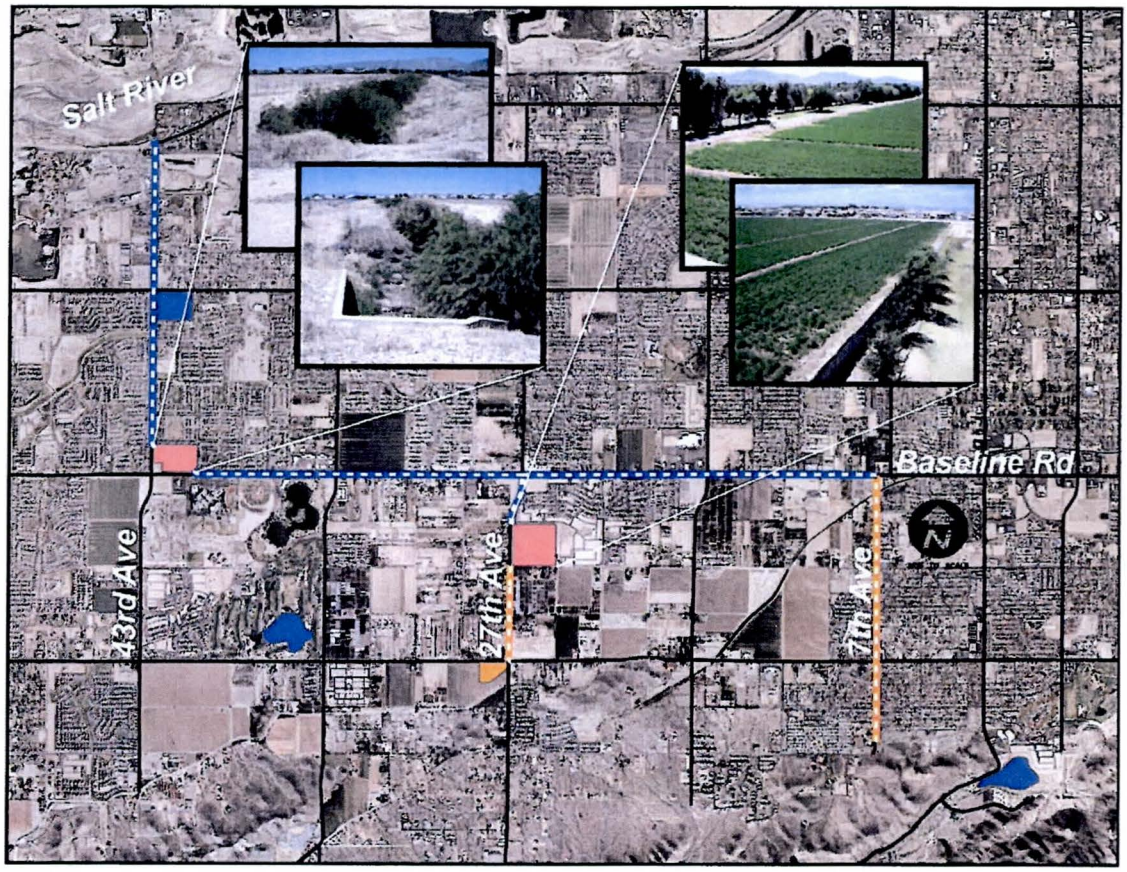
South Phoenix Two Basins Project

FCD 2011C008



Design Report

(Including Data Collection Report)

43rd Avenue and Baseline Road Basin Final Plans

27th Avenue and South Mountain Avenue Basin Final Plans

Prepared by:

Stanley Consultants INC.

Prepared for:

Flood Control District of Maricopa County

and

City of Phoenix

May 2013

SCI Project No. 23621

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Expires 9/30/13

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Design Report Electronic Files on Disc
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OTHER RELATED DOCUMENTS (Under Separate Covers)

- *South Phoenix / Laveen Drainage Improvement Project Addendum*, Stanley Consultants, May 2013
- *South Phoenix Two Basins Project Survey Report,* Stanley Consultants, May 2013
- *South Phoenix Two Basins Project Geotechnical Investigation Report,* 27th Avenue and South Mountain Avenue Basin, AMEC Environmental and Infrastructure, July 18, 2012
- *South Phoenix Two Basins Project Geotechnical Investigation Report,* 43rd Avenue and Baseline Road Basin, AMEC Environmental and Infrastructure, July 18, 2012

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1 Introduction

The primary objective of the South Phoenix Two Basins Project is to design two regional detention basins, one at the northeast corner of 27th Avenue and South Mountain Avenue and the other at the northeast corner of 43rd Avenue and Baseline Road. This report documents the engineering design of these two regional basins. The scope of work includes production of separate plan, specification and estimate packages for each basin. The Flood Control District plans to bid and construct these basins in the near future. The basins may be bid and constructed together or they may be done separately.

The design is based on regional concepts and hydrology and hydraulics developed 10 to 15 years ago as part of the South Phoenix / Laveen Drainage Improvement Project which was prepared by consultant HDR for the Flood Control District. Portions of the regional plan have already been constructed including regional storm drain trunk lines in Baseline Road and 43rd Avenue, as well as storm drain laterals in 7th Avenue, 19th Avenue, 27th Avenue, and 35th Avenue, a regional detention basin at 43rd Avenue and Southern Avenue and regional stormwater basins in the Aguila Municipal Golf Course northwest of 35th Avenue and Dobbins Road.

Figure 1.1 below illustrates the key components of the overall regional plan as well as the location and vicinity of the project.

Figure 1.1 – Key Regional Features, Project Location and Vicinity

The original scope and schedule for this project envisioned the design phase of the two regional basins being concurrent with each other following refinements to regional hydrology that were to have concluded in the first few months after notice to proceed. However, there were a number of regional hydrologic issues involving the area directly tributary to the 27th Avenue and South Mountain Avenue basin that delayed the initiation of its design phase. These issues are described in a little more detail later in this report. Meanwhile, the 43rd Avenue and Baseline Road basin was much less affected by these issues so its design phase moved forward. As a result, the 43rd Avenue basin submittals are one step ahead of the 27th Avenue basin schedule.

1.1 Project Authorization

The South Phoenix Two Basins Project is a Flood Control District of Maricopa County (District) project. The District is the lead agency and the City of Phoenix is a project partner. The project was authorized by Contract FCD 2011C008 between the District and Stanley Consultants, Inc. (Stanley) with an effective notice-to-proceed date of August 15, 2011.

1.2 Description of Basin Parcels

The South Phoenix Two Basins Project is located in central Maricopa County within the incorporated limits of the City of Phoenix. Although there are pockets of unincorporated Maricopa County land within the South Phoenix – Laveen area, both of the basin parcels are situated on City of Phoenix incorporated land. Both basin parcels were acquired several years ago by the District and are still currently under District ownership. When the basin improvements are completed, the parcels and improvements will be conveyed to the City of Phoenix for ownership, operation and maintenance.

43rd Avenue and Baseline Road Basin Parcel

The 43rd Avenue and Baseline Road basin parcel is located within Section 34 of Township 1 North, Range 2 East. It is approximately 21.5 acres and is bounded by Baseline Road to the south, 43rd Avenue to the west and the Arlington Estates Phase I and Arlington Estates Phase II residential subdivisions to the east and north, respectively. Both Baseline Road and 43rd Avenue adjacent to the parcel are fully improved arterial streets with curb and gutter and detached sidewalk. There is a separate privately owned parcel just under 1.5 acres in size right at the northeast corner of Baseline Road and 43rd Avenue that was retained by the original owner from whom the basin parcel was acquired. Both the 43rd Avenue basin parcel and the exception parcel are currently vacant.

There is an existing 6' block fence along the east and north sides of the basin parcel that was constructed with the Arlington Estates subdivisions. There is a 6' chain link fence along the Baseline Road and 43rd Avenue sides of the basin parcel and the separate privately owned exception parcel at the northeast corner of the intersection. There is an SRP 230kv overhead power line along the north side of Baseline Road that impacts the eastern part of the Baseline Road frontage. The interior of the parcel where the basin will be excavated is free of utility impacts. Basin improvements will need to consider the SRP facilities along Baseline Road and SRP's access and maintenance requirements.

27th Avenue and South Mountain Avenue Basin Parcel

The 27th Avenue and South Mountain Avenue basin parcel is located within Section 1 of Township 1 South, Range 2 east. It is approximately 37.2 acres and is bounded by

South Mountain Avenue to the south, 27th Avenue to the west, Gary Way and the Silva Mountain Unit I residential subdivision to the north and northeast. Adjacent to the south portion of the east boundary of the parcel is the Eagle Charter School. And just north of the Eagle Charter School adjacent to the north portion of the east boundary is a vacant parcel owned by the City of Phoenix. Gary Way was improved with the Silva Mountain subdivision and has vertical curb and gutter but no sidewalk on its south side adjacent to the basin parcel. 27th Avenue is a paved two lane road with no curb and gutter or sidewalk and South Mountain Avenue is a paved road with no curb and gutter.

Currently, the 27th Avenue and South Mountain Avenue basin parcel has an agricultural land use under lease arrangement with a local agri-business. That lease will be terminated when the basin is constructed. There is currently a privately owned irrigation supply pipe / open concrete ditch along the south side of the parcel (north side of South Mountain Avenue) and an earth tailwater ditch along the west side of the parcel (east side of 27th Avenue). The parcel is not fenced except along its east side where the Eagle Charter School has constructed 6' block fence adjacent to the school building nearest South Mountain Avenue and 6' chain link fence north of that adjacent to the school play ground. The vacant City of Phoenix parcel just north of the Eagle Charter School is fenced with a 3' high smooth wire fence.

The 27th Avenue and South Mountain Avenue basin parcel is relatively unencumbered by utilities. There are no overhead utilities that impact the parcel. There is potentially one underground communication facility immediately east of the irrigation tailwater ditch just east of 27th Avenue. But this facility does not appear to conflict with proposed basin grading and excavation and is outside of the basin parcel right-of-way.

The existing irrigation improvements located along South Mountain Avenue and along 27th Avenue are located either within existing or future roadway right-of-way for those roads. Those facilities will probably need to be relocated when the roadways are improved in the future. Currently, there is no irrigation relocation planned as part of the South Phoenix Two Basins Project.

Currently, there are no plans to improve either 27th Avenue or South Mountain Avenue by the City of Phoenix. The basin layout has been developed respecting future rights-of-way for these roads along with their anticipated typical roadway sections and the associated typical set-backs to allow for adjacent future multi-use, recreational trail and landscaping improvements required by the City of Phoenix.

1.3 Regional Hydrology and Hydraulics

There is significant foundational documentation of the regional drainage system and its evolution that precedes the South Phoenix Two Basins Project contained in separate prior studies, concept plans, alternative reports and as-builts. This prior documentation is a collaboration involving various public entities, most notably the Flood Control District of Maricopa County, City of Phoenix and Maricopa County Department of Transportation (MCDOT) with involvement by a number of different engineering consultants. A complete list and collection of documentation related to the South Phoenix Two Basins Project is contained in Stanley's data collection report under separate cover.

The base hydrology and hydraulics for the regional drainage system was concluded by consultant HDR and documented in their "South Phoenix / Laveen Drainage

Improvement Project, Focus Alternatives Submittal, Volume I Main Report" dated January 1997. HDR's base regional hydrology was amended to some extent in 2000 by consultant URS in support of their design of the Baseline Road roadway improvements for MCDOT and the City of Phoenix. The URS amended regional hydrology and hydraulics relate primarily to the design of the 27th Avenue and South Mountain Avenue Basin which incorporates a dynamic hydrograph routing function involving the Baseline Road regional storm drain. URS' report is titled "Storm Drain Design Report, Baseline Road (51st Avenue to 7th Avenue), 90% Submittal" dated May 1, 2000.

The URS report, among other things, updated the hydrologic and hydraulic operation of the 27th Avenue and South Mountain Avenue regional basin that had been previously designed to a concept level by HDR. This update was necessary, in part, because the basin location per the HDR concept had been moved south from its original site adjacent to Baseline Road to what is now its present location. Moving the basin created the dynamic hydrograph routing function mentioned above. The dynamic function was created by the flow diversion structure in the intersection of 27th Avenue and Baseline Road. The structure receives inflow from the east from an 84" diameter storm drain. The storm drain that continues west is a 66" diameter storm drain with a 54" diameter orifice plate covering the storm drain in the diversion structure. A 60" diameter storm drain with an adverse slope connects into the diversion structure and is routed south along 27th Avenue to the proposed 27th Avenue and South Mountain Avenue regional basin site. Flows in excess of the capacity of the 54" diameter orifice plate are routed south along 27th Avenue in the 60" diameter storm drain. The 60" storm drain also serves at the outfall for the 27th Avenue and South Mountain Avenue basin. This dynamic function can only be approximated using HEC-1 which is the foundational regional hydrology model. A secondary means of analysis using EPA SWMM 5.0 with unsteady flow capability was needed to model the outflow from the 27th Avenue and South Mountain Avenue regional basin to the existing Baseline Road storm drain, then west downstream to the 43rd Avenue and Baseline Road regional basin.

The alternatives and design concept for the 43rd Avenue and Baseline Road regional basin are covered in a report prepared by District engineering staff. That report is titled "43rd Avenue Detention Basin Design Report (FCD Project No. 117023)" dated March 1999. Prior to the District's report, there was no regional basin proposed at 43rd Avenue and Baseline Road. The regional storm drain HDR developed as part of the South Phoenix / Laveen Drainage Improvement Project which outfalls to the Salt River went south in 43rd Avenue and turned east at Baseline Road.

However, the District found that the 43rd Avenue storm drain could be significantly reduced in size if a regional basin were constructed at 43rd Avenue and Baseline Road. The District's 43rd Avenue detention basin design report was done in support of reducing the size of the 43rd Avenue storm drain. The report targets a maximum 100-year outflow from the 43rd Avenue and Baseline Road regional detention basin of 264 cfs which would be routed north in the 43rd Avenue storm drain.

The 43rd Avenue and Baseline Road Basin receives its inflow from the existing Baseline Road 96-inch diameter storm drain. This storm drain turns out from Baseline Road to the southeast corner of the basin parcel to an interim earth ditch that traverses the parcel in a straight line diagonally to the parcel's northwest corner. At that location, flow would enter an existing 72-inch diameter storm drain that leaves the basin parcel angling out to 43rd Avenue to an existing junction structure which receives local flow from a 48-

inch diameter storm drain pipe from the south. The 48-inch storm drain collects flow from the intersection of 43rd Avenue and Baseline Road and a short stretch of Baseline Road immediately east of 43rd Avenue. The combined basin outflow in the 72-inch diameter storm drain pipe and local drainage from the 48-inch diameter pipe flows north via the 43rd Avenue storm drain to the Salt River.

The concept design of the 43rd Avenue and Baseline Road basin, prepared by District engineering staff, used the effective HEC-1 regional hydrology model and a proposed elevation-storage relationship that reflected the proposed footprint of the basin parcel. The elevation-discharge relationship that worked the best assumed a 54-inch diameter orifice under inlet control. The outfall pipe, however, was designed at 72-inch diameter to ensure there would be no downstream impact on the inlet control assumption and also in recognition of the potential future refinements to elevation-storage that would not be finalized until the actual design phase of the basin.

The open channel that exists on the basin parcel simply conveys interim flows from the inlet at Baseline Road to the outlet at 43rd Avenue. The channel essentially has no storage attenuation function under regional flows. There is an existing restrictor plate obstructing the cross section of the upper portion of the 96-inch diameter storm drain at the headwall where the Baseline Road storm drain outfalls to the interim channel on the basin parcel. The restrictor plate reduces the capacity of the Baseline Road storm drain.

This restriction is in part to compensate for there being no storage attenuation on the 43rd Avenue and Baseline Road basin parcel until the basin is actually constructed. It also serves to limit flow in the Baseline Road storm drain in the interim until regional hydrology assumptions come to pass. That is, until the rest of the regional storm drain and detention basin system is constructed and until future developed condition land use, including onsite retention basins, comes to pass. Without those assumptions, current condition regional flow rates would be larger than what the regional HEC-1 model indicates.

The South Phoenix Two Basins Project design team did not find any analysis or design documentation from any of the original data that supports the sizing of the restrictor plate. The plate is thought to have been sized based on some form of submerged orifice analysis. The size of the storm drain opening below the restrictor plate was estimated by the design team and various combinations of upstream and downstream hydraulic conditions were assumed. There are combinations based on a simple submerged orifice analysis that yield capacities in the 250 cfs to 300 cfs range which would correspond to the original target design discharge of 264 cfs for the 43rd Avenue storm drain.

Stanley's scope of work at the start of the South Phoenix Two Basins Project included a review and update of the regional HEC-1 model to reflect changes in drainage pattern due to development in the 10+ years since it was last updated. Stanley was also to re-visit the Baseline Road Storm drain hydraulics as related to the 27th Avenue and South Mountain Avenue basin dynamic hydrograph routing concept to verify its operation. And Stanley was also to add a level pool routing step representing the 43rd Avenue and Baseline Road basin in the regional HEC-1 model which had not previously been integrated in the HDR or URS documentation.

During the regional review and update for the South Phoenix Two Basins Project, concerns arose over the performance of the Baseline Road storm drain, its ability, based

on the regional hydrology, to act as a hydrologic boundary and its part in the dynamic function of the 27th Avenue and South Mountain Avenue regional basin. There was also some concern about the concept design of the future 7th Avenue regional storm drain extension south from Baseline Road and how it relates to the Baseline Road storm drain hydrology and hydraulics.

The project team also felt it was necessary to identify, at least conceptually, the nature and extent of future additional regional stormwater facilities required to consummate the regional drainage plan and validate the regional HEC-1 model. That is, some form of collection and conveyance system is intuitively implied in the hydrologic assumptions of the South Phoenix / Laveen Drainage Improvement Project HEC-1 model. These facilities could potentially be significant and might also necessitate additional regional detention basins.

Stanley's initial update of the regional hydrology completed in March 2012 was expanded to an addendum of the South Phoenix / Laveen Drainage Improvement Project intended to address the various issues discussed above. That addendum titled "South Phoenix / Laveen Drainage Improvement Plan Addendum" is a free-standing report that addresses the overall regional issues. The regional addendum report, in addition to addressing the overall regional issues, also contains elements of hydrology and hydraulics that relate directly to the design of the two regional basins.

The South Phoenix Two Basins Project Design Report extracts the hydrologic and hydraulic analyses pertaining to each basin for the specific purpose of documenting the basin design(s). In addition to the pertinent regional hydrology and hydraulics, the design report also contains other elements of design documentation typical to a design report including quantity estimates and hydraulic or erosion control analyses of a non-regional nature that is specific to each basin. This design report is intended to stand alone. But for a more comprehensive understanding of the regional system hydrology and hydraulics, Stanley's South Phoenix / Laveen Drainage Improvement Project Addendum Report should also be referred to.

Figure 1.2 illustrates design discharges related to the regional basins at 43rd Avenue and Baseline Road and at 27th Avenue and South Mountain Avenue and for the Baseline Road storm drain. These discharges were collected from various report documents that existed at the time of the URS Baseline Road storm drain report dated May 1, 2000.

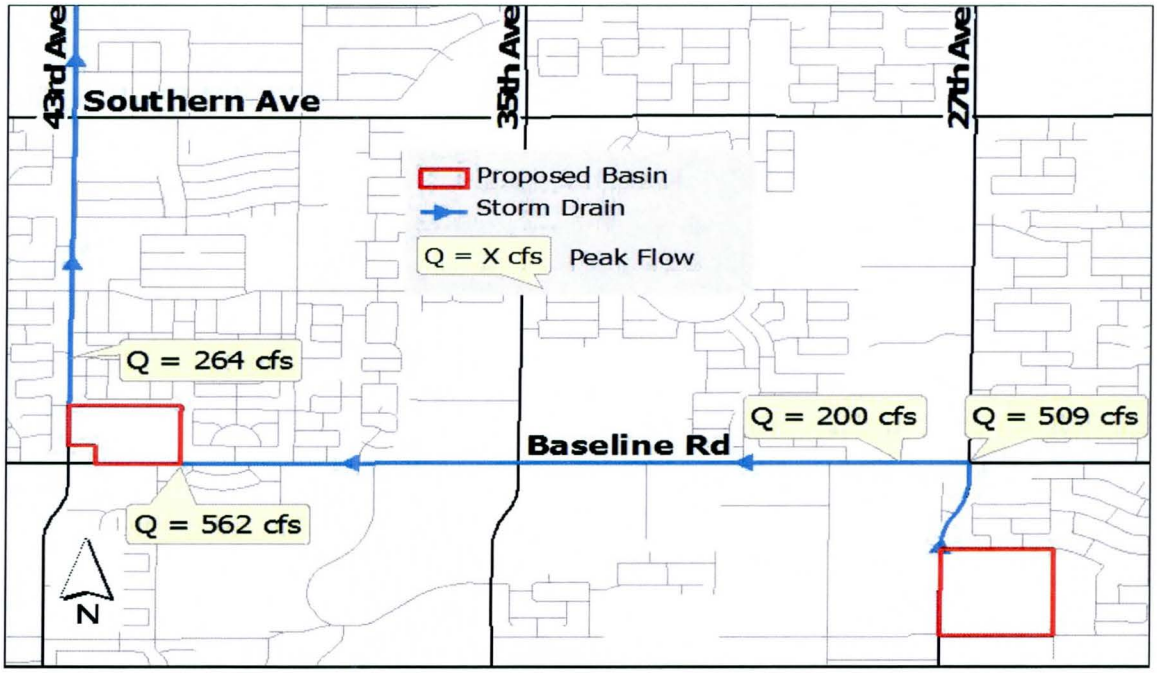

Figure 1.2 – Baseline Road Storm Drain Design Discharges Circa 2000

2 Basin Specific Regional Hydrology / Hydraulics

2.1 43rd Avenue and Baseline Road Regional Basin

There are two basic hydrologic approaches used to evaluate the design of the 43rd Avenue and Baseline Road regional basin. One approach uses the regional HEC-1 model and the other approach uses the SWMM unsteady flow model that corresponds to the HEC-1 model. The regional hydrology and development of alternatives involving future regional detention basin and storm drain alternatives is covered in much more detail in the South Phoenix / Laveen Drainage Improvement Plan Addendum prepared by Stanley consultants.

The current regional alternative at the time of this design report submittal is 'Alternative 6'. The 'Alternative 6' HEC-1 and corresponding SWMM models were used as the basis of design for both the 43rd Avenue and Baseline Road and 27th Avenue and South Mountain Avenue basins. Both the HEC-1 and SWMM models have the same elevation-storage-discharge relationships representing the 43rd Avenue and the 27th Avenue basins, the same inflow hydrograph for the local direct flow into the 27th Avenue and South Mountain Avenue basin and also the same local inflow into the Baseline Road storm drain. The elevation-storage relation for each basin is derived from their respective basin grading plan.

Figure 2.1 below illustrates the difference in hydrographs representing the inflow to the 43rd Avenue and Baseline Road basin between the straight 'Alternative 6' HEC-1 model and the corresponding SWMM unsteady flow model. The SWMM hydrograph peak is just over 35 cfs greater than the HEC-1 hydrograph. The peak times are very similar.

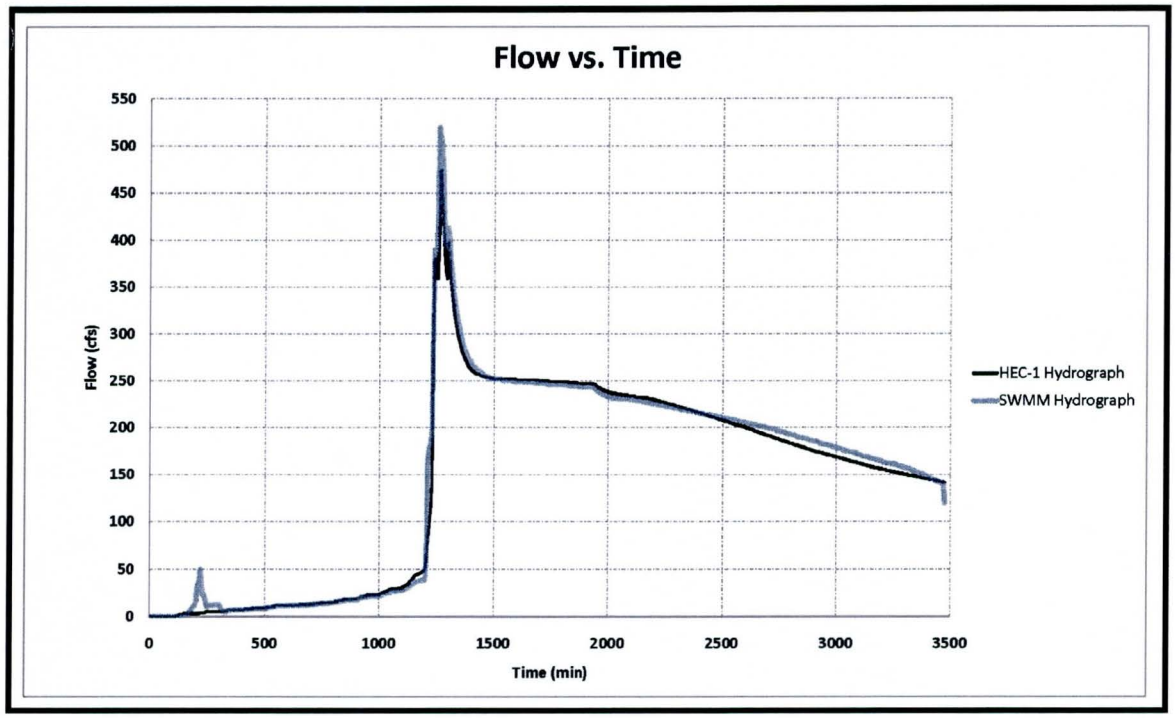

Figure 2.1 – 43rd Avenue Basin Inflow Hydrographs from HEC-1 and from SWMM

Of the various factors that could account for the difference between the two hydrographs in Figure 2.1, the outflow hydrograph from the Baseline Road and 27th Avenue junction structure is primarily accountable. The HEC-1 model outflow from this junction structure is based on a steady-state relationship to the basin stage. SWMM uses dynamic wave routing which better solves the one-dimensional Saint Venant flow equations and therefore produces the most theoretically accurate results.

These equations consist of the continuity and momentum equations for conduits and a volume continuity equation at nodes. This type of routing can account for backwater, entrance / exit losses, flow reversal and pressurized flow. Because it couples together the solution for both water levels at nodes and flow in conduits it can be applied to any general network layout, even those containing multiple downstream diversions and loops.

HEC-1 ID	Location Description	Approach 1 HEC-1 Alt 6		Approach 2 SWMM Alt 6	
		Peak Flow (cfs)	Peak Stage (ft)	Peak Flow (cfs)	Peak Stage (ft)
CPB352	Baseline Rd & 35th Ave	460	-	486	-
CG39	Baseline Rd & 39th Ave	482	-	503	-
CBR43C	Baseline Rd & 43rd Ave	487	-	522	-
STR43M	Baseline Rd & 43rd Ave Basin	253	1033.98	251	1034.00

Table 2.1 – 43rd Avenue Basin Hydrology Model Summary

The SWMM peak discharges for the regional nodes along Baseline Road between 27th Avenue and 43rd Avenue are generally considered hydrologically more correct than the corresponding pure HEC-1 discharges for reasons mentioned previously. SWMM discharges are around 5% greater than HEC-1 discharges for this stretch of the Baseline Road storm drain.

Despite the difference in inflow hydrographs at the 43rd Avenue and Baseline Road basin and the fact that SWMM level pool routing is computationally different than the HEC-1 methodology, the resulting peak stages in the basin between the two approaches are surprisingly similar. They have a spread of only about 5 inches which seems to be in good hydrologic agreement.

The peak outflow from the basin between the two approaches is very close. The peak discharge is below the original target discharge for the 43rd Avenue storm drain of 264 cfs.

The peak stages in the basin for the two approaches are around 2 feet lower than the street level overflow elevation along 43rd Avenue near the northwest corner of the basin. That freeboard could be a good hedge against potentially larger regional flows that could occur in the interim until all of the upstream regional drainage and flood control features are constructed and the future developed land use condition is closer to reality.

Upstream of Baseline Road and 27th Avenue and downstream of Baseline Road and 43rd Avenue, there is excellent corroboration in results between HEC-1 and SWMM. Between 27th Avenue and 43rd Avenue along Baseline Road, the agreement is good, certainly within the normal range of hydrologic certainty. However, SWMM-based peak discharges are all trending slightly greater than those form HEC-1 as opposed to being both above and below HEC-1.

Based on the results above, the peak stage and discharge associated with the 'Alternative 6' HEC-1 model will be reflected on the plans for this project.

In addition to the basic inflow-storage-outflow function of the 43rd Avenue basin, there is a concrete low-flow channel that takes the more frequent flows directly from the basin inlet to the basin outlet and there is a low-flow sediment storage basin component near the outlet. This sediment storage is discussed in a little more detail in the next Section 3.1.2 of the design report. The initial 30-50% submittal proposed that the basin be below the grade of the low flow channel. However, having dead storage within the basin raised concerns amongst the project team with regard to vector control issues. Therefore, the basin was reconfigured to be an inline basin along the low-flow channel alignment located near the outlet.

2.2 27th Avenue and South Mountain Avenue Regional Basin

The 27th Avenue and South Mountain Avenue regional basin is significantly involved in the investigation of the regional hydrology and hydraulics and future regional basin, storm drain and channel infrastructure in its tributary area. This investigation has been on-going since the beginning of the project. Many elements of that investigation have now been resolved or are near final resolution. The addendum to the South Phoenix / Laveen Drainage Improvement Project that Stanley is preparing has progressed significantly since the update report was submitted in March of this year.

Although the hydrology is not final, it is not anticipated that any further modifications to the model will result in changes to the 27th Avenue and South Mountain Avenue basin inflow hydrographs that would result in changes to the design approach for the basin. The future design incorporates two regional storm drains that will discharge at the basin. One storm drain, proposed to be 66-inch diameter conduit, approaches the basin from the east along South Mountain Avenue and will discharge at the southeast corner of the basin. The other storm drain is proposed to be a 54-inch diameter conduit within 27th Avenue and will discharge at the southwest corner of the basin originating from the south. The Alternative 6 HEC-1 model estimates a flow of 235 cfs for the future 66" storm drain at the southeast corner of the basin and 128 cfs for the 54" storm drain at the southwest corner of the basin. The design of the basin recognizes these future storm drains with the placement of improvements within the basin site.

The proposed design volume for the 27th Avenue and South Mountain Avenue basin was also derived through a SWMM unsteady flow model that corresponds to the 'Alternative 6' HEC-1 model. The SWMM model has the same elevation-storage-discharge relationship representing the 27th Avenue and South Mountain Avenue basin that is in the 'Alternative 6' HEC-1 model, the same inflow hydrograph for the local direct flow into the 27th Avenue and South Mountain Avenue basin and also has the same local inflow into the Baseline Road storm drain that is derived from the 'Alternative 6' HEC-1 model. The elevation-storage-discharge curve is based on proposed contours shown in the 75-95% plans.

HEC-1 ID	Location Description	Approach 1 HEC-1 Alt 6		Approach 2 SWMM Alt 6	
		Peak Flow (cfs)	Peak Stage (ft)	Peak Flow (cfs)	Peak Stage (ft)
CCBDE	Baseline Rd & 7th Ave	298	-	298	-
CBR19C	Baseline Rd & 19th Ave	326	-	293	-
C27N	Baseline Rd & 27th Ave	410	-	344	-
ST27C	Baseline Rd & 27th Ave Basin	191	1085.84	146	1085.59

Table 2.2 – 27th Avenue Basin Hydrology Model Summary

Table 2.2 shows the results of the 'Alternative 6' HEC-1 model and the SWMM unsteady model for the peak stage in the basin as very similar. The results for the peak discharge do vary significantly between the two modeling techniques. This is a result of the difference in how the total inflow to the basin is modeled between the two methods. The HEC-1 model directly adds the hydrograph from the flow within the Baseline Road storm drain to the hydrograph that is comprised of sub-basins south and east of the basin that discharge directly to the basin site. This combined hydrograph is then routed through the basin utilizing the level pool routing step. The SWMM unsteady model routes the Baseline Road storm drain hydrograph and the local direct inflow hydrograph separately through the basin using unsteady flow analysis.

Since the HEC-1 and SWMM peak stage results are similar, it was decided that the 'Alternative 6' HEC-1 results should be utilized for the basin design. This was decided because the HEC-1 model is the basic fundamental design tool that is utilized for the entire watershed. As future regional improvements are advanced and designed, the HEC-1 model will be updated accordingly to recognize their actual design. The effect these designs have on the 27th Avenue and South Mountain Avenue basin can more readily be verified within the HEC-1 model as being acceptable.

There are a couple minor exceedances in the SWMM model for the 100-year design storm event. The largest two occur at Baseline Road and 27th Avenue and Baseline Road and 7th Avenue. The exceedance at 27th Avenue occurs for less than 10 minutes while the exceedance at 7th Avenue is less than 5 minutes. Other exceedances are reported by the SWMM model but they are less than 1 minute in length. None of the exceedances are considered unreasonable. The exceedances are shown on the SWMM report printout in Appendix B.

3 Basin Specific Design

3.1 43rd Avenue Basin

3.1.1 Low-Flow Channel

An incised concrete low-flow channel has been incorporated in the layout and design of this basin. As a low-flow channel, its design criteria can be somewhat subjective. It will receive relatively frequent flow from the Baseline Road storm drain system. Concrete was chosen because it is durable and relatively easy to maintain. Also, given the existing inlet and outlet storm drain inverts, the longitudinal slope is relatively flat. So the concrete surface will provide the best range of flow velocity under that circumstance which will help reduce the amount of sediment deposition and associated maintenance within the channel.

The design discharge hydrology uses the rational method and is based on a drainage area corresponding to the right-of-way in Baseline Road from 43rd Avenue to 7th Avenue. This approach yields a 50-yr peak flow of 99 cfs and a 100-yr peak flow of 118 cfs. A channel cross section with a depth of 2 feet, bottom width of 8.5 feet and 2 : 1 side slopes was chosen. That section has a bank-full capacity of about 105 cfs which puts it in the 50- to 100-year range based on runoff from the Baseline Road right-of-way as contributing area.

The basin floor will be designed to drain to the low-flow channel. A band of riprap will be included along the length of the channel as a good measure to guard against erosion. Simple hydrology and hydraulic calculations are found in Appendix C. Please note that this preliminary calculation does not take into account:

- channel freeboard,
- effects of flow super-elevation, or
- potential backwater condition influence from the orifice outlet of the basin.

Freeboard and super-elevation may not normally be considered applicable to low-flow channel design. The channel capacity does want to be a good match for the outlet capacity under low-flow conditions. Ideally, the channel would "drown" gradually from downstream to upstream as basin inflow increases beyond a low-flow rate.

3.1.2 Sediment Storage Basin

The 43rd Avenue detention basin has been designed to store the average annual sediment yield based upon the Modified Universal Soil Loss Equation (MUSLE). The MUSLE is commonly used to predict the sediment yield in the semiarid Southwest and can be used to estimate sediment supplied from individual design storms as well as for average annual sediment production.

The determination of total sediment yield is typically defined as the wash load plus the bed load. The wash load is sediment that is suspended, typically comprised of fine particles that are not present in bed sediment (typically <0.062 mm). Bed load is sediment that moves by particle saltation (transportation by short leaps), rolling or sliding on or near the streambed. The MUSLE provides an estimate of sediment yield that supposedly only represents wash load. The bed load is typically predicted using sediment transport analyses for contributing channels.

It is assumed that for the 43rd Avenue Basin, bed load is negligible or non-existent since there are no directly connecting channels or washes. The only physical connection to the contributing area is via the existing Baseline Road storm drain. For the 43rd Avenue and Baseline Road basin, the MUSLE will be used to estimate the volume of suspended sediment that comes from contributing areas hydrologically downstream from the 27th Avenue and South Mountain Avenue basin which is considered a boundary limit for sediment contribution because it will also have sediment storage incorporated in its design. The area contributing to 43rd Avenue includes HEC-1 sub-basins that border Baseline Road from 43rd Avenue east to 7th Avenue. Sub-basins east of the 7th Avenue that drain to 7th Avenue between Baseline Road and Dobbins Road were also including in the contributing area.

Generally, it is envisioned that all of the future regional infrastructure detention basins will have sediment storage incorporated in their design. The existing Aguila Municipal Golf Course has significant sediment storage capability as does the existing regional detention basin in South Mountain Park which actually has a significant sediment dead storage component. Each of these basins would be considered a boundary limit for sediment contribution.

For the 43rd Avenue and Baseline Road basin, the sediment contributing area would consist of HEC-1 sub-basins BR35CW, BR35C1, and BR43C, BR27N, BR19C, CBDE, and SMA15E.

DDMSW Version 4.6.0 was used to calculate the sediment volume. Detailed information and guidance on the development of various factors for the MUSLE from Chapter 11 of the FCDMC Hydraulics Manual were used in this analysis.

MUSLE Analysis

The MUSLE can be used to estimate sediment supplied from individual design storms as well as for average annual sediment production. The MUSLE is:

$$Y_s = R_w K L_s C P$$

where:

Y_s = sediment yield for the storm event (tons)
R_w = storm runoff energy factor
K = soil erodibility factor
L_s = topographic factor (slope length and gradient) factor
C = cover and management factor
P = erosion control practice

Storm Runoff Energy Factor, R_w. The Storm Runoff Energy Factor, R_w, is determined by the equation:

$$R_w = a\,(V \times q_p)^b$$

where:

R_w = storm runoff energy factor
a = MUSLE coefficient, typically 95
b = MUSLE coefficient, typically 0.56
V = storm runoff volume for a particular return period (acre-ft)
q_p = storm event peak flow (cfs)

Soil Erodibility Factor, K. Soil Erodibility Factor, K, is a characteristic of the soil type. Erodibility factors will be obtained from National Resource Conservation Service (NRCS) Web Soil Survey data. For each soil map unit, an erodibility factor will be obtained and based upon the areal extent of each soil map unit, an average weighted K factor will be estimated for the entire basin.

Topographic (Slope Length and Gradient) Factor, L_s. The Slope Length and Gradient Factor, L_s is a factor that represents the basin by the slope length and gradient. The factor is determined by the equation:

$$L_s = (l/72.6)^n (0.065 + 0.0454S + 0.0065S^2)$$

where:

L_s = topographic factor
l = slope length (ft)
S = percent slope (e.g. 30 for 30%)
n = slope dependent exponent
  $n = 0.3$ for $S<3$
  $n = 0.4$ for $S=4$
  $n = 0.5$ for $S>5$

The slope length and percent slope are based upon the estimated length and average slope across the entire basin area.

Cover and Management Factor, C. The cover and management (C&M) factor, C, is the product of three factors and based upon the equation:

$$C = C_1 C_2 C_3$$

where:

C_1 = canopy cover
(effect of vegetation cover)

C_2 = mulch cover
(effect of mulch/close growing vegetation in contact with the soil)

C_3 = root cover
(effect of tillage and residual effects of land use)

The values of the three C&M factors will be estimated based upon aerial photos and available data in the study area. Figure 11.24, Figure 11.25 and Figure 11.26 from the FCDMC Drainage Design Manual-Hydraulics, will be utilized as a basis for determining these factors..

Erosion Control Practice Factor, P. This factor accounts for conservation practices such as contouring and terracing. In this area of Phoenix no such activities have taken place. However, a number of agricultural fields still exist within the area and may reflect characteristics similar to terracing.

Sediment Yield Results

The results of the analysis produced an average annual sediment yield of 0.007 ac-ft. The process for accounting for the sediment volume within the basin is handled two ways. The first way in which the sediment is accounted for is in the overall storage

volume of the basin. The overall storage volume available within the basin was reduced to recognize the sediment volume for the peak stage calculations. When large events occur, the basin will fill and sediment will potentially drop out of suspension across the entire floor and sides of the basin.

The second method that is being utilized to account for sediment is an inline sediment storage basin along the low-flow channel alignment. The basin will have a concrete bottom and is approximately 60 feet long by 20 feet wide with a depth of 2 feet. This basin has a capacity in excess 0.055 ac-ft.

3.1.3 Basin Outfall Orifice Plate

The 43rd Avenue detention basin existing outfall is a 72-inch diameter pipe. As mentioned in Section 1.3, the District's initial analysis of the 43rd Avenue Basin and the 43rd Avenue storm drain recognized a 54-inch diameter circular orifice plate on the 72-inch diameter pipe. This pipe limited the discharge from the 43rd Avenue basin to 264 cfs.

In discussions with the project team, it was determined that the discharge to the 43rd Avenue storm drain should continue to be limited to 264 cfs due to potential impacts to the 43rd Avenue storm drain outfall at the Salt River. With the updates in hydrology upstream of the 43rd Avenue Basin reflected in the 'Alternative 6' HEC-1 model, the size of the orifice plate was revisited to optimize the discharge from the basin. A 60-inch orifice plate was selected which produced a discharge of 253 cfs at a stage of 1033.98 in the basin. The rating curve for the orifice plate was developed utilizing CulvertMaster. The rating curve has been included in Appendix C.

3.1.4 Basin Inlet Restrictor Plate

The 43rd Avenue detention basin existing inlet is a 96-inch diameter pipe. The end of the pipe is partially covered by a steel restrictor plate. The restrictor plate is in place to limit the peak flow discharging to the existing trapezoidal channel that traverses the site and discharges to the 72-inch storm drain at the northwest corner of the site. The project team's desire is to remove the restrictor plate with the construction of the basin.

The design HEC-1 model for the project is based on future conditions hydrology with the proposed regional facilities in place. Until the proposed regional facilities are constructed, there is a potential for flows in excess of the future conditions hydrology flows to reach Baseline Road and be captured by the Baseline Road storm drain and conveyed to the 43rd Avenue basin. Stanley performed an analysis to determine if removing the restrictor plate could be done without creating new flooding risks downstream of the 43rd Avenue basin for the interim condition that exists until all the future regional facilities have been constructed.

The first part of the analysis was to estimate the capacity of the existing storm drain inlets along Baseline Road. The estimate was based on a flow depth at the inlets corresponding to the crown of Baseline Road. A summation of the inlet capacity along Baseline Road from 7th Avenue to 43rd Avenue produced a peak flow that was greater than the future condition peak flow that reaches the 43rd Avenue basin. However, simply adding all of these inlet capacities together for the entire reach was considered too conservative since they do not recognize timing and routing.

To account for this, it was decided that the peak flow for each mile reach would need to be converted to some form of hydrograph that could then be routed and combined with the other hydrographs along Baseline Road to the basin. In order to create hydrographs for each mile section, a "unit hydrograph", of sorts, was needed. Section 3.2.1 describes a quasi-existing condition interim HEC-1 model that Stanley created for flows that might impinge on the southern edge of the 27th Avenue and South Mountain Avenue basin. This model includes runoff from the South Mountain Park basin as well as a mixture of developed and undeveloped parcels and sub-basins between the Park and Dobbins Road. The hydrograph from this model is a reasonable representation of hydrographs that would reach Baseline Road for each mile reach. Individual hydrographs for each mile reach were created by taking the ratio of the total combined inlet flow for each mile reach by the total peak flow calculated from the above quasi-existing condition model and reducing all the ordinates of that hydrograph by that ratio. The four resultant hydrographs were then routed and combined in HEC-1 utilizing the 'Alternative 6' routing parameters for Baseline Road.

The resultant HEC-1 model produced a peak flow of 767 cfs at the 43rd Avenue basin. The routing of the peak flow through the basin's level pool routing step produced a basin discharge of 259 cfs at a stage of 1034.30 feet. These values are less than the 'Alternative 6' results for the 43rd Avenue basin. Figure 3.1 shows the resultant hydrograph from the interim conditions model and the 'Alternative 6' hydrograph for the flows entering the basin. The time to peak is very similar for both models. The total volume of flow for the 'Alternative 6' model is significantly higher than the interim hydrograph volume. In part, this is thought to be attributed to the more complete capture of flow by future regional infrastructure which will then be bled off at a much reduced rate as opposed to the potentially larger but relatively shorter duration interim flows that would reach Baseline Road with only a portion of those flows actually intercepted by the Baseline Road storm drain.

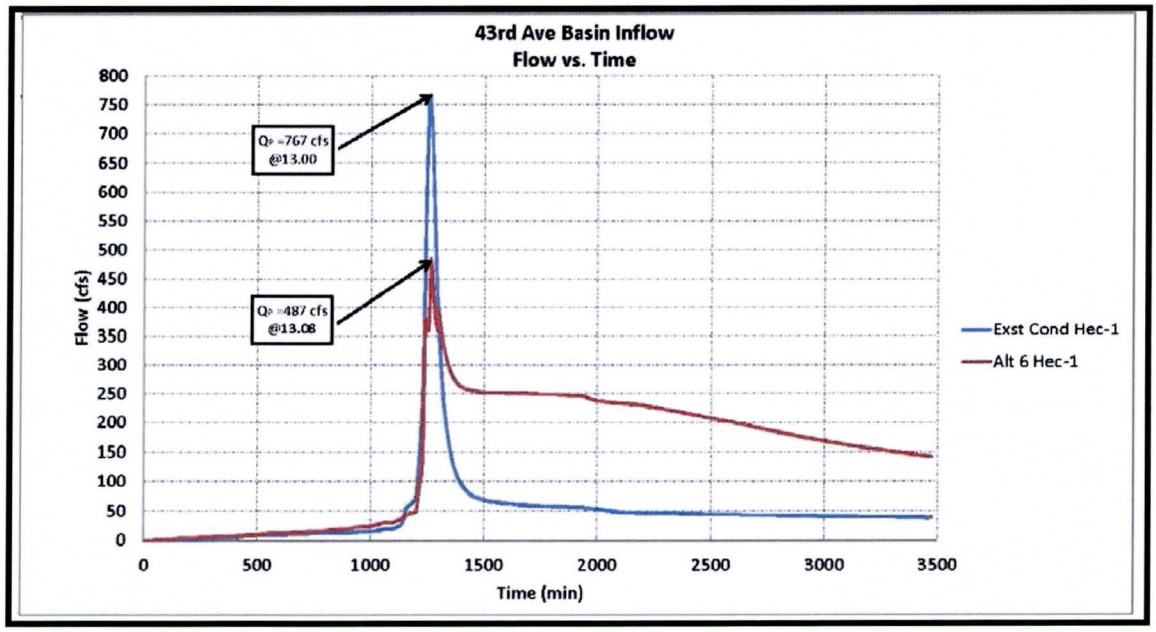

Figure 3.1 – 43rd Ave Basin Inflow Hydrographs, Interim –vs- 'Alternative 6' HEC-1

The 767 cfs peak flow of the interim hydrograph happens to correspond roughly to the capacity of the Baseline Road storm drain flowing full. The lower peak stage and outlet discharge associated at the 43rd Avenue and Baseline Road basin corresponding to the interim model are due to the smaller volume of the interim inflow hydrograph, even though it has a significantly higher peak flow. The results suggest that removal of the restrictor plate should not have an adverse impact on areas downstream of the basin. The interim condition HEC-1 model and the Baseline Road inlet calculations are included in Appendix C.

3.1.5 Basin Inlet Energy Dissipation

Inlet energy dissipation measures are needed to mitigate erosion in the bottom of the basin that may occur during peak inflows to the basin. A HEC-RAS model was prepared to simulate peak inflow and estimate entrance velocities. A total of seven HEC-RAS cross sections were used; two in the pipe, two within the concrete apron, and three just downstream of the concrete apron. Please see HEC-RAS X-Section Location figure in Appendix C. To best reflect conveyance on the basin floor, ineffective flow areas were assigned to the three cross-sections just downstream of the concrete apron in the far overbank areas. Effective flow area is projected as continuous expansion downstream at an angle of approximately 4:1 or 14 degrees from the end of the wingwalls to the cross-section RS 0.

Various conditions of inflow rate and concurrent basin ponding stage were considered at different times in the basin hydrograph routing step. The worst case scenario occurs at the time of peak inflow, at which time the stage in the basin is only about 2 feet deep which corresponds to only a few inches deep in the concrete low-flow channel near the basin inlet. The HEC-RAS starting condition at RS 0 uses normal depth S = 0.0016 ft/ft.

Based on the water surface profile, rapid change in flow depth occurs approximately 20 feet downstream of the pipe inlet to the basin resulting in hydraulic jump within concrete apron. Flow depth in the 8 foot diameter inflow pipe is approximately 5 feet just prior to entering the basin and 1.6 feet upon entrance, after which, it suddenly rises to 4 feet resulting in a hydraulic jump. Currently, the jump occurs within the concrete apron. However, a reinforced concrete sill has been implemented to better ensure the jump occurs within the concrete apron. It is a single sill at RS 3. It is 1 foot high, with a 12 foot wide opening at one wingwall for maintenance vehicle access.

Riprap is sized based on 100-year peak flow velocities according to River Mechanics Manual for DDMSW (Draft), September 2009. Riprap D_{50} = 6 inch. The basin bottom is lined with riprap apron @ thickness of $2D_{50}$ in the layout illustrated. Velocity distribution within HEC-RAS cross sections just downstream of concrete apron was used to determine the riprap extent and D_{50} size. The riprap extent and size are a result of an iterative process where riprap size was selected from the included sizing chart (developed based on River Mechanics Manual for DDMSW, equation DDMS51) and Manning's roughness coefficient was then re-estimated per the equation outlined in Table 8.1 also included in the appendix. The downstream edge of riprap terminates where overbank flow velocity is approximately 2 ft/sec.

3.1.6 Basin Side Slope Erosion Protection

This is a summary of the calculations performed to verify that the ¾" minus and 1-1/4" minus decomposed granite material gradations are suitable ground cover for the upland areas and basin side slopes, respectively.

In general runoff from the upland areas around the perimeter of the basin are conveyed in a sheet flow manner and are mostly diffused. A couple small areas concentrate flows to a narrower flow path. The largest of these areas is located in the northeast corner of the basin and has an approximate area of 0.5 acres. The 100-year peak flow was estimated for this area of 1.8 cfs. A flow velocity of 0.98 fps was calculated for the flow at the downstream end of the sub-basin in the upland area. A velocity of 2.01 fps was calculated for the adjacent basin side slope. A defined flow conveyance area is not present so a width of 20' was used for both flow velocity calculations.

The results for both sections produced a D50 requirement of less than what each material gradation specifies. Therefore, both materials are suitable ground cover options capable of handling runoff within the basin site. Refer to Appendix B for the design calculations.

3.1.7 Basin Outlet Trash Rack Capacity

A calculation was completed to estimate the flow capacity of the basin outlet trash rack to verify that the outflow from the basin is not restricted by the trash rack. The trash rack is placed on a diagonal surface away from the culvert face. The total area covered by the trash rack is greater than the culvert cross sectional area. The total open area of the trash rack was calculated minus the area covered by the steel bars. This area was then reduced by 50% to account for clogging. The calculations show that the overall open area of the trash rack reduced by 50% is greater than the culvert cross sectional area.

3.1.8 Southern Interceptor Channel

There is an excess parcel located along Baseline Road and 43rd Avenue that will remain in mostly undisturbed. This area drains north towards a portion of the southern edge of the basin. A small interceptor channel has been incorporated into the grading to capture runoff from the area. The channel drains to an ADOT double catch basin / 24" storm drain that outlets to the low flow channel in the basin. Appendix B includes calculations of the peak flow and hydraulic design and calculations for the rock mulch channel lining.

3.2 27th Avenue Basin

3.2.1 Basin Grading Configurations

During the development of the South Phoenix / Laveen Drainage Improvement Plan Addendum a couple different grading configurations were looked at for the 27th Avenue basin. One configuration has a lower floor and larger volume (Version "A") and the other had a higher floor and smaller volume (Version "B").

The Version "A" did not include an elevated terraced bottom and was hence intended to maximize the available basin volume. There was a low-flow channel function along the south and west sides of the basin that was created by a linear earth berm so that low-flows entering the basin at the southeast and southwest corners would be directed to the outlet at the northwest corner without spreading out over the basin floor.

The Version "B" of the layout had an elevated terraced bottom and an incised low-flow channel similar in function and alignment to the larger volume version. Both basin versions had the same side slopes and top perimeter. Both versions had a floor that sloped up and away from the outlet at the basin's northwest corner.

The results from the various hydrologic models run during the development of the addendum indicated that the design of the basin should incorporate as large a volume as reasonably possible with a low floor elevation. The final version of the basin utilized a low floor with no terracing and a low flow channel around the south and west sides. Initially the low flow channel had a berm on the basin floor side but that was later removed. Figures 3.2 and 3.3 illustrate the initial basin layouts studied in the addendum.

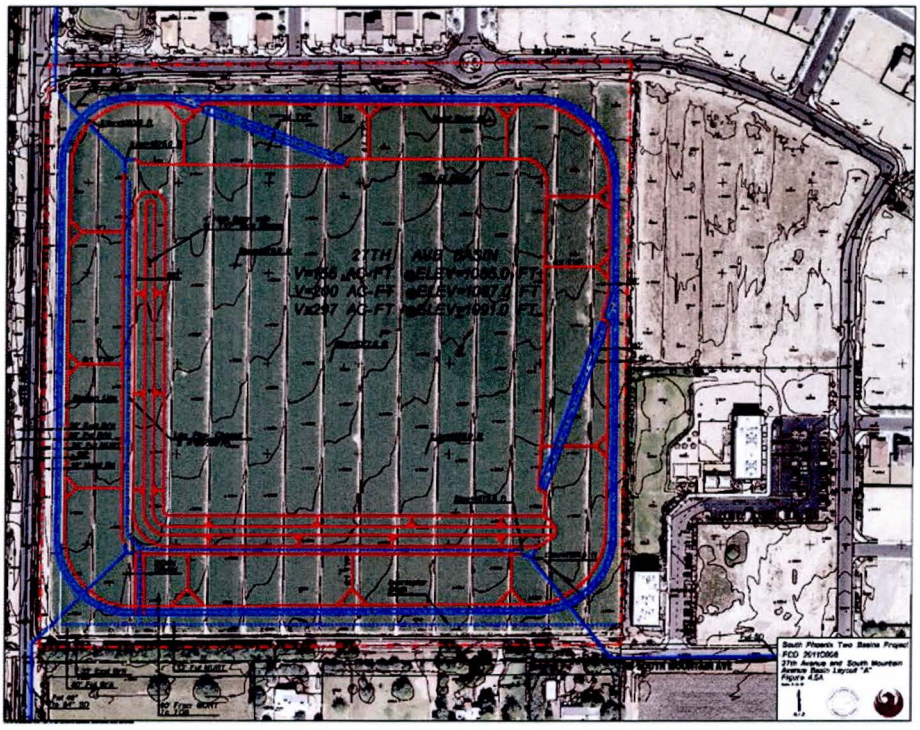

Figure 3.2 – 27th Avenue and South Mountain Avenue Version "A" Layout

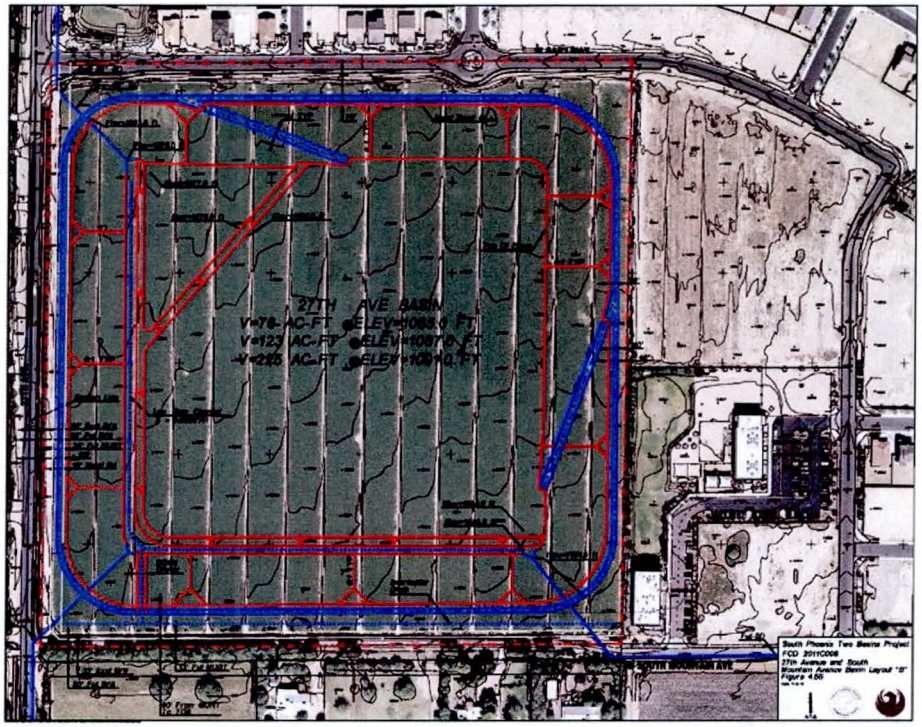

Figure 3.3 – 27th Avenue and South Mountain Avenue Version "B" Layout

3.2.2 Southern Boundary Offsite Flow

The current design of the 27th Avenue and South Mountain Avenue basin is limited to the basin site. It does not include any future regional storm drain improvements within either South Mountain Avenue or 27th Avenue or any other upstream improvements. Therefore, offsite flows will continue to approach the site as they currently do until the future facilities are constructed. An interim, quasi-existing condition hydrologic model was prepared to estimate the magnitude of these flows. The HEC-1 model estimated a 100-year flow of approximately 1,500 cfs that could potentially approach the basin site from the southeast.

This flow would be in the form of sheet flow and shallow concentrated flow fanning out from the vicinity of the 19th Avenue / Dobbins Road / Western Canal area. Of this total flow, it was estimated that about 10% of it or about 150 cfs would reach the southeast corner of the 27th Avenue and South Mountain Avenue basin. This flow was reduced by approximately 10 percent to 135 cfs to account for the reduction in rainfall values NOAA 14 exhibits for the watershed from the NOAA 2 values utilized in the previous studies.

This offsite flow would further be reduced by along South Mountain Avenue by flows that would break out and flow north at the driveway entrance to the Eagle Charter School. To estimate the magnitude of this break out flow, a broad crested weir calculation was performed for the school's driveway entrance. This calculation produced a flow of 30 cfs that would weir over the high grade break the driveway entrance. A description of how this flow is managed is given in the next section. This leaves a resultant flow of approximately 105 cfs that would reach the southeast corner of the basin site.

This flow is being captured in a surface inlet catch basin area drain and outfalls through a storm drain pipe into the basin. The inlet is the equivalent of a triple-double ADOT C-

15.80 catch basin constructed as a single structure. The grates are raised above the apron to increase their capacity. A 36" storm drain discharges the flow at the bottom of the basin within the low flow channel.

By capturing this flow at the southwest corner, the remainder of the southern edge of the basin is mostly protected from offsite flow impacts. A small collector channel has been incorporated into the basin design to capture runoff from between the existing irrigation ditch and the top of the basin. This area produces a 100-year flow of approximately 5 cfs. The collector channel has a trapezoidal section with maximum side slopes of 6:1, a bottom width of 8-feet, and is approximately 2-feet deep. It is not envisioned that the channel will be lined. The collector channel outfalls at a single surface inlet catch basin that discharges through a 24" storm drain into the basin.

3.2.3 Eastern Boundary Interceptor Channel

An estimate was also done to determine how much flow would impact the eastern edge of the basin. The north edge of South Mountain Avenue is elevated and generally directs offsite flows that reach it to the west. The exceptions to this are two north / south streets east of the basin site and the driveway entrance to the Eagle Charter School near the southeast corner of the basin site. Under a shallow flow condition described in Section 3.2.1, it is possible that flow in South Mountain Avenue could exceed the break over elevations of the intersecting north / south streets and flow north.

Under that scenario, the two streets east of the site could potentially receive overflow from South Mountain Avenue. If this happens, it is envisioned that these flows would enter the existing Silva Mountain subdivision east of the site at 23rd Avenue and 24th Avenue but it is not anticipated they would impact the 27th Avenue basin parcel.

As mentioned in the previous section the Eagle Charter School driveway would take flows north through the school property to an existing onsite retention basin adjacent to the proposed regional basin site. The flow was estimated to be 30 cfs. The school retention basin has a depressed section that allows larger than design onsite flows to discharge from the basin into the regional basin site. The flow would then continue north within the crop rows on the site and discharge to Gary Way. This flow path comprises the offsite flows that could be anticipated along the eastern edge of the 27th Avenue regional basin site. Refer to Figure 3.4 for the location of the break out flow locations along South Mountain Avenue.

A collector channel has been incorporated into the design that would convey the flows north and west to an area drain inlet just east of the maintenance access road off of Gary Way. The collector channel has a trapezoidal section with maximum side slopes of 6:1, a bottom width of 8-feet, and is approximately 2-feet deep. It is envisioned that the channel will be lined with rock mulch.

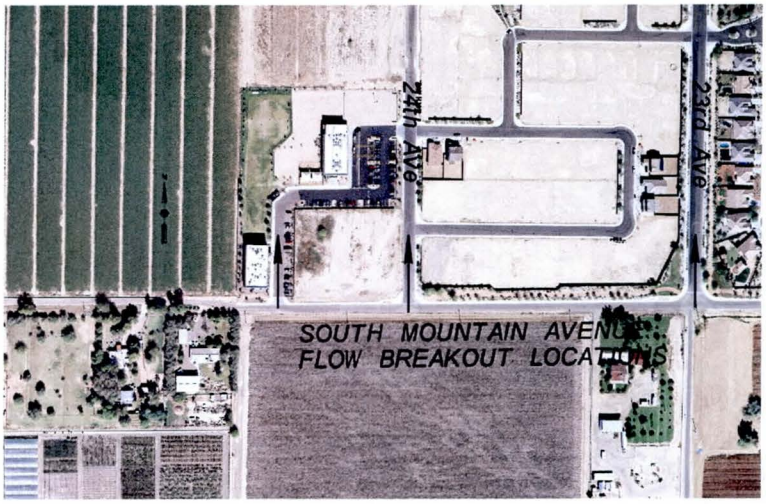

Figure 3.4 – South Mountain Avenue Potential Flow Breakout Locations

The collector channel outfalls at a surface inlet double catch basin area drain and outfalls through a storm drain pipe into the basin. The inlet is a modified double ADOT C-15.80 catch basin. The grates are raised above the apron to increase their capacity. A 24" storm drain discharges the flow at the bottom of the basin into the basin outfall wingwall.

3.2.4 Low-Flow Channel

A concrete low-flow channel has been incorporated in the layout and design of this basin. Concrete was chosen because it is durable and relatively easy to maintain.

The low-flow channel is located along the southern and western edges of the basin floor. The low flow channel has an 8.5-foot bottom width with 2:1 side slopes with a depth of 2-feet.

Simple hydraulic calculations are found in Appendix C. The calculation estimates the peak conveyance capacity for the low-flow channel. Please note that this preliminary calculation does not take into account:

- An associated hydrologic event,
- channel freeboard or,
- effects of flow super-elevation.

3.2.5 Sediment Storage Basin

The 27th Avenue detention basin was designed to store the average annual sediment yield based upon the Modified Universal Soil Loss Equation (MUSLE). The methodology described in Section 3.1.2 for the 43rd Avenue basin was followed to develop a sediment yield volume. The total basin volume recognizes the sediment yield, too.

For the 27th Avenue and South Mountain Avenue basin, the sediment contributing area would consist of HEC-1 sub-basins DRWC1C, SMA19C, BR27S, BR35CE, and DR27CN.

DDMSW Version 4.6.0 was used to calculate the sediment volume. An average annual volume of 0.012 ac-ft was calculated for the basin. A sediment basin is located at the northwest corner of the basin upstream of the basin outfall structure. The sediment basin is approximately 60 feet long by 20 feet wide and 2 feet deep. The basin has a volume in excess of 0.07 ac-ft.

3.2.6 Basin Outlet Trash Rack Capacity

A calculation was completed to estimate the flow capacity of the basin outlet trash rack to verify that the outflow from the basin is not restricted by the trash rack. The trash rack is placed on a diagonal surface away from the culvert face. The total area covered by the trash rack is greater than the culvert cross sectional area. The total open area of the trash rack was calculated minus the area covered by the steel bars. This area was then reduced by 50% to account for clogging. The calculations show that the overall open area of the trash rack reduced by 50% is greater than the culvert cross sectional area.

4 Maintenance Plan

4.1 General Considerations

In this sub-section, the following general text regarding maintenance has been excerpted from the "Maintenance of Drainage Facilities" page of the City of Phoenix Street Maintenance Division Policies and Procedures Manual dated (revised) June 2000. This is followed by a second sub-section that covers specific maintenance regarding the two basins included in this project.

PURPOSE
To ensure all drainage facilities are maintained and kept clear of objects that may impede the flow of storm runoff.

POLICY
All drainage facilities shall be inspected monthly and cleaned on a regular maintenance schedule.

PROCEDURE
The Street Maintenance Drainage Foreman is responsible for visually inspecting each drainage facility in their section on a monthly basis.

The Drainage Foreman shall schedule the cleaning as needed, but is not to exceed the established service levels unless it is determined that allowing it to exist could become an obstruction to drainage.

The established service levels are as follows:

a. Man-made drainage easements shall be inspected on a monthly basis and cleaned if necessary.

b. Dedicated natural washes shall be inspected on a monthly basis and debris removed twice a year.

c. Non-dedicated natural washes shall be inspected twice a year and the adjacent property owner notified to clean as needed. If the property owner fails to remove the debris from the wash, the Foreman shall inform the Street Maintenance Field Investigator who will follow up by notifying NIH Zoning Enforcement.

d. Man-made detention basins shall be inspected on a monthly basis and cleaned when necessary.

e. Storm drainage inlets shall be inspected on a monthly basis and cleaned when necessary.

f. Storm drainage catch basins, siphons and drywells shall be cleaned on a monthly basis. The section equipped with the vactors shall schedule these accordingly.

The Street Maintenance Section shall respond to any complaints regarding the clogging of drainage facilities and resolve the problem within five days of notification. The above service levels shall be followed for routine maintenance. Extenuating circumstances may require deviation in schedule / frequency.

4.2 Maintenance Specific to the Two Basins

Both the 43rd Avenue and Baseline Road Basin and the 27th Avenue and South Mountain Avenue Basin are regional detention basins. Each was designed as an integral part of a larger system of regional detention basins and storm drains. Portions of the overall system have already been constructed and the rest of it will be constructed as future projects.

Each of the two basins has multiple storm drain inlets and a single storm drain outlet. Each basin has a shallow rock mulch lined collector channel or 'swale' for onsite and offsite flows along portions of their perimeters. These swales receive and direct flow to catch basin inlets which, in turn, direct the flow to storm drains that outlet to the bottom of the basin.

Each basin also has a concrete low-flow channel situated along the basin bottom to receive and convey nominal flows from the storm drain inlet(s) to the basin outlet to reduce the occurrence of sheet flow and shallow flow spreading out across the bottom of the basin. Each low-flow channel incorporates an in-line debris basin near the basin outlet with a wider bottom section than the low-flow channel to provide some nominal storage space for sediment and debris.

The 43rd Avenue and Baseline Road Basin has a 96-inch diameter storm drain inlet from Baseline Road that conveys large regional flows to the basin. It also has a smaller 24-inch diameter storm drain inlet for both onsite runoff and runoff from the vacant parcels on the north side of Baseline Road east of 43rd Avenue. The outlet for the 43rd Avenue Basin is a single 72-inch diameter storm drain at its northwest corner that discharges north in 43rd Avenue. The outlet has a steel restrictor plate that limits the flow leaving the basin to a rate that the 43rd Avenue storm drain can handle.

The 43rd Avenue and Baseline Road Basin has ¾" – minus decomposed granite inert ground cover along the bottom of the basin. During runoff events that exceed the capacity of the concrete low-flow channel, flow may spread out across the bottom of the basin. If this flow condition is great enough, it may move or transport some of the ¾" – minus granite downstream toward the basin outlet. This may require that the granite be replaced or re-spread upstream as it was originally constructed

The 27th Avenue and South Mountain Avenue Basin has one 36-inch diameter storm drain inlet and two 24-inch diameter inlets. It has a single 60-inch diameter storm drain outlet that discharges north in 27th Avenue to the existing Baseline Road storm drain. During moderate to larger runoff events, it is possible that flow from the Baseline Road storm drain can travel south (upstream) in the 60-inch storm drain and back up into the 27th Avenue Basin. The 36-inch storm drain at the southeast corner of the basin is an interim inlet designed to intercept regional drainage from South Mountain Avenue. The two 24-inch storm drains at the southwest and northwest corners of the basin are designed primarily for onsite runoff but it is possible during a moderate to large runoff event that they could receive offsite flows.

There is a private irrigation structure located just off the southeast corner of the 27th Avenue and South Mountain Avenue Basin on the adjacent Eagle Charter School property. It occasionally overflows irrigation water and storm flows that enter the private irrigation system upstream from the southeast. When this occurs, the overflow will enter the basin property and be conveyed north in the perimeter swale along the east side of the project, then west along the south side of Gary Way to the 24-inch storm drain at the northwest corner of the basin parcel.

Both the 43rd Avenue and 27th Avenue Basins incorporate landscaping in the form of trees, shrubs and ground cover in their original design and construction. Some of this vegetation is planted within the perimeter swales mentioned above. The hydraulic design of these swales accounts for the landscape vegetation planted within them assuming it is fully grown and normally maintained.

All of the storm drain surface inlets designed and constructed with both basins incorporate a raised steel grate. This raised grate design reduces the chance of excessive clogging from floating debris. However, these grates should all be inspected on a regular basis per the general procedure in Section 4.1 above and accumulated debris removed as necessary.

The onsite storm drains at both the 43rd Avenue and 27th Avenue Basins incorporate relatively steep segments from the perimeter level inlets down to the outlets at the bottom of each basin. The gradients of these segments are hydraulically steep with relatively high flow velocities ranging from a little over 15 feet per second to a little over 20 feet per second for the maximum design storm. Sediment, decomposed granite and other granular material that might be conveyed into the storm drains by runoff can potentially be abrasive to the interior pipe walls. For this reason, these storm drains should be inspected once each year to evaluate abrasion which may be occurring within the pipe.

The regional storm drain outlets at both basins have sloping trash racks that are also designed to minimize the adverse impacts of accumulated floating debris. The hydraulic design incorporates a clogging factor assumption that indicates the outlet will still operate as designed if the trash rack has up to 50% of its area clogged with floating debris. However, these outlets should be inspected on a regular basis per the general procedure and cleaned as necessary.

Finally, the low-flow debris basins at each of the two basins are intended to provide a location where sediment can deposit so it does not go into the storm drain downstream. They are also intended to help trap some amount of the floating debris that will enter the basins. There is a removable reinforced concrete "sill" that spans across the bottom of the low-flow channel at the downstream end of each debris basin. This sill creates a local backwater condition that is intended to help encourage deposition of silt and debris. The concrete sills can be removed, if needed, using a backhoe and chains through the lift rings if it helps facilitate access and maintenance.

South Phoenix Two Basins Project
FCD 2011C008

43rd Ave. and Baseline Road Design Report Final Plans
27th Ave. and South Mountain Ave. Design Report Final Plans
May 2013

Appendix A

Data Collection Report

Drainage Reports

ID	Title	Date	Prepared for	Prepared By	File Name	Comments
1	Central Avenue, South Mountain Park to Baseline Road, Final Drainage Report	August, 1992	COP	PBQ & D, Inc.	1992-08 FDR, Central Ave, S Mtn Pk to Baseline Rd.pdf	Parsons Brinckerhoff was contracted by the City of Phoenix to provide final roadway and drainage design PS&E for the improvement of Central Avenue from approximately Baseline Road to the South Mountain Park entrance, a distance of approximately 2 miles.
2	Laveen Area Drainage Master Study Evaluation	1993	FCDMC	FCDMC	A117_101LaveenAreaDrainageMasterStudy_Evaluation_ADMS_.pdf	The objective of the "Re-evaluation of the Laveen ADMS" was to answer the question, "is there REALLY enough (greater than 1' depth) storm water runoff in the South Phoenix/Laveen area to generate a floodplain".
3	South Phoenix/Laveen Drainage Improvement Project Detailed Concept Alternatives Executive Summary	December, 1996	FCDMC	HDR	A117_908SouthPhoenix_LaveenDrainageImprovementProject_DetailedConceptAlternativeExecutiveSummary.pdf	The purpose of the study is to identify flood control measures which minimize the flooding in the study area.
4	Focus Alternatives Submittal Volume I: Main Report	January, 1997	FCDMC	HDR	A117_904SouthPhoenixLaveenDrainageImprovementProject_FocusAlternativeSubmittal_Vol_I_MainReport.pdf	The study area is bounded by the Salt River, Central Ave., South Mountain Park, and 43rd Ave. (26 square miles).
5	South Phoenix/Laveen Drainage Improvement Project Conceptual Level Cost Estimate	January, 1997	FCDMC	HDR	A117_921_SouthPhoenix_LaveenDrainageImprovementProject_ConceptualLevelCostEstimate.pdf	
6	Laveen Area Drainage Masterplan Project Summary	March, 1997	FCDMC	HDR	A117_913SouthPhoenixLaveenDrainageImprovementProject_ProjectSummary.pdf	
7	Baseline Road, 51st Avenue to 7th Avenue TECHNICAL MEMORANDUM DRAINAGE REPORT	July, 1997	MCDOT	URS Greiner, Inc.	A117_304_BaselineRoad_51st_Avenueto_7th_AvenueTechnicalMemorandumDrainageReport.pdf	The purpose of this Drainage Technical Memorandum is to address proposed drainage improvements to Baseline Road. Maricopa County Department of Transportation (MCDOT) plans to improve Baseline Road from a two-lane rural section to a five-lane urban section.
8	43rd Avenue & Baseline Rd, Detention Basin Concept Report	September, 1998	FCDMC	FCDMC	A117_905_43rd_AvenueandBaselineRoadDetentionBasinConceptReport_September_1998.pdf	The purpose of this report is to present the results of an investigation that was performed to explore ways of reducing the size, cost and impacts of the large storm drain in 43rd Ave determined in the "Preliminary Design Report" dated July 1997.
9	43rd Avenue Detention Basin, Design Report, 100% Submittal	March, 1999	FCDMC	FCDMC	A117_602_43rdAvenue_DetentionBasinDesignReport_100percent_SubmittalMarch_1999.pdf	The purpose of this project is to develop final construction drawings, construction special provisions, and an engineer's estimate for the construction of the 43rd Ave & Southern Ave Detention Basin
10	43rd Avenue Storm Drain Design Report	May, 1999	FCDMC	FCDMC	A117_605_43rdAvenueStormDrainFinalDesignReport.pdf	This report was prepared in support of final construction drawings for the 43rd Avenue storm drain between Baseline Road and the Salt River.
11	Storm Drain, Design Report, Baseline Road (51st Avenue to 7th Avenue)	May, 2000	MCDOT, FCDMC, COP	URS Greiner, Inc.	URS Baseline Rd Storm Drain Design Report May 2000.pdf	Additional files pertaining to this report: Appendix sections A through F.
12	Drainage Report for Humane Society - South Mountain Campus	January, 2001	DLR Group, Inc.	Atherton Engineering	AZ Humane Society DR 1-15-01.pdf	SW Corner 15th Ave and Dobbins Rd
13	Laveen Area Drainage Masterplan Final Report	November, 2001	FCDMC	HDR	A117_910Laveen_Area_Drainage_Master_Plan_FinalReport_ADMP.pdf	The purpose of the Laveen Area Drainage Master Plan (ADMP) is to quantify the extent of local flooding problems and to identify pertinent information necessary to investigate and evaluate alternative solutions to these flooding problems.
14	43rd Avenue Detention Basin Stpped Spillway Design Report	January, 2002	FCDMC	BRW, Inc	A117_606_43rdAvenue_Detention_Basin_Stepped_Spillway_Design_Report.pdf	This design report is prepared by BRW, Inc. to document the analysis/design for the 43rd Avenue Detention Basin Stepped Spillway. The 43rd Avenue Detention Basin is located at the southeast corner of the 43rd Avenue/Southern Avenue intersection
15	Final Drainage Report for Mineral Canyon, Phoenix Arizona	December, 2004	Destiny Holdings III, LLC	WRG Design Inc.	Mineral Canyon Drainage Report.pdf	The purpose of this report is to provide a detailed hydrologic and hydraulic analysis for the proposed single-family subdivision near the entrance to the South Mtn Regional Park.
16	TechnicallVfemoranclum Splitter Structure Iflydraulics, McDowell Road Basin and Storm Drain Design	January, 2006	FCDMC	Kimley-Horn and Associates, Inc.	McDowell Basin and SD Tech Memo Splitter Hydraulics KHA jan06.pdf	The McDowell Road Basin and Storm Drain design project is part of the recommended plan of the Spook Hill Area Drainage Master Plan Update (ADMPU).
17	Design Hydrology for the Laveen Area Conveyance Channel	November, 2006	FCDMC	FCDMC	Various - See 'LACC Hydrology' folder	Received on CD from FCDMC August 25, 2011

Construction Plans

ID	Title	Date	Prepared for	Prepared By	File Name	Comments
18	South Mountain Park Regional Detention Basin	1978	COP	Hoffman-Miller	South Mtn Park Det Basin Plans 1978.pdf	Bid set
19	The Golf Course at Cesar Chavez, Mass Grading, Drainage, and Infrastructure Plans	1997	FCDMC	DEI Professional Services	City of Phoenix The Golf Course at Cesar Chavez Park.pdf	Aguila Golf Course
20	South Phoenix /Laveen Drainage Improvement Project Concept Plans	1997	FCDMC	HDR	South Phoenix Laveen Drainage Improvement Project Concept Plans.pdf	Regional storm drains and detention basins
21	The Golf Course at Cesar Chavez Park, Storm Water Pollution Prevention Plans	September, 1997	COP	DEI Professional Services	The Golf Course at Cesar Chavez Park SWPPP.pdf	
22	7th Avenue Bridge Over Western Canal	May, 2000	COP	DeLeuw-Cather	7th Ave Bridge at WC DeLeuw Cather 12may00.pdf	Includes storm drain
23	Plans For The Construction Of: Baseline Road - 51st Avenue To 7th Avenue Phase I	July, 2000	MCDOT, COP	URS Greiner, Inc.	Combined URS Baseline Plans complete.pdf	As-built plans (metric)
24	90% Drainage Concept Plans For The Construction Of: Baseline Road - 51st Avenue To 7th Avenue	August, 2000	MCDOT, COP	URS Greiner, Inc.	MCDOT 90% Drainage Concept Plans.pdf	
25	43rd Avenue and Southern Avenue Detention Basin	July, 2003	MCDOT, COP	FCDMC	43rd Ave and Southern Ave Detention Basin.pdf.pdf	As-built plans
26	South Mountain Avenue Storm Drain - Central Avenue to 7th Avenue	January, 2003	COP	Sunrise Engineering	South Mtn Ave 7th to Central Sunrise 15jan04.pdf	Storm drain plans
27	Citrus Mountain Estates, A proposed 60 LOT planned residential development (PRD)	Unknown	Citrus Mountain, LLC	Atherton Engineering Inc.	Site Plan for Citrus Mountain Estates.pdf	Site plan - - not construction plan

Subdivision Plats

ID	Title	Date	Prepared for	Prepared By	File Name	Comments
28	Subdivision Plats (partial sheets)	Varies	Varies	Varies	Various - See 'Subdivision Plats' Folder	Arlington Est Phases 1 and 2, Citrus Mountain, Commons at South Mtn, Dobbins X-ing Phases 1 and 3, Mineral Canyon, Silva Mountain Unit 1, Southern Highlands and Tristanos.

Initial HEC-1 Files from FCDMC

ID	Title	Date	Prepared for	Prepared By	File Name	Comments
29	Laveen Adms (Final Hec-1) 100-Yr 24-Hr Storm, Hidden Valley Watershed/Champion Drain Watershed	December, 1996	FCDMC	HDR	Cgoffsit.dat	
30	Laveen Adms (Final Hec-1) 100-Yr 24-Hr Storm, Hidden Valley Watershed/Champion Drain Watershed	August, 2002	FCDMC	FCDMC	LB2DR1.DAT	Update by H&H Branch, Flood Control District Of Maricopa County of a previous model

GIS Data

ID	Title	Date	Prepared for	Prepared By	File Name	Comments
31	GIS data obtained from FCDMC	September, 2011	FCDMC	FCDMC	Various - See 'FCDMC GIS' Folder	Data received includes the following: Orthos_10_11, Aerials_2000, Aerials_1996, dtm, dxf and shp files.

Geotechnical Analysis

ID	Title	Date	Prepared for	Prepared By	File Name	Comments
32	Geotechnical And Environmental Study South Phoenix/Laveen Drainage Improvement Project, Fcd #94-14 Maricopa County, Arizona	December, 1996	HDR	Terrane Engineering Corporation	A117_903_GeotechnicalandEnvironmentalStudy_SouthPhoenix_LaveenDrainageImprovementProject.pdf	
33	Geotechnical Exploration 43rd Avenue Drain South Phoenix/Laveen Drainage Improvement Project	May, 1997	HDR	Terrane Engineering Corporation	A117_914_GeotechnicalExploration_43rd_AvenueDrain_SouthPhoenix_LaveenDrainageImprovementProject.pdf	
34	Geotechnical Exploration Baseline Road Basin South Phoenix/Laveen Drainage Improvement Project	May, 1997		Terrane Engineering Corporation	A117_915_GeotechnicalExploration_BaselineRoadBasin_SouthPhoenix_LaveenDrainageImprovementProject.pdf	
35	Report On Geotechnical Investigation, 43rd Avenue Channel Flood Control Basin, 43rd Avenue & Southern Phoenix, Arizona	October, 1998	FCDMC	Speedie and Associates	A117_902_ReportonGeotechnicalInvestigation_43rd_AvenueChannelFloodControlBasin_43rd_AveandSout.pdf	This report presents the results of a subsoil investigation carried out for the Flood Control District of Maricopa County 43rd Avenue Channel.

Utility Information

ID	Type of Utility	Agency	Maps Requested	Maps Received	File Name	Comments
36	Blue Stake Request	Blue Stake	9/8/2011	9/8/2011	27th_Ave_Baseline_Blue_Stake_Req.pdf 43rd_Ave_Basin_Blue_Stake_Req.pdf	PDF files contain blue stake report request scans. Blue stake reports were used to identify and contact various utility companies located in or near South Phoenix Two Basins project sites.
37	Water, Storm Drain, Sewer and ROW Quarter Section Maps	City of Phoenix	9/14/2011	9/29/2011	SPX2B Phx Quarter Section ROW 27th.pdf SPX2B Phx Quarter Section ROW 43rd.pdf SPX2B Phx Quarter Section Sewer 27th.pdf SPX2B Phx Quarter Section Sewer 43rd.pdf SPX2B Phx Quarter Section Storm Drain 27th.pdf SPX2B Phx Quarter Section Storm Drain 43rd.pdf SPX2B Phx Quarter Section Water 27th.pdf SPX2B Phx Quarter Section Water 43rd.pdf Q01-25.pdf Q01-26.pdf	Contact City of Phoenix for water quarter section maps.
38	Water	City of Phoenix	9/14/2011	9/26/2011	SPX2B 27th Aven 60-in H2O Feeder Main 1966.pdf	Contact City of Phoenix for water main plans.
39	Natural Gas	Southwest Gas	10/5/2011	10/6/2011	1-18.tif, 1-19.tif, 1-22.tif, 1-23.tif, S1-18.tif, S1-19.tif, S1-23.tif, S1-24.tif, S2-23.tif, S2-24.tif, S3-22.tif, S3-23.tif, SPX2B 1-22.tif, SPX2B 1-23.tif, SPX2B S1-23.tif, SPX2B S3-23.tif, SPX2B S1-24.tif, SPX2B S2-23.tif, SPX2B S2-24.tif, SPX2B S3-22.tif	
40	Cable, Fiber Optic	Cox Communications	10/5/2011	10/11/2011	01-18.pdf, 1-18.pdf, 01-19.pdf, 1-19.pdf, 1-22.pdf, 01-23.pdf, 1-23.pdf, 01-24.pdf, 02-23.pdf, 02-24.pdf, 03-22.pdf, 03-23.pdf	
41		CenturyLink, Inc. (Formerly Qwest)	10/5/2011	10/6/2011	SPX2B-Century Link (Qwest).pdf	
42	Underground Electric, Overhead Electric	SRP	10/6/2011	10/10/2011	SPX2B - SRP OH Location Maps.pdf SPX2B - SRP UG Location Maps.pdf	
43	Irrigation	SRP	10/6/2011	10/13/2011	Baseline43rdAve.pdf, SouthMountain27th.pdf, a-95-105.1.tif, a-95-105.2.tif, a-95-237.2.tif, a-095-0429.tif, b-112-w013.tif, b-112-w019.tif, b-112-w062.tif	
44	Natural Gas	El Paso Natural Gas-Maricopa	10/13/2011	10/18/2011	SPX2B - El Paso Gas 10-18-11.pdf	
45	Traffic Electric	City of Phoenix	10/27/2011	10/27/2011	SPX2B Phx Traffic Signal 43rd.pdf	