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TIMBER LAKES AND TIMBER RIDGE LEVEE FEASIBILITY STUDY

MONTGOMERY COUNTY, TEXAS

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presented to
Montgomery County Precinct Three

by

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CHAPTER 1
INTRODUCTION AND SUMMARY OF RESULTS

The Timber Lakes and Timber Ridge developments are located in the southern portion of Montgomery County near the confluence of Panther Branch with Spring Creek. Each of these developments suffers from severe flooding problems. This report presents the results of an analysis of the feasibility of establishing flood protection levees to remove portions of Timber Lakes and Timber Ridge from the 100-year flood plains of Panther Branch and Spring Creek.

All reviewers of this report should carefully read this section (CHAPTER 1 INTRODUCTION AND SUMMARY OF RESULTS) and inspect the exhibits at the end of the report. The remaining report sections contain information which will be useful to those performing a more thorough technical review of the report.

1.1 SUMMARY OF CONCLUSIONS

The primary conclusions of this report are as follows:

1) **Existing Flood Plain:** According to the results of the Montgomery County Flood Insurance Study, approximately 40 acres of the Timber Lakes and Timber Ridge developments are within the limits of the 100-year flood plain of Panther Branch, and approximately 340 acres are within the 100-year flood plain of Spring Creek.

2) **Panther Branch Levee:** The construction of a levee system and corresponding channel improvements to Panther Branch would remove all 40 acres of the Timber Lakes and Timber Ridge developments from the flood plain and would cost approximately $1.25 million, including related improvements. Based on aerial photos taken in April of 1986 approximately 50 homes would be removed from the Panther Branch flood plain. The cost of the levee project is about $25,000 per structure, or about $31,000 per reclaimed acre. This is compared with a total cost of over $2.6 million for buying out the affected homes and unimproved lots.

4) **Spring Creek North Levee:** Due to intervening high ground the proposed levee system along Spring Creek is broken into two parts, northern and southern sections. The northern levee and corresponding channel improvements would remove approximately 65 acres of the Timber Lakes and Timber Ridge developments from the flood plain of Spring Creek. The cost of the northern levee and related improvements would be about $2.16 million. The levee would remove approximately 90 different structures from the flood plain of Spring Creek. The cost of the northern levee project is about $24,000 per structure or about $33,200 per reclaimed acre. This compares favorably with a total cost of over $4.5 million for buying out the affected homes and unimproved lots.

5) **Spring Creek South Levee:** The southern levee and corresponding channel improvements would remove approximately 85 acres of the Timber Lakes and Timber Ridge developments from the flood plain of Spring Creek. The cost of the southern levee would be about $1.30 million, including related improvements. The levee would remove approximately 28 different structures from the flood plain of Spring Creek. The cost of the southern levee project is about $46,500 per structure or about $15,300 per reclaimed acre. This is less than the total cost of almost $2.9 million for a buy-out of the affected homes and unimproved lots.

As these results indicate, each of the three levee systems appears to provide flood protection at a total cost lower than the cost required to purchase all flood-prone residences and property and convert the area to a public use such as a park. The levees along Panther Branch and along Spring Creek in the northern portion of the study area are particularly beneficial because of the higher density of existing development in these areas.

Based upon the conclusions of this preliminary feasibility study, the following sequence of steps should be followed to complete the planning and implementation of an effective flood protection system for Timber Lakes and Timber Ridge:

1) **Panther Branch Watershed Planning Study:** A Master Drainage Planning Study should be completed for the Panther Branch watershed, so that the proposed Timber Lakes and Timber Ridge levee system can be properly coordinated with other proposed projects within the watershed. In particular, the Watershed Planning Study should address whether other alternatives, such as channel improvements, may be more cost-effective than a levee system. Such an analysis was beyond the scope of this preliminary feasibility study. A Spring Creek Watershed Planning Study should also be conducted if funds are available.
2) **Preliminary Engineering Report:** An engineering report should be prepared for the levee system. The Preliminary Engineering Report will include a much more detailed analysis and design of the proposed levee, interior drainage system, and channel improvements. The levee alignment and other aspects of the design should be refined to improve the cost vs. benefit ratio of the project. The Preliminary Engineering Report should be submitted to the Federal Emergency Management Agency in order to receive a Condition Letter of Map Revision for the proposed project.
3) **Funding:** After better cost estimates are available, an institutional framework should be created to provide construction funds, operation, and maintenance of the proposed levee system. These responsibilities may be undertaken by the existing Municipal Utility Districts.
4) **Construction Documents:** After FEMA approves the Preliminary Engineering Report for the interim improvements and funding is available, detailed construction drawings and specifications should be prepared for the proposed improvements. Construction may then be initiated.

1.2 LOCATION AND DESCRIPTION OF SITE

The Timber Lakes and Timber Ridge developments are located between Spring Creek and Panther Branch in southern Montgomery County, Texas. The developments are located just to the north of the boundary between Montgomery County and Harris County and approximately 3 miles west of Interstate Highway 45. Timber Ridge is immediately north of and adjacent to Timber Lakes. Exhibit 1 of this report illustrates the location of the developments.

Spring Creek forms much of the boundary between Montgomery and Harris Counties. Spring Creek is one of the major drainage arteries of southern Montgomery and northern Harris Counties. Portions of Grimes and Waller Counties are also within the Spring Creek watershed. The channel of Spring Creek is for the most part unimproved, and the lands within its watershed are predominantly rural.

Panther Branch is one of the major tributaries to Spring Creek, emptying into that stream just upstream (west) of Interstate Highway 45. The middle and lower portions of the watershed are heavily urbanized, with most of the urban areas contained within The Woodlands. The upper portions of the Panther Branch watershed and the watershed of its major tributary, Bear Branch, are for the most part undeveloped.

1.3 SOURCES OF DATA

The following sources of information are consulted in completing this analysis:

1) The USGS "Spring", "Tomball", "Tamina", and "Oklahoma" 7.5-minute quadrangle maps.
2) *WSP-2* computer output, Flood Hazard Boundary Maps, and plotted stream profiles from the Montgomery County Flood Insurance Study. *WSP-2* computer data was converted to *HEC-2* format for this analysis.

3) A two-foot contour map of the Timber Lakes/Timber Ridge area prepared by GMA Development Corporation from aerial photographs.
4) Information gathered during visits to the area by representatives of Dodson & Associates, Inc. in late 1988 and early 1989.
5) April 1986 aerial photographs of the area.
6) U.S. Army Corps of Engineers Engineering Manual (EM) 1110-2-1913, "Design and Construction of Levees."

CHAPTER 2
PANTHER BRANCH FLOOD PROTECTION LEVEE SYSTEM

This section of the report summarizes the results of an analysis of the feasibility of providing a flood protection levee along Panther Branch. This levee would remove the eastern portions of the Timber Lakes and Timber Ridge developments from the 100-year flood plain of Panther Branch.

2.1 FLOOD PLAIN INFORMATION

Montgomery County, Texas entered the regular National Flood Insurance Program in the 1970's with the publication of Flood Insurance Rate Maps (FIRM's) and Flood Hazard Boundary Maps (FHBM's) for unincorporated areas of the County by the Federal Emergency Management Agency (FEMA). Espey, Huston & Associates, Inc. (EHA) of Houston, Texas and the U.S. Department of Agriculture Soil Conservation Service (SCS) were FEMA's study contractors for the Montgomery County Flood Insurance Study. Panther Branch is among the streams studied in detail for the Montgomery County Flood Insurance Study.

The *WSP-2* computer program was used in the Montgomery County Flood Insurance Study to compute backwater profiles for Panther Branch. The original *WSP-2* model for Panther Branch has been revised from time to time since the completion of the Flood Insurance Study. The most recent available *WSP-2* modeling data has been provided to Dodson & Associates, Inc. by Dewberry & Davis, Inc. of Fairfax, Virginia. Dewberry & Davis, Inc. serves as a review contractor for FEMA, and is responsible for the maintenance of up-to-date modeling data on many streams within Montgomery County. Exhibit 3 of this report illustrates the existing 100-year flood plain boundaries of Panther Branch as shown on the current FEMA Flood Insurance Rate Maps. The *WSP-2* computer data was converted to *HEC-2* format for use in this analysis.

2.2 FLOOD PROTECTION LEVEE

Exhibit 3 illustrates the alignment and the extent of the proposed levee. This alignment is selected to remove as much area as possible from the 100-year flood plain of Panther Branch while reducing adverse impacts on urbanized areas. Approximately 40 acres of the Timber Ridge and the Timber Lakes developments are removed from the 100-year flood plain of Panther Branch. No removal or modification of existing businesses or residences is necessary prior to levee construction. The proposed levee is assumed to have a top width of 15 feet and 3 horizontal to 1 vertical side slopes.

Freeboard is the additional height of a levee above the design water surface elevation. Freeboard provides a measure of safety against failure of the levee system due to structural failure, settlement, wave action, or extreme water surface elevations. The Federal Emergency Management Agency, which administers the National Flood Insurance Program, has established the following guidelines with regard to levee freeboard:

> "Riverine levees must provide a minimum freeboard of three feet above the water-surface level of the base flood. An additional one foot above the minimum is required within 100 feet on either side of structures (such as bridges) riverward of the levee or wherever the flow is constricted. An additional one-half foot above the minimum at the upstream end of the levee, tapering to not less than the minimum at the downstream end of the levee, is also required." (44 CFR Ch. I, Section 65.10(b)(1)(i), 10-1-86 Edition).

The crest elevation of the Panther Branch flood protection levee is proposed to range from 123.2 feet at the downstream end to 127.0 feet at the upstream end. The 100-year water surface elevation in the Panther adjacent to the levee varies from 120.13 feet to 123.49 feet. Therefore, a minimum freeboard of 3 feet will be provided. There are no structures or constrictions in the area which

would cause the FEMA freeboard requirement to exceed 3.5 feet. Therefore, the proposed levee option will provide flood protection for Timber Lakes and Timber Ridge while complying with the levee height and freeboard requirements of the Federal Emergency Management Agency.

2.3 PANTHER BRANCH CHANNEL IMPROVEMENTS

The proposed flood protection levee will block a portion of the flow area of the Panther Branch flood plain. This loss in flow conveyance capacity may increase flood levels and flood damages. In order to eliminate these increases, the channel of Panther Branch adjacent to the proposed levee should be improved to a bottom width of 30 feet, side slopes of 3 horizontal to 1 vertical, and a flow-line slope at the natural grade of the existing channel. The total excavation requirement for these improvements is approximately 31,000 cubic yards. Exhibit 3 illustrates the extent of the proposed improvements.

2.3.1 Hydraulic Analysis of Proposed Improvements

The following procedure is used to determine the effects of the proposed levee and channel improvements on computed water surface elevations in Panther Branch:

1) The Panther Branch existing conditions *WSP-2* computer data supplied by Dewberry & Davis, Inc. is converted to the format required for the *HEC-2* computer program. The *HEC-2* program is a widely-accepted tool for the computation of flood plain, floodway, and other hydraulic data for existing and improved stream channels. The *HEC-2* program is selected for use in this analysis because of its wide acceptance and because of the flexibility which the program offers in modeling channel improvements and levees.
2) Cross-sections are inserted as necessary to provide adequate definition of the proposed levee and channel improvements. The resulting model represents a "revised existing condition" for Panther Branch, without the proposed improvements or levee.
3) The proposed levee and channel improvements are superimposed on the appropriate cross-sections of the revised existing conditions *HEC-2* model of Panther Branch. This "proposed conditions" model is used to establish water surface elevations in Panther Branch which reflect the presence of the levee and improvements.
4) The results of the revised existing conditions and proposed conditions *HEC-2* analyses are compared to determine the relative impacts of the proposed levee and recommended channel improvements on computed water surface elevations in Panther Branch.

2.3.2 Results of Hydraulic Analysis

Table 2.1 presents the computed 100-year water surface elevations in Panther Branch for revised existing and proposed conditions. As indicated, proposed conditions water surface elevations are at or below existing conditions levels throughout the affected reach of the stream.

Table 2.1 Computed 100-Year Water Surface Elevations

Cross-Section	100-Year Flow Rate (cfs)	Revised Existing Conditions (ft)	Proposed Conditions (ft)	Impact of Project (ft)
20,175	5,394	120.02	120.02	0.00
20,215	5,394	120.03	120.03	0.00
20,216	5,394	120.04	120.04	0.00
20,235	5,394	120.04	120.04	0.00
20,236	5,394	120.04	120.04	0.00
20,285	5,394	120.05	120.05	0.00
20,525	5,394	120.26	120.12	-0.14
22,525	5,394	122.54	122.08	-0.46
23,565	5,394	123.16	123.05	-0.11
24,405	5,394	123.49	123.49	0.00
25,092	5,363	123.79	123.75	-0.04

Exhibit 4 of this report illustrates the revised existing conditions 100-year water surface profile for Panther Branch. Exhibit 5 illustrates the proposed conditions 100-year water surface profile. The Technical Appendix to this report (bound separately) contains the *HEC-2* computer output from the revised conditions model of Panther Branch, and the corresponding output data for proposed conditions.

2.4 ANALYSIS OF STORMWATER DETENTION REQUIREMENTS

A preliminary estimate of the detention storage requirements for the area protected by the proposed levee may be obtained by determining the total runoff volume for the 100-year, 24-hour storm event. Assuming that no significant discharge of runoff from the interior of the leveed area to Panther Branch can occur during the storm event, this volume is equal to the required detention storage.

The total runoff volume which will collect behind the proposed levee is determined using the following procedure:

1) Delineate the area from which runoff will collect behind the levee. Compute the total levee drainage area.
2) Determine the percentage of impervious cover which exists within the levee drainage area. Assume 40% impervious cover for single-family residential developments and 80% for commercial developments.
3) Use the *Quick Hydrograph* computer program of the *HydroCalc Hydrology* software package developed at Dodson & Associates, Inc. to compute the total runoff volume. This program possesses all of the rainfall/runoff analysis options of the HEC-1 computer program for single sub-areas. Use the drainage area and percent impervious cover determined in steps 1 and 2, along with the Exponential loss rate function to compute the total volume of runoff. Use the loss rate function parameters and 100-year rainfall data recommended in the *Montgomery County Drainage Criteria Manual.*

The area from which runoff would collect behind the proposed Panther Branch levee is approximately 193 acres. All 193 acres of this area has been developed as single-family residential. The resulting impervious cover for the area is 40%. Using the *Quick Hydrograph* program, a total runoff volume of 165 acre-feet is computed. For the purpose of this feasibility analysis, this volume is assumed to be equal to the required detention volume for the Panther Branch levee.

The Technical Appendix of this report (bound separately) contains the output from the *Quick Hydrograph* program. Exhibit 2 illustrates the watershed area of the proposed levee alignment and potential detention locations.

2.5 COST ESTIMATES FOR PROPOSED FLOOD PROTECTION MEASURES

Table 2.2 presents an estimate of the total construction cost for the proposed Panther Branch levee and channel improvements. As indicated, the total cost of the project is approximately $1.25 million. Almost $800,000, or about two-thirds of the total project cost, is attributable to the construction of the interior drainage system. A more detailed analysis of interior drainage alternatives may reveal a less-costly option which could significantly reduce the total project cost.

Table 2.2 Cost Estimates for Panther Branch Levee System

Item	Units	Quantity	Unit Cost	Total Cost
Land Acquisition	Acres	15	$7,000.00	$105,000
Clearing & Grubbing	Acres	15	$1,400.00	$21,000
Hauling & Compaction	Cubic Yards	9,300	$5.00	$46,500
Channel Excavation	Cubic Yards	31,000	$3.00	$93,000
Detention Basin Excavation	Cubic Yards	266,200	$3.00	$798,600
Seeding & Fertilizing	Acres	15	$1,150.00	$17,250
Overall Sub-Total				$1,081,350
Contingency			15%	$162,203
Total Cost				**$1,243,553**

2.6 ANALYSIS OF NON-STRUCTURAL ALTERNATIVES

The structures within the flood plain portion of Timber Lakes and Timber Ridge are single-family homes built with slab-on-grade foundations. There is no effective method of raising the finished floor of such structures other than the methods employed in actual relocations. The only practical option is a buy-out of flood prone structures as may be enacted under Section 1362 of Public Law 95-128, the National Flood Insurance Program legislation. A requirement of that program is that it cover an entire flood-prone area and that the land be converted to "public use" such as park land or wildlife reserve. Therefore, the components of a buy-out program would include:

- the purchase of the flood-prone homes, lots and acreage not yet built upon;
- the present value of lost tax revenues; and
- the cost to convert purchased property to public use.

Table 2.3 lists the costs involved in a Section 1362 buy-out of flood plain areas along Panther Creek. As indicated, the total cost of the buy-out program greatly exceeds the estimated construction cost of the flood protection levee and related improvements.

Table 2.3 Costs of Buyout along Panther Creek

Item	Cost
Purchasing 50 existing homes at $28,700 each.	$1,435,000
Purchasing 44 unimproved lots at $3,900 each.	$171,600
Total Property Purchase	$1,606,600
Annual Tax Revenue Lost as a Result of Buyout, computed at an annual tax rate of $2.87/$100 value.	$46,100
Present Value of Lost Tax Revenue, computed over 30 years at a 6% annual discount rate.	$634,700
Converting 40 acres of land to public use at $10,000 per acre.	$400,000
Total Cost of Buyout and Conversion Program	**$2,641,300**

2.7 COST-BENEFIT ANALYSIS

The concept of Cost-Benefit Analysis is based on a comparison of the cost of a proposed action versus the benefit derived from the action. The proposed flood protection levee project should produce the following benefits:

- The Direct Benefit of flood loss reduction. There are no figures available to identify flood damage costs in the study area. However, significant flooding has occurred on several occasions, including the May 18, 1989 storm event.
- The opportunity for increase in *ad valorem* tax values resulting from the improvements. Those increases would be the result of: building new $30,000 homes on 44 currently undeveloped lots and the estimated $8,000 increase in value of 50 homes currently devalued due to recurring flooding. The total increase in value is estimated at $1,720,000.
- The Indirect Benefit of improvements in the quality of life. Beyond the dollar losses there are tremendous losses in quality of life factors associated with these repeated inundation of homes.

CHAPTER 3
SPRING CREEK FLOOD PROTECTION LEVEES

This section of the report summarizes the results of an analysis of the feasibility of providing a flood protection levee along Spring Creek. This levee would remove portions of the Timber Lakes and Timber Ridge developments from the 100-year flood plain of Spring Creek.

3.1 FLOOD PLAIN INFORMATION

The U.S. Army Corps of Engineers, Galveston District, analyzed Spring Creek for the Montgomery County Flood and Harris County Flood Insurance Studies. The Corps of Engineers used the *HEC-2* backwater profile computer program to compute flood plain and floodway data for Spring Creek. As is the case with Panther Branch, the original *HEC-2* model for Spring Creek has been revised since the completion of the original study. Again, however, Dodson & Associates, Inc. has been provided with the most current *HEC-2* modeling data for Spring Creek by Dewberry & Davis, Inc.

Exhibit 3 of this report illustrates the existing 100-year flood plain boundaries of Spring Creek as shown on the current FEMA Flood Insurance Rate Maps.

3.2 FLOOD PROTECTION LEVEES

Exhibit 3 illustrates the alignments and the extent of the proposed levees. Due to areas of high ground along Spring Creek the levee is broken into two parts, northern and southern. The levee alignments are selected to maximize the area removed from the 100-year flood plain of Spring Creek while minimizing adverse impacts on urbanized areas. Approximately 150 acres of the Timber Ridge and the Timber Lakes developments are removed from the 100-year flood plain of Spring Creek. Some removal or modification of existing structures may be necessary prior to levee construction. The proposed levees are assumed to have a top width of 15 feet and side slopes of 3 horizontal to 1 vertical.

The Federal Emergency Management Agency, the agency which administers the National Flood Insurance Program, has established the following guidelines with regard to levee freeboard:

> "Riverine levees must provide a minimum freeboard of three feet above the water-surface level of the base flood. An additional one foot above the minimum is required within 100 feet on either side of structures (such as bridges) riverward of the levee or wherever the flow is constricted. An additional one-half foot above the minimum at the upstream end of the levee, tapering to not less than the minimum at the downstream end of the levee, is also required." (44 CFR Ch. I, Section 65.10(b)(1)(i), 10-1-86 Edition).

The crest elevation of the Spring Creek flood protection levees is proposed to range from 125.4 feet at the downstream end to 129.6 feet at the upstream end. The 100-year water surface elevation in Spring Creek adjacent to the levee varies from 122.36 feet to 126.03 feet. Therefore, a minimum freeboard of 3 to 3.5 feet will be provided. There are no structures or constrictions in the area which would cause the FEMA freeboard requirement to exceed 3.5 feet. Therefore, the proposed levee option will provide flood protection for Timber Lakes and Timber Ridge while complying with the levee height and freeboard requirements of the Federal Emergency Management Agency.

3.3 SPRING CREEK CHANNEL IMPROVEMENTS

The construction of the proposed flood protection levee causes a loss in flow conveyance capacity in the flood plain of Spring Creek. This loss in conveyance in turn creates increases in flood levels and damages. In order to eliminate these increases, the channel of Spring Creek adjacent to the

proposed levee should be improved by clearing and grubbing and general reshaping of the channel. These improvements are sufficient to maintain computed 100-year water surface elevations at existing conditions levels. Exhibit 3 illustrates the extent of the proposed improvements.

3.4 HYDRAULIC ANALYSIS OF PROPOSED FLOOD PROTECTION MEASURES

This section of the report presents the results of an analysis to determine the effects of the proposed levee and channel improvements on computed water surface elevations in Spring Creek. These effects are assessed through the following procedure:

1) Cross-sections are inserted as necessary into the FIS *HEC-2* model of Spring Creek to provide adequate definition of the proposed levee and channel improvements. The resulting model represents a "revised existing condition" for Spring Creek and is used to establish existing water surface elevations to which "proposed conditions" results may be compared.
2) The proposed levee and channel improvements are superimposed on the appropriate cross-sections of the revised existing conditions *HEC-2* model of Spring Creek. This proposed conditions model is used to establish water surface elevations in Spring Creek which reflect the presence of the levee and improvements.
3) The results of the revised existing conditions and proposed conditions *HEC-2* analyses are compared to determine the relative impacts of the proposed levee and recommended channel improvements on computed water surface elevations in Spring Creek.

Table 3.1 presents the computed 100-year water surface elevations in Spring Creek for revised existing and proposed conditions. As indicated, proposed conditions water surface elevations are at or below existing conditions levels throughout the affected reach of the stream.

3.1 Computed 100-Year Water Surface Elevations in Spring Creek

Cross-Section	100-Year Flow Rate (cfs)	Revised Existing Conditions (ft)	Proposed Conditions (ft)	Impact (ft)
21.6	51,705	120.62	120.62	0.00
22.06	48,647	122.17	121.74	-0.43
22.35	48,647	123.04	122.36	-0.68
22.47	48,647	123.34	122.78	-0.56
22.6	48,638	123.46	122.95	-0.51
22.69	48,632	123.54	122.95	-0.59
22.77	48,627	123.6	123.10	-0.50
23.31	48,589	124.15	123.41	-0.74
23.55	48,573	124.4	123.58	-0.82
23.78	48,557	124.8	123.90	-0.90
24.09	48,536	125.26	124.45	-0.81
24.55	48,504	126.31	125.39	-0.92
24.77	48,504	126.94	125.89	-1.05
24.8	48,504	127.06	126.03	-1.03
25.3	48,453	128.13	127.15	-0.98

Exhibit 6 of this report illustrates the revised existing conditions 100-year water surface profile for Spring Creek. Exhibit 7 illustrates the proposed conditions 100-year water surface profile. The Technical Appendix of this report (bound separately) contains the *HEC-2* computer output from the revised conditions and proposed conditions models of Panther Branch.

3.5 ANALYSIS OF STORMWATER DETENTION REQUIREMENTS

A preliminary estimate of the detention storage requirements for the areas protected by the proposed levees may be obtained by determining the total runoff volume for the 100-year, 24-hour storm event. Assuming that no significant discharge of runoff from the interior of the leveed areas to Spring Creek can occur during the storm event, this volume is equal to the required detention storage.

The total runoff volume which will collect behind the proposed levees is determined using the following procedure:

1) Delineate the areas from which runoff will collect behind the levees. Compute the total drainage area of the levees.
2) Determine the percentage of impervious cover which exists within the drainage areas of the levees. Assume 40% impervious cover for single-family residential developments and 80% for commercial developments.
3) Use the *Quick Hydrograph* computer program of the *HydroCalc Hydrology* software package developed at Dodson & Associates, Inc. to compute the total runoff volumes. This program possesses all of the rainfall/runoff analysis options of the HEC-1 computer program for single sub-areas. Use the drainage area and percent impervious cover determined in steps 1 and 2, along with the Exponential loss rate function to compute the total volume of runoff. Use the loss rate function parameters and 100-year rainfall data recommended in the *Montgomery County Drainage Criteria Manual.*

The area from which runoff would collect behind the proposed northern Spring Creek levee is approximately 211 acres. The watershed area of the southern Spring levee is approximately 114 acres. All 325 acres of this area has been developed as single-family residential. The resulting impervious cover for the area is 40%. Using the *Quick Hydrograph* program, a total runoff volume of 180 acre-feet is computed for the northern levee and 98 acre-feet is computed for the southern levee. For the purpose of this feasibility analysis, this volume is assumed to be equal to the required detention volume for the Spring Creek levees.

The separately-bound Technical Appendix of this report contains the output from the *Quick Hydrograph* program. Exhibit 2 illustrates the watershed areas of the proposed levee alignments and potential detention locations.

3.6 COST ESTIMATES FOR PROPOSED FLOOD PROTECTION MEASURES

Table 3.2 presents an estimate of the total construction cost for the proposed Spring Creek levees and channel improvements. As indicated, the total cost of northern levee is approximately $2.16 million and the total cost of the southern levee is about $1.30 million. Other alternative alignments may be devised which are less expensive, yet which continue to provide flood protection to the heavily-developed northern portion of Timber Lakes.

Table 3.2 Estimated Construction Cost - Spring Creek North Levee

Item	Units	Quantity	Unit Cost	Total Cost
Clearing & Grubbing	Acres	38	$1,400.00	$53,200
Hauling & Compaction	Cubic Yards	182,000	$5.00	$910,000
Detention Basin Excavation	Cubic Yards	290,000	$3.00	$870,000
Seeding & Fertilizing	Acres	38	$1,150.00	$43,700
Overall Sub-Total				$1,876,900
Contingency			15%	$281,535
Total Cost				**$2,158,435**

Table 3.3 Estimated Construction Cost - Spring Creek South Levee

Item	Units	Quantity	Unit Cost	Total Cost
Clearing & Grubbing	Acres	45	$1,400.00	$63,000
Hauling & Compaction	Cubic Yards	108,000	$5.00	$540,000
Detention Basin Excavation	Cubic Yards	158,000	$3.00	$474,000
Seeding & Fertilizing	Acres	45	$1,150.00	$51,750
Overall Sub-Total				$1,128,750
Contingency			15%	$169,313
Total Cost				**$1,298,063**

3.7 ANALYSIS OF NON-STRUCTURAL ALTERNATIVES

The structures within the flood plain portion of Timber Lakes and Timber Ridge are single-family homes built with slab-on-grade foundations. There is no effective method of raising the finished floor of such structures other than the methods employed in actual relocations. The only practical option is a buy-out of flood prone structures as may be enacted under Section 1362 of Public Law 95-128, the National Flood Insurance Program legislation. A requirement of that program is that it cover an entire flood-prone area and that the land be converted to "public use" such as park land or wildlife reserve. Therefore, the components of a buy-out program would include:

- the purchase of the flood-prone homes, lots and acreage not yet built upon;
- the present value of lost tax revenues; and
- the cost to convert purchased property to public use.

Table 3.4 lists the costs involved in a Section 1362 buy-out of flood plain areas along the Spring Creek in the northern portion of the study area. As indicated, the total cost of the buy-out program greatly exceeds the estimated construction cost of the flood protection levee and related improvements.

Table 3.4 Costs of Buyout along Spring Creek North

Item	Cost
Purchasing 90 existing homes at $28,700 each.	$2,583,000
Purchasing 60 unimproved lots at $3,900 each.	$234,000
Total Property Purchase	$2,817,000
Annual Tax Revenue Lost as a Result of Buyout, computed at an annual tax rate of $2.87/$100 value.	$80,800
Present Value of Lost Tax Revenue, computed over 30 years at a 6% annual discount rate.	$1,113,000
Converting 65 acres of land to public use at $10,000 per acre.	$650,000
Total Cost of Buyout and Conversion Program	**$4,580,000**

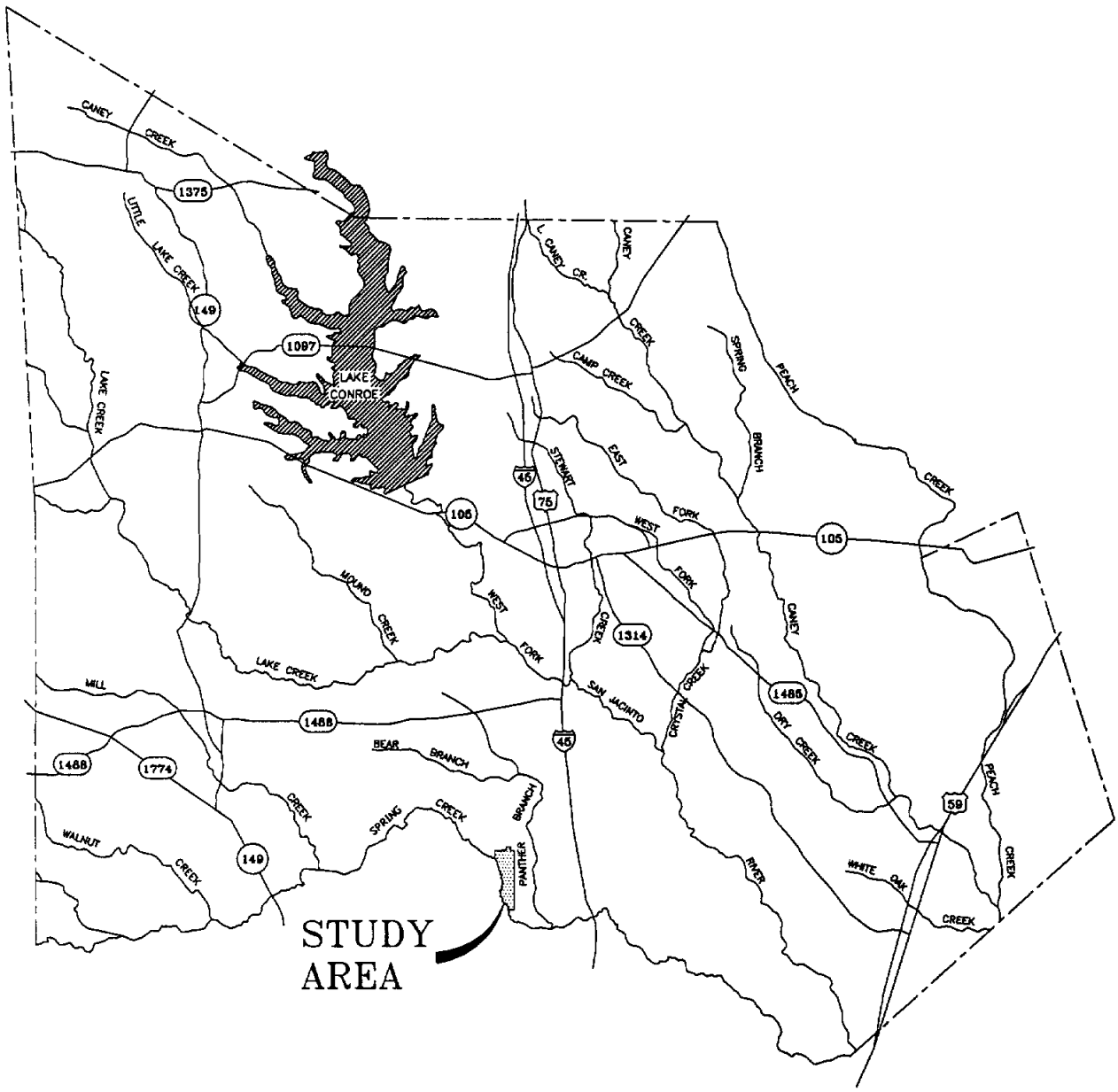
Table 3.5 Costs of Buyout along Spring Creek South

Item	Cost
Purchasing 28 existing homes at $28,700 each.	$803,600
Purchasing 170 unimproved lots at $3,900 each.	$663,000
Total Property Purchase	$1,466,600
Annual Tax Revenue Lost as a Result of Buyout, computed at an annual tax rate of $2.87/$100 value.	$42,100
Present Value of Lost Tax Revenue, computed over 30 years at a 6% annual discount rate.	$580,000
Converting 85 acres of land to public use at $10,000 per acre.	$850,000
Total Cost of Buyout and Conversion Program	**$2,896,600**

3.8 COST-BENEFIT ANALYSIS

The concept of Cost-Benefit Analysis is based on a comparison of the cost of a proposed action versus the benefit derived from the action. The proposed flood protection levee project should produce the following benefits:

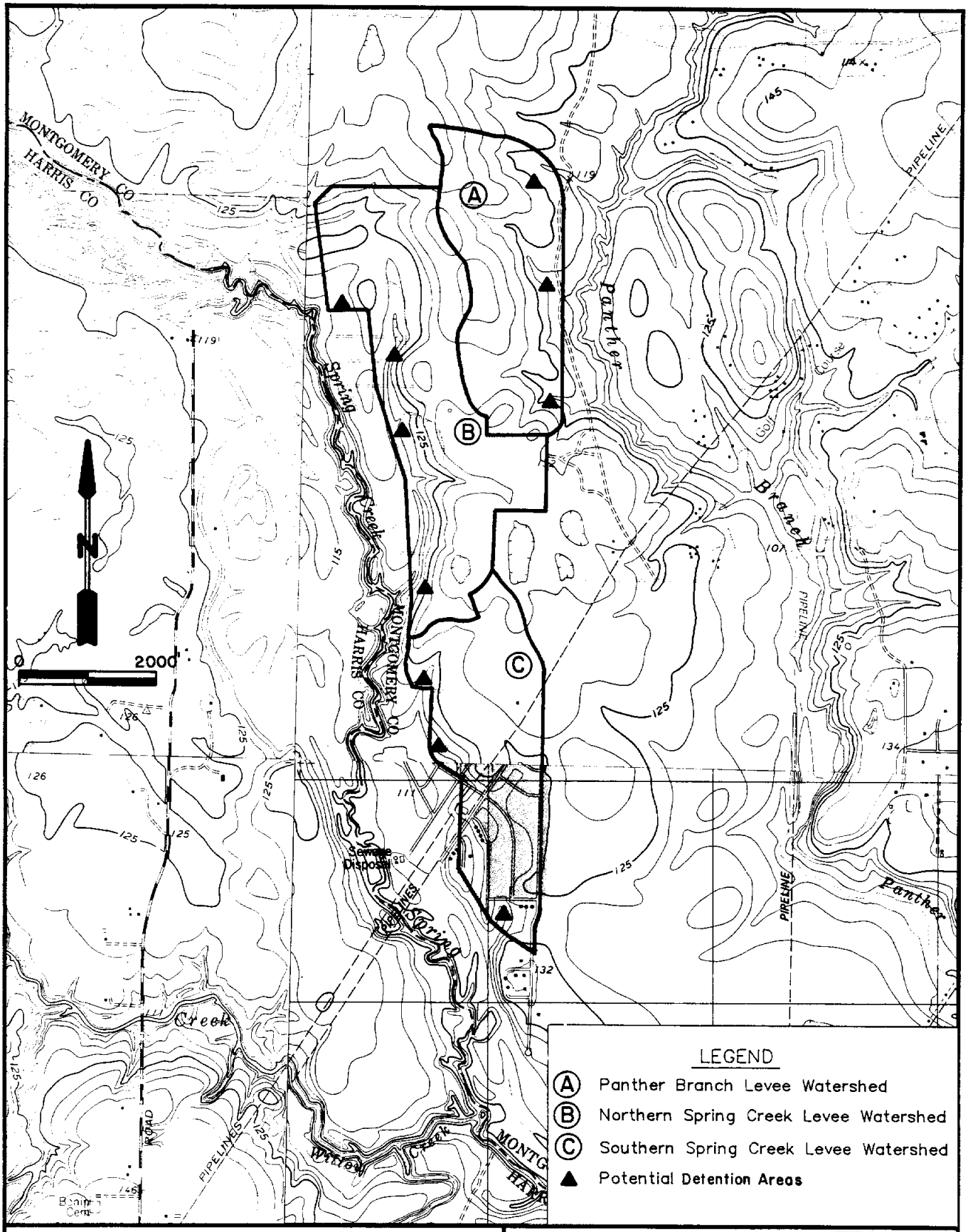
- The Direct Benefit of flood loss reduction. There are no figures available to identify flood damage costs in the study area. However, significant flooding has occurred on several occasions, including the May 18, 1989 storm event.
- The opportunity for increase in *ad valorem* tax values resulting from the improvements. Those increases would be the result of: building new $30,000 homes on 230 currently undeveloped lots and the estimated $8,000 increase in value of 118 homes currently devalued due to recurring flooding. The total increase in value is estimated at $7.844 million for the combined Spring Creek levees.
- The Indirect Benefit of improvements in the quality of life. Beyond the dollar losses there are tremendous losses in quality of life factors associated with these repeated inundation of homes.



SITE LOCATION MAP

DODSON
& ASSOCIATES, INC.
Hydrologists and Civil Engineers

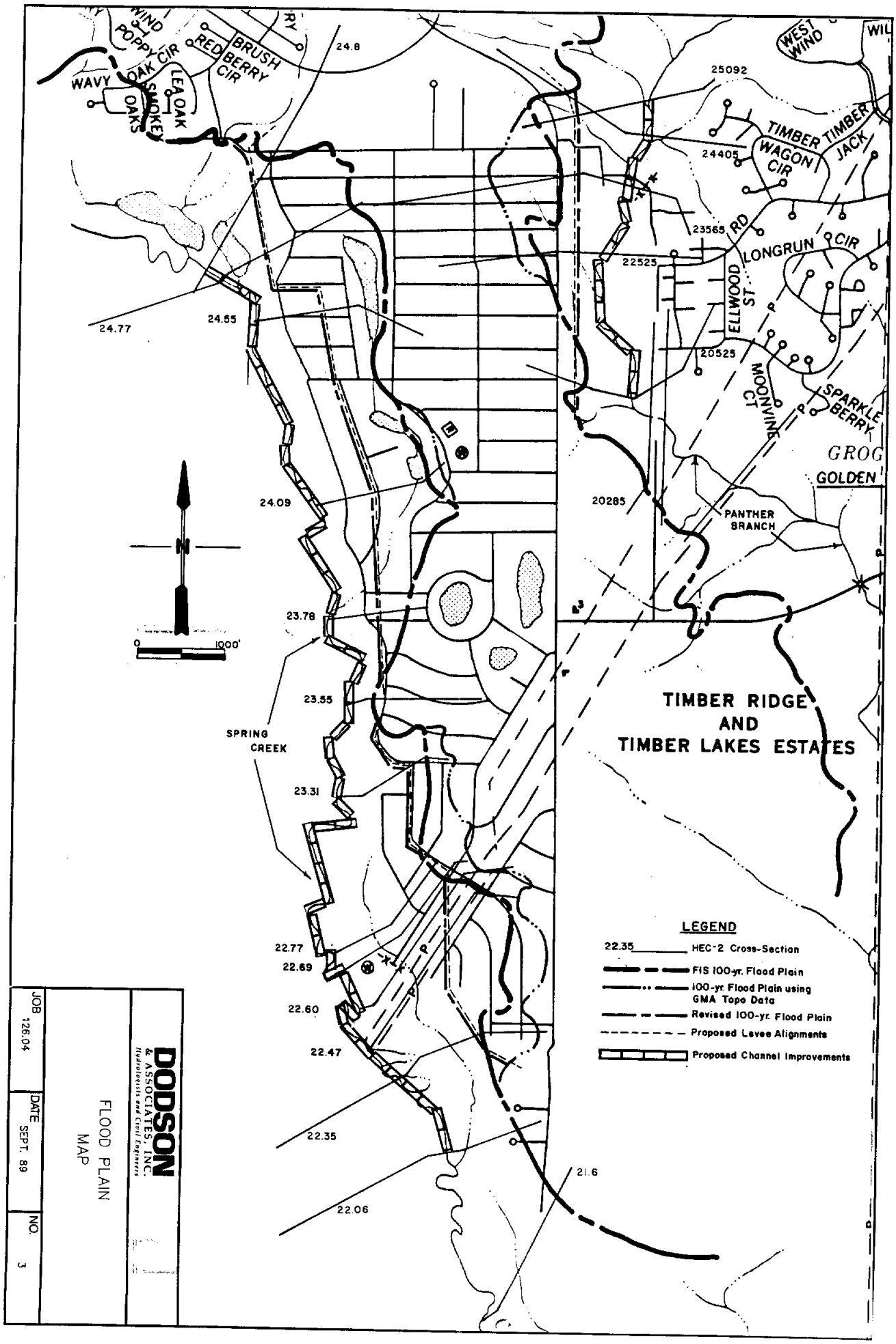
JOB	DATE	NO.
126.04	SEPT. '89	1



DRAINAGE AREA MAP

DODSON & ASSOCIATES, INC.
Hydrologists and Civil Engineers

JOB	DATE	NO.
126.04	SEPTEMBER 89	2



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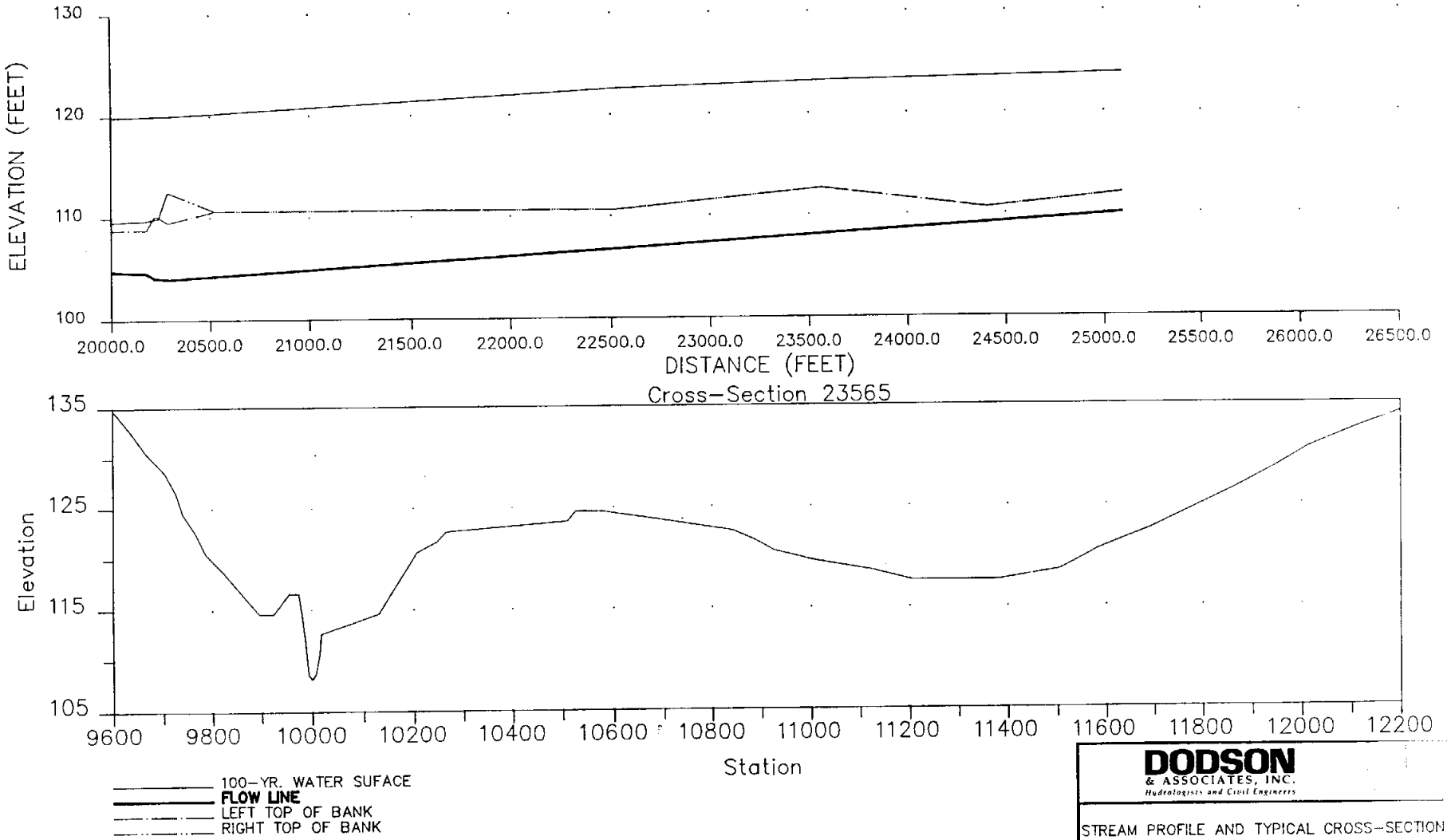
FLOOD PLAIN MAP

JOB	DATE	NO.
126.04	SEPT. 89	3



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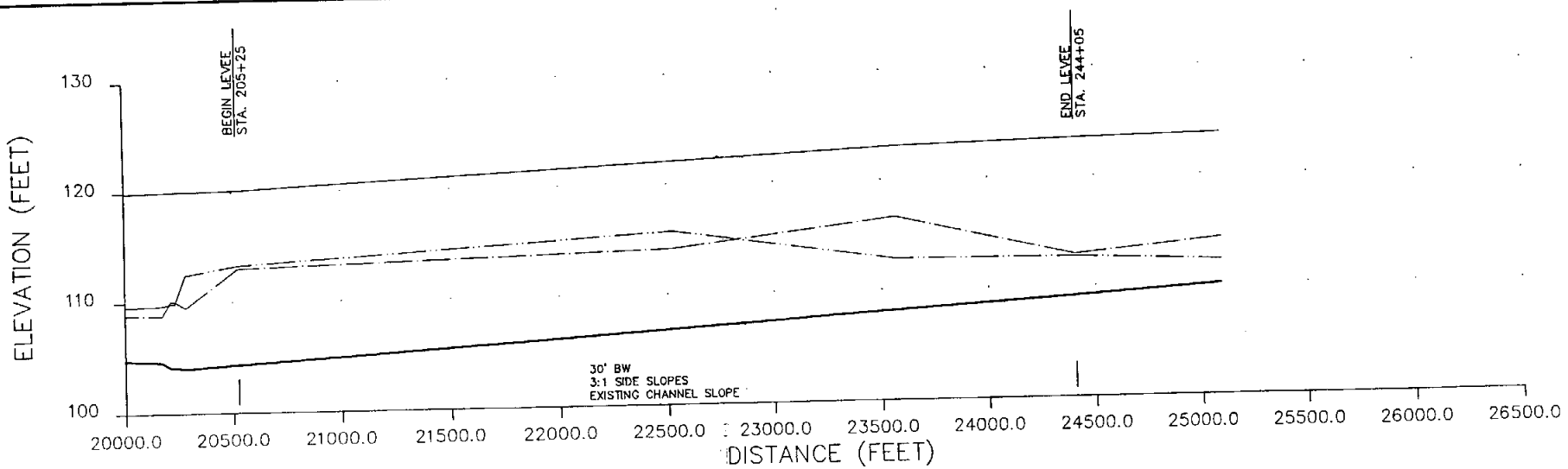
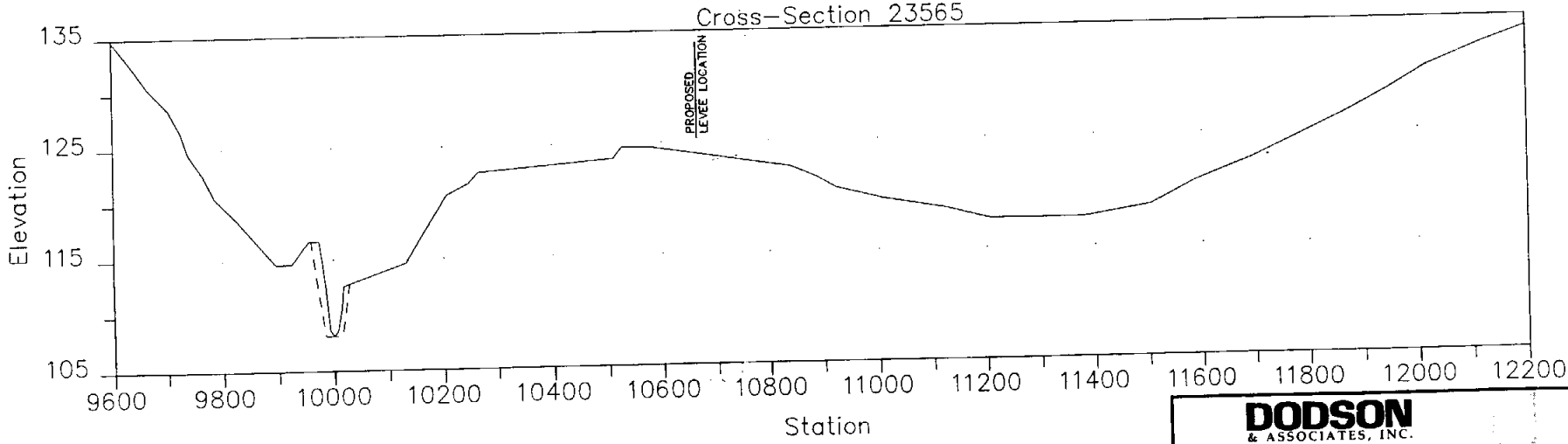
STREAM PROFILE AND TYPICAL CROSS-SECTION
PANTHER BRANCH
EXISTING CONDITIONS

JOB	DATE	NO.
126.04	SEPTEMBER 89	4



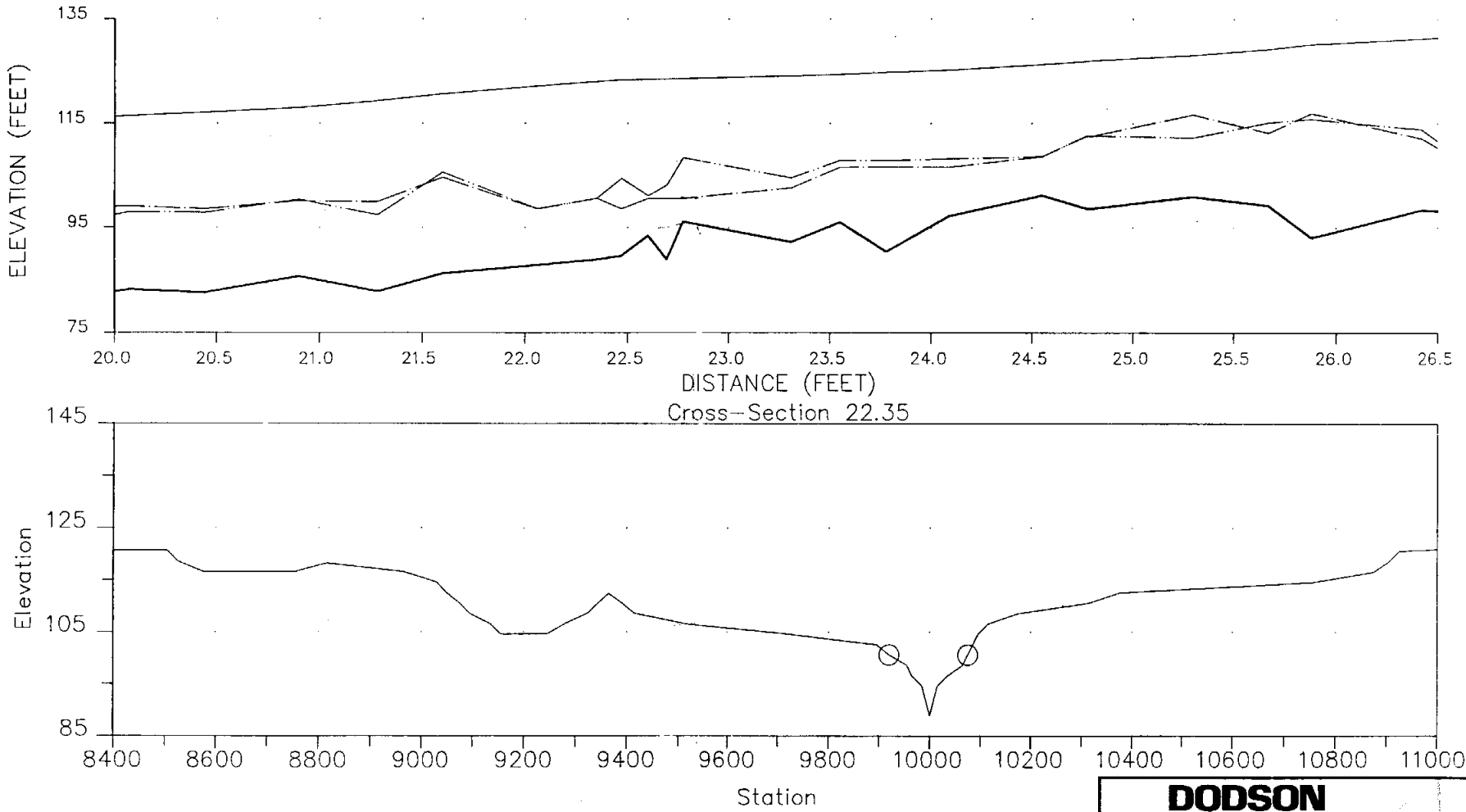


100-YR. WATER SUFACE
FLOW LINE
LEFT TOP OF BANK
RIGHT TOP OF BANK

DODSON
& ASSOCIATES, INC.
Hydrologists and Civil Engineers

STREAM PROFILE AND TYPICAL CROSS-SECTION
PANTHER BRANCH
PROPOSED CONDITIONS

JOB	DATE	NO.
126.04	SEPTEMBER 89	5

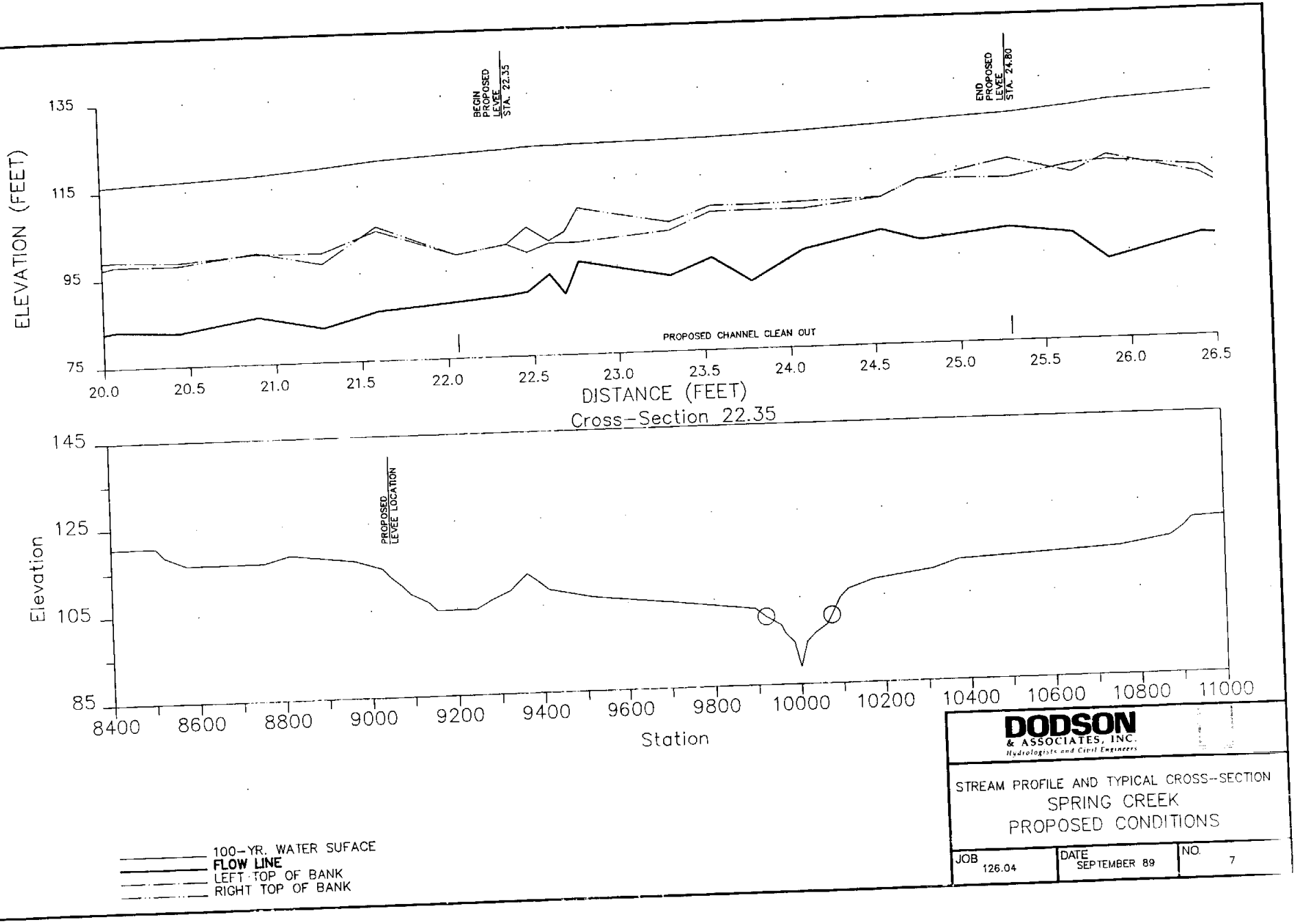


100-YR. WATER SUFACE
FLOW LINE
LEFT TOP OF BANK
RIGHT TOP OF BANK

DODSON
& ASSOCIATES, INC.
Hydrologists and Civil Engineers

STREAM PROFILE AND TYPICAL CROSS-SECTION
SPRING CREEK
EXISTING CONDITIONS

JOB	DATE	NO.
126.04	SEPTEMBER 89	6


BEGIN PROPOSED LEVEE STA. 22.35
END PROPOSED LEVEE STA. 24.80
ELEVATION (FEET)
135
115
95
75
PROPOSED CHANNEL CLEAN OUT
20.0
20.5
21.0
21.5
22.0
22.5
23.0
23.5
24.0
24.5
25.0
25.5
26.0
26.5
DISTANCE (FEET)
Cross-Section 22.35
PROPOSED LEVEE LOCATION
Elevation
145
125
105
85
8400
8600
8800
9000
9200
9400
9600
9800
10000
10200
10400
10600
10800
11000
Station
100-YR. WATER SUFACE
FLOW LINE
LEFT TOP OF BANK
RIGHT TOP OF BANK
DODSON
& ASSOCIATES, INC.
Hydrologists and Civil Engineers
STREAM PROFILE AND TYPICAL CROSS-SECTION
SPRING CREEK
PROPOSED CONDITIONS
JOB 126.04
DATE SEPTEMBER 89
NO. 7