US Army Corps
of Engineers
Philadelphia District

PEARCE CREEK CONFINED DISPOSAL AREA MODIFICATION

CECIL COUNTY
MARYLAND

STORMWATER MANAGEMENT PLAN NARRATIVE

INITIAL SUBMISSION
JUNE 2014

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PREPARED BY:

UNITED STATES ARMY CORPS OF ENGINEERS
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PHILADELPHIA, PENNSYLVANIA 19107-3390

**PEARCE CREAK CONFINED DISPOSAL AREA MODIFICATION
STORMWATER MANAGEMENT PLAN NARRATIVE**

PURPOSE

A Stormwater Management Plan is required for an application for a Maryland Department of Environment (MDE) General Permit for Stormwater Associated with Construction Activity at the Pearce Creek Confined Disposal Facility (CDF). The Environment Article of Annotated Code of Maryland (Title 4, Subtitle 2) states "…the management of stormwater runoff is necessary to reduce stream channel erosion, pollution, siltation and sedimentation, and local flooding, all of which have adverse impacts on the water and land resources of Maryland." The purpose of the following narrative and analysis is to evaluate how the improvements to the Pearce Creek CDF will influence stormwater runoff and features will be incorporated into the design to meet Maryland's stormwater statutes. The Stormwater Management Plan has been designed in accordance with the State of Maryland Department of the Environment (MDE) regulations as published in the "2000 Maryland Stormwater Design Manual, Volume 1, Stormwater Management Criteria". (SWM2000).

The Pearce Creek CDF, operated by the U.S. Army Corps of Engineers, Philadelphia District, is located in Cecil County, Maryland along the eastern shore of the Chesapeake Bay, south of the Chesapeake and Delaware (C&D) Canal. The facility was constructed at the confluence of Pearce Creek and the Elk River. The Pearce Creek CDF is one of several CDFs used to contain materials resulting from periodic dredging to maintain navigable depths in the C&D canal, Elk River and Chesapeake Bay. Figure 1 shows the location of the Pearce Creek CDF, C&D canal, Elk River, and the Chesapeake Bay.

Figure 1 – Site Map

In response to community concerns, several studies were conducted to determine the extent of the connection between groundwater quality within the CDF and in the surrounding communities. Based on these studies, it was determined that a liner system would be installed within the CDF to isolate newly placed dredge material from the underlying aquifer. In conjunction with this liner placement, other aspects of the CDF will be improved prior to resuming dredge material placement operations at the Pearce Creek CDF. These improvements include:

- Site clearing and preparation of dike subgrade
- Excavation and drying of on-site material for use in the construction activities
- Re-grading of the site to ensure positive drainage
- Installation of the liner system
- Re-grading/raising the existing containment dikes to an elevation of 50 ft NAVD88
- Relocation of the existing sluice and associated piping

PROPOSED ALTERATIONS

The Pearce Creek CDF is located adjacent to the Elk River, approximately 11.5 miles south west of Chesapeake City, MD. The existing containment dike varies in elevation from 43 to 50 feet NAVD88. The interior topography is currently sloped to drain to the southeast towards the existing sluice (See Figure 2). Drainage ditches along the outer perimeter of the CDF are sloped to drain stormwater runoff from the containment dike towards the Elk River or Pearce Creek Lake.

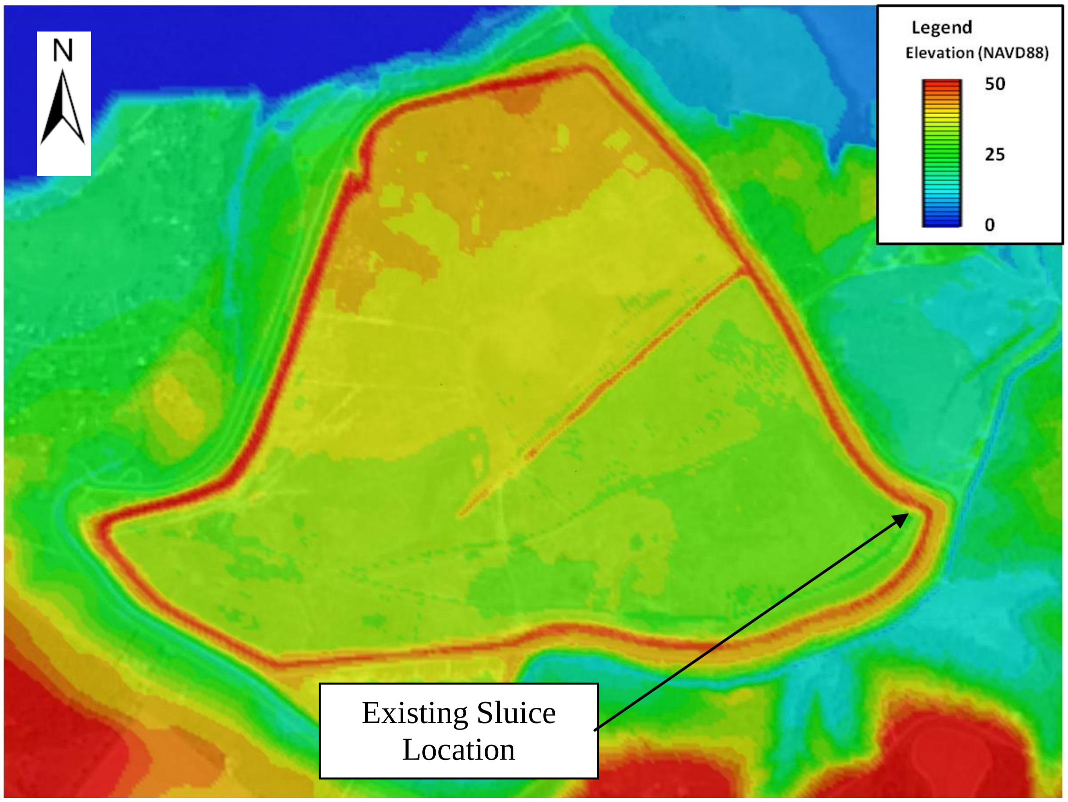

Figure 2 – Pre Construction Contours

As part of the improvements being implemented at the Pearce Creek CDF, the location of the sluice and associated piping is being relocated. This modification will relocate the sluice from the southeast corner of the CDF to the north, adjacent to the Elk River (see Figure 3). The liner system and interior topographic contours will be graded to allow positive drainage to the new sluice location. Water resulting from dredge disposal operations and stormwater falling within the 260 acre containment will flow out of the sluice, through 4 x 36 inch diameter outflow pipes, and discharge to the Elk River over an improved riprap outlet.

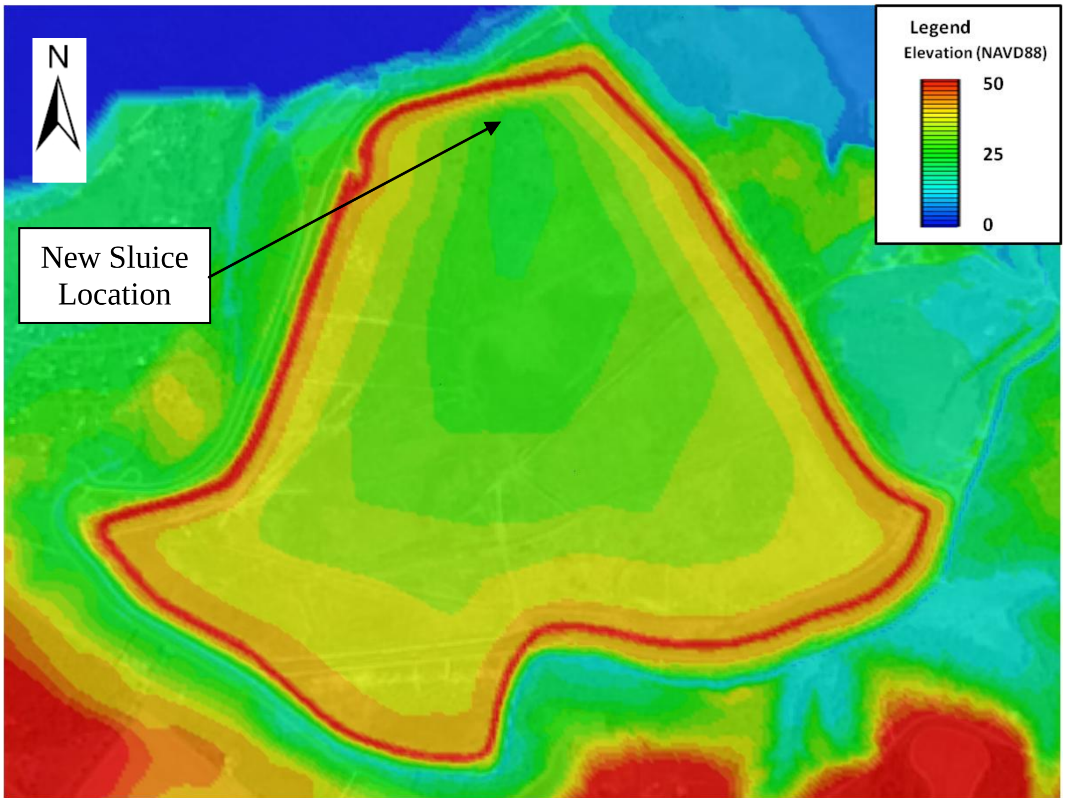

Figure 3 – Post-Construction Contours

The sluice drainage pipes will be constructed so that the inverts of the pipes are at mean high water (MHW) at the outlet to the Elk River. Stormwater runoff from the exterior face of the containment dike will continue to flow in the existing drainage ditches to the Elk River or Pearce Creek Lake.

DATA AND ASSUMPTIONS

Topography

Site specific Laser Imaging Detection and Ranging (LIDAR) data of the existing topography at the Pearce Creek CDF was collected and processed in April 2014. This high resolution LIDAR data was used to the maximum extent possible for the stormwater analyses. In locations where the drainage basins surrounding the CDF extended beyond the LIDAR data, 10 meter National Elevation Dataset (NED) data was used. This combined data set was used for all pre-construction simulations. Post-construction simulations used the combined LIDAR/NED topography as a base but were updated to reflect the proposed design contours of the CDF. The vertical datum for all elevation data sets was the North American Vertical Datum of 1988 (NAVD88).

Frequency Precipitation

The annual series 24 hour depth-frequency input to the TR55 model was tabulated from Table 2.2 of the SWM2000. These values are provided in Table 1 below.

24 hr Annual Series Precipitation Depth- Frequency	
Return Period (year)	24 hr Depth (inches)
1	2.7
2	3.3
10	5.1
100	7.3

Table 1 - 24 Hour Depth-Frequency

The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Type II rainfall distribution was selected to temporally distribute the 24 hour rainfall totals.

Soil Characteristics and Land Use

The NRCS Curve Number (CN) methodology was used to quantify infiltration. The Soil Survey Geographic (SSURGO) database for Cecil County, Maryland was used to define the soil types in the project area. Figure 4 shows the spatial distribution of the soil type surrounding the Pearce Creek CDF.

Figure 4 – Soil Types (SSURGO database)

The National Land Cover Database (NLCD) developed by the United States Geological Survey (USGS) was used to define land cover in the project area. These data sets were merged using the Watershed Modeling System (WMS) software (version 9.1) in order to develop the composite CN for each drainage basin surrounding the Pearce Creek CDF.

INTERIOR DRAINAGE

Since the proposed liner will effectively eliminate infiltration and the perimeter dikes will contain storm water falling within the CDF, it is assumed that all precipitation falling within the perimeter dikes will be contained and discharge will only occur through the sluice. During normal dredging operations, the water level in the CDF will vary. The maximum operational interior water level will be 48 ft NAVD88. This will leave a minimum of 2 feet of freeboard to the design dike crest of 50 ft NAVD88. A 100 year- 24 hour storm event would result in an additional 7.3 inches of rain within the CDF. Although this would reduce the available freeboard by 0.61 feet, the dike would not overtop under these conditions.

Based on design of the interior liner and drainage contours, the invert of the relocated sluice drainage pipes at the sluice inlet structure will be elevation 22.3 ft NAVD88. The design invert of the sluice drainage pipe outlet was set at Mean High Water (MHW). The MHW elevation in terms of the design datum NAVD88 was determined using the National Oceanic and Atmospheric Administration (NOAA) National Geodetic Survey's (NGS) Vertical Datum Transformation (VDatum) utility code. At the Pearce Creek CDF the MHW is 0.9 ft NAVD88. A design MHW of 1.0 ft NAVD88 was used to establish the invert of sluice discharge pipes.

The sluice inlet structure will be located approximately 190 ft to the interior of the centerline of the improved dike alignment. The outlet structure will be located 470 ft outside of the centerline of the improved dike alignment. Consequently, the design length of these drainage pipes is 660 ft. These pipes are designed to run on a continuous slope from the inlet to the outlet. The outlet structure adjacent to the Elk River is a periodically submerged apron that will be lined with riprap with a D_{50} of 1.6 ft.

The Federal Highway Administration's (FHWA) HY-8 model (version 7.3) was used to evaluate the sluice piping and outlet design. Four x 36 in. diameter High Density Polyethylene (HDPE) pipes are designed to carry the flow from the sluice within the CDF to the outlet structure adjacent to the Elk River. No other discharge locations are designed to convey water out of the CDF. For the HY-8 simulation the tail water elevation is assumed to be constant since the discharge is not anticipated to appreciably impact the stage of the Elk River. The invert of the discharge pipe is set at 1.0 ft NAVD88, which is slightly above MHW. Figure 5 shows the culvert performance curve based on this design criteria.

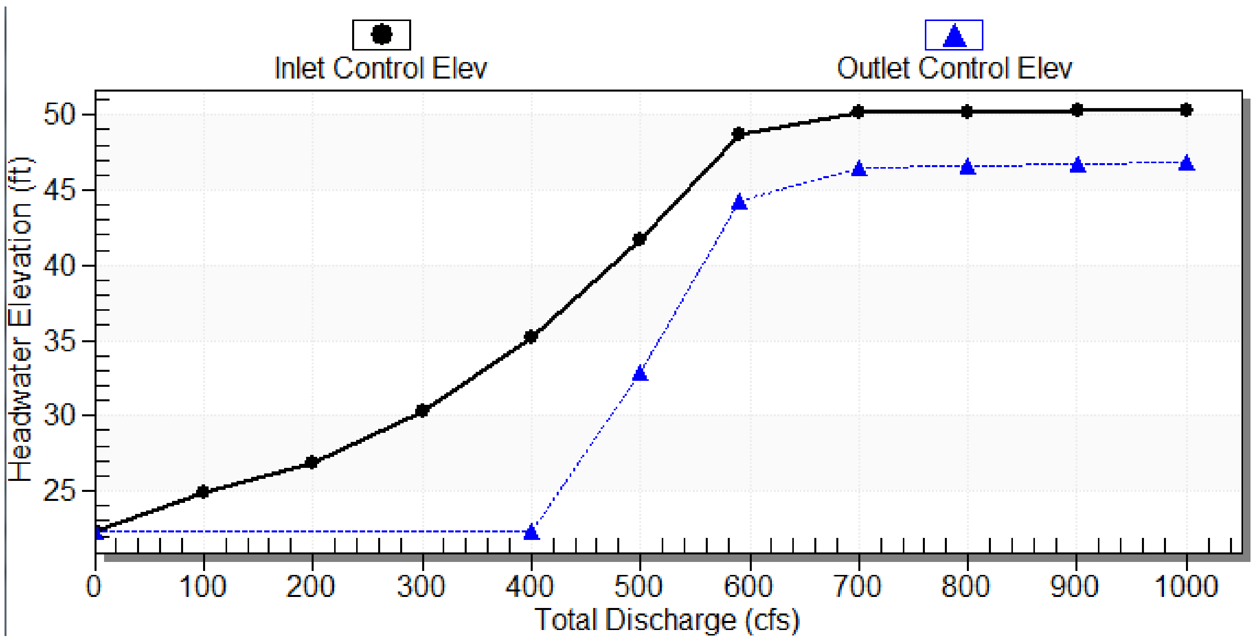

Figure 5 – Culvert Performance Curve

Since the sluice box acts as a weir, the water level inside of the sluice box will typically be below the water level in the CDF. However, for this analysis the assumption is that the head water level is 48.61 ft NAVD88 (48 ft design elevation plus the 100 year storm event of 7.3 inches). This will result in a more conservative estimate in outflow for the outlet structure channel. As show in Figure 5, the drainage pipes are inlet controlled at this head water elevation. The design flow rate at this headwater elevation is approximately 590 cfs or 147.5 cfs from each drainage pipe.

The outlet protection standards required by the "2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control" were considered for the outlet protection design. Based on Figure D.2 "Design of Outlet Protection –Minimum Tailwater Condition" of these standards, the median stone size (D_{50}) approximately 1.6 ft. based on the computed flow through each outlet pipe. Therefore, the riprap design for D_{50} of 1.6 will be adequate to meet operational and stormwater design flows. The minimum Length of Apron (L_a) for this design based on Figure D.2 is 41 ft and the minimum apron width (W) is 53.0 ft.

EXTERIOR DRAINAGE

Stormwater falling outside of the CDF is directed around the CDF though existing drainage ditches. These drainage ditches have gradual slopes and are generally grass lined. As shown in Figure 6, there are 5 drainage basins surrounding the CDF that capture the flow from the CDF perimeter dikes and surrounding areas.

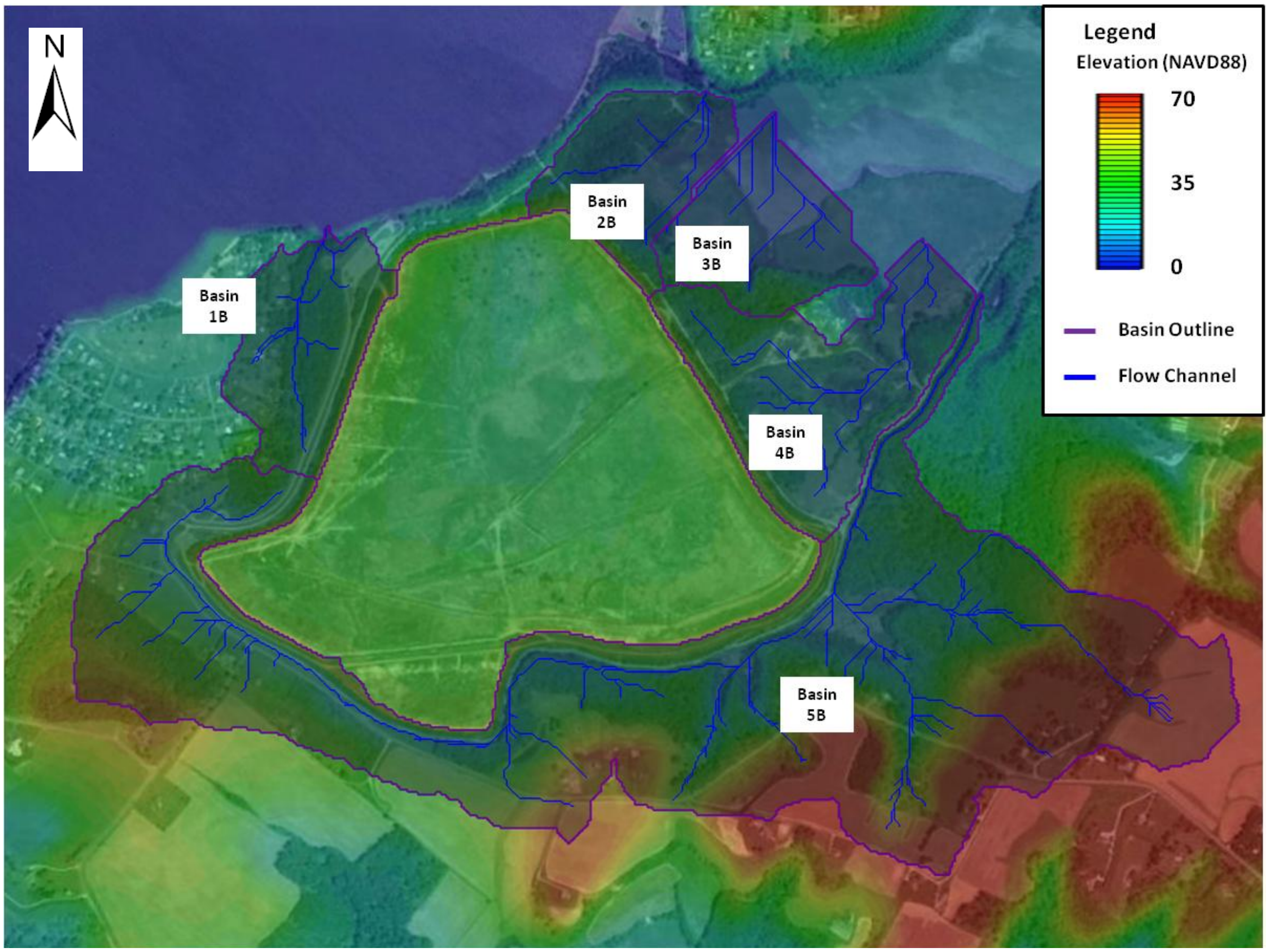

Figure 6 – Drainage Basins

TR-55 models were developed for each of these basins to evaluate the effect of raising the dike to elevation 50 ft. NAVD88 on stormwater flows. The Watershed Modeling System (WMS) software (version 9.1) was used develop these models. Land use and soil type data was used to develop a composite Curve Number (CN) for each basin. The NRCS Type II rainfall distribution was selected to temporally distribute the 24 hour rainfall for the 2 year design storm of 3.3 in.

Tables 2 and 3 show the hydraulic soil groups, land use, basin area, CN, and time of concentration (Tc) for each drainage basin for pre- and post-construction conditions, respectively.

Basin ID	HSG	Land Use Description	CN	Basin Area (A) acres	Product CN x A	Total Area acres	Composite CN	Time of Concentration
1B	B	Deciduous Forest	60	15.625	937.478	32.123	57.810	0.406
	B	Emergent Herbaceous Wetlands	58	8.205	475.897			
	B	Shrub/Scrub	56	0.786	43.993			
	B	Woody Wetlands	55	6.809	374.468			
	B	Developed, Open Space	72	0.349	25.139			
	B	Open Water	0	0.349	0.000			
2B	B	Deciduous Forest	60	7.847	470.794	34.750	45.092	0.485
	B	Woody Wetlands	55	13.710	754.047			
	B	Emergent Herbaceous Wetlands	58	1.897	110.024			
	B	Open Water	0	7.933	0.000			
	B	Cultivated Crops	69	3.363	232.034			
3B	B	Developed, Open Space	72	12.020	865.462	36.666	63.689	0.496
	B	Shrub/Scrub	56	1.470	82.326			
	B	Woody Wetlands	55	8.475	466.111			
	B	Developed, Low Intensity	77	0.432	33.294			
	B	Emergent Herbaceous Wetlands	58	6.140	356.113			
	B	Deciduous Forest	60	4.929	295.752			
	C	Woody Wetlands	70	0.865	60.534			
	C	Emergent Herbaceous Wetlands	71	1.297	92.098			
	C	Deciduous Forest	73	0.519	37.877			
	B	Developed, Medium Intensity	88	0.519	45.660			
4B	B	Emergent Herbaceous Wetlands	58	17.844	1034.955	61.387	60.239	0.873
	B	Woody Wetlands	55	19.637	1080.035			
	B	Deciduous Forest	60	6.147	368.834			
	B	Cultivated Crops	69	16.051	1107.527			
	B	Developed, Medium Intensity	88	0.342	30.053			
	B	Shrub/Scrub	56	1.366	76.499			
5B	C	Deciduous Forest	73	35.524	2593.262	308.898	67.760	3.464
	C	Cultivated Crops	79	27.005	2133.408			
	C	Developed, Open Space	81	10.564	855.646			
	B	Cultivated Crops	69	69.600	4802.404			
	C	Pasture/Hay	79	20.105	1588.278			
	B	Developed, Open Space	72	13.630	981.386			
	B	Pasture/Hay	69	19.594	1351.962			
	B	Deciduous Forest	60	35.950	2157.005			
	B	Shrub/Scrub	56	3.152	176.513			
	B	Emergent Herbaceous Wetlands	58	22.490	1304.426			
	B	Woody Wetlands	55	39.869	2192.785			
	C	Woody Wetlands	70	10.223	715.594			
	C	Emergent Herbaceous Wetlands	71	0.596	42.339			
	B	Mixed Forest	60	0.596	35.780			

Table 2 – Pre-Construction Basin Data

Basin ID	HSG	Land Use Description	CN	Basin Area (A) acres	Product CN x A	Total Area acres	Composite CN	Time of Concentration
1B	B	Deciduous Forest	60	15.755	945.280	32.389	57.810	0.407
	B	Emergent Herbaceous Wetlands	58	8.273	479.857			
	B	Shrub/Scrub	56	0.792	44.359			
	B	Woody Wetlands	55	6.865	377.584			
	B	Developed, Open Space	72	0.352	25.348			
	B	Open Water	0	0.352	0.000			
2B	B	Deciduous Forest	60	7.847	470.794	34.750	45.0918	0.485
	B	Woody Wetlands	55	13.710	754.047			
	B	Emergent Herbaceous Wetlands	58	1.897	110.024			
	B	Open Water	0	7.933	0.000			
	B	Cultivated Crops	69	3.363	232.034			
3B	B	Developed, Open Space	72	12.103	871.387	36.741	63.5129	0.496
	B	Shrub/Scrub	56	1.297	72.616			
	B	Woody Wetlands	55	8.645	475.459			
	B	Developed, Low Intensity	77	0.346	26.626			
	B	Emergent Herbaceous Wetlands	58	6.397	371.031			
	B	Deciduous Forest	60	4.841	290.462			
	C	Woody Wetlands	70	0.864	60.513			
	C	Emergent Herbaceous Wetlands	71	1.297	92.066			
	C	Deciduous Forest	73	0.692	50.485			
	B	Developed, Medium Intensity	88	0.259	22.822			
4B	B	Emergent Herbaceous Wetlands	58	18.993	1101.603	62.004	60.217	0.846
	B	Woody Wetlands	55	19.504	1072.730			
	B	Deciduous Forest	60	5.706	342.388			
	B	Cultivated Crops	69	16.097	1110.716			
	B	Developed, Medium Intensity	88	0.341	29.980			
	B	Shrub/Scrub	56	1.363	76.313			
5B	C	Deciduous Forest	73	35.514	2592.520	310.087	67.718	3.930
	C	Cultivated Crops	79	26.997	2132.797			
	C	Developed, Open Space	81	10.561	855.401			
	B	Cultivated Crops	69	69.495	4795.152			
	C	Pasture/Hay	79	20.099	1587.824			
	B	Developed, Open Space	72	13.712	987.237			
	B	Pasture/Hay	69	19.673	1357.451			
	B	Deciduous Forest	60	35.940	2156.388			
	B	Shrub/Scrub	56	3.151	176.463			
	B	Emergent Herbaceous Wetlands	58	23.165	1343.569			
	B	Woody Wetlands	55	40.368	2220.262			
	C	Woody Wetlands	70	10.220	715.389			
	C	Emergent Herbaceous Wetlands	71	0.596	42.327			
	B	Mixed Forest	60	0.596	35.769			

Table 3 – Post-Construction Basin Data

These tables indicate that the change in drainage basin size and hydraulic properties are minimal as a result of the proposed construction. Based on this data, the TR-55 model was run to simulate the peak flow in each drainage basin under both pre- and post-construction conditions. The computed peak flows and relative difference between pre- and post-construction conditions is shown on Table 4. These simulations indicated that the change in runoff and peak channel flow outside of the CDF due to the construction activities is minimal. As such no improvements to the drainage features surrounding the Pearce Creek CDF are planned.

Basin ID	Pre Construction	Post Construction	Percentage Difference
1B	6.220	6.261	0.66%
2B	0.226	0.226	0.00%
3B	13.604	13.396	-1.53%
4B	10.987	11.270	2.58%
5B	47.159	47.198	0.08%

Table 4 – Peak Flow Comparison