JOPLIN, MISSOURI

SUPPLEMENTAL STORMWATER MANAGEMENT MASTER PLAN

CITY OF JOPLIN MISSOURI

ALLGEIER, MARTIN and ASSOCIATES, INC.
Consulting Engineers and Surveyors

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Appendix A – Exhibit 1 - Recommended Storm Drainage Improvement Map
(Included in envelope at beginning of Appendices)

Appendix B – HEC-1 Data Summary

WATERSHED MAPS, Drawing Numbers 1 thru 12
(Separate attachment set)

I. INTRODUCTION

Allgeier, Martin and Associates, Inc. (AMA) entered into an agreement with the City of Joplin on January 8, 2008 to update the City's Stormwater Management Master Plan. Burns and McDonnell created the original plan in June 1998. Since 1998 many new developments have occurred, stormwater improvements have been constructed, and new aerial photography and LYDAR topographic information has been made available. The following report is intended to provide supplemental information to the City of Joplin's 1998 Stormwater Management Master Plan. Figure 1 identifies and outlines the major drainage basins included in this study. This figure is similar to the one in the original Master Plan, but has been updated and expanded to include additional areas.

AMA met with the City to determine the areas of greatest need. The public was also given the opportunity to voice concerns at a public hearing. From these sources AMA and the City developed a list of problem areas. The problem areas were prioritized and sorted into large projects (those in need of detailed hydrologic modeling) and those involving localized drainage problems that needed improvement. Recommendations and cost estimates for the proposed improvements are included in this report.

II. SCOPE

In preparation of this report a map of problem areas was developed based on public opinion and the City's recommendations. After investigations were completed the City's watershed area map was updated using the latest LYDAR topographic information. Using the revised watershed areas the original Hydrologic models were updated for those areas requiring a detailed analysis. An estimated cost for construction was determined for each of the proposed improvements. In addition, the proposed Stormwater Management Regulations were reviewed and evaluated for conformance with the current clean Water Act and Phase II requirements. AMA also

developed the GIS framework for implementing the stormwater collection system into the City's existing ArcView Based system.

III. METHOD OF ANALYSIS

A. Recommended Storm Drainage Improvement Map

The City experienced several localized flooding events during 2007 and 2008. During those events, city staff kept record of complaints dealing with street, basement, and yard flooding. A map was then made identifying all of these complaints. AMA then reviewed each of these complaints and determined which ones were caused by the city's drainage system. AMA and the City met and reviewed the map to identify any other problem areas. Using this information, a public hearing was held to give the public the opportunity to identify other areas within the drainage system that experiences flooding. The Recommended Storm Drainage Improvement Map as shown in Appendix A – Exhibit 1 identifies the problem areas that are addressed in this report. AMA conducted site investigations at each of the problems that were identified by the City of Joplin and the feasibility of making improvements was determined.

B. Watershed Area Map

The original Burns and McDonnell Watershed Area Maps were updated using the City's latest LYDAR topographic information. All of the City's modeled drainage basins were redrawn as shown in Watershed Maps, Drawing Numbers 1 thru 12 (a separate attachment to this report). The original basin label number and structure label number designations that were created by Burns and McDonnell were reused with some minor modifications to the basin label numbers. Modifications to the basins and basin labels were due to addition, subtraction, or grouping of the original basins based on current information or typographical errors on the original map. The modified basin areas were recorded as shown in Appendix B – HEC-1 Data Summary.

C. Hydrologic Model

For this study, as in the original study, HEC-1 was used to model the watersheds for the areas of interest. The HEC-1 models were updated using the revised Watershed Area Map for the areas that required a detailed analysis. The revised hydrologic modeling is consistent with preliminary design. In some cases, curve numbers and lag times were updated as well. These updates were based on the limited information discussed above. **All future detailed engineering projects will require a more detailed investigation of the project site and drainage basin, and the models shall be adjusted accordingly.**

D. Hydraulic Model

For those projects that had significant drainage areas and flow, a hydraulic model of the system was created in order to evaluate the existing design capacity and determine the needed improvements to pass the desired design capacity. The hydraulic models utilized the U.S. Army Corps of Engineers, Hydrologic Engineering Center, Flood Hydrograph Package, HEC-1 computer program, version 4.1. The NRCS dimensionless unit hydrograph method was used to generate runoff and the NRCS Curve Number technique was used to compute abstractions from rainfall. Rainfall data analyzed were for 2-, 5-, 10-, 25-, 50-, and 100-year return periods and 1-, 2-, 3-, 6-, 12-, and 24-hour storm durations. The storm duration that created the maximum discharge for each return period was used for computations of the water surface profile. The rainfall depths were distributed temporally using Huff's Quartile distributions. Rainfall was assumed to have a uniform spatial distribution. A one-minute computational interval was selected for use in modeling the rainfall-runoff response in the watershed. Frequency-based data used in the hydrologic analysis were taken from the "Rainfall Frequency Atlas for the Midwest," (1992).

Updates were made to the existing Burns & McDonnell hydrologic model as a result of new data. The computational time increment (CTI) in the data set was changed from 15-minutes to 1-minute to comply with the computational requirements of the methodology.

Table 1 shows the existing system capacity analysis summary for a few of the main projects and structures. All other existing system capacities may be obtained from the HEC-1 models. Several of the recommended projects address localized nuisance flooding of yards, streets, ditches, etc. and improvements are limited to what can be reasonably constructed. Due to the relatively small size of the drainage basins, these projects will need more detailed field information in order to provide a detailed evaluation.

IV. RECOMMENDED IMPROVEMENTS

A. Capital Improvements

For each area of interest AMA generated recommend improvements. The areas of interest are located in various watersheds throughout the City of Joplin as shown previously in Appendix A – Exhibit 1. Each area has been summarized with an existing problem description, recommended improvements, downstream controls, and potential alternatives to the recommended improvements. A construction cost estimate was also generated for each area. Based on site investigations, number of complaints received, city personnel experiences, and watershed impact, each area has also been given a recommended priority level for improvement with number one being the most critical. The assigned priority was based on the opinion of the engineer who prepared this report and the city's engineering staff after considering the factors mentioned above. As previously stated in the original Master Plan, it is important to note that the willingness of potentially benefited property owners to dedicate easements for the construction of improvements has not been considered. Another factor not considered is the potential influence of other improvement programs within the vicinity of the storm drainage improvement projects. For those reasons, the priorities should not be considered as absolute.

Table 2 lists the 41 projects identified in this report with present worth cost estimates for each. A future worth estimate for the year 2017 is also shown

since these projects may not start construction until 2011 and will not finish until possibly 2021. Following Table 2 are the individual project descriptions.

B. Minor System Improvements

The capital improvements recommended in this report are intended to correct deficiencies within the system that are known to be a nuisance by city staff, or have been reported by the citizens of the community. As these problems are corrected, other smaller components of the City's overall storm drainage system will start appearing to be deficient because the public will begin to notice them after the more prevalent problems are corrected. It is also common to experience after one problem is corrected the problem will relocate further downstream to an area that did not experience problems before.

As stated in the 1998 Stormwater Master Plan, a regular program of improvement to the minor system is an integral element in any comprehensive plan of improvement to the storm drainage system, and in obtaining public acceptance of the need for the continued devotion of resources and effort to correction of the major system deficiencies. For a minor system of the scale and age of that in the City of Joplin, an appropriate level of spending would average roughly $500,000 per year.

C. Economic Development

As the City expands its boundaries and begins to improve undeveloped land, the increase in impervious area will create problems that currently do not exists in the stormwater system. One tool used to attract new prospects to build and create jobs in the community is to provide the necessary utilities for the development. Stormwater improvements are a utility the same as water, sewer, electric, etc. The City of Joplin is fortunate to have leaders in the community who expend a great amount of effort and finances to attract new industries and expand existing ones which requires the City to have the necessary funding to improve utilities stormwater infrastructure. Based on the level of expansion over

the past 20 years, we suggest that an appropriate level of spending would average $100,000 per year.

D. Ditch and Detention Pond Maintenance

The City has many miles of improved and unimproved ditches that must be maintained for several reasons. In order for the system to function properly, obstructions must be removed on a regular basis to prevent the clogging of the system, which can cause sever flooding. If the city does not provide proper maintenance of the City system, then they could be liable for flooding caused by the lack of maintenance. Obstructions that periodically require removal include vegetation, yard debris, shopping carts, silt, illegal dumping, etc.

Since the adoption of the 1998 Stormwater Management Master Plan and the Stormwater Management Criteria, there have been numerous regional detention basins constructed in which the City is responsible for maintaining. These numbers will continue to grow as the City continues to take a proactive approach to reduce the number of areas that flood during heavy rains. There are even a larger number of private developments with detention basins in which are not maintained by the owners. Without proper maintenance the basins become overgrown with vegetation and harbor unwanted wildlife and mosquitoes. Silt will accumulate over time thereby reducing the storage available for stormwater making the detention basins less affective.

Based on the miles of ditches and number of detention basins, a suggested level of spending would average $400,000 per year.

E. Catch Basin and Closed System Maintenance

As the City continues to strive to meet the ever-changing EPA Clean Water Act and Phase II Stormwater Requirements, the need to clean silt and debris out of catch basins and stormwater pipes will increase. Most likely the City will begin seeing the installation of catch basins designed to trap sediment.

Currently the City has over 9,000 catch basins and 100 miles of stormwater pipes and culverts. Using an estimated fee of $3 per lineal foot and $100 each to clean the pipes and inlets, an annual spending of $250,000 per year for 10 years would be needed to clean the entire system.

Table 1
Existing System Capacity Analysis

Project I.D. No.	Structure I.D. No.	Description	CAP (cfs)	2 Yr. (cfs)	5 Yr. (cfs)	10 Yr. (cfs)	25 Yr. (cfs)	50 Yr. (cfs)	100 Yr. (cfs)	Remarks
1-4	1062	21" RCP	14	12	23	32	41	54	63	
1-5	1330	Ditch	480	237	388	514	634	793	909	Proir to detention
3-7	3164	21" & 24" RCP	28	20	37	52	66	84	98	All area west of Connecticut
3-10	3315	Main N of 26th		7	12	17	21	26	30	
		Main and E 26th		18	31	43	54	68	79	
		Structure 3290		129	219	298	372	469	539	
4-14	4335			3	6	9	12	16	19	Flow approx 20 ft US of Michigan & 28th
6-10	6275		440	145	246	352	454	565	653	
6-12	6168			14	25	34	42	53	61	Flow captered at III (no main channel overflow)
6-13	6071			2	3	5	8	11	14	Portion of A6070 draining to N. side of Pool
6-14	6330	Existing		520	696	1009	1408	1791	2071	
		w/Davis		407	643	861	1120	1412	1617	
		w/Davis and 15th @ 1013 ft		302	370	416	731	1014	1272	
6-15	6091	2 - 24" RCP	32	27	44	58	71	87	99	
6-15	6105	48" RCP	181	58	95	125	153	189	214	Upstream End
6-15	6105	48" RCP	181	90	146	192	234	287	326	Downstream End
7-10	7020	2-10x4	540	496	863	1176	1473	1858	2139	
7-10	7030	6x2	60	24	44	61	78	99	115	
10-3	10505	3 - 24" RCP	60	41	73	101	127	162	187	
10-4	10105	15" RCP	8	5	11	15	19	25	29	Flow down E side of Euclid at N side of Odessa
13-2	13061	Pre-detention	41	224	443	624	797	1026	1191	Detention in A13061
		Post-detention		145	264	468	664	915	1082	

Table 2
Capital Improvement Project Recommendation

Priority Number	Project ID	Project Description	2009 Cost Estimate	2017 Cost Estimate
21	1-4	Storm Sewer Improvements, 6021 W. Highland Drive	$20,000	$30,000
8	1-5	Regional Detention, W. of Arizona & N. of 32nd	$2,040,000	$3,015,000
23	1-6	Silver Creek Ditch Improvements	$313,000	$463,000
24	2-1	Shoal Creek System Improvements	$87,000	$129,000
3	3-7	Ditch & Culvert Improvements, Connecticut between 32nd & 35th	$444,000	$656,000
3	3-7A	Ditch & Culvert Improvements, Connecticut between 35th & 37th	$350,000	$518,000
11	3-8	Flume & Ditch Improvements, Grand & 34th	$10,000	$15,000
12	3-9	Curb Inlet Improvements, 32nd & Pearl	$60,000	$89,000
5	3-10	New Culvert System, Main between 25th & 27th	$363,000	$537,000
25	3-11	Water Works Culvert, Inlet, and Ditch Improvements	$473,000	$699,000
4	4-14	New Culvert System, Michigan between 30th &27th	$420,000	$621,000
20	4-15	Curb Inlet Improvements, 9th & Minnesota	$87,000	$129,000
26	4-16	Joplin Creek West System Improvements	$375,000	$555,000
27	5-3	McClelland Culvert, Inlet and Ditch Improvements	$261,000	$386,000
22	6-10	Regional Detention, 15th & Massachusetts	$1,044,000	$1,543,000
10	6-11	Culvert Improvements, 14th & Florida Ave.	$36,000	$54,000
6	6-12	Storm Sewer Improvements, Illinois between 7th & 9th	$668,000	$987,000
18	6-13	New Culvert System, Hill between Division & Mineral	$182,000	$269,000
1	6-14	Regional Detention, NE side of Murphy Blvd. & S. of 15th	$748,000	$1,106,000
7	6-15	Ditch & Culvert Improvements, 4th & School Ave.	$500,000	$739,000
28	6-16	Joplin Creek East Ditch Improvements	$675,000	$998,000
14	7-8	Curb Inlet Improvements, 4th & Tyler/Adele	$242,000	$358,000
15	7-9	Ditch Improvements, 2nd & Oliver/McCoy	$80,000	$119,000
19	7-10	Culvert Improvements, Lone Elm & Murphy Blvd.	$382,000	$565,000
29	7-11	Lone Elm Ditch & Culvert Improvements	$625,000	$924,000
37	8-2	Channel Improvement, Schifferdecker from Junge to 17th	$495,000	$732,000
38	8-3	Ditch & Culvert Improvements, 20th & Roosevelt	$423,370	$626,000
9	8-5	Culvert Improvements, Cleveland between 25th & 24th	$27,000	$40,000
9.1	8-5A	System Improvements, 25th & Cleveland	$400,000	$591,000
30	8-6	Country Club Storm Water Improvements	$174,000	$258,000
31	9-3	Leadville Basin Improvements	$384,000	$568,000
36	10-1	Channel Improvement, Canterbury Ditch 3rd to 7th	$787,000	$1,163,000
2	10-3	Ditch & Culvert Improvements, 10th & Peters Ave.	$376,000	$556,000
16	10-4	Ditch Improvements, Euclid & Odessa/Rolla	$355,000	$525,000
17	10-5	Inlet Improvements, E. of Salem & Park	$9,000	$14,000
32	10-6	Turkey Creek System Improvements	$424,000	$627,000
33	11-1	Center Creek Culvert and Ditch Improvements	$78,000	$116,000
13	12-2	Ditch & Culvert Improvements, Windsor & Michigan	$57,000	$85,000
34	12-3	Royal Heights Inlet, Culvert, & Ditch Improvements	$289,000	$427,000
35	13-1	Oakland (Baker's Branch) System Improvements	$213,000	$315,000
36	13-2	Regional Detention, Ind. Park Rd. & Kennedy Lane	$160,000	$237,000
	B	Minor System Improvements ($500,000 Annual Exp.)	$5,000,000	$5,000,000
	C	Economic Development Improvements ($100,000 Annual Exp.)	$1,000,000	$1,000,000
	D	Ditch and Detention Pond Maintenance ($400,000 Annual Exp.)	$4,000,000	$4,000,000
	E	Catch Basin and Closed System Maint. ($250,000 Annual Exp.)	$2,500,000	$2,500,000
		Sub-Total	**$27,636,370**	**$34,884,000**
		Projected Project Cost for 2009 Study		
		2009 Construction Cost Estimate	$27,636,370	$34,884,000
		Easement & Land Acquisition Services	$1,381,819	$1,744,200
		Engineering, Surveying, Bidding & Construction Management	$6,909,093	$8,721,000
		Annual i (%)	5	
		Yrs (# periods)	8	
		Total Cost	**$35,927,281**	**$45,349,200**

Joplin, Missouri
10-Year Stormwater Management Master Plan
Capital Improvement Project Recommendation

Project Name: 6021 W. Highland Drive, Relief Sewer

Project Identification Number: 1-4

Data Summary

Watershed:	Silver Creek
Priority No.:	21
Design Capacity:	25 Year
Estimated Cost:	$20,000
Model ID No.:	1062
Map Sheet Reference Number:	11

Existing Problem Description

The development has a large swale that runs through the back several properties. The property owner at 6021 W. Highland Ave. has water that backs up in the yard due to the insufficient capacity of the 21" culvert until it discharges over the road to the northwest.

Recommended Improvements

Add a parallel 24" RCP to pass the 25 year flood event.

Downstream Controls

Existing open channel immediately downstream is adequate for design discharge.

Potential Alternatives

Do nothing; allow ponding to occur on property owner.

Joplin, Missouri
10-Year Stormwater Management Master Plan
Capital Improvement Project Recommendation

Project Name: 32nd St. to 28th St. Between Mississippi Ave. & Arizona Ave.,

Project Identification Number: 1-5

Data Summary

Watershed:	Silver Creek
Priority No.:	8
Estimated Cost:	$2,040,000
Model ID No.:	1330
Map Sheet Reference Number:	8 & 9

Existing Problem Description

Roadway and property flooding downstream to I-44 is common. Excessive peak discharges at downstream structures and channels, which are above design capacities is the major cause of flooding. All structures downstream of this project are undersized as shown in the following table.

Structure	Description	Capacity	10 Yr
1335	Rock Lined Ditch		330
1333	Double 6' x 3'-6" RCB	300 - 5 Yr	330
1330	Earth Ditch		520
1327	Double 7' x 4' RCB	480 - 5 Yr	520
1326	Double 6' x 4' RCB Downstream	280 - <2 Yr	520

However, increasing capacity of these structures will not improve the flooding conditions between I-44 and 34th Street.

Recommended Improvements

Build a storm water detention facility to reduce the frequency of flooding downstream. Improvements to or replacement of structure No. 1326 downstream is recommended to increase the design capacity to 500 cfs.

Downstream Controls

Structure No. 1326 and No. 1302

Joplin, Missouri
10-Year Stormwater Management Master Plan
Capital Improvement Project Recommendation

Project Name: Connecticut Ave. Between 32nd St. & 37th St.

Project Identification Number: 3-7 & 3-7A

Data Summary

Watershed:	Water Works
Priority No.:	3
Estimated Cost:	$444,000 and $350,000
Model ID No.:	3167
Map Sheet Reference Number:	8

Existing Problem Description

The open ditch on east side of Connecticut Ave. has two drives across it north of 33rd Street, and seven drives across the ditch between 33rd Street and 34th Street, and one south of 34th Street, all of which have pipe diameters ranging from 12" to 15" to convey the ditch flow to a central point in front of 3325 Connecticut Ave. From there, the flow crosses under Connecticut Street via two reinforced concrete pipes, a 21" diameter and a 24" diameter. During heavy rainfall events the culvert pipes under the drives become clogged and force water to be diverted across Connecticut Ave causing significant erosion of the drives, traffic impediments on Connecticut Ave., and water to be forced into garages.

Recommended Improvements

Replace drives and existing small diameter pipes that are prone to clogging with 970 linear feet of 18" to 36" diameter reinforced concrete pipe along the east side of Connecticut Ave. from the end of the existing curb north of 33rd Street to the south side of 34th Street. Widen Connecticut Ave. to desired width, place curb & gutter on east side of Connecticut Ave. and add curb inlets. Construct curb inlet in front of 3325 Connecticut Ave. at the existing location of the two reinforced concrete pipes afore mentioned. The two afore mentioned existing pipes crossing Connecticut are to remain in place.

Downstream Controls

Existing 36" and 42" pipes have a 2-year design capacity.

Potential Alternatives

Project 3-7A would include improving the ditch along the East side of Connecticut all the way to 37th Street in the same manner as Project 3-7 to allow Connecticut to be widened all the way to I-44.

Joplin, Missouri
10-Year Stormwater Management Master Plan
Capital Improvement Project Recommendation

Project Name: Grand Ave. & 34th St., Paved Ditch

Project Identification Number: 3-8

Data Summary

Watershed:	Water Works
Priority No.:	11
Estimated Cost:	$10,000
Sub-basin ID No.:	3130
Map Sheet Reference Number:	8

Existing Problem Description

The flume on the south side of the intersection of Grand Ave. and 34th St. is insufficient to convey the amount of runoff that accumulates at that point. The earthen ditch to the south of the existing flume has weeds, small trees, and large deposits of sediment accumulated in it; all of which impede the water as it flows south and contributes to the water backing up into the intersection.

Recommended Improvements

Replace existing flume with type 1 flume as per City of Joplin Standard Plans. Clean and re-shape approximately 200 feet of ditch south of the new flume.

Downstream Controls

None.

Potential Alternatives

Line ditch with concrete to reduce maintenance and increase capacity of ditch without increasing current size.

Joplin, Missouri
10-Year Stormwater Management Master Plan
Capital Improvement Project Recommendation

Project Name: Intersection of 32nd St. & Pearl Ave.

Project Number: 12

Project Identification Number: 3-9

Data Summary

Watershed:	Water Works
Priority No.:	
Design Capacity:	2-year
Estimated Cost:	$59,368
Sub-basin ID No.:	3225
Map Sheet Reference Number:	8

Existing Problem Description

Water flowing from the north down Pearl Ave. does not flow into the existing curb inlets on the north side of 32nd St. The pavement surface also does not provide positive drainage into existing inlets and causes minor ponding. This causes surface water to accumulate on 32nd St. and Pearl Ave. until it evaporates.

Recommended Improvements

Install 2 – 8' x 4' curb inlet boxes on the north side of intersection to intercept flow along Pearl Ave. before it reaches 32nd St., add 30 feet of 30" RCP to connect new inlet boxes to the existing inlet boxes. Cold mill roadway surface to ensure proper drainage into existing inlets and overlay with 1 to 2 inches of asphalt.

Downstream Controls

None.

Potential Alternatives

Rework surface of intersection to force water into existing inlets, do not install new inlets or new pipes.

Joplin, Missouri
10-Year Stormwater Management Master Plan
Capital Improvement Project Recommendation

Project Name: Main St. from 25th St. to 27th St., New System

Project Identification Number: 3-10

Data Summary

Watershed:	Water Works
Priority No.:	5
Estimated Cost:	$363,000
Model ID No.:	3315
Map Sheet Reference Number:	8

Existing Problem Description

Water ponds along Main St. due to inadequate curb inlets. Structure No. 3300 (8' x 5' RCB) has a capacity of 240 cfs, the 5-year storm event yields 260 cfs more than the structure is capable of carrying, and the 10-year storm event yields 310 cfs, which is the desired design capacity.

Recommended Improvements

Install 7 – 8' x 4' curb inlets on the east side of Main St. from 25th St. to 27th St. connected with 24" RCP. Install 3 – 8' x 4' curb inlets on the north side of 27th St. empting via a 24" concrete flared end section into the open channel northwest of the 27th St. and Joplin Ave. intersection.

Downstream Controls

None.

Potential Alternatives

Run line into existing RCB on Main St.

Joplin, Missouri
10-Year Stormwater Management Master Plan
Capital Improvement Project Recommendation

Project Name: Michigan Ave. from 30th St. to 27th St., New System

Project Identification Number: 4-14

Data Summary

Watershed:	Joplin Creek West
Priority No.:	4
Estimated Cost:	$420,000
Model ID No.:	4335
Map Sheet Reference Number:	8

Existing Problem Description

Homes on the east side of Michigan Ave. are subject to flooding due to water flowing in the gutter of the street rising above the gutter and flowing east into the properties. This is due to two reasons. The first is the ditch that flows into the intersection of 30th St. & Michigan Ave. from the west flows across the intersection eastward via a gutter crossing, but during heavy rainfall events, the flow will split and contribute to the amount of water flowing north on Michigan Ave. The second is the length of roadway contributing to the gutter flow is substantial, with no relief until it reaches the existing inlets on 28th St. approximately ¼ mile north and east.

Recommended Improvements

Install a curb inlet with an opening in the back to intercept the flow from the west on the northwest side of the intersection of 30th St. & Michigan Ave. and a curb inlet on the northeast side of said intersection. Every 200 to 300 feet, install 2 - 8'x 4' curb inlet boxes, one on the east side of the road and one on the west, until reaching 28th St. Use 18" RCP to connect the inlet boxes across the street and 24" RCP to connect the inlet boxes in the north-south direction. Continue east past Kansas Ave. with three more curb inlets and 24" RCP to the existing curb inlet on the south side of 28th St. Replace the two boxes on 28th St. and the existing pipe with new curb inlets and 24" RCP. Continue north replacing the existing pipe with 24" RCP. In the schoolyard place an area drain inlet. Continue northwest to the existing curb inlet on the northwest side of 27th St. and Kansas Ave.

Downstream Controls

Structure No. 4326 has a 2-year design capacity of 87 cfs.

Potential Alternatives

Continue north on Michigan Ave., turn east with piping on 26th St. and empty into the open channel on the north side of 26th St., 120 feet east of the Michigan Ave. and 26th St. intersection.

Joplin, Missouri
10-Year Stormwater Management Master Plan
Capital Improvement Project Recommendation

Project Name: Intersection of 9th St. and Minnesota Ave., Storm Sewers

Project Number: 20

Project Identification Number: 4-15

Data Summary

Watershed:	Joplin Creek West
Priority No.:	
Design Capacity:	
Estimated Cost:	$86,878
Model ID No.:	
Map Sheet Reference Number:	5

Existing Problem Description

Excessive surface water along 9th St. caused by insufficient inlet capacity to convey runoff from roadway. Area at headwall on north side of 9th St. and entrance of pipe on south side of 9th St. partially blocked with debris and rock. Structure No. 4220 has 1330 cfs of capacity currently. 10-year storm discharge for this structure is 1570 cfs.

Recommended Improvements

Install two 8'x 4' curb inlets on 9th St. west of the intersection of 9th St. & Minnesota Ave., one on the north side of the street, one on the south side. Install 30 LF 18" RCP between the two new curb inlets. Use the existing 36" RCP on north side of 9th St., build a curb inlet box and headwall structure to utilize existing pipe. Install two 8'x 4' curb inlets on 9th St. west of the railroad tracks, replacing the existing inlets. Install 50 LF of 15" RCP between the two new curb inlets. Install two 8'x 4' curb inlets on 9th St. west of the intersection of 9th St. & the small alley going north, one on the north side of the street, one on the south side. Install 30 LF 15" RCP between the two new curb inlets. Connect the east pair of inlets to the middle pair using 175 linear feet of 18" RCP on the north side of 9th St.

Downstream Controls

None.

Potential Alternatives

Replace structure No. 4220 (2-11' x 4' RCB) with 2-15' x 4' RCB, capable of discharging more than 1570 cfs.

Use a precast single span arch for structure No. 4220.

Joplin, Missouri
10-Year Stormwater Management Master Plan
Capital Improvement Project Recommendation

Project Name: Massachusetts Ave. from 15th St. to 18th St., Regional Detention

Project Number: 22

Project Identification Number: 6-10

Data Summary

Watershed:	Joplin Creek East
Priority No.:	
Design Capacity:	
Estimated Cost:	$843,150
Model ID No.:	6280
Map Sheet Reference Number:	8

Existing Problem Description

Roadway flooding on 15th St., property flooding within the project vicinity, and excessive peak discharges at downstream structures and channels are experienced. The structure immediately downstream of this project is undersized as shown in the following table.

Structure	Description	Capacity	10 Yr
6295	2-8.5'X3' RCB approx. 1.5' of head - Upstream of Site	390 - 100 Yr	250
6285	2-5.7'X4' RCB approx. 3.5' of head - On Site	450 - 50 Yr	330
6275	2-60" RCP approx. 1'4" of head - On Site	440 - 10 Yr	440
6265	6'X6' RCB approx. 2' of head - Downstream of Site	450 – 5 Yr	460

Recommended Improvements

Convert the large area that is currently a park with trails and sports amenities into a regional detention basin. Detention in this area will reduce downstream flooding. Outlet structures will discharge under 15th Street and will be included in this project.

Downstream Controls

Structure No. 6265, a 6'X6' RCB downstream of this site is only capable of conveying 450 cfs through the structure.

Potential Alternatives

Upgrade culverts with no additional detention. This option could cause additional flooding at the 7th St. and Illinois Ave. intersection.

Joplin, Missouri
10-Year Stormwater Management Master Plan
Capital Improvement Project Recommendation

Project Name: Intersection of 14th St. and Florida Ave., Replacement

Project Identification Number: 6-11

Data Summary

Watershed:	Joplin Creek East
Priority No.:	10
Estimated Cost:	$36,000
Sub-basin ID No.:	6325
Map Sheet Reference Number:	5

Existing Problem Description

3' x 6.5' drop inlet in back yard of 2625 14th St. property not allowing enough flow into it, causes yard flooding. This is because of small openings in the box and yard debris builds up around the openings. Also, the pipe from the inlet to the street is collapsed due to tree roots.

Recommended Improvements

Add inlet to reduce chances of clogging, replace existing 18" pipe with 24" RCP, this will require the removal of several large trees.

Downstream Controls

None.

Joplin, Missouri
10-Year Stormwater Management Master Plan
Capital Improvement Project Recommendation

Project Name: Illinois Ave. Between 7th St. and 9th St., Storm Sewers

Project Identification Number: 6-12

Data Summary

Watershed:	Joplin Creek East
Priority No.:	6
Estimated Cost:	$668,000
Sub-basin ID No.:	6100
Map Sheet Reference Number:	5

Existing Problem Description

Excessive surface water due to lack of curb inlets to take runoff off roadway during low flow conditions. During high flow conditions water backs up in Joplin Creek located to the east. Consequently the existing outlet pipes conveying discharge from the roadway through the existing curb inlets become full of water with no outlet and water backs up onto Illinois Ave.

Recommended Improvements

Install two 8'x 4' curb inlets on 8th St. at the intersection of 8th St. & Illinois Ave., one on the north side and one on the south side of the street. Install 30 L.F. of 24" RCP from the north inlet box to the south inlet box. Install one 8'x 4' drop inlet in drive apron on the east side of the intersection of 8th St. & Illinois Ave. Install 55 L.F. of 36" RCP from the south inlet box on 8th St. to the drop inlet. Install one 8'x 4' curb inlet on the northeast side of Illinois Ave. at the intersection of Murphy Blvd. & Illinois Ave. Install 215 L.F. of 24" RCP from the 8'x 4' curb inlet on the northeast side of Illinois Ave. at the intersection of Murphy Blvd. & Illinois Ave. to the drop inlet. From the drop inlet install 385 L.F. of 36" RCP to the east, day-lighting in existing channel flowing north. Place stormwater check valve in channel at end of 36" RCP and at the end of all other drainage pipes from this area that are going to the open ditch.

Downstream Controls

Projects 6-1 and 6-2 should be completed in advance of this project. Upstream regional detention is needed to reduce frequency of flooding in this area.

Potential Alternatives

When water rises in channel, pump water off Illinois Ave. into channel. Replace existing piping and improved inlet boxes. Could also make channel improvements to reduce the water surface elevation in the channel, thereby reducing the potential for water backing up onto Illinois Ave.

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Capital Improvement Project Recommendation

Disconnect inlets and piping system along Illinois Ave. from Joplin Creek and bore under 7th St. utilizing inverted siphon and convey the discharge to the channel further downstream. More detailed survey information needed to determine feasibility. $500,000 included for this option.

Notes

Water flows from the main channel back up though the existing pipes into the inlet boxes and out onto Illinois Ave. This is the primary problem during high flow events, and adding the proposed improvements will not aid in alleviating this problem. Water also rises upstream of this site due to structure No. 6175, then flows north on Illinois Ave. adding to the existing flooding. Without addressing this problem first, the pump alternative would prove ineffective. Also, boring under 7th St. and conveying the discharge to the main channel downstream would be possible, but due to minimal gradient, utilities, easement acquisition, and downstream conditions, this option will be costly and possibly only provide minimal enhancement to the current conditions. Main channel improvements would provide the best results, but would also have all the caveats of boring with an even higher cost associated therewith.

Joplin, Missouri
10-Year Stormwater Management Master Plan
Capital Improvement Project Recommendation

Project Name: Ditch north of Hill St. from Division Ave. to Mineral Ave., Storm Sewers

Project Identification Number: 6-13

Data Summary

Watershed:	Joplin Creek East
Priority No.:	18
Estimated Cost:	$182,000
Model ID No.:	6070
Map Sheet Reference Number:	5

Existing Problem Description

The intersection of Division Ave. and Valley St. is susceptible to water ponding. This is due to the insufficient amount of relief provided by existing curb inlets for surface runoff to migrate from the street to the channel flowing west from the intersection. Similar problems exist at the channel and Cox Ave. intersection. Water flowing south from the Tamko complex enters a low-rise 2' wide trickle channel that overflows frequently. The low point on Mineral Ave. just north of the channel crossing the street has deficient drop inlets with broken grates and inadequate capacity.

Recommended Improvements

Construction of a new type 1 flume as per City of Joplin standard plans on the west side of Division St. into the channel to provide adequate surface relief. Existing curb inlets and drainage structures are to be left in place in this area. Beginning at Pool St., the southbound flow from Tamko can be intercepted with a curb inlet, thence the flow would be conveyed south via 30" concrete pipes to Spring St, then extending along the south side of Spring St. west to the west side of Cox Ave. via 36" concrete pipes. Finally the flow would be directed south along the west side of Cox. Ave. in 36" concrete pipes, day-lighting in the main channel at the intersection of Cox Ave. and the channel on the west side. The 4 existing curb inlets are to be left in place with existing piping. At the low point on Mineral Ave. just north of the channel, the two existing drop inlets are to be replaced with two new 8' x 4' curb inlets. In addition, install 25 L.F. of 30" RCP to connect the boxes and 108 L.F. of 30" RCP from the west box to the existing RCB to the south, flowing west.

Downstream Controls

None.

Potential Alternatives

Tamko Complex Detention

Joplin, Missouri
10-Year Stormwater Management Master Plan
Capital Improvement Project Recommendation

Project Name: Northeast side of Murphy Blvd. between 15th Street and 20th St., Regional Detention

Project Identification Number: 6-14

Data Summary

Watershed:	Joplin Creek East
Priority No.:	1
Estimated Cost:	$748,000
Model ID No.:	6335
Map Sheet Reference Number:	8

Existing Problem Description

Roadway flooding on 15th St., property flooding downstream, and excessive peak discharges at downstream structures and channels, above that which they are capable of conveying.

Recommended Improvements

Project No. 6-8, Davis Blvd. Regional Detention, must be completed prior to constructing these improvements. Convert large area that is currently a park with trails and a large channel into a regional detention basin. Detention at this area will provide downstream areas increased flood protection during peak discharges after storm events by reducing the existing 100 year design flow from 1617 cfs to 1272 cfs, which is less than the 50 year design flow. These flows assume Project No. 6-8 is complete. Constructing a berm on the south side of 15th Street and excavating the park area above the top of existing bank should accomplish the needed detention. Altering the existing channel provides minimal benefit.

Downstream Controls

Structure No. 6330 is to be replaced and reconstructed as addressed in Project ID 6-6. It should also be noted that construction of a detention facility at this location may cause the upstream structure No. 6373 (117" x 79" CMPA) to function with less capacity due to backwater and must be a consideration of the design.

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Capital Improvement Project Recommendation

Project Name: 4th St. and School Ave., Culvert and Ditch Improvements

Project Identification Number: 6-15

Data Summary

Watershed:	Joplin Creek East
Priority No.:	7
Estimated Cost:	$500,000
Model ID No.:	6091, 6105
Map Sheet Reference Number:	5

Existing Problem Description

The existing ditch and culverts running between the old railroad tracks and Empire District Electric do not have sufficient capacity and cause flooding in the Empire Buildings. The ditch empties into 2-24" RCP culverts where it crosses under 4th St. and into structure 6105, which has less than a 5-year design capacity.

Recommended Improvements

Improve the existing ditch by constructing a trapezoidal concrete ditch and utilize a 5'x2' RCB for ditch crossing into Empire. Replace existing 24" RCPs under 4th St. with a 42" RCP. Structure No. 6105 should be replaced with a 5' x 4' RCB from the ditch to School Ave. approximately 400 linear feet.

Downstream Controls

None.

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Capital Improvement Project Recommendation

Project Name: 4th St. and Tyler Ave., 4th St. and Adele Ave.

Project Identification Number: 7-8

Data Summary

Watershed:	Lone Elm
Priority No.:	14
Estimated Cost:	$242,000
Model ID No.:	7064
Map Sheet Reference Number:	4

Existing Problem Description

A significant amount of water is ponding on the south side of 4th St. just east of Tyler St. Existing inlets are unable to convey the discharge from the roadway. Excessive surface water on Tyler Ave. and Adele Ave. leading up to 4th St. due to lack of surface relief is causing frequent street flooding.

Recommended Improvements

Install 3 - 8' x 4' curb inlet boxes where Tyler Ave. and Adele Ave. intersect 4th St. Install 2 - 8' x 4' area inlet boxes on Tyler Ave. approximately 240 feet south of the Tyler Ave. and 4th St intersection. Install 2 - 8' x 4' curb inlet boxes on Adele Ave. approximately 260 feet south of the Adele Ave. and 4th St intersection. Connect curb inlet boxes with 15" to 18" RCP. Use all other existing piping and incorporate with new curb inlet boxes.

Downstream Controls

Ditch to north and exiting 3' RCP adequate for design flows. Existing pipes at connection point for new piping may need to be replaced depending on size and condition.

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Capital Improvement Project Recommendation

Project Name: 2nd St. between Oliver Ave. and McCoy Ave., also Oliver Ave. and 3rd St.

Project Identification Number: 7-9

Data Summary

Watershed:	Lone Elm
Priority No.:	15
Estimated Cost:	$80,000
Model ID No.:	7083
Map Sheet Reference Number:	4

Existing Problem Description

Stagnant water in the ditch to the east of Oliver Ave. and 3rd St. Street flooding is prominent due to an undersized curb opening at this location also. Street flooding on 2nd St. due to 2 undersized curb openings over structure No. 7083. common. Standing water due to fill placed for loading dock also a problem.

Recommended Improvements

Re-grade the ditch east from the 3rd St. and Oliver Ave. intersection, approximately 1000 L.F. to 2nd St. Cut the ditch through the fill placed to level a turn-around for the loading dock. Construct a new type 1 flume, 6' wide, to allow water to drain off of roadway and into the ditch. At structure No. 7083 replace the existing flumes with new wider type 1 flumes as per City of Joplin standard plans. At the end of each flume, place riprap to prevent erosion.

Included in the cost estimate is the reconstruction of the aerial sanitary sewer crossing just north of structure No. 7083.

Downstream Controls

None.

Joplin, Missouri
10-Year Stormwater Management Master Plan
Capital Improvement Project Recommendation

Project Name: Intersection of Lone Elm Rd. and Murphy Blvd.

Project Identification Number: 7-10

Data Summary

Watershed:	Lone Elm
Priority No.:	19
Estimated Cost:	$382,000
Model ID No.:	7020, 7030
Map Sheet Reference Number:	4

Existing Problem Description

Structure No. 7020 (2 - 10' x 4' RCB) under Murphy Blvd. is undersized, with only slightly more capacity than a 2 year storm discharge. Structure No. 7030 (6' x 2' RCB) under Lone Elm Rd. has only slightly more capacity than a 5-year storm discharge. At the north corner of the Lone Elm Rd. and Murphy Blvd. intersection, water ponds on the edge of the roadway and in the beginning of the ditch. The beginning of the ditch has silted in blocking the discharge path for surface runoff from the northeast going around the curb radius and into the ditch. On the northeast side of Lone Elm Rd. approximately 150' north of the afore mentioned intersection there is a 15" corrugated plastic pipe used for egress/ingress to a property that is also installed too high where water cannot pass in low flow conditions. In this same location, a 24" RCP runs west under Lone Elm Rd. to a concreted ditch. The ditch is capable of carrying more flow than the pipe; the pipe entrance is also partially blocked.

Recommended Improvements

Improvements to or replacement of Structure No. 7020 to enable passage of the 10-year storm event is recommended. When structure No. 7020 is replaced and allows more passage of water, structure No. 7030 would be capable of conveying more flow. Hence structure No. 7030 can remain in place, along with the 24" RCP flowing to it and the 6' x 3.5' curb inlet conveying water into the 24" RCP. On the northeast side of the intersection the ditch is to be cleaned and a type 2 flume as per City of Joplin standard plans installed to provide positive drainage from the roadway into the ditch. Re-grade approximately 120' of the earth ditch. The existing 15" CPP used for egress/ingress should be replaced with a 24" RCP. The existing 24" RCP flowing west under Lone Elm Rd. should be upgraded to a 36" RCP. Construction of a headwall at the low point of the ditch on the east side of Lone Elm Rd. will facilitate the new 24" RCP and also the new 36" RCP exit and entrance needs, respectively. Re-grade approximately 200 feet of the ditch on the east side of Lone Elm Rd. north of the new headwall structure.

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Capital Improvement Project Recommendation

Downstream Controls

The ditch north of these improvements along the west side of Lone Elm Rd. is adequate for the design discharges, however, structure No. 7010 is not. Consideration should be given to the effectiveness of these improvements given downstream restrictions.

Joplin, Missouri
10-Year Stormwater Management Master Plan
Capital Improvement Project Recommendation

Project Name: Cleveland Ave. Between 25th St. and 24th St.

Project Identification Number: 8-5

Data Summary

Watershed:	Country Club
Priority No.:	9
Estimated Cost:	$27,000
Model ID No.:	8024
Map Sheet Reference Number:	7

Existing Problem Description

Area flooding along Cleveland Ave. between 24th and 25th streets due to existing system being inadequate.

Recommended Improvements

Replace existing 16" CMP with 45 linear feet of 24" RCP and shape the gutter leading into the new flared end section.

Downstream Controls

Project 8-4 should be done in conjunction with or prior to this project.

Potential Alternatives

Existing HDPE piping and inlet system extending south from the ditch near 24th along Cleveland Ave. is a newer system that was constructed as part of the subdivision prior to the subdivisions' incorporation into the city of Joplin. This system was not designed or constructed in a manner to prevent nuisance flooding in yards and of the roadway. This system could be completely replaced for approximately $400,000 (Project 8-5A)

Joplin, Missouri
10-Year Stormwater Management Master Plan
Capital Improvement Project Recommendation

Project Name: 10th St. & Peters Ave., Ditch and Culvert Improvements

Project Identification Number: 10-3

Data Summary

Watershed:	Turkey Creek Central
Priority No.:	2
Estimated Cost:	$376,000
Model ID No.:	10500
Map Sheet Reference Number:	6

Existing Problem Description

Gravel is washing out onto Geneva Ave. from an alley. The discharge flows east across Geneva Ave. into a large flume and earth ditch. The ditch conveys the water downstream to a drive crossing, consisting of a shared gravel drive with a 36" corrugated plastic pipe (CPP) projecting from the fill. The house at 3128 9th St. is subject to flooding when the 36" CPP is unable to pass the flow and the driveway overtops. On Peters Ave. there is significant washing out of the roadway gravel into the ditch. Water flowing north on the west side of Peters Ave. in the existing ditch from 12th St. crosses Peters Ave. via 2-12" RCPs. These pipes are undersized and forces water to flow across the intersection. Water flowing from 11th St. flows east across Peters Ave. causing more erosion of the gravel in the intersection. North of the intersection of 11th St and Peters Ave. to 10th St. the street is washed out. The intersection of Peters Ave. and 10th St. is also eroded as water flows east on the south side of 10th St. across Peters Ave.

Recommended Improvements

Pave the alley from the intersection of the alley and Geneva Ave. to parking lot adjacent to Rangeline Ave. to eliminate gavel washing onto street. On Peters Ave., the 2-12" RCPs should be replaced with a 24" RCP and 2-24" flared end sections. Grade and concrete line the trapezoidal ditch on the east side of Peters Ave. the entire length, approximately 420 linear feet. Construct concrete gutter crossing at intersection of 10th St. and Peters Ave. to convey water from south ditch on 10th St across the intersection into the ditch on east side of Peters Ave. Peters Ave. should be paved from 10th St. to 12th St. Project No. 10-2 should be completed at the same time as the improvements recommended herein. Also recommended is placing the proposed 8' x 3' RCB on a skew to better align the channel. Stabilization of the bank immediately north of structure No. 10505 can be accomplished via the addition of grouted riprap on the bottom and east side of the channel, approximately 80 feet of bank needs to be stabilized.

Potential Alternatives

Add flared end section to existing 36" corrugated plastic pipe to help alleviate flooding at 3128 9th St. A parallel 36" CPP could be placed next to the existing pipe to serve this purpose better.

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10-Year Stormwater Management Master Plan
Capital Improvement Project Recommendation

Project Name: Euclid Ave. from Odessa St. to Rolla St., Ditch Improvements

Project Identification Number: 10-4

Data Summary

Watershed:	Turkey Creek Central
Priority No.:	16
Estimated Cost:	$355,000
Model ID No.:	10105
Map Sheet Reference Number:	2

Existing Problem Description

The steep ditches along the east side of Euclid Ave. are prone to erosion and frequent flooding onto the street. Compounding the problem are the small 15" pipes under driveways and streets.

Recommended Improvements

Pipe the ditch, beginning at the south side of Rolla Ave. and continuing southwest using 24" RCP to the north side of Princeton St., then further southwest to the south side of Odessa St. with 30" RCP. At each street intersection place 2 – 8' x 4' curb inlets except at the Rolla St. intersection, use only the 1 – 8' x 4' curb inlet afore mentioned. At the end of the 30" pipe, place a flared end section and concrete line the ditch to the south property line. This system will pass the 5-year design storm. A larger system is recommended if the detailed design will allow without major cost increases.

Downstream Controls

None.

Potential Alternatives

Continue on with the piping to the south.

Joplin, Missouri
10-Year Stormwater Management Master Plan
Capital Improvement Project Recommendation

Project Name: Salem St. just east of Park Ave.

Project Identification Number: 10-5

Data Summary

Watershed:	Turkey Creek Central
Priority No.:	17
Estimated Cost:	$9,000
Model ID No.:	
Map Sheet Reference Number:	2

Existing Problem Description

The ditch flowing south onto Salem St. floods across the street and continues flowing south.

Recommended Improvements

Install 24 linear feet of 24" RCP with a flared end section pointed north to intercept the southbound flow. Connect the pipe to the existing curb inlet box on the north side of Salem St.

Downstream Controls

None.

Joplin, Missouri
10-Year Stormwater Management Master Plan
Capital Improvement Project Recommendation

Project Name: Windsor St. from Michigan Ave. to Illinois Ave.

Project Identification Number: 12-2

Data Summary

Watershed:	Royal Heights
Priority No.:	13
Estimated Cost:	$57,000
Sub-basin ID No.:	12005
Map Sheet Reference Number:	2

Existing Problem Description

At the intersection of Michigan Ave. and Windsor St. the runoff flows south off the stub out of Michigan Ave. over riprap and into an earthen ditch. The ditch is eroding and the riprap is too small, causing it to migrate downstream. At the intersection of Illinois Ave. and Windsor St. the runoff flows to a low point in the street located in front of 1032 Windsor St. An existing curb inlet (8.5' x 3.5') is in place to remove the water from the street, which then flows into a 24" corrugated plastic pipe that discharges at the back of the property into an existing channel. Any overflow flows through the yard to the back of the property into the same channel. This area collects a significant amount of runoff from three directions, and the existing stormwater control devices are insufficient to remove the water in a timely fashion. At the east end (stub out) of Windsor St. the water flows straight off the street into a channel. There does not appear to be any prominent problem in this area.

Recommended Improvements

Add larger riprap where Michigan Ave. stubs out to the south. Clean out the ditch from there and line with riprap. Add curb inlet extensions to existing curb inlet in front of 1032 Windsor St. Run a parallel line consisting of 160 L.F of 24" CPP, discharging at the south side of the property.

Downstream Controls

Impractical to attempt downstream channel improvements in the woods. Limbs and debris will wash out during major storm events, the channel is adequate if not blocked.

Potential Alternatives

Channel flowing south from intersection Michigan Ave. and Windsor St. could be concreted if Michigan Ave. was not going to be extended.

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Capital Improvement Project Recommendation

Project Name: Industrial Park Road and Kennedy Lane, Regional Detention

Project Identification Number: 13-2

Data Summary

Watershed:	Baker's Branch (Oakland)
Priority No.:	36
Estimated Cost:	$160,000
Sub-basin ID No.:	13061
Map Sheet Reference Number:	3

Existing Problem Description

Excessive surface water coming from the existing industrial park is causing ditch to erode on private property to the South. The industrial park was constructed prior to regulations being in place to require storm water detention.

Recommended Improvements

Construct a six-acre regional detention basin within the industrial park to decrease the 2- and 5-year design storms by 40%, the 10-year by 25%, and the higher intense storms by approximately 10%. By controlling the more frequent storms, erosion of the natural channel may subside. Following are the estimated pre- and post-developed flows immediately downstream of the proposed detention basin:

	DISCHARGE (cfs)					
	2YR	5YR	10YR	25YR	50YR	100YR
Pre-Developed	224	443	624	797	1026	1191
Post-Developed	138	260	468	664	915	1082
% Reduction	38%	41%	25%	16%	10%	9%

Downstream Controls

None.

APPENDIX A

EXHIBIT 1 – RECOMMENDED STORM DRAINAGE IMPROVEMENT MAP

APPENDIX B

HEC –1 DATA SUMMARY

Joplin, Missouri
10-Year Stormwater Management Master Plan
HEC-1 Data Summary

	Original Model as Done by B&M			Revised Model as Completed by AMA			
SUBBASIN	AREA (SQ. MI)	CN	BASIN LAG (Hrs.)	AREA (SQ. MI)	CN	BASIN LAG (Hrs.)	COMMENTS
TCE1	4.500	75.4	0.74	5.783			
TCE2A	0.750	75.3	0.60	1.883			Includes TCE2B
TCE3	2.800	76.5	0.91	1.201			
TCE4	1.900	77	0.87	3.494			
TCE5	1.400	76.6	0.87	0.757			
TCE6	0.800	75.3	0.84				Does not exist on Area Map
1000	0.009	80	0.25	0.009			
1002	0.076	72	0.45	0.074			
1005	0.256	73	0.60	0.240			
1020	0.021	72	0.20	0.020			
1025	0.162	74	0.50	0.173			
1030	0.064	76	0.38	0.063			
1035	0.009	77	0.20	0.009			
1040	0.115	73	0.41	0.115			
1050	0.183	76	0.30	0.183			Incorrectly named 1043 in original model
1055	0.101	72	0.45	0.102			
1060	0.317	72	0.50	0.317			
1065	0.094	75	0.30	0.097			
1070	0.048	72	0.45	0.046			
1085	0.046	72	0.35	0.044			
1090	0.017	72	0.38	0.021			
1095	0.207	78	0.45	0.205			
1100	0.108	80	0.30	0.108			
1105	0.072	72	0.45	0.082			
1110	0.086	74	0.45	0.090			
1115	0.059	74	0.25	0.047			
1120	0.042	72	0.40	0.043			
1125	0.170	75	0.45	0.174			
1130	0.010	72	0.26	0.008			
1135	0.082	76	0.40	0.076			
1140	0.058	75	0.38	0.052			
1145	0.212	80	0.45	0.220			
1150	0.235	75	0.45	0.242			
1160	0.091	75	0.30	0.087			
1165	0.115	82	0.40	0.116			Removed 23.63 Ac. (Drury Site)
1170	0.009	75	0.20	0.008			
1172	0.056	85	0.25	0.053			
1175	0.125	75	0.36	0.129			
1180	0.019	75	0.25	0.019			
1185	0.054	75	0.30	0.054			
1190	0.013	83	0.20	0.013			
1195	0.031	75	0.36	0.032			
1196	0.032	85	0.21	0.032			
1200	0.056	88	0.40	0.061			Incorrectly named 1197 in original model
1203	0.062	83	0.35	0.064			
1205	0.100	87	0.36	0.098			
1210	0.124	75	0.35	0.125			
1215	0.127	80	0.35	0.115			
1220	0.096	75	0.40	0.115			
1224	0.036	75	0.25	0.035			
1225	0.051	75	0.30	0.049			
1226	0.018	79	0.20	0.018			
1230	0.007	84	0.20	0.007			
1235	0.065	75	0.40	0.053			
1240	0.009	88	0.20	0.010			

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10-Year Stormwater Management Master Plan
HEC-1 Data Summary

	Original Model as Done by B&M			Revised Model as Completed by AMA			
SUBBASIN	AREA (SQ. MI)	CN	BASIN LAG (Hrs.)	AREA (SQ. MI)	CN	BASIN LAG (Hrs.)	COMMENTS
1243	0.011	85	0.25	0.015			
1244	0.011	85	0.23	0.011			
1245	0.122	85	0.30	0.125			
1250	0.014	88	0.20	0.012			
1255	0.082	75	0.45	0.078			
1260	0.142	73	0.40	0.150			
1275	0.061	72	0.45	0.064			
1280	0.091	75	0.45	0.089			
1284	0.110	75	0.45	0.109			
1285	0.003	78	0.15	0.004			
1286	0.008	78	0.20	0.009			
1287	0.013	78	0.20	0.013			
1290	0.096	73	0.40	0.094			Incorrectly named 1288 in original model
1295	0.127	73	0.45	0.091			
1297				0.027			Not included in original model
1300	0.094	72	0.45	0.100			
1301	0.071	80	0.40	0.068			
1307	0.045	75	0.25	0.052	78	0.2	
1309	0.158	82	0.35	0.152	82.5	0.3	
1310	0.069	75	0.30	0.070	85		
1315	0.033	87.4	0.30	0.028		0.12	
1317	0.051	83	0.30	0.025	76.6	0.19	
1320	0.041	83	0.30	0.069	76.7	0.3	
1325	0.126	80	0.46	0.123	90.1	0.3	
1329	0.067	84	0.30	0.074	96.9	0.32	
1330	0.160	80	0.40	0.161	80.2	0.4	
1335	0.011	75	0.23	0.011	70	0.19	
1337	0.011	80	0.15	0.013	80.4	0.13	
1340	0.078	80	0.25	0.105	73.9	0.37	
1345	0.086	85	0.35	0.085	90.8	0.29	
1346	0.042	85	0.20	0.035	95.7	0.19	
1349	0.047	70	0.45	0.052	92.5	0.28	
1350	0.019	85	0.25	0.018	87	0.17	
2000	0.038	73	0.30	0.036			
2005				0.198			Not included in original model
2010				0.142			Not included in original model
2015	0.057	78	0.30	0.062			
2020	0.110	77	0.40	0.112			
2030	0.031	75	0.20	0.029			
2032	0.012	80	0.20	0.012			
2033	0.023	80	0.20	0.022			
2034	0.076	81	0.25	0.079			
2040	0.066	74	0.45	0.062			
2045	0.003	80	0.15	0.003			
2060	0.108	80	0.34	0.108			Incorrectly named 2055 in original model
3010	0.129	73	0.33	0.130			
3022	0.068	76	0.32	0.068			
3030	0.040	72	0.40	0.036			
3035	0.024	76	0.25	0.025			
3040	0.085	78.3	0.35	0.086			
3045	0.079	75.24	0.31	0.079			
3060	0.033	80.2	0.30	0.030			
3070	0.049	81.4	0.25	0.048			
3075	0.044	79.8	0.25	0.040			
3080	0.022	75.4	0.26	0.024			

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SUBBASIN	AREA (SQ. MI)	CN	BASIN LAG (Hrs.)	AREA (SQ. MI)	CN	BASIN LAG (Hrs.)	COMMENTS
3085	0.020	77	0.12	0.019			
3090	0.062	78.6	0.31	0.065			
3100	0.039	83	0.24	0.038			
3105	0.042	86.1	0.20	0.042			
3115	0.024	75	0.25	0.024			
3117	0.087	83	0.35	0.088			
3125	0.047	79.8	0.25	0.049			
3130	0.151	77	0.39	0.152			
3140	0.064	85.6	0.29	0.062			
3150	0.053	83	0.22	0.051			
3052	0.042	77	0.20	0.041			Incorrectly named 3152 in original model
3155	0.096	76.3	0.75	0.040			
3055	0.020	77	0.18	0.025			Incorrectly named 3155 in original model
3162	0.070	80	0.30	0.077			
3165	0.059	81.4	0.25	0.059			
3166	0.068	81	0.25	0.062			
3175	0.028	89.25	0.18	0.028			
3180	0.067	83	0.33	0.069			
3190	0.035	72	0.42	0.050			
3195	0.084	73.8	0.56	0.083			
3197	0.037	72	0.45	0.040			
3205	0.051	82.8	0.33	0.051			
3215	0.028	73.45	0.25	0.028			
3220	0.033	78	0.20	0.031			
3225	0.063	81	0.35	0.064			
3235	0.072	73	0.40	0.073	70.9	0.24	
3239	0.036	79	0.25	0.038	75.4	0.13	
3245	0.143	83	0.40	0.144	79.6	0.22	
3255	0.101	81.9	0.32	0.102	77.8	0.26	
3265	0.022	76.4	0.27	0.022	72.3	0.19	
3266	0.110	85.8	0.34	0.113	81.7	0.33	
3275	0.034	76.95	0.54	0.034	74.1	0.21	
3285	0.050	83	0.31	0.049	80.1	0.19	
3295	0.044	85.1	0.20	0.046	81.2	0.22	
3305	0.015	85.1	0.15	0.019	82.7	0.12	
3315	0.050	83.7	0.32	0.044	81.4	0.25	
3325	0.010	79.7	0.14	0.011		0.16	
3335	0.199	83	0.42	0.193	79.3	0.33	
3345	0.026	81.6	0.21	0.024	82.3	0.13	
3350	0.058	88	0.25	0.057	77.8		
3371	0.034	89	0.20	0.035	87.3	0.15	
3372	0.015	89	0.20	0.018	95.2	0.08	
3375	0.081	85	0.30	0.079	92.9	0.15	
3376	0.016	80	0.20	0.020	85.8	0.16	
3380	0.027	82	0.20	0.027	78.3	0.12	
3385	0.071	77	0.40	0.072	69.5	0.26	
3390	0.034	80	0.20	0.032	76.1	0.12	
3391	0.019	83	0.20	0.020	91	0.13	
3392	0.007	83	0.18	0.007	91	0.11	
3393	0.052	83	0.32	0.058	78.9	0.17	
3394	0.017	83	0.20	0.017	87.5	0.11	
3395	0.086	83	0.35	0.082	74.6	0.13	
3410	0.060	80	0.34	0.056	77.5	0.17	
4000	0.006	90	0.25	0.013			
4010	0.011	85	0.25	0.013			

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SUBBASIN	AREA (SQ. MI)	CN	BASIN LAG (Hrs.)	AREA (SQ. MI)	CN	BASIN LAG (Hrs.)	COMMENTS
4011	0.017	80	0.31	0.020			
4025	0.009	86	0.25	0.022			
4035	0.016	90	0.25	0.015			
4040	0.061	96	0.25	0.063			
4045	0.075	96	0.25	0.077			Removed 2 Acres, Moved to A4055
4050	0.007	83	0.2	0.009			Added 6 Acres, Field Verified by AM
4055	0.063	84	0.35	0.069			Added 2 Acres, Field Verified by AM
4060	0.031	83	0.25	0.030			
4065	0.027	83	0.38	0.022			
4070	0.052	83	0.25	0.049			
4073	0.020	81	0.35	0.022			
4075	0.028	84	0.39	0.027			
4085	0.025	83	0.25	0.023			
4095	0.044	86	0.25	0.045			
4105	0.059	86	0.3	0.052			
4110	0.082	83	0.31	0.055			
4125	0.044	72	0.68	0.039			
4126	0.039	72	0.68	0.039			
4130	0.035	82.6	0.42	0.033			
4140	0.016	83	0.3	0.027			4135 included in 4140
4145	0.034	83	0.54	0.049			
4155	0.024	90	0.25	0.018			
4164	0.012	89	0.25	0.015			
4165	0.040	88	0.25	0.039			
4166	0.010	83	0.25	0.009			
4170	0.018	92	0.25	0.019			
4175	0.016	96	0.31	0.014			
4176	0.016	96	0.31	0.019			
4180	0.030	86	0.31	0.026			
4181	0.031	86	0.31	0.035			
4185	0.028	81	0.25	0.028			
4195	0.029	83	0.34	0.031			
4205	0.017	83	0.26	0.028			
4206	0.012	83	0.2				Does not exist on Area Map
4215	0.052	82	0.4	0.050			
4225	0.080	81	0.34	0.074			
4240	0.050	91	0.25	0.047			
4245	0.040	83	0.3	0.041			
4255	0.039	80	0.4	0.040			
4256	0.048	86	0.41	0.050			
4257	0.084	84	0.4	0.093			
4265	0.069	86	0.38	0.058			
4266	0.021	86	0.3	0.032			
4275	0.067	85	0.32	0.068			
4276	0.035	85	0.2	0.035			
4285	0.074	83	0.29	0.077			
4295	0.065	82	0.4	0.066			
4300	0.107	83	0.34	0.108			
4305	0.065	83	0.25	0.069			
4310	0.033	84	0.25	0.032			
4311	0.037	88	0.2	0.040			
4312	0.025	83	0.2	0.025			
4315	0.040	82	0.37	0.044			
4320	0.051	83	0.25	0.052			
4325	0.041	83	0.25	0.041			

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SUBBASIN	AREA (SQ. MI)	CN	BASIN LAG (Hrs.)	AREA (SQ. MI)	CN	BASIN LAG (Hrs.)	COMMENTS
4330	0.114	83	0.3	0.114			
4335	0.059	83	0.25	0.055			
4340	0.145	83	0.5	0.127			
4341	0.060	83	0.3	0.074			
4345	0.037	83	0.3	0.040			
4346	0.056	83	0.25	0.055			
5000	0.050	78.6	0.30	0.046			
5005	0.021	75.4	0.41	0.017			
5010	0.080	75.5	0.45	0.081			
5007	0.0123	76	0.32	0.012			Incorrectly named 5012 in original model
5015	0.030	77.8	0.35	0.029			
5020	0.050	75	0.34	0.058			
5025	0.080	76.2	0.40	0.085			
5030	0.080	79.7	0.39	0.071			
5035	0.077	77.9	0.40	0.074			
5040	0.080	75.2	0.44	0.081			
5045	0.140	75.8	0.39	0.138			
5050	0.170	75.4	0.43	0.174			
5057	0.080	75	0.37	0.071			
5060	0.150	75.6	0.37	0.123			
5063	0.010	75	0.27	0.009			
5065	0.090	75.4	0.39	0.073			
5070	0.090	79.6	0.40	0.097			
5075	0.066	79.45	0.28	0.071			
5076	0.016	83	0.20	0.017			
5077	0.0133	79.45	0.28	0.012			
5080	0.050	75	0.39	0.056			
5085	0.070	81.6	0.28	0.071			
5090	0.120	76	0.46	0.124			Incorrectly named 5091 in original model
5097	0.030	81.4	0.29	0.031			
5100	0.060	77	0.45	0.051			
5105	0.005	78	0.20	0.004			
5106	0.025	78	0.25	0.024			
5107	0.063	80	0.25	0.055			
5108	0.140	80	0.30	0.160			
6000				0.166			Not Included in original model
6005	0.151	79.15	0.346	0.148			
6010	0.048	73.8	0.569	0.049			
6015	0.075	72.85	0.651	0.076			
6020	0.017	72.55	0.25	0.015			
6022	0.031	80	0.3	0.030			
6027	0.061	80	0.4	0.061			
6030	0.015	95	0.15	0.015			
6031	0.024	83	0.25	0.025			
6033	0.023	96	0.2	0.018			
6034	0.017	94	0.2	0.017			
6037	0.024	83	0.2	0.021			
6039	0.086	83	0.375	0.079			
6040	0.025	72.55	0.013	0.025			
6050	0.024	76.4	0.008	0.022			
6060	0.026	78.6	0.2	0.027			
6070	0.141	80	0.4	0.057			
6076				0.111			Not included in original model
6078	0.057	82	0.4	0.061			
6080	0.039	76.7	0.366	0.048			

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SUBBASIN	AREA (SQ. MI)	CN	BASIN LAG (Hrs.)	AREA (SQ. MI)	CN	BASIN LAG (Hrs.)	COMMENTS
6090	0.061	86.8	0.272	0.051			
6100	0.062	83	0.369	0.066			
6103	0.016	83	0.2				Does not exist on Area Map
6104	0.018	89	0.2				Does not exist on Area Map
6105	0.012	89	0.2				Does not exist on Area Map
6106	0.093	82.05	0.3				Does not exist on Area Map
6110				0.041			
6115				0.086			
6125	0.044	83	0.3	0.042			
6127	0.009	80	0.2	0.013			
6128	0.014	79	0.2	0.014			
6130	0.006	77	0.25	0.005			
6140	0.008	74	0.25	0.010			
6150	0.008	79	0.2	0.013			
6153	0.069	83	0.3	0.016			
6154	0.008	83	0.2	0.010			
6155	0.008	83	0.2				Does not exist on Area Map
6160				0.098			Not included in original model
6163	0.016	83	0.2				Does not exist on Area Map
6164	0.026	83	0.25				Does not exist on Area Map
6170	0.035	90	0.208	0.035			
6180	0.073	84.4	0.357	0.071			
6190	0.005	79	0.288	0.006			
6194	0.067	82.45	0.417	0.067			Includes 6205
6215	0.028	78.6	0.038	0.030			
6225	0.030	83.2	0.233	0.026			
6235	0.080	90	0.25	0.086			
6240	0.085	81.35	0.44	0.067			
6250	0.057	79.4	0.313	0.066			
6255	0.030	76	0.443	0.030			
6270	0.036	80.2	0.189	0.033			
6280	0.098	82.6	0.372	0.089			
6290	0.013	79.8	0.332	0.016			
6296	0.057	83	0.3	0.059			
6300	0.043	86	0.25	0.043			
6310	0.088	80.35	0.3	0.088	84.5		
6312	0.075	80	0.3	0.072	75.1	0.31	
6315	0.120	82	0.25	0.088	71.5	0.35	
6320	0.065	79	0.3	0.064	73.1	0.32	
6325	0.204	81.4	0.404	0.205			
6335	0.011	77	0.323	0.010			
6340	0.052	76	0.3	0.039			
6345	0.061	76.2	0.416	0.061			
6350	0.042	77	0.449	0.036			
6359	0.009	83	0.15	0.007			
6360	0.021	83	0.25	0.024			
6365	0.086	83	0.25	0.088			Incorrectly named 6366 in original model
6367	0.048	83	0.2	0.048			
6368	0.038	90	0.25	0.037	97.1	0.17	
6370	0.082	81.4	0.236	0.058	72.4	0.28	
6375	0.071	83	0.217	0.076	73	0.3	
6377	0.005	85	0.15	0.005	89.9	0.11	
6378	0.013	85	0.2	0.015	89.9	0.2	
6379	0.048	92	0.15	0.010	98	0.1	
6385				0.029			Was not included in the original model

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SUBBASIN	AREA (SQ. MI)	CN	BASIN LAG (Hrs.)	AREA (SQ. MI)	CN	BASIN LAG (Hrs.)	COMMENTS
6395				0.004			Was not included in the original model
6405	0.032	83	0.15	0.031	90.4	0.26	
6415	0.005	97	0.15				Removed from model
6417	0.012	97	0.15				Removed from model
6419	0.124	79	0.3	0.049	92	0.2	
6420				0.028	86	0.15	New basin
6421				0.039	84	0.2	New basin
6425	0.032	80	0.3	0.056			
6430	0.055	81	0.35	0.029			
6431				0.031	92	0.05	Added Davis Detention
6435	0.083	78	0.3	0.092	90		
6436	0.022	82	0.15	0.025	90	0.18	
6437	0.163	76	0.42	0.158	90	0.35	
6440	0.008	96	0.15	0.026	98	0.14	
6442	0.045	81	0.2	0.022	88	0.1	
6444	0.011	96	0.15	0.036	84	0.25	
6448	0.014	83	0.2	0.019	92	0.1	
6450	0.032	83	0.25				Replaced w/ GRE model
7000	0.153	81.4	0.27	0.153			
7005	0.090	79	0.36	0.095			
7015	0.084	75	0.41	0.084			
7025	0.069	81	0.33	0.064			
7035	0.060	76.75	0.37	0.057			
7040	0.059	83.35	0.29	0.062			
7042	0.039	83	0.25	0.036			
7043	0.036	83	0.20	0.040			
7044	0.018	83	0.20	0.022			
7050	0.050	80.35	0.36	0.047			
7060	0.054	87.8	0.26	0.049			
7070	0.024	81.95	0.29	0.023			
7080	0.024	86.4	0.28	0.025			
7081	0.051	82.15	0.32	0.048			
7082	0.043	79	0.44	0.037			
7083	0.063	84.8	0.43	0.062			
7084	0.078	86.2	0.36	0.074			
7085	0.029	84	0.29	0.028			
7095	0.035	81.45	0.34	0.032			
7105	0.011	78.75	0.36	0.010			
7115	0.075	88.6	0.33	0.073			
7125	0.038	88.8	0.29	0.034			
7127	0.036	82.9	0.32	0.035			
7140	0.012	84.4	0.31	0.010			
7145	0.003	83	0.12	0.004			
7155	0.013	83	0.35	0.014			
7165	0.011	84.5	0.30	0.011			
7175	0.012	93.5	0.13	0.012			
7177	0.040	85.1	0.31	0.043			
7185	0.022	83	0.23	0.027			
7186	0.016	98	0.17	0.015			
7187	0.009	83	0.20	0.008			
7195	0.066	83	0.26	0.066			
7200	0.073	78.05	0.51	0.069			
7205	0.018	82.7	0.52	0.017			
7210	0.107	77.3	0.59	0.113			
8000	0.025	75	0.46	0.019			

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SUBBASIN	AREA (SQ. MI)	CN	BASIN LAG (Hrs.)	AREA (SQ. MI)	CN	BASIN LAG (Hrs.)	COMMENTS
8005	0.038	75.4	0.38	0.039			
8010	0.013	75.4	0.43	0.014			
8015	0.118	78.8	0.43	0.119			
8020	0.119	79.8	0.25	0.121			
8022				0.039			*** Lag time not given
8024	0.065	80	0.21	0.064			
8025	0.041	79.5	0.53	0.038			
8030	0.130	77	0.54	0.140			
8035	0.130	77	0.58	0.126			
8040	0.123	81.79	0.45	0.119			
8050	0.087	82.85	0.44	0.090			
8055	0.054	87	0.29	0.051			
8060	0.025	75	0.32	0.025			
8065	0.063	80.75	0.42	0.074			
8070	0.036	87.8	0.30	0.019			
8075	0.050	83	0.40	0.055			
8080	0.031	78	0.35	0.032			
8085	0.072	75.16	0.45	0.059			
8090	0.137	79	0.40	0.138			
8095	0.150	80	0.45	0.150			
8097	0.030	81	0.41	0.027			
8110	0.038	84	0.37	0.044			
8115	0.061	82	0.45	0.053			
8120	0.069	78	0.48	0.075			
8125	0.051	84	0.39	0.045			Includes small unnamed basin
9000	0.087	78	0.35	0.070			
9005	0.095	77	0.35	0.129			
9010	0.130	78	0.35	0.185			
9015	0.219	77	0.22	0.210			
9020	0.198	77	0.40	0.192			
9030	0.039	81	0.20	0.039			Incorrectly named 9033 in original model
9035	0.061	79	0.30	0.052			
9040	0.113	81	0.31	0.093			
9050	0.040	81	0.29	0.044			
9060	0.047	81	0.29	0.045			
9065	0.068	83	0.28	0.060			
9075	0.022	80	0.22	0.039			
9085	0.033	81	0.20	0.029			
9090	0.013	83	0.34	0.015			
9095	0.044	77	0.29	0.047			
9105	0.045	80.6	0.24	0.044			
9115	0.037	83	0.30	0.031			
9120	0.033	77	0.24	0.012			
9125	0.017	90	0.16	0.023			
9130	0.035	83	0.25	0.030			
9135	0.049	77	0.38	0.052			
9140	0.076	85	0.26	0.123			
9145	0.036	83	0.28	0.020			
10000	0.058	78.3	0.35	0.061			
10005	0.090	82.74	0.29	0.090			
10010	0.122	75.56	0.52	0.119			
10015	0.049	75	0.37	0.052			
10020	0.132	75.24	0.63	0.136			
10025	0.079	77.4	0.57	0.061			
10030	0.095	75.69	0.41	0.090			

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	Original Model as Done by B&M			Revised Model as Completed by AMA			
SUBBASIN	AREA (SQ. MI)	CN	BASIN LAG (Hrs.)	AREA (SQ. MI)	CN	BASIN LAG (Hrs.)	COMMENTS
10035	0.071	75.96	0.41	0.070			
10040	0.082	78.6	0.35	0.087			
10045	0.011	82.5	0.20	0.012			
10055	0.015	83	0.23	0.026			
10065	0.041	79	0.30	0.036			
10075	0.020	75	0.28	0.037			Incorrectly named 10070 in original model
10080	0.015	83	0.23	0.017			
10085	0.091	75	0.45	0.073			
10090	0.052	81	0.37	0.051			
10095	0.033	81	0.35	0.033			
10100	0.076	83	0.35	0.078			
10105	0.080	81.8	0.35	0.083			
10110	0.024	75.16	0.60	0.026			
10115	0.044	83	0.32	0.042			
10120	0.046	75.24	0.33	0.036			
10125	0.058	75.4	0.29	0.052			
10130	0.097	82.76	0.33	0.096			
10135	0.053	81.24	0.37	0.049			
10140	0.054	76.1	0.37	0.054			
10145	0.079	82.5	0.39	0.088			
10150	0.030	75.24	0.05	0.071			
10155	0.065	90	0.22	0.030			
10160	0.003	90	0.17	0.003			
10170	0.002	90	0.15	0.002			
10180	0.007	90	0.14	0.010			
10190	0.025	89	0.21	0.025			
10200	0.044	76	0.39	0.036			
10210	0.034	75	0.30	0.039			
10215	0.051	79	0.38	0.049			
10225	0.090	83	0.31	0.090			Incorrectly named 10220 in original model
10235	0.018	83	0.29	0.017			
10245	0.030	83	0.29	0.032			
10255	0.047	82	0.32	0.054			
10258	0.020	90	0.20	0.016			Incorrectly named 10257 in original model
10263	0.023	81	0.27	0.019			
10266	0.025	83	0.25	0.027			
10270	0.025	83	0.23	0.039			
10280	0.028	83	0.26	0.034			Incorrectly named 10275 in original model
10285	0.011	75	0.35	0.021			Includes 10285B
10291	0.009	83	0.15	0.007			
10295	0.065	80	0.40	0.063			Incorrectly named 10293 in original model
10300	0.112	76.36	0.56	0.174			Includes 10300B
10305	0.022	76.5	0.46	0.018			
10310	0.056	82.5	0.29	0.060			
10315	0.153	77.6	0.43	0.148			
10320	0.050	78	0.40	0.053			
10340	0.008	90	0.11	0.009			
10350	0.014	85	0.23	0.013			
10360	0.021	77	0.34	0.022			
10365	0.083	80	0.37	0.086			
10370	0.076	80	0.35	0.072			
10375	0.016	85	0.20	0.011			
10376	0.016	85	0.20	0.009			
10378	0.030	85	0.30	0.029			
10385	0.033	86	0.30	0.028			

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SUBBASIN	AREA (SQ. MI)	CN	BASIN LAG (Hrs.)	AREA (SQ. MI)	CN	BASIN LAG (Hrs.)	COMMENTS
10388	0.012	85	0.20	0.018			
10395	0.042	75	0.30	0.037			
10400	0.143	75	0.48	0.098			
10405	0.069	81.16	0.41	0.080			
10410	0.049	75	0.48	0.049			
10415	0.018	90	0.20	0.017			Includes small unnamed basin
10425	0.021	82.9	0.33	0.033			
10430	0.040	90	0.25	0.029			Incorrectly named 10427 in original model
10440	0.018	81	0.30	0.022			
10445	0.045	81	0.15				Does Not Exist
10450	0.050	81	0.37	0.057			Includes small unnamed basin
10460	0.020	75	0.35	0.021			
10470	0.135	78	0.35	0.116			
10480	0.020	80	0.25	0.015			
10500	0.094	82	0.34	0.108			
10505	0.117	82	0.35	0.104			
10510	0.085	69.9	0.45	0.085			
10512	0.021	69.9	0.26	0.021			
10515	0.049	78.75	0.39	0.043			
10520	0.119	81	0.35	0.133			Includes 10520B
10535	0.010	84	0.25	0.011			
10543	0.020	82	0.20	0.014			
10546	0.128	76	0.50	0.117			
10550	0.315	75	0.70	0.331			
10555	0.059	75	0.40	0.063			
10560	0.112	75	0.45	0.111			
10565	0.050	75.8	0.32	0.049			
11000	0.032	78	0.32	0.056			
11012	0.024	78	0.37	0.022			
11014	0.024	78	0.37	0.026			
11015	0.052	77	0.29	0.034			
11020	0.029	82	0.27	0.033			
11030	0.066	75	0.36	0.058			
11035	0.130	75	0.45	0.132			
11040	0.105	80	0.40	0.115			
11045	0.070	75	0.40	0.070			
11055	0.012	78	0.30	0.018			
11057	0.015	78	0.25	0.015			
11060	0.037	81	0.36	0.038			
11065	0.066	78	0.40	0.061			Incorrectly named 11064 in original model
11070	0.078	84	0.32	0.088			
11075	0.093	75	0.35	0.100			
12000	0.081	75	0.40	0.077			
12003	0.079	75	0.44	0.080			
12005	0.066	75	0.42	0.066			
12010	0.044	78	0.38	0.042			
12018	0.008	78.2	0.25	0.010			
12025	0.010	75	0.37	0.009			
12030	0.030	75	0.38	0.028			
12040	0.091	75	0.42	0.093			
12045	0.032	75	0.48	0.029			
12050	0.105	75	0.47	0.099			
12055	0.032	75	0.48	0.033			
12058	0.039	75	0.56	0.039			
12060	0.067	75	0.50	0.066			

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SUBBASIN	AREA (SQ. MI)	CN	BASIN LAG (Hrs.)	AREA (SQ. MI)	CN	BASIN LAG (Hrs.)	COMMENTS
12065	0.068	77	0.46	0.072			
12070	0.029	81.5	0.36	0.031			
12075	0.084	80	0.40	0.085			
12080	0.040	77	0.48	0.037			
13000	0.111	75.4	0.18	0.111			
13003	0.019	75.4	0.35	0.019			
13005	0.019	75.16	0.16	0.020			
13007	0.027	81.1	0.30	0.033			
13010	0.031	79	0.34	0.030			
13015	0.091	83	0.35	0.089			
13020	0.056	81.4	0.20	0.053			
13022	0.063	81.4	0.29	0.067			
13025	0.037	77.6	0.34	0.035			
13040	0.048	80.7	0.32	0.049			
13045	0.123	74.5	0.42	0.134			
13050	0.012	81	0.27	0.010			
13060	0.089	77	0.49	0.093			
13063	0.068	75.2	0.51	0.075			
13065	0.028	75	0.44	0.031			
13075	0.103	77.1	0.32	0.101			
13076	0.094	77.1	0.31	0.093			
13085	0.078	79.2	0.34	0.081			
13090	0.027	75.2	0.40	0.025			
13095	0.054	76.1	0.38	0.053			
13100	0.073	75.2	0.45	0.062			
13105	0.018	75	0.46	0.011			
13110	0.172	80.8	0.37	0.155			
13115	0.019	79.8	0.31	0.022			
13125	0.029	77.3	0.33	0.033			
13130	0.045	75	0.47	0.041			
13135	0.081	75	0.50	0.086			
13140	0.051	75.4	0.46	0.052			
13145	0.105	75.1	0.49	0.116			
13150	0.017	75	0.40	0.011			
13160	0.100	75.8	0.55	0.108			
13165	0.073	77	0.42	0.074			
13170	0.050	76.4	0.37	0.049			
13175	0.130	74.6	0.47	0.125			
13180	0.014	75.4	0.34	0.017			
13190	0.024	75.9	0.25	0.022			
13195	0.044	76.6	0.15	0.045			
13200	0.081	77	0.32	0.080			
13205	0.009	75	0.21	0.010			
13210	0.059	78.2	0.37	0.060			
13215	0.055	74.9	0.39	0.053			
13220	0.021	75.4	0.41	0.019			
13225	0.098	73.9	0.41	0.103			
13230	0.062	74.9	0.50	0.058			
13235	0.029	75	0.40	0.034			
13240	0.113	74.5	0.51	0.116			
13245	0.066	75	0.43	0.061			
13250	0.070	75.4	0.41	0.071			
13260	0.015	75	0.39	0.014			
13265	0.051	74.75	0.47	0.049			
13270	0.195	75	0.52	0.202			

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SUBBASIN	AREA (SQ. MI)	CN	BASIN LAG (Hrs.)	AREA (SQ. MI)	CN	BASIN LAG (Hrs.)	COMMENTS
13275	0.144	77.25	0.53	0.147			
13280	0.094	74.9	0.54	0.071			
13285	0.133	74.9	0.57	0.182			
13290	0.048	75	0.46	0.046			
13295	0.219	75.6	0.79	0.272			
14000	0.059	77	0.40	0.087			
14002				0.022			Not included in original model
14003	0.016	77	0.30	0.018			Includes 14003B
14005	0.034	80	0.35	0.034			
14010	0.097	81	0.34	0.098			
14015	0.074	81	0.34	0.074			
14020	0.046	76	0.35	0.030			
14025	0.089	77	0.40	0.101			
14030	0.081	78	0.47	0.079			
14035	0.082	83	0.39	0.079			
14040	0.108	80	0.37	0.083			
14043	0.026	78	0.25	0.028			
14045	0.028	80	0.30	0.034			
14050	0.055	78	0.41	0.056			
14060	0.084	76	0.53	0.083			
14065	0.135	78	0.55	0.132			
14070	0.069	78	0.39	0.069			
14075	0.150	79	0.50	0.148			
15000	0.117	74.65	0.27	0.125			
15005	0.011	75.16	0.24	0.010			
15010	0.038	76.6	0.34	0.037			
15015	0.011	75	0.31	0.008			
15020	0.058	75.4	0.26	0.061			
15025	0.140	76.9	0.35	0.148			
16000				0.093			Not included in original model
16005				0.136			Not included in original model
16010				0.006			Not included in original model
16015	0.178	73	0.45	0.174			
16020	0.095	77	0.35	0.085			
16025	0.247	76	0.40	0.265			
16030	0.114	73	0.30	0.118			
16035	0.174	80	0.30	0.160			
16040				0.044			Not included in original model
16045				0.175			Not included in original model
16050	0.075	79	0.30	0.073			
16052	0.042	78	0.30	0.040			
16055				0.065			Not included in original model
16060	0.028	74	0.08	0.025			
16063	0.065	77	0.35	0.056			
16065	0.112	76	0.35	0.100			
16075	0.127	78	0.30	0.125			