6.1 SCOPE OF PROJECT

The confluence of Wolf River Lateral J with the Wolf River occurs approximately 3,070 feet west, as the crow flies, from the Collierville- Arlington Road crossing of the River. The stream reach of interest is from this confluence to the Shelton Road crossing of Lateral J. The length of this reach measured along the flow line of the channel is 4,017 lineal feet. The outfall from the Shelton Road wastewater treatment plant (wwtp) which consists of two (2) 24-inch diameter pipe lines runs parallel to the west bank of the stream. Records show that since 1994 the elevation of the flow line of the lateral has lowered approximately 6 feet. These same records show that the channel bottom at the Shelton Road bridge crossing has lowered approximately 1.9 feet.

The lowering of the bottom is attributed to head cutting which has occurred over the years in response to head cutting that has occurred in the Wolf River channel. In 2006 a project stabilize the stream banks and bottom gradient of the Wolf River between the bridge at Houston Levee Road and Collierville – Arlington Road was completed by the US Army Corps of Engineers. The stabilization of the Wolf River bottom gradient has eliminated the primary cause of the head cutting.

A hydraulic analysis of Lateral J was conducted. As a result of this analysis it was determined that a stable stream gradient for the lateral is 0.00112 ft./ft. (0.112%). By analyzing the profile of the existing stream it was determined that from the mouth of the lateral continuing for approximately 2,500± lineal feet upstream the bottom gradient approximates the stable stream gradient. However, the bottom gradient of the remainder of the stream up to the bridge at Shelton Road is significantly steeper. The bottom would be approximately 5 feet lower at Shelton Road if the stable gradient is projected upstream from the current stream bottom of the lateral at its mouth to the bridge crossing.

As a result of the head cutting, even though the downstream reach is at a stable bottom gradient, the bottom is incised. The banks have steep, unstable side slopes. The stream banks are eroding in such a manner that eventually a stable slope will be established. If this erosion is not controlled it is probable that the outfall lines from the wwtp will be undermined.

Although the lower 2,500 lineal feet of the lateral's stream bottom appears stable, the flowline of the Wolf River channel opposite the mouth of the lateral is approximately 8 feet lower than that of Lateral J at its mouth. There is the possibility that long term the gradient of the lateral could continue to degrade until the flowline of the River bottom is reached.

The confluence of Lateral J with the Wolf River is near the middle of the outside of a hairpin bend in the River channel. The river bank on the outside of the bend is actively eroding so that the top of the near vertical banks is moving south.

The purpose of the project is twofold. Stabilize the bottom gradient to prevent any future head cutting; and, establish stable stream bank slopes in areas where uncontrolled bank erosion will result in the undermining and failure of adjacent infrastructure. Presently there is concern about the stability of the sanitary sewer outfall lines from the Shelton Road waste water treatment plant which discharges into the Wolf River. There is approximately 1,020 lineal feet of two (2) side by side 24-inch diameter sewer lines running parallel to the stream bank that is in danger of being undermined by stream bank erosion.

The bottom gradient will be stabilized using four (4) grade control structures. The structures will consist of sheet pile; trapezoidal shaped weirs with rip-rap slope protection up and downstream of the weir. The length of the slope protection varies at each structure based upon the stream hydraulics.

The downstream most grade control will be set so that the flowline of the weir is at the existing stream bottom. The pile tip of the sheet pile wall will be set deep enough to protect against the possibility of Wolf River undercutting the structure. The sheet pile structure shall be extended into the banks to preclude the stream flows in the lateral from flanking the structure. The east side of the structure will be battered and extended into the banks to protect against the possibility that the river bank on the outside of the bend does not erode past the end of the structure.

The upstream most structure will be located approximately 200 feet downstream of the bridge at Shelton Road. This is at the point where the most recent round of head cutting had progressed as evidenced by the undermining of a waterline crossing. The flow line of the weir will be set at approximately the same elevation as the existing stream flowline at the downstream face of the bridge. This will set the lip of the weir approximately 2 feet above the current stream bottom at that point. This will create an instream pool behind the weir. It is ***likely*** that over time the area upstream of the weir would fill with silt. ***A pair of sheet piles near the center of the weir will be dropped 6-inches below the flowline of the weir. This will insure that should the area behind the weir silt up that a low flow thalweg will form.*** The two foot drop across the weir will create a scour potential. Rip rap will be used to armor against scour.

There will be two additional intermediate grade control structures. Their positions were determined by the projection upstream of the established stable gradient. Each weir will be stepped approximately 2 feet such that the 6 feet of vertical change that has occurred in the past 23 years is counterbalanced. The conditions upstream and downstream of the intermediate structures are similar to those of the upstream most structure.

There are several areas where the stream banks will be regraded to establish a stable slope. In those area where stream hydraulics allow permanent turf reinforcement matting (TRM) will be used to stabilize the slopes. Prior to installing the TRM the slopes will be seeded with a seed mixture of natural grasses and forbs. Rip rap will be used only in those areas with hydraulic conditions preclude the use of TRM. The hydraulic model created to aid in the analysis and design of the stream stabilization indicates that the stream flows often running bank full or out of banks. The plan is to install the rip rap and TRM from toe to the top of bank to protect against erosion when the stream is flowing bank full. This will also protect the banks from the effects of erosion caused when the flood waters recede and the waters flow across the top bank when re-entering the stream channel flow.

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In order to control scour rip rap will be placed across the stream bottom downstream of the three (3) upstream weirs. The length of the bottom rip rap blanket will be 50 feet. There is existing rip rap across the full stream channel section between the most upstream grade control structure and the Shelton Road bridge crossing. This rip rap will be reshaped and supplemented to provide the needed protection against erosion immediately downstream of the bridge.

The table below lists the locations the grade control structures and the locations and lengths of the planned stream bank and bottom stabilization measures.

STREAM STABILIZATION MEASURES

LOCATION		LENGTH OF STABILIZTION MEASURES				
		LEFT BANK		BOTTOM	RIGHT BANK	
FROM	TO	RIP RAP	TRM	RIP RAP	RIP RAP	TRM
0+40	1+75				130	
1+75	2+05	30			30	
2+05		GRADE CONTROL STRUCTURE No. 1				
2+05	3+30	125			125	
3+30	3+50	20				20
3+50	5+25					175
9+00	14+00					500
21+00	21+50				50	
21+50	23+00					150
23+00	24+70					170
24+70	24+95	25			25	
24+95	25+45	50		50	50	
25+45		GRADE CONTROL STRUCTURE No. 2				
25+45	26+50	15			105	
26+50	28+00				150	
30+00	31+57					157
31+57	32+07	50		50	50	
32+07		GRADE CONTROL STRUCTURE No. 3				
32+07	32+65	58			58	
32+65	36+90					
36+90	38+00					110
38+00	38+18	18			18	
38+18	38+68	50		50	50	
38+68		GRADE CONTROL STRUCTURE No. 4				
38+68(1)	40+57(2)	189		189	189	

LEFT BANK RIP RAP(3) 630

LEFT BANK TRM 0

BOTTOM RIP RAP(3) 339

RIGHT BANK RIP RAP(3) 1,030

RIGHT BANK TRM 1,282

TOTAL STREAM LENGTH MEASURED ALONG FLOWLINE OF CHANNEL IS 4,017 L.F.

(1) Existing rip rap from here to bridge to be reshaped and supplimented.
(2) Downstream face of Shelton Road bridge crossing.
(3) Includes 189 lineal feet of existing rip rap to be reshaped and supplimented

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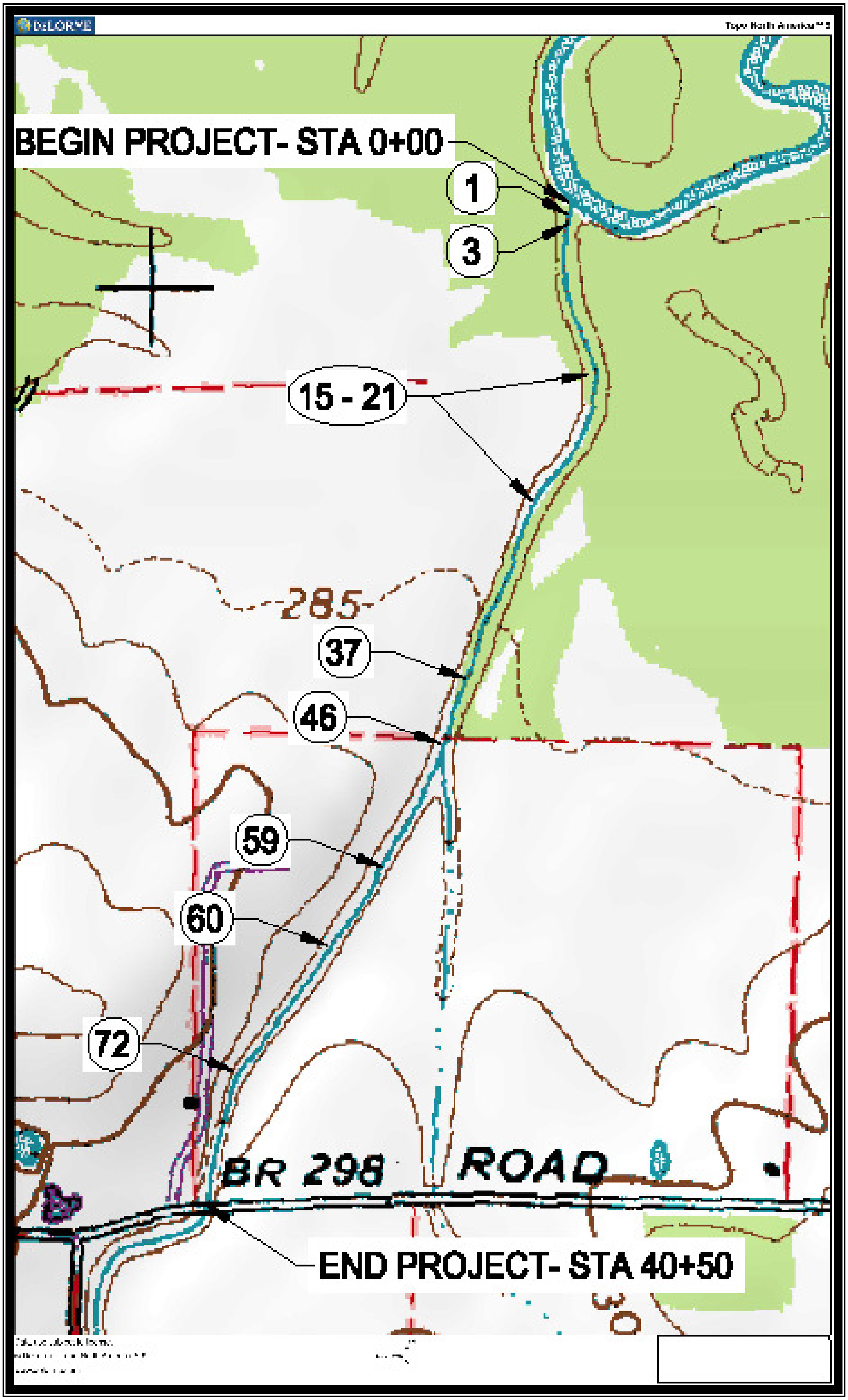
6.2 USGS MAP



DeLORME
BEGIN PROJECT- STA 0+00
1
3
15 - 21
285
37
46
59
60
72
BR 298
ROAD
END PROJECT- STA 40+50

6.3 PHOTOGRAPHS

An inventory of existing conditions along the reach of Wolf River Lateral J was performed on April 22, 2016. A copy of the report and photo log of the inventory results entitled “Wolf River Lateral “J” Collierville, TN Field Inventory April 22, 2016 Photo Log” is attached.

The locations of key points of interest are noted on the vicinity map. The numbers on the map reference a particular figure or group of figures in the report. Those key points are as follows:

Figure No.	Description
1	Unstable vertical bank on the outside of the bend in the Wolf River channel
3	Location of Grade Control Structure No. 1 – approximately 150± feet upstream of the mouth of Wolf River Lateral J
15 -21	Unstable West bank of Lateral J where active failures and erosion are occurring; threatening to undermine the outfall lines from the Shelton Road WWTP
37	Uncontrolled bank erosion downstream of storm drain culvert
46	Approximate location of Grade Control Structure No. 2
59 – 60	Grade Control Structure No. 3 is between these two locations
72	Grade Control Structure No. 4 located just downstream of waterline crossing shown in the photo. This waterline was undermined by head cutting in 2014 and was removed and re-routed.

6.4 EXISTING STREAM CHARACTERISTICS

The stream reach of Lateral J between its confluence with the Wolf River and the Shelton Road bridge crossing is irregular. There are some irregular meanders located between straight and/or mildly curving alignments. It is entrenched due to naturally occurring stream processes; however, the entrenchment has been greatly exacerbated by ongoing head cutting. It is documented that the stream bottom at its mouth has lowered approximately 6 feet in the past 23 years. The predominate soils types in the bank profile are silty clays with some traces of sand. It was determined from soils borings that there is an underlying layer of lean firm moist clay. Below the lean clay layer there is a continuous thick layer of fine to course sand. Occasionally the lean clay can be observed in the bottom of the stream channel. There are some isolated seams of sand, gravel or sandstone.

The channel depth varies from 14 feet to 9 feet. The bottom width varies from as wide as 42 feet in some of the channel bends to as narrow as 16 feet near the bridge crossing. Likewise, the top width of the channel varies widely – from 75 to 35 feet.

The stream gradient for the lower half of the stream reach is extremely mild, averaging 0.00112 feet/feet. Irregularities in the bottom create a mild pool and riffle affect. There is still active head cutting occurring in the upper half of the reach and the pools and riffles are more pronounced. There are sand and silt deposits forming point bars on the inside of the bends in the stream.

Throughout the majority of the reach the stream bank slopes are steep to very steep. Trees and shrubs along the top banks are the primary vegetation. At various locations along the stream banks the root systems of the trees have been undercut creating a concave bank slope. There are ongoing efforts to remove fallen trees from the channel; however, there are areas where unusual bank erosion has been caused and is occurring due to undercut trees falling into the channel.

There is an approximately 600 lineal foot section of the west stream bank where active slope erosion is ongoing. This erosion process occurs when weak vertical planes are created by downward seepage near the face of the near vertical bank. A crack then appears parallel to the top of bank along the weakened planes. The thin column of soil then sloughs off into the channel. The process then repeats itself. The following photo is of an area where the crack has formed but the column of soil has not yet collapsed into the stream channel. The red arrows point to either end of the crack. The black arrow and ellipse indicate the location of a sewer manhole on the waste water treatment plant outfall line.

SECTION 6.5 PROPOSED STREAM CHARACTERISTICS

The plans for the alterations to the Wolf River Lateral J were developed based upon the following goals and objectives:

1. Prevent head cutting from continuing in the future.
2. Establish a stable bottom gradient though out the reach.
3. Stabilize the stream banks to protect the sanitary sewer outfall line and other infrastructure from damage due to erosion of the banks.
4. Keep the existing horizontal alignment of the stream.
5. Avoid and minimize, when it is necessary, disturbing the stream bottom.

As a part of the design process a hydraulic model of the stream reach using HEC RAS was developed. The model was used to define the stable stream gradient to be used for design. Since the stream flows increase as you progress downstream, the model was used to define the best fit bottom width for a theoretical symmetrical trapezoidal channel section for sub-reaches. Three bottom widths were used 19.5, 18, and 15.5 feet. The widths decrease as you progress upstream.

A new stream bottom profile was defined using historic data. The stable stream gradient and the current stream bottom profile to best locate where “steps” in the flowline alignment should be placed to make up the 6 feet of vertical drop created by past head cutting. Sheet pile weirs were set at these locations to create a hard point control of the bottom gradient and channel flow geometry. The sheet piles are 3/8” thick and will create a “waffle” footprint 12-inches wide. The tumbling stream flow over the lip of the weir will require protection against bottom scour; therefore, 50 lineal feet rip rap will be placed on the bottom. Upstream of the weir a pool will be created in the bottom

Theoretical cross-sections for the entire reach were plotted using the stepped vertical alignment, the stable stream slope, and the best trapezoidal channel sections. These cross-sections were examined to determine where the projected bank slope of the ideal channel shape would impact existing infrastructure. This information was used to define the areas where the stream banks must be regraded and stabilized. Unless stream hydraulics would not allow it to be used the stream banks will be stabilized using permanent turf reinforcing mattings planted with a mixture of native grasses and forbs. In areas where necessary to insure long term stability, such as in the transitional flow areas just upstream and downstream of the weirs, the banks will be stabilized with rip rap.

Where there is no threat of ongoing bank erosion undermining existing public and private infrastructure the banks will not be altered.

SECTION 6.7 HYDROLOGIC DETERMINATIONS

The stream is known to be and acknowledged as a waters of the state; therefore, no additional hydrologic or jurisdictional reviews or determinations were sought.

SECTION 8.2 SEQUENCING OF EVENTS AND CONSTRUCTION METHODS; AND SECTION 8.3 EROSION PREVENTION AND SEDIMENT CONTROL.

For this project the two subjects are closely related. No construction equipment will be allowed to operate in the bottom of the channel. The work will proceed from downstream to upstream. No work related to the re-grading of the channel banks shall be undertaken until the sheet pile weir has been installed. The equipment required to drive the sheet piles shall be operated from the banks of the stream; it shall not be staged from the bottom. Any materials temporarily stored at the site shall be positioned a minimum of 20 feet from the existing top bank of the stream.

The weather forecast shall be closely monitored during the planning and implementation of the stream bank grading and stabilization activities. Only the amount of work that can be undertaken and completed during a forecast period of favorable weather shall be undertaken.

Each phase of the bank stabilization shall be treated as a separate job in that it must be inspected and found complete before work is begun on the next section of bank to be stabilized.

10.1 ALTERNATIVE ANALYSIS

This purpose of this project is to stabilize the gradient of the existing stream known as Wolf River Lateral J. The Wolf River has a history head cutting due to channelization of the lower Wolf in the 1960's to ameliorate severe flooding. Head cutting of the lateral streams and wet weather conveyances has been triggered by the lowering of the river bottom. This includes Lateral J. A project completed in 2007, to install grade control structures within the Wolf River has been successful in stabilizing the bottom gradient of the river between the Houston Levee Road and the Collierville-Arlington Road bridge crossings of the Wolf River. Records show that in the last 23 years the flowline of Wolf River Lateral J at its confluence with the river has dropped 6 feet.

There is no goal of the project related to improving or altering the stream to accommodate future development or reduce or control flooding. The reason for pursuing the project is to stop the stream from unraveling and stabilize those areas that have already unraveled to the point where infrastructure is in danger of exposer and possible collapse.

Other than the project that is planned there were no other practical solutions identified. The remaining alternative is to do nothing. If nothing is done then the ongoing head cutting will continue its slow but steady march upstream. In the first 2500± feet of stream upstream of its mouth the unstable banks are already sluffing and there is the possibility that the sewer outfall lines from the water treatment plant being undermined. This will require that emergency repairs to stabilize the banks be made as the need arises. If left uncontrolled and not stopped the head cutting will affect the stability of roadway and utility crossings of the stream. The first structure that will be threatened is the Shelton Road bridge crossing of the stream. A short distance upstream of the bridge is a raw sewerage collection line.

10.2 SOCIAL AND ECONOMIC IMPACTS

The no build alternative will result in the need to make emergency repairs to protect or restore infrastructure that has been made unstable due to the ongoing incising of the stream channel. Emergency repairs are more expensive that planned construction activities. Most often the work forces necessary to make the repairs are called out at odd hours and required to work continually until the situation can be brought under control.

It is usually required that a portion of a roadway be closed when a roadway crossing of a stream is affected by stream degradation. This increases the travel times of the general public and forces emergency responders to take longer routes which increases their response time.

The projects as planned will curtail the head cutting and stabilize the slopes where the sewer outfall lines are threatened.

SECTION 10.3 WATER RESOURCE DEGRADATION

This project will result in a de minimis degradation of water quality for the following reasons:

1. There will be no loss of stream length
2. There will be no loss of in stream habitat. Rather the creation of pools upstream of the grade control structures will introduce new habitat.
3. The longstanding and ongoing stream stability issues will be resolved.
4. The species composition will not be compromised. The elimination of silt from the stream that was in the past created both directly and indirectly by the head cutting will enhance the water quality and coincidently the habitat for any in stream species present.
5. The re-grading and stabilization of the banks using natural grasses and forbs in combination with a turf reinforcement matting will filter overbanks flows that previously ran over bare, un-vegetated slopes.
6. There will be some initial loss of stream canopy in some of the areas where there will be bank stabilization activities. ***Trees will be planted along the top banks in those areas where they kept a reasonable distance from the sewer outfall lines.***

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The objectives of this project do not include any measures to accommodate any development in the area.

SECTION 11.1, SECTION 11.2 and SECTION 11.3 MITIGATION, RESOURCE VALUE and MONITORING

The project will curtail the continue loss of stream resource due to the erosion that has been accelerated and exacerbated by the head cutting. This will result in no net loss of stream resources, thus there is no adverse impact to mitigate.

SECTION 11.4 PROTECTION MEASURES

The majority of the stream reach traverses land owned by either the Town of Collierville or the Chickasaw Basin Authority. The remaining property traversed by the stream is Common Open Space owned by the Raintree Homeowners Association, Inc. A drainage easement of sufficient width to encompass the stream as it traverses the property will be acquired by the Town of Collierville. The easement will obligate the Town to safeguard the stream.