGL Feet | Time <br> Occ <br> days | of Max rrence hr :min | Reported Max Depth Feet |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| JEX-10 | JUNCTION | 0.42 | 1.58 | 7149.58 | 0 | 00:45 | 1.58 |
| JEX-13 | JUNCTION | 0.33 | 1.25 | 7071.25 | 0 | 00:45 | 1.24 |
| DP4 | OUTFALL | 0.00 | 0.00 | 6998.00 | 0 | 00:00 | 0.00 |
| DP6 | OUTFALL | 0.00 | 0.00 | 7026.00 | 0 | 00:00 | 0.00 |
| DP7 | OUTFALL | 0.43 | 1.42 | 7017.42 | 0 | 00:47 | 1.38 |
| DP56 | OUTFALL | 0.34 | 1.08 | 7009.08 | 0 | 01:11 | 1.08 |
| Out6 | OUTFALL | 0.00 | 0.00 | 7270.00 | 0 | 00:00 | 0.00 |
| Out7 | OUTFALL | 0.00 | 0.00 | 7246.00 | 0 | 00:00 | 0.00 |
| Out8 | OUTFALL | 0.00 | 0.00 | 7230.00 | 0 | 00:00 | 0.00 |
| Out9 | OUTFALL | 0.00 | 0.00 | 7190.00 | 0 | 00:00 | 0.00 |
| Out10 | OUTFALL | 0.00 | 0.00 | 7250.00 | 0 | 00:00 | 0.00 |
| Out11 | OUTFALL | 0.00 | 0.00 | 7228.00 | 0 | 00:00 | 0.00 |


| DPEX-4A | OUTFALL | 0.00 | 0.00 | 7001.00 | 0 | $00: 00$ | 0.00 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| DPEX-5 | OUTFALL | 0.00 | 0.00 | 7144.00 | 0 | $00: 00$ | 0.00 |

Node Inflow Summary
$* * * * * * * * * * * * * * * * * * *$

| Total | Flow |  | Maximum | Maximum |  | Lateral |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |
|  |  |  | Lateral | Total | Time of Max | Inflow |
| Inflow | Balance |  |  |  |  |  |
|  |  |  | Inflow | Inflow | Occurrence | Volume |
| Volume | Error |  |  |  |  |  |
| Node |  | Type | CFS | CFS | days hr :min | 10^6 gal |
| gal | Percent |  |  |  |  |  |


| JEX-10 |  | JUNCTION | 221.82 | 221.82 | 0 | 00:45 | 5.04 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 5.04 | 0.000 |  |  |  |  |  |  |
| JEX-13 |  | JUNCTION | 85.43 | 85.43 | 0 | 00:45 | 2.15 |
| 2.15 | 0.000 |  |  |  |  |  |  |
| DP4 |  | OUTFALL | 106.53 | 106.53 | 0 | 00:45 | 2.86 |
| 2.86 | 0.000 |  |  |  |  |  |  |
| DP6 |  | OUTFALL | 124.02 | 124.02 | 0 | 00:45 | 3.13 |
| 3.13 | 0.000 |  |  |  |  |  |  |
| DP7 |  | OUTFALL | 116.83 | 258.75 | 0 | 00:47 | 3.1 |
| 8.16 | 0.000 |  |  |  |  |  |  |
| DP56 |  | OUTFALL | 129.43 | 160.10 | 0 | 01:05 | 3.84 |
| 6 | 0.000 |  |  |  |  |  |  |
| Out6 |  | OUTFALL | 9.32 | 9.32 | 0 | 00:50 | 0.148 |
| 0.148 | 0.000 |  |  |  |  |  |  |
| Out7 |  | OUTFALL | 31.58 | 31.58 | 0 | 00:45 | 0.648 |
| 0.648 | 0.000 |  |  |  |  |  |  |
| Out8 |  | OUTFALL | 17.25 | 17.25 | 0 | 00:45 | 0.376 |
| 0.376 | 0.000 |  |  |  |  |  |  |
| Out9 |  | OUTFALL | 4.90 | 4.90 | 0 | 00:50 | 0.0807 |
| 0.0807 | 0.000 |  |  |  |  |  |  |
| Out10 |  | OUTFALL | 8.91 | 8.91 | 0 | 00:50 | 0.139 |
| 0.139 | 0.000 |  |  |  |  |  |  |
| Out11 |  | OUTFALL | 4.42 | 4.42 | 0 | 00:45 | 0.0509 |
| 0.0509 | 0.000 |  |  |  |  |  |  |
| DPEX-4A |  | OUTFALL | 49.54 | 49.54 | 0 | 00:45 | 0.964 |
| 0.964 | 0.000 |  |  |  |  |  |  |
| DPEX-5 |  | OUTFALL | 31.56 | 31.56 | 0 | 00:45 | 0.603 |
| 0.603 | 0.000 |  |  |  |  |  |  |

```
*********************
```

Node Flooding Summary
*********************

No nodes were flooded.

## ***********************

Outfall Loading Summary
***********************

| Outfall Node | Flow <br> Freq <br> Pcnt | $\begin{aligned} & \text { Avg } \\ & \text { Flow } \end{aligned}$ CFS | Max Flow CFS | Total Volume 10^6 gal |
| :---: | :---: | :---: | :---: | :---: |
| DP4 | 92.55 | 19.10 | 106.53 | 2.856 |
| DP6 | 98.59 | 19.66 | 124.02 | 3.131 |
| DP7 | 98.59 | 51.21 | 258.75 | 8.157 |
| DP56 | 98.59 | 37.64 | 160.10 | 5.996 |
| Out6 | 36.90 | 2.48 | 9.32 | 0.148 |
| Out7 | 49.14 | 8.16 | 31.58 | 0.648 |
| Out8 | 42.15 | 5.53 | 17.25 | 0.376 |
| Out9 | 37.27 | 1.34 | 4.90 | 0.081 |
| Out10 | 36.62 | 2.35 | 8.91 | 0.139 |
| Out11 | 34.56 | 0.91 | 4.42 | 0.051 |
| DPEX-4A | 62.08 | 9.61 | 49.54 | 0.964 |
| DPEX-5 | 53.80 | 6.93 | 31.56 | 0.603 |
| System | 61.74 | 164.92 | 765.76 | 23.149 |



No conduits were surcharged.

Analysis begun on: Wed May 25 09:42:25 2022
Analysis ended on: Wed May 25 09:42:25 2022
Total elapsed time: < 1 sec

## STERLING RANCH EAST PRELIMINARY PLAN NO. 1



```
Need to provide
SWMM Input
information. Include
calculations for %
impervious, C-values
& time of cocentration.
```

STERLING RANCH EAST PRELIMINARY PLAN NO. 1 (5yr. Event)
Can Ac-ft be
Subcatchment Runoff Summary
used?

| Subcatchment | Total Precip in | Total <br> Runon <br> in | Total <br> Evap in | Total Infil in | Total <br> Runoff <br> in | Total <br> Runoff $10^{\wedge} 6 \mathrm{gal}$ | Peak <br> Runoff <br> CFS | Runoff Coeff |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| EF-A | 1.68 | 0.00 | 0.00 | 1.30 | 0.38 | 0.08 | 7.24 | 0.224 |
| EX10A | 1.68 | 0.00 | 0.00 | 1.53 | 0.15 | 0.24 | 17.80 | 0.088 |
| P1-A | 1.68 | 0.00 | 0.00 | 1.43 | 0.24 | 0.08 | 6.19 | 0.144 |
| P1-A1 | 1.68 | 0.00 | 0.00 | 0.86 | 0.79 | 0.11 | 10.79 | 0.473 |
| P1-A2 | 1.68 | 0.00 | 0.00 | 0.88 | 0.77 | 0.13 | 11.96 | 0.457 |
| P1-A3 | 1.68 | 0.00 | 0.00 | 0.75 | 0.90 | 0.04 | 4.61 | 0.534 |
| P1-A4 | 1.68 | 0.00 | 0.00 | 0.76 | 0.89 | 0.05 | 5.08 | 0.532 |
| P1-A5 | 1.68 | 0.00 | 0.00 | 0.85 | 0.80 | 0.09 | 9.64 | 0.479 |
| P1-A6 | 1.68 | 0.00 | 0.00 | 0.76 | 0.89 | 0.07 | 7.00 | 0.529 |
| P1-B | 1.68 | 0.00 | 0.00 | 1.00 | 0.65 | 0.63 | 55.37 | 0.387 |
| P1-C | 1.68 | 0.00 | 0.00 | 0.95 | 0.71 | 0.21 | 21.19 | 0.420 |
| P1-D | 1.68 | 0.00 | 0.00 | 1.00 | 0.66 | 0.56 | 52.52 | 0.392 |
| P1-E | 1.68 | 0.00 | 0.00 | 1.04 | 0.61 | 0.87 | 83.14 | 0.365 |
| P1-F | 1.68 | 0.00 | 0.00 | 1.12 | 0.54 | 1.12 | 110.51 | 0.321 |
| P2-A | 1.68 | 0.00 | 0.00 | 1.38 | 0.30 | 0.13 | 10.28 | 0.178 |
| P2-B | 1.68 | 0.00 | 0.00 | 1.01 | 0.65 | 1.04 | 90.08 | 0.385 |

Include all basins in summary table, as shown on drainage map

STERLING RANCH EAST PRELIMINARY PLAN NO. 1 (5yr. Event)

| Subcatchment | Total Precip in | Total <br> Runon in | Total <br> Evap <br> in | Total Infil in | Total <br> Runoff in | Total Runoff $10^{\wedge} 6 \mathrm{gal}$ | Peak <br> Runoff <br> CFS | Runoff <br> Coeff |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| P2-B1 | 1.68 | 0.00 | 0.00 | 0.74 | 0.91 | 0.06 | 6.56 | 0.540 |
| P2-B10 | 1.68 | 0.00 | 0.00 | 0.73 | 0.92 | 0.04 | 4.59 | 0.549 |
| P2-B2 | 1.68 | 0.00 | 0.00 | 0.74 | 0.91 | 0.05 | 4.98 | 0.540 |
| P2-B3 | 1.68 | 0.00 | 0.00 | 0.83 | 0.82 | 0.06 | 6.59 | 0.491 |
| P2-B4 | 1.68 | 0.00 | 0.00 | 0.75 | 0.90 | 0.04 | 4.16 | 0.538 |
| P2-B5 | 1.68 | 0.00 | 0.00 | 0.82 | 0.84 | 0.04 | 4.58 | 0.498 |
| P2-B6 | 1.68 | 0.00 | 0.00 | 0.73 | 0.92 | 0.03 | 2.96 | 0.547 |
| P2-B7 | 1.68 | 0.00 | 0.00 | 0.82 | 0.83 | 0.06 | 5.96 | 0.494 |
| P2-B8 | 1.68 | 0.00 | 0.00 | 0.74 | 0.92 | 0.03 | 3.21 | 0.545 |
| P2-B9 | 1.68 | 0.00 | 0.00 | 0.73 | 0.92 | 0.05 | 5.40 | 0.549 |
| P2-S 1 | 1.68 | 0.00 | 0.00 | 0.95 | 0.71 | 0.69 | 68.31 | 0.423 |
| P3-A | 1.68 | 0.00 | 0.00 | 1.00 | 0.65 | 0.93 | 82.07 | 0.387 |
| P3-C | 1.68 | 0.00 | 0.00 | 1.31 | 0.36 | 0.02 | 1.27 | 0.216 |
| P3-S2 | 1.68 | 0.00 | 0.00 | 0.92 | 0.74 | 0.24 | 24.68 | 0.439 |
| P4-A | 1.68 | 0.00 | 0.00 | 1.04 | 0.61 | 0.43 | 41.04 | 0.365 |
| P4-B | 1.68 | 0.00 | 0.00 | 1.03 | 0.63 | 0.64 | 63.26 | 0.373 |
| SC-1 | 1.68 | 0.00 | 0.00 | 1.43 | 0.25 | 0.02 | 1.78 | 0.148 |

STERLING RANCH EAST PRELIMINARY PLAN NO. 1 (5yr. Event)

| Subcatchment | Total Precip in | Total <br> Runon in | Total <br> Evap <br> in | Total Infil in | Total <br> Runoff in | Total Runoff $10^{\wedge} 6 \mathrm{gal}$ | Peak Runoff CFS | Runoff Coeff |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| SC-2 | 1.68 | 0.00 | 0.00 | 1.40 | 0.27 | 0.08 | 5.63 | 0.163 |
| SC-3 | 1.68 | 0.00 | 0.00 | 1.49 | 0.19 | 0.16 | 13.85 | 0.112 |
| SC-4 | 1.68 | 0.00 | 0.00 | 1.42 | 0.26 | 0.11 | 8.25 | 0.153 |
| TR-V | 1.68 | 0.00 | 0.00 | 1.23 | 0.44 | 0.02 | 2.29 | 0.259 |
| TR-W | 1.68 | 0.00 | 0.00 | 0.97 | 0.69 | 0.03 | 2.66 | 0.410 |

## STERLING RANCH EAST PRELIMINARY PLAN NO. 1 (5yr. Event)

Outfall Loading Summary

|  | Flow <br> Freq. <br> Pcnt. | Avg. <br> Flow <br> CFS |  | Max. <br> Flow <br> CFS |
| :--- | ---: | ---: | ---: | ---: |
| DPBGP | 46.25 | 1.54 | Total <br> Volume <br> $10 \wedge 6$ gal |  |
| EF-A-Outfall | 50.14 | 1.03 | 8.25 | 0.115 |
| EX.STKPND | 66.53 | 1.48 | 7.24 | 0.084 |
| EX-DP4 | 37.22 | 0.28 | 13.85 | 0.159 |
| EX-DP7 | 58.33 | 2.57 | 1.27 | 0.017 |
| FSD-11B | 98.19 | 7.33 | 102.33 | 1.80 |
| FSD-14A | 98.47 | 14.51 | 200.17 | 0.242 |
| FSD-14B | 97.64 | 6.72 | 96.95 | 1.0309 |
| FSD-16 | 42.78 | 25.12 | 362.95 | 3.997 |
| PNDW3 | 40.00 | 1.16 | 5.63 | 0.080 |
| SC-Outfall |  | 0.38 | 1.78 | 0.024 |

## STERLING RANCH EAST PRELIMINARY PLAN NO. 1 (5yr. Event)

Node Inflow Summary

|  | Node | Type | Maximum Lateral Inflow CFS | Maximum Total Inflow CFS | Day of Maximum Inflow | Hour of Maximum Inflow | Lateral Inflow Volume $10^{\wedge} 6 \mathrm{gal}$ | Total Inflow Volume $10^{\wedge} 6 \mathrm{gal}$ | Flow <br> Balance Error Percent |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | DP-1 | JUNCTION | 110.51 | 111.99 | 0 | 00:45 | 1.12 | 1.15 | 0.000 |
| le | DP-10-11 | JUNCTION | 90.08 | 90.08 | 0 | 00:45 | 1.04 | 1.04 | 0.000 |
| on $\longrightarrow$ | DP-12 | JUNCTION | 9.16 | 185.88 | 0 | 00:47 | 0.0862 | 2.09 | 0.000 |
|  | DP-13 | JUNCTION | 9.99 | 9.99 | 0 | 00:45 | 0.0926 | 0.0926 | 0.000 |
|  | DP-14 | JUNCTION | 63.26 | 63.26 | 0 | 00:45 | 0.635 | 0.635 | 0.000 |
|  | DP-15 | JUNCTION | 41.04 | 41.04 | 0 | 00:45 | 0.429 | 0.429 | 0.000 |
| $\searrow$ | DP-16 | JUNCTION | 0.00 | 96.75 | 0 | 00:46 | 0 | 1.06 | 0.000 |
|  | DP-17 | JUNCTION | 82.07 | 82.07 | 0 | 00:45 | 0.927 | 0.927 | 0.000 |
|  | DP-18 | JUNCTION | 24.68 | 24.68 | 0 | 00:45 | 0.238 | 0.238 | 0.000 |
|  | DP-2-3 | JUNCTION | 83.14 | 83.14 | 0 | 00:45 | 0.869 | 0.869 | 0.000 |
|  | DP-4 | JUNCTION | 0.00 | 187.03 | 0 | 00:47 | 0 | 2.03 | 0.000 |
|  | DP-5 | JUNCTION | 52.52 | 52.52 | 0 | 00:45 | 0.561 | 0.561 | 0.000 |
|  | DP-6 | JUNCTION | 16.64 | 16.64 | 0 | 00:45 | 0.161 | 0.161 | 0.000 |
|  | DP-7 | JUNCTION | 21.19 | 117.48 | 0 | 00:46 | 0.205 | 1.26 | 0.000 |
|  | DP-8 | JUNCTION | 55.37 | 55.37 | 0 | 00:45 | 0.626 | 0.626 | 0.000 |
|  | DP-9 | JUNCTION | 68.31 | 79.41 | 0 | 00:45 | 0.686 | 0.794 | -0.000 |

## STERLING RANCH EAST PRELIMINARY PLAN NO. 1 (5yr. Event)

| Node | Type | Maximum Lateral Inflow CFS | Maximum <br> Total <br> Inflow <br> CFS | Day of Maximum Inflow | Hour of Maximum Inflow | Lateral Inflow Volume $10^{\wedge} 6 \mathrm{gal}$ | Total Inflow Volume $10^{\wedge} 6 \mathrm{gal}$ | Flow <br> Balance <br> Error <br> Percent |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| DPBGP | OUTFALL | 8.25 | 8.25 | 0 | 00:45 | 0.115 | 0.115 | 0.000 |
| EF-A-Outfall | OUTFALL | 7.24 | 7.24 | 0 | 00:45 | 0.0838 | 0.0838 | 0.000 |
| EX.STKPND | OUTFALL | 13.85 | 13.85 | 0 | 00:45 | 0.159 | 0.159 | 0.000 |
| EX-DP4 | OUTFALL | 1.27 | 1.27 | 0 | 00:45 | 0.0168 | 0.0168 | 0.000 |
| EX-DP7 | OUTFALL | 17.80 | 17.80 | 0 | 00:45 | 0.242 | 0.242 | 0.000 |
| FSD-11B | OUTFALL | 0.00 | 102.33 | 0 | 00:46 | 0 | 1.16 | 0.000 |
| FSD-14A | OUTFALL | 10.28 | 200.17 | 0 | 00:48 | 0.135 | 2.31 | 0.000 |
| FSD-14B | OUTFALL | 0.00 | 96.95 | 0 | 00:46 | 0 | 1.06 | 0.000 |
| FSD-16 | OUTFALL | 6.19 | 362.95 | 0 | 00:46 | 0.0832 | 4 | 0.000 |
| JOS-TR | JUNCTION | 2.29 | 2.29 | 0 | 00:45 | 0.0248 | 0.0248 | 0.000 |
| JP1-3 | JUNCTION | 2.66 | 190.10 | 0 | 00:46 | 0.0261 | 2.04 | 0.000 |
| JP1-A12 | JUNCTION | 22.75 | 22.75 | 0 | 00:45 | 0.241 | 0.241 | 0.000 |
| JP1-A34 | JUNCTION | 9.69 | 30.20 | 0 | 00:46 | 0.0924 | 0.333 | 0.000 |
| JP2-B12 | JUNCTION | 11.54 | 11.54 | 0 | 00:45 | 0.108 | 0.108 | 0.000 |
| JP2-B34 | JUNCTION | 10.76 | 87.69 | 0 | 00:46 | 0.102 | 0.894 | 0.000 |
| JP2-B56 | JUNCTION | 7.54 | 179.56 | 0 | 00:46 | 0.0706 | 2 | 0.000 |
| PNDW3 | OUTFALL | 5.63 | 5.63 | 0 | 00:45 | 0.0804 | 0.0804 | 0.000 |

STERLING RANCH EAST PRELIMINARY PLAN NO. 1 (5yr. Event)

|  |  | Maximum <br> Lateral <br> Inflow <br> CFS | Maximum <br> Total <br> Inflow <br> CFS | Day of <br> Maximum <br> Inflow | Hour of <br> Maximum <br> Inflow | Lateral <br> Inflow <br> Volume <br> $10^{\wedge} 6 \mathrm{gal}$ | Total <br> Inflow <br> Volume <br> $10^{\wedge} 6 \mathrm{gal}$ | Flow <br> Balance <br> Error <br> Percent |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| SC-Outfall | Type | OUTFALL | 1.78 | 1.78 |  | 0 | $00: 45$ | 0.0243 |
| 0 |  |  | 0.0243 | 0.000 |  |  |  |  |

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
```

```
STERLING RANCH EAST PRELIMINARY PLAN NO. 1
PRELIMINARY DRAINAGE REPORT
DEVELOPED DRAINAGE (5 yr.)
```

** * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.

```
***********************************************************
```

*****************
Analysis Options
*****************
Flow Units ................. CFS
Process Models:
Rainfall/Runoff ......... YES
RDII ....................... NO
Snowmelt .................. NO
Groundwater .............. NO
Flow Routing ............. YES
Ponding Allowed ......... NO
Water Quality ........... NO
Infiltration Method ....... HORTON
Flow Routing Method ....... KINWAVE
Starting Date ............. 04/18/2022 00:00:00
Ending Date ............... 04/18/2022 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step .......... 00:15:00
Wet Time Step ............. 00:05:00
Dry Time Step ............. 01:00:00
Routing Time Step ......... 30.00 sec
**************************

| Volume acre-feet | Depth inches |
| :---: | :---: |
| 88.931 | 1.679 |
| 0.000 | 0.000 |
| 59.490 | 1.123 |
| 28.497 | 0.538 |
| 1.207 | 0.023 |
| -0.296 |  |


| Flow Routing Continuity | acre-feet | 10^6 gal |
| :---: | :---: | :---: |
| $* * * * * * * * * * * * * * * * * * * * * * * * * *$ | 0.000 | 0.000 |
| Wet Weather Inflow | 28.496 | 9.286 |
| Groundwater Inflow | 0.000 | 0.000 |
| RDII Inflow | 0.000 | 0.000 |
| External Inflow | 0.000 | 0.000 |
| External Outflow | 28.384 | 9.249 |
| Flooding Loss | 0.000 | 0.000 |
| Evaporation Loss | 0.000 | 0.000 |
| Exfiltration Loss | 0.000 | 0.000 |
| Initial Stored Volume | 0.000 | 0.000 |
| Final Stored Volume | 0.005 | 0.002 |
| Continuity Error (\%) | 0.376 |  |

$* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * ~$
Highest Flow Instability Indexes
$* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * ~$
****************************
Subcatchment Runoff Summary
****************************

| Total | Peak | Runoff | Total | Total | Total | Total | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Pre | Runon | Evap | Infil | Runoff |
| Runoff | Runoff | Coeff |  |  |  |  |  |
| Subcat | chment |  | in | in | in | in | in |
| 10^6 gal | CF | S |  |  |  |  |  |


| P2-B10 |  |  | 1.68 | 0.00 | 0.00 | 0.73 | 0.92 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0.04 | 4.59 | 0.549 |  |  |  |  |  |
| P2-B9 |  |  | 1.68 | 0.00 | 0.00 | 0.73 | 0.92 |
| 0.05 | 5.40 | 0.549 |  |  |  |  |  |
| P3-S2 |  |  | 1.68 | 0.00 | 0.00 | 0.92 | 0.74 |
| 0.24 | 24.68 | 0.439 |  |  |  |  |  |
| P3-A |  |  | 1.68 | 0.00 | 0.00 | 1.00 | 0.65 |
| 0.93 | 82.07 | 0.387 |  |  |  |  |  |
| P3-C |  |  | 1.68 | 0.00 | 0.00 | 1.31 | 0.36 |
| 0.02 | 1.27 | 0.216 |  |  |  |  |  |
| EF-A |  |  | 1.68 | 0.00 | 0.00 | 1.30 | 0.38 |
| 0.08 | 7.24 | 0.224 |  |  |  |  |  |
| P2-B8 |  |  | 1.68 | 0.00 | 0.00 | 0.74 | 0.92 |
| 0.03 | 3.21 | 0.545 |  |  |  |  |  |
| P2-B7 |  |  | 1.68 | 0.00 | 0.00 | 0.82 | 0.83 |
| 0.06 | 5.96 | 0.494 |  |  |  |  |  |
| P2-B5 |  |  | 1.68 | 0.00 | 0.00 | 0.82 | 0.84 |
| 0.04 | 4.58 | 0.498 |  |  |  |  |  |
| P2-B6 |  |  | 1.68 | 0.00 | 0.00 | 0.73 | 0.92 |
| 0.03 | 2.96 | 0.547 |  |  |  |  |  |
| P2-A |  |  | 1.68 | 0.00 | 0.00 | 1.38 | 0.30 |
| 0.13 | 10.28 | 0.178 |  |  |  |  |  |
| P2-B3 |  |  | 1.68 | 0.00 | 0.00 | 0.83 | 0.82 |
| 0.06 | 6.59 | 0.491 |  |  |  |  |  |
| P2-B4 |  |  | 1.68 | 0.00 | 0.00 | 0.75 | 0.90 |
| 0.04 | 4.16 | 0.538 |  |  |  |  |  |
| P4-A |  |  | 1.68 | 0.00 | 0.00 | 1.04 | 0.61 |
| 0.43 | 41.04 | 0.365 |  |  |  |  |  |
| P2-B |  |  | 1.68 | 0.00 | 0.00 | 1.01 | 0.65 |
| 1.04 | 90.08 | 0.385 |  |  |  |  |  |
| P2-S1 |  |  | 1.68 | 0.00 | 0.00 | 0.95 | 0.71 |
| 0.69 | 68.31 | 0.423 |  |  |  |  |  |
| P2-B1 |  |  | 1.68 | 0.00 | 0.00 | 0.74 | 0.91 |
| 0.06 | 6.56 | 0.540 |  |  |  |  |  |
| P2-B2 |  |  | 1.68 | 0.00 | 0.00 | 0.74 | 0.91 |
| 0.05 | 4.98 | 0.540 |  |  |  |  |  |
| P4-B |  |  | 1.68 | 0.00 | 0.00 | 1.03 | 0.63 |
| 0.64 | 63.26 | 0.373 |  |  |  |  |  |
| P1-A6 |  |  | 1.68 | 0.00 | 0.00 | 0.76 | 0.89 |
| 0.07 | 7.00 | 0.529 |  |  |  |  |  |
| P1-A5 |  |  | 1.68 | 0.00 | 0.00 | 0.85 | 0.80 |
| 0.09 | 9.64 | 0.479 |  |  |  |  |  |
| P1-A4 |  |  | 1.68 | 0.00 | 0.00 | 0.76 | 0.89 |
| 0.05 | 5.08 | 0.532 |  |  |  |  |  |
| P1-A |  |  | 1.68 | 0.00 | 0.00 | 1.43 | 0.24 |
| 0.08 | 6.19 | 0.144 |  |  |  |  |  |
| P1-A1 |  |  | 1.68 | 0.00 | 0.00 | 0.86 | 0.79 |
| 0.11 | 10.79 | 0.473 |  |  |  |  |  |


| P1-A2 |  |  | 1.68 | 0.00 | 0.00 | 0.88 | 0.77 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0.13 | 11.96 | 0.457 |  |  |  |  |  |
| P1-A3 |  |  | 1.68 | 0.00 | 0.00 | 0.75 | 0.90 |
| 0.04 | 4.61 | 0.534 |  |  |  |  |  |
| P1-C |  |  | 1.68 | 0.00 | 0.00 | 0.95 | 0.71 |
| 0.21 | 21.19 | 0.420 |  |  |  |  |  |
| P1-B |  |  | 1.68 | 0.00 | 0.00 | 1.00 | 0.65 |
| 0.63 | 55.37 | 0.387 |  |  |  |  |  |
| P1-D |  |  | 1.68 | 0.00 | 0.00 | 1.00 | 0.66 |
| 0.56 | 52.52 | 0.392 |  |  |  |  |  |
| P1-E |  |  | 1.68 | 0.00 | 0.00 | 1.04 | 0.61 |
| 0.87 | 83.14 | 0.365 |  |  |  |  |  |
| TR-W |  |  | 1.68 | 0.00 | 0.00 | 0.97 | 0.69 |
| 0.03 | 2.66 | 0.410 |  |  |  |  |  |
| TR-V |  |  | 1.68 | 0.00 | 0.00 | 1.23 | 0.44 |
| 0.02 | 2.29 | 0.259 |  |  |  |  |  |
| P1-F |  |  | 1.68 | 0.00 | 0.00 | 1.12 | 0.54 |
| 1.12 | 110.51 | 0.321 |  |  |  |  |  |
| SC-2 |  |  | 1.68 | 0.00 | 0.00 | 1.40 | 0.27 |
| 0.08 | 5.63 | 0.163 |  |  |  |  |  |
| SC-3 |  |  | 1.68 | 0.00 | 0.00 | 1.49 | 0.19 |
| 0.16 | 13.85 | 0.112 |  |  |  |  |  |
| SC-4 |  |  | 1.68 | 0.00 | 0.00 | 1.42 | 0.26 |
| 0.11 | 8.25 | 0.153 |  |  |  |  |  |
| SC-1 |  |  | 1.68 | 0.00 | 0.00 | 1.43 | 0.25 |
| 0.02 | 1.78 | 0.148 |  |  |  |  |  |
| EX10A |  |  | 1.68 | 0.00 | 0.00 | 1.53 | 0.15 |
| 0.24 | 17.80 | 0.088 |  |  |  |  |  |

Node Depth Summary
$* * * * * * * * * * * * * * * * * *$

| Node | Type | Average Depth Feet | Maximum Depth Feet | Maximum HGL Feet | Time of Max Occurrence days hr:min | Reported Max Depth Feet |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| DP-14 | JUNCTION | 0.26 | 1.80 | 7081.80 | 0 00:45 | 1.75 |
| DP-10-11 | Junction | 0.39 | 2.59 | 7048.59 | 0 00:45 | 2.48 |
| DP-12 | JUNCTION | 1.93 | 4.28 | 7036.28 | 0 00:47 | 4.04 |
| DP-13 | JUNCTION | 0.11 | 0.81 | 7011.81 | 0 00:45 | 0.79 |
| JP2-B12 | JUNCTION | 0.12 | 0.88 | 7072.88 | 0 00:45 | 0.86 |
| DP-9 | JUNCTION | 0.63 | 1.90 | 7068.90 | 0 00:45 | 1.84 |
| JP2-B34 | JUNCTION | 1.27 | 2.87 | 7057.87 | 0 00:46 | 2.76 |
| JP2-B56 | JUNCTION | 1.79 | 3.56 | 7047.56 | 0 00:45 | 3.45 |
| JP1-A12 | JUNCTION | 0.21 | 1.35 | 7105.35 | 0 00:45 | 1.31 |
| JP1-A34 | JUNCTION | 0.22 | 1.42 | 7099.42 | 0 00:46 | 1.34 |
| DP-7 | JUNCTION | 10.24 | 14.00 | 7110.00 | 0 00:46 | 11. |


| DP-8 | JUNCTION | 0.31 | 1.93 | 7097.93 | 0 | $00: 45$ | 1.88 |
| :--- | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| DP-4 | JUNCTION | 22.42 | 24.84 | 7120.84 | 0 | $00: 47$ | 24.56 |
| JP1-3 | JUNCTION | 10.32 | 12.10 | 7140.10 | 0 | $00: 46$ | 11.93 |
| DP-1 | JUNCTION | 10.06 | 10.35 | 7165.35 | 0 | $00: 48$ | 10.29 |
| JOS-TR | JUNCTION | 0.05 | 0.38 | 7190.38 | 0 | $00: 45$ | 0.37 |
| DP-17 | JUNCTION | 0.32 | 1.98 | 7031.98 | 0 | $00: 45$ | 1.91 |
| DP-6 | JUNCTION | 0.18 | 1.36 | 7099.36 | 0 | $00: 45$ | 1.32 |
| DP-5 | JUNCTION | 0.23 | 1.47 | 7111.47 | 0 | $00: 45$ | 1.43 |
| DP-2-3 | JUNCTION | 0.32 | 2.18 | 7134.18 | 0 | $00: 45$ | 2.12 |
| DP-15 | JUNCTION | 0.22 | 1.44 | 7061.44 | 0 | $00: 45$ | 1.40 |
| DP-18 | JUNCTION | 0.16 | 1.17 | 7013.17 | 0 | $00: 45$ | 1.14 |
| DP-16 | JUNCTION | 2.26 | 3.73 | 7061.73 | 0 | $00: 47$ | 3.53 |
| EF-A-Outfall | OUTFALL | 0.00 | 0.00 | 0.00 | 0 | $00: 00$ | 0.00 |
| EX-DP4 | OUTFALL | 0.00 | 0.00 | 0.00 | 0 | $00: 00$ | 0.00 |
| FSD-11B | OUTFALL | 5.32 | 6.94 | 7016.94 | 0 | $00: 46$ | 6.78 |
| FSD-14A | OUTFALL | 10.44 | 12.90 | 7018.90 | 0 | $00: 48$ | 12.45 |
| FSD-14B | OUTFALL | 0.31 | 2.05 | 7058.05 | 0 | $00: 46$ | 1.90 |
| FSD-16 | OUTFALL | 0.44 | 3.38 | 7098.38 | 0 | $00: 46$ | 3.00 |
| PNDW3 | OUTFALL | 0.00 | 0.00 | 7001.00 | 0 | $00: 00$ | 0.00 |
| EX.STKPND | OUTFALL | 0.00 | 0.00 | 7030.00 | 0 | $00: 00$ | 0.00 |
| DPBGP | OUTFALL | 0.00 | 0.00 | 7100.00 | 0 | $00: 00$ | 0.00 |
| EX-DP7 | OUTFALL | 0.00 | 0.00 | 0.00 | 0 | $00: 00$ | 0.00 |
| SC-Outfall | OUTFALL | 0.00 | 0.00 | 0.00 | 0 | $00: 00$ | 0.00 |

*******************
Node Inflow Summary *******************

## -------------

| Total | Flow |  | Maximum | Maximum |  | Lateral |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Lateral | Total | Time of Max | Inflow |  |
| Inflow | Balance |  |  |  |  |  |  |
|  |  |  | Inflow | Inflow | Occurrence | Volume |  |
| Volume | Error |  |  |  |  |  |  |
| Node |  | Type | CFS | CFS | days hr:min | 10^6 gal | 10^6 |
| gal | Percent |  |  |  |  |  |  |


| DP-14 <br> 0.635 <br> DP-10-11 | 0.000 | JUNCTION | 63.26 | 63.26 | 0 | $00: 45$ | 0.635 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 1.04 <br> DP-12 | 0.000 | JUNCTION | 90.08 | 90.08 | 0 | $00: 45$ | 1.04 |
| 2.09 <br> DP-13 | 0.000 |  | JUNCTION | 9.16 | 185.88 | 0 | $00: 47$ |


| 0.0926 | 0.000 |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| JP2-B12 |  | JUNCTION | 11.54 | 11.54 | 0 | 00:45 | 0.108 |
| 0.108 | 0.000 |  |  |  |  |  |  |
| DP-9 |  | JUNCTION | 68.31 | 79.41 | 0 | 00:45 | 0.686 |
| 0.794 | -0.000 |  |  |  |  |  |  |
| JP2-B34 |  | JUNCTION | 10.76 | 87.69 | 0 | 00:46 | 0.102 |
| 0.894 | 0.000 |  |  |  |  |  |  |
| JP2-B56 |  | JUNCTION | 7.54 | 179.56 | 0 | 00:46 | 0.0706 |
| 20 | . 000 |  |  |  |  |  |  |
| JP1-A12 |  | JUNCTION | 22.75 | 22.75 | 0 | 00:45 | 0.241 |
| 0.241 | 0.000 |  |  |  |  |  |  |
| JP1-A34 |  | JUNCTION | 9.69 | 30.20 | 0 | 00:46 | 0.0924 |
| 0.333 | 0.000 |  |  |  |  |  |  |
| DP-7 |  | JUNCTION | 21.19 | 117.48 | 0 | 00:46 | 0.205 |
| 1.26 | 0.000 |  |  |  |  |  |  |
| DP-8 |  | JUNCTION | 55.37 | 55.37 | 0 | 00:45 | 0.626 |
| 0.626 | 0.000 |  |  |  |  |  |  |
| DP-4 |  | JUNCTION | 0.00 | 187.03 | 0 | 00:47 | 0 |
| 2.03 | 0.000 |  |  |  |  |  |  |
| JP1-3 |  | JUNCTION | 2.66 | 190.10 | 0 | 00:46 | 0.0261 |
| 2.04 | 0.000 |  |  |  |  |  |  |
| DP-1 |  | JUNCTION | 110.51 | 111.99 | 0 | 00:45 | 1.12 |
| 1.15 | 0.000 |  |  |  |  |  |  |
| JOS-TR |  | JUNCTION | 2.29 | 2.29 | 0 | 00:45 | 0.0248 |
| 0.0248 | 0.000 |  |  |  |  |  |  |
| DP-17 |  | JUNCTION | 82.07 | 82.07 | 0 | 00:45 | 0.927 |
| 0.927 | 0.000 |  |  |  |  |  |  |
| DP-6 |  | JUNCTION | 16.64 | 16.64 | 0 | 00:45 | 0.161 |
| 0.161 | 0.000 |  |  |  |  |  |  |
| DP-5 |  | JUNCTION | 52.52 | 52.52 | 0 | 00:45 | 0.561 |
| 0.561 | 0.000 |  |  |  |  |  |  |
| DP-2-3 |  | JUNCTION | 83.14 | 83.14 | 0 | 00:45 | 0.869 |
| 0.869 | 0.000 |  |  |  |  |  |  |
| DP-15 |  | JUNCTION | 41.04 | 41.04 | 0 | 00:45 | 0.429 |
| 0.429 | 0.000 |  |  |  |  |  |  |
| DP-18 |  | JUNCTION | 24.68 | 24.68 | 0 | 00:45 | 0.238 |
| 0.238 | 0.000 |  |  |  |  |  |  |
| DP-16 |  | JUNCTION | 0.00 | 96.75 | 0 | 00:46 | 0 |
| 1.06 | 0.000 |  |  |  |  |  |  |
| EF-A-Out | fall | OUTFALL | 7.24 | 7.24 | 0 | 00:45 | 0.0838 |
| 0.0838 | 0.000 |  |  |  |  |  |  |
| EX-DP4 |  | OUTFALL | 1.27 | 1.27 | 0 | 00:45 | 0.0168 |
| 0.0168 | 0.000 |  |  |  |  |  |  |
| FSD-11B |  | OUTFALL | 0.00 | 102.33 | 0 | 00:46 | 0 |
| 1.16 | 0.000 |  |  |  |  |  |  |
| FSD-14A |  | OUTFALL | 10.28 | 200.17 | 0 | 00:48 | 0.135 |
| 2.31 | 0.000 |  |  |  |  |  |  |
| FSD-14B |  | OUTFALL | 0.00 | 96.95 | 0 | 00:46 | 0 |
| 1.06 | 0.000 |  |  |  |  |  |  |
| FSD-16 |  | OUTFALL | 6.19 | 362.95 | 0 | 00:46 | 0.0832 |


| PNDW3 0.000 |  | OUTFALL | 5.63 | 5.63 | 0 | 00:45 | 0.0804 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |
| 0.0804 | 0.000 |  |  |  |  |  |  |
| EX.STKPND |  | OUTFALL | 13.85 | 13.85 | 0 | 00:45 | 0.159 |
| 0.159 | 0.000 |  |  |  |  |  |  |
| DPBGP |  | OUTFALL | 8.25 | 8.25 | 0 | 00:45 | 0.115 |
| 0.115 | 0.000 |  |  |  |  |  |  |
| EX-DP7 |  | OUTFALL | 17.80 | 17.80 | 0 | 00:45 | 0.242 |
| 0.242 | 0.000 |  |  |  |  |  |  |
| SC-Outfall |  | OUTFALL | 1.78 | 1.78 | 0 | 00:45 | 0.0243 |
| 0.0243 | 0.000 |  |  |  |  |  |  |

$* * * * * * * * * * * * * * * * * * * * *$
Node Flooding Summary
*********************

Flooding refers to all water that overflows a node, whether it ponds or not.

***********************
Outfall Loading Summary
************************

| Outfall Node | Flow <br> Freq <br> Pcnt | $\begin{aligned} & \text { Avg } \\ & \text { Flow } \end{aligned}$ CFS | Max <br> Flow <br> CFS | Total Volume 10^6 gal |
| :---: | :---: | :---: | :---: | :---: |
| EF-A-Outfall | 50.14 | 1.03 | 7.24 | 0.084 |
| EX-DP4 | 37.22 | 0.28 | 1.27 | 0.017 |
| FSD-11B | 98.19 | 7.33 | 102.33 | 1.163 |
| FSD-14A | 98.47 | 14.51 | 200.17 | 2.309 |
| FSD-14B | 97.64 | 6.72 | 96.95 | 1.060 |
| FSD-16 | 98.47 | 25.12 | 362.95 | 3.997 |
| PNDW3 | 42.78 | 1.16 | 5.63 | 0.080 |
| EX.STKPND | 66.53 | 1.48 | 13.85 | 0.159 |
| DPBGP | 46.25 | 1.54 | 8.25 | 0.115 |
| EX-DP7 | 58.33 | 2.57 | 17.80 | 0.242 |
| SC-Outfall | 40.00 | 0.38 | 1.78 | 0.024 |
| System | 66.73 | 62.11 | 802.87 | 9.249 |


| Link Flow Summary <br> ********************* |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Link | Type | Maximum \|Flow| CFS | Time Occu days | of Max rrence hr:min | Maximum <br> \|Veloc| ft/sec | $\begin{aligned} & \text { Max/ } \\ & \text { Full } \\ & \text { Flow } \end{aligned}$ |  |
| CP4-B | CONDUIT | 59.07 | 0 | 00:47 | 11.86 | 0.39 | 0.43 |
| C2 | CONDUIT | 9.81 | 0 | 00:46 | 7.28 | 0.22 | 0.32 |
| C3 | CONDUIT | 11.36 | 0 | 00:46 | 8.71 | 0.40 | 0.44 |
| C4 | CONDUIT | 77.45 | 0 | 00:46 | 13.62 | 0.45 | 0.47 |
| C5 | CONDUIT | 86.38 | 0 | 00:46 | 13.95 | 0.50 | 0.50 |
| C6 | CONDUIT | 178.08 | 0 | 00:47 | 16.02 | 0.60 | 0.56 |
| C7 | CONDUIT | 183.66 | 0 | 00:48 | 15.88 | 0.64 | 0.58 |
| C8 | CONDUIT | 88.93 | 0 | 00:45 | 11.87 | 0.88 | 0.74 |
| C9 | CONDUIT | 21.50 | 0 | 00:47 | 7.45 | 0.39 | 0.44 |
| C10 | CONDUIT | 30.13 | 0 | 00:46 | 8.24 | 0.35 | 0.41 |
| C11 | CONDUIT | 120.22 | 0 | 00:46 | 10.86 | 1.03 | 0.90 |
| C12 | CONDUIT | 54.72 | 0 | 00:46 | 9.24 | 0.47 | 0.48 |
| C13 | CONDUIT | 1.96 | 0 | 00:48 | 5.85 | 0.07 | 0.17 |
| C14 | CONDUIT | 107.12 | 0 | 00:46 | 14.03 | 0.37 | 0.42 |
| C15 | CONDUIT | 187.03 | 0 | 00:47 | 15.28 | 0.53 | 0.52 |
| C16 | CONDUIT | 187.29 | 0 | 00:47 | 15.11 | 0.53 | 0.52 |
| CP3-A | CONDUIT | 79.26 | 0 | 00:46 | 13.37 | 0.47 | 0.48 |
| C17 | CONDUIT | 51.83 | 0 | 00:46 | 12.57 | 0.29 | 0.37 |
| C18 | CONDUIT | 16.16 | 0 | 00:46 | 6.18 | 0.56 | 0.53 |
| C19 | CONDUIT | 81.88 | 0 | 00:46 | 11.90 | 0.57 | 0.54 |
| C20 | CONDUIT | 40.35 | 0 | 00:45 | 11.06 | 0.35 | 0.41 |
| C21 | CONDUIT | 24.23 | 0 | 00:45 | 9.73 | 0.31 | 0.39 |
| C22 | CONDUIT | 96.95 | 0 | 00:46 | 13.72 | 0.43 | 0.46 |

## STERLING RANCH EAST PRELIMINARY PLAN NO. 1 (100yr. Event)

Subcatchment Runoff Summary

| Subcatchment | Total Precip in | Total <br> Runon <br> in | Total <br> Evap <br> in | Total Infil in | Total <br> Runoff in | Total Runoff $10^{\wedge} 6 \mathrm{gal}$ | Peak <br> Runoff <br> CFS | Runoff Coeff |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| EF-A | 2.82 | 0.00 | 0.00 | 1.53 | 1.29 | 0.29 | 19.75 | 0.458 |
| EX10A | 2.82 | 0.00 | 0.00 | 2.02 | 0.80 | 1.32 | 50.17 | 0.285 |
| P1-A | 2.82 | 0.00 | 0.00 | 1.75 | 1.07 | 0.37 | 18.97 | 0.380 |
| P1-A1 | 2.82 | 0.00 | 0.00 | 1.05 | 1.75 | 0.24 | 20.94 | 0.621 |
| P1-A2 | 2.82 | 0.00 | 0.00 | 1.15 | 1.65 | 0.29 | 23.30 | 0.584 |
| P1-A3 | 2.82 | 0.00 | 0.00 | 0.88 | 1.92 | 0.09 | 9.12 | 0.682 |
| P1-A4 | 2.82 | 0.00 | 0.00 | 0.88 | 1.91 | 0.10 | 10.01 | 0.679 |
| P1-A5 | 2.82 | 0.00 | 0.00 | 1.02 | 1.79 | 0.21 | 18.89 | 0.633 |
| P1-A6 | 2.82 | 0.00 | 0.00 | 0.90 | 1.90 | 0.14 | 13.69 | 0.674 |
| P1-B | 2.82 | 0.00 | 0.00 | 1.36 | 1.44 | 1.39 | 108.03 | 0.512 |
| P1-C | 2.82 | 0.00 | 0.00 | 1.13 | 1.67 | 0.49 | 42.78 | 0.593 |
| P1-D | 2.82 | 0.00 | 0.00 | 1.31 | 1.49 | 1.27 | 101.80 | 0.529 |
| P1-E | 2.82 | 0.00 | 0.00 | 1.37 | 1.43 | 2.03 | 161.09 | 0.509 |
| P1-F | 2.82 | 0.00 | 0.00 | 1.46 | 1.34 | 2.80 | 215.28 | 0.476 |
| P2-A | 2.82 | 0.00 | 0.00 | 1.63 | 1.19 | 0.54 | 32.61 | 0.423 |
| P2-B | 2.82 | 0.00 | 0.00 | 1.37 | 1.43 | 2.30 | 176.39 | 0.505 |

Include all basins in summary table, as shown on drainage map

STERLING RANCH EAST PRELIMINARY PLAN NO. 1 (100yr. Event)

| Subcatchment | Total Precip in | Total <br> Runon in | Total <br> Evap <br> in | Total Infil in | $\begin{gathered} \text { Total } \\ \text { Runoff } \\ \text { in } \\ \hline \end{gathered}$ | Total Runoff $10^{\wedge} 6 \mathrm{gal}$ | Peak <br> Runoff <br> CFS | Runoff Coeff |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| P2-B1 | 2.82 | 0.00 | 0.00 | 0.86 | 1.94 | 0.13 | 13.20 | 0.689 |
| P2-B10 | 2.82 | 0.00 | 0.00 | 0.83 | 1.97 | 0.09 | 9.53 | 0.698 |
| P2-B2 | 2.82 | 0.00 | 0.00 | 0.86 | 1.94 | 0.10 | 10.02 | 0.689 |
| P2-B3 | 2.82 | 0.00 | 0.00 | 0.97 | 1.84 | 0.14 | 13.28 | 0.651 |
| P2-B4 | 2.82 | 0.00 | 0.00 | 0.86 | 1.94 | 0.08 | 8.32 | 0.687 |
| P2-B5 | 2.82 | 0.00 | 0.00 | 0.94 | 1.86 | 0.10 | 9.46 | 0.660 |
| P2-B6 | 2.82 | 0.00 | 0.00 | 0.84 | 1.97 | 0.06 | 6.11 | 0.697 |
| P2-B7 | 2.82 | 0.00 | 0.00 | 0.95 | 1.85 | 0.13 | 12.14 | 0.656 |
| P2-B8 | 2.82 | 0.00 | 0.00 | 0.84 | 1.96 | 0.06 | 6.57 | 0.695 |
| P2-B9 | 2.82 | 0.00 | 0.00 | 0.83 | 1.97 | 0.11 | 11.22 | 0.698 |
| P2-S1 | 2.82 | 0.00 | 0.00 | 1.18 | 1.62 | 1.57 | 132.76 | 0.576 |
| P3-A | 2.82 | 0.00 | 0.00 | 1.36 | 1.44 | 2.06 | 160.11 | 0.512 |
| P3-C | 2.82 | 0.00 | 0.00 | 1.51 | 1.32 | 0.06 | 4.80 | 0.469 |
| P3-S2 | 2.82 | 0.00 | 0.00 | 1.09 | 1.71 | 0.55 | 49.53 | 0.607 |
| P4-A | 2.82 | 0.00 | 0.00 | 1.37 | 1.43 | 1.00 | 79.51 | 0.508 |
| P4-B | 2.82 | 0.00 | 0.00 | 1.30 | 1.50 | 1.52 | 123.34 | 0.532 |
| SC-1 | 2.82 | 0.00 | 0.00 | 1.73 | 1.10 | 0.11 | 5.65 | 0.389 |

STERLING RANCH EAST PRELIMINARY PLAN NO. 1 (100yr. Event)

| Subcatchment | Total Precip in | Total <br> Runon in | Total <br> Evap <br> in | Total Infil in | Total <br> Runoff in | Total Runoff $10^{\wedge} 6 \mathrm{gal}$ | Peak <br> Runoff <br> CFS | Runoff Coeff |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| SC-2 | 2.82 | 0.00 | 0.00 | 1.66 | 1.17 | 0.34 | 20.21 | 0.415 |
| SC-3 | 2.82 | 0.00 | 0.00 | 1.99 | 0.83 | 0.70 | 32.41 | 0.295 |
| SC-4 | 2.82 | 0.00 | 0.00 | 1.70 | 1.12 | 0.50 | 27.41 | 0.399 |
| TR-V | 2.82 | 0.00 | 0.00 | 1.45 | 1.36 | 0.08 | 5.72 | 0.483 |
| TR-W | 2.82 | 0.00 | 0.00 | 1.19 | 1.62 | 0.06 | 5.23 | 0.573 |

## STERLING RANCH EAST PRELIMINARY PLAN NO. 1 (100yr. Event)

Outfall Loading Summary

|  | Flow <br> Freq. <br> Pcnt. | Avg. <br> Flow <br> CFS |  | Max. <br> Flow <br> CFS |
| :--- | ---: | ---: | ---: | ---: |
| DPBGP | 46.53 | 6.66 | Total <br> Volume <br> $10 \wedge 6$ gal |  |
| EF-A-Outfall | 50.56 | 3.52 | 27.41 | 0.501 |
| EX.STKPND | 67.22 | 6.46 | 19.75 | 0.288 |
| EX-DP4 | 37.36 | 1.01 | 32.41 | 0.702 |
| EX-DP7 | 58.75 | 13.86 | 4.80 | 0.061 |
| FSD-11B | 98.33 | 16.43 | 201.40 | 2.611 |
| FSD-14A | 97.92 | 32.64 | 352.16 | 5.193 |
| FSD-14B | 98.47 | 15.90 | 189.49 | 2.516 |
| FSD-16 | 42.92 | 57.84 | 587.24 | 9.202 |
| PNDW3 | 4.95 | 20.21 | 0.343 |  |
| SC-Outfall | 41.53 | 1.60 | 5.65 | 0.107 |

All DP's/Outfalls need to be shown and labeled on drainage map

## STERLING RANCH EAST PRELIMINARY PLAN NO. 1 (100yr. Event)

Node Inflow Summary


STERLING RANCH EAST PRELIMINARY PLAN NO. 1 (100yr. Event)

| Node | Type | Maximum Lateral Inflow CFS | Maximum <br> Total Inflow CFS | Day of Maximum Inflow | Hour of Maximum Inflow | Lateral Inflow Volume $10^{\wedge} 6 \mathrm{gal}$ | Total Inflow Volume $10^{\wedge} 6 \mathrm{gal}$ | Flow <br> Balance <br> Error <br> Percent |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| DPBGP | OUTFALL | 27.41 | 27.41 | 0 | 00:45 | 0.501 | 0.501 | 0.000 |
| EF-A-Outfall | OUTFALL | 19.75 | 19.75 | 0 | 00:45 | 0.288 | 0.288 | 0.000 |
| EX.STKPND | OUTFALL | 32.41 | 32.41 | 0 | 00:45 | 0.702 | 0.702 | 0.000 |
| EX-DP4 | OUTFALL | 4.80 | 4.80 | 0 | 00:45 | 0.0611 | 0.0611 | 0.000 |
| EX-DP7 | OUTFALL | 50.17 | 50.17 | 0 | 00:45 | 1.32 | 1.32 | 0.000 |
| FSD-11B | OUTFALL | 0.00 | 201.40 | 0 | 00:46 | 0 | 2.61 | 0.000 |
| FSD-14A | OUTFALL | 32.61 | 352.16 | 0 | 00:48 | 0.537 | 5.19 | 0.000 |
| FSD-14B | OUTFALL | 0.00 | 189.49 | 0 | 00:46 | 0 | 2.52 | 0.000 |
| FSD-16 | OUTFALL | 18.97 | 587.24 | 0 | 00:48 | 0.37 | 9.2 | 0.000 |
| JOS-TR | JUNCTION | 5.72 | 5.72 | 0 | 00:45 | 0.0777 | 0.0777 | 0.000 |
| JP1-3 | JUNCTION | 5.23 | 364.91 | 0 | 00:46 | 0.0615 | 4.95 | 0.000 |
| JP1-A12 | JUNCTION | 44.24 | 44.24 | 0 | 00:45 | 0.524 | 0.524 | 0.000 |
| JP1-A34 | JUNCTION | 19.13 | 59.50 | 0 | 00:46 | 0.198 | 0.72 | 0.000 |
| JP2-B12 | JUNCTION | 23.22 | 23.22 | 0 | 00:45 | 0.232 | 0.232 | 0.000 |
| JP2-B34 | JUNCTION | 21.61 | 172.30 | 0 | 00:46 | 0.224 | 2.02 | 0.000 |
| JP2-B56 | JUNCTION | 15.57 | 284.55 | 0 | 00:46 | 0.155 | 4.28 | -0.000 |
| PNDW3 | OUTFALL | 20.21 | 20.21 | 0 | 00:45 | 0.343 | 0.343 | 0.000 |

STERLING RANCH EAST PRELIMINARY PLAN NO. 1 (100yr. Event)

| Node | Type | Maximum <br> Lateral <br> Inflow CFS | Maximum Total Inflow CFS | Day of Maximum Inflow | Hour of Maximum Inflow | Lateral <br> Inflow <br> Volume <br> $10^{\wedge} 6 \mathrm{gal}$ | Total <br> Inflow <br> Volume <br> $10^{\wedge} 6 \mathrm{gal}$ | Flow Balance Error Percent |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| SC-Outfall | OUTFALL | 5.65 | 5.65 | 0 | 00:45 | 0.107 | 0.107 | 0.000 |

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
```

```
STERLING RANCH EAST PRELIMINARY PLAN NO. 1
PRELIMINARY DRAINAGE REPORT
DEVELOPED DRAINAGE (100 yr.)
```


## $* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *$

NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.

```
***********************************************************
```

*****************
Analysis Options
*****************
Flow Units ................. CFS
Process Models:
Rainfall/Runoff ......... YES
RDII ....................... NO
Snowmelt .................. NO
Groundwater .............. . NO
Flow Routing ............. YES
Ponding Allowed ......... NO
Water Quality ........... NO
Infiltration Method ....... HORTON
Flow Routing Method ....... KINWAVE
Starting Date ............. 04/18/2022 00:00:00
Ending Date ............... 04/18/2022 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step .......... 00:15:00
Wet Time Step ............. 00:05:00
Dry Time Step ............. 01:00:00
Routing Time Step ......... 30.00 sec
***************************

| Volume | Depth |
| ---: | ---: |
| acre-feet | inches |
| ------------ | 2.820 |
| 149.366 | 0.000 |
| 0.000 | 1.450 |
| 76.803 | 1.357 |
| 71.885 | 0.023 |
| 1.209 |  |
| -0.355 |  |


| Flow Routing Continuity | acre-feet | 10^6 gal |
| :---: | :---: | :---: |
| Dry Weather Inflow | 0.000 | 0.000 |
| Wet Weather Inflow | 71.884 | 23.425 |
| Groundwater Inflow | 0.000 | 0.000 |
| RDII Inflow | 0.000 | 0.000 |
| External Inflow | 0.000 | 0.000 |
| External Outflow | 70.091 | 22.840 |
| Flooding Loss | 1.666 | 0.543 |
| Evaporation Loss | 0.000 | 0.000 |
| Exfiltration Loss | 0.000 | 0.000 |
| Initial Stored Volume | 0.000 | 0.000 |
| Final Stored Volume | 0.005 | 0.002 |
| Continuity Error (\%) | 0.170 |  |

```
*********************************
Highest Flow Instability Indexes
********************************
Link C8 (3)
Link C16 (3)
Link C18 (2)
Link C13 (1)
Link CP3-A (1)
```

| $* * * * * * * * * * * * * * * * * * * * * * * * * * ~$ |  |  |
| :--- | :---: | :---: |
| Routing Time Step Summary |  |  |
| $* * * * * * * * * * * * * * * * * * * * * * * *$ |  |  |
| Minimum Time Step | $:$ | 30.00 sec |
| Average Time Step | $:$ | 30.00 sec |
| Maximum Time Step | $:$ | 30.00 sec |
| Percent in Steady State | $:$ | 0.00 |
| Average Iterations per Step | : | 2.08 |
| Percent Not Converging | $:$ | 0.00 |

****************************
Subcatchment Runoff Summary
****************************

| ----------------- | Total | Total | Total | Total | Total |
| :--- | ---: | ---: | ---: | ---: | ---: | ---: |
| Total Peak Runoff | Precip | Runon | Evap | Infil | Runoff |
| Runoff Runoff <br> Subcatchment <br> $10^{\wedge} 6$ gal Coeff <br> CFS | in | in | in | in | in |


| P2-B10 |  |  | 2.82 | 0.00 | 0.00 | 0.83 | 1.97 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0.09 | 9.53 | 0.698 |  |  |  |  |  |
| P2-B9 |  |  | 2.82 | 0.00 | 0.00 | 0.83 | 1.97 |
| 0.11 | 11.22 | 0.698 |  |  |  |  |  |
| P3-S2 |  |  | 2.82 | 0.00 | 0.00 | 1.09 | 1.71 |
| 0.55 | 49.53 | 0.607 |  |  |  |  |  |
| P3-A |  |  | 2.82 | 0.00 | 0.00 | 1.36 | 1.44 |
| 2.06 | 160.11 | 0.512 |  |  |  |  |  |
| P3-C |  |  | 2.82 | 0.00 | 0.00 | 1.51 | 1.32 |
| 0.06 | 4.80 | 0.469 |  |  |  |  |  |
| EF-A |  |  | 2.82 | 0.00 | 0.00 | 1.53 | 1.29 |
| 0.29 | 19.75 | 0.458 |  |  |  |  |  |
| P2-B8 |  |  | 2.82 | 0.00 | 0.00 | 0.84 | 1.96 |
| 0.06 | 6.57 | 0.695 |  |  |  |  |  |
| P2-B7 |  |  | 2.82 | 0.00 | 0.00 | 0.95 | 1.85 |
| 0.13 | 12.14 | 0.656 |  |  |  |  |  |
| P2-B5 |  |  | 2.82 | 0.00 | 0.00 | 0.94 | 1.86 |
| 0.10 | 9.46 | 0.660 |  |  |  |  |  |
| P2-B6 |  |  | 2.82 | 0.00 | 0.00 | 0.84 | 1.97 |
| 0.06 | 6.11 | 0.697 |  |  |  |  |  |
| P2-A |  |  | 2.82 | 0.00 | 0.00 | 1.63 | 1.19 |
| 0.54 | 32.61 | 0.423 |  |  |  |  |  |
| P2-B3 |  |  | 2.82 | 0.00 | 0.00 | 0.97 | 1.84 |
| 0.14 | 13.28 | 0.651 |  |  |  |  |  |
| P2-B4 |  |  | 2.82 | 0.00 | 0.00 | 0.86 | 1.94 |
| 0.08 | 8.32 | 0.687 |  |  |  |  |  |
| P4-A |  |  | 2.82 | 0.00 | 0.00 | 1.37 | 1.43 |
| 1.00 | 79.51 | 0.508 |  |  |  |  |  |
| P2-B |  |  | 2.82 | 0.00 | 0.00 | 1.37 | 1.43 |
| 2.30 | 176.39 | 0.505 |  |  |  |  |  |
| P2-S1 |  |  | 2.82 | 0.00 | 0.00 | 1.18 | 1.62 |
| 1.57 | 132.76 | 0.576 |  |  |  |  |  |
| P2-B1 |  |  | 2.82 | 0.00 | 0.00 | 0.86 | 1.94 |
| 0.13 | 13.20 | 0.689 |  |  |  |  |  |
| P2-B2 |  |  | 2.82 | 0.00 | 0.00 | 0.86 | 1.94 |
| 0.10 | 10.02 | 0.689 |  |  |  |  |  |
| P4-B |  |  | 2.82 | 0.00 | 0.00 | 1.30 | 1.50 |
| 1.52 | 123.34 | 0.532 |  |  |  |  |  |
| P1-A6 |  |  | 2.82 | 0.00 | 0.00 | 0.90 | 1.90 |
| 0.14 | 13.69 | 0.674 |  |  |  |  |  |
| P1-A5 |  |  | 2.82 | 0.00 | 0.00 | 1.02 | 1.79 |
| 0.21 | 18.89 | 0.633 |  |  |  |  |  |
| P1-A4 |  |  | 2.82 | 0.00 | 0.00 | 0.88 | 1.91 |
| 0.10 | 10.01 | 0.679 |  |  |  |  |  |
| P1-A |  |  | 2.82 | 0.00 | 0.00 | 1.75 | 1.07 |
| 0.37 | 18.97 | 0.380 |  |  |  |  |  |
| P1-A1 |  |  | 2.82 | 0.00 | 0.00 | 1.05 | 1.75 |


| 0.24 | 20.94 | 0.621 |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| P1-A2 |  |  | 2.82 | 0.00 | 0.00 | 1.15 | 1.65 |
| 0.29 | 23.30 | 0.584 |  |  |  |  |  |
| P1-A3 |  |  | 2.82 | 0.00 | 0.00 | 0.88 | 1.92 |
| 0.09 | 9.12 | 0.682 |  |  |  |  |  |
| P1-C |  |  | 2.82 | 0.00 | 0.00 | 1.13 | 1.67 |
| 0.49 | 42.78 | 0.593 |  |  |  |  |  |
| P1-B |  |  | 2.82 | 0.00 | 0.00 | 1.36 | 1.44 |
| 1.391 | 108.03 | 0.512 |  |  |  |  |  |
| P1-D |  |  | 2.82 | 0.00 | 0.00 | 1.31 | 1.49 |
| 1.271 | 101.80 | 0.529 |  |  |  |  |  |
| P1-E |  |  | 2.82 | 0.00 | 0.00 | 1.37 | 1.43 |
| 2.031 | 161.09 | 0.509 |  |  |  |  |  |
| TR-W |  |  | 2.82 | 0.00 | 0.00 | 1.19 | 1.62 |
| 0.06 | 5.23 | 0.573 |  |  |  |  |  |
| TR-V |  |  | 2.82 | 0.00 | 0.00 | 1.45 | 1.36 |
| 0.08 | 5.72 | 0.483 |  |  |  |  |  |
| P1-F |  |  | 2.82 | 0.00 | 0.00 | 1.46 | 1.34 |
| 2.80 | 215.28 | 0.476 |  |  |  |  |  |
| SC-2 |  |  | 2.82 | 0.00 | 0.00 | 1.66 | 1.17 |
| 0.34 | 20.21 | 0.415 |  |  |  |  |  |
| SC-3 |  |  | 2.82 | 0.00 | 0.00 | 1.99 | 0.83 |
| 0.70 | 32.41 | 0.295 |  |  |  |  |  |
| SC-4 |  |  | 2.82 | 0.00 | 0.00 | 1.70 | 1.12 |
| 0.50 | 27.41 | 0.399 |  |  |  |  |  |
| SC-1 |  |  | 2.82 | 0.00 | 0.00 | 1.73 | 1.10 |
| 0.11 | 5.65 | 0.389 |  |  |  |  |  |
| EX10A |  |  | 2.82 | 0.00 | 0.00 | 2.02 | 0.80 |
| 1.32 | 50.17 | 0.285 |  |  |  |  |  |

$* * * * * * * * * * * * * * * * * *$
Node Depth Summary
$* * * * * * * * * * * * * * * * * *$

| Node | Type | Average Depth Feet | Maximum Depth Feet | Maximum <br> HGL <br> Feet | Time Occu days | of Max rrence <br> hr:min | Reported Max Depth Feet |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| DP-14 | JUNCTION | 0.41 | 2.73 | 7082.73 | 0 | 00:45 | 2.62 |
| DP-10-11 | JUNCTION | 0.61 | 3.50 | 7049.50 | 0 | 00:41 | 3.50 |
| DP-12 | JUNCTION | 2.16 | 6.50 | 7038.50 | 0 | 00:46 | 4.98 |
| DP-13 | JUNCTION | 0.15 | 1.21 | 7012.21 | 0 | 00:45 | 1.17 |
| JP2-B12 | JUNCTION | 0.17 | 1.37 | 7073.37 | 0 | 00:45 | 1.31 |
| DP-9 | JUNCTION | 0.73 | 2.94 | 7069.94 | 0 | 00:45 | 2.82 |
| JP2-B34 | JUNCTION | 1.41 | 3.89 | 7058.89 | 0 | 00:46 | 3.66 |
| JP2-B56 | JUNCTION | 1.96 | 4.70 | 7048.70 | 0 | 00:46 | 4.50 |
| JP1-A12 | JUNCTION | 0.31 | 2.05 | 7106.05 | 0 | 00:45 | 1.97 |
| JP1-A34 | JUNCTION | 0.33 | 2.12 | 7100.12 | 0 | 00:46 | 1.98 |


| DP-7 | JUNCTION | 10.44 | 14.00 | 7110.00 | 0 | $00: 41$ | 14.00 |
| :--- | :--- | ---: | ---: | ---: | ---: | ---: | ---: |
| DP-8 | JUNCTION | 0.48 | 3.03 | 7099.03 | 0 | $00: 45$ | 2.89 |
| DP-4 | JUNCTION | 22.70 | 27.50 | 7123.50 | 0 | $00: 47$ | 25.90 |
| JP1-3 | JUNCTION | 10.53 | 15.00 | 7143.00 | 0 | $00: 46$ | 12.85 |
| DP-1 | JUNCTION | 10.10 | 10.57 | 7165.57 | 0 | $00: 48$ | 10.46 |
| JOS-TR | JUNCTION | 0.10 | 0.60 | 7190.60 | 0 | $00: 45$ | 0.58 |
| DP-17 | JUNCTION | 0.49 | 3.13 | 7033.13 | 0 | $00: 45$ | 2.98 |
| DP-6 | JUNCTION | 0.28 | 2.50 | 7100.50 | 0 | $00: 44$ | 2.50 |
| DP-5 | JUNCTION | 0.36 | 2.14 | 7112.14 | 0 | $00: 45$ | 2.07 |
| DP-2-3 | JUNCTION | 0.52 | 4.00 | 7136.00 | 0 | $00: 44$ | 4.00 |
| DP-15 | JUNCTION | 0.34 | 2.13 | 7062.13 | 0 | $00: 45$ | 2.05 |
| DP-18 | JUNCTION | 0.25 | 1.75 | 7013.75 | 0 | $00: 45$ | 1.69 |
| DP-16 | JUNCTION | 2.41 | 4.61 | 7062.61 | 0 | $00: 47$ | 4.27 |
| EF-A-Outfall | OUTFALL | 0.00 | 0.00 | 0.00 | 0 | $00: 00$ | 0.00 |
| EX-DP4 | OUTFALL | 0.00 | 0.00 | 0.00 | 0 | $00: 00$ | 0.00 |
| FSD-11B | OUTFALL | 5.49 | 8.03 | 7018.03 | 0 | $00: 46$ | 7.71 |
| FSD-14A | OUTFALL | 10.68 | 14.43 | 7020.43 | 0 | $00: 48$ | 13.49 |
| FSD-14B | OUTFALL | 0.50 | 3.14 | 7059.14 | 0 | $00: 46$ | 2.85 |
| FSD-16 | OUTFALL | 0.73 | 5.47 | 7100.47 | 0 | $00: 47$ | 4.00 |
| PNDW3 | OUTFALL | 0.00 | 0.00 | 7001.00 | 0 | $00: 00$ | 0.00 |
| EX.STKPND | OUTFALL | 0.00 | 0.00 | 7030.00 | 0 | $00: 00$ | 0.00 |
| DPBGP | OUTFALL | 0.00 | 0.00 | 7100.00 | 0 | $00: 00$ | 0.00 |
| EX-DP7 | OUTFALL | 0.00 | 0.00 | 0.00 | 0 | $00: 00$ | 0.00 |
| SC-Outfall | OUTFALL | 0.00 | 0.00 | 0.00 | 0 | $00: 00$ | 0.00 |

*******************
Node Inflow Summary
*******************

| Total | Flow |  | Maximum | Maximum |  | Lateral |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |
|  |  |  | Lateral | Total | Time of Max | Inflow |
| Inflow | Balance |  |  |  |  |  |
|  |  |  | Inflow | Inflow | Occurrence | Volume |
| Volume | Error |  |  |  |  |  |
| Node |  | Type | CFS | CFS | days hr:min | 10^6 gal |
| gal | Percent |  |  |  |  |  |


| DP-14 | JUNCTION | 123.34 | 123.34 | 0 | 00:45 | 1.52 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $1.52 \quad 0.000$ |  |  |  |  |  |  |
| DP-10-11 | JUNCTION | 176.39 | 176.39 | 0 | 00:45 | 2.3 |
| $2.3-0.000$ |  |  |  |  |  |  |
| DP-12 | JUNCTION | 18.71 | 298.18 | 0 | 00:47 | 0.189 |
| $4.47 \quad 0.000$ |  |  |  |  |  |  |


| DP-13 |  | JUNCTION | 20.75 | 20.75 | 0 | 00:45 | 0.198 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0.198 | 0.000 |  |  |  |  |  |  |
| JP2-B12 |  | JUNCTION | 23.22 | 23.22 | 0 | 00:45 | 0.232 |
| 0.232 | 0.000 |  |  |  |  |  |  |
| DP-9 |  | JUNCTION | 132.76 | 155.04 | 0 | 00:45 | 1.57 |
| 1.8 | 0.000 |  |  |  |  |  |  |
| JP2-B34 |  | JUNCTION | 21.61 | 172.30 | 0 | 00:46 | 0.224 |
| 2.02 | 0.000 |  |  |  |  |  |  |
| JP2-B56 |  | JUNCTION | 15.57 | 284.55 | 0 | 00:46 | 0.155 |
| 4.28 | -0.000 |  |  |  |  |  |  |
| JP1-A12 |  | JUNCTION | 44.24 | 44.24 | 0 | 00:45 | 0.524 |
| 0.524 | 0.000 |  |  |  |  |  |  |
| JP1-A34 |  | JUNCTION | 19.13 | 59.50 | 0 | 00:46 | 0.198 |
| 0.72 | 0.000 |  |  |  |  |  |  |
| DP-7 |  | JUNCTION | 42.78 | 229.27 | 0 | 00:46 | 0.486 |
| 2.83 | 0.000 |  |  |  |  |  |  |
| DP-8 |  | JUNCTION | 108.03 | 108.03 | 0 | 00:45 | 1.39 |
| 1.39 | 0.000 |  |  |  |  |  |  |
| DP-4 |  | JUNCTION | 0.00 | 372.38 | 0 | 00:47 | 0 |
| 4.94 | 0.000 |  |  |  |  |  |  |
| JP1-3 |  | JUNCTION | 5.23 | 364.91 | 0 | 00:46 | 0.0615 |
| 4.95 | 0.000 |  |  |  |  |  |  |
| DP-1 |  | JUNCTION | 215.28 | 219.02 | 0 | 00:45 | 2.8 |
| 2.87 | 0.000 |  |  |  |  |  |  |
| JOS-TR |  | JUNCTION | 5.72 | 5.72 | 0 | 00:45 | 0.0777 |
| 0.0777 | 0.000 |  |  |  |  |  |  |
| DP-17 |  | JUNCTION | 160.11 | 160.11 | 0 | 00:45 | 2.06 |
| 2.06 | 0.000 |  |  |  |  |  |  |
| DP-6 |  | JUNCTION | 32.58 | 32.58 | 0 | 00:45 | 0.353 |
| 0.353 | -0.000 |  |  |  |  |  |  |
| DP-5 |  | JUNCTION | 101.80 | 101.80 | 0 | 00:45 | 1.27 |
| 1.27 | 0.000 |  |  |  |  |  |  |
| DP-2-3 |  | JUNCTION | 161.09 | 161.09 | 0 | 00:45 | 2.03 |
| 2.03 | 0.000 |  |  |  |  |  |  |
| DP-15 |  | JUNCTION | 79.51 | 79.51 | 0 | 00:45 | 1 |
| 10 | 0.000 |  |  |  |  |  |  |
| DP-18 |  | JUNCTION | 49.53 | 49.53 | 0 | 00:45 | 0.553 |
| 0.553 | 0.000 |  |  |  |  |  |  |
| DP-16 |  | JUNCTION | 0.00 | 188.99 | 0 | 00:46 | 0 |
| 2.52 | 0.000 |  |  |  |  |  |  |
| EF-A-Out | tfall | OUTFALL | 19.75 | 19.75 | 0 | 00:45 | 0.288 |
| 0.288 | 0.000 |  |  |  |  |  |  |
| EX-DP4 |  | OUTFALL | 4.80 | 4.80 | 0 | 00:45 | 0.0611 |
| 0.0611 | 0.000 |  |  |  |  |  |  |
| FSD-11B |  | OUTFALL | 0.00 | 201.40 | 0 | 00:46 | 0 |
| 2.61 | 0.000 |  |  |  |  |  |  |
| FSD-14A |  | OUTFALL | 32.61 | 352.16 | 0 | 00:48 | 0.537 |
| 5.19 | 0.000 |  |  |  |  |  |  |
| FSD-14B |  | OUTFALL | 0.00 | 189.49 | 0 | 00:46 | 0 |
| 2.52 | 0.000 |  |  |  |  |  |  |


| FSD-16 | OUTFALL | 18.97 | 587.24 | 0 | 00:48 | 0.37 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 9.20 .000 |  |  |  |  |  |  |
| PNDW3 | OUTFALL | 20.21 | 20.21 | 0 | 00:45 | 0.343 |
| $0.343 \quad 0.000$ |  |  |  |  |  |  |
| EX.STKPND | OUTFALL | 32.41 | 32.41 | 0 | 00:45 | 0.702 |
| 0.7020 .000 |  |  |  |  |  |  |
| DPBGP | OUTFALL | 27.41 | 27.41 | 0 | 00:45 | 0.501 |
| $0.501 \quad 0.000$ |  |  |  |  |  |  |
| EX-DP7 | OUTFALL | 50.17 | 50.17 | 0 | 00:45 | 1.32 |
| 1.320 .000 |  |  |  |  |  |  |
| SC-Outfall | OUTFALL | 5.65 | 5.65 | 0 | 00:45 | 0.107 |
| 0.1070 .000 |  |  |  |  |  |  |

$* * * * * * * * * * * * * * * * * * * * *$
Node Flooding Summary
$* * * * * * * * * * * * * * * * * * * *$

Flooding refers to all water that overflows a node, whether it ponds or not.

| Node | Hours <br> Flooded | Maximum <br> Rate CFS | Time of Max Occurrence days $\mathrm{hr}: \mathrm{min}$ | Total Flood Volume 10^6 gal | Maximum Ponded Volume 1000 ft 3 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| DP-10-11 | 0.21 | 72.94 | 0 00:46 | 0.188 | 0.000 |
| DP-12 | 0.04 | 9.15 | 0 00:47 | 0.006 | 0.000 |
| DP-7 | 0.23 | 110.83 | 0 00:46 | 0.327 | 0.000 |
| DP-4 | 0.03 | 13.28 | 0 00:48 | 0.006 | 0.000 |
| JP1-3 | 0.03 | 7.39 | 0 00:47 | 0.004 | 0.000 |
| DP-6 | 0.05 | 2.89 | 0 00:46 | 0.002 | 0.000 |
| DP-2-3 | 0.05 | 14.39 | 0 00:46 | 0.010 | 0.000 |

***********************
Outfall Loading Summary
$* * * * * * * * * * * * * * * * * * * * * * * ~$

| Outfall Node | Flow <br> Freq <br> Pcnt | $\begin{array}{r} \text { Avg } \\ \text { Flow } \\ \text { CFS } \end{array}$ | $\begin{array}{r} \text { Max } \\ \text { Flow } \\ \text { CFS } \end{array}$ | Total Volume 10^6 gal |
| :---: | :---: | :---: | :---: | :---: |
| EF-A-Outfall | 50.56 | 3.52 | 19.75 | 0.288 |
| EX-DP4 | 37.36 | 1.01 | 4.80 | 0.061 |
| FSD-11B | 98.33 | 16.43 | 201.40 | 2.611 |
| FSD-14A | 98.47 | 32.64 | 352.16 | 5.193 |
| FSD-14B | 97.92 | 15.90 | 189.49 | 2.516 |
| FSD-16 | 98.47 | 57.84 | 587.24 | 9.202 |
| PNDW3 | 42.92 | 4.95 | 20.21 | 0.343 |


| EX.STKPND | 67.22 | 6.46 | 32.41 | 0.702 |
| :---: | :---: | :---: | :---: | :---: |
| DPBGP | 46.53 | 6.66 | 27.41 | 0.501 |
| EX-DP7 | 58.75 | 13.86 | 50.17 | 1.316 |
| SC-Outfall | 41.53 | 1.60 | 5.65 | 0.107 |
| System | 67.10 | 160.88 | 1447.90 | 22.839 |

## *********************

Link Flow Summary
$* * * * * * * * * * * * * * * * * * * *$

| Link | Type | Maximum \|Flow| CFS | Time of Max Occurrence days $\mathrm{hr}: \mathrm{min}$ | Maximum \|Veloc| ft/sec | $\begin{aligned} & \text { Max/ } \\ & \text { Full } \\ & \text { Flow } \end{aligned}$ | $\begin{gathered} \text { Max/ } \\ \text { Full } \\ \text { Depth } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| CP4-B | CONDUIT | 115.72 | 0 00:47 | 13.93 | 0.76 | 0.65 |
| C2 | CONDUIT | 20.40 | 0 00:46 | 8.87 | 0.47 | 0.48 |
| C3 | CONDUIT | 22.88 | 0 00:46 | 10.26 | 0.80 | 0.67 |
| C4 | CONDUIT | 151.63 | 0 00:46 | 15.85 | 0.87 | 0.72 |
| C5 | CONDUIT | 169.73 | 0 00:46 | 16.06 | 0.98 | 0.80 |
| C6 | CONDUIT | 282.73 | 0 00:47 | 17.50 | 0.95 | 0.78 |
| C7 | CONDUIT | 305.99 | 0 00:48 | 17.38 | 1.06 | 0.91 |
| C8 | CONDUIT | 106.79 | 0 00:52 | 12.03 | 1.06 | 1.00 |
| C9 | CONDUIT | 42.03 | 0 00:46 | 8.77 | 0.77 | 0.66 |
| C10 | CONDUIT | 59.38 | 0 00:46 | 9.76 | 0.68 | 0.61 |
| C11 | CONDUIT | 124.40 | 0 00:54 | 10.81 | 1.06 | 1.00 |
| C12 | CONDUIT | 106.61 | 0 00:46 | 10.66 | 0.91 | 0.75 |
| C13 | CONDUIT | 5.11 | 0 00:48 | 7.23 | 0.18 | 0.28 |
| C14 | CONDUIT | 210.70 | 0 00:46 | 16.56 | 0.72 | 0.63 |
| C15 | CONDUIT | 372.38 | 0 00:47 | 17.66 | 1.05 | 0.91 |
| C16 | CONDUIT | 360.70 | 0 00:48 | 17.23 | 1.02 | 1.00 |
| CP3-A | CONDUIT | 154.58 | 0 00:46 | 15.51 | 0.92 | 0.75 |
| C17 | CONDUIT | 100.31 | 0 00:46 | 14.94 | 0.55 | 0.53 |
| C18 | CONDUIT | 30.99 | 0 00:47 | 7.03 | 1.07 | 0.93 |
| C19 | CONDUIT | 149.42 | 0 00:46 | 13.42 | 1.04 | 1.00 |
| C20 | CONDUIT | 78.26 | 0 00:45 | 13.03 | 0.67 | 0.60 |
| C21 | CONDUIT | 48.63 | 0 00:45 | 11.61 | 0.63 | 0.58 |
| C22 | CONDUIT | 189.49 | 0 00:46 | 15.99 | 0.83 | 0.70 |

## STORMWATER QUALITY CALCULATIONS

For each pond, include a summary table listing all contributing basins with area and percent impervious and determine overall area \& imperviousness.



| Design Procedure Form: Extended Detention Basin (EDB) |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Designer: <br> Company: <br> Date: <br> Project: <br> Location: | Marc A. Whorton, P.E. |  |  | Sheet 3 of 3 |
|  |  |  |  |  |
|  | Classic Consulting |  |  |  |
|  | May 30, 2022 |  |  |  |
|  | Sterling Ranch East Preliminary Plan No. 1 |  |  |  |
|  | FSD-11B |  |  |  |
| 10. Overflow Embankment |  |  |  |  |
| A) Describe embankment protection for 100-year and greater overtopping: |  |  |  |  |
| B) Slope of Overflow Embankment <br> (Horizontal distance per unit vertical, 4:1 or flatter preferred) |  | $\mathrm{Ze}=\square 4.00$ | $\mathrm{ft} / \mathrm{ft}$ |  |
| 11. Vegetat |  | [Choose One Irrigated Not Irrigated |  |  |
| 12. Access |  |  |  |  |
| Notes: |  |  |  |  |




| Design Procedure Form: Extended Detention Basin (EDB) |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Designer: <br> Company: <br> Date: <br> Project: <br> Location: | Marc A. Whorton, P.E. |  |  | Sheet 3 of 3 |
|  |  |  |  |  |
|  | Classic Consulting |  |  |  |
|  | May 30, 2022 |  |  |  |
|  | Sterling Ranch East Preliminary Plan No. 1 |  |  |  |
|  | FSD-14A |  |  |  |
| 10. Overflow Embankment |  |  |  |  |
| A) Describe embankment protection for 100-year and greater overtopping: |  |  |  |  |
| B) Slope of Overflow Embankment <br> (Horizontal distance per unit vertical, 4:1 or flatter preferred) |  | $\mathrm{Ze}=\square 4.00$ | $\mathrm{ft} / \mathrm{ft}$ |  |
| 11. Vegetat |  | [Choose One Irrigated Not Irrigated |  |  |
| 12. Access |  |  |  |  |
| Notes: |  |  |  |  |




| Design Procedure Form: Extended Detention Basin (EDB) |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Designer: <br> Company: <br> Date: <br> Project: <br> Location: | Marc A. Whorton, P.E. |  |  | Sheet 3 of 3 |
|  |  |  |  |  |
|  | Classic Consulting |  |  |  |
|  | May 30, 2022 |  |  |  |
|  | Sterling Ranch East Preliminary Plan No. 1 |  |  |  |
|  | FSD-14B |  |  |  |
| 10. Overflow Embankment |  |  |  |  |
| A) Describe embankment protection for 100-year and greater overtopping: |  |  |  |  |
| B) Slope of Overflow Embankment <br> (Horizontal distance per unit vertical, 4:1 or flatter preferred) |  | $\mathrm{Ze}=\square 4.00$ | $\mathrm{ft} / \mathrm{ft}$ |  |
| 11. Vegetat |  | [Choose One Irrigated Not Irrigated |  |  |
| 12. Access |  |  |  |  |
| Notes: |  |  |  |  |






WATER QUALITY TREATMENT PLAN MAP


DETENTION POND CALCULATIONS




All soils type in project
are Group A. Please
move 100\% to Group A

Define Zones and Basin Geometry
Zone 1 Volume (WQC)




Project: STERLING RANCH EAST PRELIMINARY PLAN No. 1
Basin ID: POND FSD-11B


Outlet design will be reviewed with Final Drainage Reports


User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

|  | Row 1 (required) | Row 2 (optional) | Row 3 (optional) | Row 4 (optional) | Row 5 (optional) | Row 6 (optional) | Row 7 (optional) | Row 8 (optional) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Stage of Orifice Centroid (ft) | 0.00 | 1.70 | 3.40 |  |  |  |  |  |
| Orifice Area (sq. inches) | 7.00 | 7.50 | 16.00 |  |  |  |  |  |


|  | Row 9 (optional) | Row 10 (optional) | Row 11 (optional) | Row 12 (optional) | Row 13 (optional) | Row 14 (optional) | Row 15 (optional) | Row 16 (optional) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Stage of Orifice Centroid (ft) |  |  |  |  |  |  |  |  |
| Orifice Area (sq. inches) |  |  |  |  |  |  |  |  |

User Input: Vertical Orifice (Circular or Rectangular)


User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

| Overflow Weir Front Edge Height, $\mathrm{Ho}=$ | Zone 3 Weir | Not Selected | ft (relativ feet |
| :---: | :---: | :---: | :---: |
|  | 5.00 | N/A |  |
| Overflow Weir Front Edge Length = | 10.00 | N/A |  |
| Overflow Weir Grate Slope = | 0.00 | N/A | $\mathrm{H}: \mathrm{V}$ |
| Horiz. Length of Weir Sides = | 4.00 | N/A | feet |
| Overflow Grate Type = | Close Mesh Grate | N/A |  |
| Debris Clogging \% = | 50\% | N/A | \% |


| Outlet Pipe) | Calculated Parameters for Overflow Weir |  |  |
| :---: | :---: | :---: | :---: |
|  | Zone 3 Weir | Not Selected |  |
| $=0$ ft) Height of Grate Upper Edge, $\mathrm{H}_{\mathrm{t}}=$ | 5.00 | N/A | feet |
| Overflow Weir Slope Length = | 4.00 | N/A | feet |
| Grate Open Area / 100-yr Orifice Area $=$ | 4.48 | N/A |  |
| Overflow Grate Open Area w/o Debris = | 31.64 | N/A | $\mathrm{ft}^{2}$ |
| Overflow Grate Open Area w/ Debris = | 15.82 | N/A | $\mathrm{ft}^{2}$ |


| Depth to Invert of Outlet Pipe = | Zone 3 Restrictor | Not Selected | ft (distance below basin bott inches |
| :---: | :---: | :---: | :---: |
|  | 2.50 | N/A |  |
| Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert = | 36.00 | N/A |  |
|  | 36.00 | inches |  |
| User Input: Emergency Spillway (Rectangular or Trapezoidal) |  |  |  |
| Spillway Invert Stage= | 6.50 | ft (relative to bas | bottom at Stage $=0 \mathrm{ft}$ ) |
| Spillway Crest Length = | 70.00 | feet |  |
| Spillway End Slopes = | 3.00 | $\mathrm{H}: \mathrm{V}$ |  |
| Freeboard above Max Water Surface $=$ | 1.00 | feet |  |


| Calculated ParametersOn | for Outlet Pipe w/ | ow Restriction |
| :---: | :---: | :---: |
|  | Zone 3 Restrictor | Not Selected |
|  | 7.07 | N/A |
|  | 1.50 | N/A |
|  | 3.14 | N/A |
|  | Calculated Parameters for Spillway |  |
| Spillway Design Flow Depth= | 0.95 | feet feet acres acre-ft |
| Stage at Top of Freeboard = | 8.45 |  |
| Basin Area at Top of Freeboard = | 3.38 |  |
| Basin Volume at Top of Freeboard $=$ | 13.33 |  |


| $\frac{\text { Routed Hydrograph Results }}{\text { Design Storm Return Period }=\\|}$ | The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF). |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | WQCV | EURV | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year | 500 Year |
| One-Hour Rainfall Depth (in) = | N/A | N/A | 1.19 | 1.50 | 1.75 | 2.00 | 2.25 | 2.52 | 3.48 |
| CUHP Runoff Volume (acre-ft) = | 1.387 | 4.653 | 4.293 | 5.841 | 7.157 | 8.754 | 10.141 | 11.816 | 17.305 |
| Inflow Hydrograph Volume (acre-ft) = | N/A | N/A | 4.293 | 5.841 | 7.157 | 8.754 | 10.141 | 11.816 | 17.305 |
| CUHP Predevelopment Peak Q (cfs) = | N/A | N/A | 6.6 | 18.4 | 28.0 | 50.1 | 63.0 | 80.0 | 130.0 |
| OPTIONAL Override Predevelopment Peak Q (cfs) $=$ | N/A | N/A |  |  |  |  |  |  |  |
| Predevelopment Unit Peak Flow, q (cfs/acre) = | N/A | N/A | 0.10 | 0.29 | 0.43 | 0.78 | 0.98 | 1.24 | 2.02 |
| Peak Inflow Q (cfs) = | N/A | N/A | 71.9 | 98.3 | 117.8 | 148.3 | 172.1 | 201.3 | 291.7 |
| Peak Outflow Q (cfs) $=$ | 0.7 | 1.6 | 1.5 | 7.5 | 16.4 | 32.7 | 46.4 | 67.5 | 137.8 |
| Ratio Peak Outflow to Predevelopment $\mathrm{Q}=$ | N/A | N/A | N/A | 0.4 | 0.6 | 0.7 | 0.7 | 0.8 | 1.1 |
| Structure Controlling Flow = | Plate | Plate | Plate | Overflow Weir 1 | Overflow Weir 1 | Overflow Weir 1 | Overflow Weir 1 | Overflow Weir 1 | Spillway |
| Max Velocity through Grate 1 (fps) = | N/A | N/A | N/A | 0.2 | 0.5 | 1.0 | 1.4 | 2.1 | 2.9 |
| Max Velocity through Grate 2 (fps) = | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Time to Drain 97\% of Inflow Volume (hours) = | 41 | 69 | 67 | 72 | 70 | 68 | 67 | 64 | 59 |
| Time to Drain 99\% of Inflow Volume (hours) = | 43 | 74 | 73 | 79 | 78 | 77 | 77 | 76 | 73 |
| Maximum Ponding Depth (ft) = | 2.94 | 4.97 | 4.68 | 5.25 | 5.46 | 5.76 | 5.97 | 6.26 | 6.84 |
| Area at Maximum Ponding Depth (acres) = | 1.08 | 2.17 | 2.01 | 2.32 | 2.45 | 2.61 | 2.74 | 2.83 | 3.02 |
| Maximum Volume Stored (acre-ft) $=$ | 1.391 | 4.658 | 4.053 | 5.264 | 5.789 | 6.522 | 7.111 | 7.891 | 9.616 |



Inflow Hydrographs
The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

|  | SOURCE | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Time Interval | TIME | WQCV [cfs] | EURV [cfs] | 2 Year [cfs] | 5 Year [cfs] | 10 Year [cfs] | 25 Year [cfs] | 50 Year [cfs] | 100 Year [cfs] | 500 Year [cfs] |
| 5.00 min | 0:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 0:05:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 0:10:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.78 | 0.08 | 3.82 |
|  | 0:15:00 | 0.00 | 0.00 | 6.87 | 11.21 | 13.87 | 9.31 | 11.72 | 11.35 | 19.51 |
|  | 0:20:00 | 0.00 | 0.00 | 25.39 | 33.68 | 40.41 | 25.06 | 29.22 | 31.19 | 47.45 |
|  | 0:25:00 | 0.00 | 0.00 | 56.34 | 77.94 | 96.43 | 55.11 | 64.21 | 69.80 | 112.10 |
|  | 0:30:00 | 0.00 | 0.00 | 71.88 | 98.26 | 117.80 | 124.61 | 145.55 | 162.31 | 240.92 |
|  | 0:35:00 | 0.00 | 0.00 | 66.99 | 89.81 | 106.30 | 148.33 | 172.14 | 201.33 | 291.73 |
|  | 0:40:00 | 0.00 | 0.00 | 57.88 | 76.05 | 90.13 | 140.06 | 161.83 | 190.39 | 274.50 |
|  | 0:45:00 | 0.00 | 0.00 | 48.02 | 64.06 | 76.98 | 121.99 | 140.88 | 169.62 | 244.42 |
|  | 0:50:00 | 0.00 | 0.00 | 39.64 | 54.32 | 64.57 | 107.14 | 123.71 | 149.12 | 214.64 |
|  | 0:55:00 | 0.00 | 0.00 | 33.54 | 46.00 | 55.09 | 89.45 | 103.35 | 127.24 | 183.36 |
|  | 1:00:00 | 0.00 | 0.00 | 29.45 | 40.14 | 48.97 | 74.98 | 86.79 | 110.24 | 159.34 |
|  | 1:05:00 | 0.00 | 0.00 | 26.22 | 35.53 | 44.00 | 65.21 | 75.61 | 98.94 | 143.14 |
|  | 1:10:00 | 0.00 | 0.00 | 21.95 | 31.20 | 39.15 | 54.80 | 63.62 | 81.42 | 118.39 |
|  | 1:15:00 | 0.00 | 0.00 | 17.87 | 26.33 | 34.74 | 45.24 | 52.60 | 64.61 | 94.62 |
|  | 1:20:00 | 0.00 | 0.00 | 14.68 | 21.62 | 29.41 | 35.74 | 41.51 | 48.63 | 71.17 |
|  | 1:25:00 | 0.00 | 0.00 | 12.82 | 18.84 | 24.77 | 27.89 | 32.34 | 35.43 | 52.02 |
|  | 1:30:00 | 0.00 | 0.00 | 11.88 | 17.41 | 21.70 | 22.52 | 26.06 | 27.35 | 40.34 |
|  | 1:35:00 | 0.00 | 0.00 | 11.38 | 16.51 | 19.66 | 18.96 | 21.85 | 22.46 | 33.19 |
|  | 1:40:00 | 0.00 | 0.00 | 11.11 | 14.88 | 18.21 | 16.71 | 19.16 | 19.23 | 28.41 |
|  | 1:45:00 | 0.00 | 0.00 | 10.91 | 13.42 | 17.19 | 15.17 | 17.31 | 17.01 | 25.12 |
|  | 1:50:00 | 0.00 | 0.00 | 10.75 | 12.40 | 16.47 | 14.18 | 16.12 | 15.50 | 22.87 |
|  | 1:55:00 | 0.00 | 0.00 | 9.50 | 11.65 | 15.55 | 13.48 | 15.27 | 14.42 | 21.24 |
|  | 2:00:00 | 0.00 | 0.00 | 8.27 | 10.79 | 14.06 | 13.01 | 14.70 | 13.77 | 20.26 |
|  | 2:05:00 | 0.00 | 0.00 | 6.29 | 8.22 | 10.59 | 10.02 | 11.30 | 10.61 | 15.58 |
|  | 2:10:00 | 0.00 | 0.00 | 4.50 | 5.83 | 7.46 | 7.07 | 7.96 | 7.50 | 10.99 |
|  | 2:15:00 | 0.00 | 0.00 | 3.20 | 4.15 | 5.30 | 5.04 | 5.66 | 5.39 | 7.88 |
|  | 2:20:00 | 0.00 | 0.00 | 2.26 | 2.90 | 3.75 | 3.57 | 4.01 | 3.84 | 5.61 |
|  | 2:25:00 | 0.00 | 0.00 | 1.55 | 1.96 | 2.58 | 2.46 | 2.76 | 2.65 | 3.86 |
|  | 2:30:00 | 0.00 | 0.00 | 1.03 | 1.31 | 1.75 | 1.68 | 1.89 | 1.81 | 2.64 |
|  | 2:35:00 | 0.00 | 0.00 | 0.65 | 0.87 | 1.14 | 1.13 | 1.27 | 1.21 | 1.76 |
|  | 2:40:00 | 0.00 | 0.00 | 0.36 | 0.52 | 0.67 | 0.69 | 0.77 | 0.73 | 1.06 |
|  | 2:45:00 | 0.00 | 0.00 | 0.16 | 0.26 | 0.32 | 0.35 | 0.39 | 0.37 | 0.53 |
|  | 2:50:00 | 0.00 | 0.00 | 0.06 | 0.09 | 0.11 | 0.12 | 0.14 | 0.13 | 0.18 |
|  | 2:55:00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 |
|  | 3:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:05:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:10:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:15:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:20:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
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|  | 3:45:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
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|  | 3:55:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
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|  | 4:20:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
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|  | 4:55:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:05:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:10:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:15:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:20:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:25:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:30:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:35:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:40:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:45:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:50:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:55:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
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## DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)
Summary Stage-Area-Volume-Discharge Relationships
The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically, The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

| Stage-Storage <br> Description | Stage <br> [ft] | Area <br> [ft ${ }^{2}$ ] | Area <br> [acres] | Volume <br> [ft $\left.{ }^{3}\right]$ | Volume <br> [ac-ft] | Total <br> Outflow <br> [cfs] |
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| stager best results, include the all grade slope |  |  |  |  |  |  |
| changes (e.g. ISV and Floor) |  |  |  |  |  |  |
| from the S-A-V table on |  |  |  |  |  |  |
| Sheet 'Basin'. |  |  |  |  |  |  |




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## Basin ID: POND FSD-14A



Watershed Information


After providing required inputs above including 1-hour rainfall
depths, click 'Run CUHP' to generate runoff hydrographs using depths, click 'Run CUHP' to generate runoff hydrographs using
the embedded Colorado Urban Hydrograph Procedure. Water Quality Capture Volume (WQCV) $=2.770$ acre-feet Excess Urban Runoff Volume (EURV) $=9.282$
 2 -yr Runoff Volume ( $\mathrm{P} 1=1.19 \mathrm{in}$. ) $=8.609$ acre-feet 5 -yr Runoff Volume $(\mathrm{P} 1=1.5 \mathrm{in})=$.11.740 acre-feet 10 -yr Runoff Volume (P1 = 1.75 in.) $=14.406$ $25-\mathrm{yr}$ Runoff Volume ( $\mathrm{P} 1=2 \mathrm{in}$.) $=$ 50 -yr Runoff Volume ( $\mathrm{P} 1=2.25 \mathrm{in}$ ) $)=$ 100-yr Runoff Volume ( $\mathrm{P} 1=2.52 \mathrm{in}$.) $=$
 Approxim Approximate $2-y r$ Detention Volume $=7.197$ acre-feet Approximate 10-yr Detention Volume $=12.301$ acre-feet Approximate 25 -yr Detention Volume $=13.252$ acre-feet Approximate 50 -yr Detention Volume $=13.799$ acre-feet Approximate 100 -yr Detention Volume $=14.917$ acre-feet

Define Zones and Basin Geometry

$$
\text { Zone } 1 \text { Volume (WQC) }
$$ Zone 2 Volume (EURV - Zone 1) Zone 3




All soils type in project are Group A. Please move $100 \%$ to Group A

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User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

|  | Row 1 (required) | Row 2 (optional) | Row 3 (optional) | Row 4 (optional) | Row 5 (optional) | Row 6 (optional) | Row 7 (optional) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | Row 8 (optional) 1


|  | Row 9 (optional) | Row 10 (optional) | Row 11 (optional) | Row 12 (optional) | Row 13 (optional) | Row 14 (optional) | Row 15 (optional) | Row 16 (optional) |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
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User Input: Vertical Orifice (Circular or Rectangular)


User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

|  | Zone 3 Weir | Not Selected | ft (relativ feet |
| :---: | :---: | :---: | :---: |
| Overflow Weir Front Edge Height, $\mathrm{Ho}=$ | 6.50 | N/A |  |
| Overflow Weir Front Edge Length = | 20.00 | N/A |  |
| Overflow Weir Grate Slope = | 0.00 | N/A | $\mathrm{H}: \mathrm{V}$ |
| Horiz. Length of Weir Sides $=$ | 5.00 | N/A | feet |
| Overflow Grate Type = | Close Mesh Grate | N/A |  |
| Debris Clogging \% = | 50\% | N/A | \% |

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectanqular Orifice)

| $\begin{aligned} \text { Depth to Invert of Outlet Pipe } & = \\ \text { Outlet Pipe Diameter } & =\end{aligned}$ | Zone 3 Restrictor | Not Selected | ft (distance below basin bott inches |
| :---: | :---: | :---: | :---: |
|  | 2.50 | N/A |  |
|  | 42.00 | N/A |  |
| Restrictor Plate Height Above Pipe Invert = | 36.00 | inches |  |
| r Input: Emergency Spillway (Rectangular or Trapezoidal) |  |  |  |
| Spillway Invert Stage= | 8.50 | elative to ba | bottom at Stage $=0 \mathrm{ft}$ ) |
| Spillway Crest Length = | 100.00 | et |  |
| Spillway End Slopes = | 3.00 | V |  |
| Freeboard above Max Water Surface $=$ | 1.00 | et |  |

Calculated Parameters for Overflow Weir $=0 \mathrm{ft})$ Height of Grate Upper Edge, $\mathrm{H}_{\mathrm{t}}=$ Overflow Weir Slope Length $=$
Grate Open Area / 100-yr Orifice Area $=$ Overflow Grate Open Area w/o Debris = Overflow Grate Open Area w/ Debris =

| Zone 3 Weir | Not Selected |
| :---: | :---: |
|  |  |
| 6.50 | $\mathrm{~N} / \mathrm{A}$ |
| feet |  |
| 5.00 | $\mathrm{~N} / \mathrm{A}$ |
| feet |  |
| 9.01 | $\mathrm{~N} / \mathrm{A}$ |
| 79.10 | $\mathrm{~N} / \mathrm{A}$ |
| 39.55 | ft |
|  | $\mathrm{N} / \mathrm{A}$ | $\mathrm{ft}^{2}$

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

|  | Zone 3 Restrictor | Not Selected |
| :---: | :---: | :---: |
| Outlet Orifice Area $=$ | 8.78 | N/A |
| Outlet Orifice Centroid = | 1.61 | N/A |
| f Restrictor Plate on Pipe $=$ | 2.37 | N/A | Half-Central Angle of Restrictor Plate on Pipe $=$

Calculated Parameters for Vertical Orifice

| Vertical Orifice Area $=$ Vertical Orifice Centroid = | Not Selected | Not Selected |
| :---: | :---: | :---: |
|  | N/A | N/A |
|  | N/A | N/A | feet

Routed Hydrograph Results

| WQCV | EURV | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year | 500 Year |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| N/A | N/A | 1.19 | 1.50 | 1.75 | 2.00 | 2.25 | 2.52 | 3.48 |
| 2.770 | 9.282 | 8.609 | 11.740 | 14.406 | 17.668 | 20.486 | 23.901 | 35.063 |
| N/A | N/A | 8.609 | 11.740 | 14.406 | 17.668 | 20.486 | 23.901 | 35.063 |
| N/A | N/A | 10.4 | 29.4 | 45.4 | 83.2 | 104.6 | 134.7 | 219.3 |
| N/A | N/A |  |  |  |  |  |  |  |
| N/A | N/A | 0.08 | 0.22 | 0.35 | 0.64 | 0.80 | 1.03 | 1.68 |
| N/A | N/A | 120.4 | 163.4 | 195.0 | 254.2 | 294.7 | 345.0 | 500.4 |
| 1.5 | 3.2 | 3.0 | 18.6 | 44.1 | 87.6 | 121.1 | 128.9 | 317.9 |
| N/A | N/A | N/A | 0.6 | 1.0 | 1.1 | 1.2 | 1.0 | 1.4 |
| Plate | Plate | Plate | Overflow Weir 1 | Overflow Weir 1 | Overflow Weir 1 | Overflow Weir 1 | Outlet Plate 1 | Spillway |
| N/A | N/A | N/A | 0.2 | 0.5 | 1.1 | 1.5 | 1.6 | 1.6 |
| N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| 38 | 68 | 67 | 72 | 70 | 68 | 67 | 65 | 59 |
| 40 | 73 | 71 | 77 | 77 | 76 | 75 | 74 | 72 |
| 3.17 | 6.34 | 5.83 | 6.82 | 7.12 | 7.51 | 7.76 | 8.41 | 9.21 |
| 1.62 | 2.37 | 2.27 | 2.47 | 2.53 | 2.61 | 2.66 | 2.77 | 2.90 |
| 2.770 | 9.291 | 8.111 | 10.451 | 11.199 | 12.175 | 12.832 | 14.600 | 16.899 |



Inflow Hydrographs
The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

|  | SOURCE | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Time Interval | TIME | WQCV [cfs] | EURV [cfs] | 2 Year [cfs] | 5 Year [cfs] | 10 Year [cfs] | 25 Year [cfs] | 50 Year [cfs] | 100 Year [cfs] | 500 Year [cfs] |
| 5.00 min | 0:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 0:05:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 0:10:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.83 | 0.08 | 4.10 |
|  | 0:15:00 | 0.00 | 0.00 | 7.34 | 11.99 | 14.85 | 9.97 | 13.01 | 12.20 | 23.15 |
|  | 0:20:00 | 0.00 | 0.00 | 31.15 | 42.58 | 51.34 | 32.27 | 38.23 | 40.05 | 62.65 |
|  | 0:25:00 | 0.00 | 0.00 | 75.83 | 104.57 | 128.91 | 74.63 | 87.15 | 94.34 | 150.88 |
|  | 0:30:00 | 0.00 | 0.00 | 112.78 | 155.26 | 188.30 | 169.61 | 198.29 | 220.11 | 332.99 |
|  | 0:35:00 | 0.00 | 0.00 | 120.41 | 163.39 | 195.05 | 240.34 | 279.90 | 322.30 | 472.85 |
|  | 0:40:00 | 0.00 | 0.00 | 110.81 | 147.76 | 175.58 | 254.22 | 294.73 | 345.04 | 500.39 |
|  | 0:45:00 | 0.00 | 0.00 | 96.96 | 129.27 | 154.76 | 235.64 | 272.59 | 324.43 | 469.02 |
|  | 0:50:00 | 0.00 | 0.00 | 84.57 | 114.87 | 137.59 | 212.75 | 245.96 | 295.05 | 426.65 |
|  | 0:55:00 | 0.00 | 0.00 | 74.18 | 101.73 | 121.89 | 189.94 | 219.80 | 266.52 | 385.70 |
|  | 1:00:00 | 0.00 | 0.00 | 65.29 | 89.30 | 107.94 | 166.57 | 192.99 | 239.37 | 346.52 |
|  | 1:05:00 | 0.00 | 0.00 | 58.31 | 79.25 | 97.09 | 145.75 | 169.04 | 215.23 | 311.87 |
|  | 1:10:00 | 0.00 | 0.00 | 52.29 | 72.69 | 90.30 | 126.81 | 147.28 | 187.41 | 272.92 |
|  | 1:15:00 | 0.00 | 0.00 | 46.70 | 66.78 | 85.00 | 111.80 | 130.02 | 161.00 | 235.79 |
|  | 1:20:00 | 0.00 | 0.00 | 41.63 | 59.97 | 78.00 | 97.70 | 113.61 | 136.21 | 199.86 |
|  | 1:25:00 | 0.00 | 0.00 | 37.05 | 53.03 | 68.47 | 84.42 | 98.06 | 113.63 | 166.42 |
|  | 1:30:00 | 0.00 | 0.00 | 32.62 | 46.42 | 58.33 | 71.38 | 82.74 | 93.80 | 137.12 |
|  | 1:35:00 | 0.00 | 0.00 | 28.50 | 40.63 | 49.46 | 59.17 | 68.36 | 76.23 | 111.23 |
|  | 1:40:00 | 0.00 | 0.00 | 25.19 | 34.79 | 42.45 | 48.27 | 55.56 | 60.80 | 88.67 |
|  | 1:45:00 | 0.00 | 0.00 | 23.36 | 30.49 | 38.49 | 39.50 | 45.33 | 48.41 | 71.06 |
|  | 1:50:00 | 0.00 | 0.00 | 22.53 | 27.72 | 36.08 | 34.54 | 39.54 | 41.15 | 60.59 |
|  | 1:55:00 | 0.00 | 0.00 | 20.81 | 25.79 | 33.99 | 31.34 | 35.77 | 36.47 | 53.77 |
|  | 2:00:00 | 0.00 | 0.00 | 18.59 | 24.05 | 31.45 | 29.25 | 33.27 | 33.18 | 48.96 |
|  | 2:05:00 | 0.00 | 0.00 | 15.45 | 20.39 | 26.52 | 24.82 | 28.19 | 27.65 | 40.81 |
|  | 2:10:00 | 0.00 | 0.00 | 12.08 | 15.90 | 20.65 | 19.29 | 21.87 | 21.01 | 30.99 |
|  | 2:15:00 | 0.00 | 0.00 | 9.28 | 12.13 | 15.73 | 14.55 | 16.48 | 15.51 | 22.86 |
|  | 2:20:00 | 0.00 | 0.00 | 7.13 | 9.29 | 11.97 | 11.04 | 12.47 | 11.57 | 17.04 |
|  | 2:25:00 | 0.00 | 0.00 | 5.48 | 7.09 | 9.05 | 8.43 | 9.50 | 8.85 | 12.99 |
|  | 2:30:00 | 0.00 | 0.00 | 4.16 | 5.32 | 6.74 | 6.32 | 7.11 | 6.67 | 9.76 |
|  | 2:35:00 | 0.00 | 0.00 | 3.13 | 3.92 | 5.02 | 4.69 | 5.27 | 5.00 | 7.32 |
|  | 2:40:00 | 0.00 | 0.00 | 2.31 | 2.86 | 3.74 | 3.48 | 3.91 | 3.74 | 5.47 |
|  | 2:45:00 | 0.00 | 0.00 | 1.67 | 2.08 | 2.76 | 2.61 | 2.92 | 2.80 | 4.09 |
|  | 2:50:00 | 0.00 | 0.00 | 1.14 | 1.44 | 1.93 | 1.86 | 2.08 | 1.99 | 2.90 |
|  | 2:55:00 | 0.00 | 0.00 | 0.71 | 0.95 | 1.25 | 1.23 | 1.38 | 1.32 | 1.92 |
|  | 3:00:00 | 0.00 | 0.00 | 0.39 | 0.56 | 0.71 | 0.74 | 0.82 | 0.79 | 1.14 |
|  | 3:05:00 | 0.00 | 0.00 | 0.17 | 0.28 | 0.33 | 0.37 | 0.41 | 0.39 | 0.56 |
|  | 3:10:00 | 0.00 | 0.00 | 0.06 | 0.09 | 0.10 | 0.12 | 0.13 | 0.13 | 0.18 |
|  | 3:15:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:20:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:25:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:30:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:35:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:40:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:45:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:50:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:55:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:05:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:10:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:15:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:20:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:25:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:30:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:35:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:40:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:45:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:50:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:55:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:05:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:10:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:15:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:20:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:25:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:30:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:35:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:40:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:45:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:50:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:55:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 6:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)
Summary Stage-Area-Volume-Discharge Relationships
The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically, The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

| Stage-Storage <br> Description | Stage <br> [ft] | Area <br> [ft ${ }^{2}$ ] | Area <br> [acres] | Volume <br> [ft $\left.{ }^{3}\right]$ | Volume <br> [ac-ft] | Total <br> Outflow <br> [cfs] |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
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|  |  |  |  |  |  |  |
| stager best results, include the all grade slope |  |  |  |  |  |  |
| changes (e.g. ISV and Floor) |  |  |  |  |  |  |
| from the S-A-V table on |  |  |  |  |  |  |
| Sheet 'Basin'. |  |  |  |  |  |  |




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Project: STERLING RANCH EAST PRELIMINARY PLAN/PUD NO. 3

## Basin ID: FSD-14B



| atershed Information |  |  |
| :---: | :---: | :---: |
| Selected BMP Type = | EDB | acres |
| $\begin{aligned} \text { Watershed Area } & = \\ \text { Watershed Length } & = \\ \text { Watershed Length to Centroid } & =\end{aligned}$ | 63.10 |  |
|  | 2,500 | ft |
|  | 1,250 |  |
| Watershed Slope $=$ | 0.02 | $\mathrm{t} / \mathrm{ft}$ |
| Watershed Imperviousness = Percentage Hydrologic Soil Group A = | 65.00\% |  |
|  | 0.0\% |  |
| Percentage Hydrologic Soil Group B = | 100.0\% |  |
| Percentage Hydrologic Soil Groups C/D | 0.0\% |  |
| Target WQCV Drain Time | 40.0 |  |
| Location for 1-hr Rainfall Depths = User Input |  |  |
| After providing required inputs above including 1 -hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure. |  |  |
| Water Quality Capture Volume (WQCV) $=$ Excess Urban Runoff Volume (EURV) = 2 -yr Runoff Volume ( $\mathrm{P} 1=1.19 \mathrm{in}$.) = $5-y r$ Runoff Volume ( $\mathrm{P} 1=1.5 \mathrm{in}$.) = $10-$ yr Runoff Volume ( $\mathrm{P} 1=1.75$ in.) ) $25-\mathrm{yr}$ Runoff Volume (P1 = 2 in .) $=$ | 1.336 |  |
|  | 4.478 |  |
|  | 4.138 | -feet |
|  | 5.644 | cre-feet |
|  | 6.926 | -feet |
|  | 8.495 |  |
| $50-\mathrm{yr}$ Runoff Volume (P1 = 2.25 in .) = | 9.849 |  |
|  | 11.491 |  |
| $100-\mathrm{yr}$ Runoff Volume ( $\mathrm{P} 1=2.52 \mathrm{in}$.) $=$ <br> 500-yr Runoff Volume ( $\mathrm{P} 1=3.48 \mathrm{in}$.) $=$ | 16.858 | e-feet |
| $500-\mathrm{yr}$ Runoff Volume ( $\mathrm{P} 1=3.48 \mathrm{in}$.) = <br> Approximate $2-y r$ Detention Volume $=$ | 3.472 | --e |
| Approximate 5-yr Detention Volume $=$ | 4.655 |  |
| Approximate $10-\mathrm{yr}$ Detention Volume $=$ Approximate $25-\mathrm{yr}$ Detention Volume $=$ | 5.934 |  |
|  | 6.393 |  |
| Approximate $50-\mathrm{yr}$ Detention Volume $=$ Approximate 100 -yr Detention Volume $=$ | 6.657 |  |
|  | 7.196 | acre-feet |

Define Zones and Basin Geometry

$$
\text { Zone } 1 \text { Volume (WQCV }
$$

$\qquad$

| 1.336 | acre-feet |
| :---: | :---: |
| 3.141 | acre-feet |
| 2.719 | acre-feet |
| 7.196 | acre-feet |
| user | $\mathrm{ft}^{3}$ |
| user | ft |
| user | ft |
| user | ft |
| user | $\mathrm{f} / \mathrm{ft}$ |
| user | H:V |
| user |  |




Optional User Override

| Optional User Overrides  <br>  acre-feet |  |
| :--- | :--- |
|  | acre-feet |
| inches |  |




## Project: STERLING RANCH EAST PRELIMINARY PLAN/PUD NO. 3

## Basin ID: FSD-14B



## Outlet design will be reviewed with Final Drainage Reports

| User Input: Orifice at Underdrain Outlet (typically used to drain WOCV in a Filtration BMP) |  |  |  | Calculated Parameters for Underdrain |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Underdrain Orifice Invert Depth $=$ | N/A | ft (distance below the filtration media surface) | Underdrain Orifice Area $=$ | N/A | $\mathrm{ft}^{2}$ |
| Underdrain Orifice Diameter $=$ | N/A | inches | Underdrain Orifice Centroid = | N/A | feet |


| User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP) |  |  |  | Calculated Parameters for Plate |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Centroid of Lowest Orifice $=$ | 0.00 | ft (relative to basin bottom at Stage $=0 \mathrm{ft}$ ) | WQ Orifice Area per Row = | N/A | $\mathrm{ft}^{2}$ |
| Depth at top of Zone using Orifice Plate $=$ | 5.24 | ft (relative to basin bottom at Stage $=0 \mathrm{ft}$ ) | Elliptical Half-Width $=$ | N/A | feet |
| Orifice Plate: Orifice Vertical Spacing = | 21.00 | hes | Elliptical Slot Centroid = | N/A | feet |
| Orifice Plate: Orifice Area per Row $=$ | N/A | sq. inches | Elliptical Slot Area $=$ | N/A | $\mathrm{ft}^{2}$ |

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

|  | Row 1 (required) | Row 2 (optional) | Row 3 (optional) | Row 4 (optional) | Row 5 (optional) | Row 6 (optional) | Row 7 (optional) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | Row 8 (optional)


|  | Row 9 (optional) | Row 10 (optional) | Row 11 (optional) | Row 12 (optional) | Row 13 (optional) | Row 14 (optional) | Row 15 (optional) | Row 16 (optional) |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
|  |  |  |  |  |  |  |  |  |

User Input: Vertical Orifice (Circular or Rectangular)

|  | Not Selected | Not Selected |  |
| :---: | :---: | :---: | :---: |
| Invert of Vertical Orifice $=$ | N/A | N/A | ft (relative to basin bottom at Stage $=0 \mathrm{ft}$ ) |
| Depth at top of Zone using Vertical Orifice $=$ | N/A | N/A | ft (relative to basin bottom at Stage $=0 \mathrm{ft}$ ) |
| Vertical Orifice Diameter $=$ | N/A | N/A | inches |


|  | Calculated Parameters for Vertical Orifice |  |  |
| :---: | :---: | :---: | :---: |
|  | Not Selected | Not Selected |  |
| Vertical Orifice Area $=$ | N/A | N/A | $\mathrm{ft}^{2}$ |
| Vertical Orifice Centroid $=$ | N/A | N/A | eet |

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

|  | Zone 3 Weir | Not Selected |
| :---: | :---: | :---: |
| Overflow Weir Front Edge Height, $\mathrm{Ho}=$ Overflow Weir Front Edge Length = | 5.24 | N/A |
|  | 16.00 | N/A |
| Overflow Weir Grate Slope = | 0.00 | N/A |
| Horiz. Length of Weir Sides $=$ | 4.00 | N/A |
| Overflow Grate Type = | Close Mesh Grate | N/A |
| Debris Clogging \% = | 50\% | N/A |


| Outlet Pipe) | Calculated Parameters for Overflow Weir |  |  |
| :---: | :---: | :---: | :---: |
|  | Zone 3 Weir | Not Selected |  |
| $0 \mathrm{ft})$ Height of Grate Upper Edge, $\mathrm{H}_{\mathrm{t}}=$ | 5.24 | N/A |  |
| Overflow Weir Slope Length = | 4.00 | N/A |  |
| Grate Open Area / 100-yr Orifice Area = | 5.26 | N/A |  |
| Overflow Grate Open Area w/o Debris = | 50.62 | N/A | $\mathrm{ft}^{2}$ |
| Overflow Grate Open Area w/ Debris = | 25.31 | N/A | $\mathrm{ft}^{2}$ |

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectanqular Orifice)
Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

| Depth to Invert of Outlet Pipe = Outlet Pipe Diameter $=$ or Plate Height Above Pipe Invert = | Zone 3 Restrictor | Not Selected | ft (distance below basin bottoinchesinches | Outlet Orifice Area $=$ Outlet Orifice Centroid = Half-Central Angle of Restrictor Plate on Pipe $=$ | Zone 3 Restrictor | Not Selected |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 2.50 | N/A |  |  | 9.62 | N/A |
|  | 42.00 | N/A |  |  | 1.75 | N/A |
|  | 42.00 |  |  |  | 3.14 | N/A |
| Jser Input: Emergency Spillway (Rectangular or Trapezoidal) |  | ft (relative to basin bottom at Stage $=0 \mathrm{ft}$ ) Spillway Design Flow Depth $=$ <br> feet Stage at Top of Freeboard $=$ <br> $\mathrm{H}: \mathrm{V}$ Basin Area at Top of Freeboard $=$ <br> feet Basin Volume at Top of Freeboard $=$ |  |  | Calculated Parameters for Spillway |  |
| Spillway Invert Stage= | 7.00 |  |  |  | 1.02 | feet <br> feet <br> acres <br> acre-ft |
| Spillway Crest Length = | 60.00 |  |  |  | 9.02 |  |
| Spillway End Slopes = | 3.00 |  |  |  | 1.98 |  |
| Freeboard above Max Water Surface = | 1.00 |  |  |  | 11.22 |  |

Routed Hydrograph Results

| WQCV | EURV | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year | 500 Year |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| N/A | N/A | 1.19 | 1.50 | 1.75 | 2.00 | 2.25 | 2.52 | 3.48 |
| 1.336 | 4.478 | 4.138 | 5.644 | 6.926 | 8.495 | 9.849 | 11.491 | 16.858 |
| N/A | N/A | 4.138 | 5.644 | 6.926 | 8.495 | 9.849 | 11.491 | 16.858 |
| N/A | N/A | 6.4 | 17.9 | 27.2 | 48.6 | 61.1 | 77.6 | 126.2 |
| N/A | N/A |  | 57.0 |  |  |  | 124.0 |  |
| N/A | N/A | 0.10 | 0.90 T | 0.43 | 0.77 | 0.97 | 71.97 | 2.00 |
| N/A | N/A | 68.4 | 93.9 | - 112.8 | 142.4 | 165.4 | 193.6 | 281.0 |
| 0.7 | 1.5 | 1.4 | 10.6 | 22.9 | 48.0 | 66.5 | 95.0 | 158.0 |
| N/A | N/A | N/A | 0.2 | 88 | 1.0 | 1.1 | 0.8 | 1.3 |
| Plate | Overflow Weir 1 | Plate | Overflow Weir 1 | Overflow Meir 1 | Overflow Weir 1 | Overflow weir 1 | Overflow Weir 1 | Spillway |
| N/A | N/A | N/A | 0.2 | 0.4 | 0.9 | 1/ | 1.8 | 2.6 |
| N/A | N/A | N/A | N/A | N/A | N/A | //A | N/A | N/A |
| 38 | 68 | 67 | 70 | 69 | 67 | 65 | 63 | 57 |
| 40 | 74 | 72 | 77 | 76 | 8 | 74 | 73 | 71 |
| 2.97 | 5.24 | 4.88 | 5.51 | 5.71 | 6.03 | 6.22 | 6.49 | 7.28 |
| 1.00 | 1.58 | 1.54 | 1.61 | 1.63 | 1.66 | 1.68 | 1.71 | 1.79 |
| 1.340 | 4.488 | 3.910 | 4.903 | 5.227 | 5.753 | 6.087 | 6.545 | 7.912 |

> Flows shown do not match those shown on developed drainage map. Confirm which flows are correct and


Inflow Hydrographs
The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

|  | SOURCE | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Time Interval | TIME | WQCV [cfs] | EURV [cfs] | 2 Year [cfs] | 5 Year [cfs] | 10 Year [cfs] | 25 Year [cfs] | 50 Year [cfs] | 100 Year [cfs] | 500 Year [cfs] |
| 5.00 min | 0:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 0:05:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 0:10:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.73 | 0.07 | 3.60 |
|  | 0:15:00 | 0.00 | 0.00 | 6.46 | 10.54 | 13.05 | 8.76 | 11.03 | 10.68 | 18.39 |
|  | 0:20:00 | 0.00 | 0.00 | 23.94 | 31.77 | 38.11 | 23.64 | 27.59 | 29.43 | 44.82 |
|  | 0:25:00 | 0.00 | 0.00 | 53.28 | 73.95 | 91.70 | 52.12 | 60.79 | 66.14 | 106.78 |
|  | 0:30:00 | 0.00 | 0.00 | 68.40 | 93.86 | 112.76 | 118.88 | 139.02 | 155.14 | 230.89 |
|  | 0:35:00 | 0.00 | 0.00 | 64.09 | 86.25 | 102.28 | 142.40 | 165.44 | 193.57 | 281.00 |
|  | 0:40:00 | 0.00 | 0.00 | 55.59 | 73.32 | 87.06 | 135.11 | 156.25 | 183.92 | 265.56 |
|  | 0:45:00 | 0.00 | 0.00 | 46.35 | 62.02 | 74.67 | 118.05 | 136.45 | 164.34 | 237.21 |
|  | 0:50:00 | 0.00 | 0.00 | 38.42 | 52.81 | 62.91 | 104.13 | 120.35 | 145.11 | 209.22 |
|  | 0:55:00 | 0.00 | 0.00 | 32.49 | 44.67 | 53.58 | 87.34 | 101.01 | 124.37 | 179.48 |
|  | 1:00:00 | 0.00 | 0.00 | 28.56 | 39.02 | 47.69 | 73.16 | 84.77 | 107.68 | 155.92 |
|  | 1:05:00 | 0.00 | 0.00 | 25.54 | 34.71 | 43.04 | 63.78 | 74.04 | 96.82 | 140.34 |
|  | 1:10:00 | 0.00 | 0.00 | 21.57 | 30.69 | 38.56 | 53.92 | 62.67 | 80.21 | 116.85 |
|  | 1:15:00 | 0.00 | 0.00 | 17.73 | 26.07 | 34.36 | 44.84 | 52.19 | 64.17 | 94.16 |
|  | 1:20:00 | 0.00 | 0.00 | 14.61 | 21.49 | 29.17 | 35.74 | 41.56 | 48.87 | 71.66 |
|  | 1:25:00 | 0.00 | 0.00 | 12.59 | 18.46 | 24.27 | 28.08 | 32.59 | 36.03 | 52.90 |
|  | 1:30:00 | 0.00 | 0.00 | 11.54 | 16.89 | 21.11 | 22.34 | 25.88 | 27.45 | 40.53 |
|  | 1:35:00 | 0.00 | 0.00 | 11.00 | 15.97 | 19.09 | 18.67 | 21.53 | 22.30 | 33.02 |
|  | 1:40:00 | 0.00 | 0.00 | 10.71 | 14.40 | 17.65 | 16.36 | 18.78 | 19.02 | 28.14 |
|  | 1:45:00 | 0.00 | 0.00 | 10.52 | 12.99 | 16.63 | 14.80 | 16.91 | 16.73 | 24.75 |
|  | 1:50:00 | 0.00 | 0.00 | 10.36 | 12.00 | 15.92 | 13.78 | 15.68 | 15.18 | 22.44 |
|  | 1:55:00 | 0.00 | 0.00 | 9.18 | 11.27 | 15.04 | 13.07 | 14.82 | 14.07 | 20.78 |
|  | 2:00:00 | 0.00 | 0.00 | 8.00 | 10.44 | 13.62 | 12.59 | 14.23 | 13.37 | 19.71 |
|  | 2:05:00 | 0.00 | 0.00 | 6.11 | 7.99 | 10.32 | 9.74 | 10.99 | 10.31 | 15.16 |
|  | 2:10:00 | 0.00 | 0.00 | 4.41 | 5.72 | 7.32 | 6.92 | 7.80 | 7.33 | 10.76 |
|  | 2:15:00 | 0.00 | 0.00 | 3.16 | 4.09 | 5.23 | 4.96 | 5.58 | 5.29 | 7.75 |
|  | 2:20:00 | 0.00 | 0.00 | 2.25 | 2.90 | 3.73 | 3.55 | 3.98 | 3.81 | 5.57 |
|  | 2:25:00 | 0.00 | 0.00 | 1.57 | 1.98 | 2.60 | 2.47 | 2.77 | 2.65 | 3.88 |
|  | 2:30:00 | 0.00 | 0.00 | 1.05 | 1.33 | 1.78 | 1.70 | 1.91 | 1.83 | 2.67 |
|  | 2:35:00 | 0.00 | 0.00 | 0.68 | 0.90 | 1.19 | 1.17 | 1.31 | 1.25 | 1.82 |
|  | 2:40:00 | 0.00 | 0.00 | 0.40 | 0.56 | 0.72 | 0.73 | 0.82 | 0.78 | 1.13 |
|  | 2:45:00 | 0.00 | 0.00 | 0.19 | 0.30 | 0.37 | 0.40 | 0.44 | 0.42 | 0.61 |
|  | 2:50:00 | 0.00 | 0.00 | 0.08 | 0.12 | 0.14 | 0.16 | 0.18 | 0.17 | 0.24 |
|  | 2:55:00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 |
|  | 3:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:05:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:10:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:15:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:20:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:25:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:30:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:35:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:40:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:45:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:50:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:55:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:05:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:10:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:15:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:20:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:25:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:30:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:35:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:40:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:45:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:50:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
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|  | 5:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:05:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:10:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:15:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:20:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:25:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:30:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:35:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:40:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:45:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:50:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:55:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 6:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Summary Stage-Area-Volume-Discharge Relationships
The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically, The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

| Stage - Storage Description | $\begin{gathered} \text { Stage } \\ {[\mathrm{ft}]} \end{gathered}$ | Area <br> [ $\mathrm{ft}^{2}$ ] | Area [acres] | Volume [ft ${ }^{3}$ ] | Volume [ac-ft] | $\begin{gathered} \text { Total } \\ \text { Outflow } \\ \text { [cfs] } \end{gathered}$ |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  | includ |
|  |  |  |  |  |  |  | stages of all grade slope |
|  |  |  |  |  |  |  | changes (e.g. ISV and Floor) |
|  |  |  |  |  |  |  | from the S-A-V table on |
|  |  |  |  |  |  |  | Sheet 'Basin'. |
|  |  |  |  |  |  |  | Also include the inverts of all |
|  |  |  |  |  |  |  | outlets (e.g. vertical orifice, |
|  |  |  |  |  |  |  | overflow grate, and spillway, |



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## Project: STERLING RANCH EAST PRELIMINARY PLAN NO. 1

## Basin ID: POND FSD-16



> Outlet design will be reviewed with Final Drainage Reports

| User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP) |  |  |  | Calculated Parameters for Under |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Underdrain Orifice Invert Depth = Underdrain Orifice Diameter $=$ | N/A | ft (distance below the filtration media surface) inches | Underdrain Orifice Area = Underdrain Orifice Centroid = | N/A | $\begin{aligned} & \mathrm{ft}^{2} \\ & \text { feet } \end{aligned}$ |
|  | N/A |  |  | N/A |  |
| User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP) |  |  |  | Calculated Parameters for Plate |  |
| Centroid of Lowest Orifice $=$ | 0.00 | ft (relative to basin bottom at Stage $=0 \mathrm{ft}$ ) | WQ Orifice Area per Row = | N/A | $\mathrm{ft}^{2}$ |
| Depth at top of Zone using Orifice Plate $=$ | 6.50 | ft (relative to basin bottom at Stage $=0 \mathrm{ft}$ ) | Elliptical Half-Width = | N/A | eet |
| Orifice Plate: Orifice Vertical Spacing = | 26.00 | inches | Elliptical Slot Centroid $=$ | N/A | feet |
| Orifice Plate: Orifice Area per Row = | N/A | sq. inches | Elliptical Slot Area = | N/A | $\mathrm{ft}^{2}$ |

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

|  | Row 1 (required) | Row 2 (optional) | Row 3 (optional) | Row 4 (optional) | Row 5 (optional) | Row 6 (optional) | Row 7 (optional) | Row 8 (optional) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Stage of Orifice Centroid (ft) | 0.00 | 2.20 | 4.40 |  |  |  |  |  |
| Orifice Area (sq. inches) | 16.00 | 20.00 | 80.00 |  |  |  |  |  |


|  | Row 9 (optional) | Row 10 (optional) | Row 11 (optional) | Row 12 (optional) | Row 13 (optional) | Row 14 (optional) | Row 15 (optional) | Row 16 (optional) |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
|  |  |  |  |  |  |  |  |  |

User Input: Vertical Orifice (Circular or Rectangular)

| Invert of Vertical Orifice $=$ <br> Depth at top of Zone using Vertical Orifice $=$ <br> Vertical Orifice Diameter $=$ | Not Selected | Not Selected | ft (relative to basin bottom at Stage $=0 \mathrm{ft}$ ) ft (relative to basin bottom at Stage $=0 \mathrm{ft}$ ) inches |
| :---: | :---: | :---: | :---: |
|  | N/A | N/A |  |
|  | N/A | N/A |  |
|  | N/A | N/A |  |


|  | Calculated Parameters for Vertical Orifice |  |  |
| :---: | :---: | :---: | :---: |
|  | Not Selected | Not Selected |  |
| Vertical Orifice Area $=$ | N/A | N/A | $\mathrm{ft}^{2}$ |
| Vertical Orifice Centroid $=$ | N/A | N/A | eet |

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

|  | Zone 3 Weir | Not Selected |
| :---: | :---: | :---: |
| Overflow Weir Front Edge Height, $\mathrm{Ho}=$ Overflow Weir Front Edge Length = | 6.50 | N/A |
|  | 20.00 | N/A |
| Overflow Weir Grate Slope = Horiz. Length of Weir Sides = | 0.00 | N/A |
|  | 5.00 | N/A |
| Overflow Grate Type = Debris Clogging \% = | Close Mesh Grate | N/A |
|  | 50\% | N/A |

Height of Grate Upper Edge, $\mathrm{H}_{\mathrm{t}}=$
Overflow Weir Slope Length $=$
Grate Open Area $/ 100$-yr Orifice Area $=$
Overflow Grate Open Area w/o Debris $=$
Overflow Grate Open Area w/ Debris $=$


User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectanqular Orifice)
Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate


| $\frac{\text { Routed Hydrograph Results }}{\text { Design Storm Return Period }=0}$ | The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF). |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | WQCV | EURV | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year | 500 Year |
| One-Hour Rainfall Depth (in) $=$ | N/A | N/A | 1.19 | 1.50 | 1.75 | 2.00 | 2.25 | 2.52 | 3.48 |
| CUHP Runoff Volume (acre-ft) = | 4.822 | 15.946 | 14.895 | 20.580 | 25.471 | 31.662 | 36.887 | 43.326 | 64.093 |
| Inflow Hydrograph Volume (acre-ft) = | N/A | N/A | 14.895 | 20.580 | 25.471 | 31.662 | 36.887 | 43.326 | 64.093 |
| CUHP Predevelopment Peak Q (cfs) = | N/A | N/A | 18.5 | 52.4 | 81.6 | 150.3 | 189.1 | 243.5 | 396.8 |
| OPTIONAL Override Predevelopment Peak Q (cfs) = | N/A | N/A |  |  |  |  |  |  |  |
| Predevelopment Unit Peak Flow, q (cfs/acre) = | N/A | N/A | 0.08 | 0.21 | 0.33 | 0.61 | 0.77 | 0.99 | 1.62 |
| Peak Inflow Q (cfs) $=$ | N/A | N/A | 195.2 | 271.3 | 328.6 | 431.7 | 503.6 | 589.5 | 863.9 |
| Peak Outflow Q (cfs) $=$ | 2.0 | 6.5 | 6.0 | 24.4 | 59.3 | 115.4 | 149.5 | 157.6 | 471.8 |
| Ratio Peak Outflow to Predevelopment $\mathrm{Q}=$ | N/A | N/A | N/A | 0.5 | 0.7 | 0.8 | 0.8 | 0.6 | 1.2 |
| Structure Controlling Flow = | Plate | Plate | Plate | Overflow Weir 1 | Overflow Weir 1 | Overflow Weir 1 | Outlet Plate 1 | Outlet Plate 1 | Spillway |
| Max Velocity through Grate 1 (fps) = | N/A | N/A | N/A | 0.2 | 0.7 | 1.4 | 1.8 | 1.9 | 2.0 |
| Max Velocity through Grate 2 (fps) = | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Time to Drain 97\% of Inflow Volume (hours) = | 40 | 67 | 66 | 70 | 69 | 67 | 66 | 64 | 59 |
| Time to Drain 99\% of Inflow Volume (hours) = | 43 | 73 | 72 | 77 | 77 | 76 | 75 | 74 | 71 |
| Maximum Ponding Depth (ft) = | 4.05 | 6.40 | 6.02 | 6.85 | 7.23 | 7.69 | 8.04 | 8.78 | 9.76 |
| Area at Maximum Ponding Depth (acres) = | 3.72 | 5.52 | 5.45 | 5.61 | 5.68 | 5.77 | 5.84 | 5.98 | 6.18 |
| Maximum Volume Stored (acre-ft) $=$ | 4.853 | 15.987 | 13.901 | 18.492 | 20.637 | 23.214 | 25.303 | 29.677 | 35.637 |



Inflow Hydrographs
The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

|  | SOURCE | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Time Interval | TIME | WQCV [cfs] | EURV [cfs] | 2 Year [cfs] | 5 Year [cfs] | 10 Year [cfs] | 25 Year [cfs] | 50 Year [cfs] | 100 Year [cfs] | 500 Year [cfs] |
| 5.00 min | 0:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 0:05:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 0:10:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.99 | 0.10 | 4.86 |
|  | 0:15:00 | 0.00 | 0.00 | 8.69 | 14.20 | 17.60 | 11.82 | 15.77 | 14.51 | 29.18 |
|  | 0:20:00 | 0.00 | 0.00 | 39.89 | 55.39 | 66.84 | 42.38 | 50.75 | 52.57 | 84.21 |
|  | 0:25:00 | 0.00 | 0.00 | 103.42 | 144.47 | 179.21 | 102.69 | 120.50 | 130.45 | 212.27 |
|  | 0:30:00 | 0.00 | 0.00 | 168.01 | 235.50 | 289.50 | 241.38 | 283.75 | 315.50 | 488.55 |
|  | 0:35:00 | 0.00 | 0.00 | 195.18 | 271.34 | 328.62 | 377.22 | 442.14 | 507.75 | 757.70 |
|  | 0:40:00 | 0.00 | 0.00 | 187.80 | 256.08 | 307.18 | 431.68 | 503.60 | 589.49 | 863.89 |
|  | 0:45:00 | 0.00 | 0.00 | 168.48 | 228.93 | 276.42 | 414.47 | 481.99 | 573.59 | 837.24 |
|  | 0:50:00 | 0.00 | 0.00 | 148.80 | 204.51 | 247.24 | 383.29 | 445.38 | 534.38 | 778.69 |
|  | 0:55:00 | 0.00 | 0.00 | 132.19 | 183.80 | 222.54 | 345.40 | 401.50 | 487.50 | 711.22 |
|  | 1:00:00 | 0.00 | 0.00 | 118.44 | 164.51 | 200.27 | 309.18 | 359.91 | 444.29 | 648.86 |
|  | 1:05:00 | 0.00 | 0.00 | 105.97 | 146.47 | 180.40 | 274.73 | 320.27 | 405.65 | 592.59 |
|  | 1:10:00 | 0.00 | 0.00 | 94.32 | 131.79 | 164.21 | 241.61 | 281.95 | 359.41 | 526.37 |
|  | 1:15:00 | 0.00 | 0.00 | 84.51 | 120.99 | 154.30 | 210.51 | 246.07 | 308.77 | 455.64 |
|  | 1:20:00 | 0.00 | 0.00 | 76.57 | 110.96 | 144.41 | 185.79 | 217.36 | 264.64 | 392.21 |
|  | 1:25:00 | 0.00 | 0.00 | 69.78 | 100.67 | 130.97 | 163.98 | 191.74 | 226.94 | 336.19 |
|  | 1:30:00 | 0.00 | 0.00 | 63.52 | 90.95 | 115.79 | 143.33 | 167.25 | 193.51 | 285.93 |
|  | 1:35:00 | 0.00 | 0.00 | 57.41 | 81.74 | 101.40 | 123.73 | 143.95 | 164.56 | 242.53 |
|  | 1:40:00 | 0.00 | 0.00 | 51.33 | 71.63 | 88.16 | 105.39 | 122.19 | 137.93 | 202.88 |
|  | 1:45:00 | 0.00 | 0.00 | 45.72 | 61.18 | 76.56 | 88.73 | 102.49 | 113.75 | 166.96 |
|  | 1:50:00 | 0.00 | 0.00 | 41.31 | 52.27 | 67.34 | 73.89 | 84.98 | 92.48 | 135.68 |
|  | 1:55:00 | 0.00 | 0.00 | 37.51 | 46.96 | 61.68 | 62.23 | 71.36 | 75.94 | 112.15 |
|  | 2:00:00 | 0.00 | 0.00 | 33.64 | 43.42 | 56.89 | 55.51 | 63.50 | 65.90 | 97.69 |
|  | 2:05:00 | 0.00 | 0.00 | 28.70 | 38.02 | 49.47 | 47.78 | 54.55 | 55.66 | 82.64 |
|  | 2:10:00 | 0.00 | 0.00 | 23.34 | 30.89 | 40.17 | 38.31 | 43.68 | 43.79 | 65.06 |
|  | 2:15:00 | 0.00 | 0.00 | 18.40 | 24.20 | 31.58 | 29.53 | 33.63 | 33.09 | 49.17 |
|  | 2:20:00 | 0.00 | 0.00 | 14.56 | 19.06 | 24.82 | 23.01 | 26.15 | 25.09 | 37.26 |
|  | 2:25:00 | 0.00 | 0.00 | 11.42 | 14.95 | 19.32 | 17.78 | 20.16 | 18.89 | 28.02 |
|  | 2:30:00 | 0.00 | 0.00 | 8.93 | 11.64 | 14.91 | 13.73 | 15.52 | 14.35 | 21.24 |
|  | 2:35:00 | 0.00 | 0.00 | 6.95 | 8.91 | 11.32 | 10.50 | 11.84 | 11.00 | 16.21 |
|  | 2:40:00 | 0.00 | 0.00 | 5.38 | 6.74 | 8.55 | 7.95 | 8.94 | 8.38 | 12.31 |
|  | 2:45:00 | 0.00 | 0.00 | 4.10 | 5.09 | 6.52 | 6.05 | 6.79 | 6.45 | 9.47 |
|  | 2:50:00 | 0.00 | 0.00 | 3.09 | 3.83 | 4.99 | 4.65 | 5.21 | 4.98 | 7.31 |
|  | 2:55:00 | 0.00 | 0.00 | 2.23 | 2.77 | 3.66 | 3.46 | 3.88 | 3.71 | 5.42 |
|  | 3:00:00 | 0.00 | 0.00 | 1.50 | 1.91 | 2.54 | 2.45 | 2.74 | 2.62 | 3.82 |
|  | 3:05:00 | 0.00 | 0.00 | 0.93 | 1.25 | 1.62 | 1.61 | 1.80 | 1.72 | 2.49 |
|  | 3:10:00 | 0.00 | 0.00 | 0.50 | 0.73 | 0.92 | 0.95 | 1.06 | 1.01 | 1.45 |
|  | 3:15:00 | 0.00 | 0.00 | 0.21 | 0.35 | 0.42 | 0.46 | 0.51 | 0.48 | 0.69 |
|  | 3:20:00 | 0.00 | 0.00 | 0.07 | 0.11 | 0.12 | 0.14 | 0.16 | 0.15 | 0.20 |
|  | 3:25:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:30:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:35:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:40:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:45:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:50:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 3:55:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:05:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:10:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:15:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:20:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:25:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:30:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:35:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:40:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:45:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:50:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 4:55:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:05:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:10:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:15:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:20:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:25:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:30:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:35:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:40:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:45:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:50:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 5:55:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|  | 6:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)
Summary Stage-Area-Volume-Discharge Relationships
The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically. The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

| Stage - Storage Description | Stage <br> [ft] | Area $\left[\mathrm{ft}^{2}\right]$ | Area [acres] | Volume <br> [ft ${ }^{3}$ ] | Volume <br> [ac-ft] | Total Outflow [cfs] |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  | For best results, include the |
|  |  |  |  |  |  |  | stages of all grade slope |
|  |  |  |  |  |  |  | changes (e.g. ISV and Floor) |
|  |  |  |  |  |  |  | Sheet 'Basin'. |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | Also include the inverts of all |
|  |  |  |  |  |  |  | outlets (e.g. vertical orifice, |
|  |  |  |  |  |  |  | overflow grate, and spillway, where applicable) |



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DRAINAGE MAPS








[^0]:    STERLING RANCH EAST INITIAL DEVELOPMENT PHASE BASIN DEVELOPMENT EXHIBIT

[^1]:    Basins P2-B1 ( $\left.\mathrm{Q}_{5}=7 \mathrm{cfs}, \mathrm{Q}_{100}=13 \mathrm{cfs}\right)$, Basin P2-B2 ( $\left.\mathrm{Q}_{5}=\mathbf{5 c f s}, \mathrm{Q}_{100}=10 \mathrm{cfs}\right)$, Basin P2-B3 ( $\mathrm{Q}_{5}=$ $7 \mathrm{cfs}, \mathrm{Q}_{100}=13 \mathrm{cfs}$ ), P2-B4 ( $\mathrm{Q}_{5}=4 \mathrm{cfs}, \mathrm{Q}_{100}=8 \mathrm{cfs}$ ), Basin P2-B5 ( $\mathrm{Q}_{5}=5 \mathrm{cfs}, \mathrm{Q}_{100}=9 \mathrm{cfs}$ ), Basin P2-B6 ( $\left.\mathrm{Q}_{5}=3 \mathrm{cfs}, \mathrm{Q}_{100}=6 \mathrm{cfs}\right)$, P2-B7 ( $\mathrm{Q}_{5}=6 \mathrm{cfs}, \mathrm{Q}_{100}=12 \mathrm{cfs}$ ), Basin P2-B8 ( $\mathrm{Q}_{5}=3 \mathrm{cfs}, \mathrm{Q}_{100}=7$ cfs), Basin P2-B9 ( $\left.\mathrm{Q}_{5}=\mathbf{5} \mathrm{cfs}, \mathrm{Q}_{100}=11 \mathrm{cfs}\right)$ and Basin P2-B10 ( $\left.\mathrm{Q}_{5}=\mathbf{5} \mathrm{cfs}, \mathrm{Q}_{100}=10 \mathrm{cfs}\right)$ all represent tributary area within the Sterling Ranch Road roadway extension between Dines Blvd. and Briargate Pkwy. These final designed facilities (Type R curb inlets) are shown and labeled on the drainage map. These basins have been studied in the "Drainage Letter for Sterling Ranch

[^2]:    Include EX-10 \&
    EX-13

