CHESTER ENGINEERS

Technical Memorandum

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Ref No.: 11-6496-MISS-01

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DATE: June 25, 2013

SUBJECT: Capital Reinvestment in Urban Drainage Infrastructure – 2013 and Beyond
Basis for the Development of a Comprehensive Drainage Improvement Plan

PREFACE

Chester Engineers has been contracted by the City of Jackson to prepare a Comprehensive Drainage Improvement Plan. This memorandum summarizes the work to date accomplished by the design team through limited field observations, coordination with Department of Public Works (DPW) staff, independent review of available record documentation and input from the general public. It should be noted that our subcontractor Southern Consultants has been instrumental in assisting us with the investigations of channels and institutional knowledge of the drainage infrastructure.

The majority of the drainage infrastructure was designed based on 1950's population projection as we as the climatic logical conditions at that time. Over the past sixty-three years as the City's population base and development has changed so have the storm water runoff patterns throughout the metropolitan area. The shift in areas of development combined with recent weather pattern changes in the intensity, frequency and duration of storm events has challenged the current infrastructure's ability to efficiently convey design flows from inlet locations to the discharge point without surcharging inlets or otherwise causing surface flooding despite improvements to selective conveyance channels and street projects. Aged infrastructure coupled with both erosion of and excessive sedimentation within the open channels and drainage ditches have adversely impacted the infrastructure's ability to efficiently prevent significant and repetitive surface flooding issues throughout the City.

The City's drainage infrastructure system consists of fourteen independent drainage basin conveyance piping networks, 100 miles of conveyance channels and over 200 miles of drainage tributaries. The economic reality of shrinking budgets and limited staffing in recent years has created further challenge for the DPW in establishing routine maintenance of the drainage conveyance infrastructure. Stormwater collection systems must not only be designed but maintained to provide adequate surface drainage. Public and traffic safety is critical and intimately related to surface drainage.

The design of drainage improvements and maintenance of existing discharge facilities for collection and conveyance systems must consider the following elements: stormwater quantity and quality. Local, state, and federal regulations control the allowable quantity and quality of stormwater discharges. The last documented, independent and comprehensive review of the drainage conveyance channels and tributaries was performed in 1973 titled "***Urban Systems Engineering Demonstration Program for Hinds, Madison, Rankin Counties Mississippi City Council of Governments and Pearl River Basin Development District***" was commissioned by the US Department of Housing and Urban Development (USE-MS-04-25-003). This report documented specific recommendations for capacity improvements to each of the drainage basins due to insufficient conveyance capacity along with programmatic level estimates for their respective construction costs at that time. Only a portion of the study's recommendations have been constructed

to date. The results of that report have been taken into account for several of the proposed modifications to the current infrastructure .

LIMITATIONS

All presented budgetary information and design information is only at a programmatic level. Further development of schematic and conceptual design of individual projects is warranted prior to field implementation. The recommendations for system improvements are based on very limited field observations of approximately 21 miles of the conveyance channel, selective neighborhood street flooding areas by field investigation, review of previous independent drainage studies of the metropolitan area and the consideration of stormwater best management practices. Design and maintenance recommendations have been established for master planning purposes only; despite the absence of electronic files or record documents of the drainage infrastructure, current topographic information, or a hydraulic model for the channel and conveyance network to serve as a baseline documentation of existing conveyance capacities. Estimated capital costs do not include land acquisition costs.

SECTION 1: MEMORANDUM OBJECTIVES

This technical memorandum is reflective of the asset management methodology to systematically evaluate the existing conditions and needs within the existing drainage infrastructure. This approach was utilized with the goal of minimizing, repetitive and localized surface flooding, identifying *immediate mitigation measures*, *near term protection measures*, and *long range capital improvements* to the drainage infrastructure to be implemented by the City.

A well maintained drainage conveyance system (storm drain piping, ditches and channels, pumps, etc.) collect stormwater runoff from existing impervious surfaces and right-of-way, convey it along and through the right-of-way, and discharge it to an adequate receiving body without causing adverse on- or off- site impacts while providing for safe passage of vehicles during the design storm event. Maintaining adequate capacity in an aging urban drainage conveyance system is a process that evolves as the metropolitan area develops. The primary elements of the process include ongoing system maintenance, data collection to monitor system performance, agency coordination, preliminary concept development, concept refinement, conceptual design, final design and construction. With the absence of an existing hydraulic model of the drainage system the need to leverage geographic information system, available record data to determine environmentally sustainable drainage design concepts is paramount in establishing the DPW's ability to overcome the realities of the frequent flooding issues throughout the city to ensure the viability of the drainage infrastructure to meet the demands of today and twenty or more years in to the future.

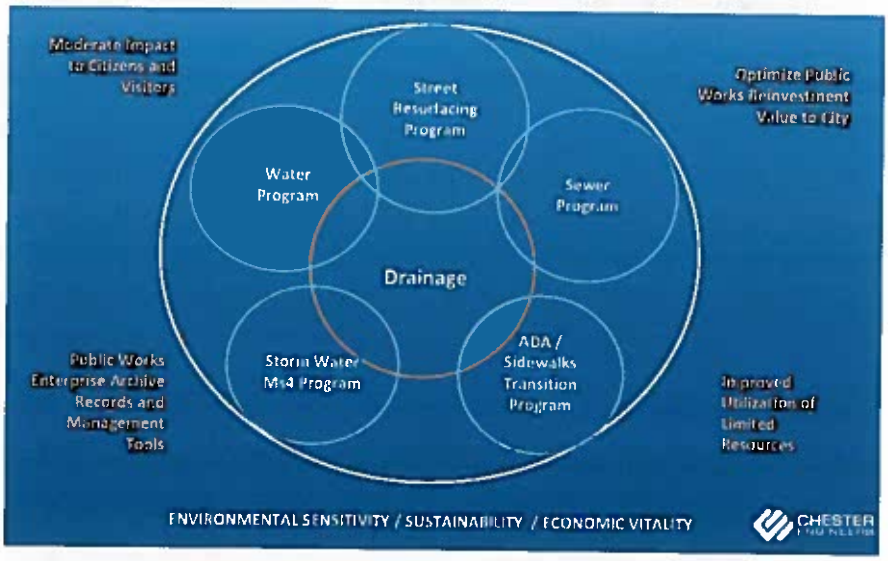
The development of a comprehensive drainage improvement strategy and long-range tools will assist City officials to:

- Facilitate the establishment of a realistic 20 year drainage infrastructure capital improvement budget.
- Budget and the implement routine best management practices for the control of discharge quantity and quality of stormwater runoff for current and future drainage infrastructure.

- ❖ Improve overall channel conveyance capacity within the individual drainage basins to ensure current infrastructure can safely discharge the 50 year design storm runoff.
- ❖ Develop engineering and analysis tools that allow the staff to proactively and predictively address surface flooding trends and review building plans to ensure new development will not have adverse effects on stormwater runoff patterns in the affected areas.

As the value engineering consultant to the City, it is important that any improvements to the drainage infrastructure be integrated with other city-wide improvement programs (Street Resurfacing, Sewer Program, etc.) as illustrated in Figure 1-1 to have the greatest impact to the bottom line of the City's operations budget.

FIGURE 1-1
INTEGRATED INFRASTRUCTURE IMPROVEMENT INITIATIVE



Utilization of an integrated approach to managing the drainage infrastructure assets will result in the following immediate Value Added Benefits to City Operations and the Public:

1. Moderate the Impact of Wet Weather Storm Events to Citizens and Visitors
2. Optimize Public Works Reinvestment Value
3. Improved Utilization of the City's Limited Resources
4. Establish a Public Works Enterprise Archive and Records and Management Tools.

This integrated approach also improves community awareness of:

1. Public Education of Environmental Sensitivity
2. Long Term Sustainability of Drainage Infrastructure Assets for Future Generations
3. Improved Economic Vitality of the City.

END OF SECTION 1

SECTION 2: BACKGROUND AND FINDINGS

The City of Jackson Drainage Infrastructure is comprised of 14 independent drainage basins with over 100 miles of conveyance channel and an additional 200 miles of drainage tributaries. The most recent comprehensive drainage study performed to address long term flooding issues in the Jackson Mississippi metropolitan area was the 1973 , ***"Urban Systems Engineering Demonstration Program for Hinds, Madison, Rankin Counties Mississippi City Council of Governments and Pearl River Basin Development District"***; was commissioned by the US Department of Housing and Urban Development. Recent field investigation findings by Chester Engineers in July 2012 and March 2013 have confirmed many of the conditions that existed in 1973 are prevalent in the conveyance channels today. The field observations coupled with the historical findings have been used as the primary basis for identification of existing capacity deficiencies within each drainage basins and establishing the long range capital improvement plan objectives.

Asset History of Maintenance

The 311 system call data was used to identify the maintenance history of the drainage infrastructure throughout theCity of Jackson. A total of 3,110 drainage system maintenance requests were lodged during the 23 month time period. Three classifications of maintenance requests were used: clogged ditches, inlet catch basin housekeeping and other maintenance requests. Analysis of this data was utilized in the assignment of probability of failure of the drainage infrastructure within each drainage basin. This score (expressed as a percentage) was determined by dividing the asset history of maintenance score based on the number of Inlet/Catch Basin House-keeping calls divided by the total number of calls for Clogged Ditches, Inlet/Catch Basin House-keeping and Other Maintenance. Field verification visits validated the need for enhanced maintenance throughout the City's drainage system to restore drainage conveyance capacity.

Condition of Channel Assets

After consultation with DPW staff, twenty-one miles of drainage channels were investigated with field teams to document not only the condition of the channels but also the ease of access, the size and construction materials of the current drainage infrastructure. A city map illustrating the extent of the site verification investigation areas completed to date can be found in Appendix 2. Table 2-1 presents a summary of the field investigation team drainage conveyance channel observations. The detailed findings of these field investigations including drainage channel exhibits indicating photograph locations, representative photographs and field observation notes were previously provided in the Chester Engineers Technical Memorandum titled ***"City of Jackson Storm Water Infrastructure Risk Management Strategic Evaluation Process – Initial Drainage Basin Prioritization"*** dated January 8, 2013.

Based on the channel investigation summary of findings and the photographs, it is apparent that the major drainage channels have not received the maintenance required to maintain adequate capacity for conveyance of rainfall runoff. Many neighborhoods areas experiencing flooding are likely due to clogged inlets and storm drains and low points in street grades which cause ponding of runoff and nuisance to residents and business owners.

In January 2013, Chester Engineers established initial *Business Risk Exposure* (BRE) assessments (Table 2-2) utilizing the data collected from the previous field observations and data to identify and prioritize "Worst Comes First" areas in need of improvement. The *Business Risk Exposure* (BRE) score is the product of two metrics: *Probability of Failure* (PoF) and *Consequence of Failure* (CoF). This methodology

was utilized to screen and prioritize those drainage area improvements that could have the greatest benefit on overall management of flooding in the metropolitan area.

TABLE 2-1
SUMMARY OF CHANNEL INVESTIGATION FINDINGS
[COMPLETED THRU DEC 19, 2012]

Location	Channel Investigation	Structure Crossings	Utility Crossings	Channel Washout	Tributary	Outfall	Tree Across Channel	Bank Failure	Debris in Channel	Riprap Failure	Beaver Dam
Belhaven Creek	6500 LF	9	10	3	2	6	4	10	10	1	
Big Creek											
Bogue Chitto Creek											
Cany Creek	25,000 LF	12	32	9	21	24	17	7	9	1	2
Eastover Creek											
Eubanks Creek	15,300 LF	9	20	3	8	23	1	4	4		
Hanging Moss Creek											
Hardy Creek	11,300 LF	8	12	2	11	24	14	8	13	2	2
Lynch Creek	12,500 LF	8	9	4	10	24	3	1	7		
Purple Creek	7500 LF	5	8	8	1	21	1	3	4		
Three Mile Creek	5000 LF	5	8	4	3	8	1	4	6		1
Town Creek											
Trahon Creek	20,000 LF	5	4	22	17	6	41	2	18		1
White Oak Creek	9300 LF	4	8	13	8	29	3	9	6		1

Note: Big, Bogue Chitto, Eastover, Hanging Moss and Town Creeks were not included in the initial channel investigation list. The local flooding areas to be investigated along Town Creek are substantial and the channel investigation will be conducted at the time of observation.

Tables 2-2 and 2-3 illustrate: 1) computation of the *BRE* Score; 2) qualification of risk level with associated "outcome strategy", or pre-emptive action and, 3) predetermined measures and protocols for each risk level.

TABLE 2-2
BUSINESS RISK EXPOSURE (BRE) DETERMINATIONS

		Consequences								
	CoF Score	1	2	3	4	5	6	7	8	9
	PoF Score / CLASSIFICATIONS	Insignificant	Low		Medium			High		Extreme
Probability	10	Almost Certain	10	20	30	40	50	60	70	80	90
	9		9	18	27	36	45	54	63	72	81
	8	Likely	8	16	24	32	40	48	56	64	72
	7		7	14	21	28	35	42	49	56	63
	6	Possible	6	12	18	24	30	36	42	48	54
	5		5	10	15	20	25	30	35	40	45
	4	Unlikely	4	8	12	16	20	24	28	32	36
	3		3	6	9	12	15	18	21	24	27
	2		2	4	6	8	10	12	14	16	18
	1	Rare	1	2	3	4	5	6	7	8	9

TABLE 2-3
BRE RECOMMENDED OUTCOME STRATEGIES

RISK LEVEL	OUTCOME STRATEGY
LOW	Condition Monitoring
MODERATE	Predictive Monitoring
HIGH	Economic Based Replacement
EXTREME	Replacement / Redesign

Furthermore, the team has identified strategies to address the City's long term local drainage concerns within each drainage basin. Belhaven Creek, Eubanks Creek and Town Creek drainage basins exhibited the highest relative *BRE* scores (Table 2-4) suggesting that improvements and enhanced maintenance in these areas receive the highest priority.

TABLE 2-4
DRAINGE BASIN BUSINESS RISK EXPOSURE SCORES

Drainage Basin	POF Score	Probability of Failure	COF Score	Consequences of Failure	BRE Score	Risk Level
Belhaven Creek	8.3	Likely	8.7	High	72	Extreme
Eubanks Creek	8.5	Likely	8.3	High	71	Extreme
Town Creek	7.5	Likely	8.8	High	66	Extreme
Lynch Creek	7.2	Likely	7.5	High	[illegible]	High
Purple Creek	8.8	Likely	5.2	Medium	46	High
White Oak Creek	8.2	Likely	5.0	Medium	41	High
Hanging Moss Creek	4.8	Unlikely	8.0	High	39	High
Cany Creek	7.0	Likely	4.2	Medium	29	Moderate
Eastover Creek	6.7	Possible	3.8	Low	26	Moderate
Bogue Chitto Creek	5.8	Possible	4.2	Medium	24	Moderate
Hardy Creek	6.5	Possible	3.0	Low	20	Moderate
Three Mile Creek	6.3	Possible	2.8	Low	18	Moderate
Trahon Creek	5.8	Possible	2.7	Low	16	Moderate
Big Creek	5.2	Possible	3.0	Low	16	Moderate

END OF SECTION 2

SECTION 3: ESTABLISHMENT OF COMPREHENSIVE DRAINAGE IMPROVEMENT PLAN LONG RANGE OBJECTIVES

The long range (20 yr) objectives for the ***Comprehensive Drainage Improvement Plan*** (CDIP) have been established based on discussions with the Director of Public Works, City's Drainage Engineer, review of available historical information, 311 call data, feedback from attendance at local homeowner association meetings and field observations. The review of this data concluded that current drainage infrastructure is inadequately conveying runoff throughout the City and it is not isolated to a few drainage basin but is widespread throughout all City wards. As such, the following objectives and strategies have been developed to address a myriad of drainage issues to alleviate localized flooding issues while ensuring the conveyance channels have sufficient capacity to drain the City's runoff into the Pearl River Drainage Basin.

The primary objective of the drainage improvement plan is to ensure the original design storm conveyance capacities are restored in all of the major conveyance channels. Unlike the 1973 report this improvement plan will be bounded by the city limits of Jackson. The other objectives of the proposed long-term drainage improvement plan are:

1. Identify and prioritize "Worst Comes First" areas in need of improvement.
2. Stabilization of existing infrastructure to handle the 50-Yr design storm.
3. Establishment of routine maintenance programs for the storm water collection and conveyance network, the conveyance channel and drainage tributaries.
4. Improve the existing urban Stormwater infrastructure to mitigate the effects of a 100-Yr Design Storm Event. The proposed improvements would consist of the following strategies:
   - ❖ Channel Widening
   - ❖ Storm Water Retention
   - ❖ Storm Water Redirection
5. Update the existing drainage infrastructure records, mapping and hydraulic carrying capacity of the existing Stormwater infrastructure.
6. Implementation of the following mitigation strategies:
   - ❖ Design of new or rehabilitated stormwater control facilities
   - ❖ Establishment of post-construction stormwater control best management practices (BMP),
   - ❖ Due diligence in implementing BMPs with regard to existing stormwater control facilities.

Field data from each of the drainage basins has been utilized to identify opportunities for improvement in each of the 14 drainage basins. When evaluating the means to improve the conveyance capacity of the existing drainage infrastructure the flooding issues were categorized either as localized street flooding issues or channel conveyance issues.

END OF SECTION 3

SECTION 4: PROJECTION OF LONG TERM CAPITAL REINVESTMENT NEEDS

Chester Engineers has projected the citywide, long term capital reinvestment needs for the urban drainage infrastructure is $995M over the next twenty years (Refer to Figure 4-1). As previously noted, initially the focus will be those areas scoring above an agreed *BRE* threshold value indicating a highest priority for resolution (i.e., "worst comes first") when determining the long term capital planning needs for the drainage infrastructure. The implementation priority of the identified drainage improvement projects will be reflective of DPW budget constraints and available funding mechanisms to support a multi-year capital improvement plan. Further input from DPW personnel is required to determine the existing budget constraints in order to complete this evaluation.

FIGURE 4-1

CITY OFJACKSON COMPREHENSIVE DRAINAGE IMPROVEMENT PLAN
FORCASTED FUNDING NEEDS
2013-2033

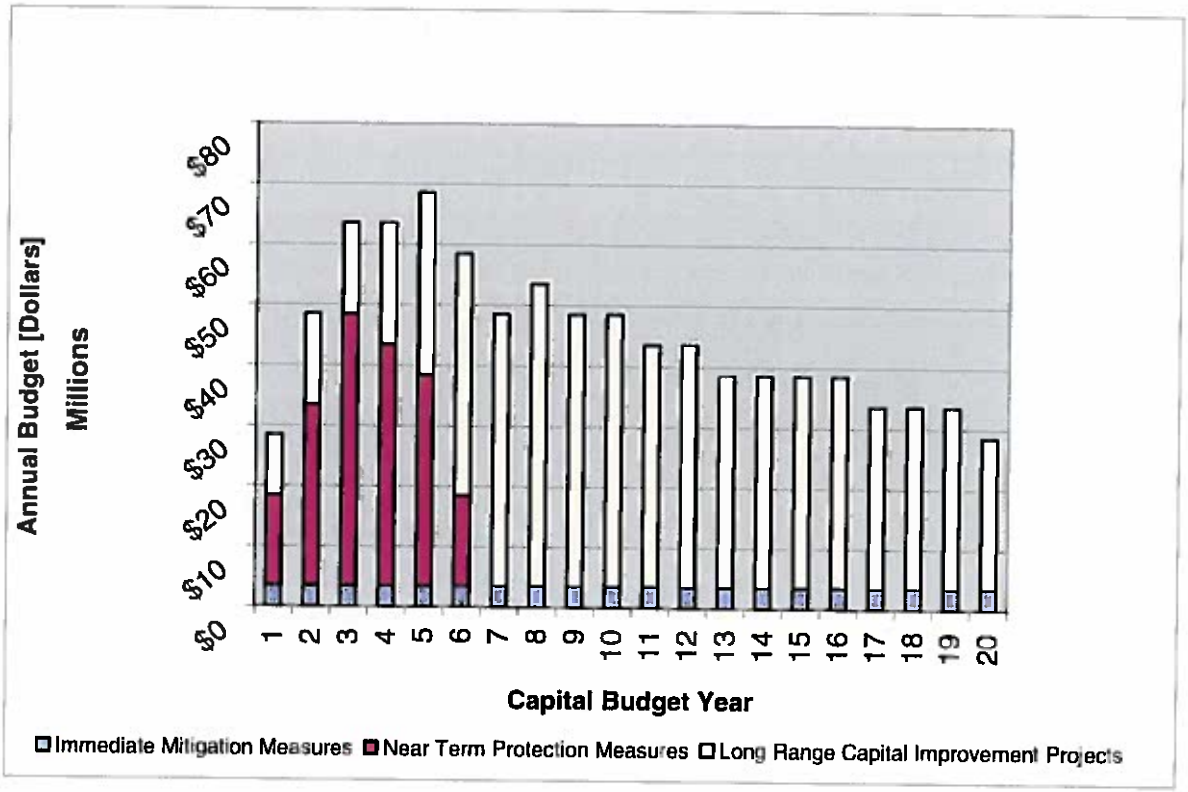


TABLE 4-1
BASIN LEVEL
FORECAST CAPITOL REINVESTMENT NEEDS

PROPOSED SCHEDULE		RECOMMENDED CIP STRATEGIES							20-YR DRAINAGE IMPROVEMENT FORECAST CAPITAL REINVESTMENT NEEDS
		ONGOING WITHIN 6 MONTHS	6 MONTHS TO 2 YEARS		YEARS 3 - 20				
		IMMEDIATE ACTION PLAN	NEAR TERM PROTECTION MEASURES		LONG TERM CAPITAL IMPROVEMENTS				
City Ward	Drainage Basin	Targeted Street Flooding Improvements	Channel / Tributary Capacity Restoration	Comprehensive Street Flooding Improvements	100 Yr Storm Channel Capacity Improvements	Capacity Retention	Capacity Detention	Capacity Redirection (Green)	
1	Purple Creek	$1,692,633	$9,027,378	$11,284,222	$22,568,444	$2,256,844	$7,334,744	$7,898,955	$62,063,220
	White Oak Creek	$659,999	$3,519,994	$4,399,993	$8,799,986	$879,999	$2,859,995	$3,079,995	$24,199,961
	Eastover Creek	$765,599	$4,083,193	$5,103,992	$10,207,984	$1,020,798	$3,317,595	$3,572,794	$28,071,955
2	Hanging Moss Creek	$1,093,486	$5,831,927	$7,289,908	$14,579,817	$1,457,982	$4,738,440	$5,102,936	$40,094,496
	Bogue Chitto	$310,068	$1,653,693	$2,067,117	$4,134,233	$413,423	$1,343,626	$1,446,982	$11,369,142
3	Eubanks Creek	$2,938,183	$15,670,311	$19,587,889	$39,175,777	$3,917,578	$12,732,128	$13,711,522	$107,733,387
3/4/7	Town Creek	$8,897,182	$47,451,636	$59,314,545	$118,629,090	$11,862,909	$38,554,454	$41,520,181	$326,229,997
4/5	Lynch Creek	$3,487,962	$18,602,466	$23,253,083	$46,506,165	$4,650,617	$15,114,504	$16,277,158	$127,891,955
6	Big Creek	$1,979,997	$10,559,983	$13,199,979	$26,399,958	$2,639,996	$8,579,986	$9,239,985	$72,599,884
	Three Mile Creek	$286,044	$1,525,566	$1,906,957	$3,813,914	$381,391	$1,239,522	$1,334,870	$10,488,263
	Hardy Creek	$333,431	$1,778,301	$2,222,876	$4,445,753	$444,575	$1,444,870	$1,556,014	$12,225,820
	Cany Creek	$2,087,973	$11,135,854	$13,919,818	$27,839,635	$2,783,964	$9,047,881	$9,743,872	$76,556,997
	Trahon Creek	$2,407,148	$12,838,123	$16,047,654	$32,095,309	$3,209,531	$10,430,975	$11,233,358	$88,262,098
7	Belhaven Creek	$201,036	$1,072,190	$1,340,238	$2,680,476	$268,048	$871,155	$938,166	$7,371,308
Totals		$27,140,740	$144,760,616	$180,938,270	$361,876,540	$36,187,654	$117,609,875	$126,656,789	$995,160,484

The following narratives provide examples of the some of the recommended mitigation measures, protection measures and improvement projects to be included in the CDIP and utilized to determine projected capital reinvestment needs of the drainage infrastructure.

4-1 IMMEDIATE CITY-WIDE FLOOD MITIGATION MEASURES

1. **Street Flooding Mitigation Measures** throughout the City have been identified in areas of repetitive flooding based on historical records and visual survey of the areas affected. These measures are aimed at minimizing and mitigating the effects of localized street flooding. Typical recommended projects include:
   - ❖ Installation of additional catch basins,
   - ❖ Widening of drainage ditches
   - ❖ Replacement of damaged and collapsed pipe culverts.

2. **Storm Drain Maintenance**

Our field observations and analysis of 311 call data confirmed the need for following immediate Street Flooding Mitigation Measures throughout the City:

- Establishment of a ***Clean Sweep Jackson*** public campaign to enlist resident is keeping seasonal lawn debris out of local gutters and catch basins. It is recommended that the City work with Neighborhood Associations to organize a city-wide collection of trash and vegetation and other debris in residential neighborhoods which accumulate in the gutters and drainage ditches throughout the City Residents and Business Owners are requested to bag all lawn clippings and leaves for pick up by City solid-waste removal crews. It is recommended that this be held semi-annually (Early Spring and Fall) to prevent the accumulation of yard debris from blocking residential street gutters and drainage ditches throughout the City.

This initiative enlists residents and business owners to become the first line of defense in flood protection of their property and neighborhood. This type of program will provide the City a tool to educate the residents of their responsibilities to clean storm drains in advance of major storm events as well the function of the area drainage basins. It all will stress the importance of removing debris from roadsides and gutters which could ultimately end up in the storm drains, tributaries and channels. Keeping the catch basins and storm drains clear not only helps to mitigate water pollution, but also reduces the likelihood of flooding during heavy rain.

- ***Deployment of Street Cleaning Contracts*** to enhance the frequency with which the City Streets and Gutters are cleaned. A windshield survey of the City indicated a significant portion of the city gutters are clogged with grit and leaves throughout the metropolitan area. It is recommended that the city begin an aggressive street cleaning program utilizing outside contractors to remove asphalt, grit and accumulated debris from the city streets over a six month period. The current DPW staffing levels do not allow for timely cleaning of the all the streets. Long term city-wide program should be established to systematically clean the street gutters on a semi annual basis. Routine cleaning of the streets should minimize localized flooding issues on city streets by restoring the conveyance capacity of the existing gutters. In addition routine street cleaning will prevent roadway grit and debris from increasing sediment accumulation in both the conveyance piping network and conveyance channels which will reduce the required frequency of channel dredging in the future. An ancillary benefit would be improved water quality in the local streams and creeks as the contaminants would no longer make there way into the receiving streams.

After a literature review, Chester estimates the City of Jackson should expect to incur street sweeping costs between $ 14.75 to $ 158 /curb mile, with an average of $ 62.45/curb mile dependent on the type of street being cleaned. An average cost per lane mile is estimated at about $102/lane mile (Reference: ***"Technical Memorandum 2 - Summary of Municipal Practices Survey***

Research in Support of an Interim Pollutant Removal Rate for Street Sweeping and Storm Drain Cleanout Activities"; A project supported by the U.S. Chesapeake Bay Program Grant CB-97322201-0 (Yr 2006)).

- ***Enhanced Catch Basin Cleanout and Maintenance*** can be accomplished by the addition of one full time dedicated crew and procurement of a second vacuum truck to the DPW to perform routine cleanout of city-wide catch basins. It is recommended that every catch basin be properly cleaned on a three year rotating basis. Current staff levels and equipment have directly impacted the DPW's ability to establish a routine cleaning schedule of the catch basins. Maintenance crews have been responding primarily to cleaning of catch basins based on the reports of clogged basins from the 311 Call System.

After a literature review Chester estimates the City of Jackson should expect to incur an average cost for catch basin cleanouts of approximately $ 58 per inlet, $1.39 per linear foot of storm drain pipe, or $ 415.56 to cleanout out both storm drains and inlets mile (Reference: ***"Technical Memorandum 2 - Summary of Municipal Practices Survey Research in Support of an Interim Pollutant Removal Rate for Street Sweeping and Storm Drain Cleanout Activities";*** A project supported by the U.S. Chesapeake Bay Program Grant CB-97322201-0 (Yr 2006)). The ratio of curb miles to lane miles is typically around 2:1 or 4:1. A few communities reported sweeping costs by street type or land use. Streets within the Business District were generally the least expensive to sweep. Of the storm drains that are cleaned, the majority of surveyed communities reported they only conducted storm drain cleanouts once every 2 years or less. This represents a typical cleanout frequency, whether it be regularly scheduled or based on complaints.

- **Encourage the Integration of Low Impact Development Approaches throughout the City for Streets Projects and in State and Local Government Parking Areas** in order to reduce storm water runoff. It is recommended that a LIDA Manual for the City of Jackson be developed and distributed for use by local developers and engineers for handling storm water. The goal should be to store and infiltrate as much storm water on site for new development in order to allow the City more time to budget for major storm water conveyance channels improvements and maintenance as well as improve the performance of existing infrastructure. As a minimum the city should encourage the design and construction of LIDA in parking areas and street repair projects.

- ***Removal of Vegetation and Debris from Drainage Ditches*** These maintenance activities can be accomplished by the addition of two full time dedicated crews and the procurement of two trucks to the DPW to perform routine cleanout of city-wide drainage ditches. It is recommended that every drainage ditch basin be properly cleared of accumulated sediments and debris on a three year rotating basis. Current staff levels and equipment have directly impacted the DPW's ability to establish a routine cleaning schedule of the drainage ditches. With

limited staff, the DPW has been required to operate in a reactionary response mode to resident reports of clogged ditches and roadway flooding based on the 311 Call System to deploy a maintenance crew as opposed to a planned routine maintenance program.

3. **Channel Clearing Projects**

Not all localized flooding in the City are the result of localized street flooding. Many of the repetitive flooding area are the result of conveyance channel capacity issues. Some repetitive flooding is the result of channel sedimentation, encroachment of development, and change in flow patterns. The flooding issues have compromised utility crossings and other city infrastructure.

Diligent inspection and prescribed maintenance are essential to maintaining system capacity. The effectiveness of best management practices (BMPs) depends upon regular inspections of the control measures. Generally, BMP inspection and maintenance falls into two categories: expected routine maintenance and non-routine (repair) maintenance. Routine maintenance is performed regularly to maintain both the aesthetics of the BMPs and their good working order. Routine inspection and maintenance helps prevent potential nuisances (odors, mosquitoes, weeds, etc.), reduces the need for repair maintenance, and reduces the chance of polluting stormwater runoff by finding and fixing problems before the next rain event. Reducing the incidence of pests and proper inspection and maintenance are essential to avoid the health and safety threats inherent in BMP neglect. The failure of structural stormwater BMPs can lead to downstream flooding, which can cause property damage, injury, and even death.

Several mitigation measures have been identified to minimize the impacts of localized channel flooding until the time when major channel capacity improvements and bank restoration projects can be fully funded. These typical projects include:

- Utility/Bridge Creek Crossing Protection
- Creek Invert and Bank Stabilization
- Construction of Temporary Earthen Berms

Channel blockages were found in 85 different locations in the 21 miles conveyance channels previously investigated (Refer to Table 1). Significant channel flow blockage issues are anticipated to be prevalent not only in the remaining 79 miles of uninvestigated channel but also in the 200 miles of drainage tributaries. Detail observations of these channel observation are provide in an appendix to this memorandum.

4. **Channel Flooding Mitigation Measures** are recommended for immediate implementation:

- ***Deployment of Channel and Tributary Cleaning Contracts*** - It is our understanding that routine maintenance activities have been hampered by the availability of the maintenance vehicles. Initially, the DPW should utilize existing channel and tributary cleaning contracts vehicles to deploy emergency crews to remove the 85 previously - identified channel blockages within the first six months of the capital improvement plan. Once this is completed the DPW should budget for the following:

Dedicated Personnel and Equipment

Additional maintenance personnel, equipment and vehicles are warranted at this time. It is recommended that a minimum of two dedicated channel maintenance crews be added to the DPW staff with appropriate vehicles and equipment to remove trees, other debris and sediment in order to clear blockages in conveyance channels that have resulted from years of sedimentation, fallen trees, utility crossing and illegal dumping of white goods within the conveyance area of the drainage channels. In order to ensure adequate channel conveyance capacity these blockages must be removed, the channel typical sections should be surveyed to determine and monitor the current system conveyance capacity and quantify the amount of the sedimentation buildup.

Maintenance Schedules

Establish a routine drainage channels maintenance schedule to ensure that all debris is removed from all major drainage channels and outfalls on a three-year rotating basis starting with the basins ranked in the extreme category. The incidence of periods of extraordinary wet weather may require an increase in frequency of channel maintenance. As maintenance data and information are compiled, maintenance frequency should be adjusted accordingly.

❖ ***Assess the Remaining Channel and Tributary Flow Conditions***

As indicated earlier, after consultation with DPW staff, twenty-one miles of drainage channels were investigated with field teams to document the condition of the channels. Based on the channel investigation summary of findings and the photographs, it is apparent that the major drainage channels have not received the maintenance required to maintain adequate capacity for conveyance of stormwater runoff. Many neighborhoods areas experiencing floods are likely due to clogged inlets and storm drains and low points in street grades which cause ponding of runoff and nuisance flows in yards and driveways. However, the local storm drainage system must discharge into the major drainage channels. These major channels must have adequate capacity to convey the collected runoff downstream without causing backup in the local storm drains. Therefore, a combination of significant major drainage channel improvements, monitoring and routine maintenance programs is necessary to address the flooding issues at the local level. It is recommended that the remaining 79 miles of major channel as well as major drainage tributaries also be investigated.

Identify and Repair Compromised Channel Crossings – Initial field survey investigation crews identified compromised channel crossings. A city map illustrating the extent of the site verification investigation areas completed to date can be found in Appendix 2. The detailed findings of these field investigations including drainage channel exhibits indicating photograph locations, representative photographs and field observation notes were presented in our previous Technical Memorandum provided in January 2013.

4-2 SELECTIVE NEAR TERM PROTECTION MEASURES

1. **Street Flooding Protection Measures** throughout the city have been identified in areas of repetitive flooding based on historical records and visual survey of selective repetitive flooding neighborhoods. These near term protection measures are aimed at protecting city infrastructure and public and private property concerns from future flood damage and ensure safe vehicular travel during storm events. These efforts should be coordinated with the ongoing street repair programs to minimize rework and disruption to businesses and residents.

   Typical recommended projects include:

   - ❖ Spot Repair [Cold Mill and Overlay Streets] to provide an adequate edge of pavement elevation to match the existing catch basin openings.
   - ❖ Re-construct grades of Selective Streets to facilitate storm water runoff flowing into drainage structures and ditches.

2. **Channel Flooding Protection Measures** throughout the city have been identified in areas of repetitive flooding based on historical records and visual survey of selective repetitive flooding neighborhoods. Typical recommended projects include:

   - ❖ Targeted Channel Dredging primarily near major roads and bridges.
   - ❖ Channel Slope Stabilization Projects [Rip/Rap Gabion] in areas where bank failure is imminent based on channel field investigations findings.

4-3 IDENTIFICATION OF LONG RANGE CAPITAL IMPROVEMENTS

With the initial prioritized drainage basins determined, potential drainage improvement projects can be identified within each basin beginning with the Extreme Risk Level basins. Completion of field investigation activities in the remaining basins is warranted based on the initial field observations. The increased volume and rate of runoff from impervious surfaces are directly related to development in urban and urbanizing areas. Effective management of storm water runoff offers a multitude of possible benefits, including protection of wetlands and aquatic ecosystems, improved quality of receiving water bodies, conservation of water resources, protection of public health, and flood control.

Capital improvements designed to convey particular recurring rainfall events, often referred to as the "design storm," result in enhanced capacity to manage associated storm water flows thus minimizing flooding incidents. Each of the drainage improvement projects will be hydraulically modeled to simulate the effectiveness of the project in reducing the flood risk within the drainage basin. The development of opinions of probable construction costs and a final *BRE* Score for each improvement project at a basin level will also be presented.

The results of the initial investigations suggest the following overall improvement strategies:

- Replacement and Redesign Drainage Assets: Belhaven, Eubanks and Town Creek
- Economic Based Improvement Projects: Lynch, Purple, White Oak and Hanging Moss Creek
- Predictive Monitoring: Cany, Eastover, Bogue Chitto, Hardy, Three Mile, Trahon, Big Creek

As there are apparent needs for improvements in each of the fourteen drainage basins the next section of this memorandum report outlines several of the specifically identified maintenance, mitigation and protection measures and capital improvement projects identified for individual drainage basin. All costs and schematic design concepts are at the programmatic level. Further engineering, design and hydraulic analysis remain to be completed.

END OF SECTION 4

SECTION 5 IDENTIFIED REINVESTMENT NEEDS IN THE BELHAVEN CREEK BASIN

5-1 DRAINAGE BASIN BACKGROUND AND DESCRIPTION

This small creek originates in the northeastern sector of Jackson, immediately north of Belhaven College. The drainage basin supplies a small lake located on the college campus. The streams in the Belhaven Creek Basin traverse a section of the City of Jackson, commonly referred to as Belhaven Heights, that is developed with relatively old, high quality homes at moderate densities. The main channel crosses the perimeter of the campus of Belhaven College. In the previous drainage study it was noted that, the drainage facilities in the basin are in good condition, and only one of the 20 structures on the creek was considered inadequate. At that time some channel improvements were recommended to meet the anticipated demands of a 50-year storm, existing channels function relatively well. In virtually all portions of the basin drainage channels are narrow and constricted by fences and structures. In many instances, the channels are constricted with trees, debris and undergrowth. Channel improvements and even routine maintenance are hampered severely by the proximity of urban development.

Selected sections of the main channel, near Belhaven College, were paved. Several of these paved sections have been destabilized over time and are now creating blockages in the flow area reducing the conveyance capacity within the change. The unpaved sections of the channel have extensive encroachment by trees and other debris that will require removal. Structure 10, at Laurel Street, is somewhat undersized and occasional problems are experienced in this area, particularly when locally heavy rains occur during high stages of the Pearl River. With continued development in the vicinity of the University Medical Center and the Fondren area runoff into the Belhaven neighborhoods has increased significantly compromising the conveyance systems ability to remove the water effectively. Our field observation teams confirmed evidence of flooding resulting from inundation of the area when locally heavy rains occur and during high stages of the Pearl River.

The following projects presented in this section are intended to be representative of the needs within the Belhaven Creek Drainage Basin and not an exhaustive listing of all the drainage needs. These projects presented herein are only selective in nature based on preliminary field investigations. Final project scopes and constructions costs may vary as conceptual and detailed design efforts dictate.

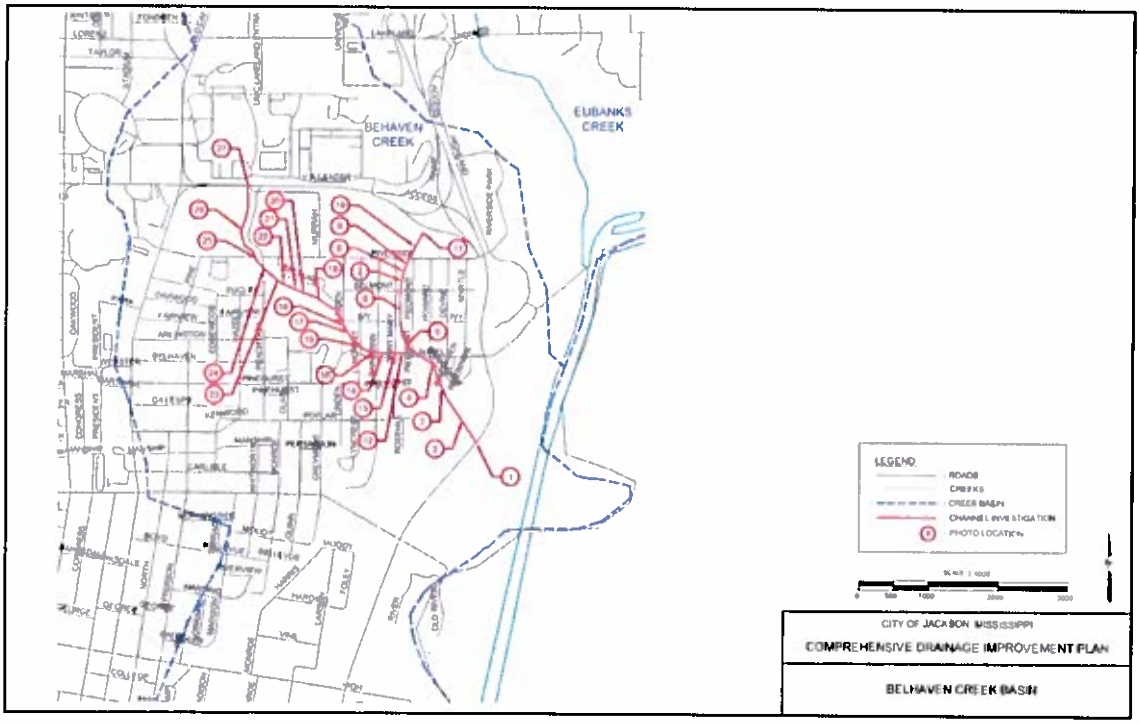
5-2 CONVEYANCE CHANNEL IMMEDIATE MAINTENANCE NEEDS

In July 2012, Chester field investigation teams canvassed 6,500 linear feet of channel inspecting 9 structure crossings, 10 utility crossings, 6 outfalls, 2 tributary, and identified 3 areas of significant channel washout, 4 downed trees obstructing channel flow, 10 areas of bank failure, 10 additional locations where debris in the channel was impacting channel capacity and 1 area of riprap failure. Much of the Belhaven Creek channel is clogged with undergrowth, trees, and in many instances debris and litter as noted above.

Refer to Table 5-1 for the map of the extent of the field investigations in the Belhaven Creek basin and Appendix 7 for a listing of the primary findings for this drainage basin.

Belhaven Conveyance Channel Maintenance		$ 168,000
	Rip-Rap Protection at Utility Crossings	$ 48,000
	Channel Debris Removal	$ 110,000
	Channel Tree Removal	$ 4,000
	Outfall Cleaning	$ 6,000

FIGURE 5 - 1
BELHAVEN CREEK – FIELD INVESTIGATION MAP



Considerable field investigations were conducted in areas of repetitive street flooding have been observed, reported by 311 call records in the vicinity of the following neighborhood streets: N. State, Woodrow Wilson, St Mary, Piedmont, Belmont, Laurel, and Peachtree.

5-3 IMMEDIATE MITIGATION MEASURE PROJECTS

Based on field observations the following project has been identified as a typical mitigation measure within the Belhaven Creek basin. Details of the budgetary cost estimated and estimated quantities can be found in Appendix 8 of this memorandum.

FIGURE 5 - 2
BELHAVEN CREEK – PHASE 1 IDENTIFIED IMMEDIATE MITIGATION MEASURES
N. STATE ST/WOODROW WILSON/ST MARY ST/ PIEDMONT ST/BELMONT ST/ LAUREL ST

Given the limited nature of our field investigations, absence of detailed survey and detailed hydraulic analysis, further investigation of repetitive area flooding within the basin, establishment of flow monitoring and a hydraulic model of the Belhaven Creek Drainage Basin is warranted prior to making further recommendations for specific immediate mitigation measure recommendations. It is recommended that the City proceed immediately with street cleaning and catch basin cleanout maintenance programs in these neighborhoods immediately to lessen the severity and occurrence of localized flooding in the area until at which time specific capacity improvement recommendations can be recommended.

5-4 NEAR TERM PROTECTION MEASURES

Based on field observations the following project has been identified as a typical mitigation measure within the Belhaven Creek basin. Details of the budgetary cost estimated and estimated quantities can be found in Appendix 8 of this memorandum.

FIGURE 5 - 3
BELHAVEN CREEK – NEAR TERM PROTECTION MEASURES
PEACHTREE ST - EAST AND WEST CHANNEL BANK STABILIZATION

FIGURE 5 - 4
BELHAVEN CREEK – NEAR TERM PROTECTION MEASURES
ST MARY ST / PIEDMONT ST / BELMONT ST / LAUREL ST CHANNEL IMPROVEMENTS

Further investigation, flow monitoring and hydraulic modeling of the Belhaven Creek Drainage Basin is warranted prior to making further recommendations for specific protection measures at this time.

5-5 LONG TERM CAPACITY IMPROVEMENT PROJECTS

As stated earlier development in the vicinity of N. State Street in and around the University Medical Center has dramatically increased stormwater runoff into downstream Belhaven neighborhoods. It is recommended that a combination of Stormwater detention and attenuation ponds be constructed in this vicinity to control the rate of runoff into the channel conveyance system Further investigation of the basin conditions is warranted prior to the initiation of preliminary design of recommended improvements. Details of the budgetary cost estimated and estimated quantities can be found in Appendix 8 of this memorandum

FIGURE 5 - 5
BELHAVEN CREEK – PHASE III IDENTIFIED LONG TERM IMPROVEMENT PROJECTS
N. STATE ST / E WOODROW WILSON AVE/ BELMONT ST / LAUREL ST
PROPOSED DETENTION / ATTENUATION PONDS

Further investigation, flow monitoring and hydraulic modeling of the Belhaven Creek Drainage Basin is warranted prior to making recommendations for specific long term conveyance capacity improvements at this time.

END OF SECTION 5

SECTION 6 IDENTIFIED REINVESTMENT NEEDS IN THE EUBANKS CREEK BASIN

6-1 DRAINAGE BASIN BACKGROUND AND DESCRIPTION

The Eubanks Creek Basin is completely developed primarily with residential land uses. Commercial uses are concentrated along State Street, Northview Drive and Meadowbrook Road, immediately east of the Illinois Central Railroad. This basin typifies the drainage problems confronting the City in its older, developed sectors. The main channel, in particular, winds through a highly developed area with flows restricted by structures infringing upon the flood plain and the channel. Trees and debris restrict the narrow drainageways, significantly impending normal runoff. Although extensive flood plain studies have not been made in the basin, it appears highly probable that a flood of the magnitude generated by a 50 -year storm would cause widespread damages particularly in the lower and middle reaches of the stream.

The 1973 study stated that the existing drainage structures along the main channel and its tributaries are grossly inadequate. Of the 44 structures in the basin 32 were found to have insufficient capacity to accommodate expected runoff from a 50-year storm. Drainage channels throughout the basin were also found to be inadequate. Of particular significance is the lack of sufficient rights-of -way along the channels to permit maintenance operations or to allow for future widening. The construction of a new channel of the required cross sectional area would entail the acquisition of developed properties at considerable costs. Channel changes to eliminate sharp bends in the creek are needed. Realignment of the channel also would entail acquisition of a number of buildings.

Channel improvements which must be undertaken if an efficient basin drainage network is to be evolved, should commence at the mouth of the creek and be continued upstream in increments generally conforming to a staged development. Deficient structures should be replaced along selected reaches of the stream at the same time channel improvements are made. The existing channels, although badly in need of cleaning and regular maintenance, are of insufficient capacity to handle runoff from storms that are likely to occur at relatively frequent intervals.

The following projects presented in this section are intended to be representative of the needs within the Eubanks Creek Drainage Basin and not an exhaustive listing of all the drainage needs. These projects presented herein are only selective in nature based on preliminary field investigations. Final project scopes and constructions costs may vary as conceptual and detailed design efforts dictate.

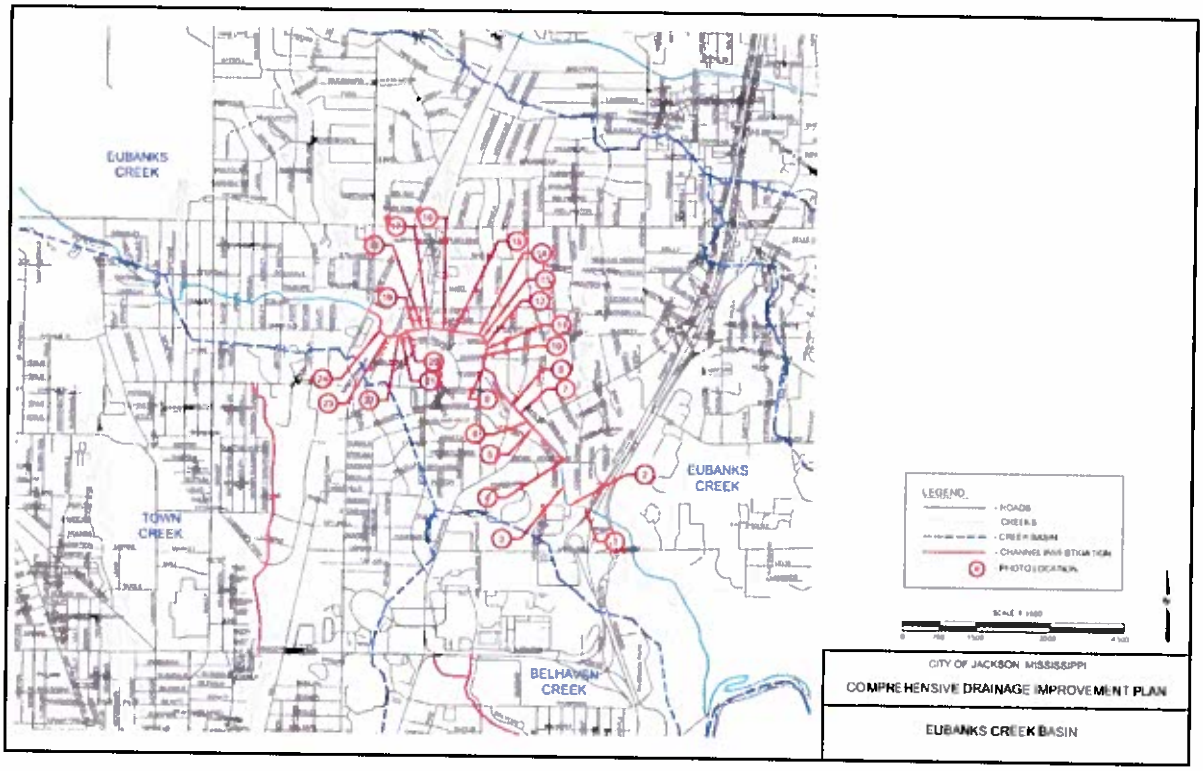
6-2 CONVEYANCE CHANNEL IMMEDIATE MAINTENANCE NEEDS

In December 2012, Chester field investigation teams canvassed 15,300 linear feet of channel inspecting 9 structure crossings, 20 utility crossings, 23 outfalls, 8 tributaries, and identified 3 areas of significant channel washout, 1 downed tree obstructing flow upstream of the I-55 frontage road, 4 areas of bank failure and 4 additional locations where debris in the channel was impacting channel capacity.

Refer to Figure 6-1 for the map of the extent of the field investigations in the Eubanks basin and Appendix 7, Page 7-2 for a detailed listing of the individual field findings.

Eubanks Conveyance Channel Improvements		$ 338,000
Rip-Rap Protection at Utility Crossings	$ 200,000	
Channel Debris Removal	$ 114,000	
Channel Tree Removal	$ 1,000	
Outfall Cleaning	$ 23,000	

FIGURE 6 - 1
EUBANKS CREEK – FIELD INVESTIGATION MAP



6-3 NEAR TERM PROTECTION MEASURE PROJECTS

As stated earlier 4 areas of bank failures were identified during field investigations. It is recommended that in the near term approximately 850 linear feet of channel bank near the Northview Drive Bridge be stabilized with gabion mat to stabilize the northeast and southwest banks after this section of channel has been cleared of debris.

FIGURE 6 - 2
EUBANKS CREEK –NEAR TERM PROTECTION MEASURES
NORTHVIEW DRIVE BRIDGE – BANK STABILIZATION

Further investigation, flow monitoring and hydraulic modeling of the Belhaven Creek Drainage Basin is warranted prior to making further recommendations for specific protection measures at this time.

6-4 LONG TERM CAPACITY IMPROVEMENT PROJECTS

For budgetary purposes it has been assumed that the excavation quantities required at this time are similar to those identified in the previous study. Additional channel survey and flow monitoring will be required prior to making specific long term capacity improvement projects within the Eubanks Creek Basin.

TABLE 6 - 1
PREVIOUSLY RECOMMENDED EUBANKS CREEK BASIN CHANNEL IMPROVEMENTS
SUMMARY OF ESTIMATED QUANTITIES AND COSTS

From. To	Estimated Excavation (Cu. Yd.)	Estimated 1973 Costs ($000)	Remarks
1 – River	253,000	190.1	Main Channel
11 – Channel	48,400	36.3	Tributary
22 – Channel	30.900	23.2	Tributary
30 – Channel	12,700	9.5	Tributary
37 – Channel	40,000	30.0	Tributary
42 – Channel	None		Tributary
TOTAL	**385,500**	**289.1**	

For budgetary purposes only it has been assumed that the excavation quantities required at this time are similar to those identified in the previous area wide study. Additional channel survey and flow monitoring will be required prior to making specific long term capacity improvement projects within the Eubanks Creek Basin.

Development of a detailed hydraulic model and hydrographic survey of the channel are warranted to confirm the required excavation quantities and to establish an updated hydraulic profile of the conveyance channel prior to replacement of any drainage structures to reflect the current level of development within the basin.

TABLE 6 - 2
PREVIOUSLY RECOMMENDED EUBANKS CREEK BASIN
REQUIRED DRAINAGE STRUCTURES AND 1973 ESTIMATED COSTS

Structure No.	Required Replacement Structure*	1973 Estimated Costs ($000)
3	C. B. (2) 8 x 8 x 30	7.2
4	C. B. 10 x 8 x 30	10.2
5	C. B. (2) 8 x 8 x 30	10.2
6	C. B. 12 x 10 x 30	10.2
7	C. B. 12 x 10 x 30	10.2
10	C. B. (2) 10 x 8 x 30	12.1
11	C. B. 8 x 8 x 30	6.4
12	C. B. (2) 8 x 6 x 30	7.3
13	C. B. (2) 8 x 6 x 30	7.3
15	C. B. (2) 8 x 8 x 60	15.4
16	C. B. (2) 10 x 8 x 60	18.6
20	C. Br. (4200)	105.0
21	C. Br. (2700)	67.5
22	C. B. (2) 5 x 6 x 30	5.7
23	C. B. 10 x 8 x 30	7.2
24	C. B. (2) 6 x 6 x 60	9.2
25	C. B. 10 x 8 x 60	9.2
26	C. B.10 x 8 x 30	7.2
27	C. B. 10 x 10 x 30	9.3
28	C. B. (2) 8 x 8 x 30	10.2
29	C. B. (2) 8 x 8 x 60	15.4
30	C. B. 8 x 6 x 60	6.6
31	C. B. 10 x 6 x 60	7.9
32	C. B. 8 x 8 x 60	9.2
33	C. Br. (3300)	82.5
34	C. Br. (3300)	82.5
35	C. Br. (6600)	165.0
37	C. B. 12 x 10 x 50	13.2
38	C. B. 12x 10 x 30	10.2
39	C. B. 14 x 10 x 50	14.7
40	C. Br.(2400)	60.0
41	C. Br.(4800)	120.0
TOTAL		**932.8**

C. B. - Concrete Box Culvert (w x ht. x in.)
C. Br. - Concrete Bridge (sq. ft. bridge deck)

C. P. - Concrete Pipe (diameter x in.)

Further investigation, flow monitoring and hydraulic modeling of the Eubank Creek Drainage Basin is warranted prior to making recommendations for specific long term conveyance capacity improvements at this time.

END OF SECTION 6

SECTION 7 IDENTIFIED REINVESTMENT NEEDS IN THE TOWN CREEK BASIN

7-1 DRAINAGE BASIN BACKGROUND AND DESCRIPTION

Town Creek originates in the northwestern sector of the Jackson and, at its lower end, drains the Jackson Central Business District. The central portion of the drainage basin is developed primarily with residential land uses consisting principally of structures built over seventy-five years ago. The drainage area at the Gallatin Street structure is 11 .3 square miles, approximately 20 per cent of the basin upstream from this point having storm sewers and improved channels." Town Creek has three principal tributaries: Airport Branch, West Branch, and East Branch. The drainage areas of these branches are 2.2, 1.8, and 2.0 square miles, respectively.

Town Creek drains the City's central business district, periodic flooding along the lower reaches of the stream has caused substantial damages to commercial properties and historically has attracted considerable attention. The lower reaches of the creek have been studied extensively by the U. S. Corps of Engineers and others in an attempt to alleviate flooding problems and to make better use of the land along its banks. Most of these studies have pointed to the apparent feasibility of relocating the creek from a point near Mill Street to its confluence with the Pearl River.

Most of the damage caused by flooding on the lower reaches of the stream has occured when locally heavy rains combine with moderate to high stages of the river. This is not the case, however, along the upper reaches of Town Creek. As a matter of record, virtually all of the land lying adjacent to the main stream as well as its three principal tributaries is subject to flooding after sustained heavy rainfall. Since most of Town Creek Basin is highly developed, with numerous instances of structures in proximity to or even in the channel, some property damage occurs with each flood. The causes of flooding along the upper reaches of the stream are obvious. In virtually all portions of the basin drainage channels are narrow and constricted by fences and structures. In many instances, the channels are constricted with trees, debris and undergrowth. Channel improvements and even routine maintenance have been hampered severely by the proximity of urban development. In addition to the inability of the drainage courses to handle storm water, a large portion of the structures throughout the basin are judged to be inadequate or marginal, at best.

The 1973 study report noted that as with most of the streams in the study area, particularly in the older, developed sections, drainage channels in the Town Creek Basin badly need cleaning and a program of regular maintenance. Based on the channel investigations performed in adjacent drainage basins it is anticipated that the Town Creek is currently in need of substantial cleaning and regular maintenance. While such a program would improve current flows considerably, massive channel improvements are needed to meet the demands of the drainage basin. Throughout the basin there are many instances of buildings intruding into drainage channels and infringing upon the flood plain, seriously impeding flood flows. In many areas, numerous structures must be acquired and removed.

7-2 CONVEYANCE CHANNEL IMMEDIATE MAINTENANCE NEEDS

Chester has not had the opportunity to conduct investigations of the conveyance channel in Town Creek. Specific recommendations for conveyance channel maintenance will be made after completion of field inspection surveys.

7-3 NEAR TERM PROTECTION MEASURE PROJECTS

Further investigation, flow monitoring and hydraulic modeling of the Town Creek Drainage Basin is warranted prior to making further recommendations for specific protection measures.

7-4 LONG TERM CAPACITY IMPROVEMENT PROJECTS

Further investigation, flow monitoring and hydraulic modeling of the Town Creek Drainage Basin is warranted prior to making recommendations for specific long term conveyance capacity improvements at this time.

END OF SECTION 7

SECTION 8 IDENTIFIED REINVESTMENT NEEDS IN THE LYNCH CREEK BASIN

8-1 DRAINAGE BASIN BACKGROUND AND DESCRIPTION

Lynch Creek originates in Hinds County immediately west of the Jackson City limits and flows southeasterly to a confluence with the Pearl River. The main stream and its principal tributary, entering at Charles Street, drain approximately 14 square miles. The basin is developed extensively with commercial properties along the lower three miles and residential properties in the stream's upper reaches. The main stream and its tributary are nine and three miles in length, respectively. Elevations along its course range from 240 to 410 feet, mean sea level.

In 1971 , the Corps of Engineers, U. S. Army, Mobile District analyzed the flood situation along Lynch Creek . The results of their analysis are contained in a report entitled " ***Flood Plain Information, Jackson, Mississippi, Lynch Creek***" and this report. According to the preceding report a flood which occurred on April 29, 1953 was the most severe flood of record on Lynch Creek. On this date a total of 4.85 inches of rainfall were recorded at the Hawkins Field gage with a maximum hourly concentration of 1.19 inches. Damage was reported to be extensive and U. S. Highway 80 was closed to traffic at Gallatin Street. Some 50 families were rescued from flood waters. It is noted that floods on Lynch Creek are of relatively short duration, with the Corps of Engineers estimating that a storm with an average frequency of occurrence of once in 100 years (hundred year storm) would cause the creek to remain out of its banks about four hours at U. S. Highway 80. For analysis purposes the Corps of Engineers has designated a hundred year storm as an "intermediate regional flood". In the 1973 study the Corps of Engineers reported that a number of main channel structures are of insufficient size to handle runoff in the event of an intermediate regional flood. These include structures at U. S. Highway 80, Terry Road, West Capital Street, and St. Charles Street. In such an event numerous smaller structures would also prove to be inadequate.

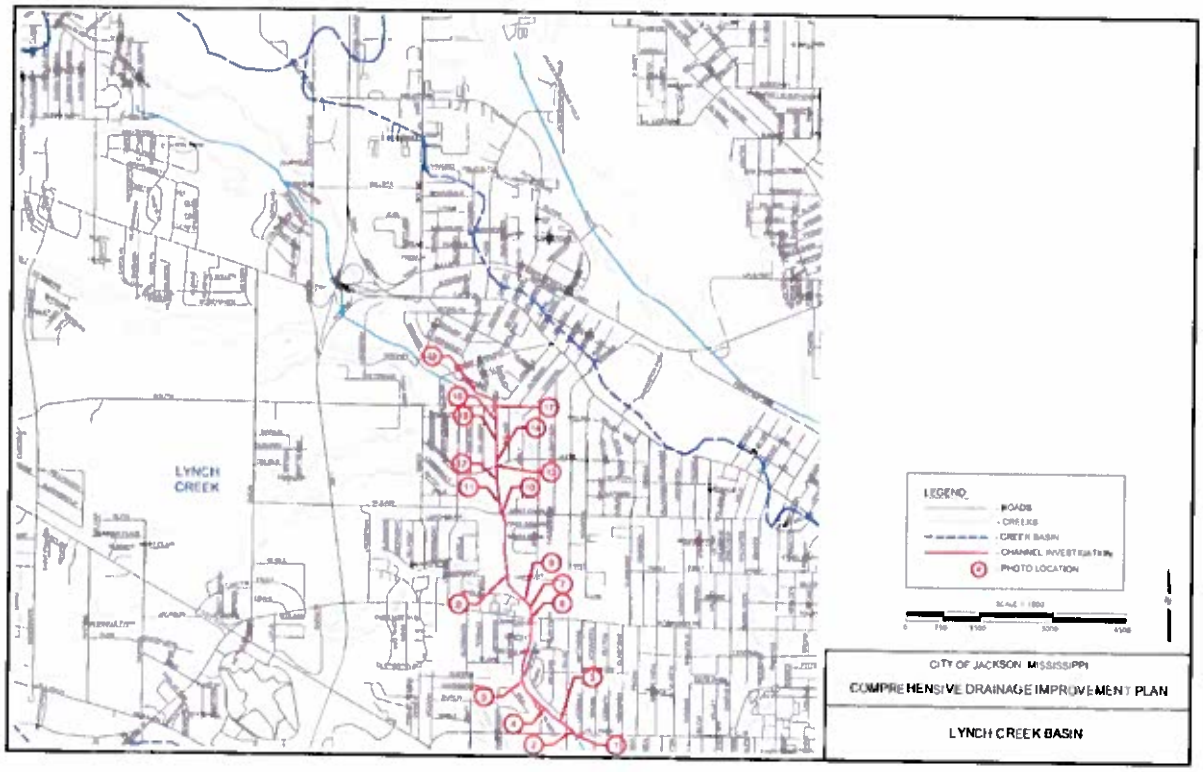
8-2 CONVEYANCE CHANNEL IMMEDIATE MAINTENANCE NEEDS

In December 2012, Chester field investigation teams canvassed 12,500 linear feet of channel inspecting 8 structure crossings, 9 utility crossings, 24 outfalls, 10 tributaries, and identified 4 areas of significant channel washout, 3 downed trees obstructing channel flow, 1 area of bank failure and 7 additional locations where debris in the channel was impacting channel capacity.

Refer to Figure 8-1 for the map of the extent of the field investigations in the Eubanks basin and Appendix 7, Page 7-2 for a detailed listing of the individual field findings.

Lynch Creek Conveyance Channel Maintenance		$ 562,000
Rip-Rap Protection at Utility Crossings	$ 110,000	
Channel Debris Removal	$ 425,000	
Channel Tree Removal	$ 3,000	
Outfall Cleaning	$ 24,000	

FIGURE 8 - 1
LYNCH CREEK – FIELD INVESTIGATION MAP



In addition to the above channel investigations a second investigation team surveyed several neighborhoods which have experience neighborhood flooding to determine immediate mitigation measures to be undertaken by the city to minimize the loss of property damage to residents and businesses along the creek until at which time detailed engineering review of the drainage basin under its current and projected development can be analyzed further.

8-3 IMMEDIATE MITIGATION MEASURES

Neighborhood street flooding investigations identified the need for several improvements to mitigate ongoing flooding in the Westland Plaza, West End Heights, Sylvan Glen Mathew Estates and Pecan Park Neighborhoods. Figure 8-2 illustrates improvements along the Lynch Creek Channel in the vicinity of St Charles Street, Robinson Road, Lynch Street and Primos Avenue.

Lynch Creek Drainage Basin Immediate Mitigation Measures		$ 887,000
Conveyance Channel Improvements		
Casa Grande 2 ft Localized Protective Earthen Berm	$ 36,000	
Casa Grande Catchment Basin Installation	$ 30,000	
Hemingway Cr/Ellis Ave Bridge 2 ft Localized Protective Earthen Berm	$ 425,000	
Channel Debris Removal	$ 50,000	
Primos Avenue at Oakmont Drive 500 linear ft Rip Rap Channel Protection	$ 231,000	

FIGURE 8 – 2
LYNCH CREEK BASIN IMMEDIATE MITIGATION MEASURES
CASA GRANDE - HEMMINGWAY CIRCLE CHANNEL IMPROVEMENTS

Queen Eleanor Lane Street Flooding

Queen Eleanor Lane - 2 ft Localized Protective Earthen Berm	$	50,000
Queen Eleanor Lane Channel Debris Removal	$	10,000

FIGURE 8 – 3
LYNCH CREEK BASIN IMMEDIATE MITIGATION MEASURES
QUEEN LAND SUBDIVISION CHANNEL IMPROVEMENTS

John Lynch Street Flooding

Hattiesburg and Tunica Streets Storm Drain and Inlet Replacements, Curb, Gutter Sidewalk and Street Paving Repairs $ 55,000

FIGURE 8 – 4
LYNCH CREEK BASIN IMMEDIATE MITIGATION MEASURES
JOHN LYNCH STREET DRAINAGE IMPROVEMENTS

8-4 NEAR TERM PROTECTION MEASURE PROJECTS

Lynch Creek Drainage Basin Near-Term Protection Measures		$ 2,775,000
Conveyance Channel Protection Projects		
St Charles/Robinson Road Lynch Creek Channel Bank Stabilization Restoration Project	$1,195,000	
Robinson Road/Lynch Street Lynch Creek Channel Bank Stabilization Restoration Project	$1,300,000	
Queen Eleanor Lane Street Flooding		
Queen Eleanor Lane Catchment Basin Installation	$ 30,000	
Queen Eleanor Lane Channel Bank Stabilization	$ 250,000	

Further investigation, flow monitoring and hydraulic modeling of the Lynch Creek Drainage Basin is warranted prior to making recommendations for specific protection measures at this time.

8-5 LONG TERM CAPACITY IMPROVEMENT PROJECTS

Lynch Creek Drainage Basin Long Term Capacity Improvement Projects		$ 1,322,000
Conveyance Channel Capacity Improvement Projects		
St Charles/Lynch Street 50/100 Yr Storm Channel Dredging	$ 200,000	
Primos Ave 8 Acre Detention/Attenuation Pond	$1,122,000*	

- *Excludes Land Acquisition Costs*

Further investigation, flow monitoring and hydraulic modeling of the Lynch Creek Drainage Basin is warranted prior to making recommendations for specific long term conveyance capacity improvements at this time.

END OF SECTION 8

SECTION 9 IDENTIFIED REINVESTMENT NEEDS IN THE PURPLE CREEK BASIN

9-1 DRAINAGE BASIN BACKGROUND AND DESCRIPTION

The 1973 study noted that many of the structures on the main channel as well as many of the structures situated on the tributaries of Purple Creek cannot adequately handle runoff from a 50-year storm. Overall, 17 of the 31 structures on Purple Creek were inadequate in terms of the criteria employed for analysis.

The Purple Creek Basin lies in the path of a fully developed residential area. The main channel as well as the various tributaries of Purple Creek are, for the most part, grossly inadequate, and new properly sized channels are needed throughout the basin. It was recommended that the new channels follow the existing drainage courses, and additional easements be acquired by the City to permit construction of facilities to the proper depths and widths.

In the 1973 study the estimated discharge (Q) based on a 50-year storm, and the approximate required channel section based on the computed Q at specific structures is presented below, however should be taken not to utilize the data presented herein for final design purposes. The estimated discharges and channels were based on general assumptions, particularly with regard to stream gradients, maximum allowable velocities, and land available for rights-of-way, and final design should be predicated on detailed surveys that exceed the complexity of the investigations called for in this technical memorandum.

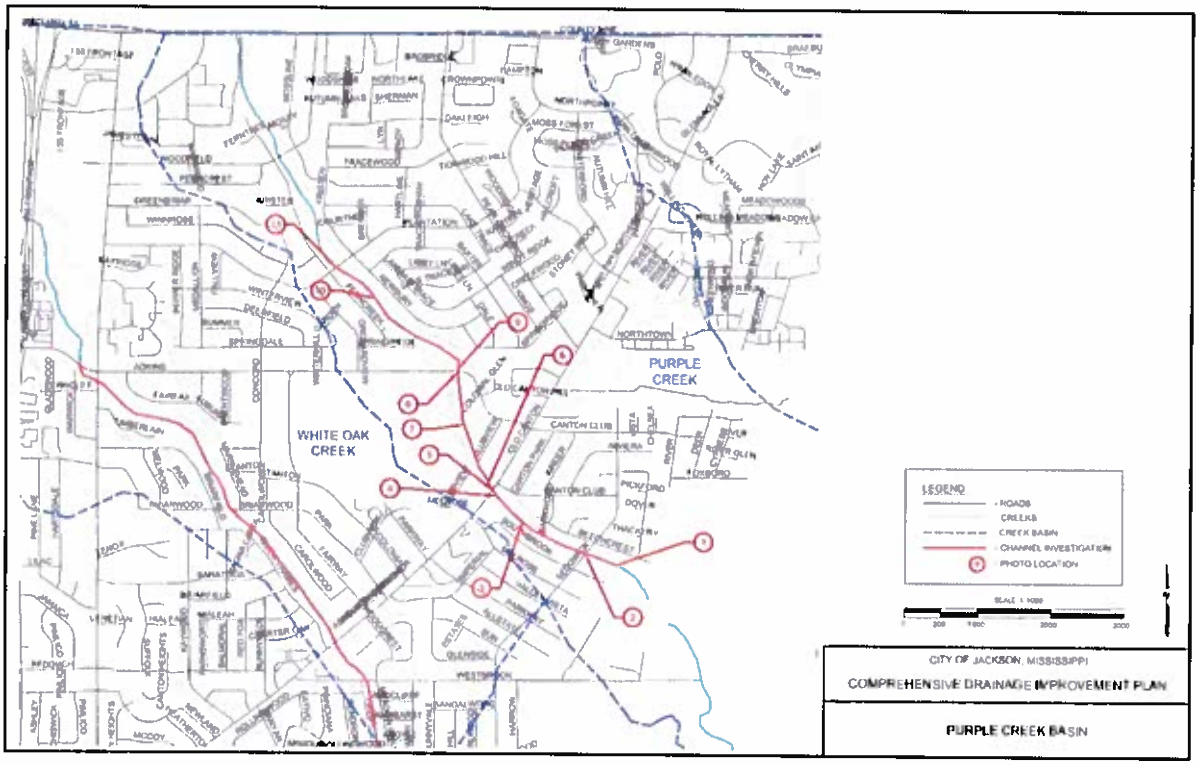
9-2 CONVEYANCE CHANNEL IMMEDIATE MAINTENANCE NEEDS

In December 2012, Chester field investigation teams canvassed 7,500 linear feet of channel inspecting 5 structure crossings, 8 utility crossings, 21 outfalls, 1 tributary, and identified 8 areas of significant channel washout, 1 downed tree obstructing channel flow, 3 areas of bank failure and 4 additional locations where debris in the channel was impacting channel capacity. Much of the Purple Creek channel is clogged with undergrowth, trees, and in many instances debris and litter from unauthorized dumping of solid wastes.

Purple Creek Conveyance Channel Maintenance		$ 203,000
Rip-Rap Protection at Utility Crossings	$ 96,000	
Channel Debris Removal	$ 85,000	
Channel Tree Removal	$ 1,000	
Outfall Cleaning	$ 21,000	

Refer to Figure 9-1 for the map of the extent of the field investigations in the Purple Creek drainage basin and Appendix 7, Page 7-2 for a detailed listing of the individual field findings.

FIGURE 9 - 1
PURPLE CREEK – FIELD INVESTIGATION MAP



9-3 IMMEDIATE MITIGATION MEASURES

Neighborhood street flooding investigations identified the need for the installation of new stormwater inlet catch basin and street paving adjustment on Riveria Street. The capital cost of the project is currently estimated at $ 15,000.

FIGURE 9 – 2
PURPLE CREEK BASIN IMMEDIATE MITIGATION MEASURES
RIVERIA STREET DRAINAGE CATCHMENT BASIN

9-4 NEAR TERM PROTECTION MEASURE PROJECTS

Further investigation, flow monitoring and hydraulic modeling of the Purple Creek Drainage Basin is warranted prior to making further recommendations for specific protection measures.

9-5 LONG TERM CAPACITY IMPROVEMENT PROJECTS

Further investigation, flow monitoring and hydraulic modeling of the Purple Creek Drainage Basin is warranted prior to making recommendations for specific long term conveyance capacity improvements at this time.

END OF SECTION 9

SECTION 10 IDENTIFIED REINVESTMENT NEEDS IN THE WHITE OAK CREEK BASIN

10-1 DRAINAGE BASIN BACKGROUND AND DESCRIPTION

From its headwaters in south central Madison County, White Oak Creek flows southeastward some seven miles to a confluence with Hanging Moss Creek, draining an area of approximately 7.8 square miles. Along the upper reaches of the creek, northwest of Interstate Highway 55, substantial commercial and residential development has occurred since the previous area drainage study was performed in 1973. Between I-55 and its mouth, the creek traverses an area developed with well established subdivisions. In this area it seems probable that damage to nearby properties would occur after sustained heavy rainfall.

In terms of capacity, the channel and most of the structures along White Oak Creek and its tributaries were deemed adequate in the 1973 study. Even though the channel was designed to handle runoff generated by a 50-year storm, flows are severely inhibited by willow trees continuing to grow in the stream bed and covering the banks. In some reaches of the creek, flows appear to have been reduced by fifty percent or more as a result of this condition.

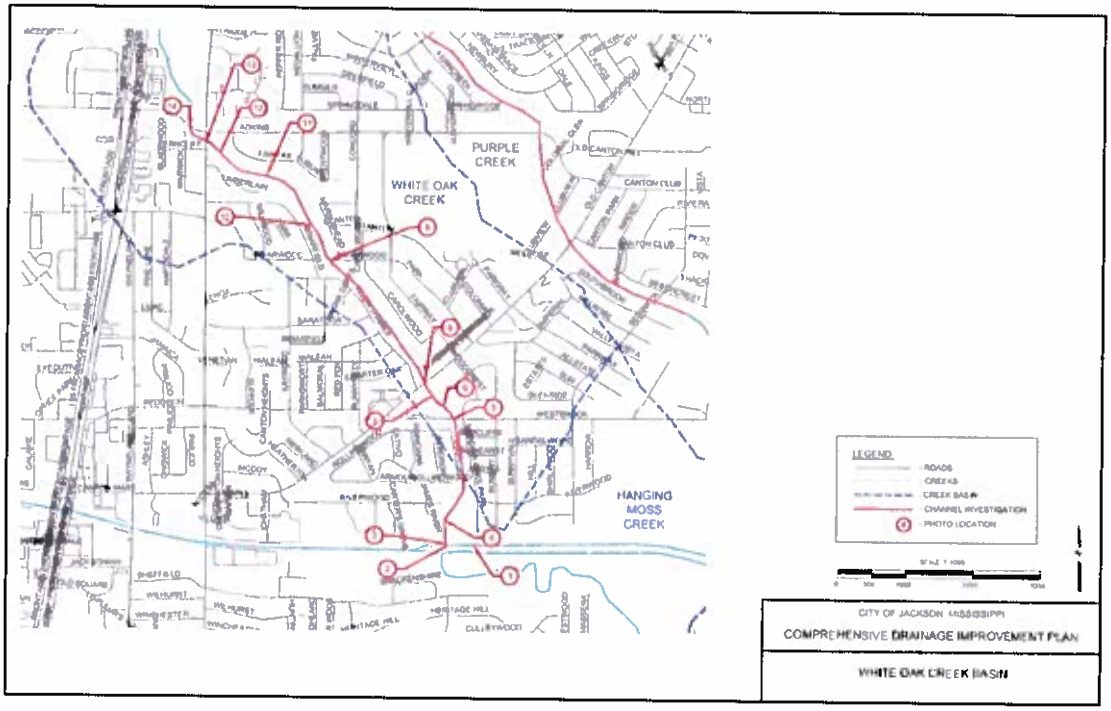
10-2 CONVEYANCE CHANNEL IMMEDIATE MAINTENANCE NEEDS

In December 2012, Chester field investigation teams canvassed 9,300 linear feet of channel inspecting 4 structure crossings, 8 utility crossings, 29 outfalls, 8 tributary, and identified 13 areas of significant channel washout, 3 downed trees obstructing channel flow, 9 areas of bank failure, 1 beaver dam and 6 additional locations where debris in the channel was impacting channel capacity. Much of the White Oak Creek channel is clogged with undergrowth, trees, and in many instances debris and litter.

White Oak Conveyance Channel Maintenance		$ 274,000
Rip-Rap Protection at Utility Crossings	$ 192,000	
Channel Debris Removal	$ 50,000	
Channel Tree Removal	$ 3,000	
Outfall Cleaning	$ 29,000	

Refer to Figure 10-1 for the map of the extent of the field investigations in the White Oak Creek drainage basin and Appendix 7 for a detailed listing of the individual field findings.

FIGURE 10 - 1
WHITE OAK CREEK – FIELD INVESTIGATION MAP



10-3 IMMEDIATE MITIGATION MEASURES

Based on channel field investigation findings the team has identified one channel restoration project in the vicinity of at Colonial Circle west of Club View Drive. It is recommended that approximately 100 linear feet of the White Oak Creek channel banks be lined with gabion baskets to stabilize the channel slope. The capital cost of the project is currently estimated at $ 28,000.

FIGURE 10 – 2
WHITE OAK CREEK BASIN IMMEDIATE MITIGATION MEASURES
COLONIAL CIRLE CONVEYANCE CHANNEL BANK STABILIZATION PROJECT

Neighborhood street flooding field investigations identified the need for and a possible location for a 0.6 acre Stormwater detention/attenuation pond to reduce the severity of flash flooding during 100 year storm events prior to the creation of long term channel improvements. It is proposed that the storm water detention pond be located adjacent to White Oak Creek in the vicinity Old Canton Road. The capital cost of the project is currently estimated at $ 120,000.

FIGURE 10 – 3
WHITE OAK CREEK BASIN IMMEDIATE MITIGATION MEASURES
OLD CANTON ROAD STORM WATER DETENTION/ATTENUATION POND

10-4 NEAR TERM PROTECTION MEASURE PROJECTS

Further investigation, flow monitoring and hydraulic modeling of the White Oak Creek Drainage Basin is warranted prior to making further recommendations for specific protection measures.

10-5 LONG TERM CAPACITY IMPROVEMENT PROJECTS

Further investigation, flow monitoring and hydraulic modeling of the White Oak Creek Drainage Basin is warranted prior to making recommendations for specific long term conveyance capacity improvements at this time.

END OF SECTION 10

SECTION 11 IDENTIFIED REINVESTMENT NEEDS IN THE HANGING MOSS CREEK BASIN

11-1 DRAINAGE BASIN BACKGROUND AND DESCRIPTION

Hanging Moss Creek originates in the southwest corner of Madison County and follows a southeasterly course, through the northeast Jackson, to its confluence with the Pearl River. Most of the area traversed by the creek is residential in character, consisting of many high quality homes. For many years Hanging Moss Creek flooded rather frequently causing damage to properties, particularly in the portion of the basin that lies west of the Illinois Central Railroad.

Extensive channel improvements were completed in the mid 1970's that greatly reduced the threat of flooding throughout the basin at that time. Most of the major structures along Hanging Moss Creek also are adequate, including the bridges over the lower reaches of the stream. The recent 311 call records indicate the need for inlet catchbasin cleaning throughout the drainage basin in order to minimized localized street flooding issues.

In 1973 it was identified that a principal problem existed at Structure 19 which carries the creek under the Illinois Central Railroad. Here the existing concrete arch (119'x 32') was recommended to be replaced with a trestle (130' x 30' x 20'). Also Structure 20, under old Highway 51 immediately east of the railroad had inadequate capacity and was recommended for replacement at that time. These two structures were envisioned to reduce greatly the threat of flooding in the upper portion of the basin, west of the Illinois Central Railroad. The lower portion of Hanging Moss Creek Basin, east of the Illinois Central Railroad, is also highly developed. The upper sector is also fully developed.

11-2 CONVEYANCE CHANNEL IMMEDIATE MAINTENANCE NEEDS

Chester Engineers has not had the opportunity to conduct channel investigations to determine the condition nor adequacy of drainage structures and the channel conditions at this point in time. This memorandum has been limited to make recommendations based on of street flooding investigations in March of 2013 and 311 call data at this time.

Hanging Moss Conveyance Channel Maintenance	$	38,250
Channel Debris Removal	$ 38,250	

11-3 IMMEDIATE MITIGATION MEASURES

Channel field investigations and a detailed review of the existing storm water conveyance infrastructure and the establishment of flow monitoring and hydraulic modeling of the Hanging Moss Creek Drainage Basin is warranted prior to making further recommendations for specific mitigation measures.

11-4 NEAR TERM PROTECTION MEASURE PROJECTS

Based on neighborhood street flooding investigation findings the team has identified one channel restoration project in the vicinity of Cooper Road Bridge. It is recommended that approximately 100 linear feet of the Hanging Moss Creek channel banks be lined with gabion baskets to stabilize the channel slope. The capital cost of the project is currently estimated at $ 61,000.

FIGURE 11 – 1
HANGING MOSS CREEK BASIN NEAR TERM PROTECTION MEASURES
LIVINGSTON ROAD CONVEYANCE CHANNEL BANK STABILIZATION PROJECT

Further investigation, flow monitoring and hydraulic modeling of the Hanging Moss Creek Drainage Basin is warranted prior to making further recommendations for specific protection measures at this time.

11-5 LONG TERM CAPACITY IMPROVEMENT PROJECTS

Further investigation, flow monitoring and hydraulic modeling of the Hanging Moss Creek Drainage Basin is warranted prior to making recommendations for specific long term conveyance capacity improvements at this time.

END OF SECTION 11

SECTION 12 IDENTIFIED REINVESTMENT NEEDS IN THE CANY CREEK BASIN

12-1 DRAINAGE BASIN BACKGROUND AND DESCRIPTION

Cany Creek heads in east central Hinds county near the intersection of McRaven and Maddox Roads, in southwest Jackson. It flows southeastward for about nine miles to its confluence with the Pearl River. Where there is substantial vacant land within the basin, the creek traverses numerous areas that are highly developed, primarily with residential and related uses. Although the Cany Creek channel and most of its principal structures appear to be adequate, on the basis of field observations, there are known instances of flooding in certain sectors.

The most severe flood of record on Cany Creek occurred on June 1, 1967, resulting in some damage to adjacent properties. However, since 1967 substantial channel improvements have been made along the lower reaches of the stream, with an attendant reduction in the probability of flooding in this sector. These improvements were made by Hinds County and local interests and there are no Federal flood control projects existing or anticipated for Cany Creek. It is noted, however, that the lower reaches of the creek flood independently of local storms during high stages of the Pearl River.

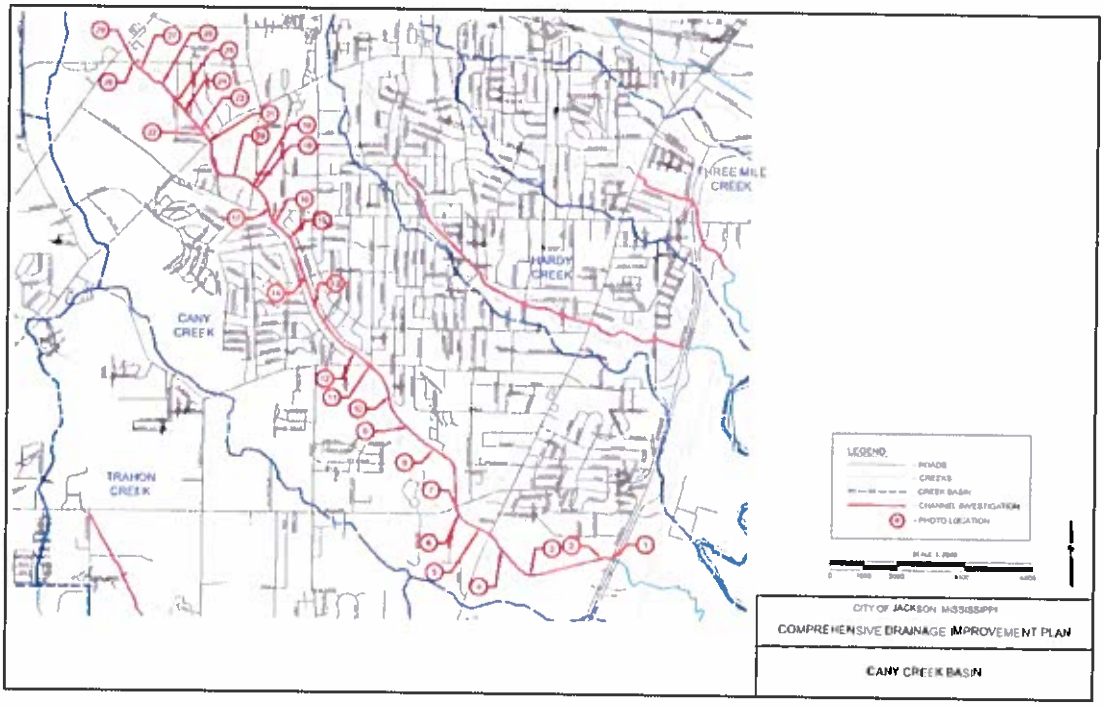
12-2 CONVEYANCE CHANNEL IMMEDIATE MAINTENANCE NEEDS

In December 2012, Chester field investigation teams canvassed 25,000 linear feet of channel inspecting 12 structure crossings, 32 utility crossings, 24 outfalls, 21 tributary, and identified 9 areas of significant channel washout,1 area of rip-rap failure, 17 downed trees obstructing channel flow, 7 areas of bank failure, 2 beaver dams and 9 additional locations where debris in the channel was impacting channel capacity. Much of the Cany Creek channel is clogged with undergrowth, trees, and in many instances debris and litter.

Cany Creek Conveyance Channel Maintenance		$ 1,294,000
Rip-Rap Protection at Utility Crossings	$ 253,000	
Channel Debris Removal	$1,000,000	
Channel Tree Removal	$ 17,000	
Outfall Cleaning	$ 24,000	

Refer to Figure 12-1 for the map of the extent of the field investigations in the Cany Creek drainage basin and Appendix 7 for a detailed listing of the individual field findings.

FIGURE 12 - 1
CANY CREEK – FIELD INVESTIGATION MAP



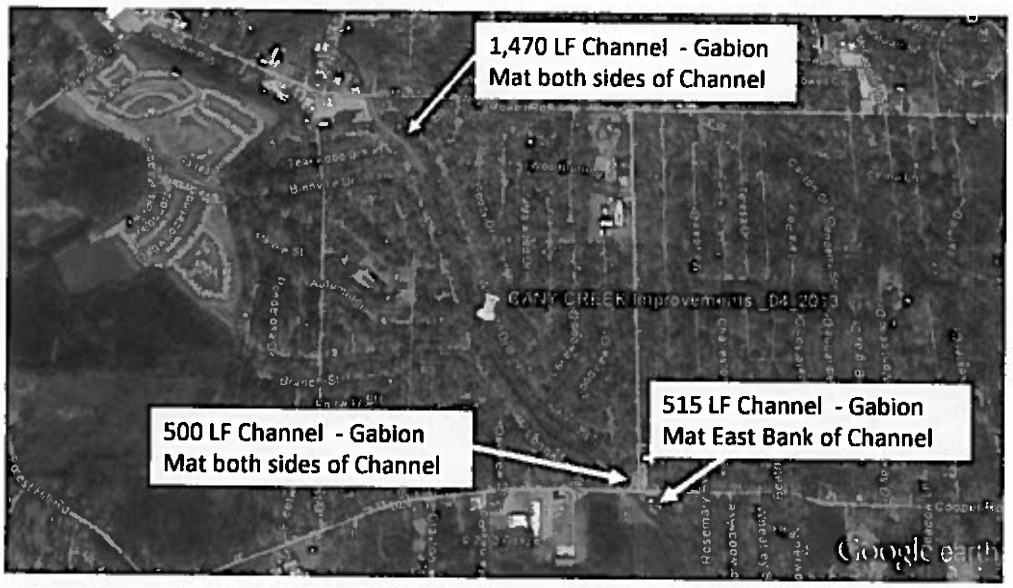
12-3 IMMEDIATE MITIGATION MEASURES

Further review of the existing storm water conveyance infrastructure and the establishment of flow monitoring and hydraulic modeling of the Cany Creek Drainage Basin is warranted prior to making recommendations for specific localized flood mitigation measures.

12-4 NEAR TERM PROTECTION MEASURE PROJECTS

Based on channel field investigation findings the team has identified two channel restoration projects in the vicinity of Cooper Road Bridge and the McDowell Road bridge. It is recommended that approximately 1,985 linear feet of the Cany Creek channel banks be lined with gabion mats to restore their design slopes. The capital cost of the project is currently estimated at $2,938,000.

FIGURE 12 – 2
CANY CREEK BASIN NEAR TERM PROTECTION MEASURES
COOPER ROAD BRIDGE, BIENVILLE ROAD AND MCDOWELL ROAD BRIDGE
VARIOUS CONVEYANCE CHANNEL BANK STABILIZATION PROJECTS



Further investigation, flow monitoring and hydraulic modeling of the Cany Creek Drainage Basin is warranted prior to making further recommendations for specific protection measures

12-5 LONG TERM CAPACITY IMPROVEMENT PROJECTS

Further investigation, flow monitoring and hydraulic modeling of the Cany Creek Drainage Basin is warranted prior to making recommendations for specific protection measures or long term improvements at this time.

END OF SECTION 12

SECTION 13 IDENTIFIED REINVESTMENT NEEDS IN THE BOGUE CHITTO CREEK BASIN

13-1 DRAINAGE BASIN BACKGROUND AND DESCRIPTION

Bogue Chitto Creek originates in the northwest corner of the Jackson and flows generally northwestward across the southwest corner of Madison County into the Big Black River. Current development in the basin consists of scattered residential and commercial uses along U.S. Highway 49 and the Presidential Hills Subdivision adjacent to a principal tributary of Bogue Chitto Creek

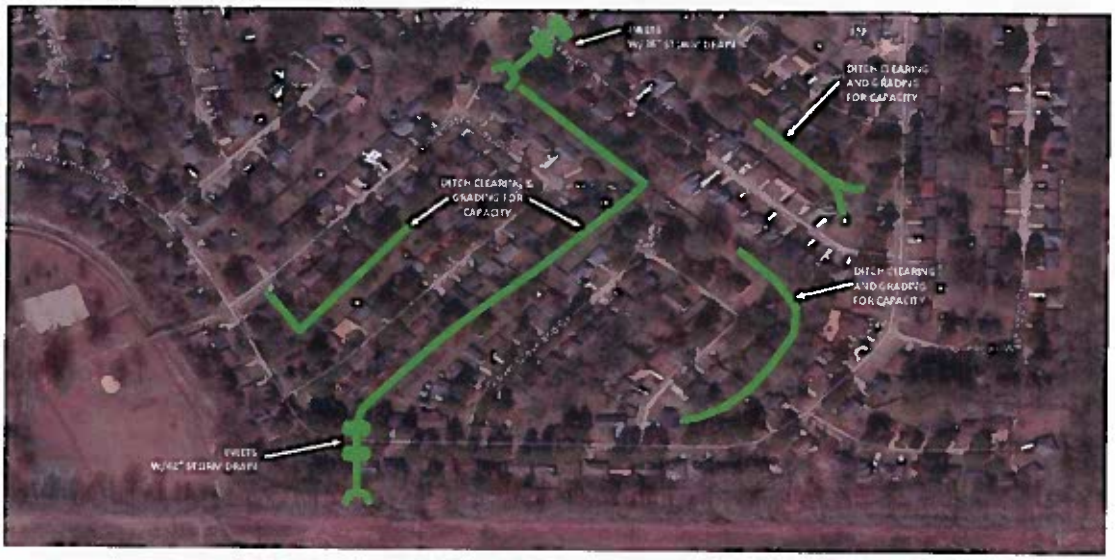
13-2 CONVEYANCE CHANNEL IMMEDIATE MAINTENANCE NEEDS

Specific recommendations for conveyance channel maintenance will be made after completion of field inspection surveys.

13-3 IMMEDIATE MITIGATION MEASURES

Based on neighborhood flooding field investigation findings our team has identified improvements to the Presidential Hills Subdivision to reduce significant flood by regrading the existing drainage ditches, replacement of several undersized storm drains and inlets with flood prone areas. The capital cost of the project is currently estimated at $ 100,000.

FIGURE 13 – 1
BOGUE CHITTO CREEK BASIN
IMMEDIATE AND NEAR TERM MITIGATION MEASURES
PRESIDENTIAL HILLS SUBDIVISION
DRAINAGE DITCH IMPROVEMENTS PROJECT



Further review of the existing storm water conveyance infrastructure and the establishment of flow monitoring and hydraulic modeling of the Bogue Chitto Creek Drainage Basin is warranted prior to making recommendations for specific localized flood mitigation measures

13-4 NEAR TERM PROTECTION MEASURE PROJECTS

Field investigation findings identified the need for the installation of a new catchment basin and 42" storm drain between William McKinley Drive and Grover Cleveland Circle in the Presidential Hills Subdivision to reduce significant flooding on Abraham Lincoln Drive. The capital cost of the project is currently estimated at $ 30,000. Refer to Figure 13-1.

Further investigation, flow monitoring and hydraulic modeling of the Bogue Chitto Creek Drainage Basin is warranted prior to making further recommendations for specific protection measures

13-5 LONG TERM CAPACITY IMPROVEMENT PROJECTS

Based on neighborhood flooding field investigation findings our team has identified improvements to the Presidential Hills Subdivision to reduce significant flood by reconstructing the select streets, installation of new curbs and storm inlets and drain and ditch improvements. The selected streets are William McKinley Circle, James Garfield Circle, Grover Cleveland Circle, Abraham Lincoln Drive. The capital cost of the project is currently estimated at $3,000,000.

FIGURE 13 – 2
BOGUE CHITTO CREEK BASIN LONG TERM IMPROVEMENTS
DRAINAGE CONVEYANCE SYSTEM UPGRADES

Further investigation, flow monitoring and hydraulic modeling of the Bogue Chitto Creek Drainage Basin is warranted prior to making recommendations for long term capacity improvements at this time.

END OF SECTION 13

SECTION 14 IDENTIFIED REINVESTMENT NEEDS IN THE HARDY CREEK BASIN

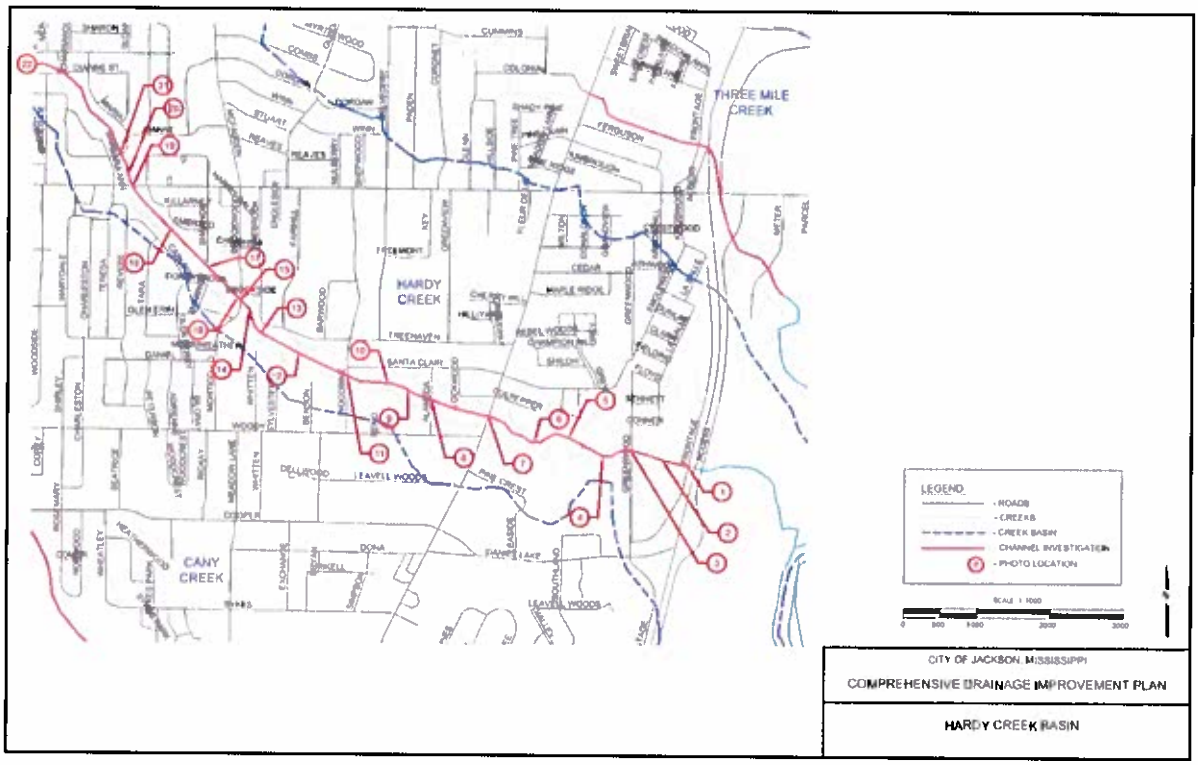
14-1 DRAINAGE BASIN BACKGROUND AND DESCRIPTION

Hardy Creek is a relatively small stream originating in south Jackson, south of Interstate Highway 20. Periodic flooding occurs near the mouth of the stream during high stages of the Pearl River and in the upper reaches of the basin. Property damage in the lower basin is very minor, however, rapid runoff of storm water combined with inadequate drainage structures causes periodic damage to properties in the upper basin.

14-2 CONVEYANCE CHANNEL IMMEDIATE MAINTENANCE NEEDS

In December 2012, Chester field investigation teams canvassed 11,300 linear feet of channel inspecting 8 structure crossings, 12 utility crossings, 24 outfalls, 11 tributary, and identified 2 areas of significant channel washout, 2 areas of rip-rap failure, 14 downed trees obstructing channel flow, 8 areas of bank failure, 2 beaver dams and 13 additional locations where debris in the channel was impacting channel capacity. Much of the Hardy Creek channel is clogged with undergrowth, trees, and in many instances debris and litter as noted above. Refer to Figure 14-1 for the map of the extent of the field investigations in the Cany Creek drainage basin and Appendix 7 for a detailed listing of the individual field findings.

FIGURE 14 - 1
HARDY CREEK – FIELD INVESTIGATION MAP



Hardy Creek Conveyance Channel Maintenance		$ 232,000
Rip-Rap Protection at Utility Crossings	$ 64,000	
Channel Debris Removal	$ 130,000	
Channel Tree Removal	$ 14,000	
Outfall Cleaning	$ 24,000	

14-3 IMMEDIATE MITIGATION MEASURES

Further review of the existing storm water conveyance infrastructure and the establishment of flow monitoring and hydraulic modeling of the Hardy Creek Drainage Basin is warranted prior to making recommendations for specific localized flood mitigation measures.

14-4 NEAR TERM PROTECTION MEASURE PROJECTS

Based on channel field investigation findings our team has identified one channel restoration project in the vicinity of Terry Road. It is recommended that approximately 200 linear feet of the east channel banks be lined with gabion mats to restore them to a 2:1 slope. The capital cost of the project is currently estimated at $154,000.

FIGURE 14 – 2
HARDY CREEK BASIN NEAR TERM PROTECTION MEASURES
ALAMEDA DRIVE BRIDGE CONVEYANCE CHANNEL BANK STABILIZATION PROJECT

Further investigation, flow monitoring and hydraulic modeling of the Hardy Creek Drainage Basin is warranted prior to making further recommendations for specific protection measures

14-5 LONG TERM CAPACITY IMPROVEMENT PROJECTS

Further investigation, flow monitoring and hydraulic modeling of the Hardy Creek Drainage Basin is warranted prior to making recommendations for specific protection measures or long term improvements at this time.

END OF SECTION 14

SECTION 15 IDENTIFIED REINVESTMENT NEEDS IN THE THREE MILE CREEK BASIN

15-1 DRAINAGE BASIN BACKGROUND AND DESCRIPTION

Originating in the southern portion of Jackson just south of Interstate Highway 20, the Three Mile Creek Basin is a relatively small stream some three miles in length. Three Mile Creek and its principal tributary drain an area that is fully developed for the most part. A large shopping center lies adjacent to the creek in the lower basin between Terry Road and Interstate Highway 55.

For the most part periodic flooding and subsequent damages to existing properties occuring periodically, particularly in the upper reaches of the basin. Although much of the channel in the upper basin is paved, the stream in its upper reaches traverses a very hilly area and storm water runoff is quite rapid. As a consequence rather frequent flooding of yards and carports in the area occurs. In addition periodic flooding also occurs at the mouth of the creek during high stages of the Pearl River.

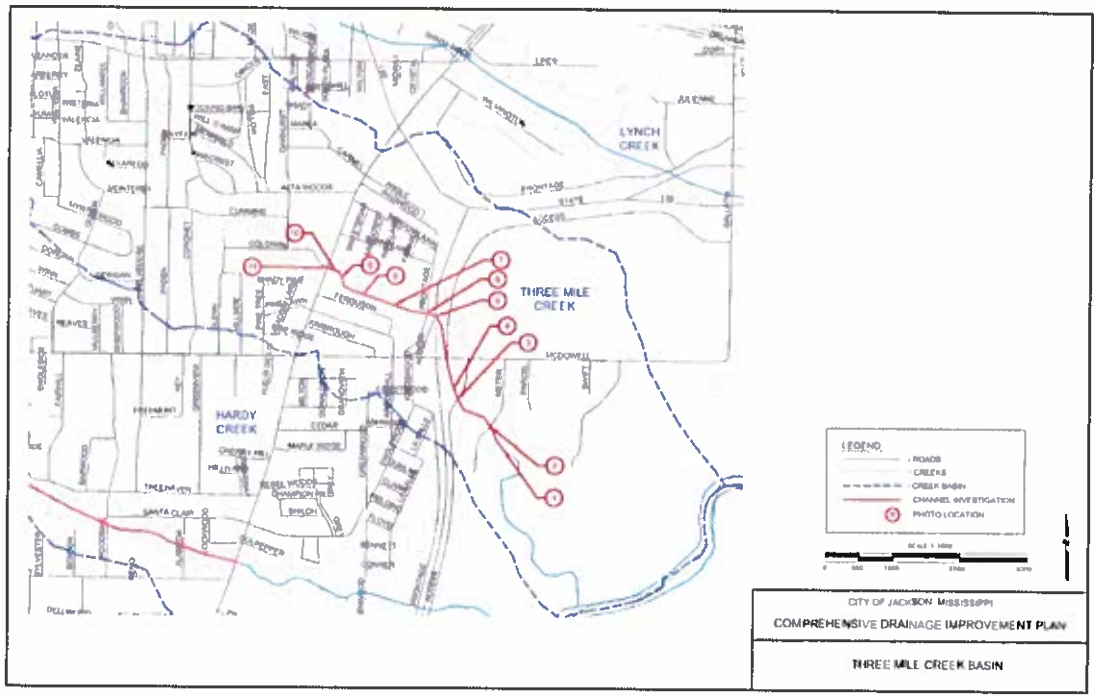
15-2 CONVEYANCE CHANNEL IMMEDIATE MAINTENANCE NEEDS

In December 2012, Chester field investigation teams canvassed 5,000 linear feet of channel inspecting 5 structure crossings, 8 utility crossings, 8 outfalls, 3 tributary, and identified 4 areas of significant channel washout, 1 downed tree obstructing channel flow, 4 areas of bank failure, 1 beaver dam and 6 additional locations where debris in the channel was impacting channel capacity. Much of the Three Mile Creek channel is clogged with undergrowth, trees, and in many instances debris and litter as noted above.

Three Mile Conveyance Channel Maintenance		$ 638,000
Rip-Rap Protection at Utility Crossings	$ 54,000	
Channel Debris Removal	$ 575,000	
Channel Tree Removal	$ 1,000	
Outfall Cleaning	$ 8,000	

Refer to Figure 15-1 for the map of the extent of the field investigations in the Three Mile Creek drainage basin and Appendix 7 for a detailed listing of the individual field findings.

FIGURE 15 - 1
THREE MILE CREEK – FIELD INVESTIGATION MAP



15-3 IMMEDIATE MITIGATION MEASURES

Given the limited nature of our field investigations, further investigation of repetitive area flooding within the basin, establishment of flow monitoring and a hydraulic model of the Three Mile Creek Drainage Basin is warranted prior to making recommendations for specific immediate mitigation measure recommendations at this time.

15-4 NEAR TERM PROTECTION MEASURE PROJECTS

Based on channel field investigation findings our team has identified one channel restoration project in the vicinity of Terry Road. It is recommended that approximately 630 linear feet of the east and west channel banks be lined with gabion mats to restore them to a 2:1 slope. The capital cost of the project is currently estimated at $1,382,000.

FIGURE 15 – 2
THREE MILE BASIN NEAR TERM PROTECTION MEASURES
TERRY ROAD CONVEYANCE CHANNEL BANK STABILIZATION PROJECT

Further investigation, flow monitoring and hydraulic modeling of the Three Mile Creek Drainage Basin is warranted prior to making further recommendations for specific protection measures

15-5 LONG TERM CAPACITY IMPROVEMENT PROJECTS

Further investigation, flow monitoring and hydraulic modeling of the Three Mile Creek Drainage Basin is warranted prior to making recommendations for specific protection measures or long term improvements at this time.

END OF SECTION 15

SECTION 16 IDENTIFIED REINVESTMENT NEEDS IN THE TRAHON CREEK BASIN

16-1 DRAINAGE BASIN BACKGROUND AND DESCRIPTION

Trahon Creek originates in south central Hinds County, south of the Jackson corporate limits, and flows southeastward to its confluence with the Pearl River. Its drainage basin encompasses about 8.3 square miles with the upper one-third developed with urban land uses. Although development in the lower two-thirds of the basin is scattered, there is evidence of planned commercial businesses, new subdivisions and related development. The entire basin lies in the path of metropolitan area expansion and should be considered as a growth area.

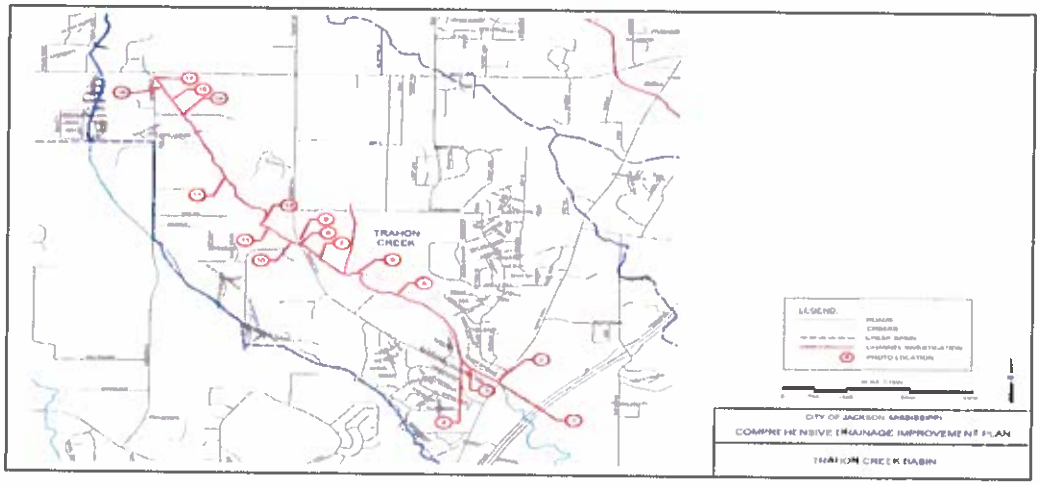
Currently, report of flooding in the basin is limited to a few scattered locations where drainage structures are inadequate and to the lower reaches of the stream where problems occur during high stages of the Pearl River.

16-2 CONVEYANCE CHANNEL IMMEDIATE MAINTENANCE NEEDS

In December 2012, Chester field investigation teams canvassed 20,000 linear feet of channel inspecting 5 structure crossings, 4 utility crossings, 6 outfalls, 17 tributary, and identified 22 areas of significant channel washout, 41 downed trees obstructing channel flow, 2 areas of bank failure, 1 beaver dam and 18 additional locations where debris in the channel was impacting channel capacity

Trahon Conveyance Channel Maintenance		$ 721,000
Rip-Rap Protection at Utility Crossings	$ 24,000	
Channel Debris Removal	$ 650,000	
Channel Tree Removal	$ 41,000	
Outfall Cleaning	$ 6,000	

FIGURE 16 - 1
TRAHON CREEK – FIELD INVESTIGATION MAP



16-3 IMMEDIATE MITIGATION MEASURES

Much of the Trahon Creek channel is clogged with undergrowth, trees, and in many instances debris and litter as noted above. The City should immediately embark on a conveyance channel maintenance program in this basin.

Given the limited nature of our field investigations, further investigation of repetitive area flooding within the basin, establishment of flow monitoring and a hydraulic model of the Trahon Creek Drainage Basin is warranted prior to making recommendations for specific immediate mitigation measure recommendations at this time.

16-4 NEAR TERM PROTECTION MEASURE PROJECTS

Further investigation, flow monitoring and hydraulic modeling of the Trahon Creek Drainage Basin is warranted prior to making recommendations for specific protection.

16-5 LONG TERM CAPACITY IMPROVEMENT PROJECTS

Further investigation, flow monitoring and hydraulic modeling of the Trahon Creek Drainage Basin is warranted prior to making recommendations for long term conveyance capacity improvements at this time.

END OF SECTION 16

SECTION 17 IDENTIFIED REINVESTMENT NEEDS IN THE BIG CREEK BASIN

17-1 DRAINAGE BASIN BACKGROUND AND DESCRIPTION

Originating in the southern western portion of Jackson encompassing a drainage area 3.52 square miles. Big Creek Basin is a relatively small stream. The Big Creek and its principal tributary drain an area that is fully developed by residential subdivsions for the most part

17-2 CONVEYANCE CHANNEL IMMEDIATE MAINTENANCE NEEDS

Specific recommendations for conveyance channel maintenance will be made after completion of field inspection surveys.

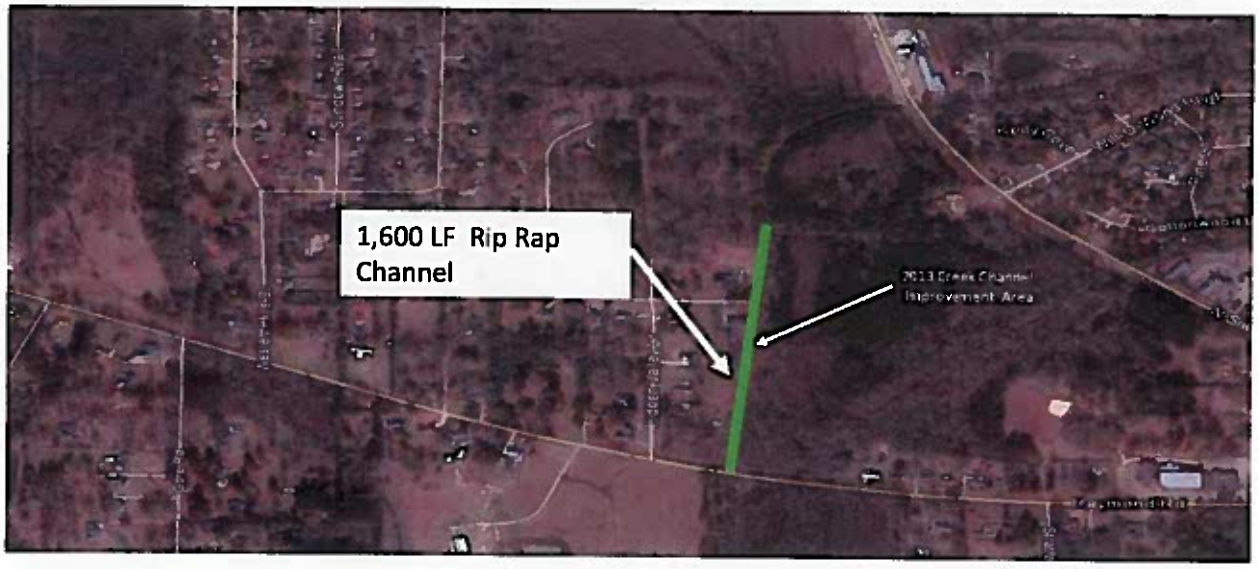
17-3 IMMEDIATE MITIGATION MEASURES

Further review of the existing storm water conveyance infrastructure and the establishment of flow monitoring and hydraulic modeling of the Big Creek Drainage Basin is warranted prior to making recommendations for specific localized flood mitigation measures

17-4 NEAR TERM PROTECTION MEASURE PROJECTS

Based on channel field investigation findings our team has identified one channel restoration project in the vicinity of Hidden Valley Lane. It is recommended that approximately 1,600 linear feet of channel bottom be lined with rip rap and the channel banks be lined to restore them to a 2:1 slope. The capital cost of the project is currently estimated at $640,000.

FIGURE 17 – 1
BIG CREEK BASIN NEAR TERM PROTECTION MEASURES
HIDDEN VALLEY LANE CHANNEL RESTORATION PROJECT



Further investigation, flow monitoring and hydraulic modeling of the Big Creek Drainage Basin is warranted prior to making recommendations for specific protection.

17-5 LONG TERM CAPACITY IMPROVEMENT PROJECTS

Further investigation, flow monitoring and hydraulic modeling of the Big Creek Drainage Basin is warranted prior to making recommendations for long term conveyance capacity improvements at this time.

END OF SECTION 17

SECTION 18: OTHER CONSIDERATIONS

Drainage Issues and Sanitary Sewer Overflows (SSO). It is important to understand that undermanaged stormwater while threatening damage to private property also contributes to the frequency and volume of sanitary sewer overflows (SSO). (SSO(s) are unpermitted, untreated discharges from the overloaded wastewater collection system and have resulted in regulatory actions against the city in the form of state orders and a federal consent decree where monetary penalties are assessed and improvements mandated.) This is especially true where stormwater cannot readily run off to a receiving water or manmade channel as designed and results in ponding, or flooding, over sanitary sewer manholes and in areas of defective and leaky sanitary sewers. This causes excessive stormwater infiltration of the sanitary sewer system potentially overwhelming its hydraulic carrying capacity.

Public Outreach and Education. In a recent article appearing in the Clarion Ledger ("Building a Better Jackson: When it rains, it pours", Dec. 20, 2012), it was stated that

> "To combat this (thousands of drainage-related complaints), the Public Works Department offers the following suggestions:
> - Place all leaves in bags.
> - Place leaf bags on the curb by 7 a.m. on your garbage collection day.
> - If there are multiple bags of leaves, half may be collected on the first garbage collection day and the other half on the second garbage collection day because of limited truck space.
> - Make sure leaves are intact and do not blow or wash into the streets near storm drains and inlets.
> - Report problems with clogged storm drains or inlets by dialing 311."

Exposure in a widely circulated publication of the issue of tree leaves obstructing drainage control facilities and associated remedies is helpful to getting the word out to the public and heightening awareness. However, often more proactive measures are necessary to continually inform and more deeply engage the citizenry. This can be done through proactive stormwater-related activities involving individual citizens, school age children, service organizations, and places of worship such as:

- Adopt-A-Stream programs;
- Reforestation programs;
- Storm drain marking;
- Stream cleanup and monitoring;
- Volunteer monitoring; and
- Wetland Plantings.

Additionally, soliciting public opinion through attitude surveys, stakeholder meetings and watershed organizations (e.g., Riverkeeper) can further increase sensitivity and understanding of the issues and prospective solutions. While the city is often viewed as a *custodian* of the urban environment, chances of success in meeting its mission and goals can only be increased by a proactive community.

Chester will make recommendations for any modified or supplemental practices in public outreach and education as a measure to contribute to the management of identified drainage issues.

We have initially assessed the condition of the drainage infrastructure assets using a variety of data sources

Historical Incident Reports. Analysis of the 311 call data was performed to identify areas of drainage concerns throughout the City of Jackson. A total of 450 flooding incident calls were reported during this time period. The severity of flooding within each drainage basin was evaluated by utilizing the total number of apparent flooding calls as a percentage of the total incident calls for that basin. The highest percentage obtained was assigned a benchmark score of 10. Each basin received the corresponding value based on this procedure. This data has been plotted on a city map (Refer to Appendix 1) to identify problematic drainage areas and basins as well as provide input to the risk management matrix. Refer to Table 18-1 below for a summary of the data analysis. Detailed Analysis of the 311 Call Data is presented in Appendix 1.

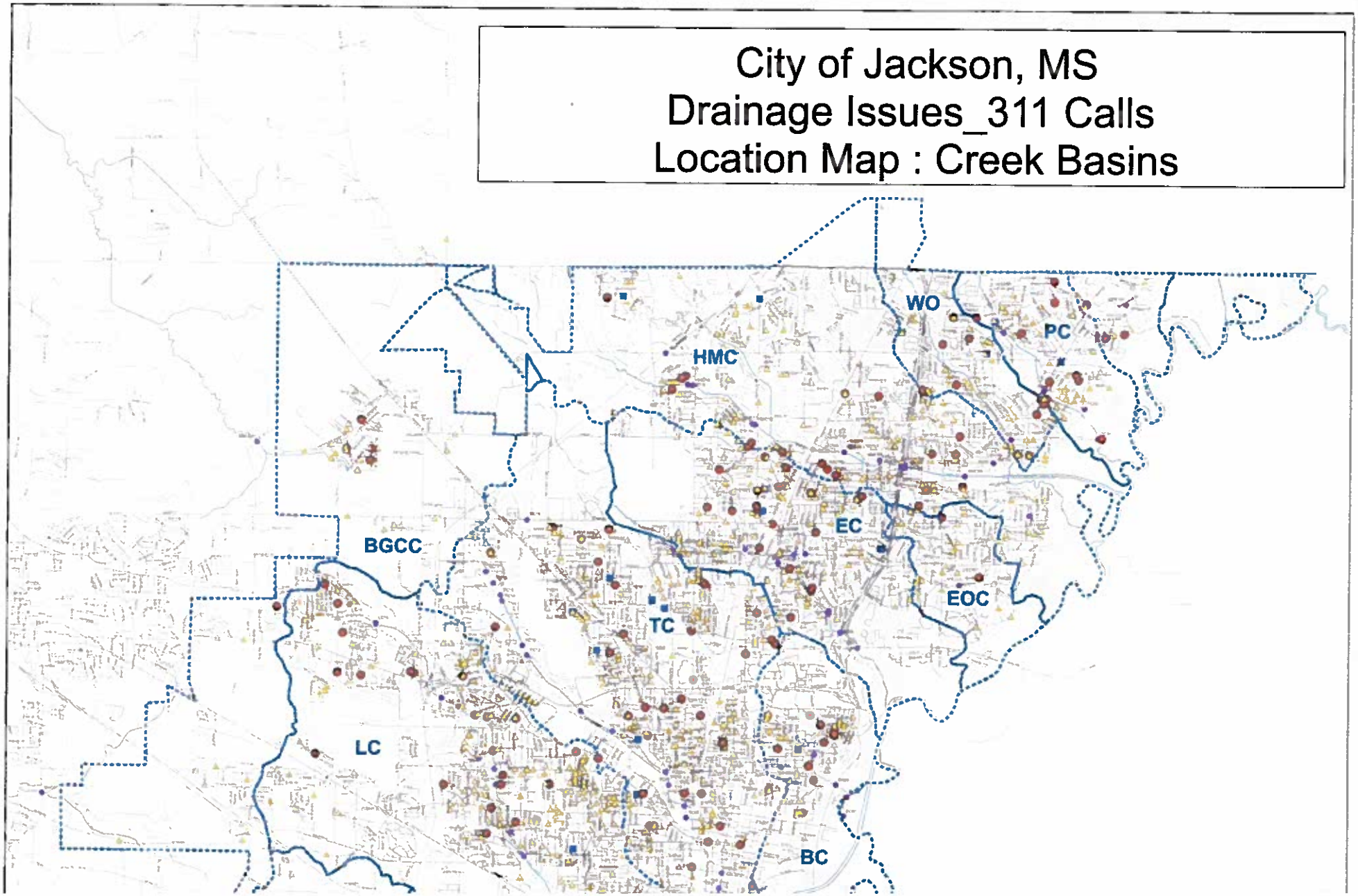
TABLE 18-1
ANALYSIS OF CITY OF JACKSON 311 SYSTEM CALL HISTORY
(2/1/2011 through 8/15/2012)

CREEK BASIN	Apparent Flooding Issue	Lodged Maintenance Requests			TOTAL 311 Calls
		Clogged Ditches	Inlet/ Catch Basin Housekeeping	Other Maintenance	
Bougue Chitto Creek	11	52			63
		3	25	24	
Big Creek	7	36			43
		0	23	13	
Belhaven Creek	23	93			116
		4	59	30	
Cany Creek	42	151			193
		19	85	47	
Eubanks Creek	37	194			231
		15	121	58	
Eastover Creek	2	43			45
		3	30	10	
Hardy Creek	9	44			53
		2	29	13	
Hanging Moss Creek	23	210			233
		21	108	81	
Lynch Creek	34	335			369
		34	218	83	
Purple Creek	19	54			73
		3	40	11	
Three Mile Creek	8	56			64
		4	35	17	
Town Creek	73	336			409
		31	191	114	
Trahon Creek	10	54			64
		5	27	22	
White Oak Creek	21	59			80
		5	29	25	
Totals	319	1629			2036

INDEX OF APPENDICIES

APPENDIX 1

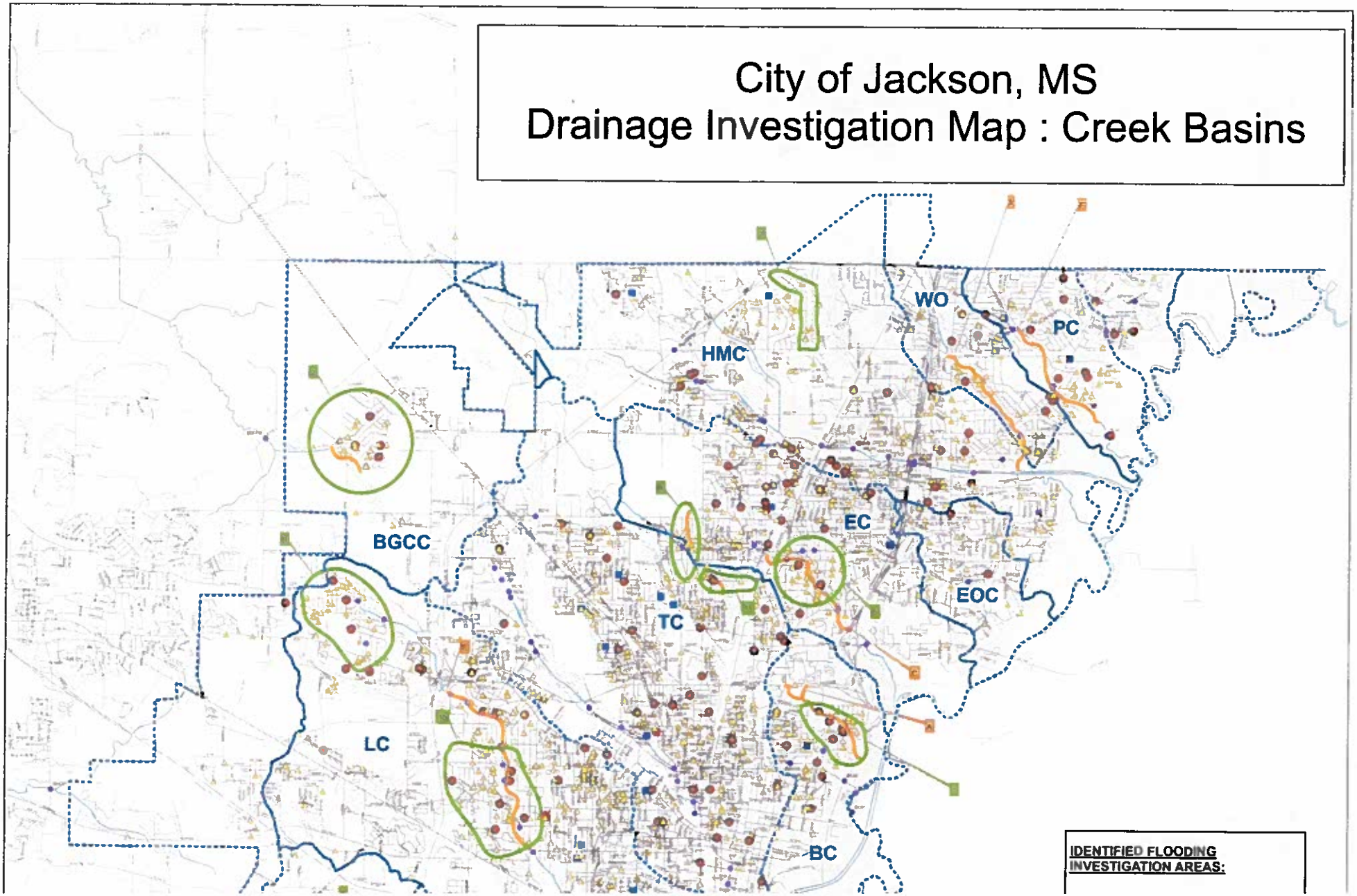
CITY OF JACKSON
311 CALL LOCATION MAP


City of Jackson, MS
Drainage Issues_311 Calls
Location Map : Creek Basins
WO
PC
HMC
EC
BGCC
EOC
TC
LC
BC

APPENDIX 2

CITY OF JACKSON
DRAINAGE SYSTEM
FIELD INVESTIGATION MAP

City of Jackson, MS
Drainage Investigation Map : Creek Basins



APPENDIX 3

CITY OF JACKSON
311 SYSTEM CALL DATA ANALYSIS

Analysis of City of Jackson 311 System Call Data

Chester Engineers received a detail list of 311 system calls dating February 2011 to December 31, 2012 from the City of Jackson for analysis as part of the Comprehensive Drainage Improvements Plan. The purpose of this analysis is to document a trend of flooding issues within the city based upon the information provided by the public and the attempt to address the concerns. The information provided in this report will give the city a broad idea of where the problems are commonly located and possibly explore new options to rectify those repeat issues. In general, all complaint calls can be classified into three components: Maintenance Issue (whether Inlet/Catch Basin Housekeeping, Clogged Ditches, or Other Maintenance), Apparent Flooding Issue and Non-Drainage Issue based on the details provided. Each call was initially grouped and analyzed by month, and then all repeat calls were viewed from an overall perspective in order to properly classify the issue at that particular address.

Calls categorized as Maintenance, Non-drainage, or Apparent Flooding issues are based on factors of timing of the call, the details provided, frequency of the call if applicable, as well as crew response and information provided from the crew during attempt to resolve complaint. The total number of calls on record provided is 3,110 as shown in the Table 3A-1 below and a breakdown of the calls as follows:

TABLE 3A-1
CITY-WIDE 311 SYSTEM CALL DATA ANALYSIS

MONTH	YEAR	TOTAL NUMBER OF COMPLAINTS	REPEAT ADDRESS	APPARENT FLOODING ISSUE	INLET/CATCH BASIN HOUSEKEEPING	CLOGGED DITCHES	OTHER MAINTENANCE
FEB*	2011	34	2	0	33	1	0
MAR	2011	243	18	32	182	23	6
APR	2011	130	0	20	67	19	24
MAY	2011	70	1	8	31	13	18
JUN	2011	70	1	9	26	8	27
JUL	2011	105	5	21	51	10	23
AUG	2011	91	3	13	34	11	33
SEP	2011	151	4	16	64	12	59
OCT	2011	79	1	7	27	8	37
NOV	2011	71	2	4	41	0	26
DEC	2011	77	1	9	52	0	16
JAN	2012	114	3	23	51	8	32
FEB	2012	200	4	39	92	10	59
MAR	2012	227	7	43	114	13	57
APR	2012	147	3	25	60	15	47
MAY	2012	142	3	31	67	3	41
JUN	2012	148	2	18	62	7	61
JUL	2012	118	1	17	59	2	40
AUG*	2012	231	4	34	80	96	21
SEP	2012	159	2	11	48	82	18
OCT	2012	149	2	6	46	86	11
NOV	2012	138	3	6	63	55	14
DEC	2012	216	4	58	98	56	4
TOTAL CALLS		3110		450	1448	538	674

Data Observations:

- 63.9% of the calls are a complaint of flooding issues as a result of inadequate maintenance in the area of the call. This value is the combination between *Inlet/Catch Basin Housekeeping* and *Clogged Ditches*.
- 21.6% of the calls resulted in maintenance that either involved cleaning other parts of the drainage system, repairs to pipes or cave-ins, or did not immediately impact flooding in the area.
- Less than 2% of the calls reference issues concerning the water or sewer infrastructure. Details of these calls were forwarded to the respective DPW division for addressing.
- Nearly 15% of the complaints documented have been noted as an *Apparent Flooding Issue* by reason of inadequate drainage infrastructure, given sufficient maintenance was performed in the area.

There are a total of 273 repeat addresses from the complaint calls between February 2011 and August 2012 with only 33% of those being considered apparent flooding issue based upon evidence that maintenance was unable to resolve flooding issues.

According to the analysis performed on the complaint calls during the 23 month period, flooding occurs during heavy rainfall generally as a result of insufficient maintenance to the drainage system. Keeping the drains, ditches, culverts and creeks free of debris is essential in achieving maximum stormwater flow under design conditions. Cases where flooding continues to occur in some areas with adequate maintenance procedures may require improvements to the drainage system to allow additional stormwater carrying capacity and prevent flooding of homes. It is apparent that maintenance is a key component to improve the functionality of the existing drainage system.

See tabulation of call information in Table 3A-2 provide call data analysis thru Aug 2012. The calls indicated in the red and yellow columns are shown on the GIS mapping with respective colors. The results for the GIS mapping were expected to identify concentrated groups of apparent flooding locations that would be readily assessed. However, the 311 Call mapping provided a scatter pattern of flooding areas that stretches across the majority of the City.

As indicated in the 311 call analysis, the majority of the complaints could be resolved by maintenance of inlets and roadside ditches. Many of the complaints due to flooding were caused by flat street grades with curb and gutter that has inadequate slope to convey runoff to the inlet locations and roadway failures that form localized low points that create ponding in the streets. Extensive, street reconstruction and maintenance of the drainage system are required.

TABLE 3A-2
TABULATION OF 311 SYSTEM CALL DATA BY BASIN
(Analysis Thru Aug 15 only)

CREEK BASIN	Color: Red	Color: Yellow			Color: Blue		TOTAL
	Apparent Flooding	Clogged Ditches	Inlet/ Catch Basin House-keeping	Other Mainte-nance	Sewer Issue	Water Leak	
Bougue Chitto Creek	11	52			0		63
		3	25	24	0	0	
Big Creek	7	36			0		43
		0	23	13	0	0	
Belhaven Creek	23	93			2		118
		4	59	30	1	1	
Cany Creek	42	151			6		199
		19	85	47	4	2	
Eubanks Creek	37	194			4		235
		15	121	58	3	1	
Eastover Creek	2	43			0		45
		3	30	10	0	0	
Hardy Creek	9	44			0		53
		2	29	13	0	0	
Hanging Moss Creek	23	210			2		235
		21	108	81	2	0	
Lynch Creek	34	335			4		373
		34	218	83	4	0	
Purple Creek	19	54			3		76
		3	40	11	3	0	
Three Mile Creek	8	56			3		67
		4	35	17	2	1	
Town Creek	73	336			7		416
		31	191	114	4	3	
Trahon Creek	10	54			2		66
		5	27	22	2	0	
White Oak Creek	21	59			2		82
		5	29	25	2	0	

Note: Town Creek was not included in the initial channel investigation list. The local flooding areas to be investigated along Town Creek are substantial and the channel investigation will be conducted at the same time.

The City of Jackson 311 Call Location Map in Appendix 1 and call information were previously presented to the Public Works staff with the request to review the information provided and identify specific areas of concern for reoccurring flooding areas. Appendix 2, Drainage Investigation Map indicates channels and areas of local flooding noted as initial areas for investigation of drainage issues. The length of channels indicated total approximately twenty-one miles and a minimum of twelve areas of local flooding were identified for investigation. Currently, the field observation of the twenty-one miles of channel has been completed and many of the local flooding areas have been investigated. Exhibits for each channel indicating the location of representative photographs, photographs, field observation information and a Summary of Findings was provided in Appendix 3 of our January 8, 2013 technical memorandum.

APPENDIX 4

GREEN AND GRAY INFRASTRUCTURE SOLUTIONS FOR DRAINAGE MANAGEMENT

Green and Gray Infrastructure Solutions for Drainage Management

In a subsequent phase of our city-wide drainage improvement planning activities, Chester will research and develop recommended approaches to mitigating drainage issues identified under this Technical Memorandum. Initially the focus will be those issues scoring above an agreed "*Business Risk Exposure*" [BRE] threshold value indicating a highest priority for resolution (i.e., "worst comes first"). Such mitigation recommendations will include new or rehabilitated stormwater control facilities and associated post-construction stormwater control best management practices (BMP), and diligence in implementing BMP with regard to existing stormwater control facilities.

In areas of the city undergoing development and/or redevelopment, various control technologies will be evaluated as measures to reduce extraordinary stormwater runoff volume and flow rates potentially impacting downstream private property and publically owned assets in the rights-of-way. Such alternative solutions would include:

- Detention/Retention Practices – ponds, wetlands
- Infiltration Facilities – infiltration basins, infiltration trenches
- Filtration Practices – sand filters, swales, grassed channels, biofilters, bioretention, filter strips.

In those areas of the city with highest priority drainage issues and virtually built out with regard to available land for new development, approaches to possibly redirecting predetermined quantities of stormwater from overburdened drainage facilities and creeks and channels to possibly underutilized control features will be considered. Other measures that can mitigate the effects of overloaded drainage facilities include the implementation of:

- Vegetated (green) roofs
- Street tree trenches
- Permeable paving and sidewalks
- Rain gardens
- Rain barrels and cisterns

In each case, options for "green" infrastructure solutions in lieu of or in conjunction with traditional "gray" infrastructure solutions will be considered. Green infrastructure is defined as strategically planned and managed networks of natural lands, working landscapes and other open spaces that conserve ecosystem values and functions and provide required benefits to human populations such as drainage management. In urban environments, gray infrastructure as it relates to stormwater is defined as pipe networks and storage systems constructed mostly of man-made materials such as concrete that collect, detain and convey stormwater which is eventually discharged to a local stream, river, lake, or treatment facility.

APPENDIX 5

DATA REQUIREMENTS FOR EVALUATING THE PERFORMANCE OF AGING DRAINAGE INFRASTRUCTURE

Data Requirements

The evaluation of storm drainage performance systems requires the accumulation of certain basic data including the following information:

Watershed mapping identifying topographic features, watershed boundaries, existing drainage patterns, and ground cover. Information sources include USGS quadrangle maps, field surveys, aerial photography, or mapping available from local river authorities, drainage districts, or other planning agencies.

Land use mapping identifying existing and expected future land uses. This information is typically available from local zoning or planning agencies.

Soils maps identifying soil types and hydrologic soil groups. This information is available in county soil surveys which can be obtained from the local U.S. Department of Agriculture, Natural Resource Conservation Service (NRCS) offices.

Flood histories and highwater mark elevations. Information of this type is obtained through local offices of the U.S. Geological Survey, National Weather Service, Federal Emergency Management Agency, U.S. Army Corps of Engineers, and/or local planning agencies, river authorities or drainage districts. Local residents or MDOT regional or district maintenance offices are other sources for this information.

Descriptions of existing drainage facilities including size, shape, material, invert information, age, condition, etc. As-built information for existing drainage facilities may be available from the local owner of the facility. If unavailable, field surveys must be performed to obtain this information.

Design and performance data for existing drainage systems. This information may be available from the local owner of the facility. If the information is not available for the existing system, it will be necessary for the designer to develop the needed information to define how the existing system will function under the new loading.

Utility plans and descriptions. Available from utility owner. If unavailable, field surveys must be performed to determine critical design information.

Existing right-of-way information. From appropriate highway agency right-of-way office, or local tax maps.

Federal, state, and local regulatory requirements. Information is available from local regulatory agencies including the U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, and the Mississippi Departments of Environmental Quality.

APPENDIX 6

EXERTS FROM US DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT USE-MS-04-25-003 URBAN SYSTEMS ENGINEERING DEMONSTRATION PROGRAM FOR HINDS, MADISON, RANKIN COUNTIES MISSISSIPPI CITY COUNCIL OF GOVERNMENTS AND PEARL RIVER BASIN DEVELOPMENT DISTRICT

Background Information on Variouis Drainage Basins Exerpts from 1973 Clark Dwitz & Associates Engineers Study – Basin Data and Identified Capacity Deficiencies

Purple Creek Basin

This basin services 7.6 square miles.

1973 Report Findings:

- 17 of 31 existing structures are inadequate to handle runoff from a 50 year storm.
- Most of the main channel and tributaries of Purple Creek are undersized.
- Maintenance of facilities is poor.

1973 Identified Drainage Improvement Needs:

- Extensive channel improvements and replacement of inadequate structures.

White Oak Creek Basin

1973 Report Findings:

- 12 existing structures are inadequate to handle runoff from a 50 year storm.
- The main channels and tributaries of White Oak Creek are adequate, although in need of cleaning and regular maintenance.
- Substantial bank erosion is evident in the vicinity of Ridgewood Road.

Hanging Moss Creek Basin

1973 Identified Drainage Improvement Needs:

- Structures requiring replacement include the trestle on the Illinois Central Railroad and the bridge over US Hwy 51.
- Total costs for improvements are estimates at $842,000 (1973) with structure replacement accounting for $777,400 of overall costs.
- Other channel improvements are minor in nature.

Eubanks Creek Basin

1973 Report Findings:

Severe drainage problems exist throughout the Eubanks Creek Basin.

- Narrow, winding and constricted channels combine with undersized drainage structures to cause widespread flooding in many areas.
- Of 44 structures in the basin, 12 have been determined to be inadequate to handle runoff from a 50 year storm.
- Drainage channels throughout the basin are grossly inadequate.
- Buildings infringing upon the flood plain and in some instances into the channel, inhibit plans for widening and realigning drainage ways.

1973 Identified Drainage Improvement Needs:

- The estimated costs for improvements total $2,225, 900 with $975,000 of the total allocated for acquisition of right of way and existing buildings.

Belhaven Creek Basin

1973 Report Findings:
(Belhaven Heights) Drainage facilities in the basin are generally in good condition with only one of 20 structures considered to be inadequate.

INVENTORY OF EXISTING CONTROL STRUCTURES BELHAVEN CREEK BASIN

Struct. No.	Type of Structure	Waterway Opening (ft^2)
1	C. B. (2) 8 x 6	96
2	C. B. (2) 8 x 6	96
3	C. B. (2) 8 x 6	96
4	C. B. (2) 8 x 6	96
5	C. B. (2) 8 x 6	96
6	C. B. (2) 8 x 6	96
7	C. B. 5 x 4	20
8	C. B. 8 x 6	48
9	T. Br.	80
10	C. B. (2) 8 x 8	128
11	T. Trestle	3708
12	C. B.l0x 20	120
13	C. B. 6 x 5	30
14	C.B.l0x5	50
15	C. B. 6 x 8	48
16	T. Br.	198
17	C.B.l0x8	80
18	C. B. (3) 8 x 6	144
19	C. B. (2) 8 x 8	128
20	C. B. (2) 10 x 8	160

1973 Identified Drainage Improvement Needs:
Total costs for improvement are estimated at $152,000.

Town Creek Basin

This 11.3 sq mile basin has three main branches (Airport Branch 2.2 sq miles; West Branch 1.8 sq miles; East Branch 2.0 sq miles) , flows through the older portion of the Jackson Urban area including the central business district.

1973 Report Findings:

- Much of the channel is undersized and clogged with trees, undergrowth and debris. In some instances buildings intrude into the drainage way.
- Of 72 control structures in the basin 57 have been judged to be inadequate.

1973 Identified Drainage Improvement Needs:

- Proposed improvements include relocation of the creek in the downtown area and a major program of channel improvements and structure replacement throughout the basin.

Lynch Creek Basin

1973 Report Findings:

- Most of the basin's drainage ways are undersized, 32 of the 62 principal structures lack sufficient capacity to handle a 50 year storm.

1973 Identified Drainage Improvement Needs:

- Improvements proposals include extensive renovation of channels and replacement of structures. Estimated costs ($2,642,400) 1973

Three Mile Creek Basin

1973 Report Findings:
Most of the channel and 15 of the basin's 22 drainage structures are inadequate.

1973 Identified Drainage Improvement Needs:
Proposed improvements include widening of existing channels and replacing inadequate structures.

Hardy Creek Basin

1973 Report Findings:

- Most of Hardy Creek has sufficient capacity to handle runoff from a 50 year storm,
- Flows currently are inhibited substantially by trees, brush, and debris that clog the waterway.
- Of 13 drainage structures in the basin, 4 are considered inadequate. However, two of the inadequate structures are bridges with replacement costs estimated at $135,000.

1973 Identified Drainage Improvement Needs:

- Estimated costs for channel improvements, structures replacement, demolition of existing facilities, and easement acquisition total $252,600.

Cany Creek Basin

1973 Report Findings:

- Most of channel remains undersized and maintenance of facilities is poor.
- Of 39 drainage structures along the creek and its tributaries, 25 lack sufficient capacity to handle runoff from a 50 year storm.

1973 Identified Drainage Improvement Needs:

- A program of channel improvements and structure replacement at a total estimated cost of $1,581,800.

Trahon Creek Basin

1973 Report Findings:

- There is no evidence of regular maintenance.
- 26 of the 44 drainage structures are inadequate.
- Much of the channel is undersized and clogged with trees, undergrowth and debris.
- In some instances buildings intrude into the drainage way.

1973 Identified Drainage Improvement Needs:

- Substantial drainage improvements are required in the basin to meet the demands of a 50-year storm.
- With development of the basin and the introduction of additional paved streets and improved local drainage facilities the rate of storm water runoff will increase, and existing deficiencies in the primary channels and control structures will become more critical.

APPENDIX 7

DECEMBER 2012 FIELD INVESTIGATION OBSERVATIONS OF SELECTIVE DRAINAGE CONVEYANCE CHANNELS

Identified Priority Operation and Maintenance Issues. Immediate maintenance attention such as debris removal and channel erosion stabilization is required in specific locations as respective drainage channel capacity is currently compromised or immediate hazards to public safety have been noted from field observations.

PRIORITY IMMEDIATE MAINTENANCE ITEMS

Cany Creek

- Robinson Road Extension – Severe wash on the southeast corner of bridge, guard rail damage on the northwest corner.
- Collapsed 18-inch diameter sanitary sewer line located approximately 700 feet downstream of TV Road.
- Repair severe washout at end of bridge at Robinson Road.

Eubanks Creek

- East side of Hawthorne Drive – Sanitary sewer smell at end of 18-inch diameter storm drain Evidence on rocks at outfall. Possible sanitary sewer break upstream of storm drain pipe outfall.

Hardy Creek

- East side of Alameda Drive. Natural gas smell at downstream end of culvert.
- Approximately 85 feet west of Woodbine Street. Broken sanitary sewer pipe flowing into creek.

Trahon Creek

- Forest Hill Road. Six inch diameter water line is unsupported and telephone line is exposed and damaged at north end of bridge.
- Approximately 100-feet south of Oak Hollow Cove evidence of sanitary sewer in the channel.

Purple Creek

- Approximately 800 feet downstream of Ridgewood Road. Extensive bank failure with power lines.

Belhaven Creek

- Evaluate stability of large tree located approximately 300 feet south of Riverside Drive. Tree is located at toe of eroding bank and is adjacent to two homes.

Three Mile Creek

- Repair 150-foot bank failure on north bank to Terry Road Bridge.

AREAS REQUIRING IMMEDIATE ATTENTION TO MAINTAIN CHANNEL CONVEYANCE CAPACITY AND MINIMIZE FLOODING CONDITIONS

Belhaven Creek

- Clear debris from railroad trestle bridge and piers on water line crossing channel north of railroad trestle.
- Remove tree from channel 600 feet north of railroad trestle.
- Remove concrete rubble from channel downstream of Laurel Street.
- Remove tree and debris from channel approximately 200 feet north of Laurel Street.
- Remove debris from box culvert at St. Mary Street.
- Remove debris from channel and box culvert at St. Ann Street.
- Remove blockage causing ponding in channel south of Linden Place.
- Remove blockage causing ponding in channel south of Riverside Drive.
- Remove tree from channel located approximately 500 feet upstream of Riverside Drive.
- Remove debris from channel located approximately 750 feet upstream of Riverside Drive.

Eubanks Creek

- Remove trees and debris from channel upstream of I-55 frontage road.
- Remove debris from 24" sewer line crossing approximately 850 upstream of I-55 frontage road.
- Remove abandoned sewer line blockage approximately 1000 feet upstream of I-55 frontage road.
- Determine blockage causing ponding water from North West Street downstream and remove.
- Remove all concrete rubble, sediment and debris from North West Street downstream to Northview Drive.
- Remove debris in channel upstream and downstream of Northview Drive box culvert.
- Remove debris in channel approximately 400 feet downstream of Northview Drive.
- Remove debris, sedimentation and vegetation from channel and State Street box culvert.
- Remove blockage at Hawthorn Bridge.
- Remove debris in channel approximately 260 feet north of Old Canton Road.

Purple Creek

- Remove tree and debris approximately 400 downstream of Sedgwick Drive.
- Remove sediment, debris and vegetation from channel at Clubview Drive and clean upstream and downstream as necessary.
- Remove tree from water line crossing and remove sediment and vegetation at location approximately 1000 feet upstream of Colonial Circle.

- Remove debris on 4-inch gas line at Plantation Drive Bridge.

Three Mile Creek

- Clear debris and rubble from channel located approximately 600 feet downstream of I-55 frontage road.
- Clear debris and rubble around pipes in channel located approximately 1000 feet downstream of I-55 frontage road.
- Remove beaver dam on tributary on north bank approximately 1400 feet downstream of I-55 frontage road.
- Remove tree across channel approximately 2400 feet downstream of I-55 frontage road.
- Remove concrete debris 250 feet downstream of railroad
- Remove debris in channel at sewer crossing downstream of railroad.
- Clean 52" CMP and 11' CMP under railroad.
- Remove riprap and debris from 24-inch sewer line upstream of railroad.
- Remove concrete debris upstream of i-55 west frontage road box culvert.
- Remove debris from water line downstream of railroad and downstream as needed.

Cany Creek

- Clear box culvert barrels of sediment and debris at I-55 frontage road.
- Clear sediment and debris from main channel and tributary 175 upstream of I-55 frontage road.
- Clean out tributary to channel location 600 feet upstream of I-55 frontage road.
- Remove tree from channel approximately 1800 feet downstream of Terry Road.
- Clearn tributary outfall to channel at location 300 feet upstream of power line crossing 1300 feet downstream of Terry Road.
- Clean debris and sediment form channel at 36-inch sewer interceptor crossing.
- Cut brush and remove sediment and debris from channel approximately 150 feet downstream of Terry Road.
- Remove debris from flume and 150-feet downstream from Terry Road bridge.
- Add additional support to sagging water line on Terry Road bridge.
- Cut brush and trees and remove from tributary approximately 600 feet upstream of Terry Road.
- Remove debris from channel and tributary approximately 1000 feet downstream of McClure Road.
- Cut brush and remove sediment from channel approximately 200 feet downstream of Terry Road bridge.

- Remove gravel, debris and tree from channel approximately 3000 feet downstream of Cooper Road. Near Wheatley Street extended.
- Remove debris and blockage at 16-inch sewer crossing located 2800 feet downstream of Cooper Road near Sykes Park.
- Remove pipe and debris from channel approximately 25600 feet downstream of Cooper Road.
- Remove limbs and debris at 36"outfall 150 feet upstream of Smallwood Street.
- Remove tree and debris form 36" outfall 250 feet upstream of Smallwood Street.
- Remove gravel and concrete debris from channel 1,000 feet upstream of of Smallwood Street.
- Remove limbs and debris from 16" gas line to clear pipe supports 1300 feet downstream of McDowell Road.
- Clean 24" outfall discharge path to channel approximately 800 feet downstream of McDowell Road.
- Cut trees and brush and remove sediment to clear complete drainageway of the wooden bridge at McDowell Road bridge.
- Remove concrete debris and limbs from channel at 350 feet downstream of McDowell Road.
- Remove concrete rubble from channel approximately 550 feet downstream of McDowell Road.
- Removed major blockage at 10" sewer line near Lakeside Drive area approximately 2400 fee upstream of McClure Road.
- Remove 12" pipe and debris at 2200 feet upstream of McClure Road near Sykes Park.
- Remove manhole form channel or provide lid for casting if active at 1600 feet upstream of McClure Road.
- Remove sediment and debris in channel approximately 1500 feet upstream of McClure Road.
- Remove concrete manhole, logs and debris from channel approximately 500 feet downstream of Cooper Road.
- Remove tree and debris from channel at 1000 downstream of Cooper Road.
- Remove old collapsed pipe and debris at 1400 feet downstream of Cooper Road.
- Remove manhole pieces, debris and sediment buidup at 1500 feet downstream of Cooper Road.
- Remove debris and gravel at 2400 feet downstream of Cooper Road.
- Remove manhole from channel at 2500 feet downstream of Cooper Road.
- Remove trees and debris near Autumn Street extended and fill eroded area 1000 feet downstream of Small wood Street.
- Remove debris from 4" gas and 12" water line crossing at 1200 feet downstream of Smallwood Street.

- Remove sediment and gravel piles 800 feet upstream of Cooper Road.
- Remove debris and leaves from channel 600 feet upstream of Cooper Road.
- Remove sediment and riprap rubble from channel at 550 feet upstream of Cooper Road.
- Remove tree, beaver dam and debris across channel at 250 feet downstream of Raymond Road.
- Remove riprap and rubble and redefine channel section 1200 upstream of Robinson Road Ext.
- Remove trees and sediment at 1100 feet upstream of Robinson Road Ext.
- Clear trees and brush and debris at 700 feet upstream o f Robinson Road Ext.
- Remove riprap and rubble and clear channel of vegetation 250 feet upstream o Robinson Road Ext.
- Repair water line leak on Raymond Road bridge.
- Remove debris from 10" sewer line at Raymond Road bridge.
- Remove sediment and scrub trees from channel for a minimum of 100 feet upstream of the Alyce Drive bridge.
- Remove stone and debris from pipe at 500 feet upstream of Alyce Drive.
- Remove tree from channel at 500 feet downstream of Gertrude Drive.
- Remove trash and debris at footbridge at 150 feet upstream of Gertrude Drive.
- Remove tree at 280 feet and 450 feet upstream of Gertrude Drive.
- Clear brush and trees from tributary at 500 feet upstream of Gertrude Drive.
- Remove two trees from channel at 950 upstream of Gertrude Drive.
- Remove trees at 1050 feet and 1100 feet downstream of TV Road.
- Remove tree and sediment at 750 feet downstream o f TV Road.
- Remove tree, brush and sediment from channel at 650 feet downstream of TV Road.
- Remove trees at 400 feet and 500 feet downstream of TV Road.
- Remove tree and sediment and redefine channel at 70 feet downstream of TV Road.

Hardy Creek and Trahon Creek

- Remove all trees crossing channel and debris from utility crossings.

  Note: Approximate tree blockage at 14 locations in Hardy Creek and over 40 locations in Trahon Creek.
- Remove debris at utility crossings totaling approximately 12 locations in Hardy Creek and 4 locations in Trahon Creek.

All Creeks

- All creeks require removal of trees, brush and debris accumulated at structures, utility crossings, storm drainage outfalls and tributary discharge points into the channels.

APPENDIX 8

BASIS OF BUDGETARY COST ESTIMATES

BASIS OF BUDGETARY COST ESTIMATES

BELHAVEN CREEK

NEAR TERM PROTECTION MEASURES
ST MARY / PIEDMONT BANK STABILIZATION PROJECT
ESTIMATED QUANTITIES AND COSTS

City of Jackson, CDIP Opinion of Probable Cost
03/10/13

St Mary Piedmont

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
	BASE BID				
1	Mobilization	1	LS	$10,000.00	$10,000.00
2	Clearing and Grubbing	1	LS	$20,000.00	$20,000.00
3	Erosion Control	1	LS	$3,000.00	$3,000.00
52	Geotextile Fabric	5,600	SY	$1.50	$8,400.00
59	Unclassified Excavation (LVM)	1,750	CY	$12.00	$21,000.00
61	24" Thick 200 LB Rip Rap	1,960	TONS	$60.00	$117,600.00
62	Gabion Baskets	1,875	CY	$75.00	$140,625.00
TOTAL BASE BID					**$290,625.00**

PEACHTREE ST - EAST AND WEST CHANNEL BANK STABILIZATION
BUDGETARY COST ESTIMATE

Drainage Improvements Plan _ City of Jackson, Mississippi — Preliminary Budgetary Cost Estimate — 16-Apr-13

$ 239,481.45 *(TOTAL Cost Option Gabion Mat)*

BELHAVEN CREEK CANAL Improvements (Length 200 '_Location: 505 ' east of Peachthree St.)

Pay Item Description	Quantity	Unit	Unit Price	Total Cost
Mobilization	1	LS	5%	$11,403.88
REMOVAL OF EXISTING CONCRETE LINING	932	SY	13.82	$12,880.24
Riprap - Gabion Mat	1065.33	SY	202.00	$215,197.33
EB, WB & Channel Bottom Total				$228,077.57

Unit prices were averaged from several sources available to Chester Engineers, Inc.

PEACHTREE ST - EAST AND WEST CHANNEL BANK STABILIZATION
ESTIMATED QUANTITIES

$228,077.57 TOTAL _ Gabion Matt Riprap (without 5% mobilization)
$11,403.88 (Mobilization)
$239,481.45 (Grand total including mobilization)

Section I

Length (ft) = 200.00
Slope and Channel bottom width = 41.94

		Area SY
a) grading		932.00
b)geotextile	47.94	1,065.33
c)Rip Rap Loose 200lb		93.20

Section II

Length (ft) = 0.00
Slope and Channel bottom width = 0.00

		Area SY
a) grading		0.00
b)geotextile	6.00	0.00
c)Rip Rap Loose 200lb		0.00

Section III

Length (ft) = 0.00
Slope and Channel bottom width = 0.00

		Area SY
a) grading		0.00
b)geotextile	6.00	0.00
c)Rip Rap Loose 200lb		0.00

EUBANKS CREEK

PHASE II IDENTIFIED NEAR TERM PROTECTION MEASURES
NORTHVIEW DRIVE BRIDGE – BANK STABILIZATION
BUDGETARY COST ESTIMATE

Drainage Improvements Plan _ City of Jackson, Mississippi **Preliminary Cost Estimate** 17-Apr-13

$ 1,473,112.74 *(TOTAL Cost Option (a) Gabion Mat)*

$ 55,454.68 *(TOTAL Cost Option (b) Loose Riprap)*

EUBANKS CREEK Channel Improvements	**SECTION I**	**(Length 740.00' east/downstream from Northview Dr. Bridge)**		
Pay Item Description	**Quantity**	**Unit**	**Unit Price**	**Total Cost**
Mobilization Option (a)	1	LS	5%	70148.23
Mobilization Option (b)	1	LS	5%	2640.70
RIPRAP Option:				
a) Riprap - Gabion Mat				
East Bank	2699.36	SY	202.00	545269.82
West Bank	2699.36	SY	202.00	545269.82
West Bank Total option (a)				**1090539.64**
b) Riprap				
Finish Grading (East Bank)	2206.02	SY	0.16	352.96
Geotextile Fabric (East Bank)	2699.36	SY	2.57	6937.34
Riprap-Loose (200 lbs)(East Bank)	220.60	TN	60.00	13236.13
Finish Grading (West Bank)	2206.02	SY	0.16	352.96
Geotextile Fabric (West Bank)	2699.36	SY	2.57	6937.34
Riprap-Loose (200 lbs)(West Bank)	220.60	TN	60.00	13236.13
Total option (b)				**41052.88**
	SECTION II	**(Length 212.00' west/ upstream from Northview Dr. Bridge)**		
a) Riprap - Gabion Mat				
East Bank	773.33	SY	202.00	156212.44
West Bank	773.33	SY	202.00	156212.44
Total option (a)				**312424.87**
b) Riprap				
Finish Grading (East Bank)	632.00	SY	0.16	101.12
Geotextile Fabric (East Bank)	773.33	SY	2.57	1987.46
Riprap-Loose (200 lbs)(East Bank)	63.20	TN	60.00	3791.97
Finish Grading (West Bank)	632.00	SY	0.16	101.12
Geotextile Fabric (West Bank)	773.33	SY	2.57	1987.46
Riprap-Loose (200 lbs)(West Bank)	63.20	TN	60.00	3791.97
Total option (b)				**11761.10**

Unit prices were averaged from several sources available to Chester Engineers, Inc.

EUBANKS CREEK CONT.

PHASE II IDENTIFIED NEAR TERM PROTECTION MEASURES
NORTHVIEW DRIVE BRIDGE – BANK STABILIZATION
ESTIMATED QUANTITIES

$52,813.98 TOTAL _ Loose Riprap Option **(b)** (without 5% mobilization)
$2,640.70 (Mobilization)
$55,454.68 (Grand total including mobilization)

$1,402,964.52 TOTAL _ Gabion Mat Option **(a)** (without 5% mobilization)
$70,148.23 (Mobilization)
$1,473,112.74 (Grand total including mobilization)

Section I					Area SY
	Length (ft) =	740.00	a) grading		2,206.02
	Slopes width =	26.83	b)geotextile	32.83	2,699.36
			c)Rip Rap Loose 200lb		220.60
Section II					Area SY
	Length (ft) =	212.00	a) grading		632.00
	Slope width =	26.83	b)geotextile	32.83	773.33
			c)Rip Rap Loose 200lb		63.20
Section III					Area SY
	Length (ft) =	0.00	a) grading		0.00
	Slope width =	0.00	b)geotextile	6.00	0.00
			c)Rip Rap Loose 200lb		0.00

HARDY CREEK

NEAR TERM PROTECTION MEASURES
ALAMEDA DRIVE BRIDGE CONVEYANCE CHANNEL BANK STABILIZATION PROJECT
BUDGETARY COST ESTIMATE

Drainage Improvements Plan _ City of Jackson, Mississippi **Preliminary Cost Estimate** 17-Apr-13

$ 618,954.93 *(TOTAL Cost Option (a) Gabion Mat)*

$ 23,999.29 *(TOTAL Cost Option (b) Loose Riprap)*

Hardy CREEK Channel Improvements **SECTION I** **(Length 200.00' east/downstream from Alameda Dr. Bridge)**

Pay Item Description	Quantity	Unit	Unit Price	Total Cost
Mobilization Option (a)	1	LS	5%	$29,474.04
Mobilization Option (b)	1	LS	5%	$1,142.82
RIPRAP Option:				
a) Riprap - Gabion Mat				
East Bank	729.56	SY	202.00	$147,370.22
West Bank	729.56	SY	202.00	$147,370.22
West Bank Total option (a)				**$294,740.44**
b) Riprap				
Finish Grading (East Bank)	596.22	SY	0.16	$95.40
Geotextile Fabric (East Bank)	729.56	SY	2.57	$1,874.96
Riprap-Loose (200 lbs)(East Bank)	59.62	TN	60.00	$3,577.33
Finish Grading (West Bank)	596.22	SY	0.16	$95.40
Geotextile Fabric (West Bank)	729.56	SY	2.57	$1,874.96
Riprap-Loose (200 lbs)(West Bank)	59.62	TN	60.00	$3,577.33
Total option (b)				**$11,095.37**
	SECTION II	**(Length 200.00' east/downstream from Alameda Dr. Bridge**		
a) Riprap - Gabion Mat				
East Bank	729.56	SY	202.00	$147,370.22
West Bank	729.56	SY	202.00	$147,370.22
Total option (a)				**$294,740.44**
b) Riprap				
Finish Grading (East Bank)	632.00	SY	0.16	$101.12
Geotextile Fabric (East Bank)	773.33	SY	2.57	$1,987.46
Riprap-Loose (200 lbs)(East Bank)	63.20	TN	60.00	$3,791.97
Finish Grading (West Bank)	632.00	SY	0.16	$101.12
Geotextile Fabric (West Bank)	773.33	SY	2.57	$1,987.46
Riprap-Loose (200 lbs)(West Bank)	63.20	TN	60.00	$3,791.97
Total option (b)				**$11,761.10**

Unit prices were averaged from several sources available to Chester Engineers, Inc.

HARDY CREEK CONT.

NEAR TERM PROTECTION MEASURES
ALAMEDA DRIVE BRIDGE CONVEYANCE CHANNEL BANK STABILIZATION PROJECT
ESTIMATED QUANTITIES

$22,856.47 TOTAL _ Loose Riprap Option **(b)** (without 5% mobilization)
$1,142.82 (Mobilization)
$23,999.29 (Grand total including mobilization)

$589,480.89 TOTAL _ Gabion Mat Option **(a)** (without 5% mobilization)
$29,474.04 (Mobilization)
$618,954.93 (Grand total including mobilization)

Section I

				Area SY
Length (ft) =	200.00	a) grading		596.22
Slopes width =	26.83	b)geotextile	32.83	729.56
		c)Rip Rap Loose 200lb		59.62

Section II

				Area SY
Length (ft) =	200.00	a) grading		596.22
Slope width =	26.83	b)geotextile	32.83	729.56
		c)Rip Rap Loose 200lb		59.62

Section III

				Area SY
Length (ft) =	0.00	a) grading		0.00
Slope width =	0.00	b)geotextile	6.00	0.00
		c)Rip Rap Loose 200lb		0.00

CANY CREEK

NEAR TERM PROTECTION MEASURES

COOPER ROAD BRIDGE, BIENVILLE ROAD AND MCDOWELL ROAD BRIDGE
VARIOUS CONVEYANCE CHANNEL BANK STABILIZATION PROJECTS
BUDGETARY COST ESTIMATE

Drainage Improvements Plan _ City of Jackson, Mississippi **Preliminary Cost Estimate** 16-Apr-13

$ 2,937,912.11 ***(TOTAL Cost Option (a) Gabion Mat)***

$ 116,475.92 ***(TOTAL Cost Option (b) Loose Riprap)***

CANY CREEK Channel Improvements	**SECTION I**	**(Length 515.00' south of Cooper Rd Bridge)**		
Pay Item Description	**Quantity**	**Unit**	**Unit Price**	**Total Cost**
Mobilization Option (a)	1.00	LS	5%	$139,900.58
Mobilization Option (b)	1.00	LS	5%	$5,546.47
RIPRAP Option:				
a) Riprap - Gabion Mat				
East Bank Total option (a)	2,152.70	SY	202.00	$434,845.40
b) Riprap				
Finish Grading (East Bank)	1,809.37	SY	0.16	$289.50
Geotextile Fabric (East Bank)	2,152.70	SY	2.57	$5,532.44
Riprap-Loose (200 lbs)(East Bank)	180.94	TN	60.00	$10,856.20
Total option (b)				**$16,678.14**
	SECTION II	**(Length 500.00' north of Cooper Rd Bridge)**		
a) Riprap - Gabion Mat				
East Bank	1,722.22	SY	202.00	$347,888.89
West Bank	1,722.22	SY	202.00	$347,888.44
Total option (a)				**$695,777.33**
b) Riprap				
Finish Grading (East Bank)	1,388.89	SY	0.16	$222.22
Geotextile Fabric (East Bank)	1,722.22	SY	2.57	$4,426.11
Riprap-Loose (200 lbs)(East Bank)	138.89	TN	60.00	$8,333.40
Finish Grading (West Bank)	1,388.89	SY	0.16	$222.22
Geotextile Fabric (West Bank)	1,722.22	SY	2.57	$4,426.11
Riprap-Loose (200 lbs)(West Bank)	138.89	TN	60.00	$8,333.40
Total option (b)				**$25,963.46**
	SECTION III	**(Length 1474.00' Bienville Rd to W. Mc. Dowell Bridge)**		
a) Riprap - Gabion Mat				
East Bank	4,127.20	SY	202.00	$833,694.40
West Bank	4,127.20	SY	202.00	$833,694.40
Total option (a)				**$1,667,388.80**
b) Riprap				
Finish Grading (East Bank)	3,144.53	SY	0.16	$503.13
Geotextile Fabric (East Bank)	4,127.20	SY	2.57	$10,606.90
Riprap-Loose (200 lbs)(East Bank)	314.45	TN	60.00	$18,867.20
Finish Grading (West Bank)	3,144.53	SY	0.16	$503.13
Geotextile Fabric (West Bank)	4,127.20	SY	2.57	$10,606.90
Riprap-Loose (200 lbs)(West Bank)	314.45	TN	60.00	$18,867.20
Total option (b)				**$59,954.46**

Unit prices were averaged from several sources available to Chester Engineers, Inc.

CANY CREEK CONT.

NEAR TERM PROTECTION MEASURES

COOPER ROAD BRIDGE, BIENVILLE ROAD AND MCDOWELL ROAD BRIDGE
VARIOUS CONVEYANCE CHANNEL BANK STABILIZATION PROJECTS
ESTIMATED QUANTITIES

$110,929.45 TOTAL _ Loose Riprap Option **(b)** (without 5% mobilization)
$5,546.47 (Mobilization)
$116,475.92 (Grand total including mobilization)

$2,798,011.53 TOTAL _ Loose Riprap Option **(a)** (without 5% mobilization)
$139,900.58 (Mobilization)
$2,937,912.11 (Grand total including mobilization)

Section I					Area SY
	Length (ft) =	515.00	a) grading		1,809.37
	Slope width =	31.62	b)geotextile	37.62	2,152.70
			c)Rip Rap Loose 200lb		180.94
Section II					Area SY
	Length (ft) =	500.00	a) grading		1,388.89
	Slope width =	25.00	b)geotextile	31.00	1,722.22
			c)Rip Rap Loose 200lb		138.89
Section III					Area SY
	Length (ft) =	1,474.00	a) grading		3,144.53
	Slope width =	19.20	b)geotextile	25.20	4,127.20
			c)Rip Rap Loose 200lb		314.45

THREE MILE CREEK

NEAR TERM PROTECTION MEASURES
TERRY ROAD CONVEYANCE CHANNEL BANK STABILIZATION PROJECT
BUDGETARY COST ESTIMATE

Drainage Improvements Plan _ City of Jackson , Mississippi — Preliminary Cost Estimate — 16-Apr-13

$ 1,381,190.49 *(TOTAL Cost Option (a) Gabion Mat)*

$ 52,593.77 *(TOTAL Cost Option (b) Loose Riprap)*

THREE MILE CREEK_CANAL Improvements — **SECTION I** (Length 280.00 '_Location: 340' east of Terry Rd)

Pay Item Description	Quantity	Unit	Unit Price	Total Cost
Mobilization Option (a)	1	LS	5%	$60,959.80
Mobilization Option (b)	1	LS	5%	$2,504.47
RIP RAP Options:				
a) Riprap - Gabion Mat				
EB, WB & Channel Bottom Total option (a)	1,762.44	SY	202.00	$356,013.78
b) Riprap- Loose				
Finish Grading (EB, WB & Channel Bottom)	1,575.78	SY	0.16	$252.12
Geotextile Fabric (EB, WB & Channel Bottom)	1,762.44	SY	2.57	$4,529.48
Riprap-Loose (200 lbs)(EB, WB & Channel Bottom)	157.58	TN	60.00	$9,454.67
Total option (b)				$14,236.27
SECTION II (Length 123.53'_Location: 340' east of Terry Rd)				
a) Riprap - Gabion Mat				
EB, WB & Channel Bottom Total option (a)	1,245.87	SY	202.00	$251,665.47
b) Riprap				
Finish Grading (EB, WB & Channel Bottom)	1,163.52	SY	0.16	$186.16
Geotextile Fabric (EB, WB & Channel Bottom)	1,245.87	SY	2.57	$3,201.88
Riprap-Loose (200 lbs)(EB, WB & Channel Bottom)	116.35	TN	60.00	$6,981.09
Total option (b)				$10,369.14
SECTION III (Length 230'_Location: 230' east of Terry Rd. Bridge)				
a) Riprap - Gabion Mat				
EB, WB & Channel Bottom Total option (a)	3,027.31	SY	202.00	$611,516.84
b) Riprap				
Finish Grading (EB, WB & Channel Bottom)	2,873.98	SY	0.16	$459.84
Geotextile Fabric (EB, WB & Channel Bottom)	3,027.31	SY	2.57	$7,780.19
Riprap-Loose (200 lbs)(EB, WB & Channel Bottom)	287.40	TN	60.00	$17,243.87
Total option (b)				$25,483.89

Unit prices were averaged from several sources available to Chester Engineers, Inc.

THREE MILE CREEK CONT.

NEAR TERM PROTECTION MEASURES
TERRY ROAD CONVEYANCE CHANNEL BANK STABILIZATION PROJECT
ESTIMATED QUANTITIES

$50,089.30 TOTAL _ Loose Riprap Option **(b)** (without 5% mobilization)
$2,504.47 (Mobilization)
$52,593.77 (Grand total including mobilization)

$1,219,196.10 TOTAL _ Gabion Mat Option **(a)** (without 5% mobilization)
$60,959.80 (Mobilization)
$1,280,155.90 (Grand total including mobilization)

Section I					Area SY
	Length (ft) =	280.00	a) grading		1,575.78
	Slope and Channel bottom width =	50.65	b)geotextile	56.65	1,762.44
			c)Rip Rap Loose 200lb		157.58
Section II					Area SY
	Length (ft) =	123.53	a) grading		1,163.52
	Slope and Channel bottom width =	84.77	b)geotextile	90.77	1,245.87
			c)Rip Rap Loose 200lb		116.35
Section III					Area SY
	Length (ft) =	230.00	a) grading		2,873.98
	Slope and Channel bottom width =	112.46	b)geotextile	118.46	3,027.31
			c)Rip Rap Loose 200lb		287.40

WHITE OAK CREEK

IMMEDIATE MITIGATION MEASURES
COLONIAL CIRLE CONVEYANCE CHANNEL BANK STABILIZATION PROJECT
BUDGETARY COST ESTIMATE AND ESTIMATED QUANTITIES

City of Jackson, CDIP Opinion of Probable Cost
03/10/13

White Oak Creek Basin - Colonial Circle Drainage Improvemens

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
	BASE BID				
1	Mobilization	1	LS	$5,000.00	$5,000.00
2	Clearing and Grubbing	1	LS	$2,000.00	$2,000.00
3	Erosion Control	1	LS	$1,000.00	$1,000.00
49	Geotextile Fabric	500	SY	$1.50	$750.00
56	Unclassified Excavation (LVM)	500	CY	$12.00	$6,000.00
58	24" Thick 200 LB Rip Rap	310	TONS	$60.00	$18,600.00
TOTAL BASE BID					**$26,350.00**
ENGINEERING/DESIGN/BIDDING/CONSTRUCTION INSPECTION (~15%)					
GRAND TOTAL DESIGN & CONSTRUCTION (PHASE I)					**$26,350.00**

WHITE OAK CREEK CONT.

IMMEDIATE MITIGATION MEASURES
OLD CANTON ROAD STORM WATER DETENTION/ATTENUATION POND
BUDGETARY COST ESTIMATE AND ESTIMATED QUANTITIES

Drainage I Improvements Plan _ City of Jackson , Mississippi 4/17/2013
Preliminary Cost Estimate

0.56-Acre Detention/Attenuation Pond (just south of Canton Rd) **$ 111,826.71**

Pond Component

Pay Item Description	Quantity	Unit	Unit Price	Total Cost
Mobilization	1	LS	10%	$10,711.06
Clearing and Grubbing	0.56	AC	15000	$8,400.00
Common Excavation	3,700.00	CY	9	$33,300.00
Prepare Soil Layer, Finish soil 6"	3,557.39	SY	0.85	$3,023.78
Performance Turf (Sod)	2,313.00	SY	1.63	$3,770.19
Excess of excavation	3,000.00	CY	9	$27,000.00
SUB-TOTAL				**$75,493.97**

Drainage Component

60" Flared Headwall & End wall Sections	2.00	EA	4300	$8,600.00
60" CMP with Flap gate	100.00	LF	170	$17,000.00
SUB-TOTAL				**$25,600.00**
Access Road to provide maintenance. Entrance through Westbrook Rd	666.67	SY	0.85	**$566.67**
Total				101660.64

Notes and Assumptions: Maintenance Road to be compacted to 97% of AASHOT T99 Density, cost to be included in Prepare Soil Layer, Finish Soil 6". Lining it with grass (sod). Unit prices were averaged from several sources available to Chester Engineers, Inc.

$101,660.64 (total without 10% mobilization)
$10,166.06 (Mobilization)
$111,826.71 (Grand total including mobilization)

WHITE OAK CREEK CONT.

IMMEDIATE MITIGATION MEASURES
COLONIAL CIRCLE
CONVEYANCE CHANNEL BANK STABILIZATION PROJECT
BUDGETARY COST ESTIMATE AND ESTIMATED QUANTITIES

City of Jackson, CDIP Opinion of Probable Cost
03/10/13

White Oak Creek Basin - Colonial Circle Drainage Improvemens

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
	BASE BID				
1	Mobilization	1	LS	$5,000.00	$5,000.00
2	Clearing and Grubbing	1	LS	$2,000.00	$2,000.00
3	Erosion Control	1	LS	$1,000.00	$1,000.00
49	Geotextile Fabric	500	SY	$1.50	$750.00
56	Unclassified Excavation (LVM)	500	CY	$12.00	$6,000.00
58	24" Thick 200 LB Rip Rap	310	TONS	$60.00	$18,600.00
TOTAL BASE BID					**$26,350.00**

BOGUE CHITTO CREEK

IMMEDIATE AND NEAR TERM MITIGATION MEASURES
PRESIDENTIAL HILLS SUBDIVISION
DRAINAGE DITCH IMPROVEMENTS PROJECT
BUDGETARY COST ESTIMATE AND ESTIMATED QUANTITIES

City of Jackson, CDIP Opinion of Probable Cost
03/10/13

Presidential Hills Immediate Action

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
	BASE BID				
1	Mobilization	1	LS	$5,000.00	$5,000.00
2	Clearing and Grubbing	1	LS	$5,000.00	$5,000.00
3	Erosion Control	1	LS	$3,000.00	$3,000.00
5	36" Reinforced Concrete Pipe, Class III	30	LF	$90.00	$2,700.00
6	42" Reinforced Concrete Pipe, Class III	60	LF	$110.00	$6,600.00
7	36" HDPE Pipe (includes Bedding)	120	LF	$75.00	$9,000.00
8	42" HDPE Pipe (includes Bedding)	240	LF	$90.00	$21,600.00
14	Concrete Headwall	3	EA	$1,500.00	$4,500.00
15	Concrete Curb Inlet	4	EA	$3,500.00	$14,000.00
16	Trapezoidal Grass Lined Ditch 4'Wx3'D & Remove Excess Mat.	1,000	CY	$12.00	$12,000.00
28	Removal of Asphalt Pavement (All Depths)	200	SY	$10.00	$2,000.00
29	Channel Excavation (FM) Cut	1,000	CY	$15.00	$15,000.00
34	Hydroseeding	1.8	AC	$4,000.00	$7,200.00
TOTAL BASE BID					**$97,600.00**
ENGINEERING/DESIGN/BIDDING/CONSTRUCTION INSPECTION (~15%)					
GRAND TOTAL DESIGN & CONSTRUCTION (PHASE I)					**$97,600.00**

LYNCH CREEK

IMMEDIATE MITIGATION MEASURES
JOHN LYNCH STREET DRAINAGE IMPROVEMENTS
[JR LYNCH STREET, TUNICA STREET TO HATTIESBURG STREET AT CATHOLIC CHURCH STORM DRAIN AND INLETS, CURB & GUTTER, SIDEWALK AND STREET PAVING]
BUDGETARY COST ESTIMATE AND ESTIMATED QUANTITIES

City of Jackson, CDIP Opinion of Probable Cost
03/10/13

LYNCH STREET DRAINAGE IMPROVEMENTS - IMMEDIATE MITIGATION MEASURES

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
	BASE BID				
1	Mobilization	1	LS	$5,000.00	$5,000.00
3	Erosion Control	1	LS	$1,000.00	$1,000.00
4	24" Reinforced Concrete Pipe, Class III	160	LF	$75.00	$12,000.00
15	Concrete Manhole	4	EA	$3,000.00	$12,000.00
16	Concrete Curb Inlet	4	EA	$3,500.00	$14,000.00
16	Concrete Curb & Gutter	290	EA	$15.00	$4,350.00
17	4' Wide Concrete Walk	130	SY	$35.00	$4,550.00
28	Removal of Asphalt Pavement (All Depths)	320	SY	$3.00	$960.00
29	Removal of Concrete Curb and Gutter	290	LF	$3.00	$870.00
30	Removal of Concrete Walk	130	SY	$5.00	$650.00
31	Removal of Concrete Inlet	1	EA	$500.00	$500.00
39	Hot Mix Asphalt, MT, 12.5-mm Mixture	35	TON	$100.00	$3,500.00
43	Granular Material (LVM)(Roadway)	38	CY	$30.00	$1,140.00
TOTAL BASE BID					**$55,520.00**
ENGINEERING/DESIGN/BIDDING/CONSTRUCTION INSPECTION (=15%)					
GRAND TOTAL DESIGN & CONSTRUCTION (PHASE I)					**$55,520.00**

PRIMOS AVENUE AT OAKMONT DRIVE
RIP RAP CHANNEL PROTECTION
BUDGETARY COST ESTIMATE AND ESTIMATED QUANTITIES

City of Jackson, CDIP Opinion of Probable Cost
03/10/13

Lynch Creek - Primos Avenue

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
	BASE BID				
1	Mobilization	1	LS	$5,000.00	$5,000.00
2	Clearing and Grubbing	1	LS	$5,000.00	$5,000.00
3	Erosion Control	1	LS	$1,500.00	$1,500.00
36	Channel Excavation (FM) Cut	500	CY	$15.00	$7,500.00
38	Borrow Excavation (FM)	800	CY	$20.00	$16,000.00
52	Geotextile Fabric	3,400	SY	$1.50	$5,100.00
61	24" Thick 200 LB Rip Rap	3,350	TONS	$60.00	$201,000.00
TOTAL BASE BID					**$231,100.00**
ENGINEERING/DESIGN/BIDDING/CONSTRUCTION INSPECTION (=15%)					
GRAND TOTAL DESIGN & CONSTRUCTION (PHASE I)					**$231,100.00**

Lynch Creek Drainage Infrastructure Improvements
St Charles Street - Robinson Road - Lynch Street

PHASE I: Immediate Near Term Mitigation Measures -2013					$ 474,000
Localized 2 FT Protective Earthen Berm				$ 73,000	
Casa Grande Subdivision	1050	LF	$ 38,000		
(Myer Ave/Casa Grande Cr)					
Mathews Estates / Pecan Park Subdivisions	900	LF	$ 35,000		
(Hemmingway Cr/Ellis Ave Bridge)					
Catchment Basin Installations				$ 35,000	
Casa Grande Subdivision			$ 10,000		
(Myer Ave/Casa Grande Cr)	2	EA			
Mathews Estates / Pecan Park Subdivisions			$ 15,000		
(Hemmingway Cr/Ellis Ave Bridge)	3	EA			
Sylvan Glen Subdivision			$ 20,000		
(Melanie Road, Gentilly Dr., Shrewsbury Ct)	4	EA			
Channel Debris Removal				$ 366,000	
St Charles/Robinson Rd	2000	LF	$ 200,000		
Robinson Rd/Lynch St	1660	LF	$ 166,000		
PHASE II: Near Term Protection Measures					$ 4,314,000
Channel Dredging 25 YR Storm				$ 3,660,000	
St Charles/Robinson Rd	2000	LF	$ 2,000,000		
Robinson Rd/Lynch St	1660	LF	$ 1,660,000		
Channel Bank Stabilization [Rip Rap/Gabion Baskets] 25 YR Storm				$ 2,196,000	
St Charles/Robinson Rd	2000	LF	$ 1,200,000		
Robinson Rd/Lynch St	1660	LF	$ 996,000		
PHASE III: Long Range Improvements -2015					$ 2,118,000
Primos Ave Stormwater Detenion/Attenuation Pond				$ 1,122,000	
Primos Ave	8	AC	$ 1,122,000		
Channel Dredging /Widening 50 YR Storm				$ 996,000	
Robinson Rd/Lynch St	1660	LF	$ 996,000		
Channel Dredging /Widening 50 YR Storm					
	62240	CY			
LYNCH CREEK IMPROVEMENTS ESTIMATED CONSTRUCTION COSTS					$ 6,906,000

Queen Lane Subdivision

PHASE I: Immediate Near Term Mitigation Measures -2013					$ 210,000
Catchment Basin Installations				$ 10,000	
Queen Lane			$ 10,000		
(Queen Eleanor Lane)	2	EA			
Channel Debris Removal				$ 200,000	
Queen Eleanor Lane	2000	LF	$ 200,000		
Short Term Protection Measures - 2014					$ 600,000
Channel Bank Stabilization [Rip Rap] 10 YR Storm				$ 600,000	
Queen Eleanor Lane	1500	LF	$ 600,000		
PHASE III: Long Range Improvements -2015					$ -
TBD	0			$ -	
Queen Lane			$ -		
LYNCH CREEK IMPROVEMENTS ESTIMATED CONSTRUCTION COSTS					$ 810,000

PURPLE CREEK

IMMEDIATE MITIGATION MEASURES
RIVIERA STREET DRAINAGE IMPROVEMENTS
BUDGETARY COST ESTIMATE AND ESTIMATED QUANTITIES

City of Jackson, CDIP Opinion of Probable Cost
03/10/13

Purple Creek Riviera Street Drainage Imiprovements'

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
	BASE BID				
1	Mobilization	1	LS	$5,000.00	$5,000.00
3	Erosion Control	1	LS	$500.00	$500.00
4	24" Reinforced Concrete Pipe, Class III	120	LF	$75.00	$9,000.00
16	Concrete Curb & Gutter	50	LF	$15.00	$750.00
28	Removal of Asphalt Pavement (All Depths)	25	SY	$3.00	$75.00
29	Removal of Concrete Curb and Gutter	50	LF	$3.00	$150.00
32	Removal of Concrete Pipe	120	LF	$15.00	$1,800.00
40	Hot Mix Asphalt, MT, 12.5-mm Mixture	6	TON	$100.00	$600.00
44	Granular Material (LVM)(Roadway)	7	TON	$45.00	$315.00
TOTAL BASE BID					**$13,190.00**
ENGINEERING/DESIGN/BIDDING/CONSTRUCTION INSPECTION (=15%)					
GRAND TOTAL DESIGN & CONSTRUCTION (PHASE I)					**$13,190.00**

HANGING MOSS CREEK

NEAR TERM PROTECTION MEASURES
LIVINGSTON ROAD CONVEYANCE CHANNEL BANK STABILIZATION PROJECT
BUDGETARY COST ESTIMATE AND ESTIMATED QUANTITIES

City of Jackson, CDIP Opinion of Probable Cost
03/10/13

Hanging Moss Creek - Livingston Road Drainage Improvements

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
	BASE BID				
1	Mobilization	1	LS	$5,000.00	$5,000.00
2	Clearing and Grubbing	1	LS	$5,000.00	$5,000.00
3	Erosion Control	1	LS	$1,500.00	$1,500.00
49	Geotextile Fabric	1,200	SY	$1.50	$1,800.00
56	Unclassified Excavation (LVM)	500	CY	$12.00	$6,000.00
58	24" Thick 200 LB Rip Rap	420	TONS	$60.00	$25,200.00
59	Gabion Baskets	354	CY	$75.00	$26,550.00
TOTAL BASE BID					**$61,050.00**
ENGINEERING/DESIGN/BIDDING/CONSTRUCTION INSPECTION (=15%)					
GRAND TOTAL DESIGN & CONSTRUCTION (PHASE I)					**$61,050.00**

BIG CREEK

IMMEDIATE MITIGATION MEASURES
HIDDEN VALLEY DRIVE CONVEYANCE CHANNEL BANK STABILIZATION PROJECT
BUDGETARY COST ESTIMATE AND ESTIMATED QUANTITIES

City of Jackson, CDIP Opinion of Probable Cost
03/10/13

Big Creek Basin -Hidden Valley Immediate Action

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
	BASE BID				
1	Mobilization	1	LS	$10,000.00	$10,000.00
2	Clearing and Grubbing	2	LS	$10,000.00	$18,000.00
3	Erosion Control	1	LS	$5,000.00	$5,000.00
52	Geotextile Fabric	11,000	SY	$1.50	$16,500.00
59	Unclassified Excavation (LVM)	4,600	CY	$12.00	$55,200.00
61	24" Thick 200 LB Rip Rap	9,400	TONS	$60.00	$564,000.00
TOTAL BASE BID					**$640,700.00**

Researched Regional CIP Programs
Mobile, AL; Shreveport, LA; Baton Rouge, LA; Columbia, SC; Bay County, Florida; Raleigh, NC; Columbia County, GA;, Athens/Clark County, GA; Griffin, GA

Populations ranging from about 30,000 to 400,000.

Most have at least inventoried their systems and prioritized areas for further study or specific projects. Many have developed Capital Improvement Plans that range from 5 – 20 years in duration, with periodic updates occurring during the longer time frames. Yearly project costs range from about $2 million to over $10 million depending on funding. Most of these programs have a dedicated funding source such as a stormwater utility or specialized tax that can be used not only to directly fund projects but also to leverage as matching funds for available grants or as revenue streams for bond issues.

Most of these cities have problems similar to Jackson – channels eroding, clogged facilities resulting in loss of capacity, etc. But it's apparent that they are much farther along in the identification and development of their programs and projects, especially those with utilities, where typically a master plan was performed as the basis for the utility structure and funding levels.

Some specific examples:

Mobile -- $1.6 - $2 million in projects for 2013
Raleigh – completed 125 individual projects for about $31 million since 2004
Bay County – generates $1.5 million a year, 5-year CIP includes about $18.5 million in projects
Baton Rouge – uses General Fund as well as gaming revenues for infrastructure projects -- $14.7 million in "bridge and drainage" projects in 2012
Athens/Clark County – 5-year CIP at about $3.4 million/year