ENVIRONMENTAL
MANAGEMENT SERVICES, INC.

September 15, 2011

Ms. D. Karen Knight, CHMM
Environmental Protection Agency, Region 4
RCRA Division, RUST Branch
61 Forsyth Street, S.W.
Atlanta, GA 30303

Re: SWMU 3-1 and 3-4 Control and Containment Design Report
Cavenham Forest Industries Inc.
Gulfport, Mississippi
MSD 057 226 961

Dear Ms. Knight:

As consultants for Cavenham Forest Industries, Inc. (CFI), Environmental Management Services, Inc (EMS) has prepared the attached document providing conceptual plans for additional remedial measures for SWMU 3-1, SWMU 3-4, Turkey Creek, and the Peninsula south of Turkey Creek at the CFI Gulfport, MS site. This report replaces a similar report that was submitted on May 22, 2009.

If you have questions or require additional information during your review of this document please call either the undersigned or Clyde Woodward at (601) 544-3674.

Sincerely,

Environmental Management Services, Inc.

P.G. For:

C. Winston Russell, P.G.
Vice President

c: J. Smith - EPA
C. Brown – MDEQ
J. Bryars – CFI - Gulfport

SWMU 3-1 AND SWMU 3-4
CONTROL AND CONTAINMENT
DESIGN REPORT

CAVENHAM FOREST INDUSTRIES, LLC
GULFPORT, MISSISSIPPI

EPA ID MSD 057 226 961

Prepared by:

ENVIRONMENTAL MANAGEMENT SERVICES, INC.

P.O. Box 15369
Hattiesburg, Mississippi 39404

September 14, 2011

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The report contained herein has been prepared by Environmental Management Services, Inc. (EMS) under the direct supervision of the environmental professionals indicated below. To the best of our knowledge all appropriate standards of care and practices were utilized to collect and report the data contained within this document. Services performed by EMS were conducted in a manner consistent with that degree of care and skill ordinarily exercised by reputable members of the same profession as EMS practicing in the same locality under similar conditions as exists at the time the service was provided. No other representation, express or implied, and no warranty or guarantee is included or intended in this proposal, or any report, opinion, document or otherwise as a result of, or part of the work by EMS, its subcontractors, or vendors.

Prepared By:

REGISTERED PROFESSIONAL GEOLOGIST
MS
0012
C. WINSTON RUSSELL

Date: 14 September 2011

C. Winston Russell, P.G.
Vice President
MS Professional Geologist No. 12

Date: September 14, 2011

Leon H. Carter, Jr., P.E.
Senior Engineer
MS Professional Engineer No. 6401

LEON H. CARTER, JR.
LICENSED PROFESSIONAL
ENGINEER
6401
9/14/11
STATE OF MISSISSIPPI

1.0 INTRODUCTION

Cavenham Forest Industries, LLC (CFI) submitted a control and containment design report to the United States Environmental Protection Agency Region 4 (EPA) and Mississippi Department of Environmental Quality on May 22, 2009. Due to FEMA requirements that the design must not create any positive change in the 100 year flood elevation, the report has been revised and updated. This revised *SWMU 3-1 and SWMU 3-4 Control and Containment Design Report* describes the conceptual design and rationale for the control and containment of releases from two areas designated Solid Waste Management Units (SWMUs), and labeled SWMU 3-1 and SWMU 3-4, within the CFI site in Gulfport, Mississippi. Note that SWMU 3 -1 is Location 1 of SWMU 3; likewise, SWMU 3-4 is Location 4 of SWMU 3. A site location map is provided in Figure 1. The purpose of the proposed control and containment measures, which include engineered subsurface and surface barriers and other measures as described herein, is to abate potential future surface and subsurface threats to human health and/or the environment related to the conditions present within and adjacent to SWMU 3-1 and SWMU 3-4.

Three areas have been identified peripheral to SWMU 3-1 and SWMU 3-4 that are addressed separately due to physical constraints and limitations. These areas are identified as the area of creek bottom sediment in "Location 6", the shallow soil in the "G-16 area", and groundwater in the "peninsula area" that borders a portion of the south bank of Turkey Creek. The locations of these areas are shown on Figure 2. This plan provides for: implementation of an in-situ sediment treatment method for Location 6 in Turkey Creek; control and containment of the primary subsurface source areas and surrounding areas in the vicinity of SWMU 3-1 and SWMU 3-4; the movement of a small volume of shallow impacted soil from the G-16 area into the contained area in accordance with the "Area of Contamination Policy" (55 FR 8758); and, the installation of dense non-aqueous phase liquid (DNAPL) removal facilities to address the impact within the peninsula area.

The proposed activities include:

1. Apply the activated carbon product, Sedimite™, to an area of sediments in Turkey Creek in Location 6, to bind potentially bio-available polycyclic aromatic hydrocarbons (PAHs), reduce PAH concentrations in pore water, and reduce the availability of contaminants for uptake by the benthic community, resulting in lower toxicity, i.e., control and containment of the contaminants.
2. Install a soil-bentonite slurry cut-off wall as an engineered subsurface barrier to groundwater and contaminant migration. The wall will extend vertically to a continuous marine clay aquitard that underlies the area, and horizontally to join the existing soil-bentonite cut-off wall in two locations, thus totally enclosing SWMU 3-1 and SWMU 3-4.
3. Remove a small quantity of shallow soil impacted by PAHs outside and adjacent to the slurry wall in the G-16 area; place the soil within the proposed area for containment, and backfill the excavation with clean soil.

4. Install sheet piling at selected locations to provide a retaining wall for backfill and cap material and to stabilize potentially problematic areas.
5. Construct an engineered surface cap barrier after filling, as warranted and grade over the area enclosed by the slurry wall to mitigate potential airborne or direct-contact exposure to humans and ecosystems, for storm protection, and to control surface water runoff.
6. Construct a concrete-lined spillway to convey flood waters from Turkey Creek to Bernard Bayou to prevent a rise in flood elevation due to the fill placed for remedial measures.
7. Construct a new open water area, emergent wetlands, and scrub shrub wetlands onsite and adjacent to Bernard Bayou for mitigation of wetland impacts due to remedial measures.
8. Plug and abandon, and replace, as warranted, monitoring wells and recovery wells that are impacted by the construction activities.
9. Maintain the existing DNAPL/groundwater recovery and treatment facilities within the SWMU 3-1 and SWMU 3-4 area.
10. Install DNAPL removal facilities in the peninsula area, consisting of three recovery wells, recovery pump, recovery piping, and storage equipment.
11. Evaluate alternatives and selectively implement measures to address groundwater impact outside the proposed engineered barriers. Alternatives to be evaluated will include: 1) expansion of the existing pump-and-treat groundwater recovery systems, and 2) targeted in-situ chemical oxidation of PAHs.

2.0 CURRENT CONDITIONS

2.1 Site Description

The CFI Gulfport site is a former wood treating facility. The facility itself is closed, and any remaining equipment from the former process is now used in the site remediation activities. Numerous groundwater monitoring and recovery wells and three water treatment units exist on the property. The CFI facility is located within Harrison County, Mississippi, and is bordered to the north by Bernard Bayou (Harrison County Industrial Seaway) and to the south by residential properties and Turkey Creek. Properties surrounding the site have mixed uses. Properties north of the subject property are used for industrial purposes. Properties west of the subject property are used for commercial purposes. Residential properties and undeveloped wooded properties bound the site to the south and southeast. A topographic site location map is provided as Figure 1. A site plan for the CFI facility is provided as Figure 2.

The lower reaches of Turkey Creek can be described as an estuary environment. Estuaries exhibit temporal and spatial variability related to the mixing of fresh water with saltwater and the influence of tides. Much of the area west of Highway 49 that forms the Turkey Creek drainage basin is undeveloped wetlands. East of Highway 49, the creek passes through mainly commercial property including the Gulfport-Biloxi Regional Airport. An aerial photograph of the surrounding area is included as Figure 3.

2.2 Site History

The CFI facility site was originally founded around 1906 by Captain J.T. Jones. The facility was a wood treating operation that initially treated pilings, timbers, and cross-ties for local railroads and piers. The facility primarily used creosote as a preservative for wood treatment although pentachlorophenol was used as a preservative in the later years of the facility's life.

Captain Jones sold his interest in the facility to Gulfport Creosoting Company. Crown Zellerbach Corporation acquired the facility in 1972 from Gulfport Creosoting Company and retained ownership until CFI acquired the facility on May 5, 1986. CFI operated the plant for approximately a year and a half before closing the site in November of 1987.

2.3 Site Investigations

Both CFI and Crown Zellerbach performed separately funded environmental investigations and onsite remediation of various areas at the site. These investigations were primarily centered on identifying areas where soil and groundwater were impacted as a result of previous wood-treating operations. These remedial actions resulted in closure of the surface impoundment, installation of two soil-bentonite cut-off walls, the treatment, containment, and/or removal of contaminated soils, the installation of recovery wells to remove impacted groundwater, the installation of subsurface groundwater injection trenches, the installation of a subsurface air-sparging system, and the installation, operation, and maintenance of three groundwater treatment systems. CFI follows regimented protocols as outlined in permits issued by the Mississippi

Department of Environmental Quality (MDEQ) for the sampling, treatment, and water discharge associated with the permitted remedial activities at this site.

Further details of site, remedial, and permitting history are outlined in the RCRA Post-Closure Permit and the NPDES Permit for the CFI-Gulfport location.

2.3.1 SWMU 3-1

SWMU 3-1 was identified during the RCRA Facility Assessment (RFA) conducted by the EPA. The RFA was conducted on August 8, 1988 by Ebasco Services Inc., an EPA contractor. SWMU 3-1 was described as a large wood waste pile located directly on the bank of an inlet to Turkey Creek. Waste in this pile included wood chips, shavings, bark, and pole ends. Small amounts of metal debris were also noted to be present. Waste characterization sampling was conducted in August of 2007 at the direction of the EPA to determine if PAHs and dioxins were present. The results of this sampling indicated some subsurface locations exhibited PAH and dioxins in the SWMU 3-1 area and within the nearby meander loop of Turkey Creek. The dioxin/furan toxicity equivalent quotient (TEQ) levels detected during the August 2007 sampling event ranged from 7.6 to 3,300 pg/g (picograms/gram; parts per trillion, ppt), well below the EPA preliminary remediation goal for industrial sites of 5,000 to 20,000 pg/g. The PAH sum of the carcinogenic equivalents of Benzo (a) Pyrene (BaP TEQs) ranged from non-detect to 23.8 mg/kg (milligrams/kilogram; parts per million, ppm). Three locations exceeded EPAs 6 mg/kg standard, at depths ranging from 4 to 10 feet below land surface. None of the surficial samples collected in August 2007 had BaP TEQ concentrations above the 6 mg/kg standard. Furthermore, the samples with elevated concentrations are located within the existing slurry wall or within the proposed containment wall area.

Additional soil sampling was conducted in February 2008 to delineate the extent of PAHs and dioxin in surficial soil and determine the risk to site workers as documented in the *RFI Phase III Site Wide Dioxin Soil Sampling Report* (December 2008) and the *SWMU 3-1 and SWMU 3-4 Interim Measures Investigation Report* (March 2009), which were previously provided to EPA and MDEQ. The sample results had no dioxin/furan congeners that exceeded EPA Regional Industrial Soil Screening Standards or Mississippi TRGs. The maximum detected Method 8290 TEQ was 54.4 ppt. Soil PAH concentrations did not exceed any EPA Regional Industrial Soil Screening Standards or MDEQ Tier 1 TRGs for restricted use. Pentachlorophenol was not detected in any SWMU 3-1 samples. The SWMU 3-1 surface soil sample results are shown on Figure 4.

In addition, numerous borings were installed in 2008 and 2009 to further characterize the geology in the area of SWMU 3-1. During installation of the borings, subsurface lithology was recorded as well as observations denoting odors, sheen, staining and visible constituents of concern (COC). As shown on Figure 5, visible COC were observed in several borings in the vicinity of SWMU 3-1.

2.3.2 SWMU 3-4

SWMU 3-4 was discovered in 1991 during the implementation of the RCRA Facility Investigation. Several years later, in 1997, the contaminant source was discovered as a result of the installation of infiltration trenches at the CFI site within the primary site slurry wall. At that time a terra cotta pipe was unearthed that had visibly contaminated soils associated with it in some areas. The pipe appeared to originate from within the slurry wall in the area of the closed surface impoundment (SWMU 1). The pipe ran east-southeast to a buried wooden sump approximately 650 feet away. This wooden sump was found to be constructed of three inch thick timbers and to be approximately four feet wide by four feet long by four feet high. The wooden sump and terra cotta pipe were eventually labeled as additional parts of SWMU 3-4. The sump was surrounded by fill materials including saw dust, bark, pole cut-offs, cinders and natural soil, all of which were visually contaminated by COC. A buried wooden box culvert was noted to lead south-southwest away from the above described wooden sump, a distance of approximately eighty-five feet. The culvert's dimensions were approximately twelve to eighteen inches wide by approximately twelve inches tall. The wooden sump was located near the northern extent of SWMU 3-4. SWMU 3-4 was previously investigated during the RFI. Although unknown at the time of the RFI, the contaminants at SWMU 3-4 are apparently the result of a release from SWMU No. 1 via the aforementioned terra cotta pipe.

Waste characterization sampling of subsurface soils was performed in August 2007 under EPA direction. The results of this sampling indicated some subsurface soil locations exhibited elevated PAH and dioxin levels in the SWMU 3-4 area. None of the samples exceeded the EPA Dioxin Preliminary Remediation Goal (PRG) of 1,000 ppt TEQ for residential sites.

As reported in the *RFI Phase III Site Wide Dioxin Soil Sampling Report* (December 2008) and *SWMU 3-1 and SWMU 3-4 Interim Measures Investigation Report* (March 2009), additional soil sampling was conducted in February 2008 to delineate the extent of PAHs and dioxin in surficial soil and determine the risk to site workers. None of the EPA Method 8290 TEQ results exceeded the 1,000 ppt EPA Dioxin PRG for residential sites. The maximum detected Method 8290 TEQ was 581.8 ppt. Only sample locations G-4 and G-16 had BaP TEQ concentrations above the EPA mandated 6.0 mg/kg residential standard. The maximum BaP TEQ concentration of 17.93 mg/kg was detected at sample location G-4. The SWMU 3-4 surface sample results are shown on Figure 4. Numerous borings were completed in 2008 and 2009 to further characterize the geology in the area of SWMU 3-4. During installation of the borings, subsurface lithology was recorded as well as observations denoting odors, sheen, staining and visible COC. As shown on Figure 5, visible COC observations generally trend southwest from the former wooden sump associated with SWMU 3-4.

2.3.3 Groundwater

Figure 6 presents the extent of PAHs in groundwater in the vicinity of SWMU 3-1 and 3-4as reported in the *SWMU 3-1 and SWMU 3-4 Interim Investigation Report*. The groundwater sampling results indicate PAH compounds were detected at concentrations exceeding the EPA or MDEQ screening standards at several sample locations, with the maximum total PAH concentration of 201.17 mg/L (milligrams/liter; parts per million, ppm) detected in GW-10.

GW-10 is located within the proposed containment wall. Wells GW-8, GW-11 and GW-18 had total PAH detections above 1 mg/L and are located outside the proposed wall.

The dioxin/furan analyses from one groundwater sample collected to the south of Turkey Creek on the peninsula indicated low levels of three dioxin/furan congeners. The TEQ was estimated conservatively, assigning the value of the detection limits for non-detects. The TEQ was calculated to be 6.4 pg/L, below the EPA drinking water maximum contaminant level (MCL) of 30 pg/L.

2.3.4 Turkey Creek Sediment

CFI has completed investigations of sediments and pore water quality in Turkey Creek, including an evaluation of risks to birds, mammals, and benthic invertebrates from PAHs. These investigations are documented in the "*Turkey Creek Sediment and Pore Water Sampling Report*" March 3, 2010 and the "*Turkey Creek Sediment and Pore Water Sampling Report Addendum*" December 3, 2010. The results of these investigations indicate PAHs present no significant risks to birds or mammals; however, potential risks to benthic invertebrates are predicted in a limited area of approximately 4,000 square feet, centered around Location 6, as indicated on Figure 2.

The PAHs observed in Turkey Creek sediments are likely releases from SWMU 3-1 and SWMU 3-4, either from surface runoff or more likely from the wooden culvert that led toward the creek from the wooden sump documented in previous reports. Wood treating materials from the source area were likely transported via surface runoff into Turkey Creek, carried downstream and deposited along with the sediments in thin seams of sand and organic matter in the depositional bank at Location 6.

Wood treating constituents in the biologically active zone of thin sediments in Location 6 are an exposure point for benthic organisms. CFI is performing a pilot study of in-situ treatment utilizing the activated carbon product, SediMite™ to manage risks to benthic invertebrates in an area of approximately 10,000 square feet. CFI prepared a work plan entitled *Pilot Study Work Plan – In-Situ Treatment of PAH Impacted Sediments at Turkey Creek*, (March 2011) to investigate the effectiveness of SediMite™ in Turkey Creek. The work plan is approved and implementation of the work plan has begun. A more detailed description of the application of SediMite™ in Turkey Creek can be found in Section 3.2 below.

2.3.5 Human Health Risk Assessment

As noted elsewhere in this report, past investigations have identified PAHs and dioxins as constituents of potential concern in environmental media (i.e. soil, surface water, and sediment) at the site. At the request of EPA, CFI has prepared the *Turkey Creek Human Health Risk Assessment Work Plan* (June 2011) that will address potential exposure to surface water and sediment from all constituents present in Turkey Creek. The Human Health Risk Assessment (HHRA) will follow EPA risk assessment guidance and will support risk-based management decisions. The HHRA will present the degree of hazard or carcinogenic risk posed by the site and will identify and discuss uncertainties in the exposure assumptions and hazard and risk estimates.

The HHRA is intended to determine if constituent concentrations detected in environmental media, as reported in laboratory analyzed sample data collected during recent sampling activities, present a risk to human health. The HHRA also includes a separate sampling plan for collection of fish and other organisms potentially consumed by recreational anglers along Turkey Creek. The HHRA sampling plan includes additional sediment and surface water samples that may be required to perform the HHRA.

The HHRA will review and evaluate the data in site environmental media, assess current and potential future exposure scenarios and quantify the potential risk and hazard to human health. The HHRA will use health protective assumptions to calculate estimates of exposure and the resulting hazard and risk to potentially exposed populations in the absence of any remedial action. However, this assumption is conservative given that several remedial actions are currently being performed (groundwater recovery, SediMite™ application) and others are planned, as described herein, (excavation of soil, cut-off wall, capping, sheet pile walls) for the SWMU 3-1 and SWMU 3-4 areas adjacent to Turkey Creek.

2.3.6 Investigation of Sediment Bar in Bernard Bayou

At the request of the EPA, CFI has prepared the *Bernard Bayou Sediment Bar Sampling Plan* (June 2011) to evaluate a sediment bar located on the south side of Bernard Bayou approximately 600 feet downstream of the mouth of Turkey Creek. In correspondence dated March 25, 2011, EPA identified the "sediment bar" and stated this is a "likely location" which may contain wood treating constituents historically released from the CFI site. The plan provides procedures for sampling the "sediment bar" for the presence of COC identified during previous investigations. The analytical results will be used to evaluate human health and ecological risks.

2.4 Health and Safety

All work activities will be conducted in accordance with the procedures in the Site Health and Safety Plan for CFI sites. This plan is available upon request.

3.0 CONTROL AND CONTAINMENT MEASURES

As discussed above, the COC identified in the SWMU 3-1 and 3-4 area through the various investigations previously referenced are:

- PAHs adsorbed onto shallow surface soils and sediment in Turkey Creek;
- PAHs associated with subsurface coal tar oil distillates that were formerly used in the wood treating process; and
- Dissolved PAHs in groundwater and Turkey Creek pore water.

Provided below is a description of control and containment measures proposed for this site that mitigate releases to SWMU 3-1, SWMU 3-4, and Turkey Creek.

3.1 Control and Containment Objectives

The objectives of the control and containment measures are to cut-off and/or control potential pathways wherein uninhibited contaminant migration could occur, thereby making these potential exposures or release pathways incomplete. Specific goals of the measures are:

- Control and contain the contaminants found in Turkey Creek sediment by reducing the bio-availability of contaminants for uptake by the benthic community, resulting in lower toxicity.
- Cut-off and control potential contaminant migration pathways for groundwater to prevent offsite migration and/or releases to sensitive receptors.
- Eliminate potential direct contact or airborne exposure pathways associated with the shallow soil impacted with low concentrations of PAH constituents located in the G-16 area, adjacent to the proposed containment facilities.
- Eliminate the potential direct contact or airborne exposure pathways throughout the SWMU location areas.
- Implement hydraulic containment, control, and reduction of the contaminant mass within the proposed containment facilities through DNAPL/groundwater recovery facilities.
- Reduce contaminant mass in the peninsula area, outside the containment facilities, to a risk-based allowable concentration through DNAPL/recovery and treatment facilities.

3.2 Turkey Creek Sediment

CFI is currently conducting a pilot study to evaluate the application of activated carbon to surficial sediments within Turkey Creek. The application is expected to enhance the sorption capacity of sediments and ultimately greatly reduce the pore water concentration of PAHs. Due to the limited size of the impacted area, the entire area of the creek where PAHs exceeding screening criteria was observed is included in the pilot study. The effectiveness of the application is being monitored through a sampling program that evaluates the pore water in the upper sediment layer.

Activated carbon is delivered to the sediments using a recently developed product trade-named SediMite™. The product incorporates activated carbon into pellets composed of dense particles that are used as a carrier. The product can be broadcast to the surface of the water, where it travels through the water column and then disintegrates slowly on the top layer of sediment. The finer activated carbon material is incorporated into the top layer of sediment through natural mixing processes such as bioturbation. SediMite™ was developed at the University of Maryland Baltimore County in collaboration with a small business under a USEPA Small Business Innovative Research Project grant and Department of Defense Strategic Environmental Research and Development Program grant.

The primary objective of the SediMite™ application is the reduction of bioavailable (dissolved) PAH concentrations in sediment following application. This performance objective will be evaluated through the analysis of pore water sampling results and the calculation of pore water PAH toxic units. The results of pore water PAH analysis before and after application of SediMite™ will be analyzed to evaluate if statistically significant (95% confidence interval) reductions are observed, and whether the after-treatment pore water PAH concentrations indicate reduction of total toxic units to acceptable values for a majority of the samples taken in the study area.

Figure 7 shows the SediMite™ application area. During June 3 through June 11, 2011, 3,600 lbs of SediMite™ was applied to this area. A second application of 5,439 lbs was applied on July 16, 2011. CFI is currently evaluating the effectiveness of the treatment which will be provided to EPA and MDEQ in a report documenting the study. The report will develop a monitoring plan for future evaluations of the effectiveness. The monitoring plan is expected to include sample collection methods, frequency, and test methods.

3.3 Hydraulic Cut-Off Wall

Control and containment measures for the source area will consist of the installation of a low permeability soil-bentonite cut-off wall that encircles the SWMU 3-1 and 3-4 area to provide containment of impacted groundwater, and installation of a soil cover to control exposure to surface soils. The hydraulic cut-off wall should have the following design properties:

- Effectively intercept and cut-off the potential migration pathways of contaminated groundwater and DNAPL from the impacted areas. The hydraulic cut-off wall should extend vertically from ground surface and tie into the H4 marine clay aquitard. Mapping of the H4 clay aquitard indicates the depth to the top of the clay in the proposed location of the cut-off wall ranges from 12.6 to 38.3 feet bgs, with an overall average depth of approximately 30 feet.
- Spatially, the wall should be placed as a barrier to potential groundwater releases to Turkey Creek, to cut-off two small inlets impacted by site activities, to encompass the entire SWMU areas, and to tie into the existing wall as shown on Figure 8.

- The wall design should be such as to reduce the permeability across the 3 feet wall section to a maximum of 1 x 10^{-7} centimeters per second (cm/sec).
- The materials of construction for the wall should be compatible with the conditions that exist within the proposed wall alignment.
- Constructability, without incident, should be of prime concern especially with respect to the terrain and proximity to the creek.
- Structural requirements must be met to withstand the exposure to physical forces that could potentially be exerted by the elements especially at the two inlet crossings.
- Assurance of quality control of the wall construction should be inherent to the design.

The proposed cut-off wall alignment, as indicated on Figure 8, accomplishes the desired segregation of the SWMU areas, and cut-off of the potential groundwater migration pathways. This alignment cuts across a pathway of known COC migration within the deeper groundwater which is evaluated in the *SWMU 3-1 and SWMU 3-4 Interim Measures Investigation Report* (March 2009). This contaminant migration pathway, which connects the impacted area beneath the peninsula area on the south side of Turkey Creek to the source areas in SWMU 3-1 and 3-4, will be eliminated. Adjacent areas impacted by historic operations located outside the wall alignment are addressed separately. Installation of the cut-off wall work pad and wall is expected to impact some of the existing monitoring and recovery wells. Plugging and abandoning of wells and the installation of replacement wells is addressed in Section 6.4.

Figure 9 shows a vertical soil profile along the alignment of the cut-off wall. Slurry wall construction will consist of the excavation of a trench, three feet wide, down to a minimum of three feet into the H4 marine clay horizon. Conventional hydraulic excavators will be used for the straight-run segments of the trench. The corner segments of the trench will be excavated using a hydraulic diaphragm wall grab capable of continuously monitoring verticality of three separate axes during excavation. A bentonite/water slurry will be used to maintain a stable open hole for placement of an engineered fill material. All spoiled material will be placed inside the containment area as fill during wall construction. An engineered fill consisting of in-situ clean soil (or imported clean soil if required), bentonite, and water will be mixed in an electronically-controlled pug mill system. The engineered fill will have a maximum hydraulic conductivity of 1 x 10^{-7} cm/sec, and will be pumped into the excavation for placement. A detailed description of the soil-bentonite wall construction process is included in Appendix A, *A.H. Beck Foundation Co., Inc., Technical Data and Procedures.*

3.4 Sheet Piling

As indicated on Figure 8, sheet piling is proposed at selected locations to serve as a retaining wall, assist in stabilization, and to prevent undermining by the Turkey Creek channel. CFI employed Eustis Engineering Company Inc. of Mississippi (Eustis Engineering) to perform soil penetration tests, laboratory analyses of soil samples, and engineering calculations required to establish the appropriate design parameters for the sheet pile installations at the locations described below. The Eustis Engineering report, *Geotechnical Investigation, Cavenham Forest*

Industries, LLC, Proposed Sheet Pile Wall, is included in Appendix B. The purpose of each segment of sheet pile wall listed is as follows:

- Cut-off the oxbow inlet and the east inlet on Turkey Creek to provide a retaining wall for backfill and cap material,
- Isolate and stabilize the Rippy Road embankment to prevent impacts due to the installation of the nearby slurry wall,
- Stabilize the "hairpin turn" in Turkey Creek on both sides of the spillway entrance to prevent erosion of the creek bank, and
- Stabilize the entrance and exit areas of the spillway to prevent undermining of the channel and provide support for a concrete barrier.

3.5 G-16 Area Soil

The *SWMU 3-1 and SWMU 3-4 Interim Measures Investigation Report* (March 2009) identified a small area of surficial soil impacted by PAHs in the vicinity of soil sample G-16. Remediation activities will include excavation of surficial soils in the G-16 area to a depth of approximately two feet below grade as shown in Figure 8. The excavated material will be disposed inside the cut-off wall within the proposed area for capping. The excavated area will be backfilled with clean soil.

3.6 Surface Grading and Cover

Surficial soils within the area surrounded by the cut-off wall will require grading and other earthwork tasks to isolate potential COC identified in the surficial soils, control surface water flow, and control potential infiltration into the subsurface. Specific tasks associated with site grading and surface cover placement are discussed below.

3.6.1 Clearing, Grubbing and Grading

A soil cover will be placed over areas where COC may be present at the surface in excess of risk-based standards. The surface cover is designed to allow controlled infiltration to enhance groundwater recovery, minimize potential storm flooding impact, and other remediation efforts. The surface cover will consist of an 8-ounce non-woven geotextile fabric, anchored per the manufacturer's recommendations. The geotextile fabric will be covered with a minimum one-foot thickness of sandy clay or silt, and one foot of topsoil to support vegetation. Areas requiring fill and the extent of the proposed soil cover are shown on Figure 10. The final cap layout is shown on Figure 11. Cross-section views of the containment wall and surface barrier are shown on Figures 12 and 13. The locations of the cross-section cuts are shown on Figure 11. The final cap elevations and the flood control spillway are the basis of a No-Rise Certification required by the National Flood Insurance Program (NFIP) and discussed in Section 6.

Due to the soft soils in portions of the construction area a perimeter engineered work pad will be used to drive the sheet piling and construct the cut-off wall. This work pad will serve as a working surface for construction equipment and as a buffer to protect Turkey Creek from potential releases of site contaminants or erosion materials.

Trees, stumps, and other vegetation within the construction area will be removed, chipped and deposited within the containment area. Site grading and addition of fill material to be placed in low lying areas shall not exceed a maximum slope of 2% in any direction. All sloped areas shall begin 25 feet from the proposed slurry wall location. Generally, excavated material from onsite will be used as fill material. No excavated material will be hauled offsite. Soils from the installation of adjacent wetland mitigation areas will be used for general fill, as warranted. Imported off-site material will be used as needed, but kept to a minimum. Any excess non-contaminated soil will be added to the soil cover on Old Pond (SWMU 6).

3.6.2 Concrete-Lined Spillway

As shown in Figure 8, a portion of the cover will be constructed of concrete to form a flood control spillway across the area to be enclosed by the cut-off wall. This structure is necessary to convey floodwaters from Turkey Creek across the site directly to Bernard Bayou, preventing a rise in flood elevation due to containment fill materials. The spillway will be approximately 84 feet wide and 3 feet deep and is discussed further in Section 6. The concrete structure will also serve as a cap to further isolate the COC in this area.

3.7 Peninsula Area Groundwater

Impacted groundwater in the peninsula area, outside of the containment walls, will be remediated using a combination of technologies. It is proposed that fluid extraction will be the primary component of the final remedy to address impacted groundwater and residual COC that may serve as a continuing source. In addition, CFI believes that chemical oxidation can be used as a final polishing measure for impacted soil and groundwater and/or residual COC mass reduction. The following sections describe activities designed to evaluate application of COC recovery and in-situ chemical oxidation technologies in areas outside of the containment areas at the site.

3.7.1 Product Recovery

Three groundwater recovery wells (RW-41, RW-42, and RW-43) were completed in the peninsula area to act as product recovery wells. Figure 8 shows the location of the three recovery wells and the well installation details and boring logs are included as Appendix C. At present, RW-41 is actively pumping to gauge the effectiveness of the recovery operation. These wells were placed in an area that has a defined structural low where COC accumulated in a subsurface depression in the top of the H4 marine clay. The wells are constructed of 4-inch diameter 316 stainless steel riser with variable lengths of wire-wrapped 316 stainless steel screens with 0.050 inch slot widths, and a 2-feet long sump. The base of the screens are approximately 6-inches below the sand/marine clay contact. The gravel pack consists of ¼-inch diameter glass beads or clean pea gravel. The annular space around the sump was filled with bentonite pellets to one-foot below the base of the screen and topped with 6-inches of 10/20 graded sand prior to placement of the gravel pack. The wells were installed in a 9-inch nominal diameter boring using a sonic drilling rig. All drilling waste materials were managed in accordance with applicable regulations. Currently, recovered product is pumped into 55-gallon drums that are held within an enclosed mobile containment structure located near the recovery wells on-site. The drums are shipped off-site for disposal every 90 days in accordance with applicable waste management regulations.

3.7.2 In-Situ Chemical Oxidation

Successful implementations at other sites suggest that in-situ chemical oxidation (ISCO) may be an effective component of the final remedy at the Gulfport site. CFI envisions several ISCO strategies may be applicable at the site including:

- COC mass reduction,
- Rapid treatment of residual COC in soil,
- Enhanced migration of COC to recovery locations due to increased heat, and
- Enhanced bioremediation.

CFI collected soil samples from contaminated areas along Bayou Bernard and during the installation of the recovery wells in the peninsula area (Figure 8). These areas were identified through subsurface investigations as having been outside the current pump-and-treat zone of influence resulting in DNAPL collection areas.

The soil samples were treated with three different oxidants to determine the most effective treatment for each area. The oxidants used for the treatability study were potassium permanganate, hydrogen persulfate, and hydrogen peroxide. Treated soils were sent to Micro Methods laboratory and analyzed for semi-volatiles, metals (manganese for permanganate samples) and soil oxidant demand (SOD). Based on the results of the study it appears that potassium permanganate and hydrogen peroxide are the most promising oxidants tested. Due to the high cost of oxidizing free product, ISCO is proposed as a final "polishing" remedial action for non-recoverable COC in groundwater and residual COC in soil. Once the recoverable COC has been removed by the recovery wells ISCO may be performed to further remediate any residual contamination from the soil and groundwater.

4.0 ALTERNATIVE REMEDIATION MEASURES

Several alternative remediation measures for both sediment and upland areas were evaluated prior to selecting the proposed measures described above. A summary of the alternative measures evaluated and the rationale for selecting the proposed measures are described below.

4.1 Alternative Turkey Creek Sediment Remediation Measures

4.1.1 Monitored Natural Recovery

Monitored natural recovery (MNR) is a remedy for contaminated sediments that typically uses ongoing, naturally occurring processes to contain, or reduce the bioavailability or toxicity of contaminated sediment. MNR does not rely on proactive remediation, but rather allows the contaminants to naturally degrade while monitoring the process through sampling and laboratory analysis. Not all sites possess the naturally occurring processes that reduce the risk of the contaminant to the human and/or ecological receptors.

The MNR alternative was deemed not feasible due to the length of time it would take for the natural degradation of the contaminants. The alternative remediation measure would not immediately protect the ecological receptors within the area of concern, and would not necessarily reduce the elevated concentrations and/or the bioavailability of the contaminants.

4.1.2 Sediment Cap

The construction of an engineered sediment cap to isolate and encapsulate the area of concern was also investigated as a possible remediation action. This plan would include the placement of a subaqueous covering of clean materials over the contaminated sediments that would remain in place. The establishment of a sediment cap would not remove the contaminants but isolate them from the surrounding environment.

This remedial option was deemed not feasible due to the difficulty of installation caused by the concrete debris scattered about the bottom and the potential of mechanical failure of the cap during flood events. The engineered cap would be effective in reaching the primary goal of the project if installation can be achieved, but has the potential of failing in the future due primarily to erosion if not properly installed. Although erosion/scour is not anticipated, in the event of large storms and/or floods, the possibility that the clay cap will be eroded exists. Although unlikely for Turkey Creek, the construction of a sediment cap in a riverine environment may potentially reduce depth and restrict flow, and may alter the sediment and flood-carrying capacity of the channel, which could raise the base flood elevation of the surrounding area. In addition, the placement of a sediment cap would cause a rise in turbidity during construction, damage to the existing ecosystem by changing the bottom substrate, and the alteration of sediment bathymetry.

4.1.3 Dredging

Dredging of contaminated sediments was considered to remove the immediate risk to benthic invertebrates within the area of concern. This option would involve physically removing surficial sediment from the bottom of the creek and disposing of it in an approved landfill. This alternative would be effective but would also prove costly and environmentally precarious. The disturbance to the bottom sediments of the creek would potentially mobilize the COC and allow them to travel downstream increasing the footprint of the contaminated area. Another environmental concern is the increase in turbidity during dredging. Financially this alternative proved to be very costly due to the price of the dredging equipment and the cost of disposing of the dredged material. Removing the benthic invertebrates along with the dredged material would also be unavoidable with this option. In addition, this alternative was found to be infeasible due to the presence of a large area of rip-rap at the bottom of the creek in the area of concern.

4.2 Alternative Upland Remediation Methods Considered

4.2.1 Alternative Methods for Cut-Off Wall Construction

Various methods for cut-off wall construction were evaluated against the above design parameters and costs. Neither of the methods evaluated met all the criteria as a stand-alone solution. However, the proposed design incorporates two of the methods to satisfy the design objectives. The methods for the cut-off wall construction considered are as follows:

Construction Method	Description	Pros	Cons
Conventional Open Trench Slurry with in-situ soil mixing	Excavation with track hoe; soil mixed with bentonite adjacent to trench or in-situ.	Least costly method.	Poor quality control of soil-bentonite mix.
In-situ Soil Mixing with hollow-stem auger	Excavation drilled with auger; bentonite added through hollow core to mix with in-situ soil.	No excavation of contaminated soil required.	Poor quality control of soil-bentonite mix.
Steel Sheet Pile with sealed joints	Driven using crane or track hoe; joint sealant added during installation.	No excavation of contaminated soil required.	Leakage through joints and corrosion of steel.
Synthetic Sheet Pile with sealed joints	Driven using crane or track hoe; joint sealant added during installation.	No excavation of contaminated soil required.	Leakage through joints and poor chemical resistance of synthetic materials to PAHs.
Conventional Open Trench Slurry with Soil Mixing Plant	Excavation with track hoe; in-situ or imported soil mixed onsite with bentonite in an electronically-controlled mixing plant; spoiled material used as fill within containment.	Precise quality control of final soil-bentonite mix.	Contaminated soil is excavated and placed in containment area as fill material; however, this is manageable.

The later method (Open Trench Slurry with Soil Mixing Plant) is proposed as it provides several advantages over the other methods and can be implemented within the confines of the desired footprint without the concerns inherent to the other methods. This method would be augmented at the inlet crossings with a structural sheet pile wall on the outer exposed side. One of the greatest advantages of this specific slurry method is the precise quality control of the final backfill mix which is monitored real time to ensure a uniform mix of bentonite and the soil matrix in compliance with the design criteria.

4.2.2 Dig and Haul

Excavation of surficial and subsurface contaminated soils in the SWMU 3-1, SWMU 3-4, and GW-16 areas, and disposal and/or treatment of the soil at an off-site facility is an option studied. The excavation of a portion of the contaminated soils is possible, and a viable option. Any excavation must capture or minimize fugitive airborne emissions during excavation and transportation activities to minimize risk to on-site workers and the public. The excavation and removal of all contaminated soils and DNAPL is also not considered achievable. CFI is recommending disposing a minimum quantity of excavated material from the G-16 area inside the proposed area for capping, and capping the remainder of contaminated soil in place.

4.2.3 In-situ Remediation

Several types of in-situ remediation methods were investigated as potential actions for the goals set forth in this document. Due to the presence of free product within the groundwater inside the proposed cut-off wall, in-situ remediation using biological activity and/or biological enhancement was deemed to be currently ineffective. Chemical oxidation is another form of in-situ remediation that was deemed to be potentially effective in the remediation of residual soil and groundwater contamination. In addition, it is believed that ISCO could reduce COC mass present in the groundwater by enhancing its migration. ISCO is discussed in further detail in Section 3.7.2 of this report.

5.0 PROJECT MANAGEMENT

CFI, as property owner of the Gulfport site, is primarily responsible for the design and implementation of the control and containment measures described in this report. CFI has retained EMS to provide all geological and engineering services required to manage this project on the behalf of CFI, including the design and oversight of construction. EMS has designed the measures described above and will obtain all permits and agency approvals required, prepare and administer contracts with construction contractors, supervise construction activities, complete selected elements of the construction activities with EMS personnel and equipment, insure quality control standards are met, collect and analyze quality assurance samples, and provide documentation/reports as required. Following installation of the containment measures, EMS will prepare a certification report stamped by a registered Mississippi professional that documents the construction activities.

6.0 CONSTRUCTION/IMPLEMENTATION

6.1 Permits Required

6.1.1 Wetlands

The installation of the remedial measures described herein will require construction activities that will impact wetlands and waters of the United States. These activities are regulated by *Section 10 of the Rivers and Harbors Acts of 1899* and *Section 404 of the Clean Water Act*. Permits will be required for these activities from the U.S. Army Corps of Engineers (USACE), the Mississippi Department of Marine Resources (MDMR), and the Mississippi Department of Environmental Quality/Office of Pollution Control (MDEQ). A *Joint Application and Notification Form* is designed for this purpose through a coordinated effort of these agencies. The application will be submitted to the MDMR (the coordinating agency) for review and approval. The MDMR will forward the application to the USACE, MDEQ, and other appropriate agencies for review and approval for their respective regulatory jurisdiction.

Elements of this work plan that may require prior approval as described above include, installation of cut-off slurry wall, installation of sheet piling, backfilling two existing inlets and additional low-lying areas, installing rip-rap, and the installation of recovery wells, and associated piping. The *Joint Application and Notification* form packet to be submitted will include information describing the project location, purpose, public benefit, names and addresses of adjacent property owners, environmental impact, specific structures to be erected, the type of work to be performed, schedule, cost, drawings, and specifications. This design report and an EPA approval letter for same are required elements of the joint permit application package.

CFI employed BMI Environmental Services (BMI) of Gulfport, Mississippi to perform a wetlands assessment of the areas to be impacted by the installation of the remedial measures. BMI determined that 3.67 acres of wetlands will be impacted as follows:

- 0.50 acres of open water
- 0.35 acres of emergent wetlands
- 0.96 acres of scrub shrub wetlands
- 1.86 acres of swamp forest wetlands

CFI has initiated the following steps to mitigate the 3.67 acres of wetlands to be impacted:

- 1.86 acres of swamp forest wetlands and 0.69 acres of scrub shrub wetlands were mitigated by purchasing wetlands mitigation credits from the *Land Trust for the Mississippi Coastal Plain* (LTMCP) through the LTMCP *In-Lieu Fee Mitigation Program*. A copy of the executed agreements between CFI and LTMCP are attached as Appendix D.
- 0.5 acres of open water, 0.38 acres of emergent wetlands, and 0.55 acres of scrub shrub wetlands will be constructed onsite to exceed the required mitigation of the 3.67 total

acres impacted. The locations of the new open water and wetlands to be constructed onsite are shown on Figures 14 and 15.

The wetlands impacted and corresponding mitigation areas are summarized as follows:

Type of Wetland	Area Impacted (acres)	Area Mitigated On-site (acres)	Area Mitigated by Purchased Credits (acres)	Total Area Mitigated (acres)
Open Water	0.50	0.50	0	0.5
Emergent	0.35	0.38	0	0.38
Scrub Shrub	0.96	0.55	0.69	1.24
Swamp Forest	1.86	0	1.86	1.86

A copy of the BMI report, *Mitigation Plan - Cavenham Forest Industries Site, Gulfport, Mississippi* is attached as Appendix E.

6.1.2 Public Trust Tidelands

The required construction activities will also impact Public Trust Tidelands held in trust by the State of Mississippi. The Mississippi Secretary of State is Trustee for the Public Trust Tidelands. The Public Trust Tidelands impacted are the two open water areas (0.5 acres) and adjacent emergent wetlands (0.35 acres) below the mean high water line on Turkey Creek, as shown on the tidal boundary surveys included in Appendix F.

Mississippi law provides for the leasing of Public Trust Tidelands to be removed from public use. CFI has entered into an agreement with the State of Mississippi to lease the 0.85 acres of impacted public trust tidelands. A copy of the lease agreement is attached as Appendix F.

6.1.3 Flood Control

A No-Rise Certification indicating no increase of the 100-year flood elevation by construction activities in the Turkey Creek and Bernard Bayou floodways is required by the National Flood Insurance Program (NFIP). The NFIP is administered by the Federal Emergency Management Agency (FEMA), and enforced by the City of Gulfport through the city’s building code and permit ordinance.

CFI employed Dewberry & Davis consultants to perform a floodplain study, assist with design modifications necessary to achieve a no-rise condition, and issue a No-Rise Certification for the final remedial design. A Floodwater Spillway, approximately 84 feet wide and 3 feet deep was designed by Dewberry & Davis to convey floodwater across the site from Turkey Creek directly to Bernard Bayou, thus preventing an otherwise ½ foot rise in flood elevation which would have been caused by the fill material required for the remedial measures. The location of the spillway is shown on Figure 8. A copy of the No-Rise Certification for Bernard Bayou is included as Appendix G. A copy of the No-Rise Certification for Turkey Creek is included as Appendix H. A copy of the Floodwater Spillway design documents is included as Appendix I.

6.1.4 Storm Water Runoff

A *Storm Water Pollution Prevention Plan and MDEQ Construction Permit* is required prior to commencement of construction activities.

6.2 Construction Sequence and Schedule

Construction steps for the upland remedial measures are as follows:

- Utilizing site specific criteria, conduct a geotechnical laboratory study to develop a desired mix design consistent with the slurry wall design parameters and onsite water supply.
- Removal of vegetation (trees, stumps, roots, etc) including chipping and placement inside the proposed area for capping.
- Installation of the structural sheet pile wall at the location of the spillway discharge.
- Construction of the new open water area, emergent wetlands, and scrub shrub wetlands onsite and adjacent to Bernard Bayou, and stockpile excavated soil onsite. The majority of the stockpiled soil will be consumed in the construction activities described below, and any excess material will be used for maintenance of the existing Old Pond cap.
- Construction of the soil work pad along the proposed wall alignment including the installation of an external containment berm between the work area and the adjacent creek. Rip rap will be placed in selected areas to prevent erosion of the creek bank.
- Installation of the structural sheet pile wall across the two inlet connections and along the creek bend area that is prone to future erosion. This would be done concurrently with dewatering of the two inlets followed by completion of the work pad construction across the inlets. Water collected from all dewatering operations will be discharged in accordance with NPDES Permit requirements.
- Equipment mobilization, stockpiling of bentonite and fill soil, setup of mixing facilities and fresh water supply, and setup of a decontamination area within the wall enclosure for equipment to be exposed to contaminated soil.
- Establish the onsite protocol for attainment and documentation of the quality control objectives for the design. Quality control results will be provided by the contractor with additional quality assurance samples collected by CFI.
- Slurry wall construction will consist of the excavation of a trench, three feet wide, down to a minimum of three feet into the H4 marine clay horizon. Conventional hydraulic excavators will be used for the straight-run segments of the trench. The corner segments of the trench will be excavated using a hydraulic diaphragm wall grab capable of continuously monitoring verticality of three separate axes during excavation. A bentonite/water slurry will be used to maintain a stable open hole for placement of an engineered fill material. All spoiled material will be placed inside the containment area as fill during wall construction. An engineered fill consisting of in-situ clean soil (or imported clean soil if required), bentonite, and water will be mixed in an electronically-

controlled pug mill system. The engineered fill will have a maximum hydraulic conductivity of 1 x 10^{-7} cm/sec, and will be pumped into the excavation for placement. A detailed description of the soil-bentonite wall construction process is included in Appendix A, *A.H. Beck Foundation Co., Inc., Technical Data and Procedures.*

- Construction of the spillway, as described in Section 3.6.2 above.
- Construction of the soil cover as described in Section 3.6 above.
- Placement of clean excess soil on the Old Pond cap for slope maintenance, as indicated on Figure 16.

An overview of the site after the completion of all construction activities is shown on Figure 16. A Gantt Chart schedule of specific tasks associated with construction of the remedial measures is included in Figure 17.

6.3 Waste Management

The majority of the excavated soil will be consumed in the construction of the remedial measures described herein. Any excess material will be used for maintenance of the existing Old Pond cap. No soil or debris containing hazardous constituents will be removed from the SWMU 3-1 and SWMU-3-4 area.

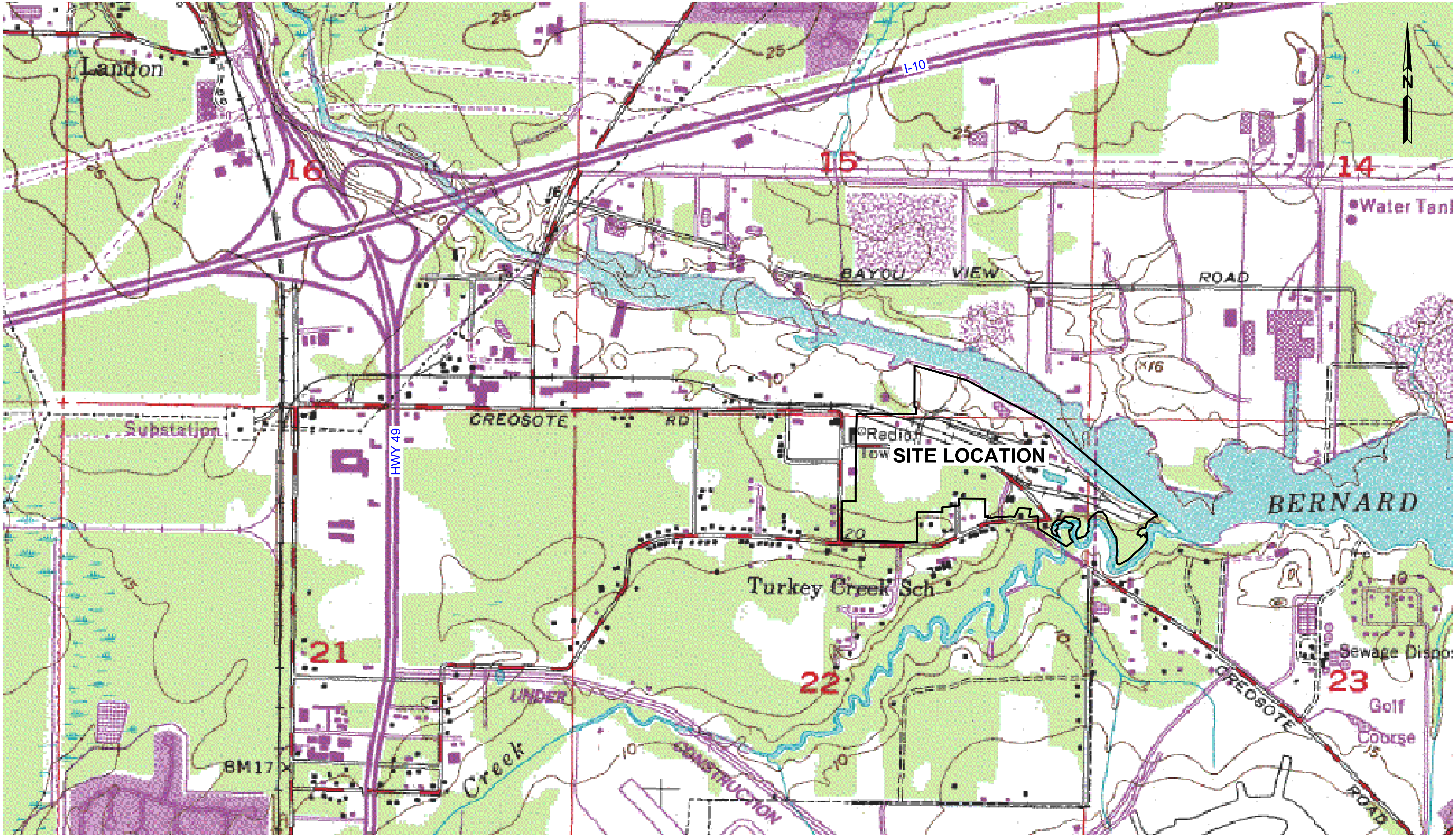
6.4 Monitoring and Recovery Wells

As indicated in Figure 8, due to direct interference with the proposed construction activities wells PW-4A, MW-9, MW-10, MW-11, and MW-12 will be plugged and abandoned prior to the start of construction. Should any of the other monitoring or recovery wells be damaged during the construction activities these wells will be replaced in their original location if they cannot be repaired. All recovery wells in this area will be shut down during the construction activities and the piping and electrical removed. Following construction activities the piping and electrical will be reconnected to recovery wells.

Well PW-4A currently serves as a RCRA boundary monitoring well, monitoring an area outside the existing RCRA cut-off wall. As this well currently monitors an area that will be included within the new cut-off wall, future use of this well is not required. Well PW-4A will be plugged and abandoned and not replaced.

Wells MW-9, MW-10, MW-11 and MW-12 are Interim Measure monitoring wells for SWMU 3-4. The locations of monitoring wells MW-11 and MW-12 will be moved to the southeast, where new wells will be installed to monitor the SWMU 3-4 area outside of the new cut-off wall. Similarly, the locations of monitoring wells MW-9 and MW-10 will be moved to the northeast to a location outside the cut-off wall.

FIGURES



SCALE 1 INCH = 1000 FEET

250 500 1000

0 250 500 1000 2000

REFERENCE: U.S.G.S. TOPOGRAPHIC MAP
7.5 MINUTE SERIES
1985 N.W.GULPORT, MS

CAD FILE:
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SCALE: 1"=1,000'
DATE: 07/17/2011
CHECKED: L.C.
DRAWN BY: T.R.B.

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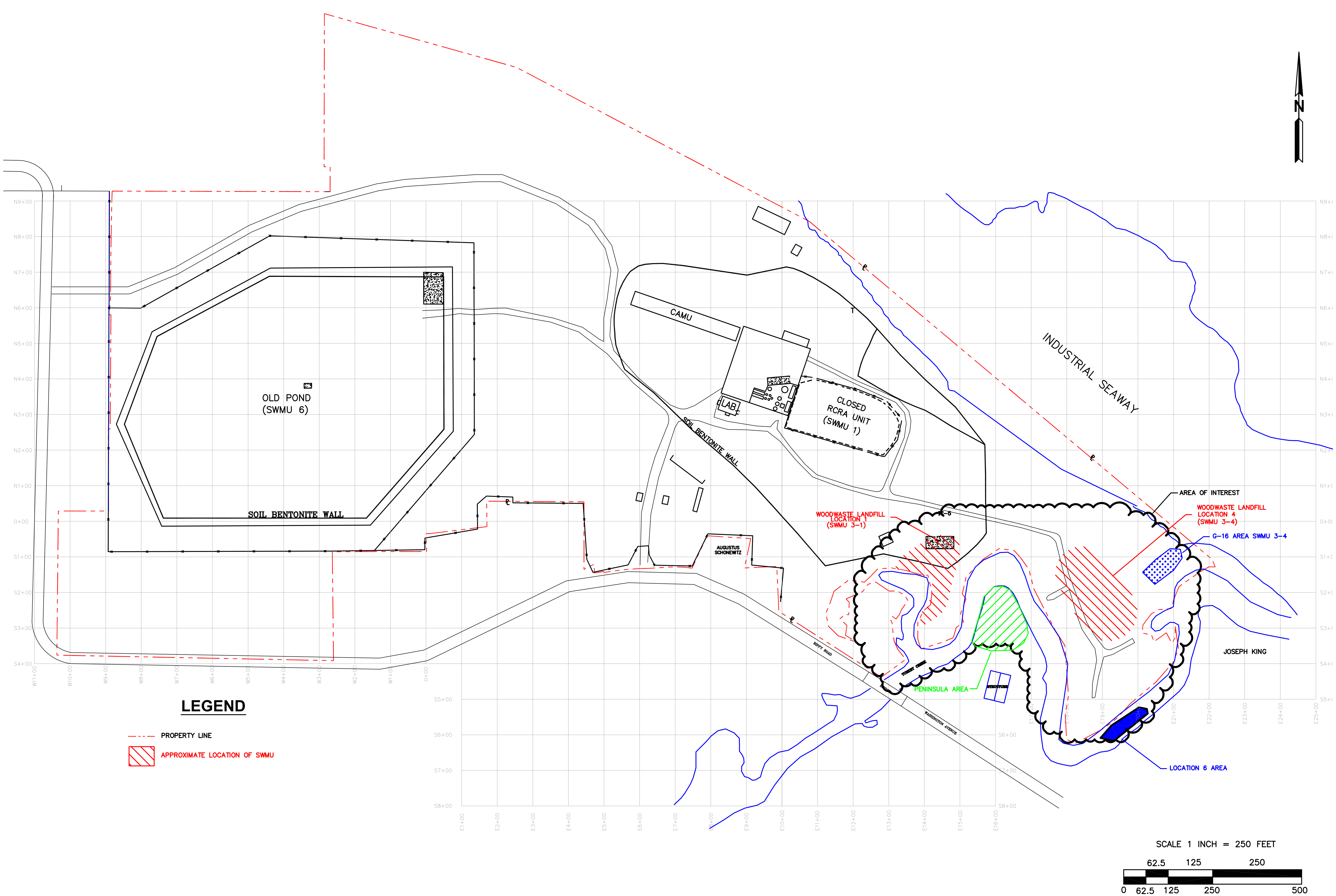
GULFPORT, MS

SITE LOCATION

SWMU 3-1, 3-4 CONTROL AND CONTAINMENT DESIGN REPORT

FIGURE
1



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SITE LAYOUT

SWMU 3-1, 3-4 CONTROL AND
CONTAINMENT DESIGN REPORT

FIGURE
2

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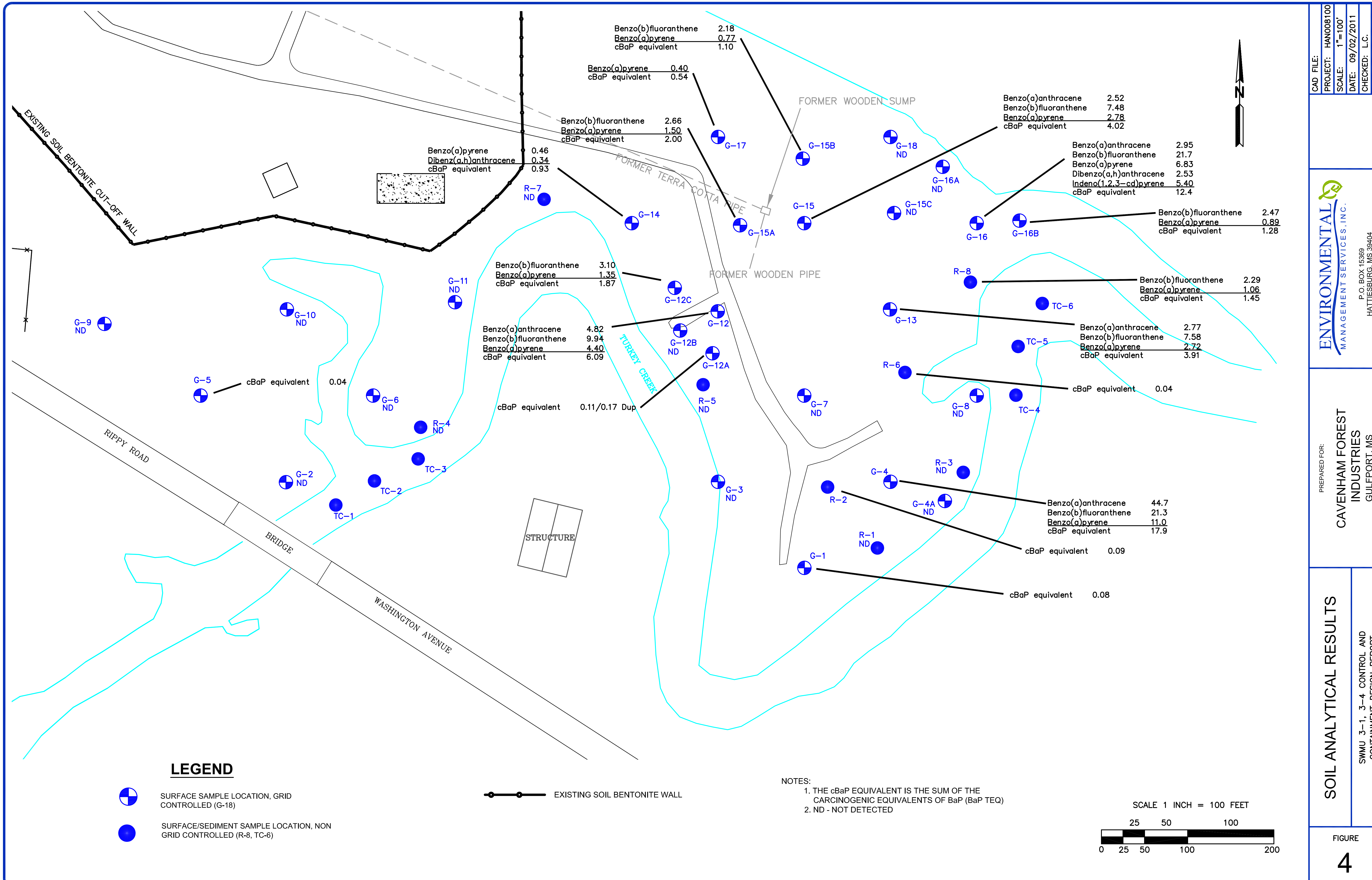
AERIAL PHOTOGRAPH

SWMU 3–1, 3–4 CONTROL AND CONTAINMENT DESIGN REPORT

FIGURE 3



Benzo(b)fluoranthene 2.18
Benzo(a)pyrene 0.77
cBaP equivalent 1.10
Benzo(a)pyrene 0.40
cBaP equivalent 0.54
Benzo(b)fluoranthene 2.66
Benzo(a)pyrene 1.50
cBaP equivalent 2.00
Benzo(a)pyrene 0.46
Dibenz(a,h)anthracene 0.34
cBaP equivalent 0.93
FORMER WOODEN SUMP
FORMER TERRA COTTA PIPE
FORMER WOODEN PIPE
EXISTING SOIL BENTONITE CUT-OFF WALL
Benzo(a)anthracene 2.52
Benzo(b)fluoranthene 7.48
Benzo(a)pyrene 2.78
cBaP equivalent 4.02
Benzo(a)anthracene 2.95
Benzo(b)fluoranthene 21.7
Benzo(a)pyrene 6.83
Dibenzo(a,h)anthracene 2.53
Indeno(1,2,3-cd)pyrene 5.40
cBaP equivalent 12.4
Benzo(b)fluoranthene 2.47
Benzo(a)pyrene 0.89
cBaP equivalent 1.28
G-17
G-15B
G-18 ND
G-16A ND
G-15
G-15C ND
G-16
G-16B
G-14
G-15A
R-7 ND
Benzo(b)fluoranthene 3.10
Benzo(a)pyrene 1.35
cBaP equivalent 1.87
G-11 ND
G-12C
G-12
G-12B ND
G-12A
G-10 ND
G-9 ND
Benzo(a)anthracene 4.82
Benzo(b)fluoranthene 9.94
Benzo(a)pyrene 4.40
cBaP equivalent 6.09
TURKEY CREEK
R-8
Benzo(b)fluoranthene 2.29
Benzo(a)pyrene 1.06
cBaP equivalent 1.45
TC-6
G-13
Benzo(a)anthracene 2.77
Benzo(b)fluoranthene 7.58
Benzo(a)pyrene 2.72
cBaP equivalent 3.91
TC-5
R-6
cBaP equivalent 0.04
G-8 ND
TC-4
G-5
cBaP equivalent 0.04
G-6 ND
R-4 ND
cBaP equivalent 0.11/0.17 Dup
R-5 ND
G-7 ND
RIPPY ROAD
TC-3
G-2 ND
TC-2
TC-1
G-3 ND
G-4
R-3 ND
R-2
G-4A ND
Benzo(a)anthracene 44.7
Benzo(b)fluoranthene 21.3
Benzo(a)pyrene 11.0
cBaP equivalent 17.9
cBaP equivalent 0.09
R-1 ND
G-1
cBaP equivalent 0.08
BRIDGE
STRUCTURE
WASHINGTON AVENUE
N
LEGEND
SURFACE SAMPLE LOCATION, GRID CONTROLLED (G-18)
SURFACE/SEDIMENT SAMPLE LOCATION, NON GRID CONTROLLED (R-8, TC-6)
EXISTING SOIL BENTONITE WALL
NOTES:
1. THE cBaP EQUIVALENT IS THE SUM OF THE CARCINOGENIC EQUIVALENTS OF BaP (BaP TEQ)
2. ND - NOT DETECTED
SCALE 1 INCH = 100 FEET
25 50 100
0 25 50 100 200
CAD FILE:
PROJECT: HAN008100
SCALE: 1"=100'
DATE: 09/02/2011
CHECKED: L.C.
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HATTIESBURG, MS 39404
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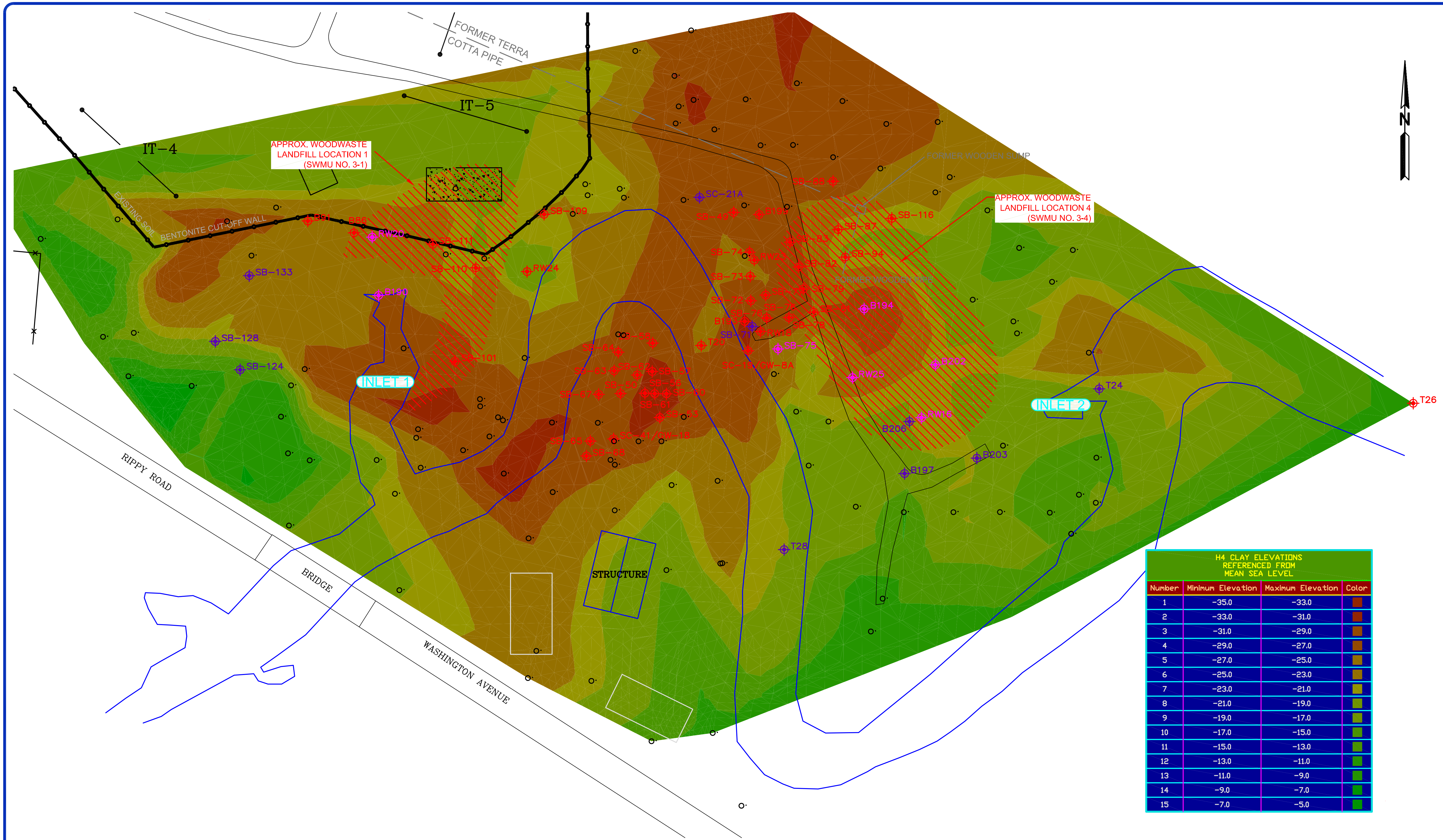
SOIL ANALYTICAL RESULTS
SWMU 3-1, 3-4 CONTROL AND CONTAINMENT DESIGN REPORT
FIGURE
4



H4 CLAY ELEVATIONS REFERENCED FROM MEAN SEA LEVEL			
Number	Minimum Elevation	Maximum Elevation	Color
1	-35.0	-33.0	
2	-33.0	-31.0	
3	-31.0	-29.0	
4	-29.0	-27.0	
5	-27.0	-25.0	
6	-25.0	-23.0	
7	-23.0	-21.0	
8	-21.0	-19.0	
9	-19.0	-17.0	
10	-17.0	-15.0	
11	-15.0	-13.0	
12	-13.0	-11.0	
13	-11.0	-9.0	
14	-9.0	-7.0	
15	-7.0	-5.0	

LEGEND

SB-71 VISIBLE COC's NOT AT BOTTOM OF H3L/TOP H4U

SB-75 VISIBLE COC's SHALLOW AND AT BOTTOM OF H3L/TOP H4U

SB-78 VISIBLE COC's AT BOTTOM OF H3L/TOP H4U ONLY

NO VISIBLE COC's OBSERVED

EXISTING SOIL BENTONITE WALL

SCALE 1 INCH = 100 FEET

25 50 100

0 25 50 100 200

CAD FILE:
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SCALE: 1"=100'
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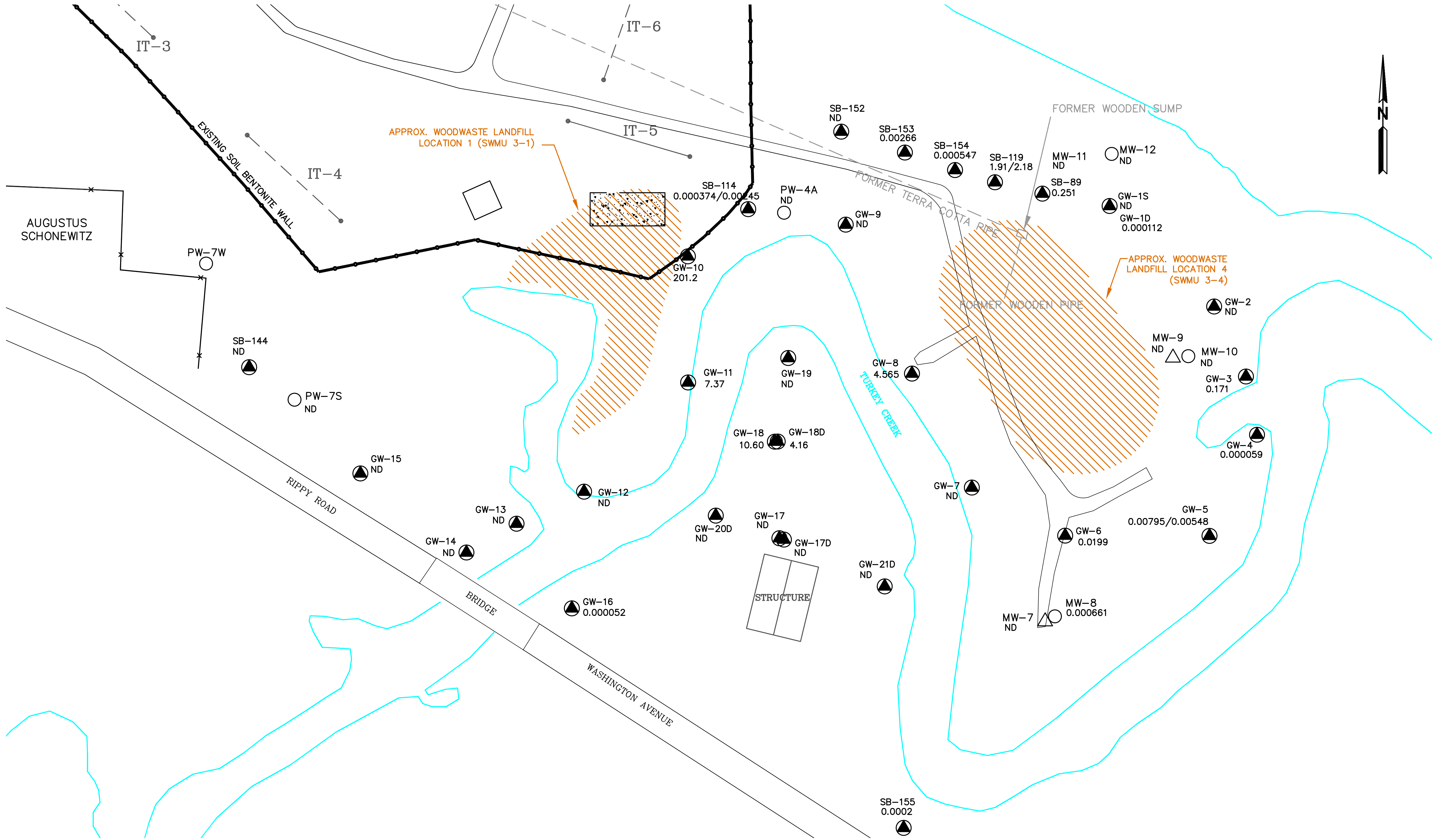
SOIL BORING OBSERVATIONS

SWMU 3-1, 3-4 CONTROL AND CONTAINMENT DESIGN REPORT

FIGURE
5



LEGEND

- TEMPORARY WELL SAMPLING LOCATION (TW-114)
- GROUNDWATER SAMPLING LOCATION (GW-16)
- MONITORING WELL (H3)
- DEEP MONITORING WELL (H5)
- EXISTING SOIL BENTONITE WALL

NOTES:
1. NUMBER IS TOTAL OF SEMIVOLATILE CONSTITUENTS OF CONCERN DETECTED. CONCENTRATION UNITS ARE mg/L.
2. ND - NOT DETECTED

SCALE 1 INCH = 100 FEET

25 50 100

0 25 50 100 200

CAD FILE:
PROJECT: HAN008100
SCALE: 1"=100'
DATE: 09/02/2011
CHECKED: L.C.
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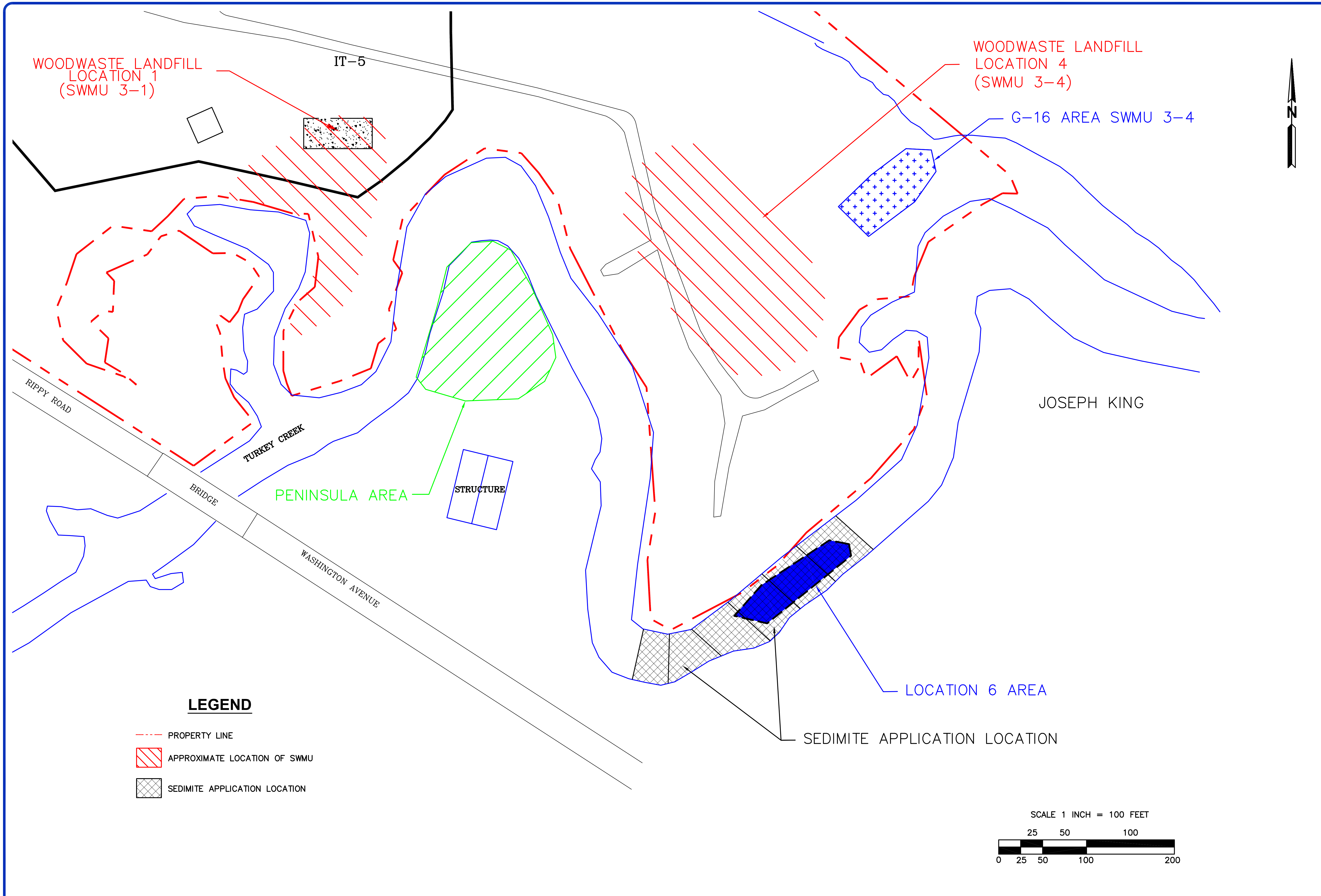
GROUNDWATER ANALYTICAL RESULTS SUMMARY

SWMU 3−1, 3−4 CONTROL AND CONTAINMENT DESIGN REPORT

FIGURE
6



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CHECKED: L.C.
DRAWN BY: K.K.

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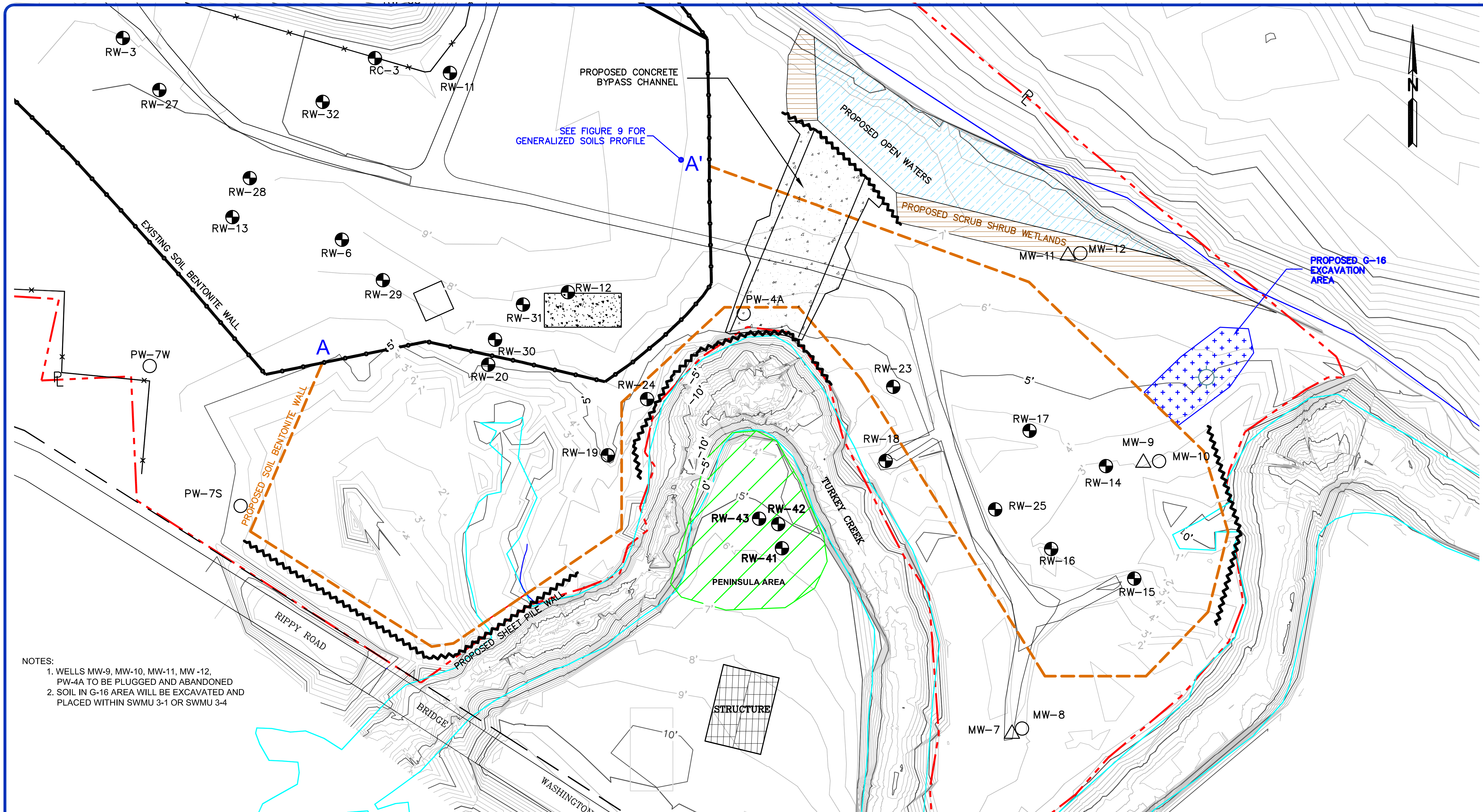
SEDIMITE APPLICATION AREA

SWMU 3-1, 3-4 CONTROL AND CONTAINMENT DESIGN REPORT

FIGURE
7



NOTES:
1. WELLS MW-9, MW-10, MW-11, MW-12, PW-4A TO BE PLUGGED AND ABANDONED
2. SOIL IN G-16 AREA WILL BE EXCAVATED AND PLACED WITHIN SWMU 3-1 OR SWMU 3-4

LEGEND

EXISTING RECOVERY WELL
MONITORING WELL (H3)
DEEP MONITORING WELL (H5)

PROPERTY LINE
EXISTING SOIL BENTONITE WALL
PROPOSED SOIL BENTONITE WALL
PROPOSED SHEET PILE WALL

EXISTING GRADE CONTOURS
— 5' — MAJOR INTERVAL
— 1' — MINOR INTERVAL

SCALE 1 INCH = 100 FEET

0 25 50 100 200

CAD FILE:
PROJECT: HAN008100
SCALE: 1"=100'
DATE: 09/12/2011
CHECKED: L.C.
DRAWN BY: T.R.B.

ENVIRONMENTAL MANAGEMENT SERVICES, INC.
P.O. BOX 15369
HATTIESBURG, MS 39404

PREPARED FOR:
CAVENHAM FOREST INDUSTRIES
GULFPORT, MS

CONTAINMENT WALL AND SURFACE BARRIER CONFIGURATION

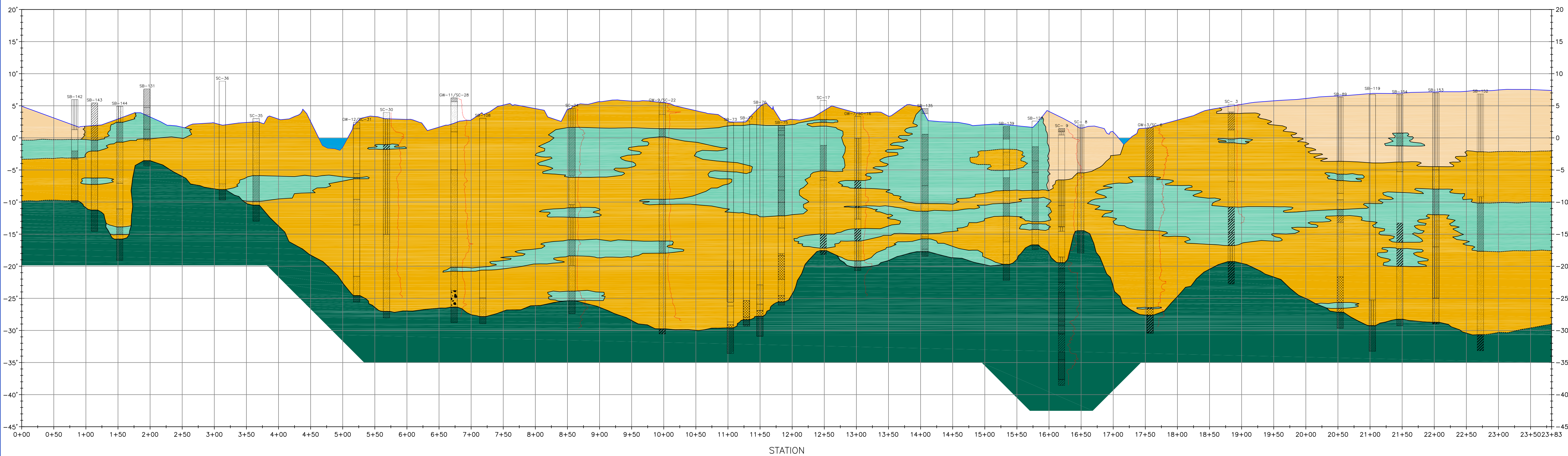
SWMU 3-1, 3-4 CONTROL AND CONTAINMENT DESIGN REPORT

FIGURE
8

GENERALIZED SOILS PROFILE
PROPOSED SLURRY WALL

A

A'



MARINE CLAY
CLAY
SAND
SILT
WATER

NOTE: SEE FIGURE 8 FOR LOCATION
OF SLURRY WALL.

CAD FILE:
PROJECT: HAN008100
SCALE: NTS
DATE: 09/08/2011
CHECKED: L.C.
DRAWN BY: P.D.M.

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MANAGEMENT SERVICES, INC.
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CAVENHAM FOREST
INDUSTRIES
GULFPORT, MS

CUT-OFF WALL PROFILE

TURKEY CREEK REMEDIATION

SHEET NO.
9

LEGEND

- EXISTING RECOVERY WELL
- MONITORING WELL (H3)
- DEEP MONITORING WELL (H5)
- PROPERTY LINE
- EXISTING SOIL BENTONITE WALL
- PROPOSED SHEET PILE WALL
- 2.4' PROPOSED DEPTH OF FILL

EXISTING GRADE CONTOURS

- 10' MAJOR INTERVAL (5-FEET)
- 4' MINOR INTERVAL (1-FEET)

SCALE 1 INCH = 100 FEET

25 50 100

0 25 50 100 200

CAD FILE:
PROJECT: HAN008100
SCALE: 1"=100'
DATE: 09/02/2011
CHECKED: L.C.
DRAWN BY: T.R.B.

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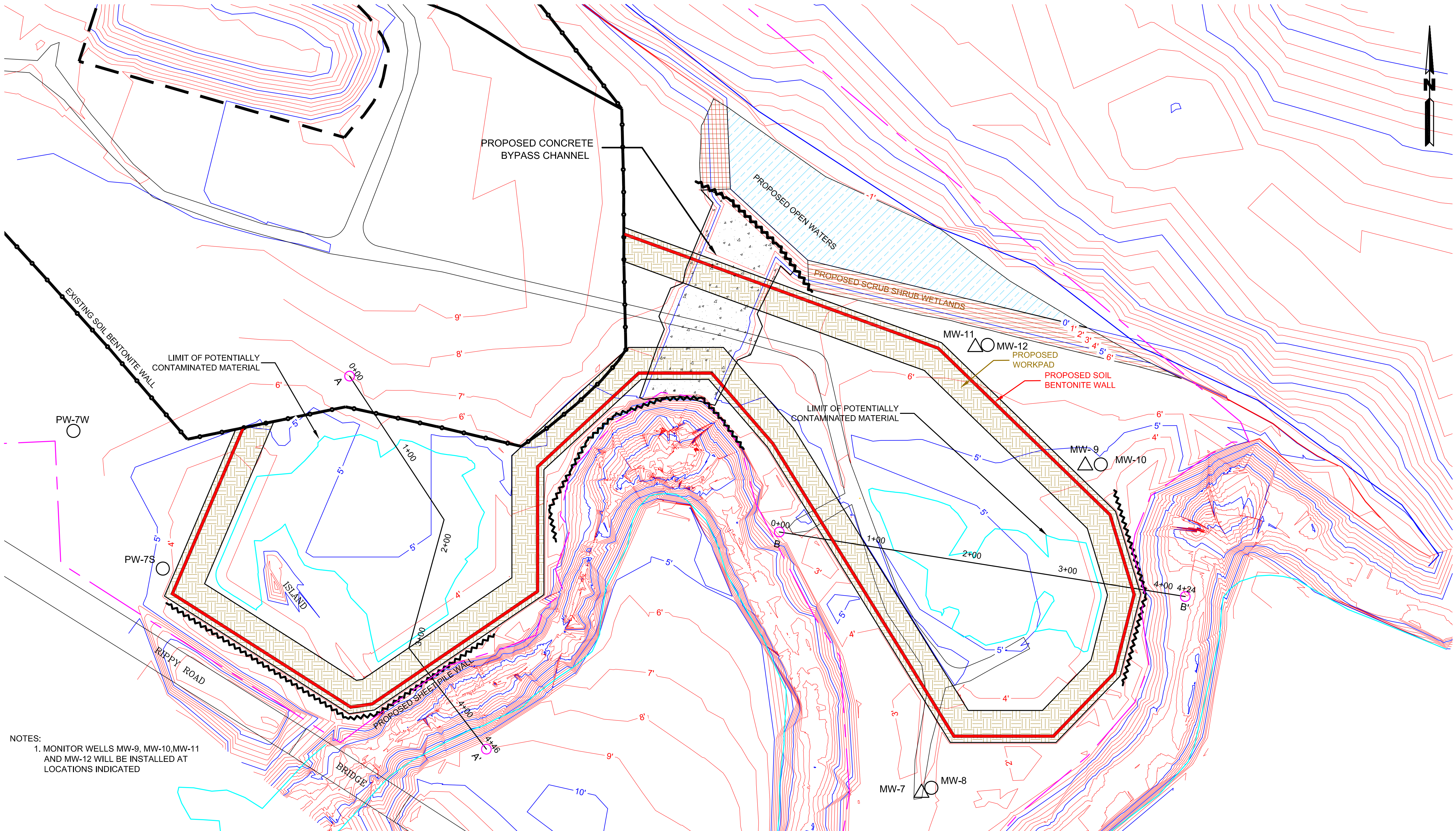
CAVENHAM FOREST INDUSTRIES
GULFPORT, MS

PROPOSED BACKFILL AREA

SWMU 3-1, 3-4 CONTROL AND CONTAINMENT DESIGN REPORT

FIGURE
10



NOTES:
1. MONITOR WELLS MW-9, MW-10, MW-11 AND MW-12 WILL BE INSTALLED AT LOCATIONS INDICATED

LEGEND

- EXISTING RECOVERY WELL
- MONITORING WELL (H3)
- DEEP MONITORING WELL (H5)
- PROPERTY LINE
- EXISTING SOIL BENTONITE WALL
- PROPOSED SHEET PILE WALL

EXISTING GRADE CONTOURS

- 10' MAJOR INTERVAL (5-FEET)
- 4' MINOR INTERVAL (1-FOOT)

SCALE 1 INCH = 100 FEET

25 50 100

0 25 50 100 200

CAD FILE:
PROJECT: HAN008100
SCALE: 1"=100'
DATE: 09/12/2011
CHECKED: L.C.
DRAWN BY: T.R.B.

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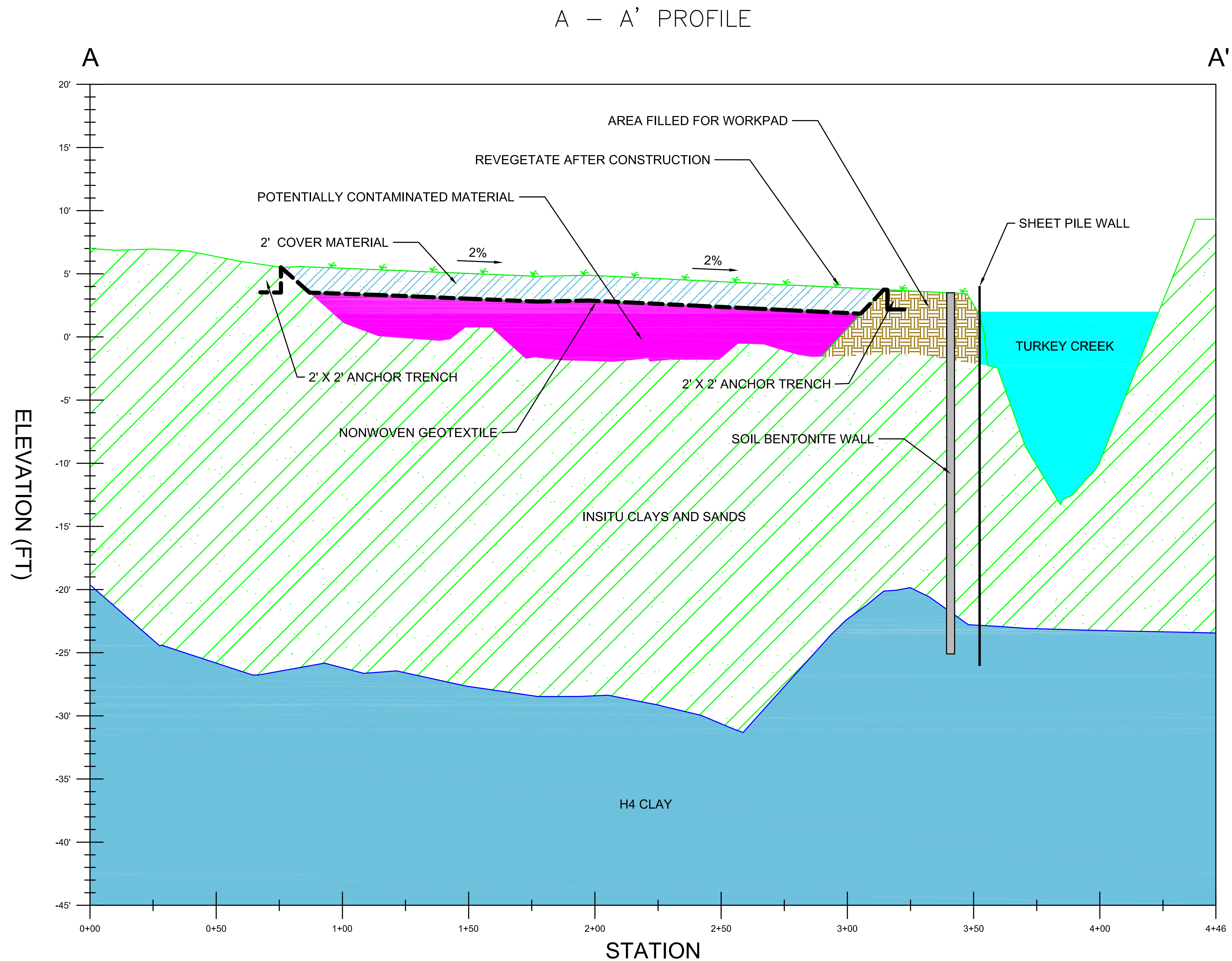
P.O. BOX 15369
HATTIESBURG, MS 39404

PREPARED FOR:
CAVENHAM FOREST INDUSTRIES
GULFPORT, MS

FINAL CAP LAYOUT

SWMU 3-1, 3-4 CONTROL AND CONTAINMENT DESIGN REPORT

FIGURE
11



CAD FILE:
PROJECT: HAN008100
SCALE:
DATE: 5/10/10
CHECKED: L.C.
DRAWN BY: T.R.B.

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P.O. BOX 15369
HATTIESBURG, MS 39404

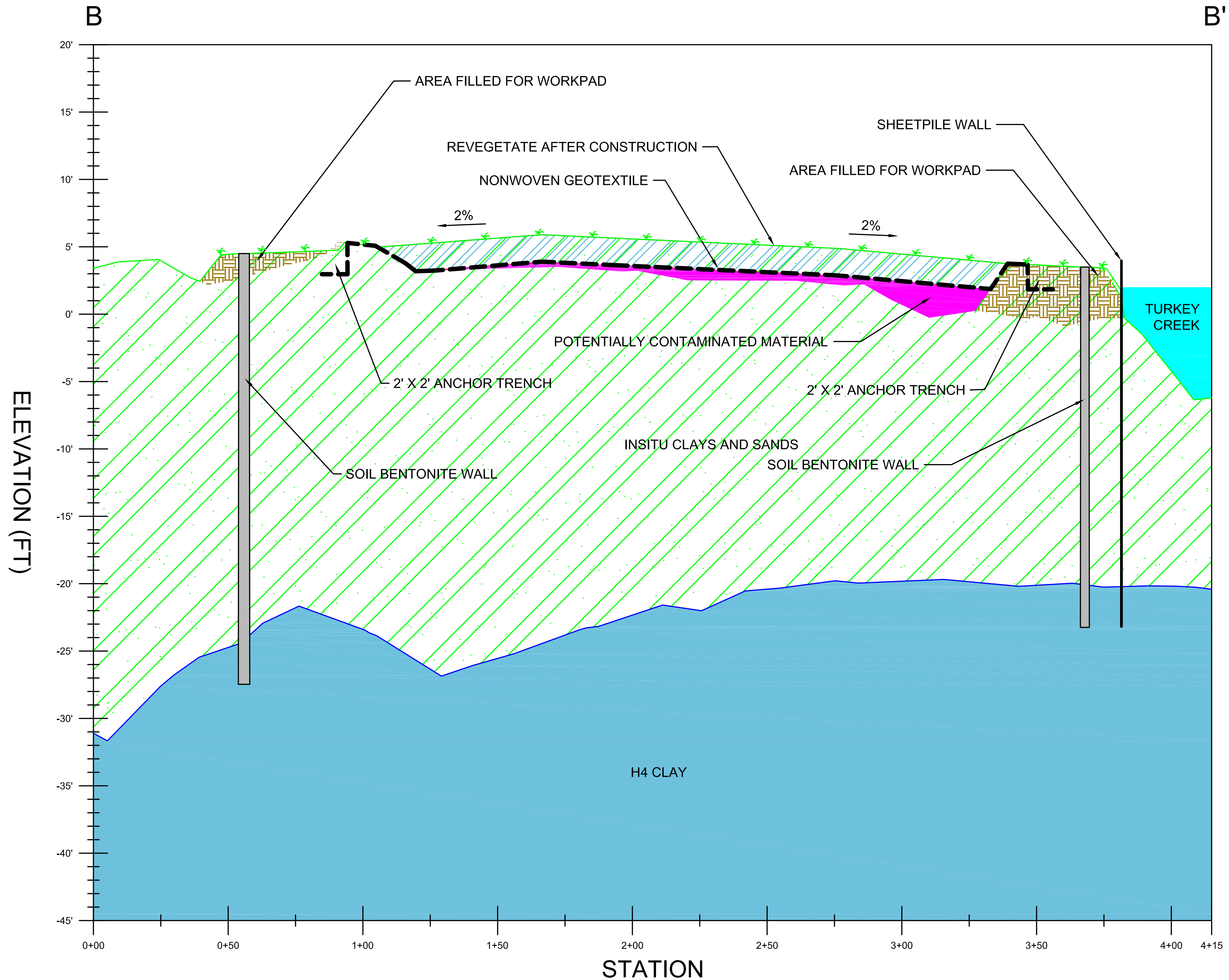
PREPARED FOR:
CAVENHAM FOREST INDUSTRIES
GULFPORT, MS

CROSS-SECTION A-A', CONTAINMENT WALL AND SURFACE BARRIER

SWMU 3-1, 3-4 CONTROL AND CONTAINMENT DESIGN REPORT

FIGURE
12

B – B' PROFILE



CAD FILE:
PROJECT: HAN008100
SCALE:
DATE: 09/12/2011
CHECKED: L.C.
DRAWN BY: T.R.B.

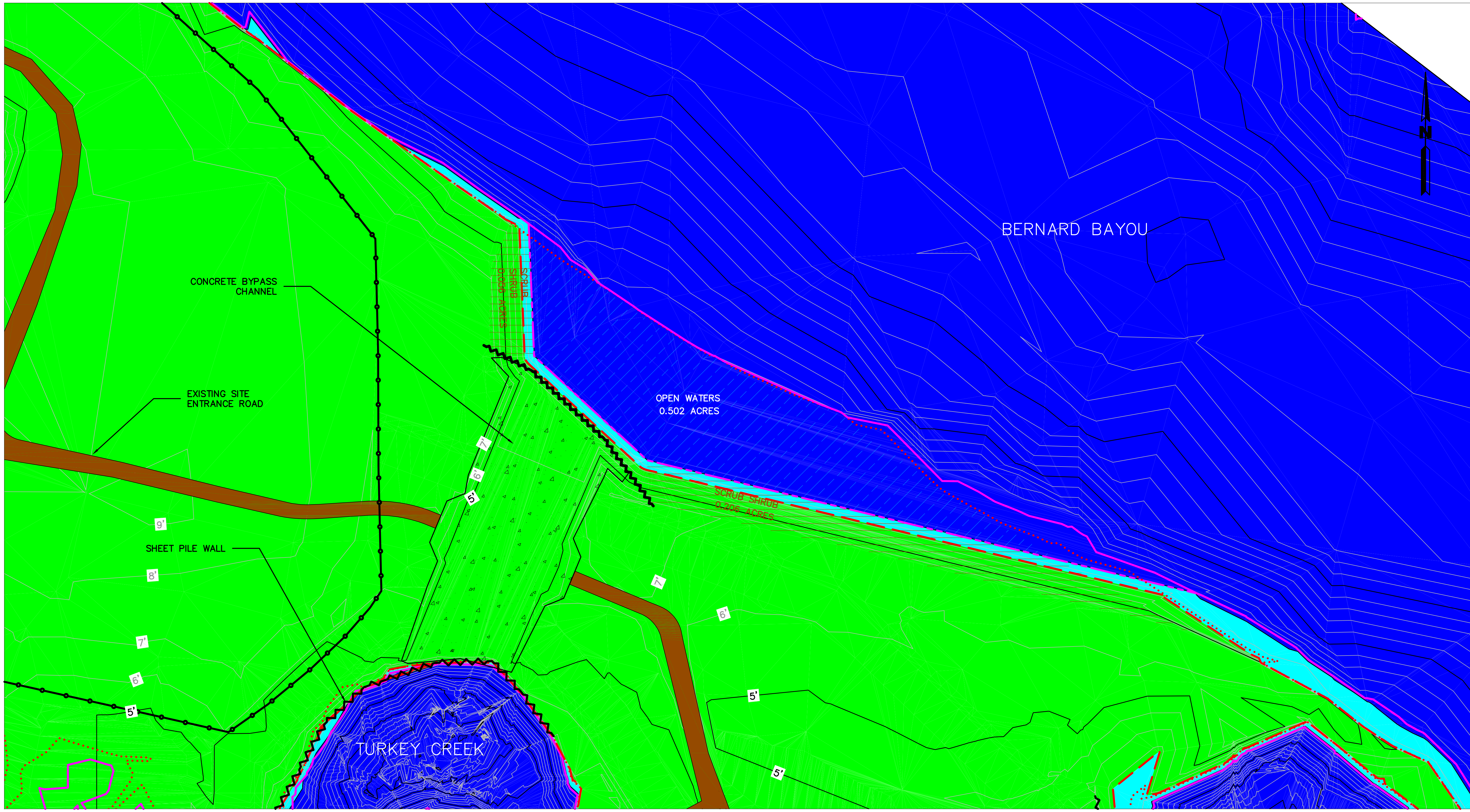
ENVIRONMENTAL MANAGEMENT SERVICES, INC.
P.O. BOX 15369
HATTIESBURG, MS 39404

PREPARED FOR:
CAVENHAM FOREST INDUSTRIES
GULFPORT, MS

CROSS-SECTION B-B', CONTAINMENT WALL AND SURFACE BARRIER

SWMU 3-1, 3-4 CONTROL AND CONTAINMENT DESIGN REPORT

SHEET NO.
13



LEGEND

- PROPERTY LINE
- EXISTING SOIL BENTONITE WALL
- EXISTING MEAN HIGH TIDE (ELEVATION = 1.69')
- EXISTING MEAN LOW TIDE (ELEVATION = 0.03')
- PROPOSED MEAN HIGH TIDE (ELEVATION = 1.69')
- PROPOSED MEAN LOW TIDE (ELEVATION = 0.03')

- ELEVATIONS < 0.03'
- ELEVATIONS 0.03' - 1.69'
- ELEVATIONS > 1.69'

FINISHED GRADE CONTOURS

- 10' — MAJOR INTERVAL (5-FEET)
- 4' — MINOR INTERVAL (1-FEET)

SCALE 1 INCH = 70 FEET

17.5 35 70

0 17.5 35 70 140

CAD FILE:
PROJECT: HAN008100
SCALE: 1"=70'
DATE: 08/11/2011
CHECKED: L.C.
DRAWN BY: T.R.B.

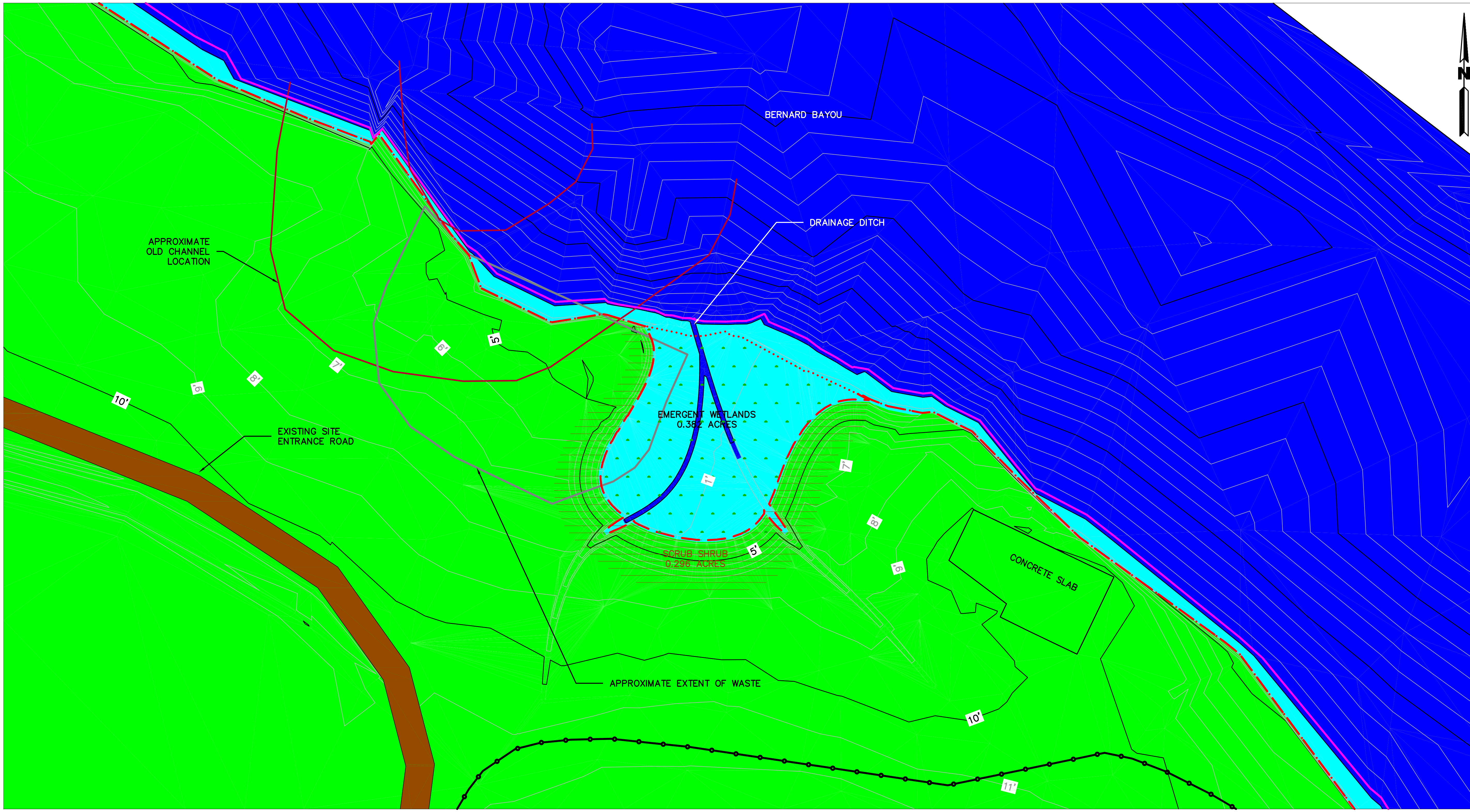
ENVIRONMENTAL MANAGEMENT SERVICES, INC.
P.O. BOX 15369
HATTIESBURG, MS 39404

PREPARED FOR:
CAVENHAM FOREST INDUSTRIES
GULFPORT, MS

PROPOSED EASTERN INLET

SWMU 3-1, 3-4 CONTROL AND CONTAINMENT DESIGN REPORT

FIGURE
14



LEGEND

PROPERTY LINE
EXISTING SOIL BENTONITE WALL
EXISTING MEAN HIGH TIDE (ELEVATION = 1.69')
EXISTING MEAN LOW TIDE (ELEVATION = 0.03')
PROPOSED MEAN HIGH TIDE (ELEVATION = 1.69')
PROPOSED MEAN LOW TIDE (ELVATION = 0.03')

ELEVATIONS < 0.03'
ELEVATIONS 0.03' - 1.69'
ELEVATIONS > 1.69'

FINISHED GRADE CONTOURS

— 10' — MAJOR INTERVAL (5-FEET)
— 4' — MINOR INTERVAL (1-FEET)

SCALE 1 INCH = 70 FEET

17.5 35 70
0 17.5 35 70 140

CAD FILE:
PROJECT: HAN008100
SCALE: 1"=70'
DATE: 08/11/2011
CHECKED: L.C.
DRAWN BY: T.R.B.

ENVIRONMENTAL
MANAGEMENT SERVICES, INC.
P.O. BOX 15369
HATTIESBURG, MS 39404

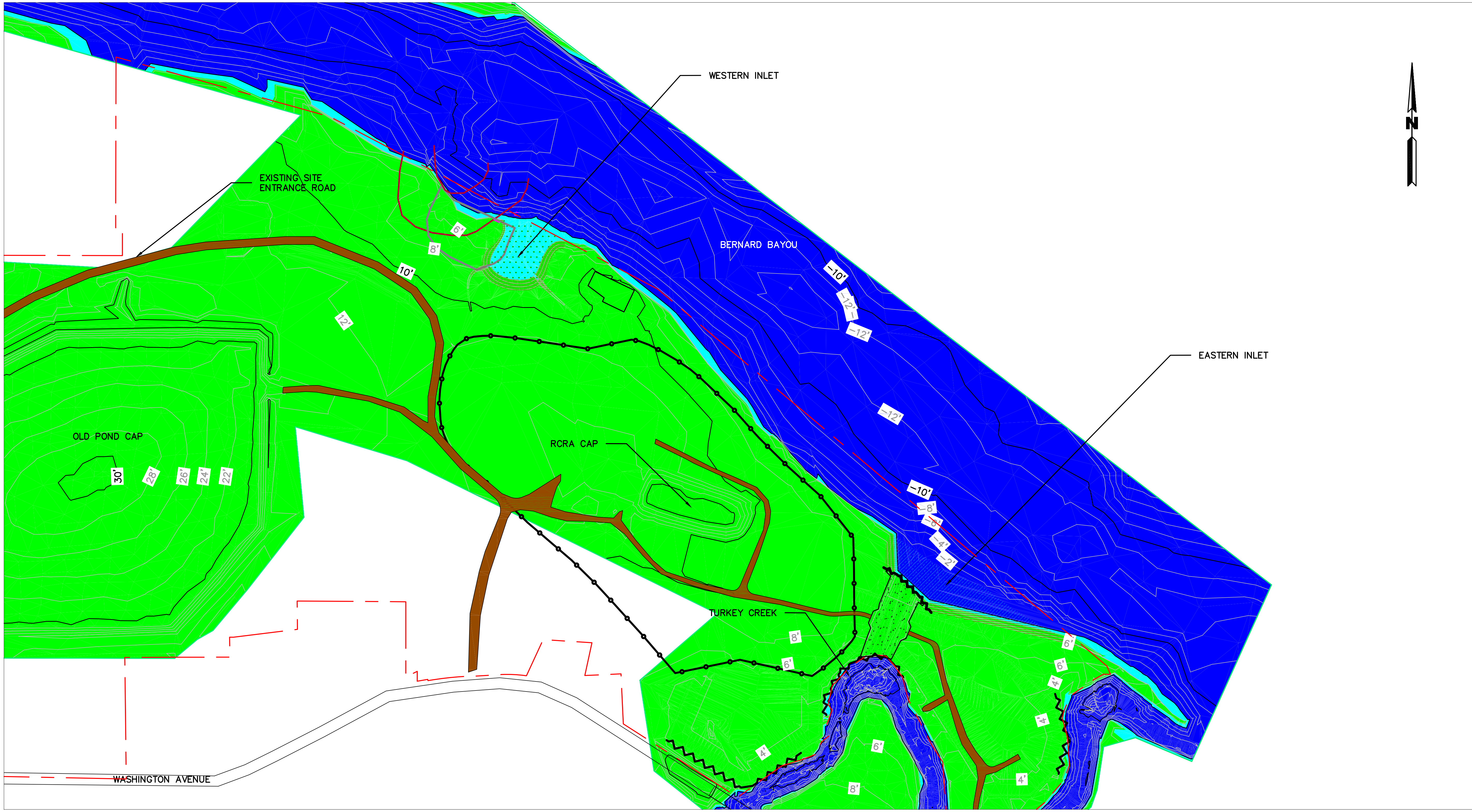
PREPARED FOR:
CAVENHAM FOREST INDUSTRIES
GULFPORT, MS

PROPOSED WESTERN INLET

SWMU 3-1,3-4 CONTROL AND CONTAINMENT DESIGN REPORT

FIGURE

15



FINISHED GRADE CONTOURS

PROPERTY LINE
EXISTING SOIL BENTONITE WALL

ELEVATIONS < 0.03'
ELEVATIONS 0.03' - 1.69'
ELEVATIONS > 1.69'

— 10' — MAJOR INTERVAL (10-FEET)
— 4' — MINOR INTERVAL (2-FEET)

SCALE 1 INCH = 250 FEET

62.5 125 250

0 62.5 125 250 500

CAD FILE:
PROJECT: HAN008100
SCALE: 1"=250'
DATE: 09/12/2011
CHECKED: L.C.
DRAWN BY: T.R.B.

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P.O. BOX 15369
HATTIESBURG, MS 39404

PREPARED FOR:
CAVENHAM FOREST INDUSTRIES
GULFPORT, MS

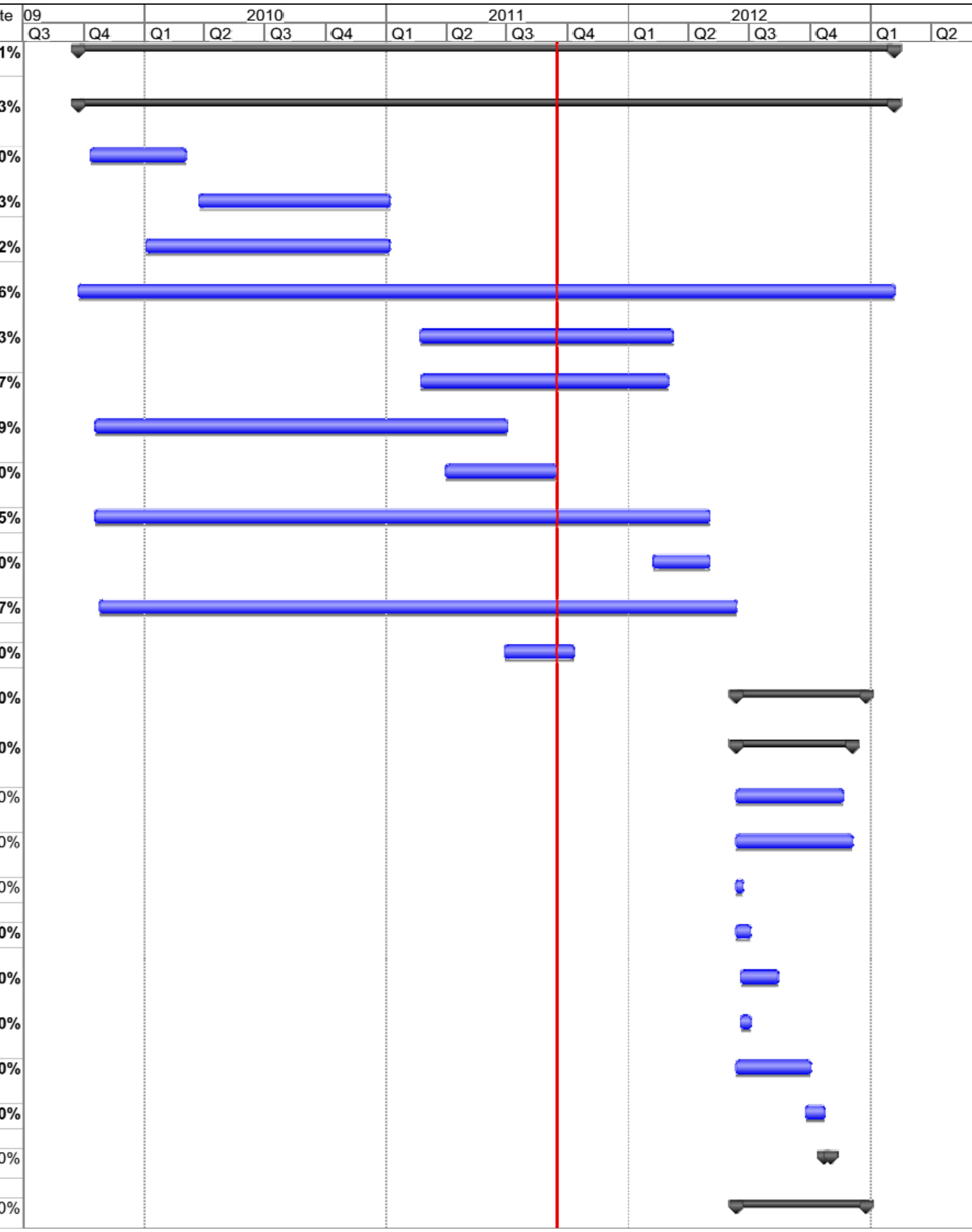
POST CONSTRUCTION SITE OVERVIEW

SWMU 3-1, 3-4 CONTROL AND CONTAINMENT DESIGN REPORT

FIGURE
16

Cavenham Forest Industries
Gulfport, Mississippi
Turkey Creek Remediation

ID	Task Name	Duration	Start	Finish	% Complete
1	**CFI GPT Turkey Creek Remediation**	865 days?	Thu 9/24/09	Mon 2/4/13	71%
2					
3	**Pre-Construction Tasks**	865 days?	Thu 9/24/09	Mon 2/4/13	83%
4					
5	Investigate TC Sediment & Pore Water	98 days	Mon 10/12/09	Wed 3/3/10	100%
12					
13	Biota/Additional Sediment Sampling and Analyses/Ecological Risk Evaluation	197 days	Thu 3/25/10	Wed 1/5/11	93%
21					
22	Investigate Property East of Turkey Creek	255 days	Mon 1/4/10	Wed 1/5/11	92%
30					
31	ISCO Testing and Treatability Study	865 days	Thu 9/24/09	Mon 2/4/13	76%
43					
44	Human Health Risk Assessment *Critical Path*	273.5 days	Mon 2/21/11	Thu 3/8/12	33%
45					
58	SediMite™ Pilot Interim Measures	267 days	Tue 2/22/11	Thu 3/1/12	57%
59					
91	Execute Lease with SOS for PublicTrust Tidelands	432 days	Mon 10/19/09	Fri 7/1/11	99%
94					
95	Revise Control & Containment Design Report	118.5 days	Fri 4/1/11	Wed 9/14/11	100%
98					
99	Obtain USACE/MDMR/MDEQ Permit	649 days	Mon 10/19/09	Tue 5/1/12	95%
107					
108	Storm Water Pollution Prevention Plan (SWPPP)	60 days	Wed 2/8/12	Tue 5/1/12	0%
111					
112	Obtain City of Gulfport Building Permit	673 days	Mon 10/26/09	Mon 6/11/12	97%
117					
118	Investigate Sediment Bar	74 days?	Wed 6/29/11	Mon 10/10/11	0%
124					
125	**Construction and Post Construction Tasks**	140 days	Tue 6/12/12	Mon 12/24/12	0%
126					
127	**Remedial Measures Implementation**	125 days	Tue 6/12/12	Mon 12/3/12	0%
128					
129	Construction Quality Assurance/Quality Control	23 wks	Tue 6/12/12	Mon 11/19/12	0%
130					
131	Project Oversight/Engineering/Supervision/Management	25 wks	Tue 6/12/12	Mon 12/3/12	0%
132					
133	Preliminary Construction Surveying	1.5 wks	Tue 6/12/12	Thu 6/21/12	0%
134					
135	Clearing and Grubbing	15 days	Tue 6/12/12	Mon 7/2/12	0%
139					
140	Work Pad Construction	40 days	Tue 6/19/12	Mon 8/13/12	0%
143					
144	Sheet Pile Wall Installation	10 days	Tue 6/19/12	Mon 7/2/12	0%
148					
149	Soil Bentonite Wall Installation	80 days	Tue 6/12/12	Mon 10/1/12	0%
155					
156	Post Soil Bentonite Wall Construction/Installation	20 days	Tue 9/25/12	Mon 10/22/12	0%
161					
162	**Remedial Measures Report**	1.5 wks	Tue 10/23/12	Thu 11/1/12	0%
163					
164	**Peninsula Oxidation**	7 mons	Tue 6/12/12	Mon 12/24/12	0%



Project: Turkey Creek Remediation
Date: Wed 9/14/11

Task		Milestone		Rolled Up Task		Rolled Up Progress		External Tasks	
Progress		Summary		Rolled Up Milestone		Split		Project Summary	

Group By Summary
Deadline

CAD FILE:
PROJECT: HAN008100
SCALE: 1"=70'
DATE: 09/13/2011
CHECKED: L.C.
DRAWN BY: T.R.B.

ENVIRONMENTAL MANAGEMENT SERVICES, INC.
P.O. BOX 15369
HATTIESBURG, MS 39404

PREPARED FOR:
CAVENHAM FOREST INDUSTRIES
GULFPORT, MS

CONSTRUCTION SCHEDULE GANTT CHART

SWMU 3-1,3-4 CONTROL AND CONTAINMENT DESIGN REPORT

FIGURE
17

APPENDIX A
Technical Data and Procedures
A.H. Beck Foundation Co., Inc.

Company History and Project Overview

COMPANY: **A. H. Beck Foundation Co., Inc.**
5123 Blanco Road
San Antonio, Texas 78216
Phone (210) 342-5261
Fax (210) 342-4965
www.ahbeck.com

CONTACT: **Steven K. Anderson**
Vice President
(210) 342-5261 ext 234
keith.anderson@ahbeck.com

A. H. Beck Foundation Co., Inc. is a specialty deep foundation contractor that has been in business since 1932. The company's heritage includes the ultimate pioneering effort of helping start the drilled shaft industry in the United States. In the decades that have followed, A.H. Beck has continued to remain at the forefront of the deep foundation and ground improvement industry, and is regarded as one of the premier deep foundation contractors in the southern United States and elsewhere. With a record of accomplishments that includes mechanically installing the first drilled shafts in the United States to thousands of successful deep foundation projects including some of the most impressive structures in the southern United States, the company has continued to grow and expand their reach into the Caribbean, Central and South America, and Russia. Beck's corporate office is located in San Antonio, Texas where the company was founded and has branch offices in Houston, Dallas, North Carolina, and San Juan, Puerto Rico. A. H. Beck has over 77 years of experience installing deep foundation and ground improvement projects in the challenging geologic formations of the southern United States and the Gulf Coast region along with some of the hardest materials found in the Appalachian Region. Beck also has many years of experience working in the soft, caving, high water table soils present along the Gulf Coast Region. Working with industry leaders in Bentonite drilling fluids, Beck has formulated extensive training programs for their key personnel in the use of drilling fluids as applied to deep foundation excavation stability and construction. Beck designs and builds most of their own foundation equipment, Bentonite slurry handling systems, and tools.

PROCESS OVERVIEW:

The bentonite cutoff wall proposed for this project will consist of a 36 inch wide trench that is keyed into a hard underlying existing clay layer at an average depth of 30 feet and extending approximately 2500 feet in length. The cutoff wall will be excavated utilizing two different types of excavation equipment so that the wall can be installed without any over-cutting at the corners. The excavation will also be sequenced so that manageable segments are excavated and backfilled daily. The backfill material will be engineered using imported fill provided by the owner from another site and mixed with high quality sodium bentonite to achieve the required hydraulic conductivity requirements. Once an engineered fill mix design is established, the imported fill will be mixed with bentonite and water in a calibrated/metered pugmill system and pumped into the excavation for placement. Printed batch tickets from the pugmill system showing the weighted quantities of imported host material, bentonite, and water will be available for each batch so that verification can be provided showing that each batch meets the engineered fill mix design requirements. The quality of this engineered soil bentonite mixture can be visually inspected, sampled, and verified above ground at anytime during the installation process before and during placement of the material into the excavation. This manufactured approach leads to superior quality assurance and quality control over other traditional in-situ or above ground mixing methods used in the industry.

PROCEDURE:

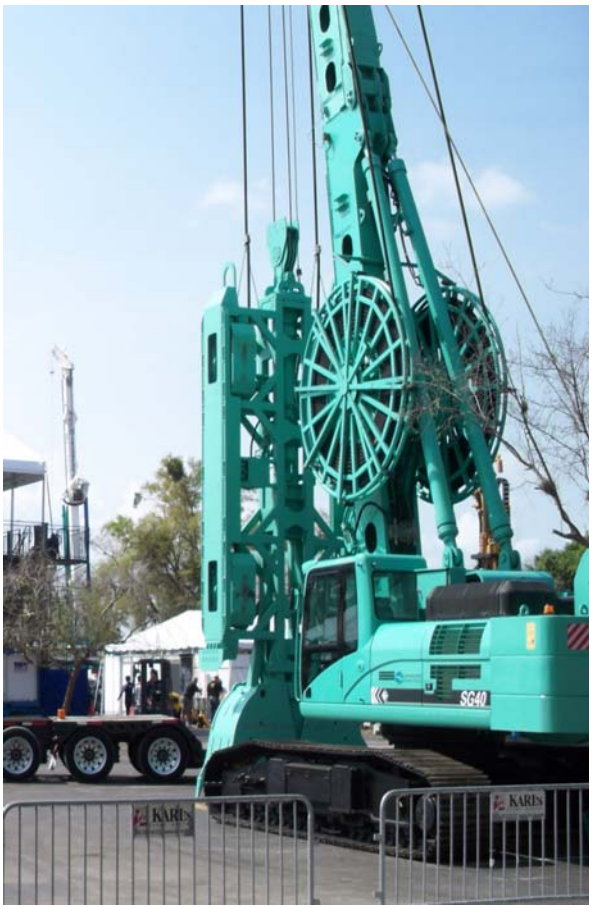
The following installation procedures are based on generalized soil information pertaining to this project. Adjustments or changes may be necessary once detailed soils information is obtained and after installation commences where the actual soil conditions and behavior can be observed.

Prior to beginning the installation of the bentonite cutoff wall, A. H. Beck will mobilize a local soil testing laboratory to the site of the imported fill to take additional soil samples which will be used for mixing with various portions of bentonite to develop a project engineered backfill mix design. The laboratory mix designs will be developed to achieve the hydraulic conductivity requirement of 1×10^{-7} cm/sec. The results of these different trail mix designs will then be analyzed for adherence to the specifications and will then be submitted to the owner for approval. Once a mix design is approved by the owner, A. H. Beck will begin installation of the bentonite cutoff wall. Conventional hydraulic excavators in conjunction with diaphragm wall grabs will be used to excavate the trench while supporting the excavation with a drilling fluid made up of bentonite slurry. The diaphragm wall gabs will be used to excavate the wall at the turns to prevent over-cutting of the excavation. After the soil is removed from the excavation and the trench is keyed into the hard underlying clay, the engineered backfill will be batched utilizing a specially designed pug mill to achieve a uniform homogeneous bentonite soil mixture. This bentonite soil mixture will then be pumped back to the excavation through a 5 inch pump line. As the cement soil mixture is placed at the bottom of the excavation it displaces the drilling fluid back out the top of the excavation. The displaced drilling fluid is pumped back to the mixing and storage tanks to be cleaned and processed for re-use. This process will achieve a higher level of quality control and quality assurance than in situ and other above ground mixing procedures since the bentonite soil mixture can be viewed, sampled, slumped, and tested above the ground prior to placement into the excavation. A print out of the metered imported fill, bentonite, and water quantities used for each batch will be available to compare with the benchmark design chosen prior to production installation.

DETAILED PROCEDURES:

1. Excavation Equipment

Traditional hydraulic excavators and hydraulic diaphragm wall grabs (shown below) capable of continuously monitoring verticality on three separate axis during excavation will both be utilized.



2. Bentonite Slurry Mixing/Cleaning/Handling Equipment

2.1. BECK manufactured 500 bbl capacity slurry mixing and cleaning tanks.

2.2. Details on Drilling Fluid.

2.2.1. The bentonite based drilling slurry will be pre-mixed in pH neutral water 12 hours prior to use.

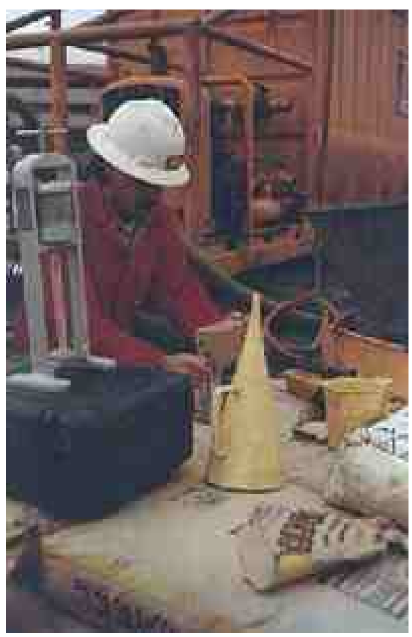
2.2.2. Bentonite slurry will be mixed at a ratio of 13 lb. of Bentonite to 1 BBL (42 gal) of water to achieve an approximate density of 65 pcf and a viscosity of 40 sec. This will then be adjusted during excavation operations and evaluation of the encountered soils.

2.2.3. Bentonite slurry will be tested a minimum of four times within the first eight hours of slurry use to control a quality mix suitable for existing soil stratas by using a Marsh Funnel to test viscosity, a Mud Scale to test the weight and pH test strips to test the pH. When the results show a consistent behavior the testing will be reduced to one test every four hours of use.

2.2.4. Water and bentonite may be needed to replenish slurry to maintain desired viscosity and weight prior to reuse.

2.2.5. During excavation the level of the slurry will be maintained at an elevation above the highest piezometric head level to maintain excavation stability.

2.2.6. After engineered fill placement into the trench excavation, the slurry will be pumped back and processed through the cleaning system separating the liquids from the solids and prepared for reuse. Any solids will be deposited off the shakers to the side of the tank.



3. Engineered Fill Batching Equipment

3.1. A custom metered pugmill, as shown below, will be utilized to meter and batch the engineered fill at up to 100 cubic yards per hour. Weighted batch computer readouts and batch tickets are generated to ensure consistent proportioning of the batch materials.

3.2. Sampling and slump testing will be performed during the batching process to verify the engineered fill properties and performance.

4. Engineered Fill Pumping/Placing Equipment

4.1. Putzmeister Model TK 100HP 180 horse power concrete pump(s) or similar capable of pumping 90 yd^3/hr with a horizontal pumping distance of over 500 feet will be utilized to pump the engineered fill from the pugmill to the cutoff wall locations.

4.2. For Certain Locations and Access Considerations - Beck designed and built self contained concrete pumps capable of pumping through 160 feet of 5" flexible pump hose at a rate of 70 yd^3/hr may be utilized.

APPENDIX B
Geotechnical Investigation Report
Eustis Engineering Company, Inc. of Mississippi

EUSTIS ENGINEERING COMPANY INC. OF MISSISSIPPI
14368 CREOSOTE ROAD
GULFPORT, MISSISSIPPI 39503-4297
PN 228-575-9888 I FN 228-575-9819
EMAIL: INFO@EUSTISENG.COM I SITE: WWW.EUSTISENG.COM

3 August 2011

Environmental Management Services, Inc.
Post Office Box 15369
Hattiesburg, Mississippi 39404-5369

Attention Mr. Clyde Woodward, Jr.

Gentlemen:

Geotechnical Investigation
Cavenham Forest Industries, LLC
Proposed Sheetpile Wall
Gulfport, Mississippi
<u>Eustis Engineering Project No. G0130</u>

Transmitted are three copies (two bound and one unbound) of our engineering report covering a geotechnical investigation for the subject project. Electronic copies of this report are also being forwarded to you and Mr. Leon H. Carter, Jr., P.E.

Thank you for asking us to perform these services.

Yours very truly,

EUSTIS ENGINEERING COMPANY INC. OF MISSISSIPPI

CHAD L. HELD
LICENSED PROFESSIONAL
ENGINEER
18856
STATE OF MISSISSIPPI

CHAD L. HELD, P.E.

D. J. Indest:jdd/jkd

GEOTECHNICAL INVESTIGATION

CAVENHAM FOREST INDUSTRIES, LLC

PROPOSED SHEETPILE WALL

GULFPORT, MISSISSIPPI

EUSTIS ENGINEERING PROJECT NO. G0130

FOR
ENVIRONMENTAL MANAGEMENT SERVICES, INC.
HATTIESBURG, MISSISSIPPI

By
Eustis Engineering Company Inc. of Mississippi
Gulfport, Mississippi

3 AUGUST 2011

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GEOTECHNICAL INVESTIGATION
CAVENHAM FOREST INDUSTRIES, LLC.
PROPOSED SHEETPILE WALL
GULFPORT, MISSISSIPPI
EUSTIS ENGINEERING PROJECT NO. G0130

INTRODUCTION

1. This report contains the results of a geotechnical investigation performed for the proposed sheetpile wall to be located at Cavenham Forest Industries, LLC's facility off of Creosote Road in Gulfport, Mississippi. The investigation was performed in general accordance with Eustis Engineering Company Inc. of Mississippi's proposal dated 16 May 2011. Option 2 of our proposal was accepted on 17 May 2011 by Mr. Clyde Woodward, Jr., representing the project's environmental engineer, Environmental Management Services, Inc., Hattiesburg, Mississippi.

2. This report has been prepared in accordance with generally accepted geotechnical engineering practice for the exclusive use of Cavenham Forest Industries and Environmental Management Services for specific application to the subject site. In the event of any changes in the nature, design, or location of the proposed sheetpile wall, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report are modified and verified in writing. Should these data be used by anyone other than Cavenham Forest Industries or Environmental Management Services they should contact Eustis Engineering for interpretation of data and to secure any other information pertinent to this project.

3. The analyses and recommendations contained in this report are based in part on data obtained from the soil borings and cone penetrometer tests (CPTs). The

nature and extent of variations in subsoil conditions between and away from the boring and CPT locations may not become evident until construction. If variations then appear, it will be necessary to reevaluate the recommendations contained in this report.

4. Recommendations and conclusions contained in this report are to some degree subjective and should be used only for design purposes. This report should not be included in the contract plans and specifications. However, the results of the soil borings, laboratory tests, and CPTs contained in the Appendices of this report may be included in the plans and specifications.

SCOPE

5. Eustis Engineering's original scope was to perform eight undisturbed soil borings. Locations 2 and 3 were changed to CPTs due to inaccessibility of our truck mounted drill rig. Therefore, the investigation was modified to the performance of six soil test borings and two CPTs to determine subsurface conditions and stratification, and to obtain samples of the various substrata. Soil mechanics laboratory tests, performed on samples obtained from the borings, were used to evaluate the physical properties of the subsoils. This report includes the boring logs, plots of reduced CPT data, a summary of the laboratory test data, a discussion of the subsoil and ground water conditions, bulkhead requirements, local and global stability of the bulkhead, estimates of settlement due to placing fill behind the bulkhead, and general construction recommendations.

6. Our scope does not include an evaluation of the existing or proposed soil bentonite walls. Our scope also did not include slope stability analyses of the proposed filling or Turkey Creek bank slopes away from the proposed bulkhead locations.

FIELD INVESTIGATION

General

7. Six undisturbed sample type soil test borings, designated as B-1 and B-4 through B-8, were made at the site from 24 through 27 May 2011. Two CPTs (CPT-2 and CPT-3) were made on 31 May 2011. The soil borings and CPTs were each made to a depth of 40 feet below the existing ground surface. The locations were staked by a representative of Environmental Management Services prior to our arrival at the site. Using a handheld GPS device, the latitude and longitude of each location was recorded and is provided on the boring logs. A site vicinity map is provided on Figure 1 and the approximate locations of the borings and CPTs are shown on Figure 2. Detailed descriptive logs of the borings and laboratory tests are shown in both tabular and graphical form in Appendix I. Logs of the CPTs are provided in Appendix II. Upon completion of drilling the borings and performing the CPTs, the holes were backfilled in accordance with current regulatory requirements.

Soil Borings

8. The undisturbed soil borings were made with a truck mounted rotary type drill rig. Undisturbed samples of cohesive or semi-cohesive subsoils were obtained at close intervals or changes in strata using a 3-in. diameter thinwall Shelby tube sampler. The samples were immediately extruded from the sampler, inspected, and visually classified by Eustis Engineering's soil technician. Pocket penetrometer tests were performed on the soil samples to give a general indication of their shear strength or consistency. The results of these tests are shown on the boring logs under the column heading "PP." Representative samples were then promptly placed in moisture proof containers and sealed for preservation of their natural moisture content.

9. Samples of cohesionless and semi-cohesive materials were obtained during the performance of in situ Standard Penetration Tests. This test consists of driving a 2-in. diameter sampler 1 foot into the soil after first seating it 6 inches. A 140-lb weight dropped 30 inches is used to advance the sampler. The number of blows required to drive the sampler is indicative of the relative density of cohesionless soils and the consistency of cohesive soils. The samples were retained in moisture proof containers for preservation of their natural moisture content. The results of the Standard Penetration Tests are shown on the boring logs under the column heading "SPT."

Cone Penetrometer Tests

10. The CPTs were performed using our truck mounted rig and a 10-cm^2 cross-sectional area cone with a 60° apex angled tip and 150-cm^2 sleeve area. The penetrometer was hydraulically advanced into the ground at a rate of 2-cm/sec. Parameters (tip resistance, friction resistance, and pore pressure) were recorded at 5-cm depth intervals. The results of the CPTs were plotted graphically with depth. These plots are provided in Appendix II. The plots provide tip resistance (q_t), sleeve friction (f_s), pore pressure (u_2), and friction ratio (R_f). Testing was performed in accordance with methods and procedures outlined in ASTM D 5778-07.

LABORATORY TESTS

11. Soil mechanics laboratory tests, consisting of natural water content, unit weight, unconfined compression shear (UC), and unconsolidated undrained triaxial compression shear (OB), were performed on samples obtained from the undisturbed borings. In addition, Atterberg liquid and plastic limits tests were performed on selected representative samples to aid in classification of the subsoils and to give an indication of their relative compressibility. The test establishing the

percent passing a No. 200 sieve (-#200) was also performed on a semi-cohesive soil to aid in its classification. The results of these laboratory tests are summarized on the boring logs in Appendix I.

12. Grain size analyses were also performed on selected samples of cohesionless soils to determine their particle distribution (PD) curves. The results of these tests are shown graphically on separate sheets following the boring logs in Appendix I.

DESCRIPTION OF SUBSOIL CONDITIONS

Stratigraphy

13. Reference to Borings 4 through 8 and CPTs 2 and 3 show the underlying deposits encountered consist of interbedded strata of very soft to very stiff clay, sandy clay, silty clay, and organic clay; very loose to dense fine sand, silty sand, and clayey sand; and loose to very compact sandy silt from the existing ground surface to the termination of the borings at the 40-ft depth. Subsoils encountered at Boring 1 consisted of medium stiff to very stiff clay, silty clay, and sandy clay with wood, organic matter, and sand layers from the existing ground surface to the termination of the boring at the 40-ft depth. Samples taken between the 4 and 30-ft depths in Boring 4 were noted to have a chemical odor. Our interpretation of the stratigraphy encountered at each boring is shown on the boring logs in Appendix I. Interpreted CPT logs are provided in Appendix II.

Ground Water

14. Long term measurements of the ground water were not recorded during our field investigation. Eustis Engineering performed a geotechnical investigation in 2010 for a proposed bypass channel. At the time of the previous investigation the ground water was observed to be 3 feet below the existing ground surface. The depth to

ground water will vary with climatic conditions, drainage improvements, water levels in nearby waterways (Turkey Creek and Bernard Bayou), and other factors. The depth to ground water should be determined by those persons responsible for construction immediately prior to beginning work.

FOUNDATION ANALYSIS

Furnished Information

15. A plan drawing of the site dated 10 May 2010 and showing the proposed capping plan was provided by Environmental Management Services. Based on this drawing, cantilever sheetpile walls are to be constructed at three locations across the site. Profiles A, B, C, and D were also provided. Fill will be required in some areas behind the wall in order to provide a working platform for construction equipment. Fill will also be placed at the site in order to cap potentially contaminated areas. The height of fill will range from 2 to 6 feet. Fill heights of 5 to 6 feet will be in localized areas which are not immediately behind the wall. A continuous soil-bentonite cutoff wall will also be constructed approximately 100 to 125 feet behind the sheetpile walls. Design of the bentonite wall is beyond our scope of work.

16. Drawings furnished by Environmental Management Services indicate the top of wall will be at approximate el 4 (furnished datum). Existing grades at the borings were also estimated as el 4. The mean low water level (MLWL) and extreme low water level (ELWL) for Turkey Creek were furnished as el 0 and el -4, respectively.

Bulkhead Design Requirements

17. Design Assumptions. Our analyses are based on furnished drawings and the information outlined in "Furnished Information." We have assumed average soil design parameters for the evaluation of the local and global stability of the

bulkhead. These average parameters selected for design of the wall are shown on Figure 3. In addition, our analyses assume adhesion between the sheetpile wall and subsoils to be 50%. As previously noted, the thickness and relative density of sand deposits varies between and away from the boring locations. Thus, the parameters and stratigraphy shown on Figure 3 are not appropriate for the design of the soil-bentonite cutoff wall. We have assumed the ground surface adjacent to the wall to be at the top of the wall at el 4. During construction, we assumed a uniform a uniform surcharge load is present behind the wall that does not exceed 200 psf. After construction, we assumed the approximate slope of the fill behind the wall will be a minimum of 5 horizontal to 1 vertical with no additional surcharge loads. Should these assumptions or furnished information not be valid, Eustis Engineering should be contacted immediately to reanalyze the wall. Specifically, we have assumed surcharge loads associated with construction equipment and construction of working pads above el 4 will not exceed 200 psf. Eustis Engineering should be notified if any permanent surcharge loads will be placed within 30 feet of the proposed bulkheads. Our analyses assume the ground surface behind the wall will be no higher than el 6 within 100 feet of the wall. Should the sheetpile wall be used for containment, Eustis Engineering should be contacted to evaluate seepage.

18. <u>Method of Analyses.</u> Eustis Engineering utilized the U.S. Army Corps of Engineers' computer program entitled "CWALSHT" for evaluation of the local stability of the proposed bulkhead. Unfactored soil parameters were used in these analyses. The estimated maximum bending moment in the sheetpile section was determined using a factor of safety of 1. Adequate factors of safety should be used to determine the structural requirements. The recommended sheetpile tip elevation was determined by factoring the penetration.

19. <u>Results of Analyses.</u> A summary of the results of our analyses for the proposed cantilevered sheetpile walls is summarized below in Table 1 and also provided on Figure 3.

TABLE 1: SUMMARY OF SHEETPILE ANALYSIS RESULTS

WATER LEVEL IN TURKEY CREEK	UNIFORM SURCHARGE LOAD (PSF)	SUMMARY OF BULKHEAD ANALYSES		
		ESTIMATED FACTOR OF SAFETY ≈ 1.3[1]	FACTOR OF SAFETY ≈ 1.0	
		RECOMMENDED PILE TIP ELEVATION (FEET - FURNISHED DATUM)	MAXIMUM MOMENT (FT-LBS/FT)	SCALED DEFLECTION (LB-IN.^{3})
El 0 (MLWL)	200	El -31	32,016 @ El -17.4	1.38×10^{10} @ El 4.0
El -4 (ELWL)	200	El -37	69,176 @ El -20.6	3.98×10^{10} @ El 4

A factor of safety of approximately 1.3 was applied to the estimated tip penetration.

20. The estimated maximum bending moments have not been factored (factor of safety ≈ 1.0). Adequate factors of safety should be applied to structural components. To obtain deflection in inches, divide the maximum scaled deflection by the product of the modulus of elasticity of the sheet in psi and the sheet moment of inertia in inches^4. The tolerable deflection should be considered when selecting the sheetpile section.

Slope Stability

21. General. Global stability analyses were performed by the LMVD Method of Planes analysis. To our knowledge, the existing banks have not shown any signs of distress. Installation of a cantilever bulkhead will improve the stability of the bank as fill is placed to cap and grade the site. We have estimated the minimum factor of safety for global stability of the bulkhead to be approximately 2.37 as shown on Figure 3. Our analyses assume the bank geometry within Turkey Creek to be no lower than el -10 within 100 feet of the wall. However, we also recommend bank slopes extend at a minimum of 3 horizontal to 1 vertical above el -10 within this 100-

ft width. Additional loadings (e.g., additional fills, buildings, etc.) in the vicinity of the walls have not been considered in our analyses. Increases in loadings in the retained fill behind the wall, as well as scour or dredging within Turkey Creek in front of the wall, have the potential of decreasing the factors of safety with respect to global stability and should be further assessed by Eustis Engineering.

General Site Filling - Cap Fill

22. General Fill. Clay fill may be used as backfill, but should not be used as structural fill beneath roadways and paved areas. Clay fill should meet the material requirements for an AASHTO A-4 or A-6 material or a Class B8 or B9 borrow material per Section 703.21 of the Mississippi Standard Specifications for Road and Bridge Construction. Additional fill requirements may be necessary for environmental consideration for the cap, but were beyond our scope of services. Should future plans for the site include constructing structures and/or pavements in the areas to be filled, Eustis Engineering should be contacted to give recommendations for alternative fill materials.

23. Placement and Compaction. Clay backfill placed behind the sheetpile wall may be compacted to at least 95% of its maximum dry density near optimum moisture in accordance with ASTM D 698 to meet assumptions for our local and global stability analyses. Backfill should be placed in loose lifts of 8 to 12 inches. Additional compaction requirements may be necessary to achieve permeability requirements. Fill should not be placed above the limits described for our local and global stability analyses.

24. Quality Control. Density tests should be performed on each lift of the compacted fill to determine if the contractor has achieved the recommended density. All filling and compaction operations should be accomplished only during periods of dry

weather. The contractor should exercise caution during and after inclement weather to ensure subsoil support is not degraded by construction operations.

25. Fill Settlement. Consolidation of the subsoils can be expected due to placement of fill to reach finished grade. Based on furnished information and drawings, fill heights will average around 4 feet above existing grade where fill is to be placed. Based on the furnished information, we estimate settlement of the existing ground surface near the center of an area with plan dimensions of 200' x 250' due to the placement of approximately 4 feet of fill to be 3 to 5 inches.

26. Approximately one-fourth of the center settlement will occur at the corners of the filled area. If additional fill heights or changes in the fill plan area are considered, Eustis Engineering should be contacted to reevaluate potential settlement. Additional settlement could result from the use of poor quality fill materials or improper placement and compaction of fill.

Vibrations

27. General. Sheetpile installation, hauling of fill materials, and other construction operations will cause vibrations that may affect nearby structures, pavements, and underground utilities. Damage due to construction vibrations is usually associated with movements of equipment, particularly heavy trucks and cranes. Vibrations associated with vehicular construction traffic are dependent on the size and speed of individual vehicles as well as frequency.

28. Measurement. If vibrations are a concern, we recommend peak particle velocities due to construction operations be monitored at critical structures or pavements with a seismograph during all construction operations that have a potential to cause vibrations (e.g., hauling of fill, installing sheetpiles, moving equipment). The record

of peak particle velocities will provide information in assessing potential damage and the types of changes best suited to the project requirements.

29. Generally, peak particle velocities of 1.5 to 2.0 in./sec are considered to be threshold levels for structural damage. Low peak particle velocity levels can also be a problem for poorly constructed buildings or structures that have been previously stressed by settlement or other movements. In such cases, vibrations on the order of 0.5 in./sec can initiate cosmetic damage or further cosmetic damage that has already taken place in the structure. Peak particle velocities between 0.25 and 0.5 in./sec may be sensed as being detrimental by human perception. In addition, peak particle velocities of 0.25 in./sec may densify cohesionless or semi-cohesive deposits (such as fill materials) and result in settlement of structures founded in these materials. Considering the potential for cosmetic damage and the adverse perception to human response, we recommend a level of 0.5 in./sec be set as a construction tolerance for transient construction activities. This level is generally achievable with current construction methods. However, for sustained peak particle velocities in excess of 0.25 in./sec at a pavement, utility, or structure of concern, Eustis Engineering should be notified.

30. Mitigation Techniques. Mitigation techniques to dampen the effects of vibrations on structures are generally associated with decreasing the energy exciting vibrations through the soil. For construction traffic, tight speed controls can greatly reduce the vibrations imparted to adjacent structures.

ADDITIONAL GEOTECHNICAL SERVICES

31. To provide continuity among the investigation, design, and construction phases, Eustis Engineering should be retained to provide additional services during completion of the project. These services may include consultation during design and construction, providing inspection of excavations, reviewing site drainage plans

and construction sequences proposed by the contractor, testing and approval of proposed materials, concrete testing and inspection, vibration monitoring, and any other soils and materials testing services. Eustis Engineering offers a complete range of materials testing services which will provide quality control during construction and conformance to design specifications.

32. In summary, Eustis Engineering should be retained to monitor all geotechnical related work performed by the contractor. If construction problems arise, Eustis Engineering should be notified to participate in the development of solutions. This participation permits the geotechnical engineer to evaluate the effects of unanticipated conditions and propose solutions on the geotechnical design assumptions particular to the project. The design geotechnical engineer may also be able to judge how site specific soil and ground water conditions will affect the success of a proposed construction alternative.

EUSTIS ENGINEERING COMPANY INC.
OF MISSISSIPPI

GEOTECHNICAL ENGINEERS

14368 CREOSOTE ROAD GULFPORT, MISSISSIPPI

SITE VICINITY MAP

CAVENHAM FOREST INDUSTRIES, LLC
PROPOSED SHEETPILE WALL
GULFPORT, MISSISSIPPI

DRAWN BY: J.L.S.	PLOT DATE: 12 JULY 11	CADD FILE: FIGURE 1.DGN
CHECKED BY: D.J.I.	JOB NO.: G0130	FIGURE 1

DENOTES LOCATION OF UNDISTURBED SOIL BORINGS DRILLED:
24 THROUGH 27 MAY 2011

▲ DENOTES LOCATION OF CONE PENETROMETER TESTS PERFORMED:
31 MAY 2011

NOT TO SCALE

**EUSTIS ENGINEERING COMPANY INC.
OF MISSISSIPPI**

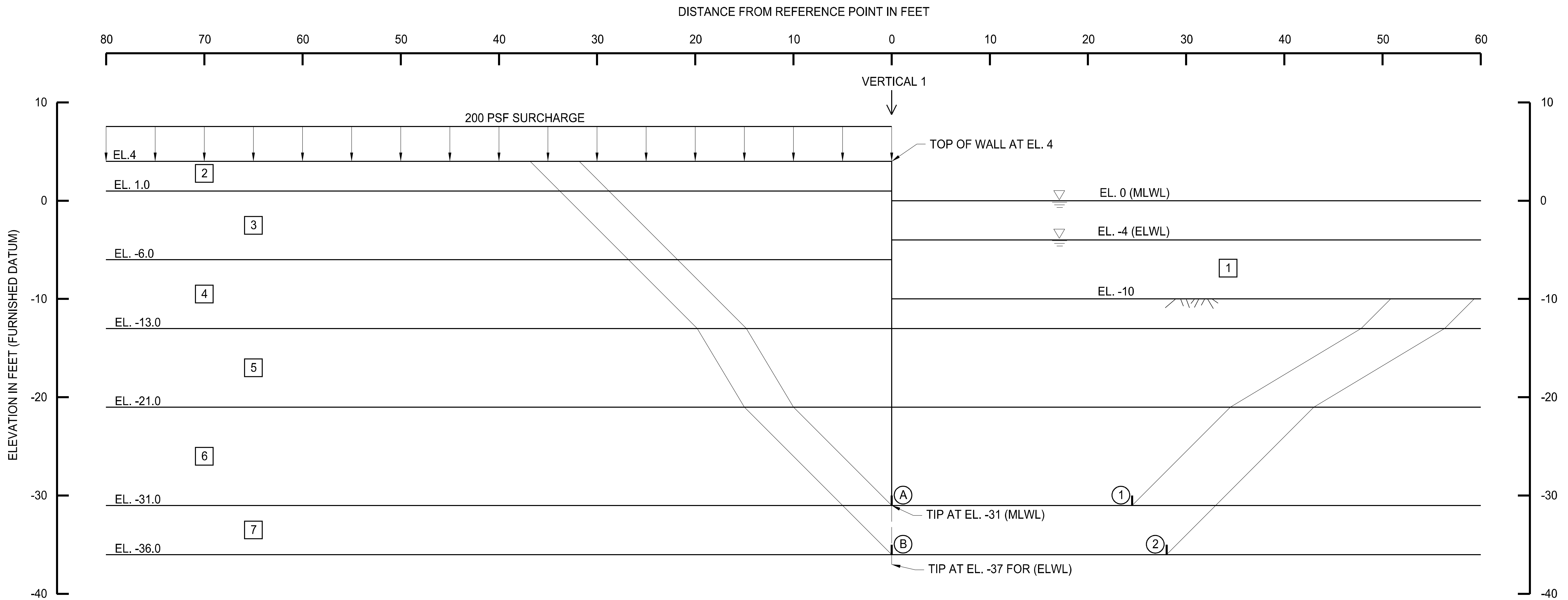
GEOTECHNICAL ENGINEERS

14368 CREOSOTE ROAD GULFPORT, MISSISSIPPI

BORING AND CONE PENETROMETER TEST
LOCATION PLAN

CAVENHAM FOREST INDUSTRIES, LLC
PROPOSED SHEETPILE WALL
GULFPORT, MISSISSIPPI

DRAWN BY: J.L.S.	PLOT DATE: 8 JULY 11	CADD FILE: G0130LOCATION PLAN.DGN
CHECKED BY: D.J.I.	JOB NO.: G0130	FIGURE 2



LOW WATER LEVEL IN TURKEY CREEK	UNIFORM SURCHARGE LOAD (PSF)	SUMMARY OF BULKHEAD ANALYSES		
		ESTIMATED FACTOR OF SAFETY ≈ 1.3	FACTOR OF SAFETY ≈ 1.0	
		RECOMMENDED PILE TIP ELEVATION (FEET - FURNISHED DATUM)	MAXIMUM MOMENT (FT-LBS/FT)	SCALED DEFLECTION (LB-IN^3)
EL. 0	200	EL. -31	32,016 @ EL. -17.4	1.38×10^{10} @ EL. 4
EL. 4	200	EL. -37	69,176 @ EL. -20.6	3.98×10^{10} @ EL. 4

FAILURE SURFACE	SUMMATION OF FORCES IN KIPS/L.F.		FACTOR OF SAFETY
	RESISTING	DRIVING	
A 1	88.55	37.29	2.37
B 2	121.66	43.40	2.80

SOIL NO.	DESCRIPTION	FRICTION ANGLE IN DEGREES	UNIT WEIGHT IN PCF	COHESION IN PSF	
				AVG.	BASE
1	WATER	0	62	0	0
2	CLAY	0	120	600	600
3	CLAY	0	90	200	200
4	CLAY	0	103	300	300
5	SAND	28	120	0	0
6	CLAY	0	120	1000	1000
7	CLAY	0	125	1200	1200

NOTES:

1.) MLWL - MEAN LOW WATER LEVEL.
2.) ELWL - EXTREME LOW WATER LEVEL.
3.) BULKHEAD ANALYSES WERE PERFORMED FOR BOTH MLWL AND ELWL.
4.) ESTIMATED MINIMUM BENDING MOMENTS HAVE NOT BEEN FACTORED (F.O.S. ≈ 1). SHEETPILE TIP ELEVATIONS ARE BASED ON FACTORING COMPUTED PENETRATIONS BY 1.3 (F.O.S. ≈ 1.3).
5.) STABILITY ANALYSES WERE ONLY PERFORMED FOR ELWL.
6.) FACTOR OF SAFETY COMPUTED AS RATIO OF RESISTING TO DRIVING FORCES.

EUSTIS ENGINEERING COMPANY INC. OF MISSISSIPPI
GEOTECHNICAL ENGINEERS
14368 CREOSOTE ROAD GULFPORT, MISSISSIPPI

BULKHEAD AND BANK STABILITY GEOMETRY

CAVENHAM FOREST INDUSTRIES, LLC
PROPOSED SHEETPILE WALL
GULFPORT, MISSISSIPPI

DRAWN BY: J.L.S.	PLOT DATE: 3 AUG 11	CADD FILE: FIGURE 3.DGN
CHECKED BY: D.J.I.	JOB NO.: G0130	FIGURE 3

APPENDIX I

LEGEND AND NOTES FOR LOG OF BORING AND TEST RESULTS

PP — Pocket penetrometer: Resistance in tons per square foot

SPT — Standard Penetration Test: Number of blows of a 140-lb hammer dropped 30 inches required to drive 2-in. O.D., 1.4-in. I.D. sampler a distance of 1 foot into the soil after first seating it 6 inches

SPLR — Type of Sampling: Shelby, SPT, Auger, No sample

SYMBOL — Clay, Silt, Sand, Peat/Humus, Shells, Stone/Gravel

Predominant type shown heavy; Modifying type shown light

USC — Unified Soil Classification

DENSITY — Unit weight in pounds per cubic foot

SHEAR TESTS

TYPE

- UC — Unconfined compression shear
- OB — Unconsolidated undrained triaxial compression shear on one specimen confined at the approximate overburden pressure
- UU — Unconsolidated undrained triaxial compression shear
- CU — Consolidated undrained triaxial compression shear
- DS — Direct shear

Ø — Angle of internal friction in degrees

c — Cohesion in pounds per square foot

ATTERBERG LIMITS

- LL — Liquid Limit
- PL — Plastic Limit
- PI — Plasticity Index

OTHER TESTS

- CON — Consolidation
- PD — Particle size distribution (sieve and/or hydrometer)
- k — Coefficient of permeability in centimeters per second
- SP — Swelling pressure in pounds per square foot

Other laboratory test results reported on separate figures

GENERAL NOTES

(1) If a ground water depth is shown on the boring log, these observations were made at the time of drilling and were measured below the existing ground surface. These observations are shown on the boring logs. However, ground water levels may vary due to seasonal fluctuations and other factors. If important to construction, the depth to ground water should be determined by those persons responsible for construction immediately prior to beginning work.

(2) While the individual logs of borings are considered to be representative of subsurface conditions at their respective locations on the dates shown, it is not warranted that they are representative of subsurface conditions at other locations and times.

EUSTIS ENGINEERING

LOG OF BORING AND TEST RESULTS

CAVENHAM FOREST INDUSTRIES, LLC
PROPOSED SHEETPILE WALL
GULFPORT, MISSISSIPPI

Ground Elev.: **Datum:** **Gr. Water Depth:** See Text **Job No.:** G0130 **Date Drilled:** 5/27/11 **Boring:** 1 **Refer to "Legends & Notes"**

Scale In Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth In Feet	Water Content Percent	Density Dry	Density Wet	Shear Tests Type	Shear Tests ø	Shear Tests C	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
0	4.50				Stiff tan & light gray clay w/wood & roots	CH	1	2-3	20	105	127	UC	--	1812					
					Medium stiff tan clay w/wood	CH	2	5-6	48										
					Stiff tan & gray silty clay w/wood	CL	3	8-9							26	12	14		
10					Medium stiff tan & gray clay w/trace of wood	CH	4	11-12	36										
		7			Medium stiff greenish-gray clay w/trace of roots	CH	5	13.5-15	34										
	2.50				Stiff grennish-gray clay w/silt pockets & wood	CH	6	18-19	31										
20	1.50				w/fine sand layers		7	23-24	29										
30	4.00				Very stiff greenish-gray clay w/fine sand lenses (fissures)	CH	8	29-30	26	98	123	UC	--	2679					
	2.75				Very stiff greenish-gray sandy clay	CL	9	34-35	24										
	4.50				Very stiff greenish-gray clay	CH	10	38-39	21	106	128	UC	--	2368					
40																			
50																			

Comments: Latitude: 30° 25.459' N
Longitude: 89° 04.249' W

EUSTIS ENGINEERING

LOG OF BORING AND TEST RESULTS

CAVENHAM FOREST INDUSTRIES, LLC
PROPOSED SHEETPILE WALL
GULFPORT, MISSISSIPPI

Ground Elev.: **Datum:** **Gr. Water Depth:** See Text **Job No.:** G0130 **Date Drilled:** 5/26/11 **Boring:** 4 **Refer to "Legends & Notes"**

Scale In Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth In Feet	Water Content Percent	Density Dry	Density Wet	Shear Tests Type	Shear Tests ø	Shear Tests C	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
0	2.00				Medium compact red, black, gray, & tan sandy silt w/decayed wood & shell fragments	ML	1	2-3	9										
	1.25				Soft tan & gray sandy clay w/roots, organic matter, & gravel (chemical odor)	CL	2	5-6	21										
	0.75				Soft dark brown clay w/wood & roots (chemical odor)	CH	3	8-9	90										
10					Very soft dark brown humus (chemical odor)	Pt	4	11-12	74										
		5			Medium stiff dark brown organic clay w/humus layers (chemical odor)	OH	5	13.5-15	65										
20		10			Loose dark brown & gray fine sand w/clay pockets (chemical odor)	SP	6	18.5-20	22										
		2			Very loose dark brown fine sand w/clayey sand layers (chemical odor)	SP	7	23.5-25											
		16			Medium dense gray fine sand (chemical odor)	SP	8	26.5-28											PD
30		9			Loose dark gray fine sand	SP	9	29.5-31	20										
	2.00				Medium stiff greenish-gray silty clay w/trace of sandy clay	CL	10	33-34	28	95	121	UC	--	713	35	22	13		
	1.50				Stiff gray & greenish-gray silty clay	CL	11	38-39											
40																			
50																			

Comments: Latitude: 30° 25.490' N
Longitude: 89° 04.170' W

EUSTIS ENGINEERING

LOG OF BORING AND TEST RESULTS

CAVENHAM FOREST INDUSTRIES, LLC
PROPOSED SHEETPILE WALL
GULFPORT, MISSISSIPPI

Ground Elev.: **Datum:** **Gr. Water Depth:** See Text **Job No.:** G0130 **Date Drilled:** 5/26/11 **Boring:** 5 **Refer to "Legends & Notes"**

Scale In Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth In Feet	Water Content Percent	Density Dry	Density Wet	Shear Tests Type	Shear Tests ø	Shear Tests C	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
0		14			Medium compact tan & brown sandy silt w/gravel	ML	1	0-1.5	6										
		4			Soft gray & tan silty clay	CL	2	3-4.5											
					Medium compact gray & tan sandy silt w/wood	ML	3	4.5-6	17										
		13			Medium dense gray silty sand	SM	4	7.5-9											PD
10		16			Medium dense gray fine sand	SP	5	10.5-12	22										
		22					6	13.5-15											
		2			Very soft dark brown clay w/organic matter & decayed wood	CH	7	16.5-18							109	46	63		
20	1.00				Stiff tan & gray silty clay w/organic matter	CL	8	19-20	23	103	126	UC	--	1087					
	1.00				Loose brown & gray clayey sand w/fine sand layers	SC	9	23-24	20										
		23			Medium dense gray fine sand	SP	10	25.5-27											
30		14			w/decayed wood		11	28.5-30	24										
					Loose to medium dense gray fine sand	SP													
	2.00				Medium stiff greenish-gray silty clay	CL	12	34-35	26	97	122	UC	--	984					
					Stiff gray silty clay w/fine sand layers	CL													
40	3.00						13	39-40	28	96	123	UC	--	1019					
50																			

Comments: Latitude: 30° 25.491' N
Longitude: 89° 04.138' W

EUSTIS ENGINEERING COMPANY, INC.

LOG OF BORING AND TEST RESULTS

CAVENHAM FOREST INDUSTRIES, LLC
PROPOSED SHEETPILE WALL
GULFPORT, MISSISSIPPI

Ground Elev.: **Datum:** **Gr. Water Depth:** See Text **Job No.:** G0130 **Date Drilled:** 5/24/11 **Boring:** 6 **Refer to "Legends & Notes"**

Scale In Feet	PP	SPT	Visual Classification	USC	Sample Number	Depth In Feet	Water Content Percent	Density Dry	Density Wet	Shear Tests Type	Shear Tests ø	Shear Tests C	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
0		19	Medium compact brown sandy silt w/roots & shell fragments	ML	1	0-1.5	6										
		18	Medium dense gray & tan silty sand w/clayey silt	SM	2	3-4.5											
		51	Very dense gray & tan silty sand	SM	3	6-7.5											PD
10		31	Dense gray & tan fine sand	SP	4	9-10.5											
		18	Medium dense gray silty sand	SM	5	12-13.5											
		7	Soft dark gray sandy clay w/organic matter & decayed wood	CL	6	15-16.5	50										
20	0.50		Medium stiff dark brown clay w/trace of organic matter	CH	7	18-19	39	82	113	UC	–	873					
	0.25		Soft dark brown sandy clay	CL	8	23-24	25	101	125	UC	–	434	26	17	9		
	1.00		Medium dense dark gray clayey sand w/decayed wood	SC	9	28-29	26	99	124	OB	0	863					
30			Loose to medium dense gray fine sand	SP													
			w/trace of wood		10	33-34											PD
		29	Medium dense gray fine sand w/silt	SP-SM	11	34.5-36											
40		34	Dense gray fine sand w/silt	SP	12	38.5-40	20										
50																	

Comments: Latitude: 30° 25.523' N
Longitude: 89° 04.140' W

EUSTIS ENGINEERING

LOG OF BORING AND TEST RESULTS

CAVENHAM FOREST INDUSTRIES, LLC
PROPOSED SHEETPILE WALL
GULFPORT, MISSISSIPPI

(Sheet 1 of 1)

Ground Elev.: **Datum:** **Gr. Water Depth:** See Text **Job No.:** G0130 **Date Drilled:** 5/25/11 **Boring:** 7 **Refer to "Legends & Notes"**

Scale In Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth In Feet	Water Content Percent	Density		Shear Tests			Atterberg Limits				Other Tests
										Dry	Wet	Type	ø	C	LL	PL	PI		
0	1.00				Stiff light gray, red, & tan clay w/roots	CH	1	1-2	30	89	115	UC	--	1152					
					Soft dark brown humus w/trace of fine sand, wood, & roots	Pt	2	4-5	60										
					w/trace of fine sand & wood		3	8-9											
10					Soft gray & dark brown sandy clay w/organic matter & fine sand layers	CL	4	10-11	46	71	103	OB	0	278					
					Loose dark gray clayey sand w/decayed wood	SC	5	14-15	54										PD
		4			Very loose gray fine sand w/wood	SP	6	15.5-17											
20		7			Loose greenish-gray sandy silt w/clay pockets	ML	7	18.5-20	32										
	1.25				Loose to medium dense greenish-gray silty sand w/clay layers & trace of decayed wood	SM	8	24-25	28										
	3.75				Very stiff greenish-gray clay (fissures)	CH	9	28-29	21	104	127	UC	--	3016	57	19	38		
30	3.00						10	33-34											
40	2.25				Stiff gray silty clay	CL	11	39-40	28	96	122	UC	--	1209					
50																			

Comments: Latitude: 30° 25.438' N
Longitude: 89° 04.063' W

EUSTIS ENGINEERING

LOG OF BORING AND TEST RESULTS

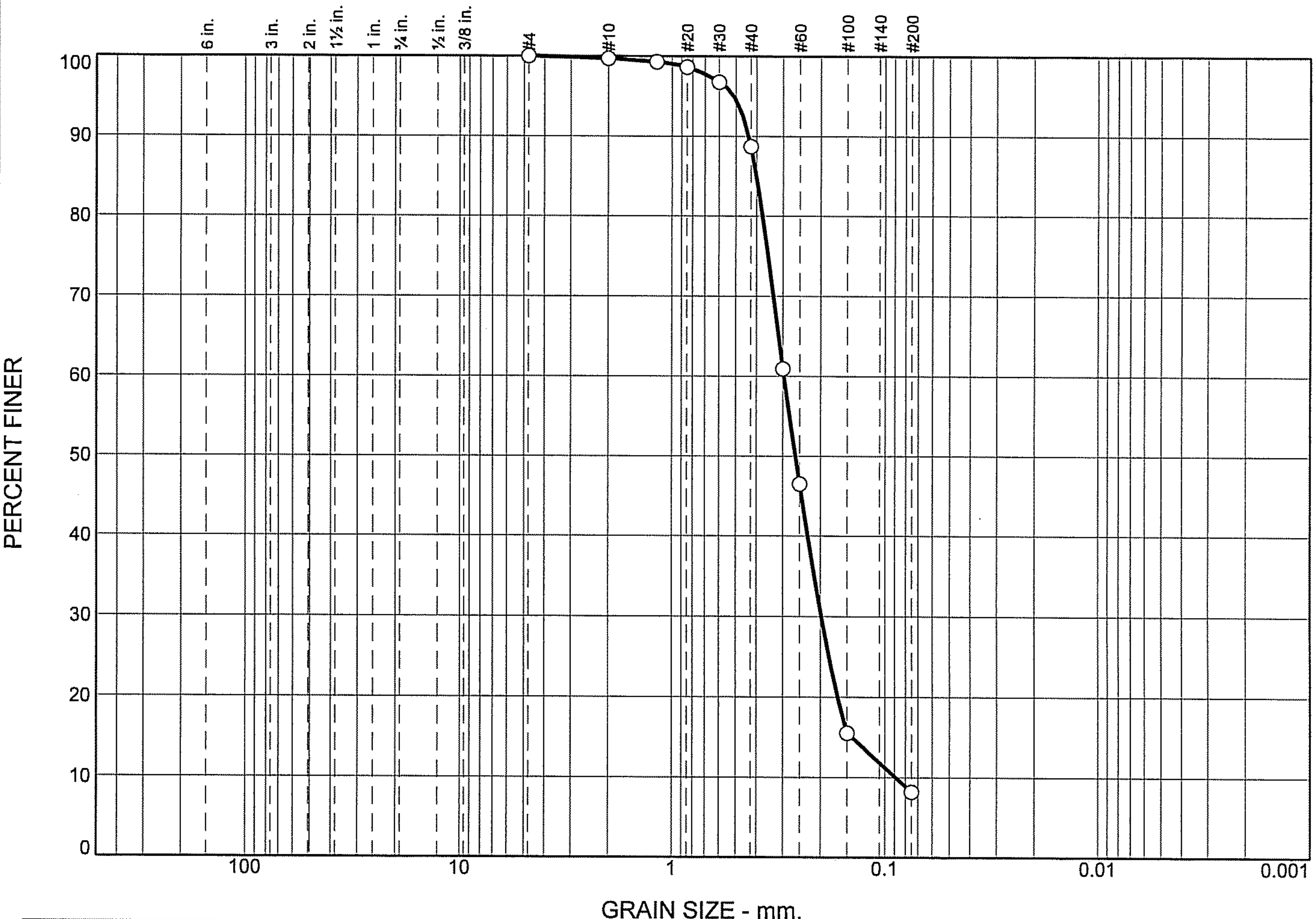
CAVENHAM FOREST INDUSTRIES, LLC
PROPOSED SHEETPILE WALL
GULFPORT, MISSISSIPPI

Ground Elev.: **Datum:** **Gr. Water Depth:** See Text **Job No.:** G0130 **Date Drilled:** 5/24-25/11 **Boring:** 8 **Refer to "Legends & Notes"**

Scale In Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth In Feet	Water Content Percent	Density		Shear Tests			Atterberg Limits				Other Tests
										Dry	Wet	Type	ø	C	LL	PL	PI		
0	1.00				Medium stiff dark brown humus w/roots & wood	Pt	1	1-2	53										
	0.75				Very compact gray & tan sandy silt w/roots & decayed wood	ML	2	4-5	16	115	133	UC	--	4226	18	17	1		
					Medium compact gray sandy silt	ML	3	6-7	16										-#200 = 88.6%
		18					4	7-8.5											
10		2			Soft dark gray sandy clay w/trace of decayed wood	CL	5	10-11.5	31										
		2			Very soft dark gray silty clay w/trace of decayed wood	CL	6	13-14.5	47						37	21	16		
	1.00				Medium dense gray fine sand w/silty clay layers & trace of decayed wood	SP	7	17-18	21	107	129	OB	0	3155					
20		4			Very loose dark gray & tan fine sand	SP	8	20-21.5											PD
		29			Medium dense gray fine sand	SP	9	23-24.5											
		18			Very stiff greenish-gray sandy clay	CL	10	26-27.5											
30	3.00				Medium stiff greenish-gray clay w/fine sand lenses	CH	11	29-30	32	90	119	UC	--	528					
	1.00				Medium dense gray & greenish-gray clayey sand w/clay pockets	SC	12	33-34	21	104	127	OB	0	877					
		20			Very stiff greenish-gray silty clay w/clayey sand layers	CL	13	35.5-37											
		17			Very stiff greenish-gray silty clay		14	38.5-40	21										
40																			
50																			

Comments: Latitude: 30° 25.472' N
Longitude: 89° 04.073' W

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.3	11.0	80.5	8.2	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.4001	0.2966	0.2618	0.1978	0.1426	0.0889	1.48	3.34

Material Description	USCS	AASHTO
○ MD G FISA	SP	

Project No. G0130 **Client:**

Project: CAVENHAM FOREST INDUSTRIES

○ **Source of Sample:** 4 **Depth:** 26.5 **Sample Number:** 8

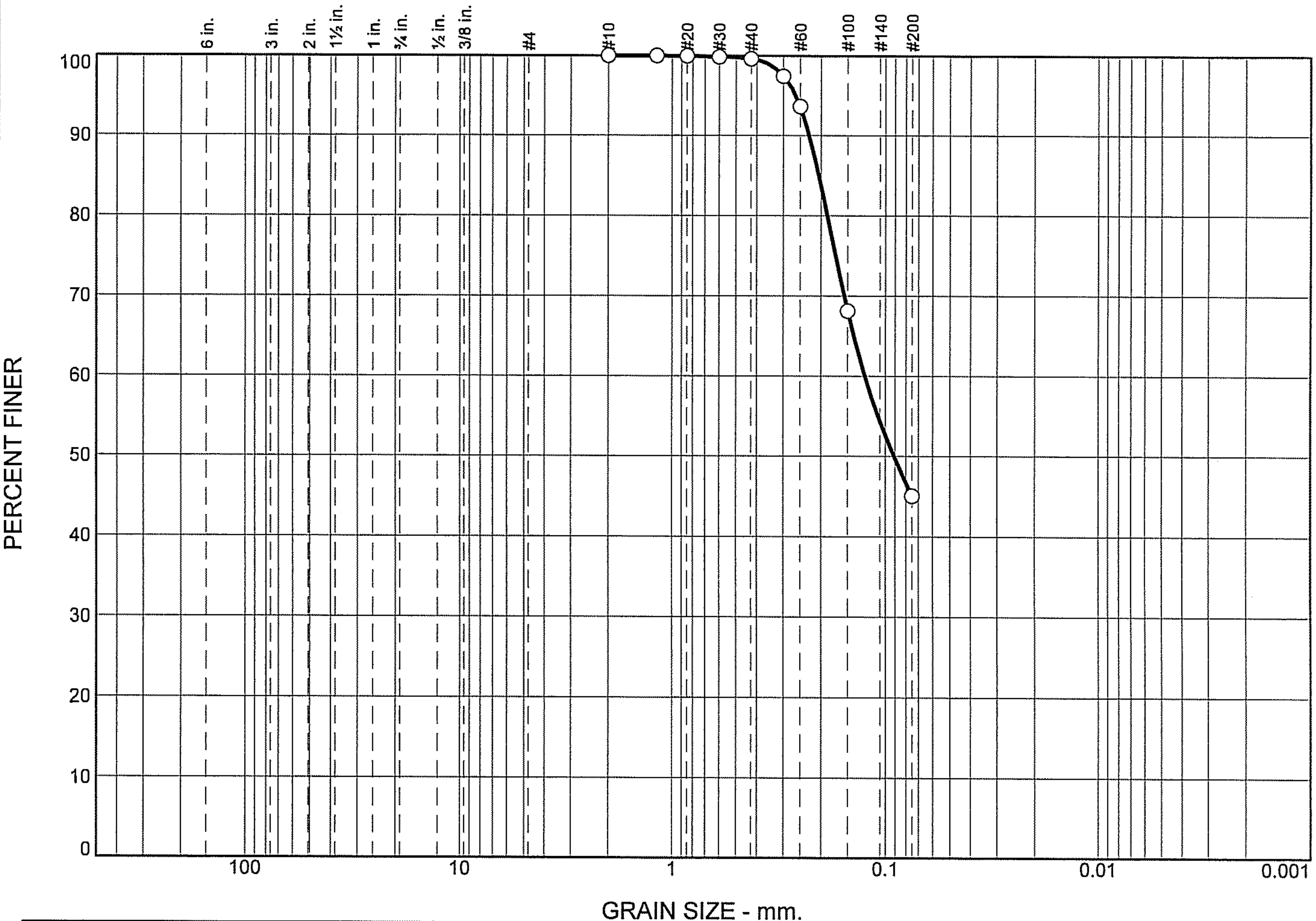
EUSTIS
Metairie, Louisiana
Lafayette, Louisiana
Gulfport, Mississippi

Remarks:

Figure

Tested By: SJP **Checked By:** LWR

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.4	54.6	45.0	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.2045	0.1247	0.0911					

Material Description	USCS	AASHTO
○ MD G SISA	SM	

Project No. G0130 **Client:**

Project: CAVENHAM FOREST INDUSTRIES

○ **Source of Sample:** 5 **Depth:** 7.5 **Sample Number:** 4

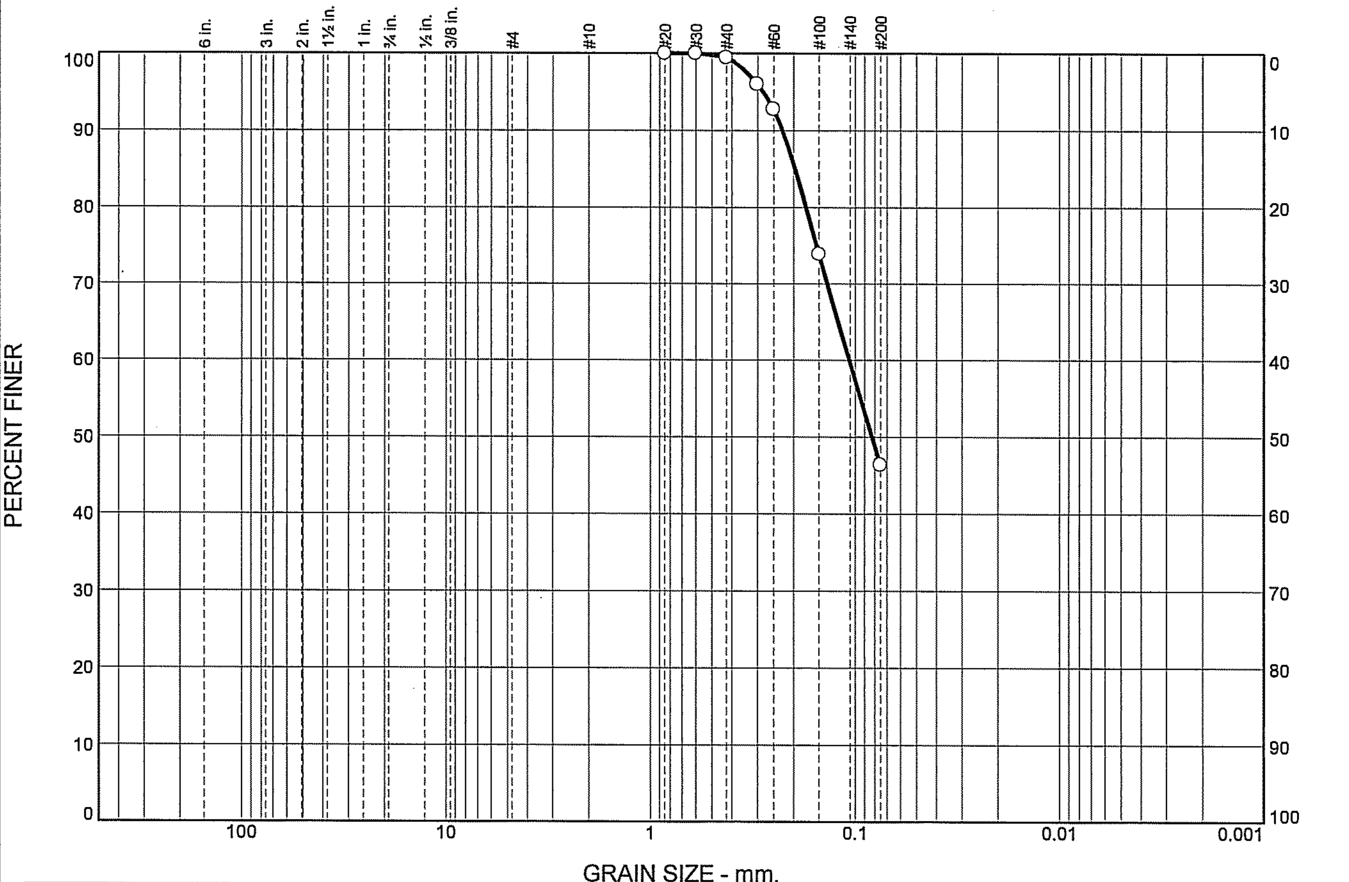
EUSTIS
Metairie, Louisiana
Lafayette, Louisiana
Gulfport, Mississippi

Remarks:

Figure

Tested By: SJP **Checked By:** LWR

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.5	53.1	46.4	

╳	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.1961	0.1066	0.0824					

Material Description	USCS	AASHTO
○ VD G & T SISA	SM	

Project No. G0130 **Client:**
Project: CAVENHAM FOREST INDUSTRIES, LLC
PROPOSED SHEETPILE WALL
○ **Source of Sample:** 6 **Depth:** 6 **Sample Number:** 3

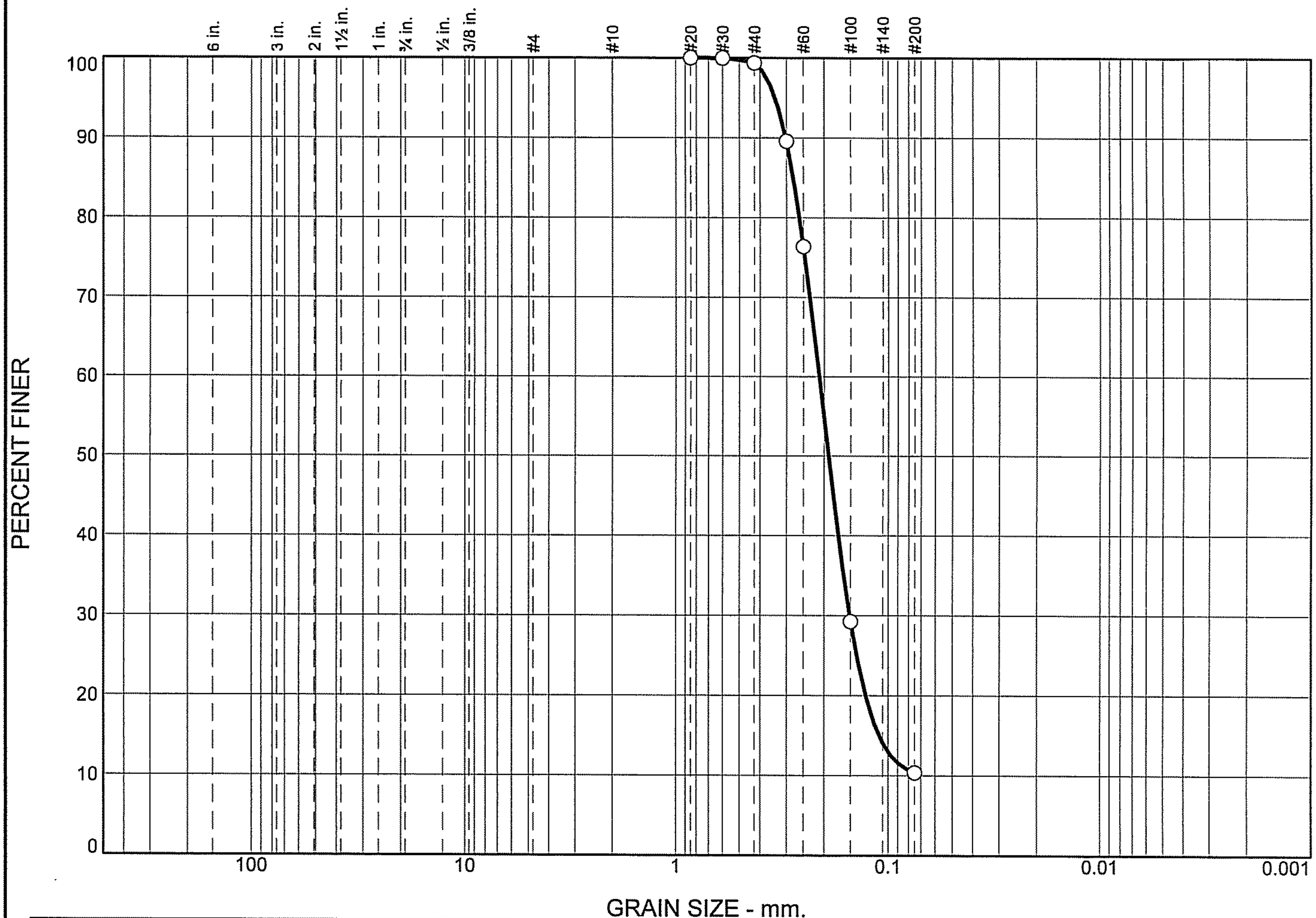
Remarks:

EUSTIS
Metairie, Louisiana
Lafayette, Louisiana
Gulfport, Mississippi

Figure

Tested By: SJP **Checked By:** LWR

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.6	89.0	10.4	

╳	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.2790	0.2102	0.1901	0.1516	0.1101			

Material Description	USCS	AASHTO
○ MD G FISA W/ SI	SP-SM	

Project No. G0130 **Client:**
Project: CAVENHAM FOREST INDUSTRIES

○ **Source of Sample:** 6 **Depth:** 34.5 **Sample Number:** 11

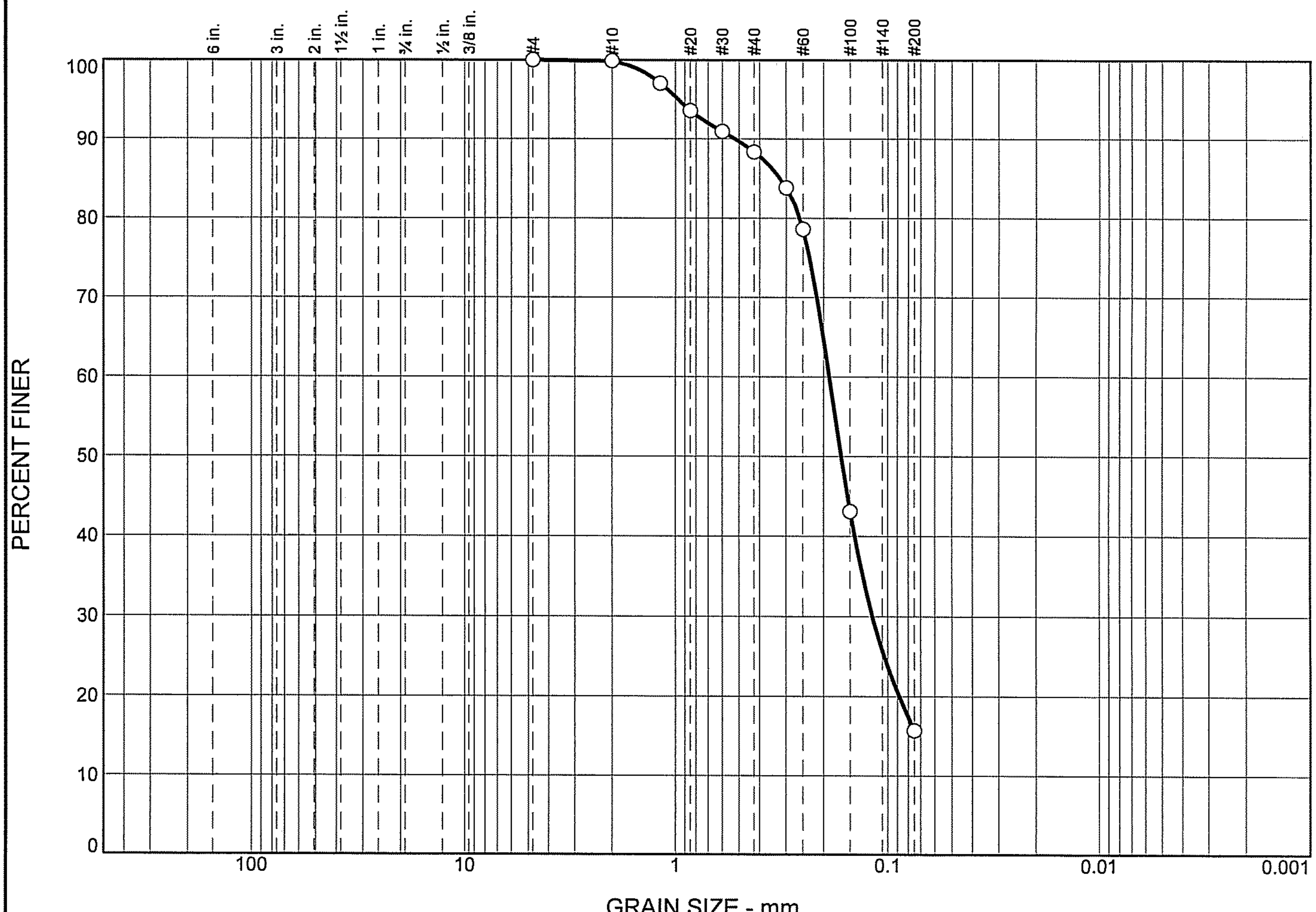
EUSTIS
Metairie, Louisiana
Lafayette, Louisiana
Gulfport, Mississippi

Remarks:

Figure

Tested By: SJP **Checked By:** LWR

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.1	11.5	72.7	15.7	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.3204	0.1877	0.1650	0.1179				

Material Description	USCS	AASHTO
○ LO DK G CLSA W/ DEC WD	SC	

Project No. G0130 **Client:**

Project: CAVENHAM FOREST INDUSTRIES

○ **Source of Sample:** 7 **Depth:** 14 **Sample Number:** 5

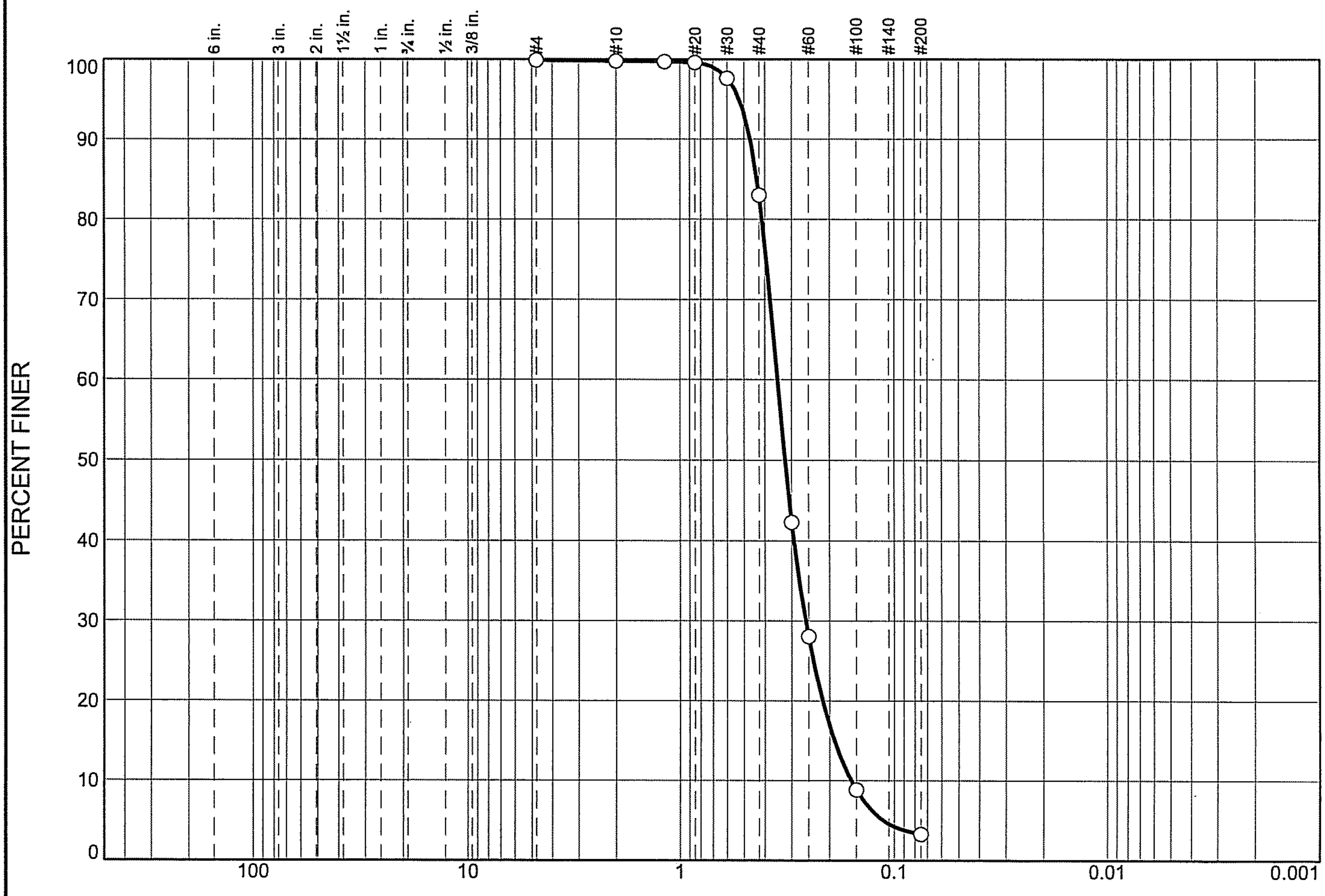
EUSTIS
Metairie, Louisiana
Lafayette, Louisiana
Gulfport, Mississippi

Remarks:

Figure

Tested By: SJP **Checked By:** LWR

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				0.1	16.8	79.7	3.3	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.4350	0.3484	0.3215	0.2578	0.1895	0.1586	1.20	2.20

Material Description	USCS	AASHTO
○ VLO DK G & T FISA	SP	

Project No. G0130 **Client:**

Project: CAVENHAM FOREST INDUSTRIES

○ **Source of Sample:** 8 **Depth:** 20 **Sample Number:** 8

EUSTIS
Metairie, Louisiana
Lafayette, Louisiana
Gulfport, Mississippi

Remarks:

Figure

Tested By: SJP **Checked By:** LWR

APPENDIX II

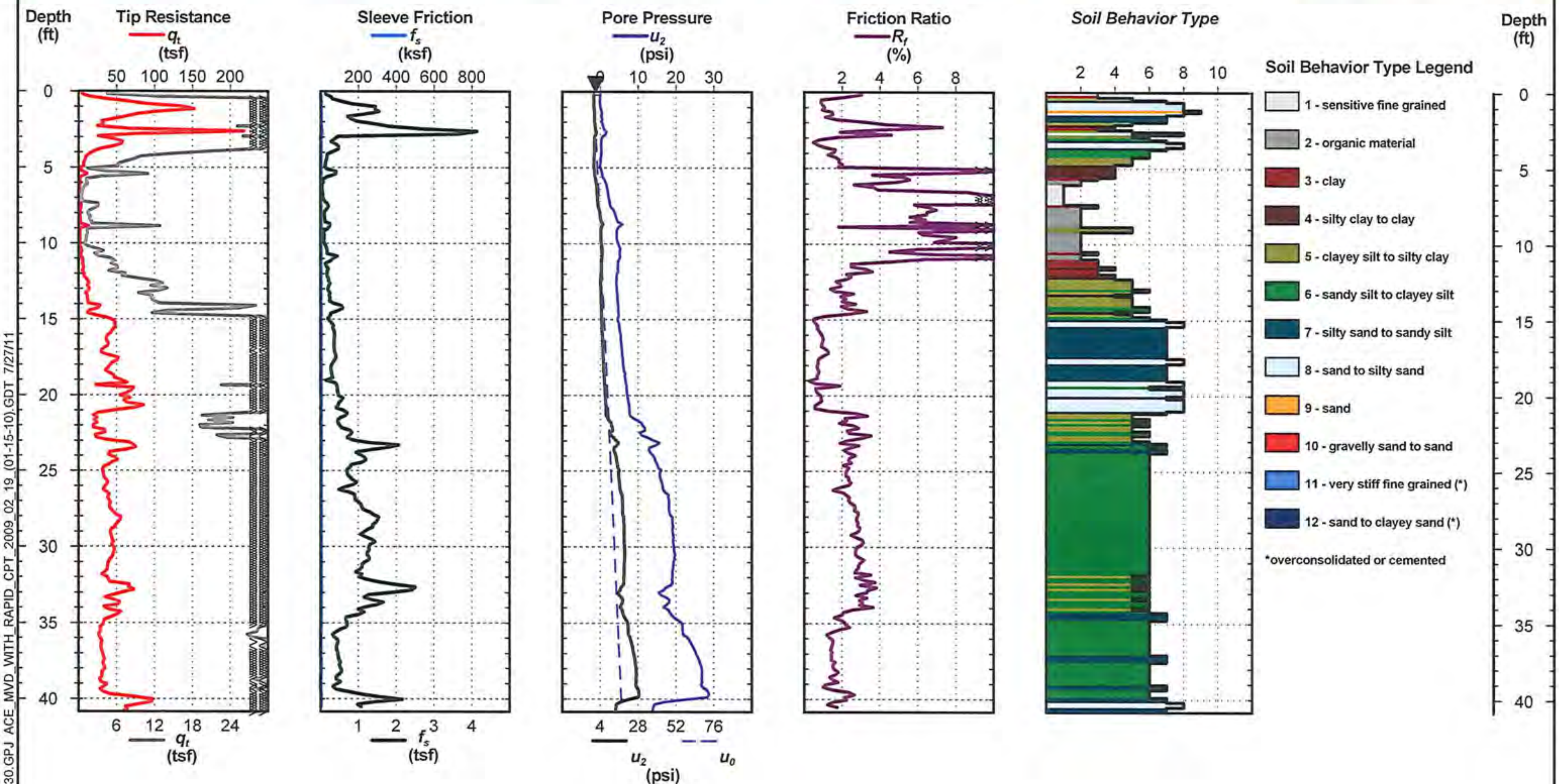
EUSTIS ENGINEERING

Cavenham Forest Industries, LLC
Proposed Sheetpile Wall
Gulfport MsGulfport, Mississippi
Project No: G0130

Cone Penetration Test

CPT 2

Date: 05/31/11
Operator: G.Reitmeyer
Latitude: 30.42408333
Longitude: -89.07018333
CPT ID/Net Area Ratio: DTA1061 / 0.8
Water Depth: 0
Total Depth: 40.9 ft



Notes: Soil behavior type was determined using friction ratio classification chart (after Robertson *et al.*, 1986).
Test performed in general accordance with ASTM D5778-07.

Electronic Filename: G0130CPT SPT-2.cpt *Page 1 of 1*

EE STANDARD CPT LOG G0130.GPJ ACE_MVD_WITH_RAPID_CPT_2009_02_19_(01-15-10).GDT 7/27/11

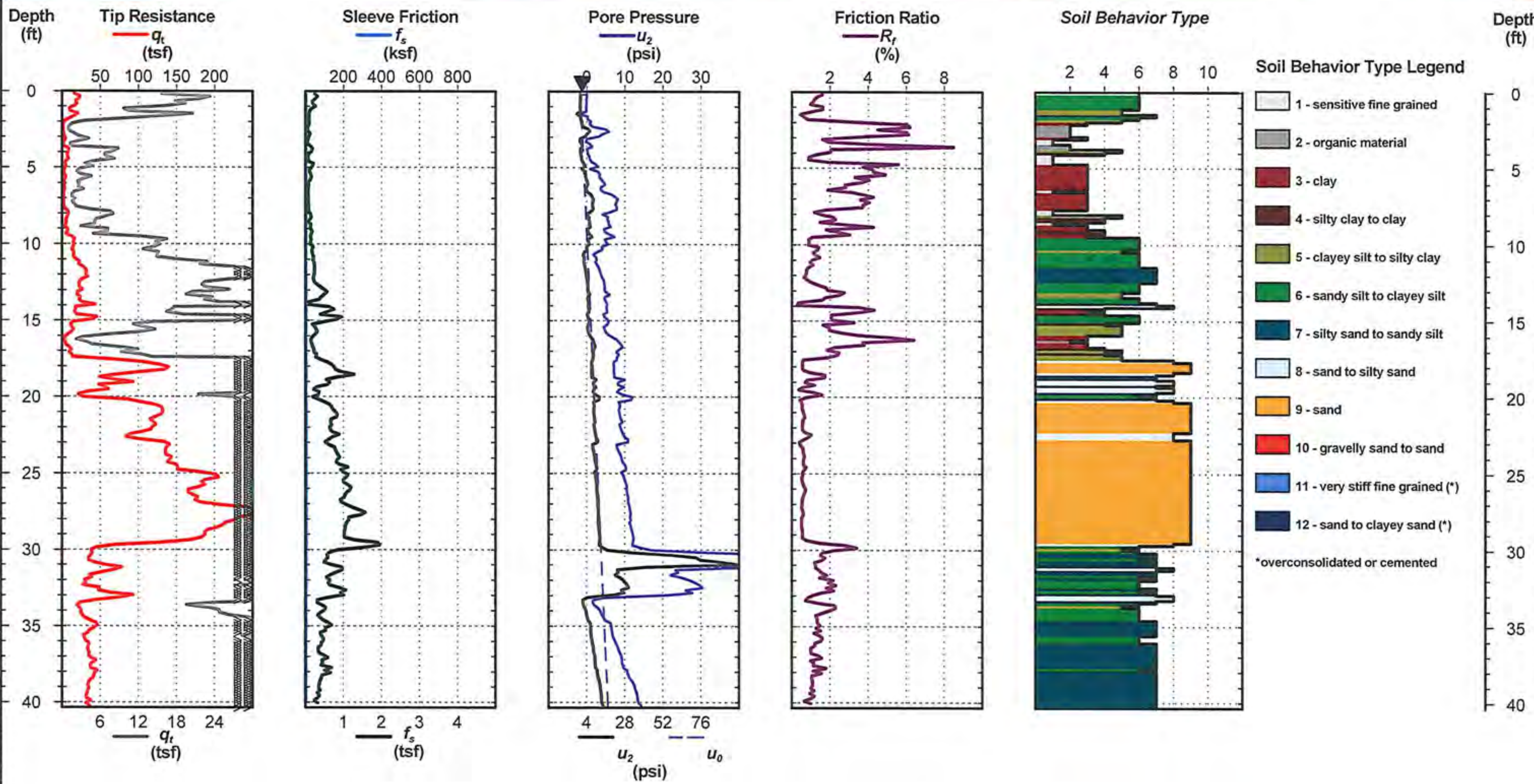
EUSTIS ENGINEERING

Cavenham Forest Industries, LLC
Proposed Sheetpile Wall
Gulfport MsGulfport, Mississippi
Project No: G0130

Cone Penetration Test

CPT 3

Date: 05/31/11
Operator: G.Reitmeyer
Latitude: 30.42413333
Longitude: -89.06983333
CPT ID/Net Area Ratio: DTA1061 / 0.8
Water Depth: 0
Total Depth: 40.4 ft



Notes: Soil behavior type was determined using friction ratio classification chart (after Robertson *et al.*, 1986).
Test performed in general accordance with ASTM D5778-07.

Electronic Filename: G0130CPT SPT-3.cpt *Page 1 of 1*

EE STANDARD CPT LOG G0130.GPJ ACE_MVD_WITH_RAPID_CPT_2009_02_19 (01-15-10).GDT 7/27/11

APPENDIX C
Peninsula Recovery Well Logs

Project No.:	HAN008100	Northing:	-327.34	Geologist:	SMF
Project:	ISCO	Easting:	1634.38	Drill Method:	Sonic
Location:	Gulfport, MS	Grd. Elev:	5.69	Driller:	WHE
Date:	9-19-09	Total Depth (ft. bls)	45.0	Checked By:	SMF

Boring No.: RW-41

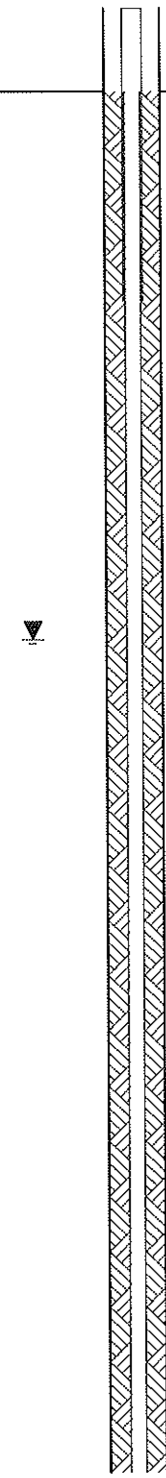
ENVIRONMENTAL
MANAGEMENT SERVICES, INC.
P.O. Box 15369
Hattiesburg, MS 39404

SUBSURFACE PROFILE

Depth (ft.)	Symbol	Description / Unified Soil Classification	Lab Sample No.	FID (ppm)
		Ground Surface		
0–1		Topsoil		
1–9		Stiff yellowish brown Silty CLAY (CL) - with gravel		
9–16.5		Loose dark brown Silty fine SAND (SM)		
16.5–20		Dense light grey medium SAND (SP) - with woody debris		

Well Completion Details

Stickup: 4.44'



NEW WELL BORELOGS.GPJ ENV MANAGEMENT.GDT 12/16/09

Project No.:	HAN008100	Northing:	-327.34	Geologist:	SMF
Project:	ISCO	Easting:	1634.38	Drill Method:	Sonic
Location:	Gulfport, MS	Grd. Elev:	5.69	Driller:	WHE
Date:	9-19-09	Total Depth (ft. bls)	45.0	Checked By:	SMF

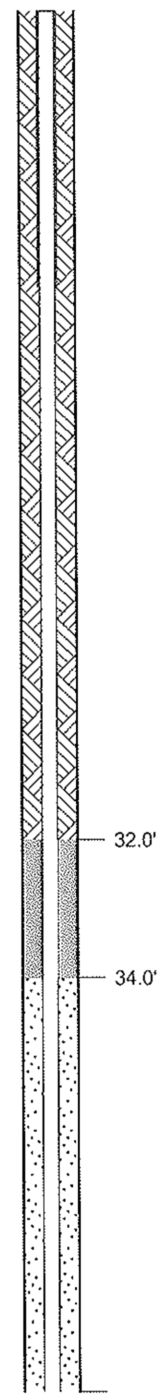
Boring No.: RW-41

ENVIRONMENTAL
MANAGEMENT SERVICES, INC.
P.O. Box 15369
Hattiesburg, MS 39404

SUBSURFACE PROFILE

Depth (ft.)	Description / Unified Soil Classification	Lab Sample No.	FID (ppm)
20 – 23	Dense light grey medium SAND (SP) - with woody debris *(Continued)*		
23 – 23.5	Stiff dark brown CLAY (CL-CH)		
23.5 – 36	Very dense light grey medium SAND (SP) - creosote saturation from 33.5 to 36 - with woody debris 2" pea gravel		
36 – 40	Very stiff green CLAY (CH) - with sand pockets and creosote in sand		

Well Completion Details

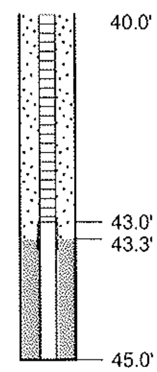


Project No.:	HAN008100	Northing:	-327.34	Geologist:	SMF
Project:	ISCO	Easting:	1634.38	Drill Method:	Sonic
Location:	Gulfport, MS	Grd. Elev:	5.69	Driller:	WHE
Date:	9-19-09	Total Depth (ft. bls)	45.0	Checked By:	SMF

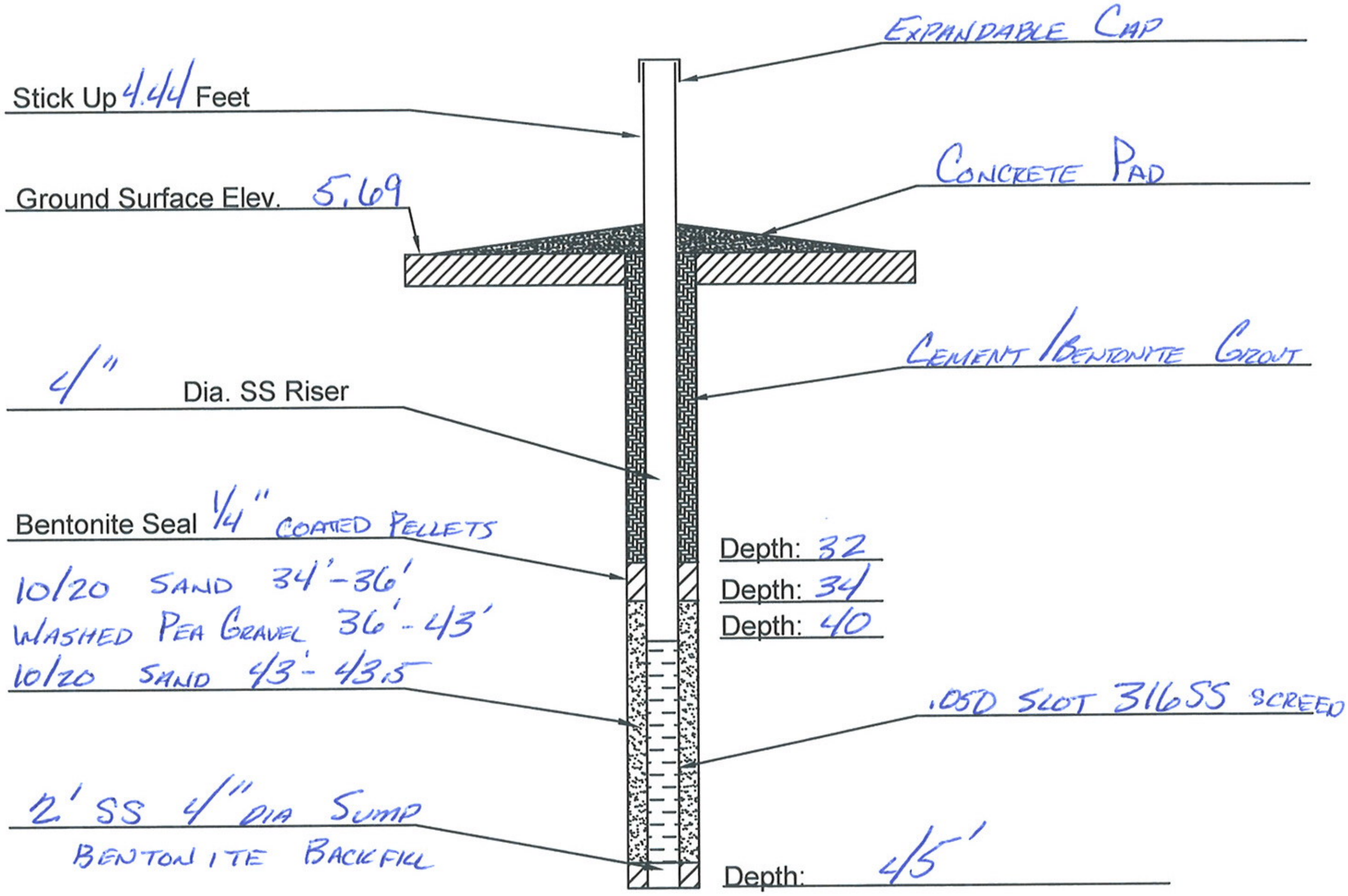
Boring No.: RW-41

ENVIRONMENTAL MANAGEMENT SERVICES, INC.
P.O. Box 15369
Hattiesburg, MS 39404

SUBSURFACE PROFILE			SAMPLE		Well Completion Details
Depth (ft.)	Symbol	Description / Unified Soil Classification	Lab Sample No.	FID (ppm)	
40–42.5		very stiff Silty CLAY (CL) - sand seam saturated with creosote at 40.5 to 41			
42.5–45		Dense green Silty SAND (SM)			



Project Name:	Gulfport - ISCO	Geologist:	S. Fleming
Project Number:	HAND-08-100	Driller:	Walker Hill
Well Number:	RW-41	Water Level:	7.94
Total Depth:	45	Date:	9-19-09



Note: Depth measured from ground surface.

* All SS is 316

WELL INSTALLATION DETAIL

DATE:	APPROVED: BY: DATE:	DRAWN BY: CAD NO.	
ENVIRONMENTAL MANAGEMENT SERVICES, INC.			FIGURE

Project No.:	HAN008100	Northing:	-303.02	Geologist:	SMF
Project:	ISCO	Easting:	1630.45	Drill Method:	Sonic
Location:	Gulfport, MS	Grd. Elev:	5.13	Driller:	WHE
Date:	9-19-09	Total Depth (ft. bls)	40.0	Checked By:	SMF

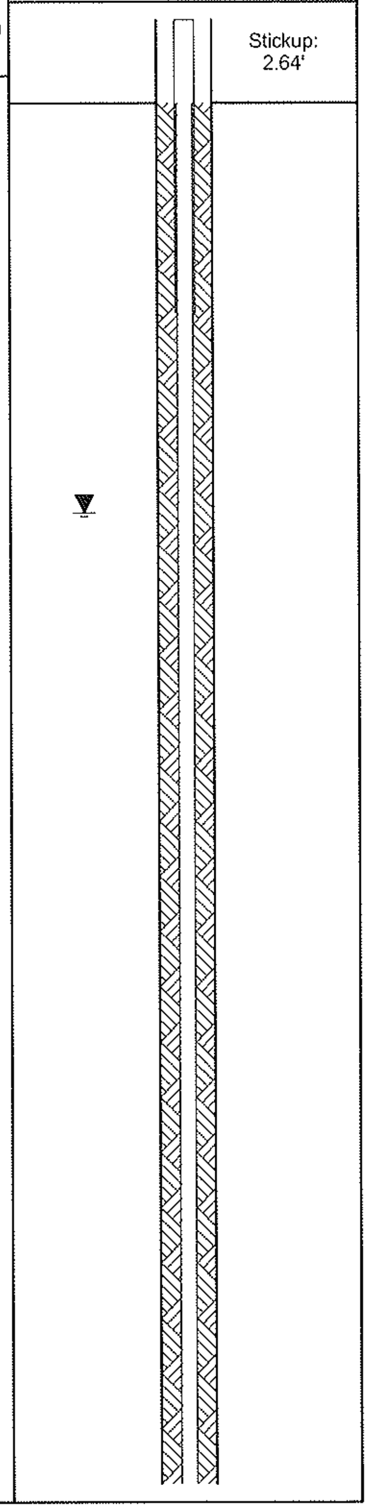
Boring No.: RW-42

ENVIRONMENTAL
MANAGEMENT SERVICES, INC.
P.O. Box 15369
Hattiesburg, MS 39404

SUBSURFACE PROFILE

Depth (ft.)	Symbol	Description / Unified Soil Classification	Lab Sample No.	FID (ppm)
0		Ground Surface		
0–10		Bit plugged with concrete debris 1' recovery		
10–11.5	SM	Firm light grey Silty fine SAND (SM) - with roots and wood debris		
11.5–17.5		Dark brown Silty CLAY (CL-OL) - with roots and woody debris - organic odor		
17.5–20	SM	Brown silty fine SAND (SM)		

Well Completion Details



NEW WELL BORELOGS.GPJ ENV MANAGEMENT.GDT 12/16/09

Project No.:	HAN008100	Northing:	-303.02	Geologist:	SMF
Project:	ISCO	Easting:	1630.45	Drill Method:	Sonic
Location:	Gulfport, MS	Grd. Elev:	5.13	Driller:	WHE
Date:	9-19-09	Total Depth (ft. bls)	40.0	Checked By:	SMF

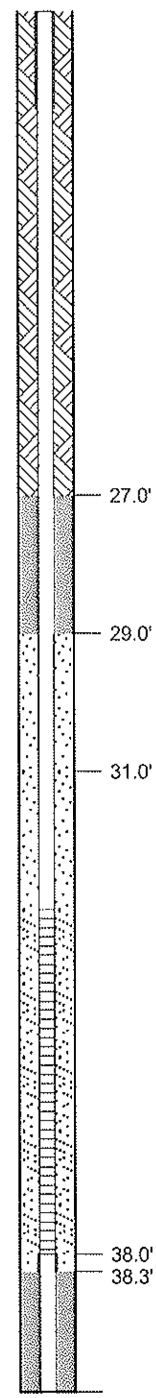
Boring No.: RW-42

ENVIRONMENTAL
MANAGEMENT SERVICES, INC.
P.O. Box 15369
Hattiesburg, MS 39404

SUBSURFACE PROFILE

Depth (ft.)	Description / Unified Soil Classification	Lab Sample No.	FID (ppm)
20 – 24	Very dense dark grey Silty fine SAND (SM) - with roots		
24 – 26.5	Very dense light grey fine to medium SAND (SP)		
26.5 – 28	Very dense greyish brown Silty fine SAND (SM) - with roots and organic odor		
28 – 32	Very dense light grey fine SAND (SP) - creosote 30.5 to 37.5		
32 – 32.5	Dense pea GRAVEL (GW) - creosote saturated		
32.5 – 37.5	Very dense light grey fine SAND (SP) - with creosote		
37.5 – 40	Stiff green Silty CLAY (CL) - no odor		

Well Completion Details



NEW WELL BORELOGS.GPJ ENV MANAGEMENT.GDT 12/16/09

Project No.:	HAN008100	Northing:	-303.02	Geologist:	SMF
Project:	ISCO	Easting:	1630.45	Drill Method:	Sonic
Location:	Gulfport, MS	Grd. Elev:	5.13	Driller:	WHE
Date:	9-19-09	Total Depth (ft. bls)	40.0	Checked By:	SMF

Boring No.: RW-42

ENVIRONMENTAL
MANAGEMENT SERVICES, INC.
P.O. Box 15369
Hattiesburg, MS 39404

SUBSURFACE PROFILE			SAMPLE		Well Completion Details
Depth (ft.)	Symbol	Description / Unified Soil Classification	Lab Sample No.	FID (ppm)	
40					40.0'
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
51					
52					
53					
54					
55					
56					
57					
58					
59					
60					

Project Name: Gulfport-ISCO

Geologist: S Fleming

Project Number: HAND08-100

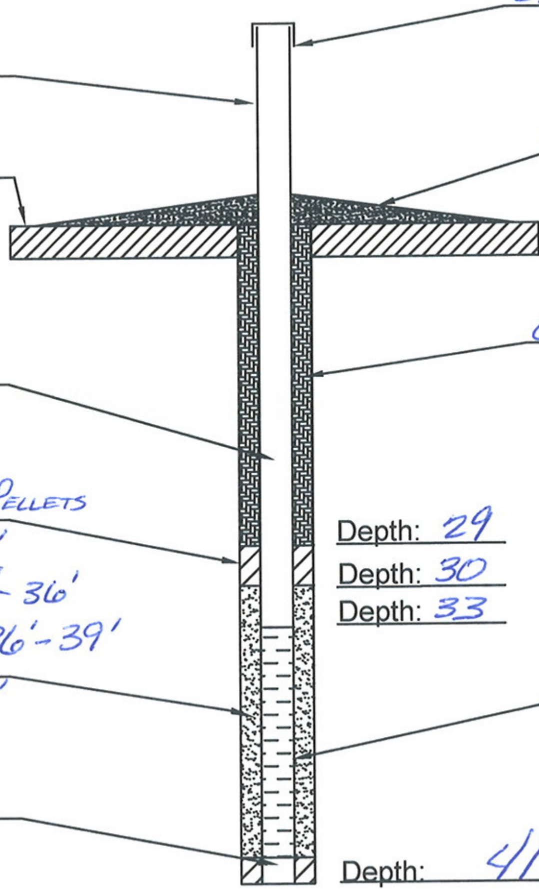
Driller: Walker Hill

Well Number: RW-42

Water Level: 5.94

Total Depth: 40

Date: 9-19-09



Expandable Cap

Stick Up 2.64 Feet

Ground Surface Elev. 5.13

Concrete Pad

Cement/Bentonite Grout

4" Dia. SS Riser

Bentonite Seal 1/4" Coated Pellets

Depth: 29

10/20 Sand 30'-31'

Depth: 30

Washed Pea Gravel 31'-36'

Depth: 33

6mm Glass Beads 36'-39'

10/20 Sand 39'-39.5'

0.50 Slot 316SS Screen

2' SS 4" Dia Sump

Bentonite Backfill

Depth: 41'

Note: Depth measured from ground surface.

* All SS is 316

WELL INSTALLATION DETAIL			
DATE:	APPROVED: BY: DATE:	DRAWN BY:	
		CAD NO.	
ENVIRONMENTAL MANAGEMENT SERVICES, INC.			FIGURE

Project No.:	HAN008100	Northing:	-296.61	Geologist:	SMF
Project:	ISCO	Easting:	1611.30	Drill Method:	Sonic
Location:	Gulfport, MS	Grd. Elev:	5.22	Driller:	WHE
Date:	9-19-09	Total Depth (ft. bls)	41.0	Checked By:	SMF

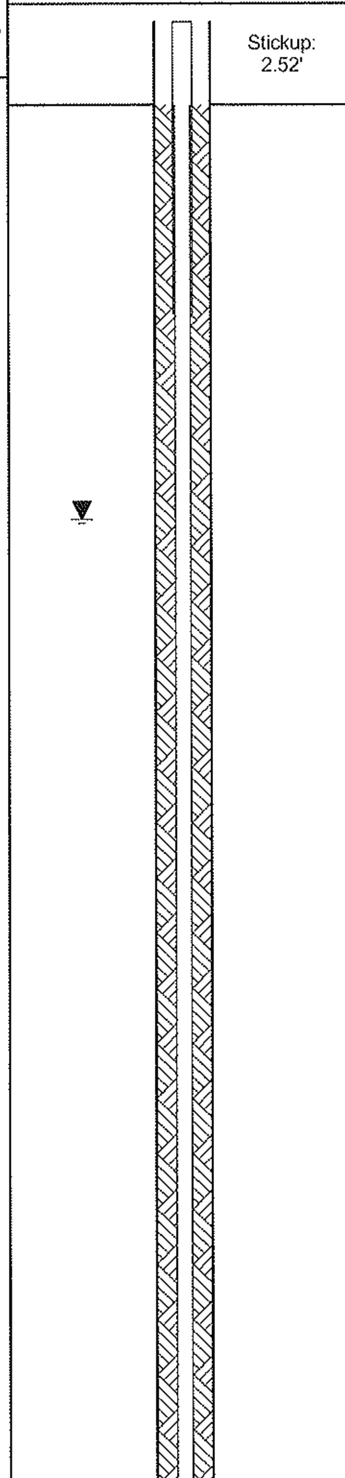
Boring No.: RW-43

ENVIRONMENTAL
MANAGEMENT SERVICES, INC.
P.O. Box 15369
Hattiesburg, MS 39404

SUBSURFACE PROFILE

Depth (ft.)	Symbol	Description / Unified Soil Classification	Lab Sample No.	FID (ppm)
		Ground Surface		
0–6		Red Clayey SAND (SC) - Fill? - concrete debris		
6–12		Very soft dark brown CLAY (CL) - with woody debris and roots		
12–17		Interbedded dark brown CLAY (CL) and light grey fine SAND (SP) - with woody debris and roots		
17–20		Dense light grey fine SAND (SP)		

Well Completion Details



Project No.:	HAN008100	Northing:	-296.61	Geologist:	SMF
Project:	ISCO	Easting:	1611.30	Drill Method:	Sonic
Location:	Gulfport, MS	Grd. Elev:	5.22	Driller:	WHE
Date:	9-19-09	Total Depth (ft. bls)	41.0	Checked By:	SMF

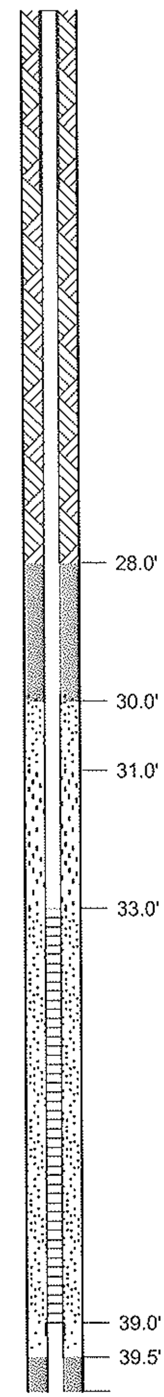
Boring No.: RW-43

ENVIRONMENTAL MANAGEMENT SERVICES, INC.
P.O. Box 15369
Hattiesburg, MS 39404

SUBSURFACE PROFILE

Depth (ft.)	Description / Unified Soil Classification	Lab Sample No.	FID (ppm)
20–22.5	Dense light grey fine SAND (SP) *(Continued)*		
22.5–23.5	Interbedded light grey fine SAND (SP) and dark brown silty CLAY (CL) -with roots		
23.5–27	Dense light grey fine SAND (SP)		
27–28	Interbedded light grey fine SAND (SP) and dark brown silty CLAY (CL) -with roots		
28–29.5	Dense light grey fine SAND (SP)		
29.5–30	Firm dark brown Clayey SAND (SC) - with peat		
30–34.5	Dense light grey fine SAND (SP) - with creosote at 32'		
34.5–35	8" Pea GRAVEL (GW) - with creosote		
35–38	Dense light grey fine SAND (SP) - with creosote		
38–38.5	6" Pea Gravel - with creosote		
38.5–40	Very stiff green Silty CLAY (CL)		

Well Completion Details



Project No.:	HAN008100	Northing:	-296.61	Geologist:	SMF
Project:	ISCO	Easting:	1611.30	Drill Method:	Sonic
Location:	Gulfport, MS	Grd. Elev:	5.22	Driller:	WHE
Date:	9-19-09	Total Depth (ft. bls)	41.0	Checked By:	SMF

Boring No.: RW-43

ENVIRONMENTAL
MANAGEMENT SERVICES, INC.
P.O. Box 15369
Hattiesburg, MS 39404

SUBSURFACE PROFILE			SAMPLE		Well Completion Details
Depth (ft.)	Symbol	Description / Unified Soil Classification	Lab Sample No.	FID (ppm)	
40					40.0'
41					41.0'
42					
43					
44					
45					
46					
47					
48					
49					
50					
51					
52					
53					
54					
55					
56					
57					
58					
59					
60					

NEW WELL BORELOGS.GPJ ENV MANAGEMENT.GDT 12/16/09

Project Name: Gulfport - ISCO

Geologist: S. Fleming

Project Number: HAND-08-0100

Driller: Walker Hill

Well Number: RW-43

Water Level: 6.01

Total Depth: 40'

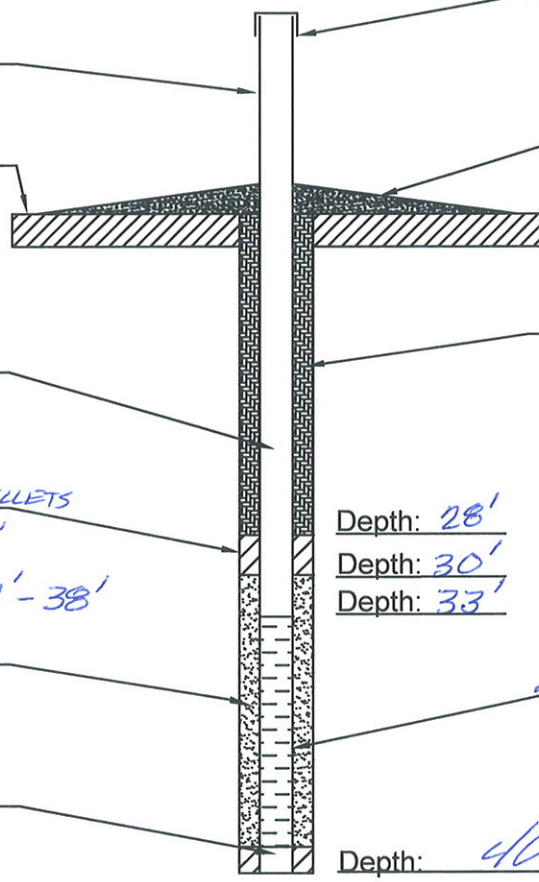
Date: 9-19-09

Expandable Cap

Stick Up 2.52 Feet

Concrete Pad

Ground Surface Elev.



Cement/Bentonite Grout

4" Dia. SS Riser

Bentonite Seal 1/4" coated Pellets

10/20 sand 30'-31'

Washed Pea Gravel 31' - 38'

Depth: 28'

Depth: 30'

Depth: 33'

.050 slot 316 SS screen

2' SS 4" dia Sump

Bentonite Backfill

Depth: 40'

Note: Depth measured from ground surface.

* All SS is 316

WELL INSTALLATION DETAIL

DATE:	APPROVED: BY: DATE:	DRAWN BY: CAD NO.

ENVIRONMENTAL MANAGEMENT SERVICES, INC.

FIGURE

APPENDIX D
Credit Sales Agreements
Coastal Mississippi In-Lieu Fee Program

Coastal Mississippi In-Lieu Fee Program

CREDIT SALE AGREEMENT

Coastal Mississippi In-Lieu Fee Program Contract # 2011-01-LB

BETWEEN: Land Trust for the Mississippi Coastal Plain (Land Trust) **(Sponsor)**

AND: Cavenham Forest Industries, LLC **(Developer)**

DATED: 3/18/2011

RECITALS

A. The Sponsor has a general banking instrument approved by the U.S. Army Corps of Engineers (USACE)-Mobile District, U.S. Environmental Protection Agency (EPA), U.S. Fish and Wildlife Service (USFWS), Mississippi Department of Marine Resources (MDMR), Mississippi Department of Wildlife, Fisheries and Parks (MDWFP), and Mississippi Department of Environmental Quality (MDEQ) to establish a comprehensive in-lieu fee mitigation banking program in coastal Mississippi. As part of that program, the Land Trust has been authorized to sell advance credits in the Turkey Creek watershed.

B. The Sponsor is currently charging $16,500.00 per mitigation credit, to recover the Sponsor's cost of developing and maintaining wetlands for mitigation in this watershed at the Long Beach ILF site.

C. It has been mutually agreed between USACE, EPA, USFWS, MDMR, MDWFP and MDEQ and the Sponsor that mitigation requirements for development of property identified as Tax Parcel No(s) 08091-01-002.000 and 0909L-05-006.000, located within the City of Gulfport, Harrison County can be satisfied through the purchase of mitigation credits from the Coastal Mississippi In-Lieu Fee Program.

D. The Developer desires to fill 1.14 acres of wetlands, and to purchase from the Sponsor mitigation credits to satisfy the Developer's mitigation obligations.

E. Under permit # to be supplied when issued by USACE and permit # to be supplied when issued by MDMR, the Developer is responsible for securing wetland mitigation bank credits.

AGREEMENT

1. The Developer will pay the Sponsor the sum of $65,835.00 for mitigation credits.

2. After receipt of payment, the Sponsor will provide the Developer with a certificate of credit sales and will notify USACE and MDMR that the Developer's obligation for wetlands mitigation has been met. At that time, the Sponsor will allocate 3.99 credits from completed or approved wetlands mitigation projects to meet the mitigation obligation covered by this Agreement.

SPONSOR	DEVELOPER
Land Trust for the Mississippi Coastal Plain	**Cavenham Forest Industries, LLC**
By: Judy Steckler	By: Robert S. Markwell
Name: Judy Steckler	Name: Robert S. Markwell
Title: Executive Director	Title: President
Date: 4-22-11	Date: 04-20-11

Coastal Mississippi In-Lieu Fee Program

CREDIT SALE AGREEMENT

Coastal Mississippi In-Lieu Fee Program Contract # 2011-02-MSW

BETWEEN: Land Trust for the Mississippi Coastal Plain (Land Trust) **(Sponsor)**

AND: Cavenham Forest Industries, LLC **(Developer)**

DATED: 3/18/2011

RECITALS

A. The Sponsor has a general banking instrument approved by the U.S. Army Corps of Engineers (USACE)-Mobile District, U.S. Environmental Protection Agency (EPA), U.S. Fish and Wildlife Service (USFWS), Mississippi Department of Marine Resources (MDMR), Mississippi Department of Wildlife, Fisheries and Parks (MDWFP), and Mississippi Department of Environmental Quality (MDEQ) to establish a comprehensive in-lieu fee mitigation banking program in coastal Mississippi. As part of that program, the Land Trust has been authorized to sell advance credits in the Turkey Creek watershed.

B. The Sponsor is currently charging $15,000.00 per mitigation credit, to recover the Sponsor's cost of developing and maintaining wetlands for mitigation in this watershed at the Middle School West ILF site.

C. It has been mutually agreed between USACE, EPA, USFWS, MDMR, MDWFP and MDEQ and the Sponsor that mitigation requirements for development of property identified as Tax Parcel No(s) 08091-01-002.000 and 0909L-05-006.000, located within the City of Gulfport, Harrison County can be satisfied through the purchase of mitigation credits from the Coastal Mississippi In-Lieu Fee Program.

D. The Developer desires to fill 1.41 acres of wetlands, and to purchase from the Sponsor mitigation credits to satisfy the Developer's mitigation obligations.

E. Under permit # to be supplied when issued by USACE and permit # to be supplied when issued by MDMR, the Developer is responsible for securing wetland mitigation bank credits.

AGREEMENT

1. The Developer will pay the Sponsor the sum of $31,650.00.00 for mitigation credits.

2. After receipt of payment, the Sponsor will provide the Developer with a certificate of credit sales and will notify USACE and MDMR that the Developer's obligation for wetlands mitigation has been met. At that time, the Sponsor will allocate 2.11 credits from completed or approved wetlands mitigation projects to meet the mitigation obligation covered by this Agreement.

SPONSOR
Land Trust for the Mississippi Coastal Plain

By: Judy Steckler

Name: Judy Steckler
Title: Executive Director
Date: 4-20-11

DEVELOPER
Cavenham Forest Industries, LLC

By: Robert S. Markwell

Name: Robert S. Markwell
Title: President
Date: 04-20-11

APPENDIX E
Wetlands Mitigation Plan – Cavenham Forest Industries Site
BMI Environmental Services, LLC

MITIGATION PLAN

CAVENHAM FOREST INDUSTRIES SITE

GULFPORT, MISSISSIPPI

Prepared by
BMI Environmental Services, LLC
Gulfport, Mississippi

for
Environmental Management Services, Inc.
Hattiesburg, Mississippi

August 17, 2011

MITIGATION PLAN
CFI GULFPORT SITE
GULFPORT, MISSISSIPPI

1.0 INTRODUCTION

The Cavenham Forest Industries Inc. (CFI) site is a former wood treatment facility that operated from 1906 until 1987. As a result of environmental investigations, subsurface contamination was detected, and CFI has been working with the US Environmental Protection Agency and the Mississippi Department of Environmental Quality to remove and/or treat the contamination.

CFI has developed a remediation plan that will address the environmental contamination at the site. The remediation activities will cause impacts to wetlands and waters of the United States (WOUS). Permits will be required from state and federal regulatory agencies and CFI will be required to conduct mitigation activities to reduce unavoidable impacts to wetlands and WOUS. This report discusses the impacts and outlines a plan to mitigate the unavoidable impacts.

2.0 IMPACT SUMMARY

CFI proposes to conduct remediation activities at the CFI Gulfport Site (Figure 1). Those remediation activities will result in unavoidable impacts to wetlands and WOUS. The project will result in the filling of approximately 0.5 acres of WOUS, 1.86 acres of swamp forest wetlands, 0.35 acres of emergent wetlands, and 0.96 acres of scrub shrub wetlands. The total area of impact to wetlands and open-water is approximately 3.67 acres. A map showing the wetland impacts by wetlands type is provided as Figure 2.

3.0 WETLANDS ASSESSMENT/CREDIT DETERMINATION

In order to determine an ecological value of the wetlands to be impacted and to form a quantitative basis for determining mitigation requirements for a proposed environmental remediation project that would impact those wetlands a functional assessment was performed using the Wetlands Rapid Assessment Procedure developed by the South Florida Water Management District in 1997. The habitat values for the wetlands areas for this project are based on the calculated WRAP scores as provided in the Wetlands Assessment Report which is attached as Appendix A of this report. A summary of the WRAP scores for the wetlands areas that will be impacted by the project is shown in Table 1.

Table 1. Wetlands Assessment Summary for the CFI-Gulfport Site

TYPE OF WETLANDS IMPACTED	WRAP SCORE
WOUS	-
Swamp Forest	51.74 %
Scrub Shrub	28.33 %
Emergent Wetlands	58.33 %
AVERAGE WRAP SCORE	**46.13**

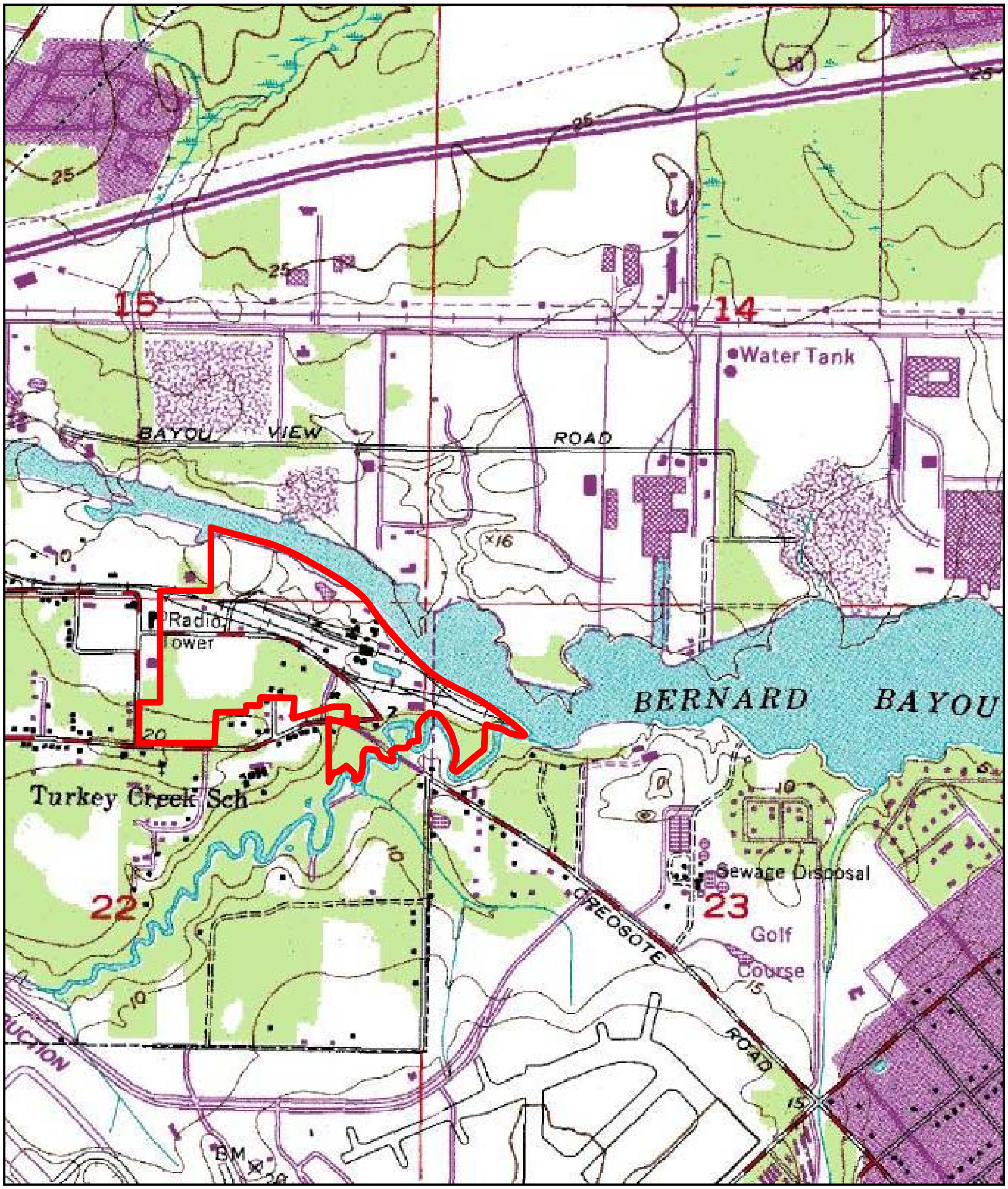


Figure 1: Vicinity Map

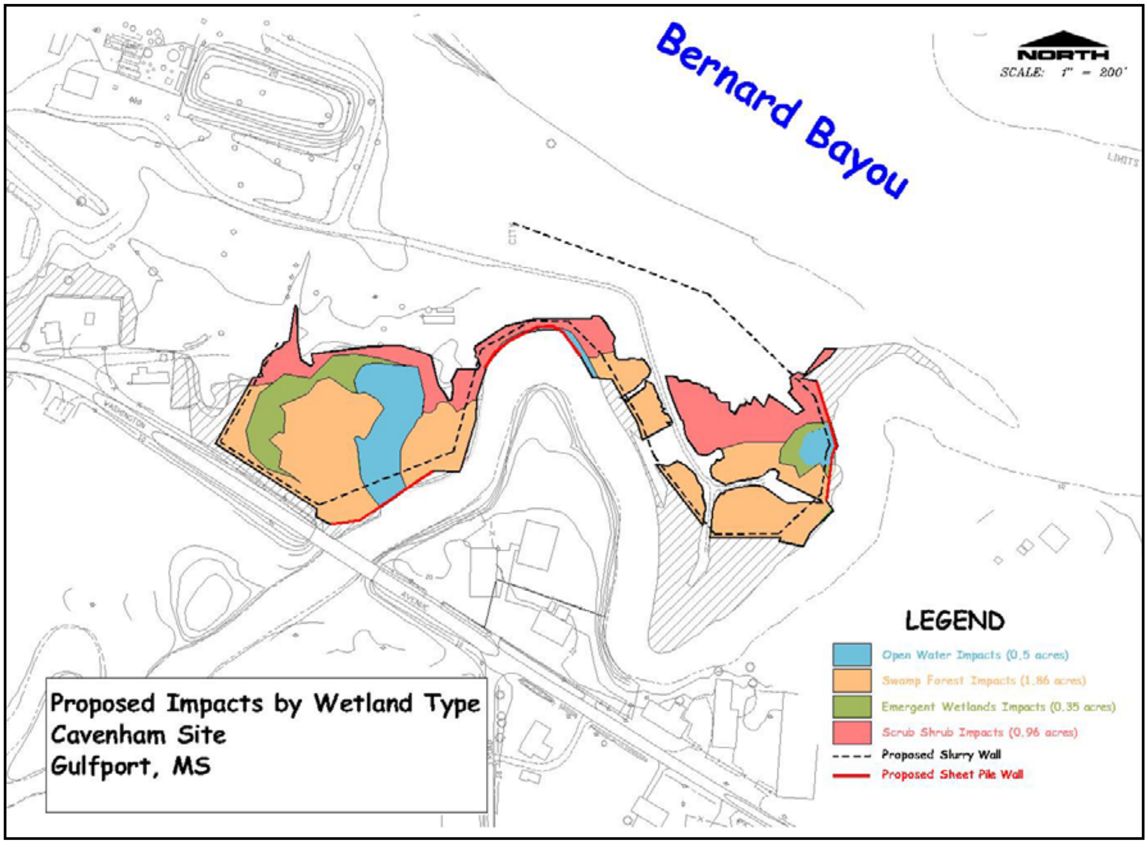


Figure 2: Wetlands Impacts Map

Using the WRAP scores referenced in Table 1, the wetlands credits required to compensate for the wetland impacts were calculated by multiplying the area of impact for each wetlands type by the WRAP score. These values are shown in Table 2.

Table 2. Wetlands Credit Requirements for On-site Mitigation for the CFI-Gulfport Site

TYPE OF WETLANDS IMPACTED	AREA IMPACTED	WRAP SCORE	WRAP CREDITS REQUIRED
WOUS	0.5 Ac	-	
Swamp Forest	1.86 Ac	51.74 %	0.96
Scrub Shrub	0.96 Ac	28.33 %	0.27
Emergent Wetlands	0.35 Ac	58.33 %	0.20
TOTAL ACRES IMPACTED	**3.67 Ac**		

Considering the fact that CFI proposes to purchase mitigation credits from a mitigation bank for some of the compensatory mitigation, the WRAP scores shown in Table 1 were converted to relative habitat quality. This conversion is required because the mitigation banks currently in operation use a ratio method for determining the required mitigation credits rather than the WRAP score. Since the WRAP scores are numerical, the WRAP scores were converted to relative quality level (High, Medium, and Low) using general guidance provided by the Corps of Engineers on similar projects. The conversion values are shown in Table 3. It should be noted that conversion values shown in Table 3 do not show a conversion for Emergent Wetlands or Open Water habitat because the mitigation banks do not offer mitigation credits for these types of habitats.

Table 3: Wetlands Conversion Table

TYPE OF WETLANDS IMPACTED	AREA IMPACTED	WRAP SCORE	CONVERTED HABITAT QUALTY LEVEL
Swamp Forest	1.86 Ac	51.74	Low
TOTAL ACRES IMPACTED	**1.86 Ac**		

4.0 MITIGATION WORK PLAN

In order to compensate for the unavoidable loss of wetlands associated with this project, CFI proposes a comprehensive mitigation plan that involves mitigation credit purchase from a wetland mitigation bank and creation mitigation to replace wetlands impacted by the project.

4.1 MITIGATION OBJECTIVES

The goal of this revised mitigation plan is to restore the functions and values of the existing wetlands within the proposed mitigation tract, and to provide for a long-term management plan that will insure the maintenance of the natural plant communities which once existed on this tract of land.

4.2 SITE SELECTION

The mitigation site selected for this project consists of two (2) upland areas along the shoreline of Bernard Bayou which forms the northern boundary of the CFI property. The areas were selected by CFI based on the fact that the mitigation areas were on-site, they do not require any additional impacts to wetlands or WOUS, and the newly established mitigation areas will add ecological value to the aquatic resources of Bayou Bernard.

4.3 SITE PROTECTION INSTRUMENT

Once mitigation is completed, a legal description of the mitigation areas will be prepared, and a conservation easement will be placed on the mitigation areas. This conservation easement will be filed in the Harrison County Chancery Clerks Office and the land records at the Harrison County Courthouse.

4.4 MITIGATION CREDIT PURCHASE

CFI proposes to purchase mitigation credits from a mitigation bank to provide compensatory mitigation for impacts to the Swamp Forest Wetlands. Based on the conversion calculation, CFI will purchase mitigation credits from an approved mitigation bank to compensate for impacts to 1.86 acres of low quality Swamp Forest Wetlands.

4.5 CREATION MITIGATION ACTIVITIES

In addition to the mitigation credit purchase activities, CFI proposes to conduct creation mitigation to provide compensatory mitigation for the Scrub/Shrub Wetlands, the Emergent Wetlands and the Open Water Habitat (See figure 4).

4.5.1 OPEN WATER CREATION

CFI proposes to create a shallow open water area that will be excavated along the northern boundary of the site. The open water areas will be excavated using either a long stick backhoe operating on mats, or a dragline with a clam shell bucket. Care will be taken to minimize any fall back of material into the created marsh during excavation activities. The open water areas will vary in width and will be no deeper than -3 feet at mean high water. The location of the tidal channels is shown in Figures 4 and 5. The total area of aquatic habitat to be created is 0.502 acres.

4.5.2 EMERGENT WETLANDS CREATION

CFI proposes to create emergent wetlands from existing upland areas that are adjacent to the tidally influenced waters of Bernard Bayou. The upland areas will be cleared and graded and wetland vegetation will be planted on the sites. The area for tidal marsh creation is approximately 0.382 acres and is shown in Figure 4. Plant species selected for the emergent wetlands creation in these areas include *Spartina alternaflora* and *Scirpus olneyi*.

4.5.3 SCRUB SHRUB CREATION

CFI proposes to create scrub shrub wetlands habitat from existing upland areas that are adjacent to Bernard Bayou. The upland areas will be cleared and graded and wetland vegetation will be planted on the sites. The areas of uplands that will be modified to create scrub shrub wetlands are shown in Figures 4 and 5. Plant species for the scrub shrub wetlands areas will include *Myrica cerifera*, *Baccharis halimifolia*, and *Spartina pattens*. The total area of scrub shrub wetlands to be created is approximately 0.556 acres.

4.5.4 CREATION MITIGATION RECAP

The proposed creation mitigation activities outlined in Sections 4.5.1 through 4.5.3 should provide appropriate mitigation for the impacts associated with the remediation activities required by EPA. A recap of the mitigation activities and the associated mitigation credits to be generated by the mitigation activities is shown below in Table 4.

Table 4. Proposed Creation Mitigation and Mitigation Credits by Mitigation Type

PRESENT HABITAT TYPE	FUTURE HABITAT TYPE/ MITIGATION ACTIVITY	AREA (AC)	EXISTING WRAP SCORE	FUTURE WRAP SCORE	DELTA	WRAP CREDITS
Uplands	Open Water (Creation)	0.502	-	-		-
Uplands	Scrub/Shrub (Creation)	0.556	0	60 %	60 %	0.33
Uplands	Emergent (Creation)	0.382	0	60 %	60 %	0.229
					TOTAL CREDITS	**0.529**

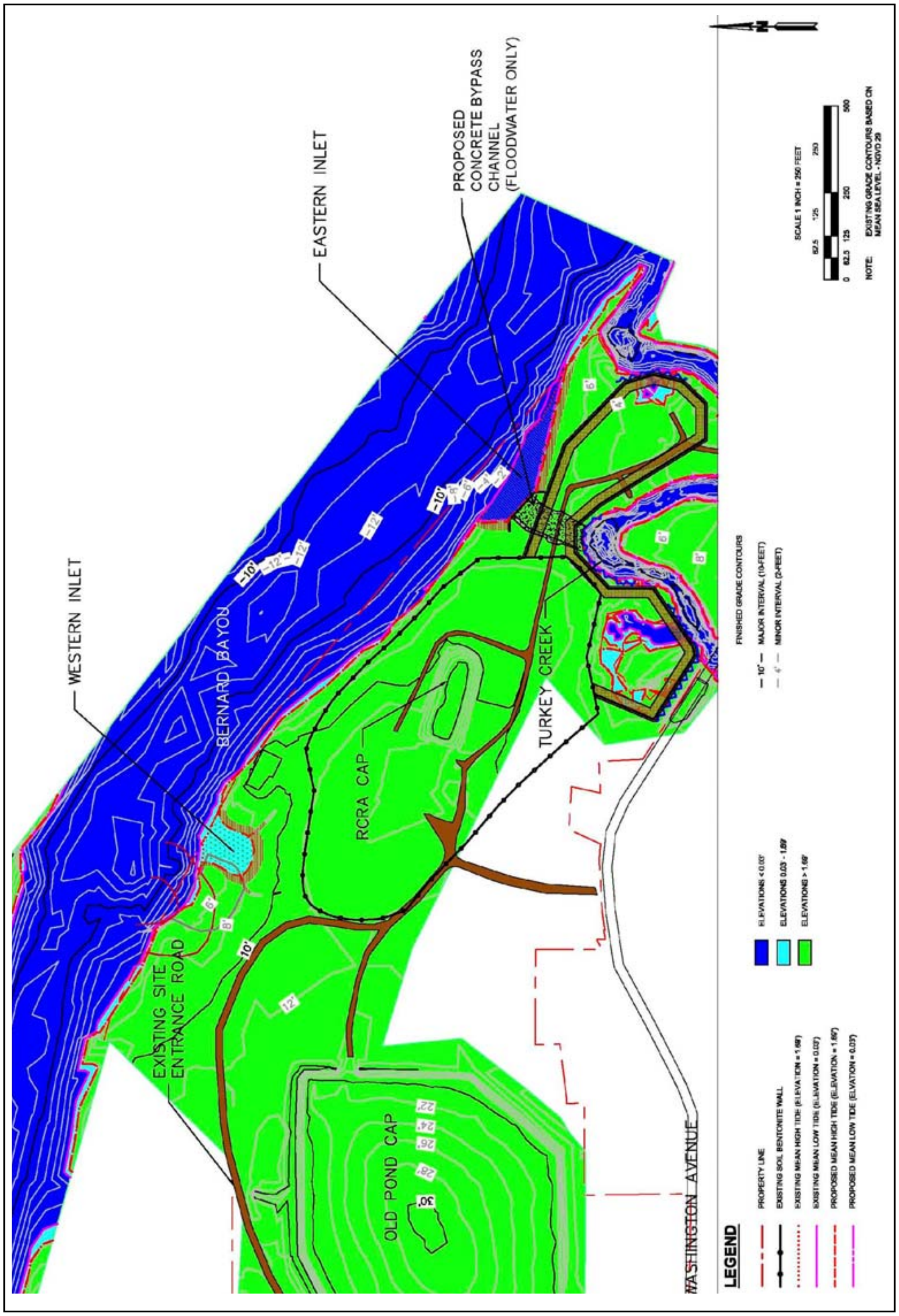


Figure 3. Proposed On-site Mitigation Areas for CFI Mitigation Plan.

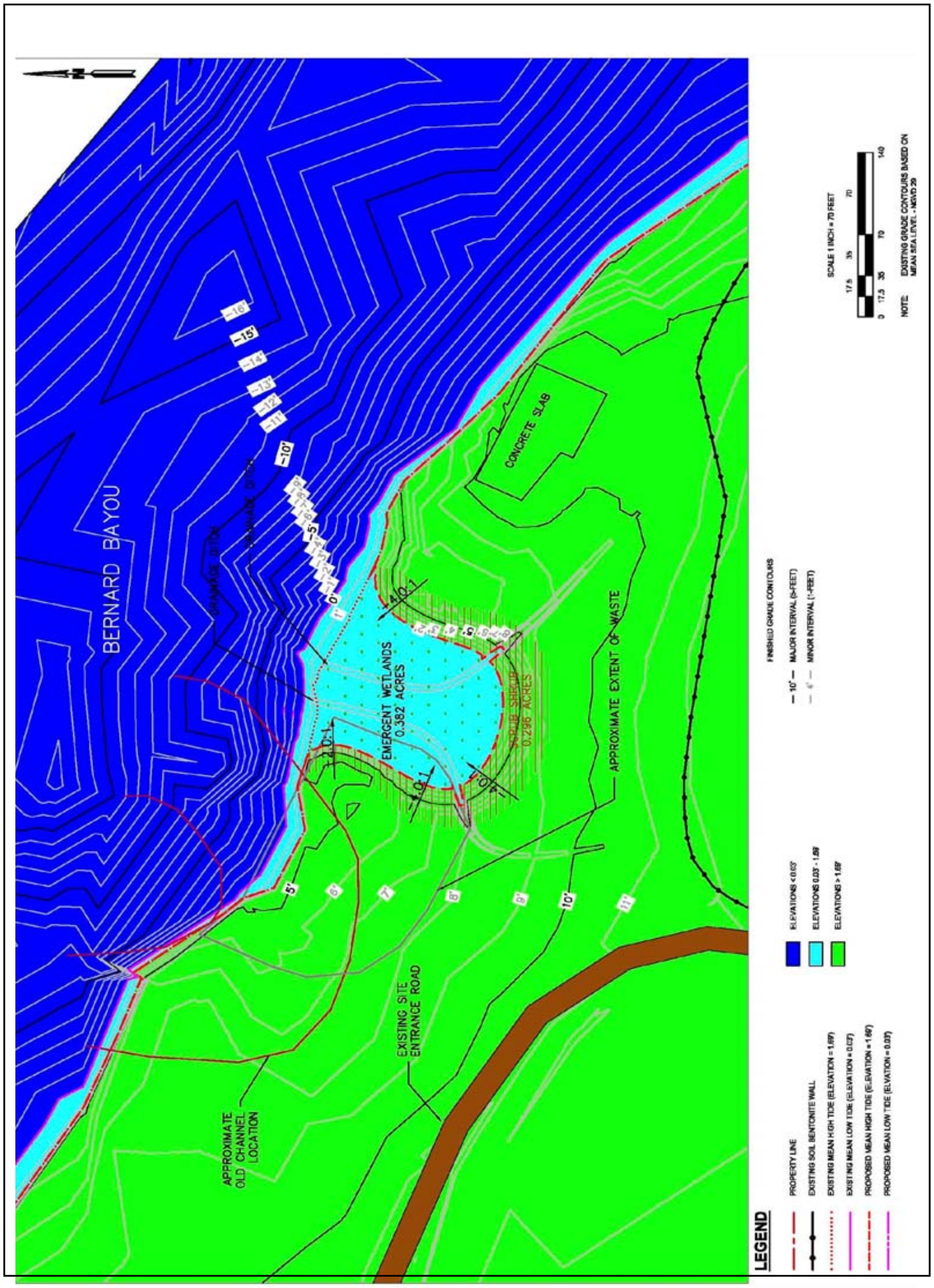


Figure 4. Proposed Open Water Inlet West and Wetlands Areas for CFI Mitigation Plan.

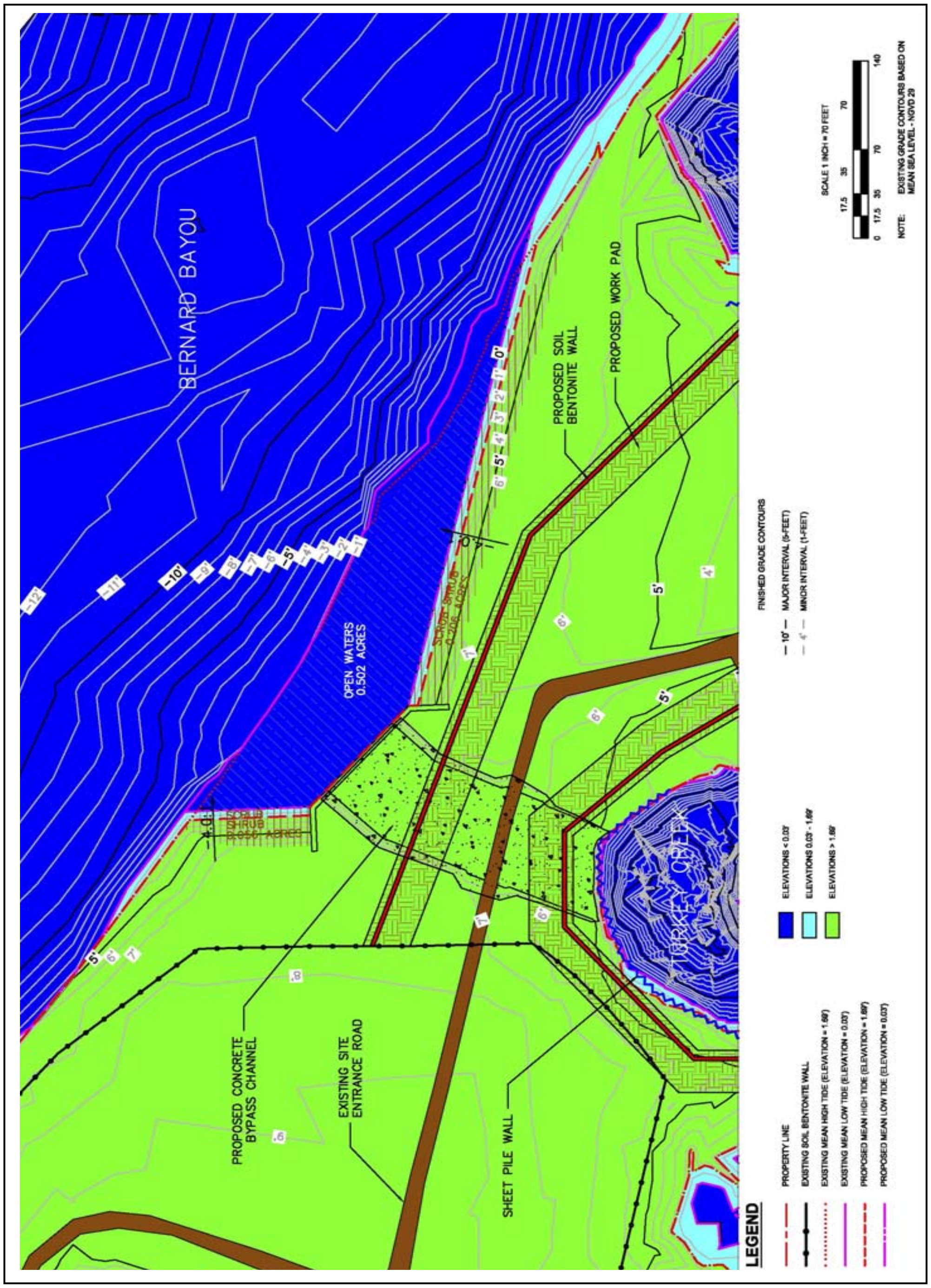


Figure 5. Proposed East Open Water Inlet and Wetlands Area for CFI Mitigation Plan

4.6 IMPLEMENTATION AND GENERAL CONDITIONS

The mitigation plan proposed by CFI will be implemented concurrent with or in advance of the project impacts. The success of any mitigation effort depends on several critical factors. These factors generally include adequate hydrology, substrate stabilization, planting materials, control of noxious plants, and proper maintenance and monitoring.

4.7 SITE PREPARATION

The goal of site preparation is to establish the proper physical habitat whereby functional wetlands can be established. Site preparation will consists of general grading to establish the proper elevations and slopes for the specific habitat type.

4.8 PLANTING MATERIALS

Planting materials for the wetlands creation elements will be obtained from nursery stock. Supplemental plantings of various species of wetlands plants will be made using nursery stock purchased by CFI.

4.9 SUCCESS CRITERIA

Success criteria for the mitigation will be based on the survival and growth of the newly created wetlands areas. The success of the wetlands creation will be based on a survival rate of 85% of the transplanted species and 95% coverage after five (5) growing seasons. Measurements of survival and growth will be made on an annual basis and if the survival ratio falls below 85%, replacement sprigs will be planted.

4.10 MONITORING

Initial monitoring of the mitigation areas during construction will be on an “as needed” basis to insure the mitigation activities are conducted in accordance with the plan. On-site monitoring will consist of an annual assessment of plant survival and growth. A minimum of four (4) random sites will be selected within the mitigation area and measurements will be taken for each plot. This information along with field notes and photographs will be provided to the resource agencies at the end of each calendar year.

4.11 ADAPTIVE MANAGEMENT ACTION

In the event the mitigation effort is not successful, CFI will implement a Remedial Action Plan. The plan will consist of a minimum of two (2) actions. If it is determined that the success criteria have not been achieved, the area will be re-planted. If re-planting is not successful, the area will be re-evaluated to identify additional measures that should be taken to achieve the successful re-establishment of the desired plant species.

5.0 SUMMARY

In order to compensate for the unavoidable loss of wetlands associated with remediation activities at the Cavenham Gulfport Site, CFI proposes a comprehensive mitigation plan. The mitigation plan will involve mitigation credits purchase and on-site creation and. The mitigation proposed for this project is based on WRAP Scores assigned to each habitat type. Based on a comparison of the mitigation credits required as shown in Table 2 and the mitigation credits to be generated by the proposed creation mitigation as shown in Table 4, the mitigation proposed by CFI believes will compensate for the unavoidable loss.

APPENDIX A
WETLAND ASSESSMENT REPORT

WETLANDS ASSESSMENT

CAVENHAM SITE

GULFPORT, MISSISSIPPI

BMI Environmental Services, LLC
Gulfport, Mississippi

for

Environmental Management Services, Inc.
Hattiesburg, Mississippi

August 21, 2009

WETLANDS RAPID ASSESSMENT PROCEDURE
CFI GULFPORT SITE
GULFPORT, MISSISSIPPI

1.0 INTRODUCTION

This report describes the results of a functional assessment of the wetlands located in the eastern portion of an ± 82 acre tract of land on the south side of Bayou Bernard, north and west of Turkey Creek in Gulfport, Harrison County, Mississippi. This assessment was conducted in order to establish an ecological value of the wetlands and to form a quantitative basis for determining mitigation requirements for a proposed environmental remediation project that would impact those wetlands.

2.0 SITE DESCRIPTION AND BACKGROUND

The Cavenham Forest Industries Inc. (CFI) site is a former wood treatment facility that operated from 1906 until 1987. As a result of environmental investigations, subsurface contamination was detected, and CFI has been working with the US Environmental Protection Agency and the Mississippi Department of Environmental Quality to remove and/or treat the contamination. Geographically the site is located in portion of Sections 15, 22, and 23 of Township 7 South, Range 11 West, Harrison County, Mississippi. h bisects the site. Please see Figure 1 for a location map of this site.

Historically, the entire site was most likely part of a large, pine savannah wetlands that transitioned into a mixed pine and forested swamp wetland adjacent to Turkey Creek. As the site was developed, areas were excavated to create holding ponds, and the fill material was dispersed throughout the site to create laydown areas for the creosote treated wood products. There is also evidence that some of the shoreline areas along Turkey Creek have been modified by erosion and changes in the course of the creek as evidenced by the oxbow/meander scar.

3.0 METHODOLOGY

Aerial photography for the site was analyzed for common vegetative signatures indicating the presence of wetland and upland habitats. A general land cover classification map was developed and field verified. ES The work was performed on foot utilizing Trimble GPS equipment to map the limits of habitat types and other key features. Indicators were used to develop the habitat boundaries: vegetation, soils, and hydrology.

The functional analysis methodology used for wetland habitats in this site evaluation was the Wetland Rapid Assessment Procedure (WRAP). WRAP is a rating index developed by the South Florida Water Management District in 1997 to assist the regulatory evaluation of wetlands and wetland mitigation sites. The procedure has shown itself to be highly repeatable, and has been adopted by the U.S. Army Corps of Engineers for use in their wetland permitting program. WRAP can be used in combination with professional judgment to provide an accurate and consistent evaluation of wetland sites. WRAP assesses, on a 0 to 3 basis, each of six major criteria, including wildlife utilization, wetland overstory/shrub canopy, vegetative ground cover, adjacent upland support/wetland

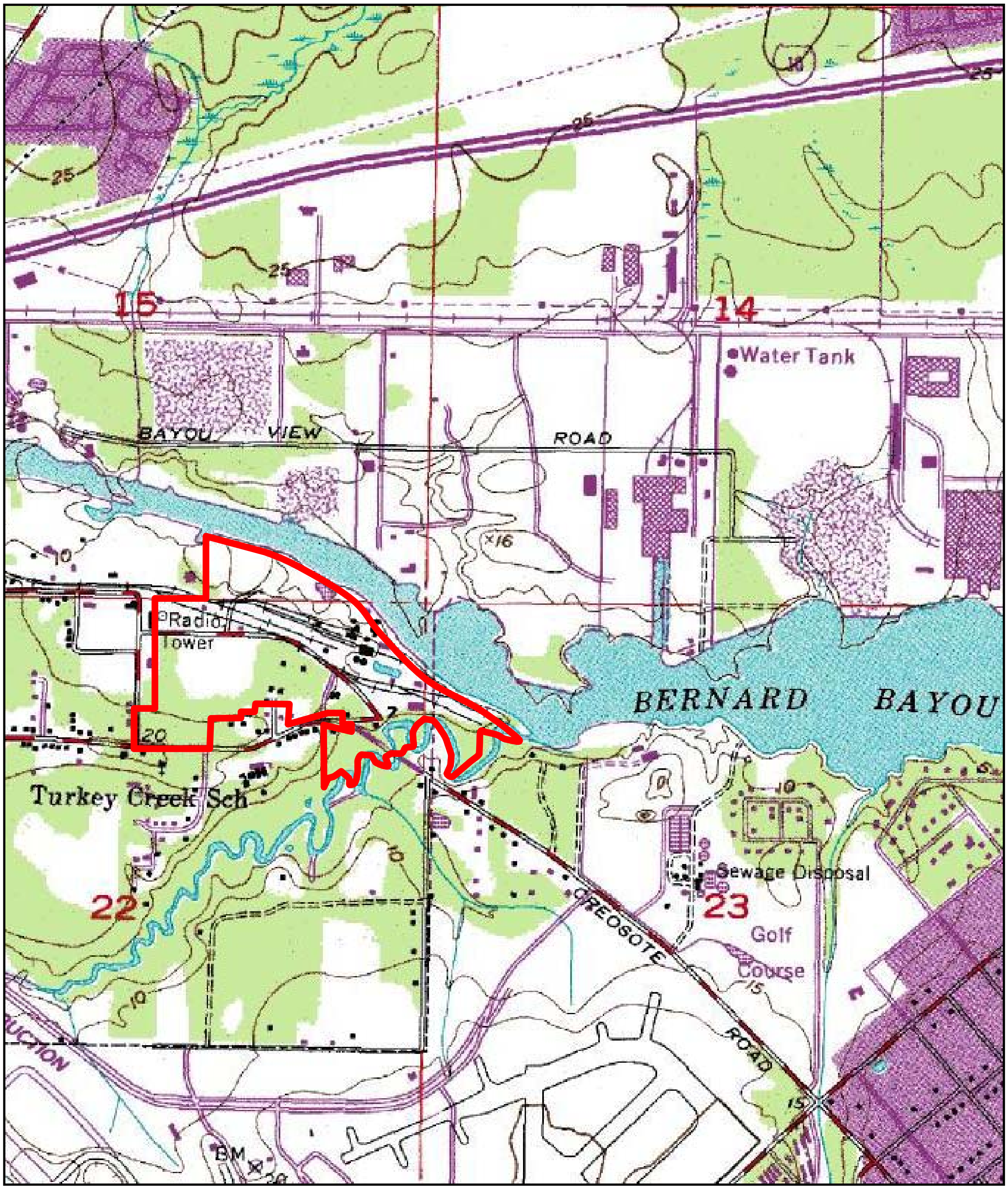


Figure 1: Vicinity Map (Source: USGS Quadrangle Map)

A matrix provided in the WRAP manual assists the rating biologist in arriving at an appropriate score for each of the indices. These scores are then added, and the result divided by the highest possible score to obtain a comparison number between 0.0 and 1.0. Each wetland type is rated according to its attributes; WRAP is not intended to compare different wetland community types to each other (i.e., marsh to wet prairie), rather, it is an evaluative method by habitat type. Generally speaking, wetlands with a rating above 0.66 are considered to be high quality wetland; those with a score between 0.33 and 0.66 of medium quality; and those with a score below 0.32 of low quality. Multiplying the WRAP score obtained times the acreage of the wetland can provide a numerical value of functional quality. This can then be compared with a similar numerical value for mitigation areas to determine possible net loss/gain of wetland function and value for a particular project.

Overview of Plant Communities

The wetlands plant communities observed on the site vary based on topography and proximity to Turkey Creek and Bayou Bernard. are described below using the classification system described in the Classification of Wetlands and Deepwater Habitats of the United States, U.S. Fish & Wildlife Service (FWS/OBS-79/31.

Estuarine Intertidal Emergent Wetlands - These wetlands areas occur along the margins of bays, bayous, and the lower portions of creeks which are influenced by tides. Dominant vegetation varies with distance from the Mississippi Sound and bays with the more salt tolerant species such as smooth oyster grass (*Spartina alternaflora*) and black needlerush (*Juncus roemarianus*) dominating in higher salinity areas, with needle rush and sawgrass (*Cladium jamaicense)* becoming more dominant in the backwaters and riverine areas

Estuarine Intertidal Scrub-Shrub Wetlands - The scrub-shrub wetlands occur at a higher landscape position than the emergent wetlands, and are not regularly flooded by high tides. Dominant plants in the scrub-shrub wetlands include wax myrtle (*Myrica certifera*), grounsel bush (*Baccharis halimifolia*), and salt marsh hay (*Spartina pattens*).

Palustrine Forested "Swamp Forest" Wetlands - The Swamp Forest wetlands is a type of palustrine forested found in the lower Gulf coastal plain which includes wet pond cypress depressions, white cedar swamps, and bay swamp forests which are associated with brooks, creeks, and rivers. Common tree species include sweet bay *(Magnolia virginiana*), black gum (*Nyssa sylvatica*), red maple (*Acer rubrum*), and cypress (*Taxodium sp.*), and slash pine (*Pinus elliotti)*.

4.0 Findings

The findings for the three (3) distinct wetland plant community types are discussed below and shown graphically in Figure 2. A detailed discussion of the habitats, there relative size, and the specific wetland characteristics are also discussed. The quality of these wetlands is generally very low, and the encroachment by man has reduced the habitat value significantly. Areas of wetlands have been cleared, portion of the wetlands have been filled, and timber has been removed in the past. In addition to the man induced activities, Hurricane Katrina washed large quantities of debris into some of the wetlands causing habitat disturbance.

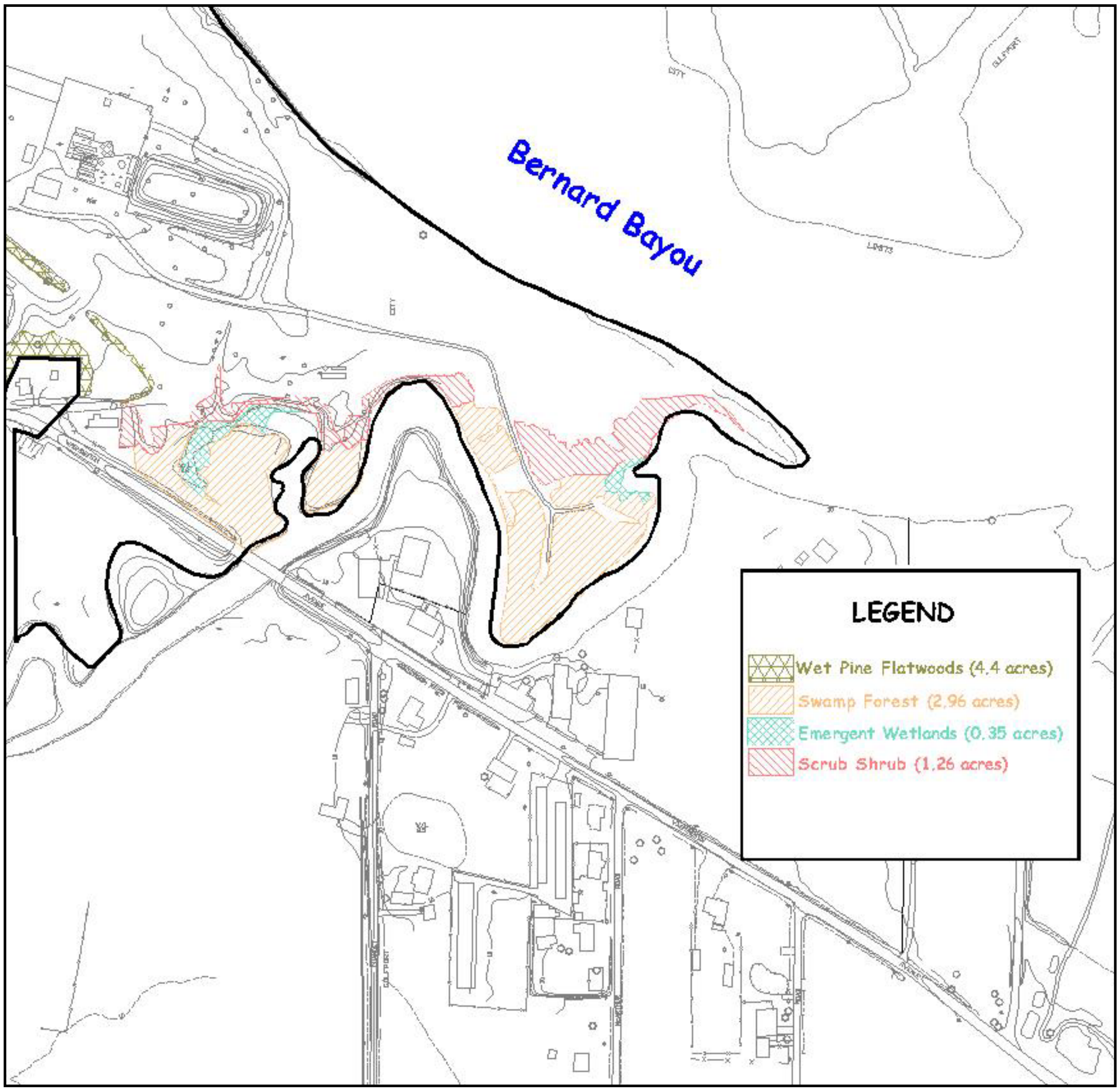


Figure 2: Wetlands Plant Communities CGFI-Gulfport

4.1 Estuarine Intertidal Wetlands

The estuarine intertidal wetlands, also described herein as emergent wetlands are located adjacent to the open water areas of Turkey Creek as it meanders along the eastern portion of the site. The WRAP score for the emergent wetlands is 58.33% (See Figure 3).

WETLAND RAPID ASSESSMENT PROCEDURE

☐ PROPOSED
☑ EXISTING CONDITIONS

COUNTY: Harrison | PROJECT: CFI-Gulfport | DATE: 8/12/2009 | REVIEWER: L.Lewis | FLUCCS CODE:
APP. #: | WETLAND TYPE: ☐ FORESTED ☑ Non-Forested

LAND USE CATEGORY: Industrial | WETLAND AREA: 0.35 ACRES; 0.35 ACRES OF IMPACT | SECONDARY IMPACTS: ☑ NO ☐ YES %= ACRES | MELALEUCA INVASION >50%: ☐ NO ☐ YES

WRAP SCORE
58.33%

WILD LIFE UTILIZATION	2.5
WETLAND CANOPY	N/A
WETLAND GROUND COVER	1
HABITAT SUPPORT / BUFFER	2

BUFFER TYPE	SCORE	% AREA	SUB TOTAL
Wetland/Open Water	2	100	2
			0
			0
			0
			0

FIELD HYDROLOGY	2
WATER QUALITY INPUT & TREATMENT	1.25

LAND USE CATEGORY

LAND USE CATEGORY	SCORE	% AREA	SUB TOTAL
Natural	2.5	100	2.5
			0
			0
			0
			0
		LU TOTAL	2.5

PRETREATMENT CATEGORY

PRETREATMENT CATEGORY	SCORE	% AREA	SUB TOTAL
			0
			0
			0
			0
			0
		PT TOTAL	0

WILDLIFE UTILIZATION
Site provides minimal to moderate evidence of habitat that target wildlife referenced for emergent wetlands habitat. The emergent wetlands provide sufficient habitat for reptiles and amphibians, and provides sufficient habitat ot support small freshwater and brackish waster fish species. The is very little evidence of any large or small mammal utilization.

WETLAND CANOPY
This wetland type does not have a naturally occurring tree/shrub canopy component. This evaluation criteria is not applicable to the evaluation for emergent wetlands and is not included in the fianl WRAP calculation (See Section 2.2.2.1 of the WRAP assessment procedure).

WETLAND GROUND COVER
Target ground cover vegetation is minimal to moderate. Estimates indicate that percent cover for target ground cover in most areas is less than 30%. The most significant target species observed include sawgrass and bulltongue; however, it should be noted that much of the emergent marsh is begining to be dominated by torpedo grass (Panicum repens).

HABITAT SUPPORT/BUFFER
Emergent wetlands are surrounded by wetlands that vary in width from 30 to 100 feet. There are no upland corridors of any significance and portions of the emergent wetlands transition to open water. The emegent wetlands provide some food and foragging functions, but very little value in terms of cover and roosting.

FIELD HYDROLOGY
Site hydrology is considered adequate to maintain the target wetlands species; however, flooding and movement of flood waters from upstream areas of Turkey Creek may be negatively impacting wetlands plant composition.

WQ INPUT & TREATMENT
Land use is undeveloped wetlands with moderate wildlife and water quality values. These areas do not provide significant pre-treatment functions

Figure 3. WRAP Sheet for Estuarine Intertidal (Emergent) Wetlands

4.2 Estuarine Intertidal Scrub/Shrub Wetlands

The estuarine Intertidal Scrub/Shrub Wetlands are located "up-slope" of the emergent wetlands and are generally found along the border between uplands and the wetlands along the eastern margin of the CFI-Gulfport site. The WRAP score for the scrub/shrub wetlands is 28.33% (See Figure 4).

☐ PROPOSED
☑ EXISTING CONDITIONS

WETLAND RAPID ASSESSMENT PROCEDURE

COUNTY:	PROJECT	DATE	REVIEWER	FLUCCS CODE
Harrison	CFI-Gulfport		L.Lewis	

APP. #:

WETLAND TYPE: ☐ FORESTED ☑ Non-Forested

LAND USE CATEGORY	WETLAND AREA	SECONDARY IMPACTS	MELALEUCA INVASION >50%
Industrial	1.26 ACRES	☑ NO ☐ YES %=	☐ NO ☐ YES
	0.96 ACRES OF IMPACT	ACRES	

WRAP SCORE
28.33%

WILD LIFE UTILIZATION	1
WETLAND CANOPY	N/A
WETLAND GROUND COVER	0.5
HABITAT SUPPORT / BUFFER	1

BUFFER TYPE	SCORE	% AREA	SUB TOTAL
Upland Buffer West	0	50	0
Wetlands Buffer	2	50	1
			0
			0
			0

FIELD HYDROLOGY	1
WATER QUALITY INPUT & TREATMENT	0.75

LAND USE CATEGORY

LAND USE CATEGORY	SCORE	% AREA	SUB TOTAL
Industrial	0.5	50	0.25
Natural (Wetlands)	2.5	50	1.25
			0
			0
			0
		LU TOTAL	1.5

PRETREATMENT CATEGORY

PRETREATMENT CATEGORY	SCORE	% AREA	SUB TOTAL
			0
			0
			0
			0
			0
		PT TOTAL	0

WILDLIFE UTILIZATION
Site does not provide significant habitat for aquatic species or large mammals. Habitat is considered marginal for small mamals such as racoons, reptiles, and amphibians.

WETLAND CANOPY
This wetland type does not have a naturally occurring tree/shrub canopy component. This evaluation criteria is not applicable to the evaluation for emergent wetlands and is not included in the fianl WRAP calculation (See Section 2.2.2.1 of the WRAP assessment procedure).

WETLAND GROUND COVER
Groundcover is very limited. Scrub/shrub species such as wax myrtle, (Myrica cerifera) and groundsel bush (Baccharis halimifolia) shade out ground and limit growth of groundcover species.

HABITAT SUPPORT/BUFFER
There is no habitat buffer on the western side of the scrub/shrub wetlands area. The eastern side of the scrub/shrub wetlans has a wetlands buffer that is approximately 300 feet wide. The habitat varies from swamp forest wetlands to emergent wetlands of minimal to moderate value.

FIELD HYDROLOGY
Site hydrology is considered minimally adequate to maintain the target wetlands species. Hydrologiy is mainly from irregular flooding events and storm tides.

WQ INPUT & TREATMENT
The western portion of the scrub/shrub wetlands is adjacent to CFI-Gulfport and water quality input from this area is considered low. The eastern portion of this wetlands area is surrounded by minimal to moderate quality wetlands which have limited water quality input values. there is no significant pre-treatment features associated with land surrounding the scrub/shrub wetlands.

Figure 4. WRAP Sheet for Scrub/Shrub Wetlands

4.3 Palustrine Forested Wetlands

The Palustrine Forested Wetlands are also located “up-slope” of the emergent wetlands and are generally found along the margins of Turkey Creek. For the purposes of this report, these wetlands are also described as “Swamp Forest” wetlands and the WRAP score for is 51.74% (See Figure 5).

☐ PROPOSED
☑ EXISTING CONDITIONS

WETLAND RAPID ASSESSMENT PROCEDURE

COUNTY:	PROJECT	DATE	REVIEWER	FLUCCS CODE	
Harrison	CFI-Gulfport	8/12/2009	L.Lewis	WETLAND TYPE:	☑ FORESTED ☐ Non-Forested

APP. #:

LAND USE CATEGORY	WETLAND AREA	SECONDARY IMPACTS	MELALEUCA INVASION >50%
Industrial	2.98 ACRES	☑ NO ☐ YES %=	☐ NO ☐ YES
	1.86 ACRES OF IMPACT	ACRES	

WRAP SCORE
51.74%

WILD LIFE UTILIZATION	2
WETLAND CANOPY	2
WETLAND GROUND COVER	1.5
HABITAT SUPPORT / BUFFER	1.125

BUFFER TYPE	SCORE	% AREA	SUB TOTAL
Upland Buffer South	1.5	50	0.75
Upland Buffer West	0	25	0
Upland/Wetland East	1.5	25	0.375
Upland/Wetland North	0	25	0
			0

FIELD HYDROLOGY	2
WATER QUALITY INPUT & TREATMENT	0.6875

LAND USE CATEGORY

LAND USE CATEGORY	SCORE	% AREA	SUB TOTAL
Industrial	1	75	0.75
natural	2.5	25	0.625
			0
			0
			0
		LU TOTAL	1.375

PRETREATMENT CATEGORY

PRETREATMENT CATEGORY	SCORE	% AREA	SUB TOTAL
			0
			0
			0
			0
			0
		PT TOTAL	0

WILDLIFE UTILIZATION

Site provides minimal evidence of significant habitat for target wildlife referenced for mixed hardwoods/swamp forest habitat. Hydrology is sufficient to support reptiles and amphibians, particularly water snakes, water moccasins, various species of turtles, and amphibians. These wetlands do not support target fish species. Very little evidence of large mammal utilization but the site could provide limited habitat for squirrels and racoons. Both residential and industrial development limit wildlife utilization for this habitat type.

WETLAND CANOPY

Moderate wetland overstory (over 20%) with some evidence of natural recruitment. No significant evidence of exotics and envasives (less than 25%); however, some areas have large numbers of Chinese tallow sapolings. There is a large number of storm damaged trees and snags that are scattered throughout the site. Little evidence of wildlife utilization. Shrub canopy

WETLAND GROUND COVER

Target ground cover vegetation is minimal to moderate. Estimates indicate that target ground cover species in most areas is over 30%. Dominant ground cover species include sedges and rushes. The most significant target species observed include royal fern, sawgrass, and bulltongue.

HABITAT SUPPORT/BUFFER

Habitat buffer on the south side of the site is greater than 300 feet wide and it has some potential to provide a wildlife corridor, but the habitat value is low. Also the habitat buffer is somewhat isolated from the project area and is separated by a two lane road that limits wildlife movement and connectivity to subject wetland area. The habitat buffer on the north and west sides are non existent. Wetland buffer on the east side is more than 300 feet at the present time, it is undeveloped at the present time, but the habitat value of this buffer area low.

FIELD HYDROLOGY

Site hydrology is considered adequate to maintain the target wetlands species. The natural hydrology has been impacts by roads, landfill, and dredging acitivites that have altered the natural course of Turkey Creek.

WQ INPUT & TREATMENT

The subject site is relatively flat and hydrology is primarily rainfall driven. The site is exposed to irregular inundation by tidal water and flood waters of Turkey Creek. Water Quality Input from adjoining property is low and there is no evidence of any significant pretreatmen activities.

Figure 5 WRAP Sheet for Palustrine Forested (Swamp Forest) Wetlands

5.0 SUMMARY

This report describes the results of a functional assessment of the wetlands located in the eastern portion of an ± 82 acre tract of land on the south side of Bayou Bernard, north and west of Turkey Creek in Gulfport, Harrison County, Mississippi. This assessment was conducted in order to establish an ecological value of the wetlands and to form a quantitative basis for determining mitigation requirements for a proposed environmental remediation project that would impact those wetlands.

The functional analysis methodology used for in this site evaluation is the WRAP is a rating index which was developed by the South Florida Water Management District in 1997 to assist the regulatory evaluation of wetlands and wetland mitigation sites. The WRAP methodology has been adopted by the U.S. Army Corps of Engineers for use in their wetland permitting program and will serve as the method for assessing the current value of wetlands on the site.

Based on the wetlands delineation conducted for this site and the site observations made during the functional assessment work, three (3) types of wetlands plant communities were noted. The type of wetlands habitat, the area of each wetlands, and the WRAP score are shown in the table below.

Table 1: Summary Table

HABITAT DESCRIPTION	ACRES	WRAP SCORE
Estuarine Intertidal Emergent Wetlands	0.35	58.33 %
Estuarine Intertidal Scrub/Shrub Wetlands	1.26	28.33 %
Palustrine Forested Swamp Forest Wetlands	2.96	51.74 %
AVERAGE SCORE		**46.13 %**

The WRAP scores range from a low of 28.33% for the Scrub/Shrub Wetlands to a high of 51.74% for the Swamp Forest Wetlands, and the average score was 46.13%. In general the scores are considered low and indicate conditions that have been impacted by man-induced fill and development.

REFERENCES

Cowardin, L.M., Carter, V., Golet, F.C., and LaRoe, E.T., 1979. Classification of Wetlands and Deepwater Habitats of the United States, U.S. Fish & Wildlife Service (FWS/OBS-79/31), Washington, D.C.

Environmental Laboratory, 1987. Corps of Engineers Wetlands Delineation Manual. U.S. Army Engineer, Waterway Experiment Stations, Vicksburg, Mississippi

Miller, R.E., and Gunsalus, B.E., 1999. Wetland Rapid Assessment Procedure. (Technical Publication REG-001) Natural Resource Management Division Regulation Department South Florida Water Management District, West Palm Beach, Florida

Mississippi Department of Wildlife Fisheries and Parks, 2005. Mississippi's Comprehensive Wildlife Conservation Strategy, Mississippi Department of Wildlife Fisheries and Parks, Jackson Mississippi.

Natural Resource Conservation Service, 1975. Soil Survey of Harrison County, Mississippi. U.S. Department of Agriculture, Natural Resource Conservation Service (formerly Soil Conservation Service

Natural Resource Conservation Service, 1991. Hydric soils of the United State of America: 1991. U.S. Department of Agriculture, Natural Resource Conservation Service (formerly Soil Conservation Service, Washington, D.C.

APPRENDIX F
Public Trust Tidelands Lease
State of Mississippi

SCANNED

REVIEWED

1st Judicial District
Instrument 2011 5303 D - J1
Filed/Recorded 8/19/2011 04:43 P
Total Fees $ 16.00
18 Pages Recorded

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Document Prepared by Office of the Secretary of State Raymond D. Carter, Public Lands Attorney Post Office Box 97 Gulfport, MS 39502 (228) 864-0254 ☐ Not a Mississippi Attorney ■ Mississippi Attorney Bar No. 8444	**Return Original Document to** Office of the Secretary of State Post Office Box 97 Gulfport, MS 39502 (228) 864-0254 *If left blank, original document will be returned to document preparer.*

PUBLIC TRUST TIDELANDS LEASE

CAVENHAM FOREST INDUSTRIES, LLC

(Turkey Creek Remediation Project)

Lessor	Lessee
State of Mississippi c/o Secretary of State Public Lands Division Post Office Box 136 Jackson, Mississippi 39205-0136 (601) 359-6373	**Cavenham Forest Industries, LLC** 9502 Creosote Road Gulfport, Mississippi 39503 (228) 865-4400

Indexing Instructions

Sections 22 and 23, Township 7 South, Range 11 West, First Judicial District of Harrison County, MS

This document contains 18 pages with the cover page(s) included as an integral part of the document.
If there is not enough space for all required information on this page, continue to the next page.

2

Prepared by:
Secretary of State
Post Office Box 97
Gulfport, MS 39502
(228) 864-0254

Return to:
Secretary of State
Post Office Box 97
Gulfport, MS 39502
(228) 864-0254

PUBLIC TRUST TIDELANDS LEASE
CAVENHAM FOREST INDUSTRIES, LLC.
(Turkey Creek Remediation Project)

STATE OF MISSISSIPPI
COUNTY OF HARRISON

THIS AGREEMENT, made and entered into this the ___ day of ___________, 201__, by and between the SECRETARY OF STATE, with the approval of the GOVERNOR, for and on behalf of the STATE OF MISSISSIPPI, hereinafter referred to as "LESSOR,"

Secretary of State
Public Lands Division
700 North Street
Jackson, Mississippi 39202
(601) 359-6373

and CAVENHAM FOREST INDUSTRIES, LLC, a Delaware Limited Liability Company registered to do and doing business in the State of Mississippi, hereinafter referred to as "LESSEE."

Cavenham Forest Industries, LLC
9502 Creosote Road
Gulfport, Mississippi 39503
(228) 865-4400

WITNESSETH:

THAT FOR THE TERM and in consideration of the rentals hereinafter set forth, and covenants, conditions, and obligations to be observed and performed by LESSEE, LESSOR does hereby lease and rent unto LESSEE, pursuant to the authority of MISS. CODE ANN. § 29-1-107

(Supp. 2010), the following described submerged land or tideland, hereinafter referred to as LEASE PREMISES, to-wit:

See legal description provided by LESSEE, attached hereto as Exhibit 1. The described property being two tracts containing a total of 36,155 square feet, more or less, of submerged land located on Turkey Creek, located within Sections 22 and 23, Township 7 South, Range 11 West, First Judicial District of Harrison County, MS.

1. TERM.

1.1 The primary term of this lease shall be for forty (40) years, beginning on the 1st day of May, 2011, and terminating on the 30th day of April, 2051. If LESSEE has complied with all terms, covenants, conditions, and obligations of this lease, as of the expiration of the primary term, and so long as LESSEE continues to present satisfactory evidence of LESSEE's right to occupy the adjacent uplands, LESSEE shall have the option to extend this lease for a renewal term of twenty five (25) years on such terms and provisions as may then be agreed upon by LESSOR and LESSEE, subject to the renegotiation of annual rental based on appraisal obtained by LESSOR.

2. RENT.

2.1 The parties hereto agree that LEASE PREMISES contains 36,155 square feet of submerged lands or tidelands. During the first five (5) year period of May 1, 2011, to April 30, 2016, LESSEE covenants and agrees to pay annual rental to LESSOR in the sum of TWO THOUSAND FIVE HUNDRED THIRTY ONE ($2,531.00) DOLLARS. Payment of the first year's rent shall be made upon execution of this lease.

3. RENT ADJUSTMENT.

3.1 (a) LESSOR shall, at the end of each five (5) year period of the primary term of this lease, determine the annual rent for the following five year period in accordance with MISS. CODE ANN. §29-1-107(2) (1972) as amended, or such other applicable statute as may then be in effect.

3.1 (b) If LESSOR determines that the rent for the ensuing five (5) year period should be fixed by adjusting the current rent by the increase in the All Urban Consumer Price Index—all items ("CPI"), then LESSOR shall calculate the amount of the rent adjusted by the CPI and notify LESSEE, and the rent for the ensuing five (5) year period shall be fixed as adjusted by the CPI. Said rental amount shall be calculated by multiplying the last effective annual rent in the final year of the preceding five (5) year period by a fraction, having as its numerator the monthly CPI index number for the first calendar month of the five (5) year period during which the adjustment is to take effect, and as its denominator the monthly CPI index number for the first calendar month of the preceding five (5) year period.

3.1 (c) If not adjusted by the CPI, LESSOR shall adjust rent by obtaining an appraisal of the fair market rent for LEASE PREMISES from an appraiser of its own choosing, and the rent for the ensuing five (5) year period shall be fixed at the amount stated in LESSOR'S appraisal.

3.1 (d) In any event, the adjusted annual rent shall be the greater of the amount determined by the aforesaid appraisal procedure or the amount as adjusted by the CPI. However, in no event, shall the adjusted annual rent for any five (5) year period of the lease term be less than the amount fixed as the final annual rent effective for the preceding five (5) year lease term.

3.1 (e) In the event that LESSOR and LESSEE cannot agree on a rental amount, the lease may be cancelled at the option of LESSOR.

3.2 LESSOR and LESSEE each agree to cooperate and use good faith and diligent efforts to complete the foregoing appraisal procedure at the beginning of the five (5) year period for which the adjusted rent is being determined. If for any reason the rent adjustment procedure by appraisal as set forth in Paragraphs 3.1(a)-(d) is not completed prior to the beginning of the ensuing five year period, LESSOR and LESSEE agree that the interim annual rent pending completion of the appraisal procedure shall be equal to the last effective annual rent for the final lease year of the preceding five (5) year period as adjusted by the All Urban Consumer Price Index—all items in the manner provided in Paragraph 3.1(b). If the fair market rent finally fixed by the appraisal procedure is in excess of the interim annual rent, LESSEE shall pay to LESSOR such excess within thirty (30) days after the appraisal procedure is completed.

3.3 LESSOR and LESSEE acknowledge and agree that any appraisal made for the purpose of determining fair market rent for LEASE PREMISES will deduct the value of any improvements owned by LESSEE which substantially enhance the value of LEASE PREMISES.

3.4 All appraisers employed for purposes of review and adjustment of rent under this LEASE shall be at minimum, State Certified General Real Estate Appraiser, shall be disinterested and shall have no personal interest or bias with respect to LESSOR or to LESSEE. Any such appraiser shall act independently and shall not be compensated on any basis that is contingent on a particular result or outcome or on any action or event resulting from any analysis, opinions or conclusions contained in such appraiser's appraisal, shall act in good faith and in accord with the highest professional standards, and shall endeavor to accurately and fairly determine the true fair market rent for LEASE PREMISES without favor or bias toward the interests of either LESSOR or LESSEE.

3.5 LESSEE agrees to cooperate with and furnish financial and value data concerning the LEASE PREMISES to all appraisers employed to perform appraisals pursuant to the terms and provisions of this lease. Information will be furnished for the periods requested by said appraisers.

4. PLACE AND TIME OF PAYMENT.

4.1 Rent shall be payable annually on or before May 1st. All rent under this lease is payable to the order of the Mississippi Secretary of State.

4.2 Payments may be made by electronic transfer of funds through Automated Clearinghouse ("ACH") to the attention of Accounts Receivable. ACH payment details shall be transmitted to the attention of Accounting Division, via U.S. mail at P.O. Box 136, Jackson, Mississippi 39205 or by courier delivery at 401 Mississippi Street, Jackson, Mississippi 39205, or via fax at (601) 359-2894.

4.3 Alternatively, payments may be made by check and transmitted to the attention of Accounting Division. Check payment shall be sent via U.S. mail to P.O. Box 136, Jackson Mississippi 39205 or by courier delivery to 700 North Street, Jackson Mississippi 39202.

4:4 Payments for annual rent shall not be considered made until actually received in the designated account for the Office of the Secretary of State in Jackson, Mississippi.

5. PENALTY FOR PAST DUE RENT BALANCES.

5.1 If any sum required to be paid under this lease is not made within thirty (30) days of the due date, LESSEE shall be assessed and pay a penalty of one percent (1%) per month or any part thereof on any such sum from the date due until paid. The penalty for any such late payment shall each month be added to the unpaid amount and thereafter shall be deemed to be a part of the past due sum. If upon cancellation or termination of this lease for any reason, LESSEE has not paid all sums required to be paid under this lease, said penalty shall continue to be assessed against any sums owed by LESSEE until paid.

6. RIGHT TO RE-LEASE.

6.1 Pursuant to MISS. CODE ANN. § 29-1-107 (1972) as amended, LESSEE is hereby granted the prior right, exclusive of all other persons, to re-lease at the expiration of this lease, on such terms and provisions as may then be agreed upon between LESSEE and LESSOR, if at the expiration of the secondary term LESSEE has faithfully complied with all terms, covenants, conditions and obligations of the lease as renewed, so long as LESSEE continues to present satisfactory evidence of LESSEE'S right to occupy the adjacent uplands.

7. TAXES, SURVEY COSTS, RECORDING FEES.

7.1 LESSEE covenants and agrees to pay any and all general taxes and special assessments, if ever any there be, applicable to LESSEE'S interest in LEASE PREMISES and improvements thereon; further, LESSEE covenants and agrees to pay any and all survey costs and recording fees in connection with this lease or any other fees so determined by law.

8. TRANSFERABILITY OF LEASE.

8.1 LESSEE shall NOT sublease LEASE PREMISES nor assign, or transfer this lease without the prior written permission of the Secretary of State or his successor. LESSEE shall, within thirty (30) days after execution of an approved sublease or assignment, file a copy thereof, including the total consideration therefor, with the Secretary of State.

9. PUBLIC ACCESS ASSURED.

9.1 LESSEE agrees to maintain free public access to any remaining open water portion of LEASE PREMISES subject to rules and regulations reasonably necessary to ensure the safety and convenience of all users.

10. DEFAULT, CANCELLATION OR FORFEITURE.

10.1 The parties herein expressly agree that in the event of any default under this lease which can be cured solely by the payment of a liquidated sum of money including, but not limited to, the payment of any tax, assessment or rent due under this lease, then it shall be lawful for LESSOR, either with or without process of law, to enter and repossess LEASE PREMISES if such default is not cured by LESSEE within thirty (30) days after written notice to LESSEE and to distrain for any rent, assessment or other sum due under this lease at the sole election of LESSOR. If LESSOR elects the remedy of re-entry and repossession, then LESSEE agrees to peaceably surrender possession of LEASE PREMISES to LESSOR in the manner provided in Paragraphs 26.3 and 26.4. However, nothing herein is to be deemed or construed to mean that LESSOR, in electing one remedy or another available to LESSOR, shall not be permitted to hold LESSEE liable for any unpaid rent, assessment or other sums due to the time of LESSOR'S re-entry and repossession of LEASE PREMISES. LESSEE shall be liable for the payment of all reasonable attorney's fees, expenses and costs of LESSOR required for the collection of any sums due under this lease. For purposes of this lease any ad valorem tax or assessment due any county or municipality applicable to LEASE PREMISES not contested in the manner provided by law and the annual rent as determined under Paragraphs 2 and 3 shall be deemed to be a liquidated sum.

10.2 LESSEE'S default under any other material provisions of this lease which cannot be cured solely by the payment of a liquidated sum of money, as provided in Paragraph 10.1, shall result, at the option of LESSOR, in the cancellation of this lease after thirty (30) days written notice of default to LESSEE, if such default is not cured by LESSEE within said thirty (30) day period. However, the period of time for curing any such default may be extended for a reasonable period not to exceed one hundred and eighty (180) days from date of notice of default if (a) there is a reasonable probability that such default can be cured within a reasonable time, (b) LESSEE continuously persists in a diligent, good faith effort to cure such default, and (c) during aforesaid thirty (30) day period, LESSEE undertook and maintained a diligent, good faith effort to cure such default and the failure to cure such default was not the fault of LESSEE. Any further extension of time beyond one hundred and eighty days (180) shall only be granted upon mutual written agreement of LESSOR and LESSEE. LESSEE shall be liable for the payment of all reasonable attorney's fees, expenses and costs of LESSOR incurred in the enforcement of this Paragraph 10.2.

10.3 As to all other conditions, covenants, and obligations imposed on LESSEE under this lease not subject to Paragraph 10.1 or 10.2, enforcement shall be by proceeding at law or in equity to restrain violation and to recover damages, if any, including reasonable expenses of litigation and reasonable attorney's fees, as may be awarded by the court. Such enforcement by proceedings at law or in equity may be instituted after thirty (30) days written notice to LESSEE if the default or violation has not been cured within that thirty (30) day period. However, the period of time for curing any such default may be extended for a reasonable period not to exceed one hundred and eighty (180) days from date of notice of default if (a) there is a reasonable probability that such default can be cured within a reasonable time, (b) LESSEE continuously persists in a diligent, good faith effort to cure such default, and (c) during aforesaid thirty (30) day period, LESSEE undertook and maintained a diligent, good faith effort to cure such default and the failure to cure such default was not the fault of LESSEE. Any further extension of time of more than one hundred and eighty (180) days shall only be granted upon mutual written agreement of LESSOR and LESSEE.

11. RENT NOT REFUNDABLE.

11.1 LESSOR and LESSEE agree that any rent paid during the term of this lease is non-refundable and LESSEE waives any right or claim it may have to refund of rents paid under the term of this lease.

12. IMPROVEMENTS.

12.1 LESSOR hereby consents to LESSEE'S development and operation of improvements as shown on Exhibit 1. LESSEE agrees to construct, operate and maintain all improvements on LEASE PREMISES as shown on Exhibit 1 attached hereto. Said improvements shall be in aid of navigation and not obstructions thereto.

12.2 LESSOR acknowledges that the improvements which exist on the effective date of this lease on LEASE PREMISES are not the property of LESSOR. LESSOR acknowledges that all improvements constructed by LESSEE on LEASE PREMISES as provided in Paragraph 12.1 shall be owned by LESSEE.

12.3 All property of LESSEE, including all improvements, modifications or additions to improvements on LEASE PREMISES shall be constructed in a good and workmanlike manner, shall be operated and maintained at LESSEE'S expense in a good state of repair and in a clean, orderly, healthful, and attractive condition, with due regard to public health and safety.

12.4 LESSEE shall, at its sole cost and expense, make any and all additions to, repairs, alterations, maintenance, replacements, or changes about and to the improvements on LEASE PREMISES, which may be required by any public authority affecting the property and its use.

12.5 LESSEE recognizes that LESSOR has a public interest in establishing and maintaining an attractive view from the water side. Accordingly, LESSEE agrees that all elevations of LESSEE'S improvements on LEASE PREMISES shall be constructed and maintained for visual and aesthetic appeal.

13. RESTRICTIONS ON USE.

13.1 LESSEE shall comply with any and all applicable federal, state, county or city laws, statutes, regulations, building codes, building requirements, safety or conservation regulations, fire codes, ordinances, pollution standards, or zoning regulations.

14. NO CLAIM OF TITLE OR INTEREST.

14.1 LESSEE, in accepting this lease, does hereby agree that no claim of title or interest to LEASE PREMISES shall be made by reason of the occupancy or use thereof; that all title and interest to LEASE PREMISES is vested in the LESSOR. LESSEE further acknowledges and agrees that he is entitled to no rights to adjoining submerged lands, tidelands or other public trust lands as a result of this lease.

15. CATASTROPHIC DESTRUCTION.

15.1 In the event of catastrophic destruction by natural causes of LESSEE'S improvements on the LEASED PREMISES, LESSEE may terminate this LEASE at its option, provided the LEASE PREMISES are surrendered in a condition at least equal to that at the inception of this LEASE. LESSOR agrees that it shall interpose no objection should LESSEE decide to rebuild those improvements demolished in such a catastrophe; however, LESSOR reserves the right to terminate the LEASE unless LESSEE notifies LESSOR within one hundred and eighty (180) days after the catastrophic destruction of its intent to rebuild, setting forth the schedule for rebuilding and thereafter, with due diligence on schedule, constructs new facilities of same or similar kind as those destroyed, consistent with the USES and terms set forth in this LEASE. The schedule for rebuilding shall not exceed one year (1) year and shall provide for the commencement of construction not more than six (6) months after notice of the intent to rebuild is given.

16. DUE DILIGENCE.

16.1 LESSEE shall be responsible for any damages that may be caused to LESSOR'S property by the activities of LESSEE under this lease, and shall exercise due diligence in the protection of other property of LESSOR in the vicinity thereof against damage or waste from any and all causes. LESSEE shall not deposit any refuse on any State property adjoining LEASE PREMISES. Disposition of refuse and waste shall be consistent with local and State health regulations.

17. INDEMNITY AND HOLD HARMLESS.

17.1 LESSEE agrees to hold and save harmless, protect and indemnify LESSOR, the Secretary of State, the Governor, and their successors, employees, officers and agents, from and against any and all loss, damages, claims, suits or actions at law or equity, judgments and costs, including attorney's fees, which may arise or grow out of any injury or death of persons or loss or damage to property connected with LESSEE'S exercise of any right granted or conferred hereby, or LESSEE'S use, maintenance, operation or condition of the property herein leased or the activities thereon conducted by LESSEE, whether sustained by LESSEE, its respective agents or employees, or by any other persons, or corporations which seek to hold LESSOR liable.

17.2 In addition to the general indemnity agreement set forth in the immediately preceding paragraph, LESSEE also specifically agrees to hold and save harmless, protect and indemnify LESSOR, the Secretary of State, the Governor and their successors, employees, officers and agents, from and against any and all loss, damages, claims, suits or actions at law or equity, judgments and costs, including attorney's fees, which may arise or grow out of LESSOR'S reliance upon LESSEE'S representation that LESSEE has the right to occupy the uplands adjacent to LEASE PREMISES and to exercise littoral or riparian rights in connection therewith.

17.3 In executing this lease, LESSOR is relying on a survey, legal description and/or depiction (see Exhibit 1) provided by the LESSEE. LESSEE expressly assumes all liability for the correctness thereof and expressly agrees to indemnify and save harmless LESSOR, the Secretary of State, the Governor and their successors, employees, officers and agents, for all liability, damages (including damages to land, aquatic life and other natural resources), expenses, causes of actions, suits, claims, costs, fees, including attorneys' fees and costs, penalties (civil and criminal) or judgments arising out of State's reliance on LESSEE'S survey, legal description and/or depiction.

18. QUIET AND PEACEFUL POSSESSION.

18.1 LESSEE shall have quiet and peaceful possession of LEASE PREMISES so long as compliance is made by LESSEE with the terms of this agreement. LESSEE agrees to deliver possession of LEASE PREMISES peaceably and promptly at the expiration or termination of this lease.

19. RIGHT OF ENTRY.

19.1 LESSOR reserves the right to enter onto LEASE PREMISES to inspect the premises to determine compliance with the lease terms herein. LESSEE grants LESSOR the right of ingress and egress upon LESSEE'S adjoining uplands at reasonable times for purposes of gaining access for such inspection.

20. PERMITTED USE.

20.1 It is expressly agreed by and between the parties that LESSEE will not occupy or use, nor permit to be occupied or used, LEASE PREMISES for any unlawful purposes.

20.2 It is specifically agreed that LESSEE will use LEASE PREMISES or any part thereof only for environmental remediation as ordered and approved by the Environmental Protection Agency, including the filling and capping of the submerged lands to contain any existing contamination. It is expressly agreed that any other activity shall be excluded from any use of LEASE PREMISES.

20.3 It is expressly agreed that gaming or any related or ancillary, direct or indirect activity of gaming shall be excluded from any use of LEASE PREMISES.

21. LESSOR NOT RESPONSIBLE.

21.1 LESSEE assumes full responsibility for the condition of the premises and LESSOR shall not be liable or responsible for any damages or injuries caused by any vices or defects therein to LESSEE or to any occupant or to anyone in or on LEASE PREMISES who derives his right to be thereon from LESSEE. LESSEE agrees to maintain the LEASE PREMISES in good condition, keeping the structures and equipment located thereon in a good state of repair in the interests of public health and safety.

22. LIABILITY INSURANCE.

22.1 LESSEE, at its sole cost and expense, shall, during the entire term hereof, procure, pay for and keep in full force and effect: (i) comprehensive general liability and property damage insurance with respect to LEASE PREMISES, permitted uses, and improvements thereon and the operations of, or on behalf of LESSEE in, on or about the LEASE PREMISES, including but not limited to owned and non-owned automobile (vehicle) liability, personal injury, XCU, blanket contractual, owner's protective, broad form property damage and product/completed operations liability coverage for not less than One Million ($1,000,000.00) Dollars combined limit per occurrence for bodily injury, death, and property damage liability; (ii) worker's compensation coverage; (iii) with respect to improvements, alterations and the like required or permitted to be made by LESSEE, contingent liability and builder's all-risk insurance, in amounts satisfactory to LESSOR and as is reasonably commercially available; and (iv) insurance against fire, vandalism, malicious mischief and such other additional perils as now are or hereafter may be included in a standard fire, extended coverage and special extended coverage endorsement from time to time in general use in Gulfport, Mississippi, .

22.2 Each policy evidencing insurance required to be carried by LESSEE pursuant to this Paragraph shall contain the following provisions and/or clauses: (i) a cross-liability clause; (ii) a provision that such policy and the coverage evidenced thereby shall be primary and that any coverage carried by LESSOR shall be excess insurance and non-contributing with respect to any policies carried by LESSEE; (iii) a provision including LESSOR as additional insured; (iv) a waiver by the insurer of any right to subrogation against LESSOR, its officers, agents, employees and representatives; (v) a severability clause; (vi) a provision that the insurer will not cancel or change the coverage provided by such policy without first giving LESSOR thirty (30) days written notice; (vii) to the extent obtainable, a provision to the effect that any amounts payable by virtue of loss of rentals or business interruption shall be computed and stated separately in any settlement entered into by the insurer under the policy involved. All net insurance proceeds from hazard insurance on LESSEE owned improvements may be paid to an applicable LEASEHOLD MORTGAGEEE so long as adequate provision reasonably satisfactory to LESSOR has been made in each case for the use of all proceeds for the repair and restoration of damaged or destroyed improvements on LEASE PREMISES.

22.3 All policies of insurance provided for herein shall be written as primary policies (without "contribution" or "solely in excess of coverage carried by LESSOR" provision) with responsible and solvent insurance companies authorized to do business in Mississippi with a policyholder's rating of "A" (Excellent) or better and a financial rating of "X" or better in Best's Insurance Reports - Fire and Casualty. Within 60 days of the execution of this LEASE, LESSEE shall supply LESSOR (and at all times during the term of the LEASE keep on file with LESSOR) a certificate of insurance accurately reflecting the coverage required hereby. Notwithstanding anything to the contrary contained within this provision, LESSEE'S obligations to carry insurance as provided herein may be brought within the coverage of a so-called "blanket" policy or policies of insurance carried and maintained by LESSEE, so long as such policy or policies segregate the amount of coverage applicable to the premises of which LEASE PREMISES forms a part. In the event that LESSEE fails to procure, maintain and /or pay for at all times and for the durations specified in this LEASE, or fails to carry insurance required by law or governmental regulation, LESSOR may (but without obligation to do so) at any time or from time to time, and without notice, procure such insurance and pay the premiums therefore, in which event LESSEE shall repay LESSOR all sums so paid by LESSOR, together with penalties thereon as provided in Paragraph 5 and any costs or expenses incurred by LESSOR in connection therewith, within ten (10) days following LESSOR'S written demand for such payment.

23. RESERVATION OF MINERAL RIGHTS.

23.1 LESSEE further covenants and agrees that this lease and interest of LESSEE SHALL NOT include any mineral, oil or gas, coal, lignite, or other subterranean rights WHATSOEVER.

24. RIGHT TO CANCEL UPON INSOLVENCY OF LESSEE.

24.1 LESSEE covenants and agrees that if an execution or process is levied upon LEASE PREMISES or if a Petition in Bankruptcy be filed by or against LESSEE in any court of competent jurisdiction, LESSOR shall have the right at its option, to cancel this lease. LESSEE covenants and agrees that this lease and the interest of LESSEE hereunder shall not, without the written consent of the Secretary of State or his successor first obtained, be subject to garnishment or sale under execution or otherwise in any suit or proceeding which may be brought by or against said LESSEE.

25. WAIVER NOT A DISCHARGE.

25.1 No failure, or successive failures, on the part of LESSOR to enforce any provisions, nor any waiver or successive waivers on its part of any provision herein, shall operate as a discharge thereof or render the same inoperative or impair the right of LESSOR to enforce the same upon any renewal thereof or in the event of subsequent breach or breaches.

26. CANCELLATION UPON FAILURE TO COMPLY.

26.1 In the event of the invalidation of any material provision of this lease by a final, non-appealable judgment or court order, either LESSOR or LESSEE may cancel this lease, or LESSOR and LESSEE may renegotiate this lease on mutually agreeable terms.

26.2 LESSEE shall be in default, if LESSEE should at any time fail to make permitted uses of LEASE PREMISES, or abandons LEASE PREMISES for a period of ninety (90) consecutive days, or uses LEASE PREMISES in violation of any applicable law or regulation, and this lease may be canceled by LESSOR after thirty (30) days written notice to LESSEE. Any further extension of time under Paragraph 26.2 shall be granted only upon mutual written agreement of LESSOR and LESSEE. LESSEE shall be liable for the payment of all reasonable attorney's fees, expenses and costs of LESSOR incurred in the enforcement of Paragraph 26.2.

26.3 Immediately upon the cancellation or termination of this lease for any reason, LESSOR shall be entitled to take possession of LEASE PREMISES, custom and usage to the contrary notwithstanding, and LESSEE covenants and agrees to immediately and peaceably quit, deliver up and surrender possession of LEASE PREMISES to LESSOR, provided LESSEE shall promptly remove improvements and restore LEASE PREMISES as provided in Paragraph 26.4.

26.4 LESSEE shall have one hundred and eighty (180) days from the date this lease is cancelled or terminated for any reason to remove LESSEE'S improvements, structures and equipment and to restore LEASE PREMISES to a condition at least equal to that at the inception of this lease. If LESSEE declines or fails to remove such improvements, structures and equipment or restore LEASE PREMISES within the time provided, then such improvements, structures and equipment will be deemed forfeited by LESSEE, and may be removed and/or sold by LESSOR. Any costs incurred by LESSOR in the removal of such improvements, structures and equipment or restoring LEASE PREMISES shall be paid for from the proceeds of sale of such improvements, structures and equipment. If funds derived from the sale of such improvements, structures and equipment are insufficient to pay such costs, LESSEE shall be liable for such deficiency and to aid of recovery of any such deficiency, LESSOR is hereby granted a lien upon the interest of LESSEE in adjacent uplands, and such lien shall be enforceable in proceedings as provided by law.

27. NOTICE.

27.1 All notifications required under the terms of this lease shall be made by U.S. mail, return receipt requested, or by rapid delivery courier service to the parties at the following addresses:

Secretary of State:

Assistant Secretary of State
Public Lands Division

(by U. S. Mail)
Post Office Box 136
Jackson, Mississippi 39205-0136

(by Courier)
700 North Street
Jackson, Mississippi 39202

Telephone: (601) 359-6373
Facsimile: (601) 359-1461

Cavenham Forest Industries, LLC: (by U. S. Mail or Courier)
One Oxford Centre
Suite 300
Pittsburgh, Pennsylvania, 15219

Telephone: (412) 208-8812

28. LAWS OF MISSISSIPPI TO GOVERN.

28.1 This agreement is to be governed by the laws of the STATE OF MISSISSIPPI, both as to interpretation and performance.

29. MISCELLANEOUS.

29.1 As a condition precedent to the exercise of any USE or right granted to LESSEE under this LEASE, LESSEE covenants and binds itself, its successors and its assigns to faithfully and timely comply with all the terms and provisions of this LEASE.

29.2 The remedies set forth in this LEASE are not exclusive, and the election of one remedy by LESSOR shall not be deemed or construed as a waiver of any other remedy available to LESSOR. In addition to the remedies provided in this LEASE, LESSOR shall be entitled to whatever remedies it may have otherwise at law or in equity.

29.3 LESSOR and LESSEE agree that they will execute and deliver, at the request of the other, any and all such documents or other written instruments as may be reasonably necessary or appropriate to carry out and effectuate the intent and purpose of this LEASE and the EXHIBIT attached hereto.

29.4 No amendments or additions to LEASE shall be binding unless in writing and signed by all parties.

29.5 All covenants and agreements herein shall bind and inure to the benefit of the parties hereto and to their successors and assigns.

29.6 This instrument constitutes the entire agreement between LESSOR and LESSEE and supersedes all prior understandings, previous negotiations, and any memoranda or understanding with respect to the subject matter hereof.

29.7 Each individual executing this LEASE on behalf of LESSEE represents and warrants that he/she is duly authorized to do so on behalf of said LESSEE, and that this LEASE is binding upon said LESSEE in accordance with its terms. LESSEE shall, at LESSOR'S request, deliver a certified copy of its resolution authorizing said execution.

30. DEFINITIONS.

30.1 LEASE shall mean that lease agreement by and between the State of Mississippi, by the Secretary of State, with the approval of the Governor, and Cavenham Forest Industries, LLC, effective May 1, 2011, for certain submerged lands or tidelands referred to as LEASE PREMISES.

30.2 LEASE PREMISES shall mean, see legal description provided by LESSEE, attached hereto as Exhibit 1.

30.3 LESSEE shall mean Cavenham Forest Industries, LLC.

30.4 LESSOR shall mean the State of Mississippi, acting by and through the Secretary of State with the approval of the Governor.

30.5 RESTRICTIONS shall mean any and all federal, state, county, district or city laws, statutes, regulations, building codes, building requirements, safety or conservation regulations, fire codes, ordinances, environmental and health laws and regulations, zoning regulations and permits applicable to LESSEE'S use of and activities on LEASE PREMISES.

30.6 USE shall have the meaning set forth in Section 20 herein.

IN WITNESS WHEREOF, this lease is executed by LESSOR and LESSEE, this the _____ day of _______________, ____.

LESSEE:
CAVENHAM FOREST INDUSTRIES, LLC

BY: [signature]
Printed Name: Robert S Markwell
Title: President

COMMONWEALTH
~~STATE~~ OF PENNSYLVANIA
COUNTY OF ALLEGHENY

PERSONALLY APPEARED BEFORE ME, the undersigned authority in and for said county and state, on this 13 day of MAY, 2011, within my jurisdiction the within named ROBERT S. MARKWELL, personally known to me to be the PRESIDENT of CAVENHAM FOREST INDUSTRIES, LLC, who acknowledged that he/she executed the above and foregoing LEASE AGREEMENT as the act and deed of said company, on the date and for the purposes therein stated, being first duly authorized to so do.

Donna Lee Kopach
NOTARY PUBLIC

My Commission Expires:
MARCH 22, 2015

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Donna Lee Kopach, Notary Public
City of Pittsburgh, Allegheny County
My Commission Expires March 22, 2015
MEMBER, PENNSYLVANIA ASSOCIATION OF NOTARIES

LESSOR:
STATE OF MISSISSIPPI
C. DELBERT HOSEMANN, JR.
SECRETARY OF STATE

BY: [signature]
GERALD MCWHORTER
ASSISTANT SECRETARY OF STATE
PUBLIC LANDS DIVISION

STATE OF MISSISSIPPI
COUNTY OF HINDS

PERSONALLY APPEARED BEFORE ME, the undersigned authority in and for said county and state, on this 10th day of June, 2011, within my jurisdiction the within named GERALD MCWHORTER, personally known to me to be the ASSISTANT SECRETARY OF STATE of the STATE OF MISSISSIPPI, who acknowledged that he executed the above and foregoing LEASE AGREEMENT as the act and deed of said ASSISTANT SECRETARY OF STATE for and on behalf of the STATE OF MISSISSIPPI, on the date and for the purposes therein stated, being first duly authorized to so do.

Kristen Adams
NOTARY PUBLIC

My Commission Expires:

STATE OF MISSISSIPPI
NOTARY PUBLIC
ID # 91139
KRISTEN ADAMS
Commission Expires
May 4, 2013
COPIAH COUNTY

16

APPROVED BY THE GOVERNOR of the State of Mississippi on the 29th day of July, 2011.

HALEY BARBOUR, GOVERNOR

STATE OF MISSISSIPPI
COUNTY OF HINDS

PERSONALLY APPEARED BEFORE ME, the undersigned authority in and for said county and state, on this 29th day of July, 2011 within my jurisdiction the within named HALEY BARBOUR, personally known to me to be the GOVERNOR of the STATE OF MISSISSIPPI, who acknowledged that he executed the above and foregoing LEASE AGREEMENT as the act and deed of said GOVERNOR for and on behalf of the STATE OF MISSISSIPPI, on the date and for the purposes therein stated, being first duly authorized to so do.

NOTARY PUBLIC

My Commission Expires:

STATE OF MISSISSIPPI NOTARY PUBLIC ID # 45729 BETHANY J. BRYANT Commission Expires Sept. 7, 2012 RANKIN COUNTY

BEARINGS SHOWN ON THIS PLAT ARE GRID BEARINGS BASED ON THE NAD 83 EAST ZONE STATE PLANE COORDINATE SYSTEM AND DETERMINED BY STATIC GPS OBSERVATIONS. THEY ARE REFERENCED TO THE NATIONAL SPATIAL REFERENCE SYSTEM THROUGH THE UNITED STATES GEODETIC SURVEY ON-LINE POSITIONING USER SERVICE.

ALL DISTANCES SHOWN ON THIS PLAT ARE IN U.S. SURVEY FEET. (1'=0.999998 U.S. SURVEY FEET)

NOTE:

THE MEAN HIGH WATER LINE DEPICTED ON THIS PLAT OF SURVEY WAS LOCATED ON JULY 28 AND 29, 2009 BASED ON THE 1980-2001 NATIONAL TIDAL DATUM EPOCH. THE LOCAL ELEVATION OF THE MEAN HIGH WATER DATUM FOR THAT LINE WAS CALCULATED USING SIMULTANEOUS OBSERVATIONS BETWEEN THE DEPICTED TIDE STATION FOR THIS SITE AND THE NOAA TURKEY CREEK, BERNARD BAYOU TIDE STATION (874-7437).

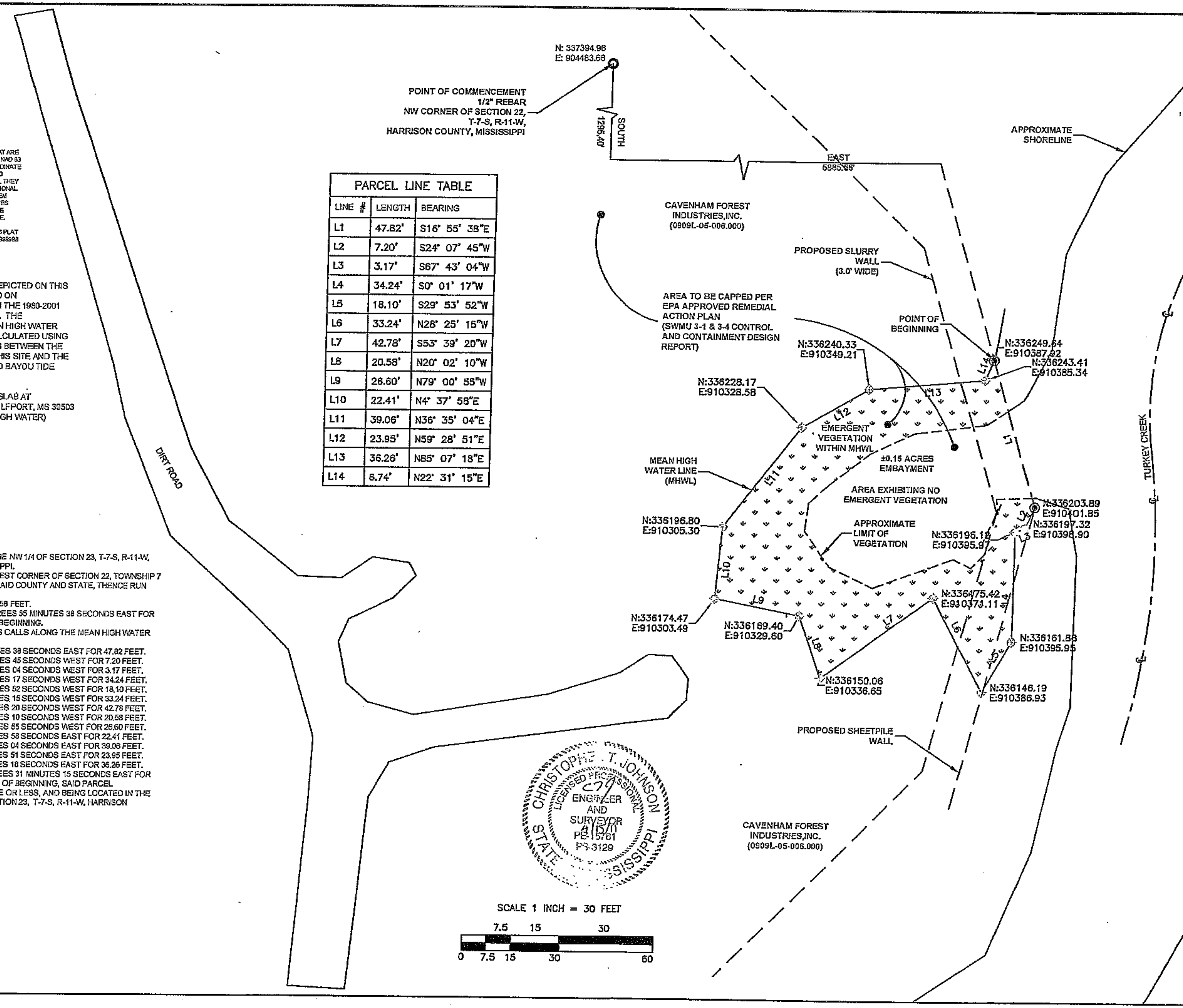
BENCHMARK- (X) IN CONCRETE SLAB AT
13992 WASHINGTON AVENUE GULFPORT, MS 39503
8.31 FEET ABOVE MHW (MEAN HIGH WATER)
N: 335951.53
E: 909789.71

TIDE STATION- S-TC-02
N: 336052.68
E: 910035.85

LEGAL DESCRIPTION:

MEAN HIGH WATER LINE

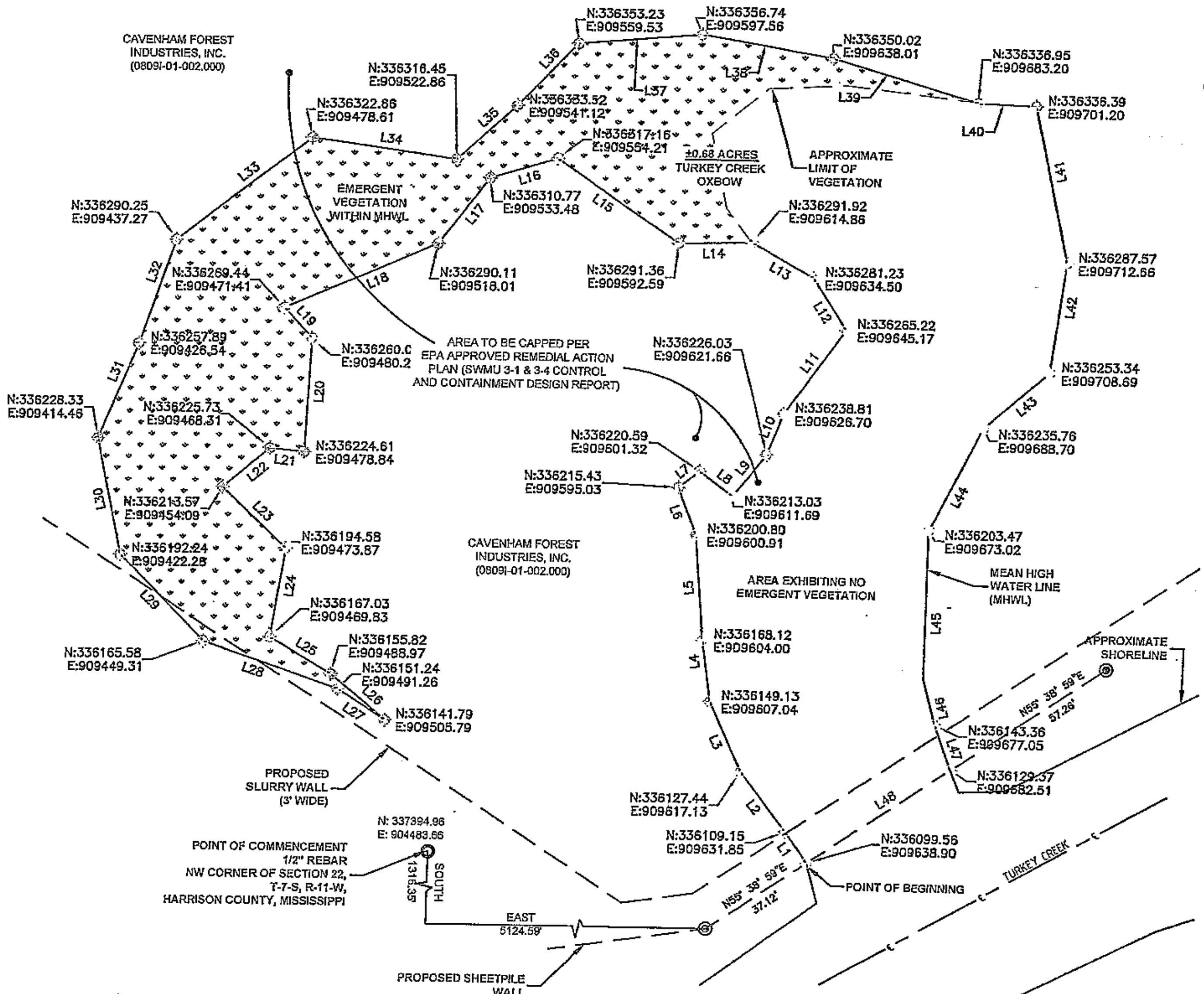
1) A PART OF THE NW 1/4 OF THE NW 1/4 OF SECTION 23, T-7-S, R-11-W, HARRISON COUNTY, MISSISSIPPI.
2) COMMENCE AT THE NORTHWEST CORNER OF SECTION 22, TOWNSHIP 7 SOUTH, RANGE 11 WEST, IN SAID COUNTY AND STATE, THENCE RUN SOUTH FOR 1295.40 FEET.
3) THENCE RUN EAST FOR 5885.56 FEET.
4) THENCE RUN SOUTH 16 DEGREES 55 MINUTES 38 SECONDS EAST FOR 64.21 FEET TO THE POINT OF BEGINNING.
5) THENCE RUN THE FOLLOWING CALLS ALONG THE MEAN HIGH WATER LINE:
6) SOUTH 16 DEGREES 55 MINUTES 38 SECONDS EAST FOR 47.82 FEET.
7) SOUTH 24 DEGREES 07 MINUTES 45 SECONDS WEST FOR 7.20 FEET.
8) SOUTH 67 DEGREES 43 MINUTES 04 SECONDS WEST FOR 3.17 FEET.
9) SOUTH 00 DEGREES 01 MINUTES 17 SECONDS WEST FOR 34.24 FEET.
10) SOUTH 29 DEGREES 53 MINUTES 52 SECONDS WEST FOR 18.10 FEET.
11) NORTH 28 DEGREES 25 MINUTES 15 SECONDS WEST FOR 33.24 FEET.
12) SOUTH 53 DEGREES 39 MINUTES 20 SECONDS WEST FOR 42.78 FEET.
13) NORTH 20 DEGREES 02 MINUTES 10 SECONDS WEST FOR 20.58 FEET.
14) NORTH 79 DEGREES 00 MINUTES 55 SECONDS WEST FOR 26.60 FEET.
15) NORTH 04 DEGREES 37 MINUTES 58 SECONDS EAST FOR 22.41 FEET.
16) NORTH 36 DEGREES 35 MINUTES 04 SECONDS EAST FOR 39.06 FEET.
17) NORTH 59 DEGREES 28 MINUTES 51 SECONDS EAST FOR 23.95 FEET.
18) NORTH 85 DEGREES 07 MINUTES 18 SECONDS EAST FOR 36.26 FEET.
19) THENCE RUN NORTH 22 DEGREES 31 MINUTES 15 SECONDS EAST FOR 6.74 FEET, BACK TO THE POINT OF BEGINNING, SAID PARCEL CONTAINING 0.15 ACRES, MORE OR LESS, AND BEING LOCATED IN THE NW 1/4 OF THE NW 1/4 OF SECTION 23, T-7-S, R-11-W, HARRISON COUNTY, MISSISSIPPI.



PARCEL LINE TABLE

LINE #	LENGTH	BEARING
L1	47.82'	S16° 55' 38"E
L2	7.20'	S24° 07' 45"W
L3	3.17'	S67° 43' 04"W
L4	34.24'	S0° 01' 17"W
L5	18.10'	S29° 53' 52"W
L6	33.24'	N28° 25' 15"W
L7	42.78'	S53° 39' 20"W
L8	20.58'	N20° 02' 10"W
L9	26.60'	N79° 00' 55"W
L10	22.41'	N4° 37' 58"E
L11	39.06'	N36° 35' 04"E
L12	23.95'	N59° 28' 51"E
L13	36.26'	N85° 07' 18"E
L14	6.74'	N22° 31' 15"E

PARCEL LINE TABLE		
LINE #	LENGTH	BEARING
L1	11.90'	N36° 21' 42"W
L2	23.47'	N38° 48' 48"W
L3	23.93'	N24° 57' 32"W
L4	19.23'	N9° 04' 17"W
L5	32.82'	N5° 25' 01"W
L6	15.77'	N21° 52' 17"W
L7	8.14'	N50° 37' 26"E
L8	12.83'	S53° 53' 10"E
L9	16.38'	N37° 29' 59"E
L10	13.74'	N21° 30' 35"E
L11	32.23'	N34° 58' 44"E
L12	19.24'	N33° 40' 22"W
L13	22.36'	N61° 26' 51"W
L14	22.28'	S88° 34' 34"W
L15	46.24'	N56° 05' 36"W
L16	21.69'	S72° 52' 39"W
L17	25.81'	S36° 48' 48"W
L18	50.98'	S66° 04' 53"W
L19	12.91'	S43° 21' 50"E
L20	35.47'	S2° 18' 52"W
L21	10.59'	N83° 55' 06"W
L22	18.72'	S49° 26' 54"W
L23	27.41'	S46° 10' 54"E
L24	27.84'	S8° 20' 58"W
L25	22.18'	S59° 38' 14"E
L26	21.90'	S50° 10' 39"E
L27	17.34'	N56° 58' 28"W
L28	44.33'	N71° 08' 06"W
L29	37.96'	N45° 23' 17"W
L30	36.93'	N12° 14' 18"W
L31	31.93'	N22° 13' 53"E
L32	34.10'	N18° 21' 06"E
L33	52.52'	N51° 54' 15"E
L34	44.69'	S82° 01' 03"E
L35	24.99'	N46° 56' 04"E
L36	26.98'	N43° 02' 44"E
L37	38.18'	N84° 44' 13"E
L38	41.01'	S80° 34' 33"E
L39	47.04'	S73° 51' 52"E
L40	18.01'	S88° 13' 02"E
L41	50.15'	S13° 12' 34"E
L42	34.46'	S6° 37' 11"W
L43	26.61'	S48° 39' 47"W
L44	35.90'	S25° 54' 48"W
L45	45.64'	S0° 05' 25"W
L46	15.04'	S15° 50' 39"E
L47	15.02'	S21° 19' 17"E
L48	52.82'	S55° 38' 59"W



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8.37 FEET ABOVE MHW (MEAN HIGH WATER)
N: 335951.53
E: 909789.71

TIDE STATION- S-TC-01
N: 336025.39
E: 919546.89

CHRISTOPHER T. JOHNSON
LICENSED PROFESSIONAL ENGINEER AND SURVEYOR
4/15/11
PE-15761
PS-3129
STATE OF MISSISSIPPI

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15) NORTH 21 DEGREES 30 MINUTES 35 SECONDS
16) NORTH 34 DEGREES 58 MINUTES 44 SECONDS
17) NORTH 33 DEGREES 40 MINUTES 22 SECONDS
18) NORTH 61 DEGREES 26 MINUTES 51 SECONDS
19) SOUTH 88 DEGREES 34 MINUTES 34 SECONDS
20) NORTH 56 DEGREES 05 MINUTES 36 SECONDS
21) SOUTH 72 DEGREES 52 MINUTES 39 SECONDS
22) SOUTH 36 DEGREES 48 MINUTES 48 SECONDS
23) SOUTH 66 DEGREES 04 MINUTES 53 SECONDS
24) SOUTH 43 DEGREES 21 MINUTES 50 SECONDS
25) SOUTH 02 DEGREES 18 MINUTES 52 SECONDS
26) NORTH 83 DEGREES 55 MINUTES 06 SECONDS
27) SOUTH 49 DEGREES 26 MINUTES 54 SECONDS
28) SOUTH 46 DEGREES 10 MINUTES 54 SECONDS
29) SOUTH 08 DEGREES 20 MINUTES 58 SECONDS
30) SOUTH 59 DEGREES 38 MINUTES 14 SECONDS
31) SOUTH 50 DEGREES 10 MINUTES 39 SECONDS
32) NORTH 56 DEGREES 58 MINUTES 28 SECONDS
33) NORTH 71 DEGREES 08 MINUTES 06 SECONDS
34) NORTH 45 DEGREES 23 MINUTES 17 SECONDS
35) NORTH 12 DEGREES 14 MINUTES 18 SECONDS
36) NORTH 22 DEGREES 13 MINUTES 53 SECONDS
37) NORTH 18 DEGREES 21 MINUTES 06 SECONDS
38) NORTH 51 DEGREES 54 MINUTES 15 SECONDS
39) SOUTH 82 DEGREES 01 MINUTES 03 SECONDS
40) NORTH 46 DEGREES 56 MINUTES 04 SECONDS
41) NORTH 43 DEGREES 02 MINUTES 44 SECONDS
42) NORTH 84 DEGREES 44 MINUTES 13 SECONDS
43) SOUTH 80 DEGREES 34 MINUTES 33 SECONDS
44) SOUTH 73 DEGREES 51 MINUTES 52 SECONDS
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SCALE 1 INCH = 40 FEET

0 10 20 40 80

APPENDIX G
No-Rise/No-Impact Certification and Report for Bernard Bayou
Dewberry & Davis, Inc. of Mississippi

CAVENHAM FOREST INDUSTRIES, LLC

SITE REMEDIATION ACTIVITIES

"NO-RISE / NO-IMPACT" CERTIFICATION AND REPORT

FOR

BERNARD BAYOU

IN

GULFPORT, MISSISSIPPI

HARRISON COUNTY

BY

DEWBERRY & DAVIS, INC. OF MISSISSIPPI
8401 ARLINGTON BLVD.
FAIRFAX, VA
22031

SEPTEMBER 12, 2011

Dewberry

9/12/2011

TABLE OF CONTENTS

INTRODUCTION

This report was prepared for Cavenham Forest Industries, LLC (CFI) to document the procedures and analysis used to develop a "No-Rise / No-Impact" Certification for Bernard Bayou.

From FEMA guidance document "Guidance for "No-Rise / No-Impact" Certification for Proposed Developments in Regulatory Floodways" dated September 1, 2004, it states that "prior to issuing any development permits involving activities in a regulatory floodway, the community must obtain a certification stating the proposed development will not impact the pre-project base flood elevations, regulatory floodway elevations, or regulatory floodway widths. The certification should be obtained from the permittee and be signed and sealed by a professional engineer in accordance with State Licensing Board specifications."

HISTORY OF THE CFI SITE AND PROPOSED PROJECT

The following information is taken from the "SWMU 3-1 and SWMU 3-4 Control and Containment Design Report" by Environmental Management Services, Inc. for the CFI site dated August 25, 2011. This describes the history and current conditions for this subject property.

"The CFI Gulfport site is a former wood treating facility. The facility itself is closed, and any remaining equipment from the former process is now used in the site remediation activities. Numerous groundwater monitoring and recovery wells and three water treatment units exist on the property. The CFI facility is located within Harrison County, Mississippi, and is bordered to the north by Bernard Bayou (Harrison County Industrial Seaway) and to the south by residential properties and Turkey Creek. Properties north of the subject property are used for industrial purposes. Properties west of the subject property area used for commercial purposes. Residential properties and undeveloped wooded properties bound the site to the south and southwest."

HYDRAULIC MODEL DEFINITIONS

The following provides definitions of the various models that have been developed in the terms they are referred to by FEMA.

Effective Model – The current regulatory base flood elevations are based upon the "effective model" and it is the starting point for the modeling of any proposed development in the floodplain.

Duplicate Effective – Reproduction of the effective hydraulic model used in the effective Flood Insurance Study (FIS).

Corrected Effective Model – Corrects any modeling errors that exist in the Duplicate Effective Model, adds any additional cross sections to the Duplicate Effective Model required to represent the proposed project, and incorporates more detailed topographic information than that used in the effective model.

Post-Project Model – The appropriate model (Duplicate Effective / Corrected Effective / Pre-Project Conditions Model) is revised to reflect post-project conditions.

BACKGROUND FOR THIS ANALYSIS

In order to prepare the "No-Rise / No-Impact" certification for proposed developments encroaching onto the regulatory floodway for this project, we prepared the following information as required by FEMA.

Currently Effective Model

We obtained the Current Effective model through the standard FEMA procedures through the FEMA Library. This HEC-2 version 4.6.2 information was provided to us in electronic format for the Multiple Storm and Floodway models. See Appendix A for a copy of the files received from the FEMA Library.

Duplicate Effective Model

Purpose of Duplicate Effective Model: Upon receipt of the step-backwater hydraulic model, the engineer should run the effective hydraulic model to duplicate the data in the effective FIS.

We received two models through the FEMA Library for Bernard Bayou. One model was the Current Effective HEC-2 Floodway model and the other was the Multiple Storm HEC-2 model. However, the Base Flood Elevations (BFEs) for these two models did not match with one another exactly. The discrepancy lies in a pier width on one of the upstream bridges and the location of the last cross section.

The Floodway model was used as the basis for the Duplicate Effective Conditions since the flood elevations coincided with the Current Effective Floodway Data Table from the FIS. The HEC-2 model matched well at the FDT cross section locations. The HEC-RAS Duplicate Effective begins to deviate from the Current Effective model at cross section I. This was caused by modeling differences for the bridge calculations. Therefore, the model was truncated at a point prior to this deviation and well upstream of the tie-in point and subject property.

We performed the conversion between the Current Effective models received from the FEMA Library and the Duplicate Effective models using HEC-RAS 4.0. The models matched within the FEMA allowable 0.1 foot tolerance for all cross-sections. Please see Appendix B for the electronic files for Duplicate Effective Model by Dewberry using HEC-RAS 4.0.

Reach	RAS Station	Effective Station	Corrected Station	Effective WSE	Duplicate WSE	Duplicate - Effective WSE
Bernard Bayou	E = 1	3000	3000	3.77	3.77	0.00
Bernard Bayou	F = 2	10725	10725	4.15	4.15	0.00
Bernard Bayou	G = 3	16900	16315	4.34	4.34	0.00
Bernard Bayou	H = 4	19300	18715	4.24	4.24	0.00
Bernard Bayou	5	19350	18765	5.02	5.00	-0.02

Table 1 – Current Effective versus Duplicate Effective Results

Corrected Effective Conditions Model

Purpose of the Corrected Effective Conditions Model: Revise the duplicate effective model to reflect site-specific existing conditions by adding new cross-sections (two or more) in the area of the proposed development, without the proposed development in place. Regulatory floodway limits should be manually set at the new cross-section locations by measuring from the effective FIRM or FBFM. The cumulative reach lengths of the waterway should remain unchanged. The results of these analyses will indicate the base flood elevations and the regulatory floodway elevations for the effective hydraulic model revised to incorporate existing conditions at the proposed project site.

Please note that the cumulative reach lengths for the Corrected Effective model and Post-Proposed Conditions models do not match the Current Effective models. During the No-Rise/No-Impact modeling for this project, it was determined that the actual reach lengths were longer than what is provided in the Current Effective models. Therefore, the reach length values were changed to match current field conditions in this revision area.

In Appendices E (cross-section plots) and H (certified topographic workmap), the three additional cross-sections (2.3, 2.5 and 2.7) were added to this model based on field survey by Environmental Management Services, Inc., Hattiesburg, Mississippi, dated October 30, 2009 as shown in Appendix F. Based on the latest design for this project, two inlets (West and East) were added to the project. Therefore, four additional cross-sections (2.35, 2.36, 2.44 and 2.45) were also added to this model between surveyed sections 2.3 and 2.5. The cross-section data was derived from terrain and survey field referenced above. The Effective Conditions roughness coefficients and expansion/contraction coefficients were maintained through the new cross-sections. Please see Appendix B for the electronic files for Corrected Effective Model by Dewberry using HEC-RAS 4.0.

The floodway widths in the area of cross-sections 2.3 through 2.7 differ from the effective floodway width as shown on the current effective FIRM panel 28047C0262G dated June 16, 2009. The floodway widths developed as a part of this No-Rise/No-Impact study area based on new topographic data from field survey and terrain modeling; therefore, these sections represent corrected floodway widths between cross-sections 2.3 and 2.7. There are no effective cross-sections near the project area; therefore, the floodway represented in this study area is not based on the latest available topographic data.

Post-Proposed Conditions Model

Purpose of Proposed Conditions Model: Modify the existing conditions models to reflect the proposed development using the new cross-sections, while retaining the currently adopted regulatory floodway widths. The overbank roughness parameters should remain the same unless a valid explanation of how the proposed development will impact the roughness parameters is included with the supporting data. The results of this floodway hydraulic model will indicate the regulatory floodway elevations for proposed conditions at the project site. These results must indicate NO impact on the base flood elevations, regulatory floodway elevations, or regulatory floodway widths shown in the Duplicate Effective Model or in the Existing Conditions Model.

The cross-sections 2.3, and 2.5 representing the proposed conditions for this site reflect the proposed 105'x70'x6" concrete pad and associated backfill to be part of the remediation project along Bernard Bayou. The cross-sections 2.35, 2.36, 2.44 and 2.45 representing the proposed conditions for this site reflect the proposed Western Inlet and Eastern Inlet. The roughness coefficients were adjusted in the right overbanks to represent the concrete-lined bypass channel at the Eastern Inlet and the mitigated wetlands at the Western Inlet. Please see Appendix B for the electronic files for Post-Proposed Conditions Model by Dewberry using HEC-RAS 4.0. Appendices C and D contain the annotated FIRM and Floodway Data Tables produced by Dewberry.

The floodway widths in the area of cross-sections 2.3 through 2.7 match the Corrected Effective floodway width and are based on the latest topographic data in this study area. The floodway widths in this area differ from the floodway widths as shown on the current effective FIRM panel 28047C0262G dated June 16, 2009. The floodway widths developed as a part of this No-Rise/No-Impact study area based on new topographic data from field survey and terrain modeling; therefore, these sections represent corrected floodway widths between cross-sections 2.3 and 2.7. There are no effective cross-sections near the project area; therefore, the floodway represented in this study area is not based on the latest available topographic data.

Reach	RAS Station	Effective Station	Corrected Station	Duplicate WSE	Corrected WSE	Post-Project WSE	Corrected - Duplicate WSE	Post-Project-Corrected WSE
Bernard Bayou	E = 1	3000	3000	3.77	3.77	3.77	0.00	0.00
Bernard Bayou	F = 2	10725	10725	4.15	4.15	4.15	0.00	0.00
Bernard Bayou	2.3	N/A	11864	4.19*	4.17	4.17	-0.02	0.00
Bernard Bayou	2.35	N/A		4.20*	4.19	4.19	-0.01	0.00
Bernard Bayou	2.36	N/A		4.21*	4.21	4.21	0.00	0.00
Bernard Bayou	2.44	N/A		4.23*	4.21	4.21	-0.02	0.00
Bernard Bayou	2.45	N/A		4.24*	4.22	4.22	-0.02	0.00
Bernard Bayou	2.5	N/A	13785	4.25*	4.23	4.23	-0.02	0.00
Bernard Bayou	2.7	N/A	15136	4.30*	4.28	4.28	-0.02	0.00
Bernard Bayou	G = 3	16900	16315	4.34	4.36	4.36	0.02	0.00
Bernard Bayou	H = 4	19300	18715	4.24	4.26	4.26	0.02	0.00
Bernard Bayou	5	19350	18765	5.00	5.02	5.02	0.02	0.00

* interpolated WSE

Table 2 – Base Flood Elevation Results

Reach	RAS Station	Effective Station	Corrected Station	Current Effective Floodway	Duplicate Effective Floodway	Corrected Effective Floodway	Post-Project Floodway	Post-Project-Corrected Floodway
Bernard Bayou	E = 1	3000	3000	750	749.59	749.59	749.59	0.00
Bernard Bayou	F = 2	10725	10725	736	735.89	735.89	735.89	0.00
Bernard Bayou	2.3	N/A	11864			481.23	481.23	0.00
Bernard Bayou	2.35					596.15	596.15	0.00
Bernard Bayou	2.36					661.09	661.09	0.00
Bernard Bayou	2.44					382.69	382.69	0.00
Bernard Bayou	2.45					379.32	379.32	0.00
Bernard Bayou	2.5	N/A	13785			447.60	447.60	0.00
Bernard Bayou	2.7	N/A	15136			347.43	347.43	0.00
Bernard Bayou	G = 3	16900	16315	282	281.56	281.60	281.60	0.00
Bernard Bayou	H = 4	19300	18715	124	124.00	124.00	124.00	0.00
Bernard Bayou	5	19350	18765		124.00	124.00	124.00	0.00

Table 2 – Floodway Results

Please note: Output files from the HEC-2 and HEC-RAS models are located in Appendix G of this report.

CONCLUSION

Based on the FEMA guidance document "Guidance for "No-Rise / No-Impact" Certification for Proposed Developments in Regulatory Floodways", there is no adverse affect to the Post-Project Conditions due to the Cavenham Forest Industries, LLC remediation work planned along Bernard Bayou.

There are no mappable differences for the annotated FIRM panel for this project. The additional cross-sections are shown on the annotated Floodway Data Table for this project which also shows that there are NO changes to the floodway for this project.

However, the floodway widths in the area of study as part of this No-Rise/No-Impact report area based on the latest topographic data and do differ from the effective floodway widths as represented on the current effective FIRM panel. The differences are solely due to the better topographic data used to verify that the subject project meets the criteria for a No-Rise/No-Impact study. There are no floodway differences due to the project.

It is our recommendation that Harrison County pursue an update or revision to the effective floodway boundary along this area of Bernard Bayou due to better topographic data provided in this report. This update or revision in the form of a Letter of Map Revision (LOMR) for FEMA acceptance will be addressed under separate cover.

Appendix I contains the No-Rise / No-Impact Engineering Certification as required by FEMA for this case.

APPENDIX A
COPY OF CURRENT EFFECTIVE FIS HYDRAULICS MODELS

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T1      BASED ON FIS STUDY FROM PAPER PRINTOUT
T2      HARRISON COUNTY, MISSISSIPI
T3      BERNARD BAYOU            10 YR FLOOD
T4      PROPOSED CLOMR MODEL              3/98   JC FILENAME:    BPROPFH2.IH2

J1     0       2                                                     1.75
J2     1               -1
J3    38      43        1      26      39       4     150     110
J3
J5   -10     -10

NC   .08     .08      .03      .1      .3

QT     5    7200    10000   14900   22000   14900

X1   0.8      24     2061    2811    3000    3000    5750
GR   8.6    2000      7.6    2061     0.7    2062     -10    2111   -13.3    2161
GR   -14    2211    -12.8    2261      -3    2311      .9    2341     1.5    2342
GR    .1    2397     -1.3    2407     -.6    2414      .8    2417       1    2599
GR   -.2    2604     -5.5    2649     -13    2699   -10.8    2719    -8.2    2774
GR   -.1    2810      3.1    2811     7.2    3188      15    3800

X1   0.9      21     2450    3193    5500    5700    7725
GR    14    2000     11.9    2313     6.7    2450    -7.1    2510   -12.7    2560
GR -13.8    2610    -14.8    2660   -14.3    2710   -14.8    2760   -13.7    2810
GR -12.8    2860    -10.3    2910   -10.2    2960   -11.5    3010      -9    3060
GR  -9.1    3110     -2.8    3160     2.9    3193    10.5    3284    12.4    3394
GR    15    3475

QT     5    4930     6750   10200   15000   10200

NC   .06     .06      .04

X1   1.0      22      300     583    5500    6000    6175
GR  15.0       0     10.0      50     5.0      75     3.0     300     0.7     303
GR  -1.3     313     -3.2     323    -4.6     333   -11.9     343   -13.5     363
GR -13.8     383    -14.8     403   -14.7     423   -14.8     443   -14.3     463
GR -14.3     523     -8.3     543    -1.3     563     0.7     572     5.9     583
GR  10.0    1050     15.0    1375

NC   .08     .08    0.045

X1   2.0      25      626     750    2350    2400    2400
GR    17       0     13.9     600     5.9     610     3.2     620     2.0     626
GR   0.6     627     -1.4     630    -0.7     640    -2.7     650    -6.7     660
GR  -8.6     670     -7.9     680    -7.3     690    -8.2     700    -6.6     710
GR  -2.2     720     -1.1     730    -1.6     740     0.6     744     2.9     750
GR   6.1     760      6.9     770    12.4     777    13.9     780    14.0     800

QT     5    4600     6300    9300   13500    9300

NC                             .3      .5

* CHANGED X3 ELEVATIONS FROM 13.9 TO 12.5
X1   2.1                               50      50      50
X3    10                                                     12.5    12.5

* CHANGED BWC FROM 101 TO 86 AND SS FROM 2.0 TO 2.34
SB  1.05     1.6      2.6              86     8.0    2480    2.34    -6.5    -6.5

* CHANGED X3 ELEVATIONS FROM 13.9 TO 12.5 AND BT 638 TO 626 AND 757 TO 750
X1   2.2                               24      24      24
X2                      1    12.5    13.9
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X3    10                                                    12.5    12.5
BT   -11     600    13.9       0     619    13.9       0     626    13.9       0
BT           657    13.9       0     676    13.9       0     678    13.9       0
BT           719    13.9       0     738    13.9       0     750    13.9       0
BT           777    13.9       0     780    13.9       0

* CHANGED X3 ELEV FROM 12.6 TO 10.6
X1   3.0      25     711     851      30      70      55
X3    10                                                    10.6    10.6
GR  17.0       0    13.9     600    12.6     700     5.6     701     5.4     711
GR   0.6     721    -2.1     731    -3.9     741    -4.2     751    -4.6     761
GR  -6.4     771    -8.4     781    -7.4     791    -8.8     801    -9.7     811
GR  -9.9     821    -1.6     831     0.6     836     3.1     841     8.4     851
GR  10.2     861    11.5     871    11.8     881    12.6     882    13.0     900

* CHANGED BWC FROM 127 TO 121 AND SS FROM 2.0 TO 1.19
SB  1.05     1.6     2.6             121    12.0    2480    1.19    -6.9    -6.9

* CHANGED X3 ELEV FROM 12.6 TO 10.6 AND BT 852 TO 851
X1   3.1                              10      10      10
X2                     1    10.6    12.6
X3    10                                                    10.6    10.6
BT   -15     700    12.6       0     711    12.6       0     725    12.6       0
BT           739    12.6       0     752    12.6       0     767    12.6       0
BT           781    12.6       0     796    12.6       0     810    12.6       0
BT           824    12.6       0     838    12.6       0     851    12.6       0
BT           866    12.6       0     881    12.6       0     882    12.6       0

X1   3.2      21     440     570     200     100     150
GR  15.0       0    10.0     100     5.0     300     5.4     440     0.6     450
GR  -2.1     460    -3.9     470    -4.2     480    -4.6     490    -6.4     500
GR  -8.4     510    -7.4     520    -8.8     530    -9.7     540    -9.9     550
GR  -1.6     560     0.6     565     3.1     570     5.0     600    10.0     650
GR  15.0     775

* ADDED NC
NC                            .1      .3

X1   300      19     318     538     650     900     700
GR  16.4       0    16.0      22     7.0     100    12.0     114    12.8     200
GR  12.0     255    10.4     300     8.0     318     3.5     333    -5.0     357
GR  -5.0     457     3.5     500     8.0     538     6.0     558     4.0     568
GR   2.8     600    10.7     700    18.0     800    20.4     900

* ADDED NC
NC                            .3      .5

* CHANGED X3 ELEV FROM 25 TO 22
X1   301      12     116     304      50      50      50
X3    10                                                      22      22
GR  26.8       0    26.2      74    22.0      76    17.0      86    17.0     116
GR  -5.0     160    -5.0     260    17.0     304    17.0     334    21.0     342
GR  25.0     346    25.1     400

* CHANGED BWC FROM 188 TO 100 & INVERT ELEV FROM 2.5 TO -5
SB  1.05    1.60    2.60             100     4.0    4325     2.0      -5      -5

* CHANGED X3 ELEV FROM 25 TO 22 AND ADDED BT'S 116 AND 304
X1   302       0       0       0      24      24      24
X2     0       0       1    22.0    25.0
X3    10                                                      22      22
BT   -10       0    26.8    26.8      74    26.2    22.0     116   26.04      22
BT           124    26.0    22.0     174    25.8    21.8     244    25.6    21.6
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```
BT           294    25.4    21.4     304   25.36   21.36     344    25.2    21.2
BT           346    25.0    21.0

* CHANGED X3 ELEV FROM 29.7 TO 25.7 AND 28.88
X1   303      13     572     760      50     210      90
X3    10                                                    25.7   28.88
GR  35.0       0    29.2     460    29.7     510    26.0     527    17.0     542
GR  17.0     572    -5.0     616    -5.0     716    17.0     760    17.0     790
GR  30.0     816    34.0     830    35.0    1010

* CHANGED BWC FROM 75 TO 100, SS FROM 3.8 TO 2, AND ELCHD FROM -5.5 TO -5.0
SB  1.05    1.60    2.60             100    12.0    6583       2    -5.0    -5.0

* CHANGED ELLC FROM 30 TO 28.88
* CHANGED X3 FROM 29.7 TO 25.7 AND 28.88 AND ADDED BT'S 572 AND 760
X1   304                             150     150     150
X2                     1   28.88    29.7
X3    10                                                    25.7   28.88
BT   -10     510    29.7    25.7     550    30.1    26.1     572   30.26   26.26
BT           590    30.4    26.4     630    31.0    27.0     700    31.7    27.7
BT           750    32.7    28.7     760   32.88   28.88     790    33.4    29.4
BT           830    34.0    30.0

* CHANGED X3 ELEV FROM 25.8 TO 22.51 AND 22.04
X1   307      12     207     455      80     280     160    .625
X3    10                                                   22.51   22.04
GR  27.0       0    26.8      90    22.8     105    17.0     117    17.0     207
GR  -5.0     251    -5.0     411    17.0     455    17.0     565    21.8     575
GR  25.8     590    25.0    1000

* CHANGED BWC FROM 210 TO 160 AND ELCHU AND ELCHD FROM 3.3 TO -5.0
SB  1.05     1.6     2.6             100     7.0    4770     2.0    -5.0    -5.0

* CHANGED ELLC FROM 22.8 TO 22.51 AND ELTRD FROM 25.8 TO 25.7
* CHANGED X3 ELEV FROM 25.8 TO 22.51 AND 22.04 AND ADDED BT'S 207 AND 455
X1   308      12     207     455      50      50      50    .625
X2                     1   22.51    25.7                            .625
X3    10                                                   22.51   22.04
BT   -11      90    26.8    22.8     130    25.7    22.7     170    26.6    22.6
BT           207   26.51   22.51     210    26.5    22.5     430    26.1    22.1
BT           455   26.04   22.04     470    26.0    22.0     510    25.9    21.9
BT           550    25.8    21.8     590    25.8    21.8
GR  27.0       0    26.8      90    22.8     105    17.0     117    17.0     207
GR  -5.0     251    -5.0     411    17.0     455    17.0     565    21.8     575
GR  25.8     590    25.0    1000

NC                  0.06

X1   309       8      36     224      50      50      50
GR  20.0       0    17.0       6    17.0      36    -5.0      80    -5.0     180
GR  17.5     224    17.0     254    20.0     260

* ADDED NC
NC                            .1      .3

X1   310                            1230    1230    1230

* ADDED CROSS SECTIONS 310.1 THROUGH 310.8 TO REFLECT PROPOSED CHANNEL

* MODIFIED MANNING'S "n" VALUES TO REFLECT MAINTAINED GRASS-LINED CHANNEL
* ADDED CONTRACTION/EXPANSION COEFFICIENTS
NC                  .035
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```
X1 310.1       4    1000  1209.8     530     530     530
GR    16    1000    -2.3  1054.9    -2.3  1154.9      16  1209.8

* PROPOSED SOUTHERN BRIDGE
* ADDED CONTRACTION/EXPANSION COEFFICIENTS
NC                            .3      .5
X1 310.2       4    1000  1209.8     200     200     200
X3    10                                                      16      16
GR    16    1000    -2.3  1054.9    -2.3  1154.9      16  1209.8

SB  1.05     1.6     2.6             100       3    2630       3    -2.3    -2.3

* CHANGED X2 ELEV FROM 15 TO 16
X1 310.3       4    1000  1209.8      60      60      60
X2                     1      15      16
X3    10                                                      16      16
BT    -6    1000      16      16    1003      16      15  1054.9      16      15
BT        1154.9      16      15  1206.8      16      15  1209.8      16      16
GR    16    1000    -2.3  1054.9    -2.3  1154.9      16  1209.8

X1 310.4       4    1000  1209.8      80      80      80
GR    16    1000    -2.3  1054.9    -2.3  1154.9      16  1209.8

* ADDED NC
NC                            .1      .3
X1 310.5       7    1000    1260     245     245     245
GR    16    1000      -2    1054      -2    1154       8    1184       6    1224
GR    10    1252      16    1260

X1 310.6       5    1000  1187.1     230     230     230
GR    16    1000    -1.4  1052.2    -1.4  1152.2     5.6  1173.2      16  1187.1

X1 310.7       5    1000  1187.1     210     210     210
GR  15.7    1000    -1.7  1052.2    -1.7  1152.2     5.3  1173.2    15.7  1187.1

X1 310.8       5    1000 1141.75     190     190     190
GR    18    1000       1 1012.75      -2 1021.75      -2 1081.75      18 1141.75

* END OF MODIFIED CROSS SECTIONS

QT     5    2700    3700    5460    7600    5460

* CHANGED MANNING'S "n" VALUE BACK TO EXISTING
* ADDED CONTRACTION/EXPANSION COEFFICIENTS
NC                    .06      .3      .5

X1   313      19     500     600     110     110     110
X3    10                                                      25      25
GR  27.0       0    26.3     100    25.7     200    25.5     400    26.4     421
GR   8.9     454     9.7     500     9.2     512     5.5     535     1.5     540
GR  -0.9     560     2.3     570     9.2     590    10.7     600    10.5     635
GR  26.4     661    25.8    1000    26.0    1100    27.2    1400

* CHANGED BWC FROM 166 TO 165, SS FROM 2 TO 1.87, AND INVERT FROM 5 TO 6.4
SB  1.05    1.60    2.60             165    1.87    4000       2     6.4     6.4

* ADDED BT'S 500 AND 600
X1   314                             102     102     102
X2                     1    25.0    26.4
X3    10                                                      25      25
BT   -10     421    26.4       0     451    26.5       0     481    26.7       0
BT           500    26.7       0     511    26.7       0     571    26.7       0
BT           600    26.7       0     601    26.7       0     631    26.5       0
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```
BT           661    26.4       0

X1     4      44     620     950     450     250     550
X3    10                                                      22      22
GR  25.0       0    22.4     575    20.9     580    15.9     590    10.7     600
GR   9.1     610     7.8     620     7.4     630     5.2     640     4.7     650
GR   2.9     660     4.4     670     4.4     680     1.7     690     0.8     698
GR  -1.4     700    -1.5     710    -0.6     720    -0.8     730    -0.6     740
GR  -1.2     750    -0.2     760     0.2     770    -0.2     780    -0.1     790
GR  -0.6     800     0.5     810     4.0     820    -0.3     830    -1.6     840
GR  -0.4     850    -0.2     860     0.7     870     1.6     880     1.9     890
GR  -0.4     900    -1.4     910    -1.6     920     1.0     930     5.0     940
GR  10.6     950    17.5     960    22.2     970    25.0    1050

SB  1.05    1.60     2.6             314    27.0    6880    1.93     1.0     1.0

* CHANGED BT'S 633 TO 620 AND 955 TO 950
X1    41                              10      10      10
X2                     1    22.0      25
X3    10                                                      22      22
BT   -31       0    25.0       0     575    25.4       0     588    25.4       0
BT           604    25.4       0     617    25.4       0     620    25.4       0
BT           646    25.4       0     661    25.4       0     675    25.4       0
BT           689    25.4       0     703    25.4       0     716    25.4       0
BT           731    25.4       0     745    25.4       0     759    25.4       0
BT           773    25.4       0     787    25.4       0     802    25.4       0
BT           815    25.4       0     829    25.4       0     843    25.4       0
BT           857    25.4       0     872    25.4       0     885    25.4       0
BT           899    25.4       0     914    25.4       0     927    25.4       0
BT           943    25.4       0     950    25.4       0     970    25.4       0
BT          1050    25.0       0

X1     5      34    1148    1228     150     250     250
X3    10                                                      21      21
GR  25.0       0    21.9    1000    20.9    1001    17.3    1008    12.5    1018
GR  11.2    1028    11.0    1038    10.3    1048    10.4    1058    10.1    1068
GR   9.3    1078     9.3    1088     9.0    1098     8.7    1108     8.9    1118
GR   8.8    1128     8.1    1138     9.9    1148     7.0    1158     2.3    1168
GR   0.7    1171     0.1    1178    -0.8    1188    -0.1    1198     0.7    1200
GR   2.7    1208     5.7    1218    11.7    1228    11.8    1238    12.1    1248
GR  15.9    1258    18.1    1267    21.9    1268    25.0    1600

SB  1.05    1.60    2.60             210    12.0    3280     2.0     6.5     6.5

* CHANGED BT'S FROM 1135 TO 1148 AND FROM 1129 TO 1228
X1    51                              35      35      35
X2                     1    21.0    21.9
X3    10                                                      21      21
BT   -14    1000    21.9       0    1001    21.9       0    1021    21.9       0
BT          1040    21.9       0    1059    21.9       0    1077    21.9       0
BT          1097    21.9       0    1115    21.9       0    1148    21.9       0
BT          1167    21.9       0    1197    21.9       0    1228    21.9       0
BT          1248    21.9       0    1268    21.9       0

X1    52                              50      50      50

* ADDED NC
NC                            .1      .3

X1     6      14    1005    1085    2200    2700    2500
GR  25.0       0    20.5     200   19.14    1000    12.5    1005     6.5    1018
GR   2.7    1031     1.9    1037     1.7    1047     2.7    1050     6.3    1056
GR  12.0    1065    14.7    1085    20.0    1300    25.0    1700
```

```
EJ

T1      BASED ON FIS STUDY FROM PAPER PRINTOUT
T2      HARRISON COUNTY, MISSISSIPI
T3      BERNARD BAYOU            25 YR FLOOD
T4      PROPOSED CLOMR MODEL              9/97   JC FILENAME:    BPROPFH2.IH2
J1   -10       3                                                      2.5
J2     2              -1

T1      BASED ON FIS STUDY FROM PAPER PRINTOUT
T2      HARRISON COUNTY, MISSISSIPI
T3      BERNARD BAYOU           100 YR FLOOD
T4      PROPOSED CLOMR MODEL              9/97   JC FILENAME:    BPROPFH2.IH2
J1   -10       4                                                     3.77
J2     3              -1

T1      BASED ON FIS STUDY FROM PAPER PRINTOUT
T2      HARRISON COUNTY, MISSISSIPI
T3      BERNARD BAYOU           500 YR FLOOD
T4      PROPOSED CLOMR MODEL              9/97   JC FILENAME:    BPROPFH2.IH2
J1   -10       5                                                      5.0
J2    15              -1


ER
```

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1*******************************************
        ***************************************
 *  HEC-2 WATER SURFACE PROFILES             *
        *  U.S. ARMY CORPS OF ENGINEERS       *
 *                                           *
        *  HYDROLOGIC ENGINEERING CENTER      *
 *  Version   4.6.2;  May 1991               *
        *  609 SECOND STREET, SUITE D         *
 *                                           *
        *  DAVIS, CALIFORNIA 95616-4687       *
 *  RUN DATE    14JUL00    TIME   14:55:24  *
        *          (916) 756-1104             *
 *******************************************
        ***************************************




                                             X     X  XXXXXXX   XXXXX
XXXXX
                                             X     X  X        X     X            X
   X
                                             X     X  X        X
   X
                                             XXXXXXX  XXXX     X          XXXXX
XXXXX
                                             X     X  X        X                  X
                                             X     X  X        X     X            X
                                             X     X  XXXXXXX   XXXXX
XXXXXXX
1
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                              PAGE    1



THIS RUN EXECUTED 14JUL00    14:55:24
 *************************************
  HEC-2 WATER SURFACE PROFILES

  Version   4.6.2;  May 1991
 *************************************


 T1      BASED ON FIS STUDY FROM PAPER PRINTOUT
 T2      HARRISON COUNTY, MISSISSIPI
 T3      BERNARD BAYOU            10 YR FLOOD
 T4      PROPOSED CLOMR MODEL             3/98   JC FILENAME:    BPROPFH2.IH2


 J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q
WSEL      FQ

       0         2
1.75
```

```
 J2  NPROF      IPLOT      PRFVS      XSECV      XSECH      FN       ALLDC      IBW
CHNIM      ITRACE

       1                   -1



 J3  VARIABLE CODES FOR SUMMARY PRINTOUT

      38         43          1         26         39          4        150
110



 J5  LPRNT    NUMSEC                    ********REQUESTED SECTION NUMBERS********

     -10       -10



 NC      .08        .08        .03         .1         .3


 QT        5       7200      10000      14900      22000      14900


 X1      0.8         24       2061       2811       3000       3000       5750

 GR      8.6       2000        7.6       2061        0.7       2062        -10
    2111      -13.3       2161
 GR      -14       2211      -12.8       2261         -3       2311         .9
    2341        1.5       2342
 GR       .1       2397       -1.3       2407        -.6       2414         .8
    2417          1       2599
 GR      -.2       2604       -5.5       2649        -13       2699      -10.8
    2719       -8.2       2774
 GR      -.1       2810        3.1       2811        7.2       3188         15
    3800


 X1      0.9         21       2450       3193       5500       5700       7725

 GR       14       2000       11.9       2313        6.7       2450       -7.1
    2510      -12.7       2560
 GR    -13.8       2610      -14.8       2660      -14.3       2710      -14.8
    2760      -13.7       2810
 GR    -12.8       2860      -10.3       2910      -10.2       2960      -11.5
    3010         -9       3060
 GR     -9.1       3110       -2.8       3160        2.9       3193       10.5
    3284       12.4       3394
 GR       15       3475


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 QT        5       4930       6750      10200      15000      10200


 NC      .06        .06        .04
```

```
X1   1.0      22     300     583     5500     6000     6175

GR  15.0       0    10.0      50      5.0       75      3.0
  300      0.7     303
GR  -1.3     313    -3.2     323     -4.6      333    -11.9
  343    -13.5     363
GR -13.8     383   -14.8     403    -14.7      423    -14.8
  443    -14.3     463
GR -14.3     523    -8.3     543     -1.3      563      0.7
  572      5.9     583
GR  10.0    1050    15.0    1375



NC   .08     .08   0.045


X1   2.0      25     626     750     2350     2400     2400

GR    17       0    13.9     600      5.9      610      3.2
  620      2.0     626
GR   0.6     627    -1.4     630     -0.7      640     -2.7
  650     -6.7     660
GR  -8.6     670    -7.9     680     -7.3      690     -8.2
  700     -6.6     710
GR  -2.2     720    -1.1     730     -1.6      740      0.6
  744      2.9     750
GR   6.1     760     6.9     770     12.4      777     13.9
  780     14.0     800


QT     5    4600    6300    9300    13500     9300


NC                            .3       .5


  CHANGED X3 ELEVATIONS FROM 13.9 TO 12.5
X1   2.1                                 50       50       50

X3    10
 12.5     12.5

  CHANGED BWC FROM 101 TO 86 AND SS FROM 2.0 TO 2.34

SB  1.05     1.6     2.6                 86      8.0     2480
 2.34     -6.5    -6.5

  CHANGED X3 ELEVATIONS FROM 13.9 TO 12.5 AND BT 638 TO 626 AND 757 TO 750
X1   2.2                                 24       24       24

X2                     1    12.5     13.9

X3    10
 12.5     12.5
BT   -11     600    13.9       0      619     13.9        0
  626     13.9       0
BT           657    13.9       0      676     13.9        0
  678     13.9       0
BT           719    13.9       0      738     13.9        0
  750     13.9       0
```

```
BT                 777       13.9          0        780       13.9          0


  CHANGED X3 ELEV FROM 12.6 TO 10.6

X1      3.0         25        711        851         30         70         55

X3       10
   10.6        10.6
GR     17.0          0       13.9        600       12.6        700        5.6
    701         5.4        711
GR      0.6        721       -2.1        731       -3.9        741       -4.2
    751        -4.6        761
GR     -6.4        771       -8.4        781       -7.4        791       -8.8
    801        -9.7        811
GR     -9.9        821       -1.6        831        0.6        836        3.1
    841         8.4        851
GR     10.2        861       11.5        871       11.8        881       12.6
    882        13.0        900

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  CHANGED BWC FROM 127 TO 121 AND SS FROM 2.0 TO 1.19

SB     1.05        1.6        2.6                   121       12.0       2480
   1.19        -6.9       -6.9

  CHANGED X3 ELEV FROM 12.6 TO 10.6 AND BT 852 TO 851
X1      3.1                                          10         10         10

X2                              1       10.6       12.6

X3       10
   10.6        10.6
BT      -15        700       12.6          0        711       12.6          0
    725        12.6          0
BT                 739       12.6          0        752       12.6          0
    767        12.6          0
BT                 781       12.6          0        796       12.6          0
    810        12.6          0
BT                 824       12.6          0        838       12.6          0
    851        12.6          0
BT                 866       12.6          0        881       12.6          0
    882        12.6          0


X1      3.2         21        440        570        200        100        150

GR     15.0          0       10.0        100        5.0        300        5.4
    440         0.6        450
GR     -2.1        460       -3.9        470       -4.2        480       -4.6
    490        -6.4        500
GR     -8.4        510       -7.4        520       -8.8        530       -9.7
    540        -9.9        550
GR     -1.6        560        0.6        565        3.1        570        5.0
    600        10.0        650
GR     15.0        775


  ADDED NC
```

```
NC                                       .1          .3


X1      300          19         318         538         650         900         700

GR     16.4           0        16.0          22         7.0         100        12.0
    114         12.8         200
GR     12.0         255        10.4         300         8.0         318         3.5
    333         -5.0         357
GR     -5.0         457         3.5         500         8.0         538         6.0
    558          4.0         568
GR      2.8         600        10.7         700        18.0         800        20.4
    900

  ADDED NC

NC                                       .3          .5


  CHANGED X3 ELEV FROM 25 TO 22
X1      301          12         116         304          50          50          50

X3       10
     22           22
GR     26.8           0        26.2          74        22.0          76        17.0
     86         17.0         116
GR     -5.0         160        -5.0         260        17.0         304        17.0
    334         21.0         342
GR     25.0         346        25.1         400


  CHANGED BWC FROM 188 TO 100 & INVERT ELEV FROM 2.5 TO -5

SB     1.05        1.60        2.60                     100         4.0        4325
    2.0           -5           -5

  CHANGED X3 ELEV FROM 25 TO 22 AND ADDED BT'S 116 AND 304
X1      302           0           0           0          24          24          24

X2        0           0           1        22.0        25.0

X3       10
     22           22
BT      -10           0        26.8        26.8          74        26.2        22.0
    116        26.04          22
BT                  124        26.0        22.0         174        25.8        21.8
    244         25.6        21.6
BT                  294        25.4        21.4         304       25.36       21.36
    344         25.2        21.2
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BT                  346        25.0        21.0


  CHANGED X3 ELEV FROM 29.7 TO 25.7 AND 28.88

X1      303          13         572         760          50         210          90

X3       10
```

```
   25.7      28.88
GR     35.0          0       29.2        460       29.7        510       26.0
    527       17.0        542
GR     17.0        572       -5.0        616       -5.0        716       17.0
    760       17.0        790
GR     30.0        816       34.0        830       35.0       1010


  CHANGED BWC FROM 75 TO 100, SS FROM 3.8 TO 2, AND ELCHD FROM -5.5 TO -5.0

SB     1.05       1.60       2.60                   100       12.0       6583
      2       -5.0       -5.0

  CHANGED ELLC FROM 30 TO 28.88
  CHANGED X3 FROM 29.7 TO 25.7 AND 28.88 AND ADDED BT'S 572 AND 760
X1      304                                         150        150        150

X2                              1      28.88       29.7

X3       10
   25.7      28.88
BT      -10        510       29.7       25.7        550       30.1       26.1
    572      30.26      26.26
BT                 590       30.4       26.4        630       31.0       27.0
    700       31.7       27.7
BT                 750       32.7       28.7        760      32.88      28.88
    790       33.4       29.4
BT                 830       34.0       30.0


  CHANGED X3 ELEV FROM 25.8 TO 22.51 AND 22.04

X1      307         12        207        455         80        280        160
   .625
X3       10
  22.51      22.04
GR     27.0          0       26.8         90       22.8        105       17.0
    117       17.0        207
GR     -5.0        251       -5.0        411       17.0        455       17.0
    565       21.8        575
GR     25.8        590       25.0       1000


  CHANGED BWC FROM 210 TO 160 AND ELCHU AND ELCHD FROM 3.3 TO -5.0

SB     1.05        1.6        2.6                   100        7.0       4770
    2.0       -5.0       -5.0

  CHANGED ELLC FROM 22.8 TO 22.51 AND ELTRD FROM 25.8 TO 25.7
  CHANGED X3 ELEV FROM 25.8 TO 22.51 AND 22.04 AND ADDED BT'S 207 AND 455
X1      308         12        207        455         50         50         50
   .625
X2                              1      22.51       25.7
               .625
X3       10
  22.51      22.04
BT      -11         90       26.8       22.8        130       25.7       22.7
    170       26.6       22.6
BT                 207      26.51      22.51        210       26.5       22.5
    430       26.1       22.1
BT                 455      26.04      22.04        470       26.0       22.0
    510       25.9       21.9
BT                 550       25.8       21.8        590       25.8       21.8
```

```
GR     27.0          0       26.8         90       22.8        105       17.0
    117         17.0         207
GR     -5.0        251       -5.0        411       17.0        455       17.0
    565         21.8         575
GR     25.8        590       25.0       1000


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NC                             0.06


X1      309          8         36        224         50         50         50

GR     20.0          0       17.0          6       17.0         36       -5.0
     80         -5.0         180
GR     17.5        224       17.0        254       20.0        260


  ADDED NC

NC                                          .1         .3


X1      310                                        1230       1230       1230


  ADDED CROSS SECTIONS 310.1 THROUGH 310.8 TO REFLECT PROPOSED CHANNEL

  MODIFIED MANNING'S "n" VALUES TO REFLECT MAINTAINED GRASS-LINED CHANNEL
  ADDED CONTRACTION/EXPANSION COEFFICIENTS

NC                             .035


X1    310.1          4       1000     1209.8        530        530        530

GR       16       1000       -2.3     1054.9       -2.3     1154.9         16
 1209.8

  PROPOSED SOUTHERN BRIDGE
  ADDED CONTRACTION/EXPANSION COEFFICIENTS

NC                                          .3         .5

X1    310.2          4       1000     1209.8        200        200        200

X3       10
     16           16
GR       16       1000       -2.3     1054.9       -2.3     1154.9         16
 1209.8


SB     1.05        1.6        2.6                   100          3       2630
      3         -2.3        -2.3

  CHANGED X2 ELEV FROM 15 TO 16
X1    310.3          4       1000     1209.8         60         60         60
```

```
X2                            1         15          16

X3      10
     16          16
BT      -6        1000        16         16        1003         16         15
 1054.9          16         15
BT              1154.9        16         15      1206.8         16         15
 1209.8          16         16
GR      16        1000      -2.3     1054.9        -2.3     1154.9         16
 1209.8


X1    310.4          4      1000     1209.8          80         80         80

GR      16        1000      -2.3     1054.9        -2.3     1154.9         16
 1209.8

  ADDED NC

NC                                       .1          .3

X1    310.5          7      1000       1260         245        245        245

GR      16        1000        -2       1054          -2       1154          8
   1184           6       1224
GR      10        1252        16       1260


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X1    310.6          5      1000     1187.1         230        230        230

GR      16        1000      -1.4     1052.2        -1.4     1152.2        5.6
 1173.2          16     1187.1


X1    310.7          5      1000     1187.1         210        210        210

GR    15.7        1000      -1.7     1052.2        -1.7     1152.2        5.3
 1173.2        15.7     1187.1


X1    310.8          5      1000    1141.75         190        190        190

GR      18        1000         1    1012.75          -2    1021.75         -2
1081.75          18    1141.75

  END OF MODIFIED CROSS SECTIONS


QT       5        2700      3700       5460        7600       5460


  CHANGED MANNING'S "n" VALUE BACK TO EXISTING
  ADDED CONTRACTION/EXPANSION COEFFICIENTS
NC                           .06         .3          .5
```

```
X1      313         19        500        600        110        110        110

X3       10
     25         25
GR     27.0          0       26.3        100       25.7        200       25.5
    400       26.4       421
GR      8.9        454        9.7        500        9.2        512        5.5
    535        1.5       540
GR     -0.9        560        2.3        570        9.2        590       10.7
    600       10.5       635
GR     26.4        661       25.8       1000       26.0       1100       27.2
   1400

  CHANGED BWC FROM 166 TO 165, SS FROM 2 TO 1.87, AND INVERT FROM 5 TO 6.4

SB     1.05       1.60       2.60                   165       1.87       4000
      2        6.4        6.4

  ADDED BT'S 500 AND 600
X1      314                                         102        102        102

X2                              1       25.0       26.4

X3       10
     25         25
BT      -10        421       26.4          0        451       26.5          0
    481       26.7         0
BT                 500       26.7          0        511       26.7          0
    571       26.7         0
BT                 600       26.7          0        601       26.7          0
    631       26.5         0
BT                 661       26.4          0



X1        4         44        620        950        450        250        550

X3       10
     22         22
GR     25.0          0       22.4        575       20.9        580       15.9
    590       10.7       600
GR      9.1        610        7.8        620        7.4        630        5.2
    640        4.7       650
GR      2.9        660        4.4        670        4.4        680        1.7
    690        0.8       698
GR     -1.4        700       -1.5        710       -0.6        720       -0.8
    730       -0.6       740
GR     -1.2        750       -0.2        760        0.2        770       -0.2
    780       -0.1       790
GR     -0.6        800        0.5        810        4.0        820       -0.3
    830       -1.6       840
GR     -0.4        850       -0.2        860        0.7        870        1.6
    880        1.9       890
GR     -0.4        900       -1.4        910       -1.6        920        1.0
    930        5.0       940
GR     10.6        950       17.5        960       22.2        970       25.0
   1050

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                                     PAGE    7
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```
SB     1.05       1.60       2.6                   314       27.0       6880
   1.93        1.0        1.0

  CHANGED BT'S 633 TO 620 AND 955 TO 950
X1       41                                         10         10         10

X2                              1       22.0        25

X3       10
    22         22
BT      -31          0      25.0          0        575       25.4          0
    588        25.4        0
BT                 604      25.4          0        617       25.4          0
    620        25.4        0
BT                 646      25.4          0        661       25.4          0
    675        25.4        0
BT                 689      25.4          0        703       25.4          0
    716        25.4        0
BT                 731      25.4          0        745       25.4          0
    759        25.4        0
BT                 773      25.4          0        787       25.4          0
    802        25.4        0
BT                 815      25.4          0        829       25.4          0
    843        25.4        0
BT                 857      25.4          0        872       25.4          0
    885        25.4        0
BT                 899      25.4          0        914       25.4          0
    927        25.4        0
BT                 943      25.4          0        950       25.4          0
    970        25.4        0
BT                1050      25.0          0


X1        5         34      1148       1228        150        250        250

X3       10
    21         21
GR     25.0          0      21.9       1000       20.9       1001       17.3
   1008        12.5       1018
GR     11.2       1028      11.0       1038       10.3       1048       10.4
   1058        10.1       1068
GR      9.3       1078       9.3       1088        9.0       1098        8.7
   1108         8.9       1118
GR      8.8       1128       8.1       1138        9.9       1148        7.0
   1158         2.3       1168
GR      0.7       1171       0.1       1178       -0.8       1188       -0.1
   1198         0.7       1200
GR      2.7       1208       5.7       1218       11.7       1228       11.8
   1238        12.1       1248
GR     15.9       1258      18.1       1267       21.9       1268       25.0
   1600


SB     1.05       1.60      2.60                   210       12.0       3280
    2.0         6.5        6.5

  CHANGED BT'S FROM 1135 TO 1148 AND FROM 1129 TO 1228
X1       51                                         35         35         35

X2                              1       21.0       21.9
```

```
 X3      10
     21           21
 BT     -14        1000       21.9          0        1001        21.9           0
    1021        21.9          0
 BT                1040       21.9          0        1059        21.9           0
    1077        21.9          0
 BT                1097       21.9          0        1115        21.9           0
    1148        21.9          0
 BT                1167       21.9          0        1197        21.9           0
    1228        21.9          0
 BT                1248       21.9          0        1268        21.9           0


 X1      52                                            50          50          50


   ADDED NC

 NC                                     .1           .3


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                                      PAGE    8


 X1        6          14       1005       1085        2200        2700        2500

 GR     25.0           0       20.5        200       19.14        1000        12.5
    1005         6.5       1018
 GR      2.7        1031        1.9       1037         1.7        1047         2.7
    1050         6.3       1056
 GR     12.0        1065       14.7       1085        20.0        1300        25.0
    1700


1
    14JUL00      14:55:24
                                      PAGE    9


 T1       BASED ON FIS STUDY FROM PAPER PRINTOUT
 T2       HARRISON COUNTY, MISSISSIPI
 T3       BERNARD BAYOU           25 YR FLOOD
 T4       PROPOSED CLOMR MODEL             9/97   JC FILENAME:    BPROPFH2.IH2

 J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q
WSEL      FQ

      -10         3
 2.5

 J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN       ALLDC     IBW
CHNIM      ITRACE

       2                   -1



1
    14JUL00      14:55:24
                                      PAGE   10
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 T1       BASED ON FIS STUDY FROM PAPER PRINTOUT
 T2       HARRISON COUNTY, MISSISSIPI
 T3       BERNARD BAYOU           100 YR FLOOD
 T4       PROPOSED CLOMR MODEL              9/97   JC FILENAME:    BPROPFH2.IH2

 J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q
WSEL      FQ

      -10         4
3.77

 J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN       ALLDC     IBW
CHNIM      ITRACE

       3                  -1



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    14JUL00      14:55:24
                                PAGE   11


 T1       BASED ON FIS STUDY FROM PAPER PRINTOUT
 T2       HARRISON COUNTY, MISSISSIPI
 T3       BERNARD BAYOU           500 YR FLOOD
 T4       PROPOSED CLOMR MODEL              9/97   JC FILENAME:    BPROPFH2.IH2

 J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q
WSEL      FQ

      -10         5
 5.0

 J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN       ALLDC     IBW
CHNIM      ITRACE

      15                  -1




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THIS RUN EXECUTED 14JUL00    14:55:24
 *************************************
  HEC-2 WATER SURFACE PROFILES

  Version   4.6.2;  May 1991
 *************************************


 NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF
ERRORS LIST
```

BERNARD BAYOU

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	VCH	XLCH	TOPWID
	.800	7200.00	1.75	1.38	.00	748.73
	.800	10000.00	2.50	1.74	.00	749.07
	.800	14900.00	3.77	2.22	.00	811.05
	.800	22000.00	5.00	2.88	.00	924.33
*	.900	7200.00	1.91	.79	7725.00	716.47
*	.900	10000.00	2.75	1.03	7725.00	724.93
*	.900	14900.00	4.15	1.39	7725.00	746.83
*	.900	22000.00	5.59	1.87	7725.00	770.31
*	1.000	4930.00	1.99	1.38	6175.00	273.41
*	1.000	6750.00	2.87	1.77	6175.00	276.41
*	1.000	10200.00	4.34	2.42	6175.00	429.98
*	1.000	15000.00	5.88	3.18	6175.00	512.38
*	2.000	4930.00	1.92	6.44	2400.00	121.38
*	2.000	6750.00	2.79	7.74	2400.00	127.65
*	2.000	10200.00	4.24	9.67	2400.00	138.03
*	2.000	15000.00	5.70	12.08	2400.00	148.03
	2.100	4600.00	2.24	5.71	50.00	122.29
	2.100	6300.00	3.25	6.78	50.00	124.00
	2.100	9300.00	5.00	8.11	50.00	124.00
	2.100	13500.00	6.96	9.72	50.00	124.00
	2.200	4600.00	2.33	5.64	24.00	122.51
	2.200	6300.00	3.38	6.66	24.00	124.00
	2.200	9300.00	5.20	7.94	24.00	124.00
	2.200	13500.00	7.28	9.44	24.00	124.00
	3.000	4600.00	2.62	4.74	55.00	123.23
	3.000	6300.00	3.75	5.66	55.00	127.79
	3.000	9300.00	5.68	6.80	55.00	134.87
	3.000	13500.00	7.92	8.06	55.00	139.11

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SECNO	Q	CWSEL	VCH	XLCH	TOPWID
3.100	4600.00	2.67	4.71	10.00	123.46
3.100	6300.00	3.84	5.60	10.00	128.13
3.100	9300.00	5.82	6.71	10.00	135.12
3.100	13500.00	8.13	7.93	10.00	139.50
3.200	4600.00	2.89	4.58	150.00	124.33
3.200	6300.00	4.11	5.43	150.00	143.35
3.200	9300.00	6.19	6.38	150.00	359.56
3.200	13500.00	8.83	6.78	150.00	491.68
300.000	4600.00	3.80	3.87	700.00	209.86
300.000	6300.00	5.22	4.32	700.00	256.11

300.000	9300.00	7.46	4.72	700.00	334.35
300.000	13500.00	9.94	5.11	700.00	420.66
301.000	4600.00	3.82	4.43	50.00	135.28
301.000	6300.00	5.23	5.11	50.00	140.91
301.000	9300.00	7.41	6.00	50.00	149.64
301.000	13500.00	9.81	7.03	50.00	159.24
302.000	4600.00	3.84	4.42	24.00	135.35
302.000	6300.00	5.25	5.10	24.00	141.00
302.000	9300.00	7.44	5.98	24.00	149.77
302.000	13500.00	9.86	7.00	24.00	159.43
303.000	4600.00	3.96	4.35	90.00	135.83
303.000	6300.00	5.39	5.02	90.00	141.55
303.000	9300.00	7.60	5.90	90.00	150.39
303.000	13500.00	10.04	6.90	90.00	160.15
304.000	4600.00	4.01	4.33	150.00	136.03
304.000	6300.00	5.46	4.98	150.00	141.83
304.000	9300.00	7.70	5.84	150.00	150.78
304.000	13500.00	10.17	6.83	150.00	160.70
307.000	4600.00	4.18	4.49	160.00	122.96
307.000	6300.00	5.65	5.22	160.00	126.62
307.000	9300.00	7.90	6.21	160.00	132.24
307.000	13500.00	10.38	7.36	160.00	138.46
308.000	4600.00	4.21	4.48	50.00	123.04
308.000	6300.00	5.69	5.20	50.00	126.73
308.000	9300.00	7.96	6.18	50.00	132.40
308.000	13500.00	10.48	7.31	50.00	138.69
309.000	4600.00	4.34	4.16	50.00	136.95
309.000	6300.00	5.86	4.78	50.00	142.95
309.000	9300.00	8.19	5.59	50.00	152.17
309.000	13500.00	10.80	6.51	50.00	162.51

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	SECNO	Q	CWSEL	VCH	XLCH	TOPWID
	310.000	4600.00	6.06	3.41	1230.00	143.76
	310.000	6300.00	7.80	3.93	1230.00	150.64
	310.000	9300.00	10.39	4.63	1230.00	160.89
	310.000	13500.00	13.31	5.41	1230.00	172.41
	310.100	4600.00	6.44	4.17	530.00	152.46
	310.100	6300.00	8.20	4.56	530.00	163.02
	310.100	9300.00	10.82	5.09	530.00	178.73
*	310.100	13500.00	13.78	5.67	530.00	196.45
	310.200	4600.00	6.59	4.08	200.00	153.37
	310.200	6300.00	8.35	4.48	200.00	163.91
	310.200	9300.00	10.97	5.01	200.00	179.60
	310.200	13500.00	13.92	5.60	200.00	197.32
	310.300	4600.00	6.60	4.08	60.00	153.43
	310.300	6300.00	8.36	4.48	60.00	163.98
	310.300	9300.00	10.98	5.01	60.00	179.68

	310.300	13500.00	13.94	5.59	60.00	197.42
	310.400	4600.00	6.66	4.05	80.00	153.74
	310.400	6300.00	8.42	4.45	80.00	164.29
	310.400	9300.00	11.04	4.98	80.00	179.99
	310.400	13500.00	13.99	5.57	80.00	197.72
	310.500	4600.00	6.83	4.09	245.00	175.31
	310.500	6300.00	8.63	4.23	245.00	220.26
	310.500	9300.00	11.28	4.42	245.00	239.54
	310.500	13500.00	14.27	4.75	245.00	252.53
	310.600	4600.00	6.99	4.38	230.00	148.07
	310.600	6300.00	8.75	4.79	230.00	155.66
	310.600	9300.00	11.33	5.37	230.00	166.85
	310.600	13500.00	14.27	6.03	230.00	179.58
	310.700	4600.00	7.18	4.10	210.00	150.16
	310.700	6300.00	8.94	4.52	210.00	157.78
	310.700	9300.00	11.52	5.13	210.00	168.97
	310.700	13500.00	14.46	5.80	210.00	181.71
*	310.800	4600.00	7.14	6.08	190.00	101.04
*	310.800	6300.00	8.85	6.74	190.00	107.43
*	310.800	9300.00	11.35	7.65	190.00	116.81
*	310.800	13500.00	14.20	8.64	190.00	127.49
*	313.000	2700.00	6.78	11.20	110.00	55.97
*	313.000	3700.00	8.72	10.08	110.00	73.69
*	313.000	5460.00	11.50	8.77	110.00	100.00
*	313.000	7600.00	14.63	8.12	110.00	100.00

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	SECNO	Q	CWSEL	VCH	XLCH	TOPWID
*	314.000	2700.00	9.16	6.76	102.00	77.60
*	314.000	3700.00	9.19	9.20	102.00	77.91
	314.000	5460.00	11.57	8.67	102.00	100.00
	314.000	7600.00	14.66	8.09	102.00	100.00
*	4.000	2700.00	10.20	.92	550.00	329.29
*	4.000	3700.00	11.07	1.15	550.00	330.00
*	4.000	5460.00	13.26	1.38	550.00	330.00
*	4.000	7600.00	16.13	1.55	550.00	330.00
	41.000	2700.00	10.20	.92	10.00	329.29
	41.000	3700.00	11.07	1.15	10.00	330.00
	41.000	5460.00	13.26	1.38	10.00	330.00
	41.000	7600.00	16.13	1.55	10.00	330.00
*	5.000	2700.00	10.07	5.06	250.00	77.28
*	5.000	3700.00	10.86	6.21	250.00	78.60
*	5.000	5460.00	12.97	7.15	250.00	80.00
*	5.000	7600.00	15.77	7.69	250.00	80.00
	51.000	2700.00	10.14	5.00	35.00	77.40
	51.000	3700.00	10.99	6.11	35.00	78.81
	51.000	5460.00	13.12	7.04	35.00	80.00
	51.000	7600.00	15.91	7.60	35.00	80.00

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        52.000   2700.00      10.39       4.59      50.00    177.19
        52.000   3700.00      11.42       5.18      50.00    201.28
 *      52.000   5460.00      13.84       5.07      50.00    237.37
 *      52.000   7600.00      16.84       4.74      50.00    252.90

         6.000   2700.00      15.75       4.06    2500.00    124.72
         6.000   3700.00      17.15       4.63    2500.00    182.89
         6.000   5460.00      18.80       5.49    2500.00    251.27
         6.000   7600.00      20.49       5.80    2500.00   1134.24

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                                PAGE   16


 BERNARD BAYOU

 SUMMARY PRINTOUT TABLE  110


       SECNO     CWSEL     DIFKWS       EG      TOPWID     QLOB       QCH      QROB
 PERENC    STENCL     STCHL     STCHR    STENCR

          .800      1.75        .00      1.78    748.73        .00   7200.00       .00
     .00       .00   2061.00   2811.00       .00
          .800      2.50        .00      2.55    749.07        .00  10000.00       .00
     .00       .00   2061.00   2811.00       .00
          .800      3.77        .00      3.85    811.05        .00  14898.06      1.94
     .00       .00   2061.00   2811.00       .00
          .800      5.00        .00      5.13    924.33        .00  21962.82     37.18
     .00       .00   2061.00   2811.00       .00

 *        .900      1.91        .00      1.92    716.47        .00   7200.00       .00
     .00       .00   2450.00   3193.00       .00
 *        .900      2.75        .00      2.76    724.93        .00  10000.00       .00
     .00       .00   2450.00   3193.00       .00
 *        .900      4.15        .00      4.18    746.83        .00  14899.41       .59
     .00       .00   2450.00   3193.00       .00
 *        .900      5.59        .00      5.64    770.31        .00  21994.18      5.82
     .00       .00   2450.00   3193.00       .00

 *       1.000      1.99        .00      2.02    273.41        .00   4930.00       .00
     .00       .00    300.00    583.00       .00
 *       1.000      2.87        .00      2.92    276.41        .00   6750.00       .00
     .00       .00    300.00    583.00       .00
 *       1.000      4.34        .00      4.43    429.98      20.60  10179.40       .00
     .00       .00    300.00    583.00       .00
 *       1.000      5.88        .00      6.04    512.38     216.05  14783.95       .00
     .00       .00    300.00    583.00       .00

 *       2.000      1.92        .00      2.56    121.38        .00   4930.00       .00
     .00       .00    626.00    750.00       .00
 *       2.000      2.79        .00      3.72    127.65       1.00   6749.00       .00
     .00       .00    626.00    750.00       .00
 *       2.000      4.24        .00      5.69    138.03      19.78  10177.44      2.78
     .00       .00    626.00    750.00       .00
 *       2.000      5.70        .00      7.95    148.03      78.68  14898.92     22.41
     .00       .00    626.00    750.00       .00

         2.100      2.24        .00      2.75    122.29        .00   4600.00       .00
     .00       .00    626.00    750.00       .00
         2.100      3.25        .00      3.96    124.00        .00   6300.00       .00
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   .00       .00    626.00    750.00       .00
      2.100      5.00       .00      6.02    124.00       .00   9300.00       .00
   .00       .00    626.00    750.00       .00
      2.100      6.96       .00      8.43    124.00       .00  13500.00       .00
   .00       .00    626.00    750.00       .00

      2.200      2.33       .00      2.82    122.51       .00   4600.00       .00
   .00       .00    626.00    750.00       .00
      2.200      3.38       .00      4.07    124.00       .00   6300.00       .00
   .00       .00    626.00    750.00       .00
      2.200      5.20       .00      6.18    124.00       .00   9300.00       .00
   .00       .00    626.00    750.00       .00
      2.200      7.28       .00      8.67    124.00       .00  13500.00       .00
   .00       .00    626.00    750.00       .00

      3.000      2.62       .00      2.96    123.23       .00   4600.00       .00
   .00       .00    711.00    851.00       .00
      3.000      3.75       .00      4.25    127.79       .00   6300.00       .00
   .00       .00    711.00    851.00       .00
      3.000      5.68       .00      6.40    134.87       .00   9300.00       .00
   .00       .00    711.00    851.00       .00
      3.000      7.92       .00      8.93    139.11       .00  13500.00       .00
   .00       .00    711.00    851.00       .00

      3.100      2.67       .00      3.01    123.46       .00   4600.00       .00
   .00       .00    711.00    851.00       .00
      3.100      3.84       .00      4.32    128.13       .00   6300.00       .00
   .00       .00    711.00    851.00       .00
      3.100      5.82       .00      6.52    135.12       .00   9300.00       .00
   .00       .00    711.00    851.00       .00
      3.100      8.13       .00      9.11    139.50       .00  13500.00       .00
   .00       .00    711.00    851.00       .00

      3.200      2.89       .00      3.22    124.33       .00   4600.00       .00
   .00       .00    440.00    570.00       .00
      3.200      4.11       .00      4.57    143.35       .00   6296.27      3.73
   .00       .00    440.00    570.00       .00
      3.200      6.19       .00      6.81    359.56    118.35   9098.08     83.56
   .00       .00    440.00    570.00       .00
      3.200      8.83       .00      9.47    491.68   1141.78  11999.72    358.50
   .00       .00    440.00    570.00       .00

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                           PAGE   17


      SECNO      CWSEL     DIFKWS        EG      TOPWID      QLOB       QCH      QROB
 PERENC     STENCL      STCHL      STCHR     STENCR

    300.000      3.80       .00      4.03    209.86       .00   4592.53      7.47
   .00       .00    318.00    538.00       .00
    300.000      5.22       .00      5.51    256.11       .00   6216.97     83.03
   .00       .00    318.00    538.00       .00
    300.000      7.46       .00      7.79    334.35       .28   8908.87    390.85
   .00       .00    318.00    538.00       .00
    300.000      9.94       .00     10.32    420.66     45.06  12433.77   1021.17
   .00       .00    318.00    538.00       .00

    301.000      3.82       .00      4.13    135.28       .00   4600.00       .00
   .00       .00    116.00    304.00       .00
    301.000      5.23       .00      5.63    140.91       .00   6300.00       .00
   .00       .00    116.00    304.00       .00
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 301.000      7.41       .00      7.97   149.64       .00   9300.00       .00
.00       .00   116.00   304.00      .00
 301.000      9.81       .00     10.58   159.24       .00  13500.00       .00
.00       .00   116.00   304.00      .00

 302.000      3.84       .00      4.14   135.35       .00   4600.00       .00
.00       .00   116.00   304.00      .00
 302.000      5.25       .00      5.65   141.00       .00   6300.00       .00
.00       .00   116.00   304.00      .00
 302.000      7.44       .00      8.00   149.77       .00   9300.00       .00
.00       .00   116.00   304.00      .00
 302.000      9.86       .00     10.62   159.43       .00  13500.00       .00
.00       .00   116.00   304.00      .00

 303.000      3.96       .00      4.25   135.83       .00   4600.00       .00
.00       .00   572.00   760.00      .00
 303.000      5.39       .00      5.78   141.55       .00   6300.00       .00
.00       .00   572.00   760.00      .00
 303.000      7.60       .00      8.14   150.39       .00   9300.00       .00
.00       .00   572.00   760.00      .00
 303.000     10.04       .00     10.78   160.15       .00  13500.00       .00
.00       .00   572.00   760.00      .00

 304.000      4.01       .00      4.30   136.03       .00   4600.00       .00
.00       .00   572.00   760.00      .00
 304.000      5.46       .00      5.84   141.83       .00   6300.00       .00
.00       .00   572.00   760.00      .00
 304.000      7.70       .00      8.23   150.78       .00   9300.00       .00
.00       .00   572.00   760.00      .00
 304.000     10.17       .00     10.90   160.70       .00  13500.00       .00
.00       .00   572.00   760.00      .00

 307.000      4.18       .00      4.50   122.96       .00   4600.00       .00
.00       .00   129.38   284.38      .00
 307.000      5.65       .00      6.07   126.62       .00   6300.00       .00
.00       .00   129.38   284.38      .00
 307.000      7.90       .00      8.49   132.24       .00   9300.00       .00
.00       .00   129.38   284.38      .00
 307.000     10.38       .00     11.22   138.46       .00  13500.00       .00
.00       .00   129.38   284.38      .00

 308.000      4.21       .00      4.53   123.04       .00   4600.00       .00
.00       .00   129.38   284.38      .00
 308.000      5.69       .00      6.11   126.73       .00   6300.00       .00
.00       .00   129.38   284.38      .00
 308.000      7.96       .00      8.55   132.40       .00   9300.00       .00
.00       .00   129.38   284.38      .00
 308.000     10.48       .00     11.31   138.69       .00  13500.00       .00
.00       .00   129.38   284.38      .00

 309.000      4.34       .00      4.61   136.95       .00   4600.00       .00
.00       .00    36.00   224.00      .00
 309.000      5.86       .00      6.21   142.95       .00   6300.00       .00
.00       .00    36.00   224.00      .00
 309.000      8.19       .00      8.67   152.17       .00   9300.00       .00
.00       .00    36.00   224.00      .00
 309.000     10.80       .00     11.46   162.51       .00  13500.00       .00
.00       .00    36.00   224.00      .00

 310.000      6.06       .00      6.24   143.76       .00   4600.00       .00
.00       .00    36.00   224.00      .00
 310.000      7.80       .00      8.04   150.64       .00   6300.00       .00
.00       .00    36.00   224.00      .00
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     310.000     10.39       .00     10.73    160.89        .00   9300.00        .00
    .00        .00     36.00    224.00        .00
     310.000     13.31       .00     13.76    172.41        .00  13500.00        .00
    .00        .00     36.00    224.00        .00

     310.100      6.44       .00      6.71    152.46        .00   4600.00        .00
    .00        .00   1000.00   1209.80        .00
     310.100      8.20       .00      8.53    163.02        .00   6300.00        .00
    .00        .00   1000.00   1209.80        .00
     310.100     10.82       .00     11.22    178.73        .00   9300.00        .00
    .00        .00   1000.00   1209.80        .00
*    310.100     13.78       .00     14.27    196.45        .00  13500.00        .00
    .00        .00   1000.00   1209.80        .00

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                                   PAGE   18


      SECNO      CWSEL     DIFKWS       EG      TOPWID      QLOB        QCH       QROB
 PERENC     STENCL      STCHL      STCHR     STENCR

     310.200      6.59       .00      6.85    153.37        .00   4600.00        .00
    .00        .00   1000.00   1209.80        .00
     310.200      8.35       .00      8.66    163.91        .00   6300.00        .00
    .00        .00   1000.00   1209.80        .00
     310.200     10.97       .00     11.36    179.60        .00   9300.00        .00
    .00        .00   1000.00   1209.80        .00
     310.200     13.92       .00     14.41    197.32        .00  13500.00        .00
    .00        .00   1000.00   1209.80        .00

     310.300      6.60       .00      6.86    153.43        .00   4600.00        .00
    .00        .00   1000.00   1209.80        .00
     310.300      8.36       .00      8.67    163.98        .00   6300.00        .00
    .00        .00   1000.00   1209.80        .00
     310.300     10.98       .00     11.37    179.68        .00   9300.00        .00
    .00        .00   1000.00   1209.80        .00
     310.300     13.94       .00     14.42    197.42        .00  13500.00        .00
    .00        .00   1000.00   1209.80        .00

     310.400      6.66       .00      6.92    153.74        .00   4600.00        .00
    .00        .00   1000.00   1209.80        .00
     310.400      8.42       .00      8.73    164.29        .00   6300.00        .00
    .00        .00   1000.00   1209.80        .00
     310.400     11.04       .00     11.42    179.99        .00   9300.00        .00
    .00        .00   1000.00   1209.80        .00
     310.400     13.99       .00     14.47    197.72        .00  13500.00        .00
    .00        .00   1000.00   1209.80        .00

     310.500      6.83       .00      7.09    175.31        .00   4600.00        .00
    .00        .00   1000.00   1260.00        .00
     310.500      8.63       .00      8.90    220.26        .00   6300.00        .00
    .00        .00   1000.00   1260.00        .00
     310.500     11.28       .00     11.58    239.54        .00   9300.00        .00
    .00        .00   1000.00   1260.00        .00
     310.500     14.27       .00     14.63    252.53        .00  13500.00        .00
    .00        .00   1000.00   1260.00        .00

     310.600      6.99       .00      7.29    148.07        .00   4600.00        .00
    .00        .00   1000.00   1187.10        .00
     310.600      8.75       .00      9.11    155.66        .00   6300.00        .00
    .00        .00   1000.00   1187.10        .00
     310.600     11.33       .00     11.78    166.85        .00   9300.00        .00
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     .00        .00   1000.00   1187.10       .00
      310.600     14.27       .00     14.83    179.58       .00  13500.00       .00
     .00        .00   1000.00   1187.10       .00

      310.700      7.18       .00      7.44    150.16       .00   4600.00       .00
     .00        .00   1000.00   1187.10       .00
      310.700      8.94       .00      9.26    157.78       .00   6300.00       .00
     .00        .00   1000.00   1187.10       .00
      310.700     11.52       .00     11.93    168.97       .00   9300.00       .00
     .00        .00   1000.00   1187.10       .00
      310.700     14.46       .00     14.98    181.71       .00  13500.00       .00
     .00        .00   1000.00   1187.10       .00

 *    310.800      7.14       .00      7.72    101.04       .00   4600.00       .00
     .00        .00   1000.00   1141.75       .00
 *    310.800      8.85       .00      9.55    107.43       .00   6300.00       .00
     .00        .00   1000.00   1141.75       .00
 *    310.800     11.35       .00     12.26    116.81       .00   9300.00       .00
     .00        .00   1000.00   1141.75       .00
 *    310.800     14.20       .00     15.35    127.49       .00  13500.00       .00
     .00        .00   1000.00   1141.75       .00

 *    313.000      6.78       .00      8.73     55.97       .00   2700.00       .00
     .00        .00    500.00    600.00       .00
 *    313.000      8.72       .00     10.30     73.69       .00   3700.00       .00
     .00        .00    500.00    600.00       .00
 *    313.000     11.50       .00     12.69    100.00       .00   5460.00       .00
     .00        .00    500.00    600.00       .00
 *    313.000     14.63       .00     15.65    100.00       .00   7600.00       .00
     .00        .00    500.00    600.00       .00

 *    314.000      9.16       .00      9.86     77.60       .00   2700.00       .00
     .00        .00    500.00    600.00       .00
 *    314.000      9.19       .00     10.50     77.91       .00   3700.00       .00
     .00        .00    500.00    600.00       .00
      314.000     11.57       .00     12.74    100.00       .00   5460.00       .00
     .00        .00    500.00    600.00       .00
      314.000     14.66       .00     15.68    100.00       .00   7600.00       .00
     .00        .00    500.00    600.00       .00

 *      4.000     10.20       .00     10.21    329.29       .00   2700.00       .00
     .00        .00    620.00    950.00       .00
 *      4.000     11.07       .00     11.09    330.00       .00   3700.00       .00
     .00        .00    620.00    950.00       .00
 *      4.000     13.26       .00     13.29    330.00       .00   5460.00       .00
     .00        .00    620.00    950.00       .00
 *      4.000     16.13       .00     16.16    330.00       .00   7600.00       .00
     .00        .00    620.00    950.00       .00

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       SECNO      CWSEL    DIFKWS       EG      TOPWID      QLOB       QCH      QROB
 PERENC    STENCL      STCHL      STCHR     STENCR

       41.000     10.20       .00     10.21    329.29       .00   2700.00       .00
     .00        .00    620.00    950.00       .00
       41.000     11.07       .00     11.09    330.00       .00   3700.00       .00
     .00        .00    620.00    950.00       .00
       41.000     13.26       .00     13.29    330.00       .00   5460.00       .00
     .00        .00    620.00    950.00       .00
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      41.000     16.13       .00     16.17    330.00       .00   7600.00       .00
    .00       .00    620.00    950.00       .00

 *     5.000     10.07       .00     10.46     77.28       .00   2700.00       .00
    .00       .00   1148.00   1228.00       .00
 *     5.000     10.86       .00     11.46     78.60       .00   3700.00       .00
    .00       .00   1148.00   1228.00       .00
 *     5.000     12.97       .00     13.76     80.00       .00   5460.00       .00
    .00       .00   1148.00   1228.00       .00
 *     5.000     15.77       .00     16.69     80.00       .00   7600.00       .00
    .00       .00   1148.00   1228.00       .00

      51.000     10.14       .00     10.53     77.40       .00   2700.00       .00
    .00       .00   1148.00   1228.00       .00
      51.000     10.99       .00     11.57     78.81       .00   3700.00       .00
    .00       .00   1148.00   1228.00       .00
      51.000     13.12       .00     13.89     80.00       .00   5460.00       .00
    .00       .00   1148.00   1228.00       .00
      51.000     15.91       .00     16.81     80.00       .00   7600.00       .00
    .00       .00   1148.00   1228.00       .00

      52.000     10.39       .00     10.70    177.19    134.92   2565.08       .00
    .00       .00   1148.00   1228.00       .00
      52.000     11.42       .00     11.80    201.28    383.80   3316.20       .00
    .00       .00   1148.00   1228.00       .00
 *    52.000     13.84       .00     14.16    237.37   1176.96   4228.07     54.97
    .00       .00   1148.00   1228.00       .00
 *    52.000     16.84       .00     17.10    252.90   2280.82   5092.51    226.67
    .00       .00   1148.00   1228.00       .00

       6.000     15.75       .00     16.00    124.72      3.02   2685.93     11.05
    .00       .00   1005.00   1085.00       .00
       6.000     17.15       .00     17.47    182.89      8.10   3581.07    110.83
    .00       .00   1005.00   1085.00       .00
       6.000     18.80       .00     19.23    251.27     19.46   4972.18    468.36
    .00       .00   1005.00   1085.00       .00
       6.000     20.49       .00     20.91   1134.24    376.17   6036.54   1187.30
    .00       .00   1005.00   1085.00       .00

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 BERNARD BAYOU

 SUMMARY PRINTOUT TABLE  150


       SECNO     XLCH      ELTRD     ELLC       ELMIN       Q       CWSEL     CRIWS
   EG       10*KS      VCH      AREA      .01K

        .800       .00       .00       .00    -14.00   7200.00      1.75       .00
   1.78       .60      1.38   5200.96  9317.61
        .800       .00       .00       .00    -14.00  10000.00      2.50       .00
   2.55       .82      1.74   5762.64 11039.39
        .800       .00       .00       .00    -14.00  14900.00      3.77       .00
   3.85      1.10      2.22   6734.90 14220.09
        .800       .00       .00       .00    -14.00  22000.00      5.00       .00
   5.13      1.56      2.88   7802.16 17629.48

 *      .900   7725.00       .00       .00    -14.80   7200.00      1.91       .00
   1.92       .09       .79   9081.71 24404.87
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*      .900   7725.00       .00       .00    -14.80  10000.00      2.75       .00
   2.76       .14      1.03   9683.25 26942.99
*      .900   7725.00       .00       .00    -14.80  14900.00      4.15       .00
   4.18       .22      1.39  10712.62 31632.30
*      .900   7725.00       .00       .00    -14.80  22000.00      5.59       .00
   5.64       .36      1.87  11803.83 36804.41

*     1.000   6175.00       .00       .00    -14.80   4930.00      1.99       .00
   2.02       .47      1.38   3561.77  7221.74
*     1.000   6175.00       .00       .00    -14.80   6750.00      2.87       .00
   2.92       .71      1.77   3802.88  7988.33
*     1.000   6175.00       .00       .00    -14.80  10200.00      4.34       .00
   4.43      1.18      2.42   4311.89  9407.84
*     1.000   6175.00       .00       .00    -14.80  15000.00      5.88       .00
   6.04      1.82      3.18   5072.45 11129.39

*     2.000   2400.00       .00       .00     -8.60   4930.00      1.92       .00
   2.56     34.24      6.44    765.61   842.55
*     2.000   2400.00       .00       .00     -8.60   6750.00      2.79       .00
   3.72     42.67      7.74    873.74  1033.33
*     2.000   2400.00       .00       .00     -8.60  10200.00      4.24       .00
   5.69     52.11      9.67   1066.64  1412.93
*     2.000   2400.00       .00       .00     -8.60  15000.00      5.70       .00
   7.95     65.69     12.08   1276.08  1850.73

      2.100     50.00       .00       .00     -8.60   4600.00      2.24       .00
   2.75     25.44      5.71    805.49   912.06
      2.100     50.00       .00       .00     -8.60   6300.00      3.25       .00
   3.96     30.15      6.78    929.66  1147.26
      2.100     50.00       .00       .00     -8.60   9300.00      5.00       .00
   6.02     32.69      8.11   1146.29  1626.60
      2.100     50.00       .00       .00     -8.60  13500.00      6.96       .00
   8.43     36.31      9.72   1389.08  2240.49

      2.200     24.00     13.90     12.50     -8.60   4600.00      2.33       .00
   2.82     24.47      5.64    815.44   929.82
      2.200     24.00     13.90     12.50     -8.60   6300.00      3.38       .00
   4.07     28.51      6.66    945.41  1179.83
      2.200     24.00     13.90     12.50     -8.60   9300.00      5.20       .00
   6.18     30.38      7.94   1171.71  1687.18
      2.200     24.00     13.90     12.50     -8.60  13500.00      7.28       .00
   8.67     32.99      9.44   1429.62  2350.52

      3.000     55.00       .00       .00     -9.90   4600.00      2.62       .00
   2.96     13.92      4.74    970.68  1232.81
      3.000     55.00       .00       .00     -9.90   6300.00      3.75       .00
   4.25     17.43      5.66   1112.99  1509.02
      3.000     55.00       .00       .00     -9.90   9300.00      5.68       .00
   6.40     20.68      6.80   1366.85  2045.20
      3.000     55.00       .00       .00     -9.90  13500.00      7.92       .00
   8.93     23.14      8.06   1674.67  2806.14

      3.100     10.00     12.60     10.60     -9.90   4600.00      2.67       .00
   3.01     13.64      4.71    977.41  1245.50
      3.100     10.00     12.60     10.60     -9.90   6300.00      3.84       .00
   4.32     16.93      5.60   1124.04  1531.15
      3.100     10.00     12.60     10.60     -9.90   9300.00      5.82       .00
   6.52     19.83      6.71   1385.21  2088.33
      3.100     10.00     12.60     10.60     -9.90  13500.00      8.13       .00
   9.11     21.96      7.93   1703.36  2880.98

      3.200    150.00       .00       .00     -9.90   4600.00      2.89       .00
   3.22     12.61      4.58   1003.81  1295.58
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     3.200    150.00        .00        .00     -9.90   6300.00       4.11        .00
   4.57     15.13      5.43   1167.05  1619.57
     3.200    150.00        .00        .00     -9.90   9300.00       6.19        .00
   6.81     16.26      6.38   1665.58  2306.59
     3.200    150.00        .00        .00     -9.90  13500.00       8.83        .00
   9.47     13.78      6.78   2790.29  3636.84

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      SECNO     XLCH      ELTRD     ELLC      ELMIN       Q       CWSEL     CRIWS
    EG       10*KS      VCH       AREA      .01K

    300.000    700.00        .00        .00     -5.00   4600.00       3.80        .00
   4.03     10.57      3.87   1205.04  1415.12
    300.000    700.00        .00        .00     -5.00   6300.00       5.22        .00
   5.51     11.47      4.32   1539.51  1860.09
    300.000    700.00        .00        .00     -5.00   9300.00       7.46        .00
   7.79     11.39      4.72   2191.13  2755.09
    300.000    700.00        .00        .00     -5.00  13500.00       9.94        .00
  10.32      9.92      5.11   3136.32  4286.92

    301.000     50.00        .00        .00     -5.00   4600.00       3.82        .00
   4.13     12.40      4.43   1037.71  1306.23
    301.000     50.00        .00        .00     -5.00   6300.00       5.23        .00
   5.63     13.93      5.11   1231.89  1688.15
    301.000     50.00        .00        .00     -5.00   9300.00       7.41        .00
   7.97     15.42      6.00   1548.85  2367.98
    301.000     50.00        .00        .00     -5.00  13500.00       9.81        .00
  10.58     17.37      7.03   1919.56  3238.73

    302.000     24.00      25.00      22.00     -5.00   4600.00       3.84        .00
   4.14     12.32      4.42   1040.06  1310.68
    302.000     24.00      25.00      22.00     -5.00   6300.00       5.25        .00
   5.65     13.81      5.10   1235.27  1695.05
    302.000     24.00      25.00      22.00     -5.00   9300.00       7.44        .00
   8.00     15.28      5.98   1553.93  2379.38
    302.000     24.00      25.00      22.00     -5.00  13500.00       9.86        .00
  10.62     17.18      7.00   1927.23  3257.50

    303.000     90.00        .00        .00     -5.00   4600.00       3.96        .00
   4.25     11.75      4.35   1056.38  1341.69
    303.000     90.00        .00        .00     -5.00   6300.00       5.39        .00
   5.78     13.19      5.02   1254.71  1734.87
    303.000     90.00        .00        .00     -5.00   9300.00       7.60        .00
   8.14     14.62      5.90   1577.30  2432.10
    303.000     90.00        .00        .00     -5.00  13500.00      10.04        .00
  10.78     16.45      6.90   1956.03  3328.29

    304.000    150.00      29.70      28.88     -5.00   4600.00       4.01        .00
   4.30     11.53      4.33   1063.15  1354.61
    304.000    150.00      29.70      28.88     -5.00   6300.00       5.46        .00
   5.84     12.89      4.98   1264.42  1754.85
    304.000    150.00      29.70      28.88     -5.00   9300.00       7.70        .00
   8.23     14.23      5.84   1591.87  2465.09
    304.000    150.00      29.70      28.88     -5.00  13500.00      10.17        .00
  10.90     15.93      6.83   1977.93  3382.42

    307.000    160.00        .00        .00     -5.00   4600.00       4.18        .00
   4.50     11.74      4.49   1023.74  1342.33
    307.000    160.00        .00        .00     -5.00   6300.00       5.65        .00
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  6.07     13.36      5.22   1206.54  1723.76
    307.000   160.00        .00       .00     -5.00   9300.00      7.90       .00
  8.49     15.19      6.21   1497.49  2386.21
    307.000   160.00        .00       .00     -5.00  13500.00     10.38       .00
 11.22     17.52      7.36   1834.01  3225.32

    308.000    50.00     25.70     22.51     -5.00   4600.00      4.21       .00
  4.53     11.61      4.48   1027.54  1349.96
    308.000    50.00     25.70     22.51     -5.00   6300.00      5.69       .00
  6.11     13.17      5.20   1212.07  1735.73
    308.000    50.00     25.70     22.51     -5.00   9300.00      7.96       .00
  8.55     14.93      6.18   1505.98  2406.47
    308.000    50.00     25.70     22.51     -5.00  13500.00     10.48       .00
 11.31     17.16      7.31   1847.10  3259.39

    309.000    50.00        .00       .00     -5.00   4600.00      4.34       .00
  4.61     18.12      4.16   1106.76  1080.62
    309.000    50.00        .00       .00     -5.00   6300.00      5.86       .00
  6.21     20.16      4.78   1318.85  1403.27
    309.000    50.00        .00       .00     -5.00   9300.00      8.19       .00
  8.67     22.19      5.59   1662.93  1974.29
    309.000    50.00        .00       .00     -5.00  13500.00     10.80       .00
 11.46     24.59      6.51   2074.11  2722.18

    310.000  1230.00        .00       .00     -5.00   4600.00      6.06       .00
  6.24     10.06      3.41   1348.40  1450.11
    310.000  1230.00        .00       .00     -5.00   6300.00      7.80       .00
  8.04     11.31      3.93   1604.38  1873.33
    310.000  1230.00        .00       .00     -5.00   9300.00     10.39       .00
 10.73     12.82      4.63   2007.86  2597.33
    310.000  1230.00        .00       .00     -5.00  13500.00     13.31       .00
 13.76     14.48      5.41   2493.39  3547.13

    310.100   530.00        .00       .00     -2.30   4600.00      6.44       .00
  6.71      7.05      4.17   1103.75  1732.41
    310.100   530.00        .00       .00     -2.30   6300.00      8.20       .00
  8.53      6.87      4.56   1381.33  2404.30
    310.100   530.00        .00       .00     -2.30   9300.00     10.82       .00
 11.22      6.66      5.09   1828.71  3602.54
*   310.100   530.00        .00       .00     -2.30  13500.00     13.78       .00
 14.27      6.62      5.67   2382.75  5248.39

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                             PAGE   22


     SECNO     XLCH      ELTRD     ELLC      ELMIN       Q       CWSEL     CRIWS
 EG        10*KS      VCH      AREA      .01K

    310.200   200.00        .00       .00     -2.30   4600.00      6.59       .00
  6.85      6.63      4.08   1126.86  1785.96
    310.200   200.00        .00       .00     -2.30   6300.00      8.35       .00
  8.66      6.53      4.48   1405.58  2465.80
    310.200   200.00        .00       .00     -2.30   9300.00     10.97       .00
 11.36      6.40      5.01   1854.72  3676.05
    310.200   200.00        .00       .00     -2.30  13500.00     13.92       .00
 14.41      6.40      5.60   2411.41  5337.77

    310.300    60.00     16.00     15.00     -2.30   4600.00      6.60       .00
  6.86      6.61      4.08   1128.33  1789.36
    310.300    60.00     16.00     15.00     -2.30   6300.00      8.36       .00
  8.67      6.50      4.48   1407.39  2470.41
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     310.300     60.00     16.00     15.00     -2.30   9300.00     10.98       .00
  11.37      6.38      5.01   1857.07  3682.71
     310.300     60.00     16.00     15.00     -2.30  13500.00     13.94       .00
  14.42      6.37      5.59   2414.45  5347.30

     310.400     80.00       .00       .00     -2.30   4600.00      6.66       .00
   6.92      6.47      4.05   1136.46  1808.33
     310.400     80.00       .00       .00     -2.30   6300.00      8.42       .00
   8.73      6.39      4.45   1415.95  2492.22
     310.400     80.00       .00       .00     -2.30   9300.00     11.04       .00
  11.42      6.29      4.98   1866.26  3708.79
     310.400     80.00       .00       .00     -2.30  13500.00     13.99       .00
  14.47      6.30      5.57   2424.54  5378.89

     310.500    245.00       .00       .00     -2.00   4600.00      6.83       .00
   7.09      7.93      4.09   1125.76  1633.18
     310.500    245.00       .00       .00     -2.00   6300.00      8.63       .00
   8.90      7.92      4.23   1489.91  2238.47
     310.500    245.00       .00       .00     -2.00   9300.00     11.28       .00
  11.58      6.12      4.42   2104.66  3757.81
     310.500    245.00       .00       .00     -2.00  13500.00     14.27       .00
  14.63      5.12      4.75   2841.96  5965.61

     310.600    230.00       .00       .00     -1.40   4600.00      6.99       .00
   7.29      8.03      4.38   1049.89  1623.72
     310.600    230.00       .00       .00     -1.40   6300.00      8.75       .00
   9.11      7.63      4.79   1315.79  2281.07
     310.600    230.00       .00       .00     -1.40   9300.00     11.33       .00
  11.78      7.35      5.37   1732.05  3430.00
     310.600    230.00       .00       .00     -1.40  13500.00     14.27       .00
  14.83      7.30      6.03   2240.26  4995.67

     310.700    210.00       .00       .00     -1.70   4600.00      7.18       .00
   7.44      6.56      4.10   1122.00  1795.33
     310.700    210.00       .00       .00     -1.70   6300.00      8.94       .00
   9.26      6.44      4.52   1392.41  2482.25
     310.700    210.00       .00       .00     -1.70   9300.00     11.52       .00
  11.93      6.42      5.13   1813.90  3670.97
     310.700    210.00       .00       .00     -1.70  13500.00     14.46       .00
  14.98      6.53      5.80   2328.98  5284.94

*    310.800    190.00       .00       .00     -2.00   4600.00      7.14       .00
   7.72     14.91      6.08    757.06  1191.49
*    310.800    190.00       .00       .00     -2.00   6300.00      8.85       .00
   9.55     15.18      6.74    934.54  1617.08
*    310.800    190.00       .00       .00     -2.00   9300.00     11.35       .00
  12.26     15.60      7.65   1215.08  2354.47
*    310.800    190.00       .00       .00     -2.00  13500.00     14.20       .00
  15.35     16.15      8.64   1562.92  3359.73

*    313.000    110.00       .00       .00      -.90   2700.00      6.78       .00
   8.73    311.87     11.20    241.12   152.89
*    313.000    110.00       .00       .00      -.90   3700.00      8.72       .00
  10.30    206.51     10.08    367.16   257.47
*    313.000    110.00       .00       .00      -.90   5460.00     11.50       .00
  12.69    114.91      8.77    622.37   509.34
*    313.000    110.00       .00       .00      -.90   7600.00     14.63       .00
  15.65     57.22      8.12    935.54  1004.71

*    314.000    102.00     26.40     25.00      -.90   2700.00      9.16       .00
   9.86     88.74      6.76    399.60   286.62
*    314.000    102.00     26.40     25.00      -.90   3700.00      9.19       .00
  10.50    163.80      9.20    402.31   289.10
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     314.000    102.00     26.40     25.00      -.90   5460.00     11.57       .00
  12.74    110.42      8.67    629.85   519.59
     314.000    102.00     26.40     25.00      -.90   7600.00     14.66       .00
  15.68     56.52      8.09    939.00  1010.91

 *     4.000    550.00       .00       .00     -1.60   2700.00     10.20       .00
  10.21       .76       .92   2941.77  3095.80
 *     4.000    550.00       .00       .00     -1.60   3700.00     11.07       .00
  11.09      1.05      1.15   3228.55  3609.13
 *     4.000    550.00       .00       .00     -1.60   5460.00     13.26       .00
  13.29      1.17      1.38   3951.77  5054.92
 *     4.000    550.00       .00       .00     -1.60   7600.00     16.13       .00
  16.16      1.11      1.55   4896.09  7224.58

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                              PAGE   23


      SECNO     XLCH      ELTRD     ELLC      ELMIN       Q       CWSEL     CRIWS
  EG       10*KS      VCH       AREA      .01K

      41.000     10.00     25.00     22.00     -1.60   2700.00     10.20       .00
  10.21       .76       .92   2941.72  3095.71
      41.000     10.00     25.00     22.00     -1.60   3700.00     11.07       .00
  11.09      1.05      1.15   3228.62  3609.26
      41.000     10.00     25.00     22.00     -1.60   5460.00     13.26       .00
  13.29      1.17      1.38   3952.50  5056.46
      41.000     10.00     25.00     22.00     -1.60   7600.00     16.13       .00
  16.17      1.11      1.55   4897.53  7228.11

 *     5.000    250.00       .00       .00      -.80   2700.00     10.07       .00
  10.46     33.85      5.06    534.10   464.09
 *     5.000    250.00       .00       .00      -.80   3700.00     10.86       .00
  11.46     45.21      6.21    596.03   550.26
 *     5.000    250.00       .00       .00      -.80   5460.00     12.97       .00
  13.76     44.15      7.15    764.12   821.77
 *     5.000    250.00       .00       .00      -.80   7600.00     15.77       .00
  16.69     36.32      7.69    987.99  1261.09

      51.000     35.00     21.90     21.00      -.80   2700.00     10.14       .00
  10.53     32.77      5.00    539.67   471.65
      51.000     35.00     21.90     21.00      -.80   3700.00     10.99       .00
  11.57     42.97      6.11    605.91   564.44
      51.000     35.00     21.90     21.00      -.80   5460.00     13.12       .00
  13.89     41.91      7.04    776.10   843.37
      51.000     35.00     21.90     21.00      -.80   7600.00     15.91       .00
  16.81     34.93      7.60    999.65  1285.98

      52.000     50.00       .00       .00      -.80   2700.00     10.39       .00
  10.70     26.54      4.59    670.51   524.12
      52.000     50.00       .00       .00      -.80   3700.00     11.42       .00
  11.80     29.06      5.18    867.35   686.31
 *    52.000     50.00       .00       .00      -.80   5460.00     13.84       .00
  14.16     19.80      5.07   1415.49  1227.06
 *    52.000     50.00       .00       .00      -.80   7600.00     16.84       .00
  17.10     12.35      4.74   2149.93  2162.36

       6.000   2500.00       .00       .00      1.70   2700.00     15.75       .00
  16.00     17.42      4.06    687.30   646.96
       6.000   2500.00       .00       .00      1.70   3700.00     17.15       .00
  17.47     18.33      4.63    903.85   864.25
       6.000   2500.00       .00       .00      1.70   5460.00     18.80       .00
```

19.23	20.87	5.49	1263.09	1195.07			
6.000	2500.00	.00	.00	1.70	7600.00	20.49	.00
20.91	19.37	5.80	2286.80	1726.71			

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BERNARD BAYOU

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	.800	7200.00	1.75	.00	.00	.00	748.73	.00
	.800	10000.00	2.50	.75	.00	.00	749.07	.00
	.800	14900.00	3.77	1.27	.00	.00	811.05	.00
	.800	22000.00	5.00	1.23	.00	.00	924.33	.00
*	.900	7200.00	1.91	.00	.16	.00	716.47	7725.00
*	.900	10000.00	2.75	.83	.25	.00	724.93	7725.00
*	.900	14900.00	4.15	1.40	.38	.00	746.83	7725.00
*	.900	22000.00	5.59	1.44	.59	.00	770.31	7725.00
*	1.000	4930.00	1.99	.00	.08	.00	273.41	6175.00
*	1.000	6750.00	2.87	.88	.12	.00	276.41	6175.00
*	1.000	10200.00	4.34	1.47	.19	.00	429.98	6175.00
*	1.000	15000.00	5.88	1.55	.30	.00	512.38	6175.00
*	2.000	4930.00	1.92	.00	-.07	.00	121.38	2400.00
*	2.000	6750.00	2.79	.87	-.08	.00	127.65	2400.00
*	2.000	10200.00	4.24	1.45	-.10	.00	138.03	2400.00
*	2.000	15000.00	5.70	1.46	-.19	.00	148.03	2400.00
	2.100	4600.00	2.24	.00	.33	.00	122.29	50.00
	2.100	6300.00	3.25	1.00	.46	.00	124.00	50.00
	2.100	9300.00	5.00	1.75	.76	.00	124.00	50.00
	2.100	13500.00	6.96	1.96	1.26	.00	124.00	50.00
	2.200	4600.00	2.33	.00	.08	.00	122.51	24.00
	2.200	6300.00	3.38	1.05	.13	.00	124.00	24.00
	2.200	9300.00	5.20	1.83	.20	.00	124.00	24.00
	2.200	13500.00	7.28	2.08	.32	.00	124.00	24.00
	3.000	4600.00	2.62	.00	.29	.00	123.23	55.00
	3.000	6300.00	3.75	1.13	.37	.00	127.79	55.00
	3.000	9300.00	5.68	1.93	.47	.00	134.87	55.00
	3.000	13500.00	7.92	2.25	.64	.00	139.11	55.00
	3.100	4600.00	2.67	.00	.05	.00	123.46	10.00
	3.100	6300.00	3.84	1.17	.09	.00	128.13	10.00
	3.100	9300.00	5.82	1.98	.14	.00	135.12	10.00
	3.100	13500.00	8.13	2.32	.21	.00	139.50	10.00
	3.200	4600.00	2.89	.00	.22	.00	124.33	150.00
	3.200	6300.00	4.11	1.22	.28	.00	143.35	150.00
	3.200	9300.00	6.19	2.08	.38	.00	359.56	150.00
	3.200	13500.00	8.83	2.64	.70	.00	491.68	150.00

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SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
300.000	4600.00	3.80	.00	.91	.00	209.86	700.00
300.000	6300.00	5.22	1.42	1.11	.00	256.11	700.00
300.000	9300.00	7.46	2.23	1.27	.00	334.35	700.00
300.000	13500.00	9.94	2.48	1.11	.00	420.66	700.00
301.000	4600.00	3.82	.00	.02	.00	135.28	50.00
301.000	6300.00	5.23	1.41	.00	.00	140.91	50.00
301.000	9300.00	7.41	2.18	-.05	.00	149.64	50.00
301.000	13500.00	9.81	2.40	-.13	.00	159.24	50.00
302.000	4600.00	3.84	.00	.02	.00	135.35	24.00
302.000	6300.00	5.25	1.41	.02	.00	141.00	24.00
302.000	9300.00	7.44	2.19	.03	.00	149.77	24.00
302.000	13500.00	9.86	2.41	.05	.00	159.43	24.00
303.000	4600.00	3.96	.00	.12	.00	135.83	90.00
303.000	6300.00	5.39	1.43	.14	.00	141.55	90.00
303.000	9300.00	7.60	2.21	.16	.00	150.39	90.00
303.000	13500.00	10.04	2.44	.18	.00	160.15	90.00
304.000	4600.00	4.01	.00	.05	.00	136.03	150.00
304.000	6300.00	5.46	1.45	.07	.00	141.83	150.00
304.000	9300.00	7.70	2.24	.10	.00	150.78	150.00
304.000	13500.00	10.17	2.48	.14	.00	160.70	150.00
307.000	4600.00	4.18	.00	.17	.00	122.96	160.00
307.000	6300.00	5.65	1.46	.19	.00	126.62	160.00
307.000	9300.00	7.90	2.25	.20	.00	132.24	160.00
307.000	13500.00	10.38	2.49	.21	.00	138.46	160.00
308.000	4600.00	4.21	.00	.03	.00	123.04	50.00
308.000	6300.00	5.69	1.48	.04	.00	126.73	50.00
308.000	9300.00	7.96	2.27	.06	.00	132.40	50.00
308.000	13500.00	10.48	2.52	.09	.00	138.69	50.00
309.000	4600.00	4.34	.00	.13	.00	136.95	50.00
309.000	6300.00	5.86	1.52	.17	.00	142.95	50.00
309.000	9300.00	8.19	2.33	.23	.00	152.17	50.00
309.000	13500.00	10.80	2.61	.32	.00	162.51	50.00
310.000	4600.00	6.06	.00	1.72	.00	143.76	1230.00
310.000	6300.00	7.80	1.74	1.95	.00	150.64	1230.00
310.000	9300.00	10.39	2.59	2.20	.00	160.89	1230.00
310.000	13500.00	13.31	2.91	2.50	.00	172.41	1230.00
310.100	4600.00	6.44	.00	.38	.00	152.46	530.00
310.100	6300.00	8.20	1.76	.40	.00	163.02	530.00
310.100	9300.00	10.82	2.62	.43	.00	178.73	530.00
* 310.100	13500.00	13.78	2.95	.47	.00	196.45	530.00

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SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
310.200	4600.00	6.59	.00	.15	.00	153.37	200.00

	310.200	6300.00	8.35	1.76	.15	.00	163.91	200.00
	310.200	9300.00	10.97	2.61	.15	.00	179.60	200.00
	310.200	13500.00	13.92	2.95	.15	.00	197.32	200.00
	310.300	4600.00	6.60	.00	.01	.00	153.43	60.00
	310.300	6300.00	8.36	1.76	.01	.00	163.98	60.00
	310.300	9300.00	10.98	2.62	.01	.00	179.68	60.00
	310.300	13500.00	13.94	2.96	.02	.00	197.42	60.00
	310.400	4600.00	6.66	.00	.06	.00	153.74	80.00
	310.400	6300.00	8.42	1.76	.06	.00	164.29	80.00
	310.400	9300.00	11.04	2.62	.06	.00	179.99	80.00
	310.400	13500.00	13.99	2.96	.06	.00	197.72	80.00
	310.500	4600.00	6.83	.00	.17	.00	175.31	245.00
	310.500	6300.00	8.63	1.79	.21	.00	220.26	245.00
	310.500	9300.00	11.28	2.65	.24	.00	239.54	245.00
	310.500	13500.00	14.27	3.00	.28	.00	252.53	245.00
	310.600	4600.00	6.99	.00	.16	.00	148.07	230.00
	310.600	6300.00	8.75	1.76	.12	.00	155.66	230.00
	310.600	9300.00	11.33	2.58	.05	.00	166.85	230.00
	310.600	13500.00	14.27	2.93	-.01	.00	179.58	230.00
	310.700	4600.00	7.18	.00	.19	.00	150.16	210.00
	310.700	6300.00	8.94	1.76	.19	.00	157.78	210.00
	310.700	9300.00	11.52	2.58	.19	.00	168.97	210.00
	310.700	13500.00	14.46	2.94	.19	.00	181.71	210.00
*	310.800	4600.00	7.14	.00	-.04	.00	101.04	190.00
*	310.800	6300.00	8.85	1.70	-.09	.00	107.43	190.00
*	310.800	9300.00	11.35	2.50	-.17	.00	116.81	190.00
*	310.800	13500.00	14.20	2.85	-.26	.00	127.49	190.00
*	313.000	2700.00	6.78	.00	-.36	.00	55.97	110.00
*	313.000	3700.00	8.72	1.94	-.12	.00	73.69	110.00
*	313.000	5460.00	11.50	2.77	.15	.00	100.00	110.00
*	313.000	7600.00	14.63	3.13	.43	.00	100.00	110.00
*	314.000	2700.00	9.16	.00	2.37	.00	77.60	102.00
*	314.000	3700.00	9.19	.03	.47	.00	77.91	102.00
	314.000	5460.00	11.57	2.38	.07	.00	100.00	102.00
	314.000	7600.00	14.66	3.09	.04	.00	100.00	102.00
*	4.000	2700.00	10.20	.00	1.04	.00	329.29	550.00
*	4.000	3700.00	11.07	.87	1.88	.00	330.00	550.00
*	4.000	5460.00	13.26	2.19	1.69	.00	330.00	550.00
*	4.000	7600.00	16.13	2.86	1.46	.00	330.00	550.00

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	41.000	2700.00	10.20	.00	.00	.00	329.29	10.00
	41.000	3700.00	11.07	.87	.00	.00	330.00	10.00
	41.000	5460.00	13.26	2.19	.00	.00	330.00	10.00
	41.000	7600.00	16.13	2.86	.00	.00	330.00	10.00
*	5.000	2700.00	10.07	.00	-.13	.00	77.28	250.00
*	5.000	3700.00	10.86	.79	-.21	.00	78.60	250.00

*	5.000	5460.00	12.97	2.11	-.30	.00	80.00	250.00
*	5.000	7600.00	15.77	2.80	-.36	.00	80.00	250.00
	51.000	2700.00	10.14	.00	.07	.00	77.40	35.00
	51.000	3700.00	10.99	.85	.13	.00	78.81	35.00
	51.000	5460.00	13.12	2.13	.15	.00	80.00	35.00
	51.000	7600.00	15.91	2.79	.15	.00	80.00	35.00
	52.000	2700.00	10.39	.00	.25	.00	177.19	50.00
	52.000	3700.00	11.42	1.04	.44	.00	201.28	50.00
*	52.000	5460.00	13.84	2.41	.71	.00	237.37	50.00
*	52.000	7600.00	16.84	3.00	.92	.00	252.90	50.00
	6.000	2700.00	15.75	.00	5.36	.00	124.72	2500.00
	6.000	3700.00	17.15	1.40	5.73	.00	182.89	2500.00
	6.000	5460.00	18.80	1.65	4.96	.00	251.27	2500.00
	6.000	7600.00	20.49	1.70	3.66	.00	1134.24	2500.00

SUMMARY OF ERRORS AND SPECIAL NOTES

```
WARNING SECNO=      .900  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=      .900  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=      .900  PROFILE=  3  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=      .900  PROFILE=  4  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=     1.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=     1.000  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=     1.000  PROFILE=  3  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=     1.000  PROFILE=  4  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=     2.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=     2.000  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=     2.000  PROFILE=  3  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=     2.000  PROFILE=  4  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=   310.100  PROFILE=  4  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=   310.800  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=   310.800  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=   310.800  PROFILE=  3  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=   310.800  PROFILE=  4  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=   313.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=   313.000  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=   313.000  PROFILE=  3  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=   313.000  PROFILE=  4  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=   314.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
CAUTION SECNO=   314.000  PROFILE=  2  HYDRAULIC JUMP D.S.

WARNING SECNO=     4.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=     4.000  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=     4.000  PROFILE=  3  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=     4.000  PROFILE=  4  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
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WARNING SECNO=      5.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=      5.000  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=      5.000  PROFILE=  3  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=      5.000  PROFILE=  4  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=     52.000  PROFILE=  3  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=     52.000  PROFILE=  4  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
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T1      BASED ON FIS STUDY FROM PAPER PRINTOUT
T2      HARRISON COUNTY, MISSISSIPI
T3      BERNARD BAYOU           100 YR FLOOD
T4      DUPLICATE EFFECTIVE MODEL        4/98   JC FILENAME:    BPROPFW3.IH2

J1       0       4                                                    3.77
J2       1              -1
J3      38      43       1      26      39       4
J3     110     200

NC     .08     .08     .03      .1      .3

QT       5    7200   10000   14900   22000   14900

ET                                          10.4

X1     0.8      24    2061    2811    3000    3000    5750
GR     8.6    2000     7.6    2061     0.7    2062     -10    2111   -13.3    2161
GR     -14    2211   -12.8    2261      -3    2311      .9    2341     1.5    2342
GR      .1    2397    -1.3    2407     -.6    2414      .8    2417       1    2599
GR     -.2    2604    -5.5    2649     -13    2699   -10.8    2719    -8.2    2774
GR     -.1    2810     3.1    2811     7.2    3188      15    3800

ET                                          10.4

X1     0.9      21    2450    3193    5500    5700    7725
GR      14    2000    11.9    2313     6.7    2450    -7.1    2510   -12.7    2560
GR -13.8      2610   -14.8    2660   -14.3    2710   -14.8    2760   -13.7    2810
GR -12.8      2860   -10.3    2910   -10.2    2960   -11.5    3010      -9    3060
GR    -9.1    3110    -2.8    3160     2.9    3193    10.5    3284    12.4    3394
GR      15    3475

QT       5    4930    6750   10200   15000   10200

NC     .06     .06     .04

ET                                          10.4

X1     1.0      22     300     583    5500    6000    6175
GR    15.0       0    10.0      50     5.0      75     3.0     300     0.7     303
GR    -1.3     313    -3.2     323    -4.6     333   -11.9     343   -13.5     363
GR -13.8       383   -14.8     403   -14.7     423   -14.8     443   -14.3     463
GR -14.3       523    -8.3     543    -1.3     563     0.7     572     5.9     583
GR    10.0    1050    15.0    1375

NC     .08     .08   0.045

ET                                          10.4

X1     2.0      25     626     750    2350    2400    2400
GR      17       0    13.9     600     5.9     610     3.2     620     2.0     626
GR     0.6     627    -1.4     630    -0.7     640    -2.7     650    -6.7     660
GR    -8.6     670    -7.9     680    -7.3     690    -8.2     700    -6.6     710
GR    -2.2     720    -1.1     730    -1.6     740     0.6     744     2.9     750
GR     6.1     760     6.9     770    12.4     777    13.9     780    14.0     800

QT       5    4600    6300    9300   13500    9300

NC                              .3      .5

ET                                          10.4

* ADDED X3
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X1   2.1                                50      50      50
X3    10                                                        12.5    12.5

* BWC CHANGED FROM 101 TO 86 AND SS FROM 2.0 TO 2.34
SB  1.05     1.6     2.6              86     8.0    2480    2.34    -6.5    -6.5

ET                                         10.41

* ADDED X3 AND CHANGED BT 638 TO 626 AND 757 TO 750
X1   2.2                                24      24      24
X2                     1    12.5    13.9
X3    10                                                        12.5    12.5
BT   -11     600    13.9       0     619    13.9       0     626    13.9       0
BT           657    13.9       0     676    13.9       0     678    13.9       0
BT           719    13.9       0     738    13.9       0     750    13.9       0
BT           777    13.9       0     780    13.9       0

ET                                          10.4

* ADDED X3
X1   3.0      25     711     851      30      70      55
X3    10                                                        10.6    10.6
GR  17.0       0    13.9     600    12.6     700     5.6     701     5.4     711
GR   0.6     721    -2.1     731    -3.9     741    -4.2     751    -4.6     761
GR  -6.4     771    -8.4     781    -7.4     791    -8.8     801    -9.7     811
GR  -9.9     821    -1.6     831     0.6     836     3.1     841     8.4     851
GR  10.2     861    11.5     871    11.8     881    12.6     882    13.0     900

* CHANGED BWC FROM 127 TO 121 AND SS FROM 2.0 TO 1.19
SB  1.05     1.6     2.6             121    12.0    2480    1.19    -6.9    -6.9

ET                                         10.41

* ADDED X3 AND CHANGED BT 852 TO 851
X1   3.1                                10      10      10
X2                     1    10.6    12.6
X3    10                                                        10.6    10.6
BT   -15     700    12.6       0     711    12.6       0     725    12.6       0
BT           739    12.6       0     752    12.6       0     767    12.6       0
BT           781    12.6       0     796    12.6       0     810    12.6       0
BT           824    12.6       0     838    12.6       0     851    12.6       0
BT           866    12.6       0     881    12.6       0     882    12.6       0

ET                                          10.4

X1   3.2      21     440     570     200     100     150
GR  15.0       0    10.0     100     5.0     300     5.4     440     0.6     450
GR  -2.1     460    -3.9     470    -4.2     480    -4.6     490    -6.4     500
GR  -8.4     510    -7.4     520    -8.8     530    -9.7     540    -9.9     550
GR  -1.6     560     0.6     565     3.1     570     5.0     600    10.0     650
GR  15.0     775

* ADDED NC
NC                            .1      .3

ET                                          10.4

X1   300      19     318     538     650     900     700
GR  16.4       0    16.0      22     7.0     100    12.0     114    12.8     200
GR  12.0     255    10.4     300     8.0     318     3.5     333    -5.0     357
GR  -5.0     457     3.5     500     8.0     538     6.0     558     4.0     568
GR   2.8     600    10.7     700    18.0     800    20.4     900
```

```
* ADDED NC
NC                            .3      .5

ET                                            10.4

* ADDED X3
X1   301      12     116     304      50      50      50
X3    10                                                      22      22
GR  26.8       0    26.2      74    22.0      76    17.0      86    17.0     116
GR  -5.0     160    -5.0     260    17.0     304    17.0     334    21.0     342
GR  25.0     346    25.1     400

* CHANGED BWC FROM 188 TO 100 & INVERT ELEV FROM 2.5 TO -5
SB  1.05    1.60    2.60             100     4.0    4325       2      -5      -5

ET                                           10.41

* ADDED X3 AND BT'S 116 AND 304
X1   302       0       0       0      24      24      24
X2     0       0       1    22.0    25.0
X3    10                                                      22      22
BT   -10       0    26.8    26.8      74    26.2    22.0     116   26.04      22
BT           124    26.0    22.0     174    25.8    21.8     244    25.6    21.6
BT           294    25.4    21.4     304   25.36   21.36     344    25.2    21.2
BT           346    25.0    21.0

ET                                            10.4

* ADDED X3
X1   303      13     572     760      50     210      90
X3    10                                                    25.7   28.88
GR  35.0       0    29.2     460    29.7     510    26.0     527    17.0     542
GR  17.0     572    -5.0     616    -5.0     716    17.0     760    17.0     790
GR  30.0     816    34.0     830    35.0    1010

* CHANGED BWC FROM 75 TO 100, SS FROM 3.8 TO 2.0, AND ELCHD FROM -5.5 TO -5.0
SB  1.05    1.60    2.60             100    12.0    6583     2.0    -5.0    -5.0

ET                                           10.41

* CHANGED ELLC FROM 30 TO 28.88
* ADDED X3 AND BT'S 572 AND 760
X1   304                             150     150     150
X2                     1   28.88    29.7
X3    10                                                    25.7   28.88
BT   -10     510    29.7    25.7     550    30.1    26.1     572   30.26   26.26
BT           590    30.4    26.4     630    31.0    27.0     700    31.7    27.7
BT           750    32.7    28.7     760   32.88   28.88     790    33.4    29.4
BT           830    34.0    30.0

ET                                            10.4

* ADDED X3
X1   307      12     207     455      80     280     160    .625
X3    10                                                   22.51   22.04
GR  27.0       0    26.8      90    22.8     105    17.0     117    17.0     207
GR  -5.0     251    -5.0     411    17.0     455    17.0     565    21.8     575
GR  25.8     590    25.0    1000

* CHANGED BWC FROM 210 TO 100 AND ELCHU AND ELCHD FROM 3.3 TO -5.0
SB  1.05     1.6     2.6             100     7.0    4770     2.0    -5.0    -5.0

ET                                           10.41
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```
* COPIED GR'S FROM 307
* CHANGED ELLC FROM 22.8 TO 22.51 AND ELTRD FROM 25.8 TO 25.7
* ADDED X3 AND BT'S 207 AND 455
X1   308      12     207     455      50      50      50    .625
X2                     1   22.51    25.7                            .625
X3    10                                                  22.51   22.04
BT   -11      90    26.8    22.8     130    25.7    22.7     170    26.6    22.6
BT           207   26.51   22.51     210    26.5    22.5     430    26.1    22.1
BT           455   26.04   22.04     470    26.0    22.0     510    25.9    21.9
BT           550    25.8    21.8     590    25.8    21.8
GR  27.0       0    26.8      90    22.8     105    17.0     117    17.0     207
GR  -5.0     251    -5.0     411    17.0     455    17.0     565    21.8     575
GR  25.8     590    25.0    1000

NC                  0.06

ET                                          10.4

X1   309       8      36     224      50      50      50
GR  20.0       0    17.0       6    17.0      36    -5.0      80    -5.0     180
GR  17.5     224    17.0     254    20.0     260

* ADDED NC
NC                            .1      .3

ET                                          10.4

X1   310                                1230    1230    1230


* ADDED CROSS SECTIONS 310.1 THROUGH 310.8 TO REFLECT PROPOSED CHANNEL

* MODIFIED MANNING'S "n" VALUE TO REFLECT MAINTAINED GRASS-LINED CHANNEL
NC                  .035

ET                                           9.1                    1000  1209.8

X1 310.1       4    1000  1209.8     530     530     530
GR    16    1000    -2.3  1054.9    -2.3  1154.9      16  1209.8

* PROPOSED SOUTHERN BRIDGE
* ADDED COEFFICIENTS OF CONTRACTION/EXTRACTION

NC                            .3      .5

ET                                           9.1                    1000  1209.8

* ADDED X3
X1 310.2       4    1000  1209.8     200     200     200
X3     0
GR    16    1000    -2.3  1054.9    -2.3  1154.9      16  1209.8

SB  1.05     1.6     2.6             100       3    2630       3    -2.3    -2.3

ET                                          9.11                    1000  1209.8

* ADDED X3
X1 310.3       4    1000  1209.8      60      60      60
X2                     1      15      16
X3     0
BT    -6    1000      16      16    1003      16      15  1054.9      16      15
BT        1154.9      16      15  1206.8      16      15  1209.8      16      16
```

```
GR    16    1000    -2.3  1054.9    -2.3  1154.9      16  1209.8

ET                                         9.1                    1000  1209.8

X1 310.4       4    1000  1209.8      80      80      80
GR    16    1000    -2.3  1054.9    -2.3  1154.9      16  1209.8

* ADDED NC
NC                          .1      .3
ET                                         9.1                    1000    1260

X1 310.5       7    1000    1260     245     245     245
GR    16    1000      -2    1054      -2    1154       8    1184       6    1224
GR    10    1252      16    1260

ET                                         9.1                    1000  1187.1

X1 310.6       5    1000  1187.1     230     230     230
GR    16    1000    -1.4  1052.2    -1.4  1152.2     5.6  1173.2      16  1187.1

ET                                         9.1                    1000  1187.1

X1 310.7       5    1000  1187.1     210     210     210
GR  15.7    1000    -1.7  1052.2    -1.7  1152.2     5.3  1173.2    15.7  1187.1

ET                                         9.1                    1000 1141.75

X1 310.8       5    1000 1141.75     190     190     190
GR    18    1000       1 1012.75      -2 1021.75      -2 1081.75      18 1141.75

* END OF MODIFIED CROSS SECTIONS

* ADDED NC
NC                  0.06      .3      .5

QT     5    2700    3700    5460    7600    5460

ET                                         9.1                     500     600

* ADDED X3
X1   313      19     500     600     110     110     110
X3    10
GR  27.0       0    26.3     100    25.7     200    25.5     400    26.4     421
GR   8.9     454     9.7     500     9.2     512     5.5     535     1.5     540
GR  -0.9     560     2.3     570     9.2     590    10.7     600    10.5     635
GR  26.4     661    25.8    1000    26.0    1100    27.2    1400

* CHANGED BWC FROM 166 TO 165, SS FROM 2 TO 1.87, AND INVERT FROM 5 TO 6.4
SB  1.05    1.60    2.60       0     165     6.5    4000    1.87     6.4     6.4

ET                                        9.11                     500     600

* ADDED X3 AND ADDED BT'S 500 AND 600
X1   314                             102     102     102
X2                     1    25.0    26.4
X3    10
BT   -10     421    26.4       0     451    26.5       0     481    26.7       0
BT           500    26.7       0     511    26.7       0     571    26.7       0
BT           600    26.7       0     601    26.7       0     631    26.5       0
BT           661    26.4       0

ET                                        10.4
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```
* ADDED X3
X1     4      44     620     950     450     250     550
X3    10                                                     7.8    17.5
GR  25.0       0    22.4     575    20.9     580    15.9     590    10.7     600
GR   9.1     610     7.8     620     7.4     630     5.2     640     4.7     650
GR   2.9     660     4.4     670     4.4     680     1.7     690     0.8     698
GR  -1.4     700    -1.5     710    -0.6     720    -0.8     730    -0.6     740
GR  -1.2     750    -0.2     760     0.2     770    -0.2     780    -0.1     790
GR  -0.6     800     0.5     810     4.0     820    -0.3     830    -1.6     840
GR  -0.4     850    -0.2     860     0.7     870     1.6     880     1.9     890
GR  -0.4     900    -1.4     910    -1.6     920     1.0     930     5.0     940
GR  10.6     950    17.5     960    22.2     970    25.0    1050

SB  1.05    1.60     2.6             314    27.0    6880    1.93     1.0     1.0

ET                                         10.41

* CHANGED ELTRD FROM 25.4 TO 25.0
* ADDED X3 AND CHANGED BT'S FROM 633 TO 620 AND FROM 955 TO 950
X1    41                                  10      10      10
X2                     1    22.0      25
X3    10                                                     7.8    17.5
BT   -31       0    25.0       0     575    25.4       0     588    25.4       0
BT           604    25.4       0     617    25.4       0     620    25.4       0
BT           646    25.4       0     661    25.4       0     675    25.4       0
BT           689    25.4       0     703    25.4       0     716    25.4       0
BT           731    25.4       0     745    25.4       0     759    25.4       0
BT           773    25.4       0     787    25.4       0     802    25.4       0
BT           815    25.4       0     829    25.4       0     843    25.4       0
BT           857    25.4       0     872    25.4       0     885    25.4       0
BT           899    25.4       0     914    25.4       0     927    25.4       0
BT           943    25.4       0     950    25.4       0     970    25.4       0
BT          1050    25.0       0

ET                                           9.1                    1086    1228

* ADDED X3
X1     5      34    1148    1228     150     250     250
X3    10
GR  25.0       0    21.9    1000    20.9    1001    17.3    1008    12.5    1018
GR  11.2    1028    11.0    1038    10.3    1048    10.4    1058    10.1    1068
GR   9.3    1078     9.3    1088     9.0    1098     8.7    1108     8.9    1118
GR   8.8    1128     8.1    1138     9.9    1148     7.0    1158     2.3    1168
GR   0.7    1171     0.1    1178    -0.8    1188    -0.1    1198     0.7    1200
GR   2.7    1208     5.7    1218    11.7    1228    11.8    1238    12.1    1248
GR  15.9    1258    18.1    1267    21.9    1268    25.0    1600

SB  1.05    1.60    2.60             210    12.0    3280     2.0     6.5     6.5

ET                                          10.4

* ADDED X3 AND CHANGED BT'S 1135 TO 1148 AND 1229 TO 1228
X1    51      34    1148    1228      35      35      35
X2                     1    21.0    21.9
X3    10                                                     9.9     117
BT   -14    1000    21.9       0    1001    21.9       0    1021    21.9       0
BT          1040    21.9       0    1059    21.9       0    1077    21.9       0
BT          1097    21.9       0    1115    21.9       0    1148    21.9       0
BT          1167    21.9       0    1197    21.9       0    1228    21.9       0
BT          1248    21.9       0    1268    21.9       0
GR  25.0       0    21.9    1000    20.9    1001    17.3    1008    12.5    1018
GR  11.2    1028    11.0    1038    10.3    1048    10.4    1058    10.1    1068
GR   9.3    1078     9.3    1088     9.0    1098     8.7    1108     8.9    1118
```

```
GR   8.8    1128     8.1    1138     9.9    1148     7.0    1158     2.3    1168
GR   0.7    1171     0.1    1178    -0.8    1188    -0.1    1198     0.7    1200
GR   2.7    1208     5.7    1218    11.7    1228    11.8    1238    12.1    1248
GR  15.9    1258    18.1    1267    21.9    1268    25.0    1600

ET                                           9.1                     1085    1228

X1    52      34    1148    1228      50      50      50
GR  25.0       0    21.9    1000    20.9    1001    17.3    1008    12.5    1018
GR  11.2    1028    11.0    1038    10.3    1048    10.4    1058    10.1    1068
GR   9.3    1078     9.3    1088     9.0    1098     8.7    1108     8.9    1118
GR   8.8    1128     8.1    1138     9.9    1148     7.0    1158     2.3    1168
GR   0.7    1171     0.1    1178    -0.8    1188    -0.1    1198     0.7    1200
GR   2.7    1208     5.7    1218    11.7    1228    11.8    1238    12.1    1248
GR  15.9    1258    18.1    1267    21.9    1268    25.0    1600

* ADDED NC
NC                            .1      .3

ET                                           9.1                     1005    1085

X1   5.9      14    1005    1085    2000    2500    2300
GR  24.8       0    20.3     200   18.94    1000    12.3    1005     6.3    1018
GR   2.5    1031     1.7    1037     1.5    1047     2.5    1050     6.1    1056
GR  11.8    1065    14.5    1085    19.8    1300    24.8    1700
EJ

T1      BASED ON FIS STUDY FROM PAPER PRINTOUT
T2      HARRISON COUNTY, MISSISSIPI
T3      BERNARD BAYOU           FLOODWAY
T4      DUPLICATE EFFECTIVE MODEL        4/98   JC FILENAME:    BPROPFW3.IH2
J1   -10       6                                                     4.77
J2    15              -1


ER
```

```
1*********************************************
        ***************************************
 *  HEC-2 WATER SURFACE PROFILES             *
        *  U.S. ARMY CORPS OF ENGINEERS        *
 *                                           *
        *  HYDROLOGIC ENGINEERING CENTER       *
 *  Version   4.6.2;  May 1991               *
        *  609 SECOND STREET, SUITE D          *
 *                                           *
        *  DAVIS, CALIFORNIA 95616-4687        *
 *  RUN DATE    09APR98    TIME   10:54:35  *
        *          (916) 756-1104              *
 *********************************************
        ***************************************
```

```
                                             X     X  XXXXXXX   XXXXX
XXXXX
                                             X     X  X        X     X            X
   X
                                             X     X  X        X
   X
                                             XXXXXXX  XXXX     X          XXXXX
XXXXX
                                             X     X  X        X                  X

                                             X     X  X        X     X            X

                                             X     X  XXXXXXX   XXXXX
XXXXXXX
```

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                              PAGE   1

THIS RUN EXECUTED 09APR98   10:54:35
 ****
  HEC-2 WATER SURFACE PROFILES

  Version   4.6.2; May 1991
 ****

 T1   BASED ON FIS STUDY FROM PAPER PRINTOUT
 T2   HARRISON COUNTY, MISSISSIPI
 T3   BERNARD BAYOU   100 YR FLOOD
 T4   PROPOSED CLOMR MODEL   3/98   JC FILENAME: BBPROPFW.DAT

 J1 ICHECK   INQ   NINV   IDIR   STRT   METRIC   HVINS   Q
WSEL   FQ

                  4
3.77

```
 J2  NPROF     IPLOT     PRFVS     XSECV     XSECH      FN       ALLDC     IBW
CHNIM     ITRACE

       1         0        -1


 J3  VARIABLE CODES FOR SUMMARY PRINTOUT

    150        110        200


 J5  LPRNT    NUMSEC                    ********REQUESTED SECTION NUMBERS********

    -10       -10


 NC      .08        .08        .03         .1         .3


 QT        5       7200      10000      14900      22000      14900


 ET                                                            10.4


 X1      0.8         24       2061       2811       3000       3000       5750

 GR      8.6       2000        7.6       2061        0.7       2062        -10
    2111      -13.3       2161
 GR      -14       2211      -12.8       2261         -3       2311         .9
    2341        1.5       2342
 GR       .1       2397       -1.3       2407        -.6       2414         .8
    2417        1         2599
 GR      -.2       2604       -5.5       2649        -13       2699      -10.8
    2719       -8.2       2774
 GR      -.1       2810        3.1       2811        7.2       3188         15
    3800

 X1      0.9         21       2450       3193       5500       5700       7725

 GR       14       2000       11.9       2313        6.7       2450       -7.1
    2510      -12.7       2560
 GR    -13.8       2610      -14.8       2660      -14.3       2710      -14.8
    2760      -13.7       2810
 GR    -12.8       2860      -10.3       2910      -10.2       2960      -11.5
    3010         -9       3060
 GR     -9.1       3110       -2.8       3160        2.9       3193       10.5
    3284       12.4       3394
 GR       15       3475


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                                  PAGE    2



 QT        5       4930       6750      10200      15000      10200
```

```
NC      .06         .06         .04


X1      1.0          22         300         583        5500        6000        6175

GR     15.0           0        10.0          50         5.0          75         3.0
    300         0.7         303
GR     -1.3         313        -3.2         323        -4.6         333       -11.9
    343       -13.5         363
GR    -13.8         383       -14.8         403       -14.7         423       -14.8
    443       -14.3         463
GR    -14.3         523        -8.3         543        -1.3         563         0.7
    572         5.9         583
GR     10.0        1050        15.0        1375



NC      .08         .08       0.045


X1      2.0          25         626         750        2350        2400        2400

GR       17           0        13.9         600         5.9         610         3.2
    620         2.0         626
GR      0.6         627        -1.4         630        -0.7         640        -2.7
    650        -6.7         660
GR     -8.6         670        -7.9         680        -7.3         690        -8.2
    700        -6.6         710
GR     -2.2         720        -1.1         730        -1.6         740         0.6
    744         2.9         750
GR      6.1         760         6.9         770        12.4         777        13.9
    780        14.0         800


QT        5        4600        6300        9300       13500        9300


NC                                           .3          .5


  ADDED X3
X1      2.1                                              50          50          50

X3       10


  CHANGED BWC FROM 101 TO 86 AND SS FROM 2.0 TO 2.34

SB     1.05         1.6         2.6                      86         8.0        2480
   2.34        -6.5        -6.5

ET                                                                10.41


  ADDED X3 ADN CHANGED BT 638 TO 626 AND 757 TO 750
X1      2.2                                              24          24          24

X2                                1        12.5        13.9

X3       10

BT      -11         600        13.9           0         619        13.9           0
```

```
     626          13.9           0
 BT                   657         13.9          0          676          13.9          0
     678          13.9           0
 BT                   719         13.9          0          738          13.9          0
     750          13.9           0
 BT                   777         13.9          0          780          13.9          0


   ADDED X3

 X1      3.0          25          711         851           30            70         55

 X3       10

 GR     17.0           0         13.9         600         12.6           700        5.6
     701           5.4          711
 GR      0.6         721         -2.1         731         -3.9           741       -4.2
     751          -4.6          761
 GR     -6.4         771         -8.4         781         -7.4           791       -8.8
     801          -9.7          811
 GR     -9.9         821         -1.6         831          0.6           836        3.1
     841           8.4          851
1
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                                PAGE    3


 GR     10.2         861         11.5         871         11.8           881       12.6
     882          13.0          900

   CHANGED BWC FROM 127 TO 121 AND SS FROM 2.0 TO 1.19

 SB     1.05         1.6          2.6                      121          12.0       2480
    1.19          -6.9         -6.9

 ET                                                                    10.41


   ADDED X3 AND CHANGED BT 852 TO 851
 X1      3.1                                                10            10         10

 X2                                 1        10.6         12.6

 X3       10

 BT      -15         700         12.6           0          711          12.6          0
     725          12.6           0
 BT                   739         12.6          0          752          12.6          0
     767          12.6           0
 BT                   781         12.6          0          796          12.6          0
     810          12.6           0
 BT                   824         12.6          0          838          12.6          0
     851          12.6           0
 BT                   866         12.6          0          881          12.6          0
     882          12.6           0


 X1      3.2          21          440         570          200           100        150

 GR     15.0           0         10.0         100          5.0           300        5.4
     440           0.6          450
 GR     -2.1         460         -3.9         470         -4.2           480       -4.6
     490          -6.4          500
```

```
GR     -8.4         510        -7.4         520         -8.8         530         -9.7
    540         -9.9         550
GR     -1.6         560         0.6         565          3.1         570          5.0
    600         10.0         650
GR     15.0         775

  ADDED NC

NC                                           .1           .3


X1      300          19         318         538          650         900          700

GR     16.4           0        16.0          22          7.0         100         12.0
    114         12.8         200
GR     12.0         255        10.4         300          8.0         318          3.5
    333         -5.0         357
GR     -5.0         457         3.5         500          8.0         538          6.0
    558          4.0         568
GR      2.8         600        10.7         700         18.0         800         20.4
    900

  ADDED NC

NC                                           .3           .5


  ADDED X3
X1      301          12         116         304           50          50           50

X3       10

GR     26.8           0        26.2          74         22.0          76         17.0
     86         17.0         116
GR     -5.0         160        -5.0         260         17.0         304         17.0
    334         21.0         342
GR     25.0         346        25.1         400


  CHANGED BWC FROM 188 TO 100 & INVERT ELEV FROM 2.5 TO -5
1
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SB     1.05        1.60        2.60                      100         4.0         4325
      2           -5           -5

ET                                                                 10.41


  ADDED X3 AND BT'S 116 AND 304
X1      302           0           0           0           24          24           24

X2        0           0           1        22.0         25.0

X3       10

BT      -10           0        26.8        26.8           74        26.2         22.0
    116        26.04          22
BT                  124        26.0        22.0          174        25.8         21.8
```

```
    244        25.6        21.6
BT                294        25.4       21.4         304       25.36       21.36
    344        25.2        21.2
BT                346        25.0       21.0


  ADDED X3

X1      303          13         572        760          50         210          90

X3       10

GR     35.0           0        29.2        460        29.7         510        26.0
    527        17.0         542
GR     17.0         572        -5.0        616        -5.0         716        17.0
    760        17.0         790
GR     30.0         816        34.0        830        35.0        1010


  CHANGED BWC FROM 75 TO 100, SS FROM 3.8 TO 2.0, AND ELCHD FROM -5.5 TO -5.0

SB     1.05        1.60        2.60                    100        12.0        6583
      2        -5.0        -5.0

ET                                                               10.41


  CHANGED ELLC FROM 30 TO 28.88
  ADDED X3 AND BT'S 572 AND 760
X1      304                                            150         150         150

X2                                1      28.88        29.7

X3       10

BT      -10         510        29.7       25.7         550        30.1        26.1
    572       30.26       26.26
BT                590        30.4       26.4         630        31.0        27.0
    700        31.7        27.7
BT                750        32.7       28.7         760       32.88       28.88
    790        33.4        29.4
BT                830        34.0       30.0


  ADDED X3

X1      307          12         207        455          80         280         160
   .625
X3       10

GR     27.0           0        26.8         90        22.8         105        17.0
    117        17.0         207
GR     -5.0         251        -5.0        411        17.0         455        17.0
    565        21.8         575
GR     25.8         590        25.0       1000


  CHANGED BWC FROM 210 TO 100 AND ELCHU AND ELCHD FROM 3.3 TO -5.0

SB     1.05         1.6         2.6                    100         7.0        4770
    2.0        -5.0        -5.0

ET                                                               10.41
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```
   CHANGED ELLC FROM 22.8 TO 22.51 AND ELTRD FROM 25.8 TO 25.7
   ADDED X3 AND BT'S 207 AND 455
1
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 X1      308          12         207         455          50          50          50
    .625
 X2                                1       22.51        25.7
                .625
 X3       10

 BT      -11          90        26.8        22.8         130        25.7        22.7
     170         26.6        22.6
 BT                  207       26.51       22.51         210        26.5        22.5
     430         26.1        22.1
 BT                  455       26.04       22.04         470        26.0        22.0
     510         25.9        21.9
 BT                  550        25.8        21.8         590        25.8        21.8

 GR     27.0           0        26.8          90        22.8         105        17.0
     117         17.0         207
 GR     -5.0         251        -5.0         411        17.0         455        17.0
     565         21.8         575
 GR     25.8         590        25.0        1000



 NC                             0.06


 X1      309           8          36         224          50          50          50

 GR     20.0           0        17.0           6        17.0          36        -5.0
      80         -5.0         180
 GR     17.5         224        17.0         254        20.0         260


   ADDED NC

 NC                                           .1          .3


 X1      310                                            1230        1230        1230

   ADDED CROSS SECTIONS 310.1 THROUGH 310.8 TO REFLECT PROPOSED CHANNEL

   MODIFIED MANNING'S "n" VALUE TO REFLECT MAINTAINED GRASS-LINED CHANNEL

 NC                             .035


 ET                                                                9.1
                1000      1209.8

 X1    310.1           4        1000      1209.8         530         530         530

 GR       16        1000        -2.3      1054.9        -2.3      1154.9          16
  1209.8
```

```
  PROPOSED SOUTHERN BRIDGE
  ADDED COEFFICIENTS OF CONTRACTION/EXTRACTION


NC                                     .3          .5


ET                                                             9.1
             1000      1209.8

  ADDED X3
X1    310.2         4       1000    1209.8         200         200         200

X3        0

GR       16      1000       -2.3    1054.9        -2.3      1154.9          16
 1209.8

1
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SB     1.05       1.6        2.6                   100           3        2630
      3      -2.3        -2.3

ET                                                            9.11
             1000      1209.8

  ADDED X3
X1    310.3         4       1000    1209.8          60          60          60

X2                             1        15          16

X3        0

BT       -6      1000         16        16        1003          16          15
 1054.9        16          15
BT             1154.9         16        15      1206.8          16          15
 1209.8        16          16
GR       16      1000       -2.3    1054.9        -2.3      1154.9          16
 1209.8


ET                                                             9.1
             1000      1209.8

X1    310.4         4       1000    1209.8          80          80          80

GR       16      1000       -2.3    1054.9        -2.3      1154.9          16
 1209.8

  ADDED NC

NC                                     .1          .3

ET                                                             9.1
             1000        1260

X1    310.5         7       1000      1260         245         245         245
```

```
GR        16       1000         -2       1054         -2       1154          8
   1184          6       1224
GR        10       1252         16       1260



ET                                                            9.1
               1000      1187.1

X1     310.6          5       1000     1187.1        230        230        230

GR        16       1000       -1.4     1052.2       -1.4     1152.2        5.6
  1173.2         16      1187.1


ET                                                            9.1
               1000      1187.1

X1     310.7          5       1000     1187.1        210        210        210

GR      15.7       1000       -1.7     1052.2       -1.7     1152.2        5.3
  1173.2       15.7      1187.1


ET                                                            9.1
               1000     1141.75

X1     310.8          5       1000    1141.75        190        190        190

GR        18       1000          1    1012.75         -2    1021.75         -2
1081.75          18     1141.75

  END OF MODIFIED CROSS SECTIONS

1
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QT         5       2700       3700       5460       7600       5460


  CHANGED MANNING'S "n" VALUE BACK TO EXISTING
  ADDED COEFFICIENTS OF CONTRACTION/EXTRACTION
NC                             .06         .3         .5


ET                                                            9.1
                500         600

  ADDED X3
X1       313         19        500        600        110        110        110

X3        10

GR      27.0          0       26.3        100       25.7        200       25.5
    400       26.4         421
GR       8.9        454        9.7        500        9.2        512        5.5
    535        1.5         540
GR      -0.9        560        2.3        570        9.2        590       10.7
    600       10.5         635
GR      26.4        661       25.8       1000       26.0       1100       27.2
```

```
     1400

    CHANGED BWC FROM 166 TO 165, SS FROM 2 TO 1.87, AND INVERT FROM 5 TO 6.4

  SB     1.05       1.60       2.60                    165         6.5        4000
     1.87         6.4        6.4

  ET                                                               9.11
                  500        600

    ADDED X3 AND BT'S 500 AND 600
  X1      314                                          102         102         102

  X2                              1       25.0        26.4

  X3       10

  BT      -10        421       26.4          0         451        26.5           0
      481        26.7          0
  BT                 500       26.7          0         511        26.7           0
      571        26.7          0
  BT                 600       26.7          0         601        26.7           0
      631        26.5          0
  BT                 661       26.4          0



  ET                                                                9.1
                  620        950

    ADDED X3
  X1        4         44        620        950         450         250         550

  X3       10

  GR     25.0          0       22.4        575        20.9         580        15.9
      590        10.7        600
  GR      9.1        610        7.8        620         7.4         630         5.2
      640         4.7        650
  GR      2.9        660        4.4        670         4.4         680         1.7
      690         0.8        698
  GR     -1.4        700       -1.5        710        -0.6         720        -0.8
      730        -0.6        740
  GR     -1.2        750       -0.2        760         0.2         770        -0.2
      780        -0.1        790
  GR     -0.6        800        0.5        810         4.0         820        -0.3
      830        -1.6        840
  GR     -0.4        850       -0.2        860         0.7         870         1.6
      880         1.9        890
  GR     -0.4        900       -1.4        910        -1.6         920         1.0
      930         5.0        940
  GR     10.6        950       17.5        960        22.2         970        25.0
     1050

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                                 PAGE    8



  SB     1.05       1.60        2.6                    314        27.0        6880
     1.93         1.0        1.0
```

```
ET                                                                    9.11
                620         950

  CHANGED ELTRD FROM 25.4 TO 25.0
  ADDED X3 AND CHANGED BT'S 633 TO 620 AND FROM 955 TO 950
X1       41                                                10          10          10

X2                                   1       22.0          25

X3       10

BT      -31           0       25.0           0            575         25.4           0
    588        25.4           0
BT                  604       25.4           0            617         25.4           0
    620        25.4           0
BT                  646       25.4           0            661         25.4           0
    675        25.4           0
BT                  689       25.4           0            703         25.4           0
    716        25.4           0
BT                  731       25.4           0            745         25.4           0
    759        25.4           0
BT                  773       25.4           0            787         25.4           0
    802        25.4           0
BT                  815       25.4           0            829         25.4           0
    843        25.4           0
BT                  857       25.4           0            872         25.4           0
    885        25.4           0
BT                  899       25.4           0            914         25.4           0
    927        25.4           0
BT                  943       25.4           0            950         25.4           0
    970        25.4           0
BT                 1050       25.0           0


ET                                                                     9.1
               1148        1228

  ADDED X3
X1        5          34       1148        1228            150          250         250

X3       10

GR     25.0           0       21.9        1000           20.9         1001        17.3
   1008        12.5        1018
GR     11.2        1028       11.0        1038           10.3         1048        10.4
   1058        10.1        1068
GR      9.3        1078        9.3        1088            9.0         1098         8.7
   1108         8.9        1118
GR      8.8        1128        8.1        1138            9.9         1148         7.0
   1158         2.3        1168
GR      0.7        1171        0.1        1178           -0.8         1188        -0.1
   1198         0.7        1200
GR      2.7        1208        5.7        1218           11.7         1228        11.8
   1238        12.1        1248
GR     15.9        1258       18.1        1267           21.9         1268        25.0
   1600


SB     1.05        1.60       2.60                        210         12.0        3280
    2.0         6.5         6.5

ET                                                                    9.11
```

```
              1148        1228

  ADDED X3 AND CHANGED BT'S FROM 1135 TO 1148 AND FROM 1129 TO 1128
X1       51                                             35          35          35

X2                                1       21.0        21.9

X3       10

BT      -14        1000        21.9           0        1001        21.9           0
   1021        21.9           0
BT                 1040        21.9           0        1059        21.9           0
   1077        21.9           0
BT                 1097        21.9           0        1115        21.9           0
   1148        21.9           0
BT                 1167        21.9           0        1197        21.9           0
   1228        21.9           0
BT                 1248        21.9           0        1268        21.9           0


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ET                                                                 9.1
              1068        1248

X1       52          34        1148        1228          50          50          50

GR     25.0           0        21.9        1000        20.9        1001        17.3
   1008        12.5        1018
GR     11.2        1028        11.0        1038        10.3        1048        10.4
   1058        10.1        1068
GR      9.3        1078         9.3        1088         9.0        1098         8.7
   1108         8.9        1118
GR      8.8        1128         8.1        1138         9.9        1148         7.0
   1158         2.3        1168
GR      0.7        1171         0.1        1178        -0.8        1188        -0.1
   1198         0.7        1200
GR      2.7        1208         5.7        1218        11.7        1228        11.8
   1238        12.1        1248
GR     15.9        1258        18.1        1267        21.9        1268        25.0
   1600


ET                                                                 9.1
              1005        1065

  ADDED NC
NC                                           .1          .3


X1        6          14        1005        1085        2200        2700        2500

GR     25.0           0        20.5         200       19.14        1000        12.5
   1005         6.5        1018
GR      2.7        1031         1.9        1037         1.7        1047         2.7
   1050         6.3        1056
GR     12.0        1065        14.7        1085        20.0        1300        25.0
   1700
```

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1
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                              PAGE   10


 T1      BASED ON FIS STUDY FROM PAPER PRINTOUT
 T2      HARRISON COUNTY, MISSISSIPI
 T3      BERNARD BAYOU           FLOODWAY
 T4      PROPOSED CLOMR MODEL             9/97   JC FILENAME:    BBPROPFW.OUT

 J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q
WSEL      FQ

                  6
4.77

 J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN       ALLDC     IBW
CHNIM      ITRACE

      15         0        -1


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                              PAGE   11




THIS RUN EXECUTED 09APR98    10:54:35
 *************************************
  HEC-2 WATER SURFACE PROFILES

  Version   4.6.2;  May 1991
 *************************************


 NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF
ERRORS LIST


 BERNARD BAYOU

 SUMMARY PRINTOUT TABLE  110


       SECNO     CWSEL    DIFKWS      EG      TOPWID     QLOB       QCH      QROB
 PERENC    STENCL     STCHL     STCHR    STENCR

         .800      3.77       .00      3.85    811.05       .00  14898.06      1.94
     .00        .00   2061.00   2811.00       .00
         .800      4.77      1.00      4.83    749.59       .00  14900.00       .00
     .00   2061.00   2061.00   2811.00  2811.00

 *       .900      4.15       .00      4.18    746.83       .00  14899.41       .59
     .00        .00   2450.00   3193.00       .00
 *       .900      5.06       .92      5.09    735.92       .00  14900.00       .00
     .00   2450.00   2450.00   3193.00  3193.00

 *      1.000      4.34       .00      4.43    429.98     20.60  10179.40       .00
     .00        .00    300.00    583.00       .00
```

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*      1.000       5.22        .88       5.30    281.56         .00  10200.00         .00
    .01    300.00    300.00    583.00   583.00

*      2.000       4.24        .00       5.69    138.03       19.78  10177.44        2.78
    .00       .00    626.00    750.00      .00
*      2.000       5.15        .92       6.34    124.00         .00  10200.00         .00
    .01    626.00    626.00    750.00   750.00

       2.100       5.02        .00       6.03    143.37       33.15   9259.40        7.45
    .00       .00    626.00    750.00      .00
       2.100       5.72        .70       6.60    124.00         .00   9300.00         .00
    .01    626.00    626.00    750.00   750.00

       2.200       5.22        .00       6.18    144.73       37.49   9253.39        9.12
    .00       .00    626.00    750.00      .00
       2.200       5.87        .65       6.71    149.17       52.90   9231.34       15.76
    .00    626.00    626.00    750.00   750.00

       3.000       5.67        .00       6.39    144.86         .44   9299.56         .00
    .00       .00    711.00    851.00      .00
       3.000       6.23        .56       6.87    135.90         .00   9300.00         .00
    .00    711.00    711.00    851.00   851.00

       3.100       5.81        .00       6.51    145.13        1.15   9298.85         .00
    .00       .00    711.00    851.00      .00
       3.100       6.34        .54       6.97    146.22        5.73   9294.27         .00
    .00    711.00    711.00    851.00   851.00

       3.200       6.18        .00       6.80    359.08      116.57   9100.40       83.03
    .00       .00    440.00    570.00      .00
       3.200       6.61        .43       7.22    130.00         .00   9300.00         .00
    .05    440.00    440.00    570.00   570.00

     300.000       7.45        .00       7.78    334.07         .27   8909.69      390.04
    .00       .00    318.00    538.00      .00
     300.000       7.82        .37       8.17    217.89         .00   9300.00         .00
    .06    318.00    318.00    538.00   538.00

     301.000       7.40        .00       7.96    149.61         .00   9300.00         .00
    .00       .00    116.00    304.00      .00
     301.000       7.80        .39       8.32    151.18         .00   9300.00         .00
    .00    116.00    116.00    304.00   304.00

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                                PAGE   12


      SECNO      CWSEL     DIFKWS        EG       TOPWID      QLOB        QCH       QROB
 PERENC    STENCL      STCHL      STCHR    STENCR

     302.000       7.44        .00       7.99    149.75         .00   9300.00         .00
    .00       .00    116.00    304.00      .00
     302.000       7.83        .39       8.34    151.30         .00   9300.00         .00
    .00    116.00    116.00    304.00   304.00

     303.000       7.59        .00       8.13    150.37         .00   9300.00         .00
    .00       .00    572.00    760.00      .00
     303.000       7.96        .37       8.47    151.88         .00   9300.00         .00
    .00    572.00    572.00    760.00   760.00

     304.000       7.69        .00       8.22    150.76         .00   9300.00         .00
    .00       .00    572.00    760.00      .00
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   304.000      8.05       .36      8.55   152.20        .00   9300.00        .00
  .00    572.00    572.00    760.00   760.00

   307.000      7.89       .00      8.49   132.23        .00   9300.00        .00
  .00       .00    129.38    284.38      .00
   307.000      8.23       .34      8.80   133.08        .00   9300.00        .00
  .00    129.38    129.38    284.38   284.38

   308.000      7.96       .00      8.55   132.39        .00   9300.00        .00
  .00       .00    129.38    284.38      .00
   308.000      8.29       .33      8.85   133.22        .00   9300.00        .00
  .00    129.38    129.38    284.38   284.38

   309.000      8.18       .00      8.67   152.15        .00   9300.00        .00
  .00       .00     36.00    224.00      .00
   309.000      8.50       .32      8.96   153.41        .00   9300.00        .00
  .00     36.00     36.00    224.00   224.00

   310.000     10.39       .00     10.72   160.88        .00   9300.00        .00
  .00       .00     36.00    224.00      .00
   310.000     10.57       .18     10.89   161.59        .00   9300.00        .00
  .00     36.00     36.00    224.00   224.00

   310.100     10.82       .00     11.22   178.72        .00   9300.00        .00
  .00       .00   1000.00   1209.80      .00
   310.100     10.98       .16     11.37   179.68        .00   9300.00        .00
209.80   1000.00   1000.00   1209.80  1209.80

   310.200     10.96       .00     11.36   179.59        .00   9300.00        .00
  .00       .00   1000.00   1209.80      .00
   310.200     11.12       .15     11.50   180.51        .00   9300.00        .00
209.80   1000.00   1000.00   1209.80  1209.80

   310.300     10.98       .00     11.37   179.67        .00   9300.00        .00
  .00       .00   1000.00   1209.80      .00
   310.300     11.13       .15     11.51   180.59        .00   9300.00        .00
209.80   1000.00   1000.00   1209.80  1209.80

   310.400     11.03       .00     11.42   179.97        .00   9300.00        .00
  .00       .00   1000.00   1209.80      .00
   310.400     11.18       .15     11.56   180.88        .00   9300.00        .00
209.80   1000.00   1000.00   1209.80  1209.80

   310.500     11.28       .00     11.58   239.53        .00   9300.00        .00
  .00       .00   1000.00   1260.00      .00
   310.500     11.42       .14     11.71   240.15        .00   9300.00        .00
260.00   1000.00   1000.00   1260.00  1260.00

   310.600     11.33       .00     11.78   166.84        .00   9300.00        .00
  .00       .00   1000.00   1187.10      .00
   310.600     11.47       .14     11.90   167.44        .00   9300.00        .00
187.10   1000.00   1000.00   1187.10  1187.10

   310.700     11.52       .00     11.93   168.96        .00   9300.00        .00
  .00       .00   1000.00   1187.10      .00
   310.700     11.65       .13     12.05   169.52        .00   9300.00        .00
187.10   1000.00   1000.00   1187.10  1187.10

*  310.800     11.35       .00     12.26   116.80        .00   9300.00        .00
  .00       .00   1000.00   1141.75      .00
*  310.800     11.48       .13     12.37   117.30        .00   9300.00        .00
141.75   1000.00   1000.00   1141.75  1141.75
```

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 *    313.000     11.62       .00     12.54    187.98    348.07   5045.90     66.03
    .00       .00    500.00    600.00       .00
 *    313.000     11.63       .01     12.78    100.00       .00   5460.00       .00
  100.00    500.00    500.00    600.00   600.00

      314.000     11.78       .00     12.64    188.53    370.54   5009.51     79.95
    .00       .00    500.00    600.00       .00
      314.000     11.87       .09     12.93    100.00       .00   5460.00       .00
  100.00    500.00    500.00    600.00   600.00

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        SECNO      CWSEL     DIFKWS       EG      TOPWID      QLOB       QCH       QROB
 PERENC    STENCL      STCHL      STCHR    STENCR

 *      4.000     13.06       .00     13.09    358.12     41.02   5418.07       .91
    .00       .00    620.00    950.00       .00
 *      4.000     13.42       .36     13.45    330.00       .00   5460.00       .00
  330.00    620.00    620.00    950.00   950.00

       41.000     13.07       .00     13.10    358.13     41.05   5418.04       .91
    .00       .00    620.00    950.00       .00
       41.000     13.42       .36     13.45    330.00       .00   5460.00       .00
  330.00    620.00    620.00    950.00   950.00

 *      5.000     12.94       .00     13.39    233.12    976.31   4459.75     23.95
    .00       .00   1148.00   1228.00       .00
 *      5.000     13.14       .20     13.91     80.00       .00   5460.00       .00
   80.00   1148.00   1148.00   1228.00  1228.00

       51.000     13.00       .00     13.44    233.39    990.36   4443.84     25.81
    .00       .00   1148.00   1228.00       .00
       51.000     13.28       .28     14.02     80.00       .00   5460.00       .00
   80.00   1148.00   1148.00   1228.00  1228.00

       52.000     13.17       .00     13.58    234.22   1031.60   4396.84     31.56
    .00       .00   1148.00   1228.00       .00
 *     52.000     13.91       .74     14.28    180.00    955.35   4449.87     54.79
  180.00   1068.00   1148.00   1228.00  1248.00

        6.000     18.90       .00     19.31    255.05     19.87   4952.02    488.11
    .00       .00   1005.00   1085.00       .00
        6.000     19.77       .88     20.40     60.00       .00   5460.00       .00
   60.00   1005.00   1005.00   1085.00  1065.00

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 BERNARD BAYOU

 SUMMARY PRINTOUT TABLE  150

        SECNO      XLCH       ELTRD      ELLC       ELMIN        Q        CWSEL     CRIWS
   EG        10*KS       VCH       AREA       .01K

          .800        .00       .00       .00    -14.00  14900.00      3.77       .00
    3.85      1.10      2.22   6734.90 14220.09
```

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        .800        .00         .00         .00    -14.00  14900.00       4.77         .00
   4.83        .78      2.00   7463.78 16921.09

*       .900    7725.00         .00         .00    -14.80  14900.00       4.15         .00
   4.18        .22      1.39  10712.62 31632.30
*       .900    7725.00         .00         .00    -14.80  14900.00       5.06         .00
   5.09        .18      1.31  11381.43 34842.47

*      1.000    6175.00         .00         .00    -14.80  10200.00       4.34         .00
   4.43       1.18      2.42   4311.89  9407.84
*      1.000    6175.00         .00         .00    -14.80  10200.00       5.22         .00
   5.30       1.00      2.29   4459.07 10224.99

*      2.000    2400.00         .00         .00     -8.60  10200.00       4.24         .00
   5.69      52.11      9.67   1066.64  1412.93
*      2.000    2400.00         .00         .00     -8.60  10200.00       5.15         .00
   6.34      39.22      8.75   1166.31  1628.81

       2.100      50.00         .00         .00     -8.60   9300.00       5.02         .00
   6.03      32.16      8.06   1176.61  1640.01
       2.100      50.00         .00         .00     -8.60   9300.00       5.72         .00
   6.60      27.17      7.52   1235.98  1784.22

       2.200      24.00       13.90       12.50     -8.60   9300.00       5.22         .00
   6.18      29.92      7.88   1205.25  1700.20
       2.200      24.00       13.90       12.50     -8.60   9300.00       5.87         .00
   6.71      23.86      7.36   1300.92  1904.08

       3.000      55.00         .00         .00     -9.90   9300.00       5.67         .00
   6.39      20.74      6.81   1367.10  2041.93
       3.000      55.00         .00         .00     -9.90   9300.00       6.23         .00
   6.87      17.66      6.45   1441.14  2213.04

       3.100      10.00       12.60       10.60     -9.90   9300.00       5.81         .00
   6.51      19.89      6.72   1386.94  2085.46
       3.100      10.00       12.60       10.60     -9.90   9300.00       6.34         .00
   6.97      16.93      6.38   1464.93  2259.99

       3.200     150.00         .00         .00     -9.90   9300.00       6.18         .00
   6.80      16.31      6.38   1662.13  2302.64
       3.200     150.00         .00         .00     -9.90   9300.00       6.61         .00
   7.22      15.68      6.28   1481.77  2348.43

     300.000     700.00         .00         .00     -5.00   9300.00       7.45         .00
   7.78      11.42      4.72   2189.13  2752.35
     300.000     700.00         .00         .00     -5.00   9300.00       7.82         .00
   8.17      11.13      4.73   1966.21  2787.43

     301.000      50.00         .00         .00     -5.00   9300.00       7.40         .00
   7.96      15.45      6.01   1547.96  2365.99
     301.000      50.00         .00         .00     -5.00   9300.00       7.80         .00
   8.32      13.84      5.79   1607.09  2499.72

     302.000      24.00       25.00       22.00     -5.00   9300.00       7.44         .00
   7.99      15.30      5.99   1553.05  2377.42
     302.000      24.00       25.00       22.00     -5.00   9300.00       7.83         .00
   8.34      13.73      5.77   1611.59  2509.99

     303.000      90.00         .00         .00     -5.00   9300.00       7.59         .00
   8.13      14.64      5.90   1576.47  2430.21
     303.000      90.00         .00         .00     -5.00   9300.00       7.96         .00
   8.47      13.19      5.69   1633.62  2560.37
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  304.000    150.00     29.70     28.88     -5.00   9300.00      7.69       .00
 8.22     14.25      5.85   1591.06  2463.26
  304.000    150.00     29.70     28.88     -5.00   9300.00      8.05       .00
 8.55     12.91      5.65   1645.68  2588.09

  307.000    160.00       .00       .00     -5.00   9300.00      7.89       .00
 8.49     15.21      6.21   1496.82  2384.63
  307.000    160.00       .00       .00     -5.00   9300.00      8.23       .00
 8.80     13.92      6.03   1541.85  2492.61

  308.000     50.00     25.70     22.51     -5.00   9300.00      7.96       .00
 8.55     14.95      6.18   1505.32  2404.91
  308.000     50.00     25.70     22.51     -5.00   9300.00      8.29       .00
 8.85     13.72      6.00   1549.53  2511.18

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   SECNO     XLCH      ELTRD     ELLC      ELMIN      Q        CWSEL     CRIWS
 EG       10*KS      VCH      AREA      .01K

  309.000     50.00       .00       .00     -5.00   9300.00      8.18       .00
 8.67     22.22      5.59   1662.21  1973.05
  309.000     50.00       .00       .00     -5.00   9300.00      8.50       .00
 8.96     20.43      5.44   1710.71  2057.76

  310.000   1230.00       .00       .00     -5.00   9300.00     10.39       .00
10.72     12.83      4.63   2007.44  2596.55
  310.000   1230.00       .00       .00     -5.00   9300.00     10.57       .00
10.89     12.31      4.57   2036.35  2650.83

  310.100    530.00       .00       .00     -2.30   9300.00     10.82       .00
11.22      6.67      5.09   1828.30  3601.38
  310.100    530.00       .00       .00     -2.30   9300.00     10.98       .00
11.37      6.38      5.01   1857.19  3683.07

  310.200    200.00       .00       .00     -2.30   9300.00     10.96       .00
11.36      6.40      5.02   1854.32  3674.92
  310.200    200.00       .00       .00     -2.30   9300.00     11.12       .00
11.50      6.14      4.94   1882.12  3753.93

  310.300     60.00     16.00     15.00     -2.30   9300.00     10.98       .00
11.37      6.38      5.01   1856.67  3681.59
  310.300     60.00     16.00     15.00     -2.30   9300.00     11.13       .00
11.51      6.12      4.94   1884.37  3760.34

  310.400     80.00       .00       .00     -2.30   9300.00     11.03       .00
11.42      6.29      4.98   1865.87  3707.68
  310.400     80.00       .00       .00     -2.30   9300.00     11.18       .00
11.56      6.04      4.91   1893.23  3785.62

  310.500    245.00       .00       .00     -2.00   9300.00     11.28       .00
11.58      6.13      4.42   2104.17  3756.46
  310.500    245.00       .00       .00     -2.00   9300.00     11.42       .00
11.71      5.83      4.35   2138.45  3851.75

  310.600    230.00       .00       .00     -1.40   9300.00     11.33       .00
11.78      7.36      5.37   1731.72  3429.05
  310.600    230.00       .00       .00     -1.40   9300.00     11.47       .00
11.90      7.08      5.30   1754.71  3496.28
```

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     310.700    210.00       .00       .00    -1.70   9300.00     11.52        .00
  11.93      6.42      5.13   1813.59  3670.04
     310.700    210.00       .00       .00    -1.70   9300.00     11.65        .00
  12.05      6.20      5.07   1835.63  3735.70

*    310.800    190.00       .00       .00    -2.00   9300.00     11.35        .00
  12.26     15.61      7.66   1214.86  2353.86
*    310.800    190.00       .00       .00    -2.00   9300.00     11.48        .00
  12.37     15.06      7.56   1230.43  2396.83

*    313.000    110.00       .00       .00     -.90   5460.00     11.62        .00
  12.54     91.76      7.95    785.93   570.00
*    313.000    110.00       .00       .00     -.90   5460.00     11.63        .00
  12.78    110.96      8.59    635.84   518.34

     314.000    102.00     26.40     25.00     -.90   5460.00     11.78        .00
  12.64     83.38      7.70    815.45   597.96
     314.000    102.00     26.40     25.00     -.90   5460.00     11.87        .00
  12.93     98.84      8.28    659.45   549.19

*      4.000    550.00       .00       .00    -1.60   5460.00     13.06        .00
  13.09      1.21      1.39   3974.03  4954.47
*      4.000    550.00       .00       .00    -1.60   5460.00     13.42        .00
  13.45      1.15      1.36   4004.41  5083.01

      41.000     10.00     25.00     22.00    -1.60   5460.00     13.07        .00
  13.10      1.21      1.39   3974.85  4956.12
      41.000     10.00     25.00     22.00    -1.60   5460.00     13.42        .00
  13.45      1.15      1.36   4005.13  5084.49

*      5.000    250.00       .00       .00     -.80   5460.00     12.94        .00
  13.39     29.78      5.86   1203.38  1000.45
*      5.000    250.00       .00       .00     -.80   5460.00     13.14        .00
  13.91     44.70      7.02    777.89   816.69

      51.000     35.00     21.90     21.00     -.80   5460.00     13.00        .00
  13.44     28.98      5.80   1217.00  1014.31
      51.000     35.00     21.90     21.00     -.80   5460.00     13.28        .00
  14.02     42.82      6.92    788.94   834.38

      52.000     50.00       .00       .00     -.80   5460.00     13.17        .00
  13.58     26.70      5.64   1257.93  1056.57
*     52.000     50.00       .00       .00     -.80   5460.00     13.91        .00
  14.28     21.42      5.30   1272.92  1179.68

1
   09APR98      10:54:35
                             PAGE   16


      SECNO     XLCH      ELTRD     ELLC      ELMIN       Q      CWSEL     CRIWS
  EG       10*KS      VCH      AREA      .01K

       6.000   2500.00       .00       .00     1.70   5460.00     18.90        .00
  19.31     20.16      5.42   1286.25  1216.13
       6.000   2500.00       .00       .00     1.70   5460.00     19.77        .00
  20.40     28.10      6.38    855.28  1030.02

1
   09APR98      10:54:35
                             PAGE   17
```

BERNARD BAYOU

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	.800	14900.00	3.77	.00	.00	.00	811.05	.00
	.800	14900.00	4.77	1.00	.00	1.00	749.59	.00
*	.900	14900.00	4.15	.00	.38	.00	746.83	7725.00
*	.900	14900.00	5.06	.92	.29	.92	735.92	7725.00
*	1.000	10200.00	4.34	.00	.19	.00	429.98	6175.00
*	1.000	10200.00	5.22	.88	.15	.88	281.56	6175.00
*	2.000	10200.00	4.24	.00	-.10	.00	138.03	2400.00
*	2.000	10200.00	5.15	.92	-.06	.92	124.00	2400.00
	2.100	9300.00	5.02	.00	.78	.00	143.37	50.00
	2.100	9300.00	5.72	.70	.56	.70	124.00	50.00
	2.200	9300.00	5.22	.00	.20	.00	144.73	24.00
	2.200	9300.00	5.87	.65	.15	.65	149.17	24.00
	3.000	9300.00	5.67	.00	.45	.00	144.86	55.00
	3.000	9300.00	6.23	.56	.36	.56	135.90	55.00
	3.100	9300.00	5.81	.00	.14	.00	145.13	10.00
	3.100	9300.00	6.34	.54	.11	.54	146.22	10.00
	3.200	9300.00	6.18	.00	.38	.00	359.08	150.00
	3.200	9300.00	6.61	.43	.27	.43	130.00	150.00
	300.000	9300.00	7.45	.00	1.27	.00	334.07	700.00
	300.000	9300.00	7.82	.37	1.21	.37	217.89	700.00
	301.000	9300.00	7.40	.00	-.05	.00	149.61	50.00
	301.000	9300.00	7.80	.39	-.02	.39	151.18	50.00
	302.000	9300.00	7.44	.00	.03	.00	149.75	24.00
	302.000	9300.00	7.83	.39	.03	.39	151.30	24.00
	303.000	9300.00	7.59	.00	.16	.00	150.37	90.00
	303.000	9300.00	7.96	.37	.14	.37	151.88	90.00
	304.000	9300.00	7.69	.00	.10	.00	150.76	150.00
	304.000	9300.00	8.05	.36	.09	.36	152.20	150.00
	307.000	9300.00	7.89	.00	.20	.00	132.23	160.00
	307.000	9300.00	8.23	.34	.18	.34	133.08	160.00
	308.000	9300.00	7.96	.00	.06	.00	132.39	50.00
	308.000	9300.00	8.29	.33	.06	.33	133.22	50.00

1
09APR98 10:54:35
PAGE 18

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
309.000	9300.00	8.18	.00	.23	.00	152.15	50.00

	309.000	9300.00	8.50	.32	.21	.32	153.41	50.00
	310.000	9300.00	10.39	.00	2.21	.00	160.88	1230.00
	310.000	9300.00	10.57	.18	2.07	.18	161.59	1230.00
	310.100	9300.00	10.82	.00	.43	.00	178.72	530.00
	310.100	9300.00	10.98	.16	.41	.16	179.68	530.00
	310.200	9300.00	10.96	.00	.15	.00	179.59	200.00
	310.200	9300.00	11.12	.15	.14	.15	180.51	200.00
	310.300	9300.00	10.98	.00	.01	.00	179.67	60.00
	310.300	9300.00	11.13	.15	.01	.15	180.59	60.00
	310.400	9300.00	11.03	.00	.06	.00	179.97	80.00
	310.400	9300.00	11.18	.15	.05	.15	180.88	80.00
	310.500	9300.00	11.28	.00	.24	.00	239.53	245.00
	310.500	9300.00	11.42	.14	.23	.14	240.15	245.00
	310.600	9300.00	11.33	.00	.05	.00	166.84	230.00
	310.600	9300.00	11.47	.14	.05	.14	167.44	230.00
	310.700	9300.00	11.52	.00	.19	.00	168.96	210.00
	310.700	9300.00	11.65	.13	.18	.13	169.52	210.00
*	310.800	9300.00	11.35	.00	-.17	.00	116.80	190.00
*	310.800	9300.00	11.48	.13	-.17	.13	117.30	190.00
*	313.000	5460.00	11.62	.00	.28	.00	187.98	110.00
*	313.000	5460.00	11.63	.01	.15	.01	100.00	110.00
	314.000	5460.00	11.78	.00	.16	.00	188.53	102.00
	314.000	5460.00	11.87	.09	.24	.09	100.00	102.00
*	4.000	5460.00	13.06	.00	1.28	.00	358.12	550.00
*	4.000	5460.00	13.42	.36	1.55	.36	330.00	550.00
	41.000	5460.00	13.07	.00	.00	.00	358.13	10.00
	41.000	5460.00	13.42	.36	.00	.36	330.00	10.00
*	5.000	5460.00	12.94	.00	-.13	.00	233.12	250.00
*	5.000	5460.00	13.14	.20	-.28	.20	80.00	250.00
	51.000	5460.00	13.00	.00	.06	.00	233.39	35.00
	51.000	5460.00	13.28	.28	.14	.28	80.00	35.00
	52.000	5460.00	13.17	.00	.18	.00	234.22	50.00
*	52.000	5460.00	13.91	.74	.63	.74	180.00	50.00

1
09APR98 10:54:35
PAGE 19

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
6.000	5460.00	18.90	.00	5.72	.00	255.05	2500.00
6.000	5460.00	19.77	.88	5.86	.88	60.00	2500.00

1
09APR98 10:54:35
PAGE 20

SUMMARY OF ERRORS AND SPECIAL NOTES

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WARNING SECNO=       .900  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=       .900  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=      1.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=      1.000  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=      2.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=      2.000  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=    310.800  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=    310.800  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=    313.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=    313.000  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=      4.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=      4.000  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=      5.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=      5.000  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=     52.000  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
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1
09APR98 10:54:35
PAGE 21

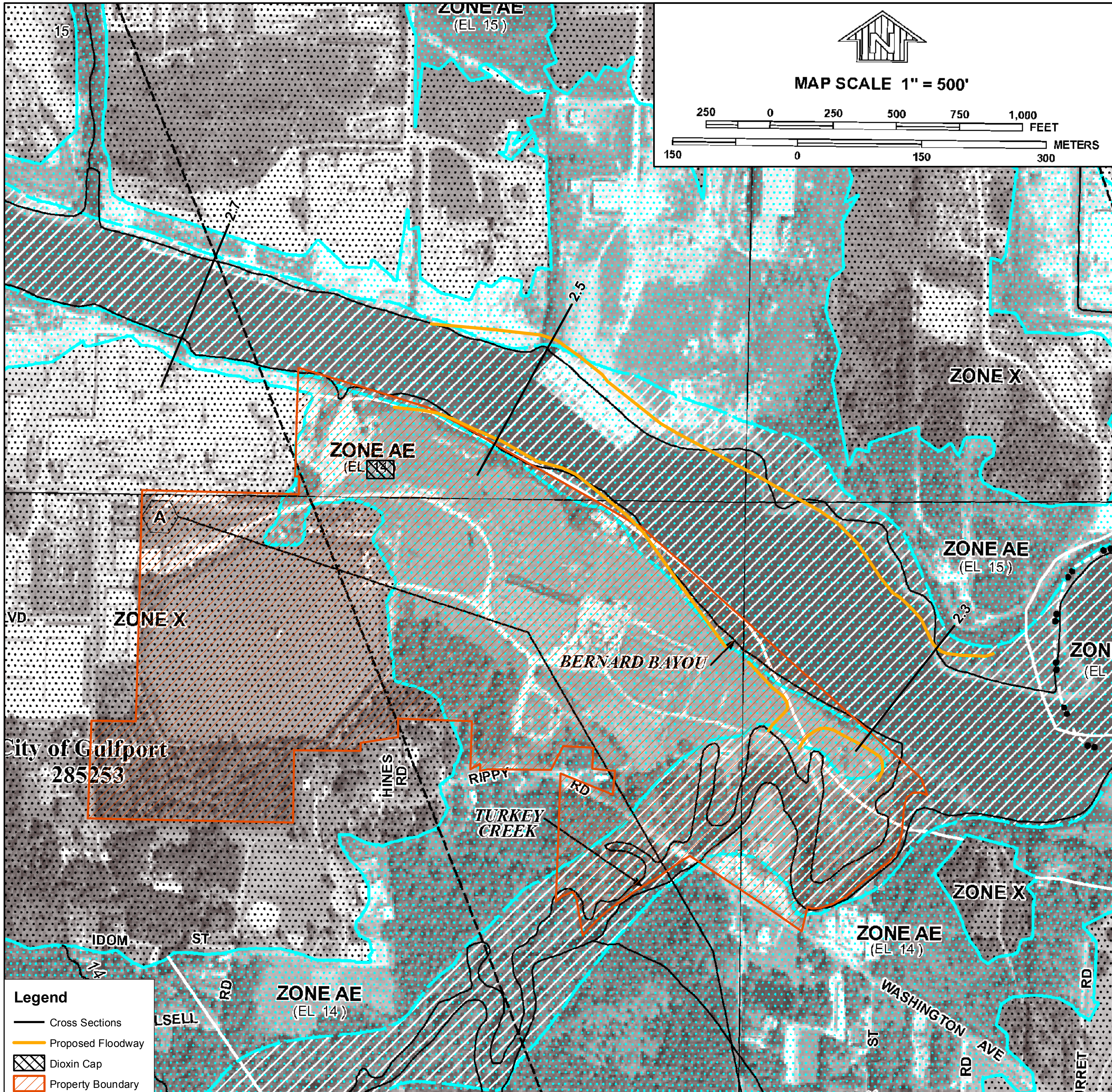
FLOODWAY DATA, BERNARD BAYOU
PROFILE NO. 2

STATION	------- FLOODWAY ------- WIDTH	SECTION AREA	MEAN VELOCITY	WATER SURFACE ELEVATION WITH FLOODWAY	WITHOUT FLOODWAY	DIFFERENCE
.800	750.	7464.	2.0	4.8	3.8	1.0
.900	736.	11381.	1.3	5.0	4.1	.9
1.000	282.	4459.	2.3	5.2	4.3	.9
2.000	124.	1166.	8.7	5.1	4.2	.9
2.100	124.	1236.	7.5	5.7	5.0	.7
2.200	149.	1301.	7.1	5.9	5.2	.7
3.000	136.	1441.	6.5	6.3	5.7	.6
3.100	146.	1465.	6.3	6.3	5.8	.5
3.200	130.	1482.	6.3	6.6	6.2	.4
300.000	218.	1966.	4.7	7.9	7.5	.4
301.000	151.	1607.	5.8	7.8	7.4	.4
302.000	151.	1612.	5.8	7.8	7.4	.4
303.000	152.	1634.	5.7	8.0	7.6	.4
304.000	152.	1646.	5.7	8.1	7.7	.4
307.000	133.	1542.	6.0	8.2	7.9	.3
308.000	133.	1550.	6.0	8.3	8.0	.3
309.000	153.	1711.	5.4	8.5	8.2	.3
310.000	162.	2036.	4.6	10.6	10.4	.2

310.100	180.	1857.	5.0	11.0	10.8	.2
310.200	181.	1882.	4.9	11.2	11.0	.2
310.300	181.	1884.	4.9	11.2	11.0	.2
310.400	181.	1893.	4.9	11.2	11.0	.2
310.500	240.	2138.	4.3	11.4	11.3	.1
310.600	167.	1755.	5.3	11.4	11.3	.1
310.700	170.	1836.	5.1	11.6	11.5	.1
310.800	117.	1230.	7.6	11.4	11.3	.1
313.000	100.	636.	8.6	11.6	11.6	.0
314.000	100.	659.	8.3	11.9	11.8	.1
4.000	330.	4004.	1.4	13.5	13.1	.4
41.000	330.	4005.	1.4	13.5	13.1	.4
5.000	80.	778.	7.0	13.1	12.9	.2
51.000	80.	789.	6.9	13.3	13.0	.3
52.000	180.	1273.	4.3	13.9	13.2	.7
6.000	60.	855.	6.4	19.8	18.9	.9

APPENDIX B
DATA FILES ONLY – DUPLICATE EFFECTIVE, CORRECTED EFFECTED AND POST-PROPOSED HYDRAULIC MODELS

APPENDIX C
ANNOTATED FIRM PANEL



150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0262G

FIRM

FLOOD INSURANCE RATE MAP

HARRISON COUNTY, MISSISSIPPI

AND INCORPORATED AREAS

PANEL 262 OF 575

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GULFPORT, CITY OF	285253	0262	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
28047C0262G

EFFECTIVE DATE

Federal Emergency Management Agency

APPENDIX D
ANNTATED FLOODWAY DATA TABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Bernard Bayou								
A	3,000	989	3,527	2.0	*	1.9[2]	2.9	1.0
B	9,450	816	3,446	2.0	*	2.4[2]	3.3	0.9
C	10,684	1,130	7,870	0.9	*	2.5[2]	3.4	0.9
D	19,584	979	2,103	3.3	*	3.0[2]	3.7	0.7
E	25,334	750	7,464	2.0	*	3.8[2]	4.8	1.0
F	33,059	736	11,381	1.3	*	4.1[2]	5.0	0.9
G	39,234	282	4,459	2.3	*	4.3[2]	5.2	0.9
H	41,634	124	1,166	8.7	*	4.2[2]	5.1	0.9
I	41,923	130	1,533	6.1	*	6.2[2]	7.1	0.9
J	42,623	218	1,966	4.7	*	7.5[2]	7.9	0.4
K	44,427	162	2,036	4.6	14.7	10.4[2]	10.6	0.2
L	46,282	100	636	8.6	15.0	11.6[2]	11.6	0.0
M	46,934	330	4,004	1.4	15.4	13.1[2]	13.5	0.4
N	47,199	80	778	7.0	15.4	13.1[2]	13.1	0.0
O	49,699	60	855	6.4	19.1	18.9[2]	19.8	0.9
P	50,849	397	3,066	1.9	22.0	21.9[2]	22.9	1.0
Q	59,499	530	2,741	1.9	30.0	30.0	31.0	1.0
R	69,149	573	2,950	1.8	43.8	43.8	44.8	1.0
S	76,999	596	2,811	1.3	56.5	56.5	57.5	1.0
T	87,599	542	2,815	1.4	73.6	73.6	74.6	1.0

[1] Feet above confluence with Back Bay of Biloxi
[2] Elevation computed without consideration of storm surge effects from Back Bay of Biloxi
* BFE determined by coastal storm surge flooding

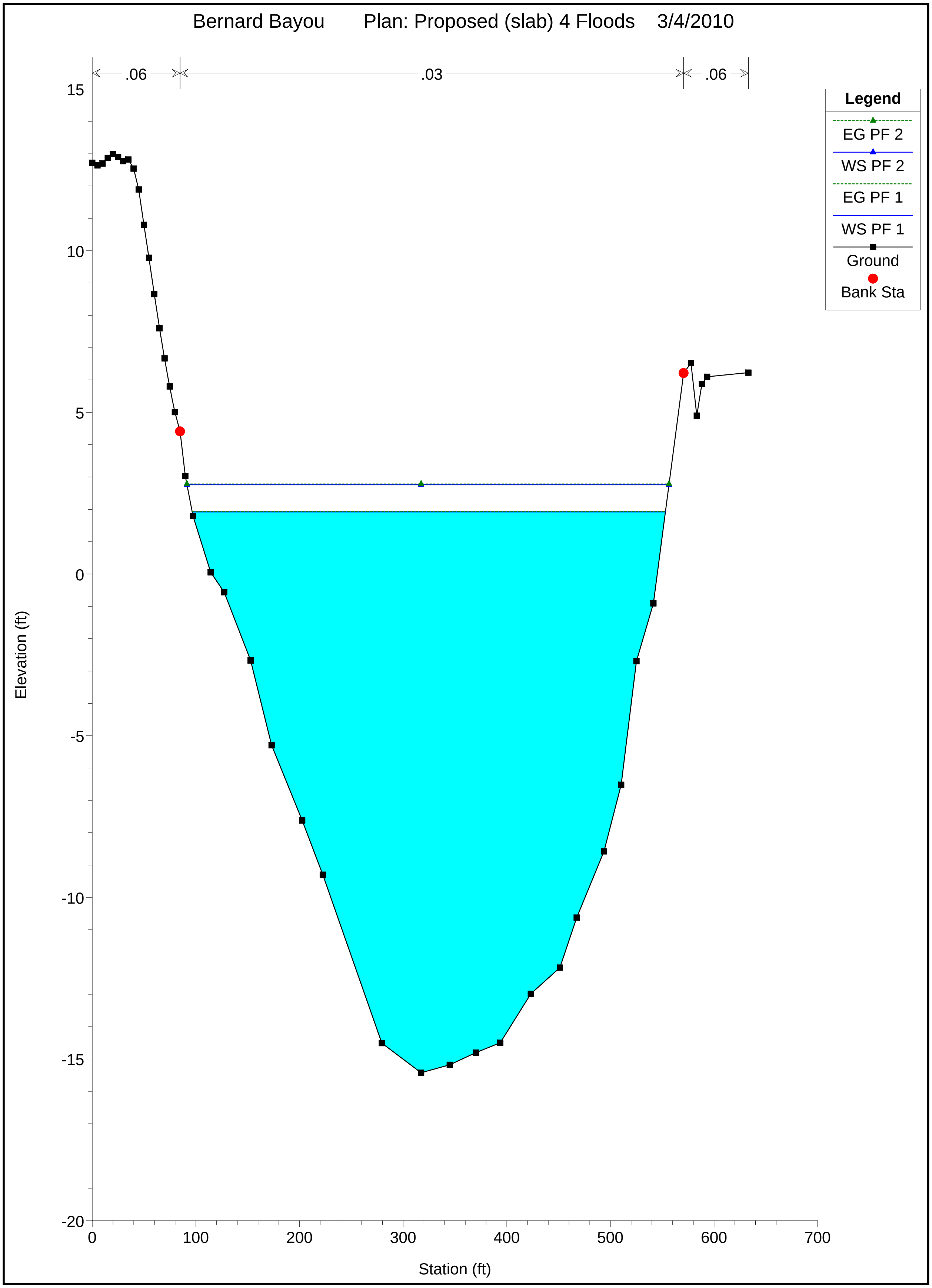
TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
HARRISON COUNTY, MS
AND INCORPORATED AREAS

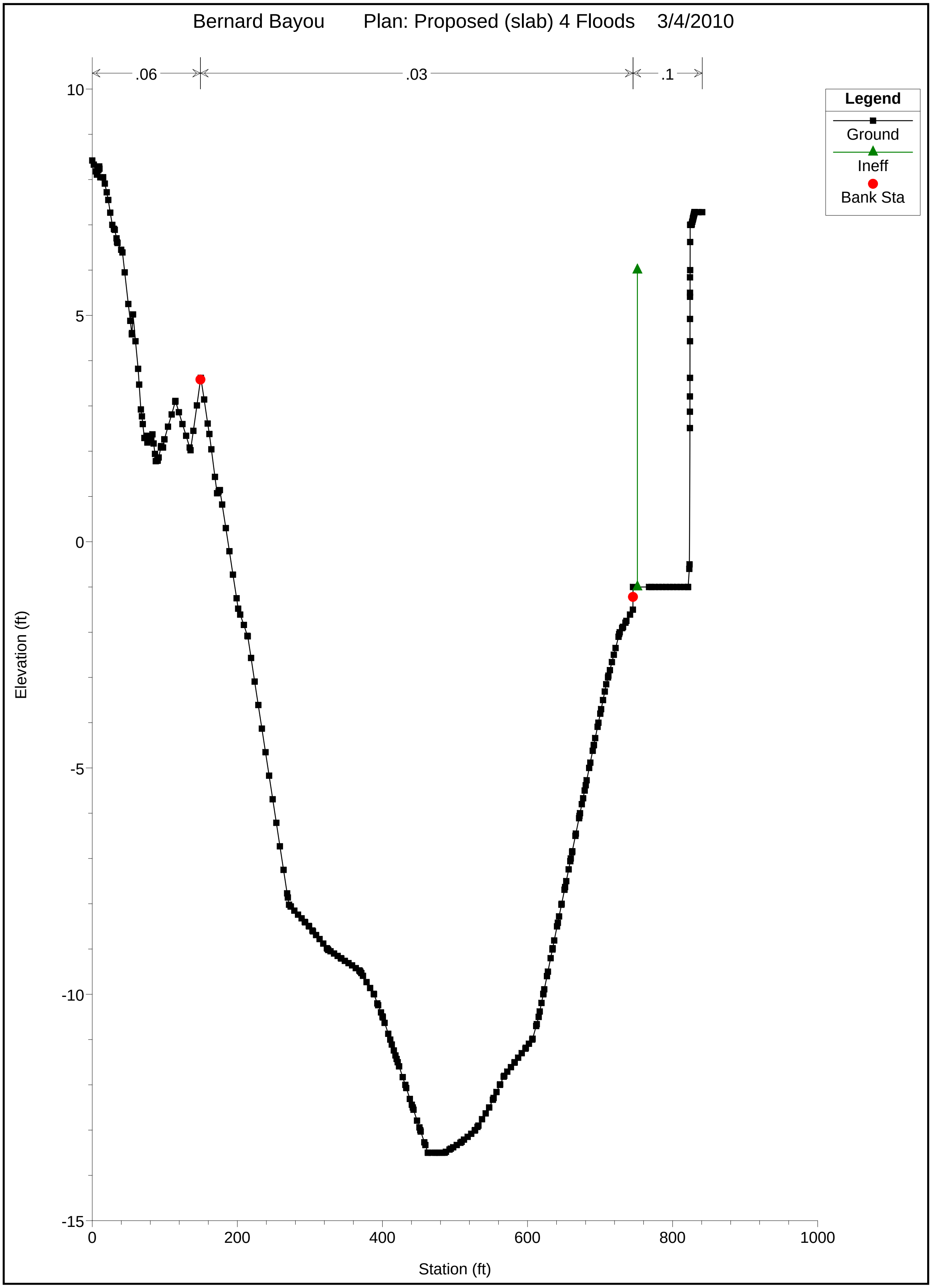
FLOODWAY DATA

BERNARD BAYOU

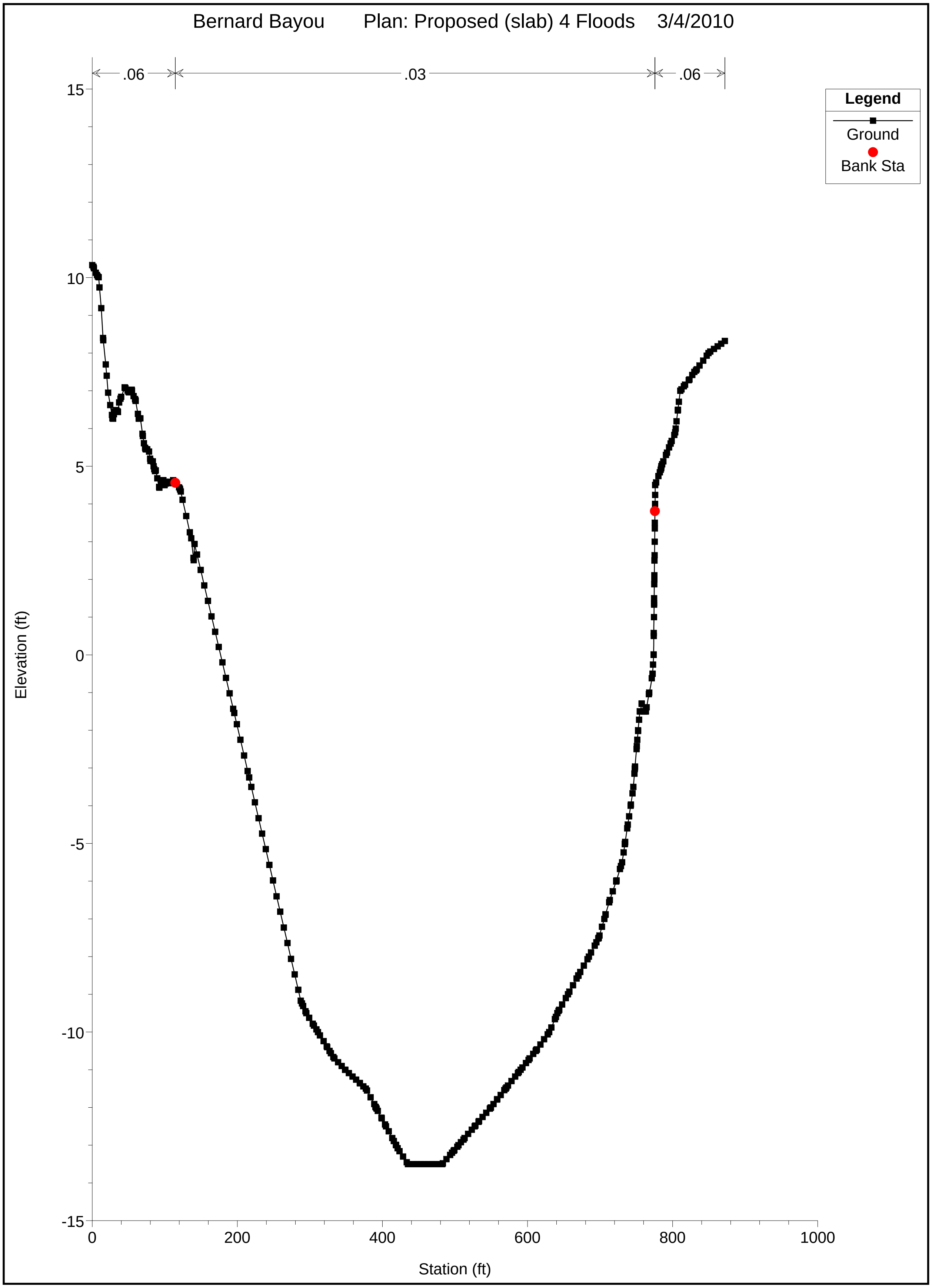
APPENDIX E
CROSS-SECTION PLOTS FOR ADDITIONAL CROSS-SECTIONS

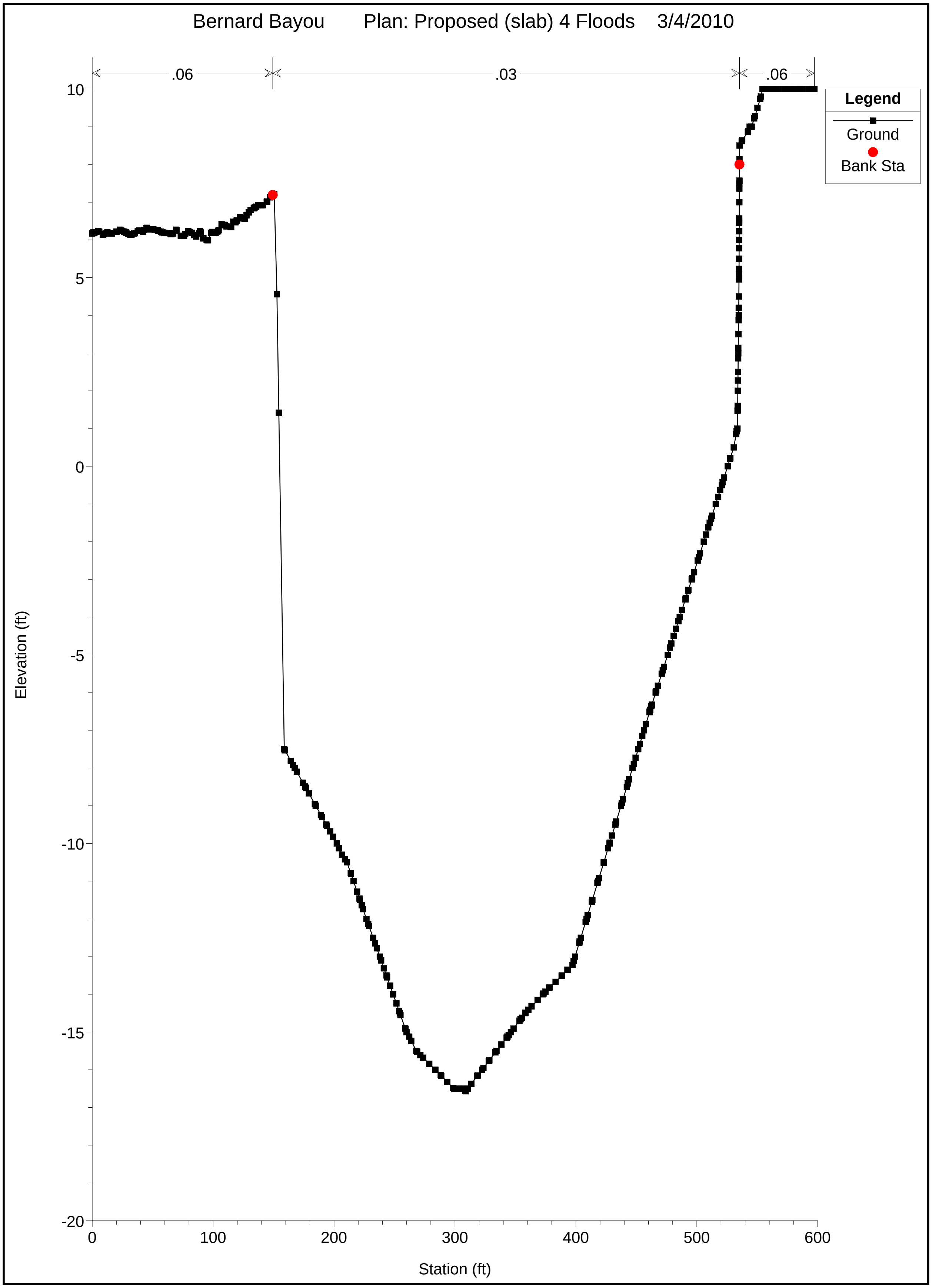


Bernard Bayou Plan: Proposed (slab) 4 Floods 3/4/2010
.06
.03
.06
Legend
EG PF 2
WS PF 2
EG PF 1
WS PF 1
Ground
Bank Sta
15
10
5
0
-5
-10
-15
-20
Elevation (ft)
0
100
200
300
400
500
600
700
Station (ft)

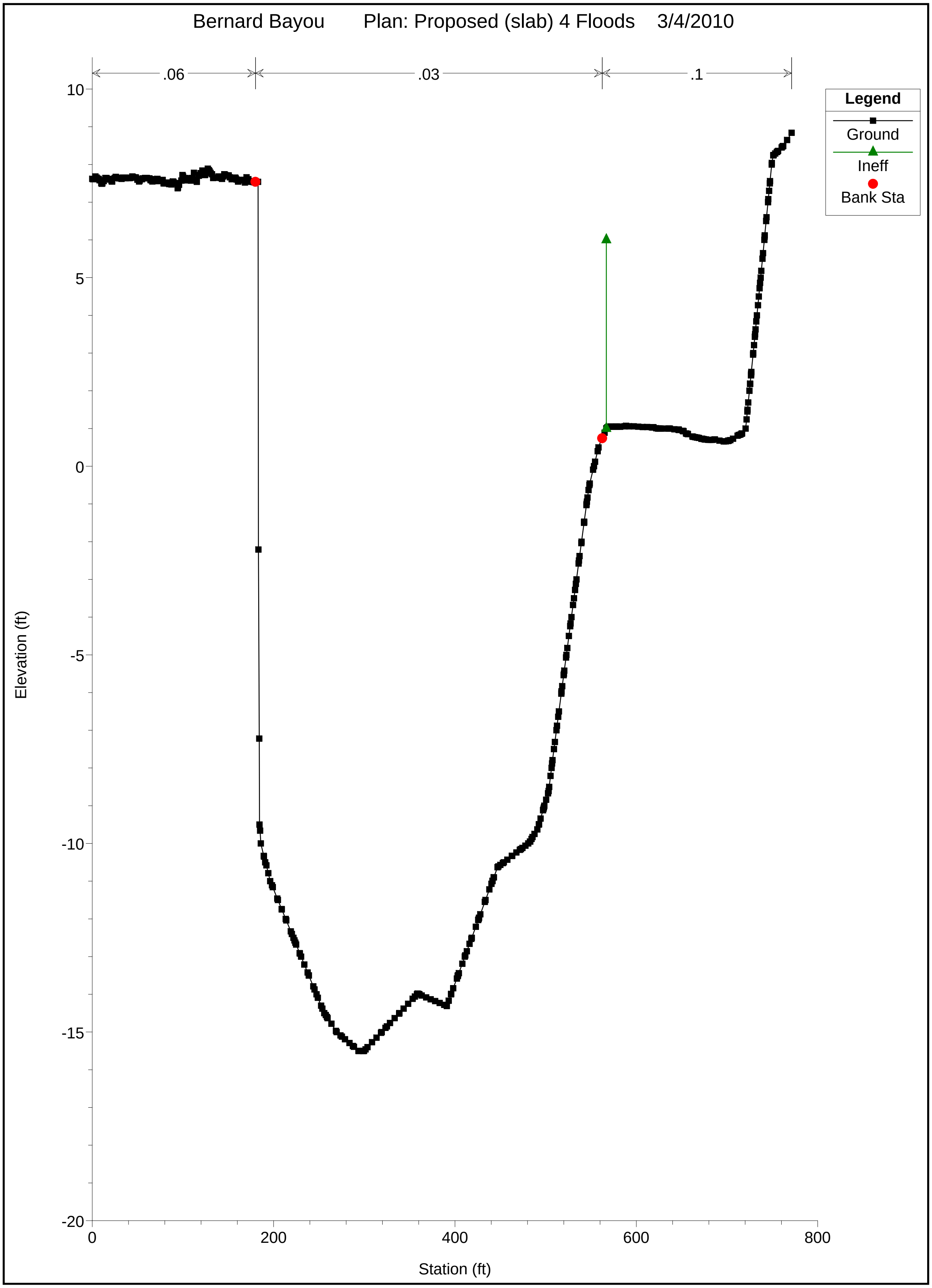


Bernard Bayou Plan: Proposed (slab) 4 Floods 3/4/2010
.06
.03
.1
Legend
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
10
5
0
-5
-10
-15
0
200
400
600
800
1000

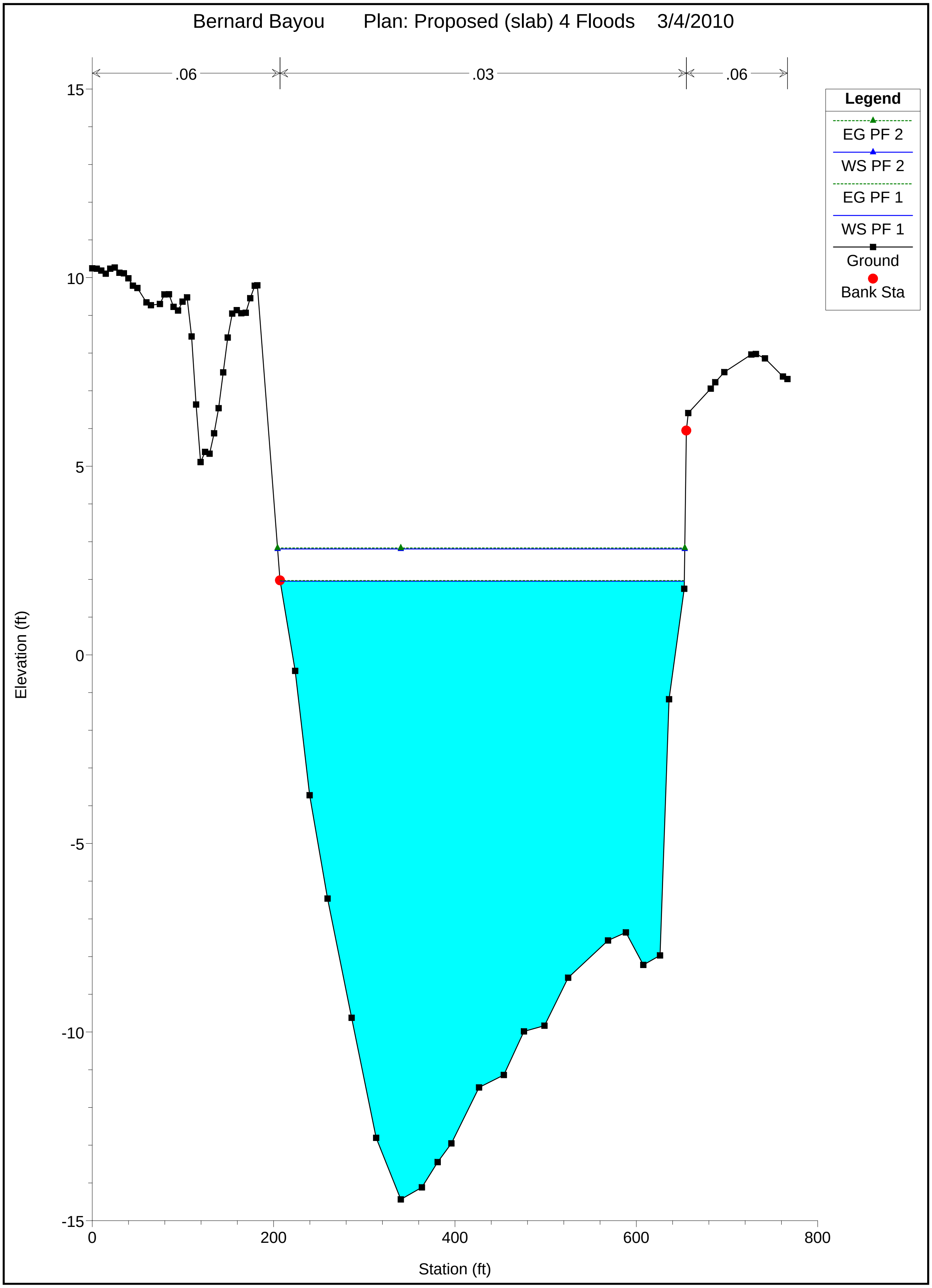

Bernard Bayou Plan: Proposed (slab) 4 Floods 3/4/2010
.06
.03
.06
Legend
Ground
Bank Sta
Elevation (ft)
Station (ft)
15
10
5
0
-5
-10
-15
0
200
400
600
800
1000



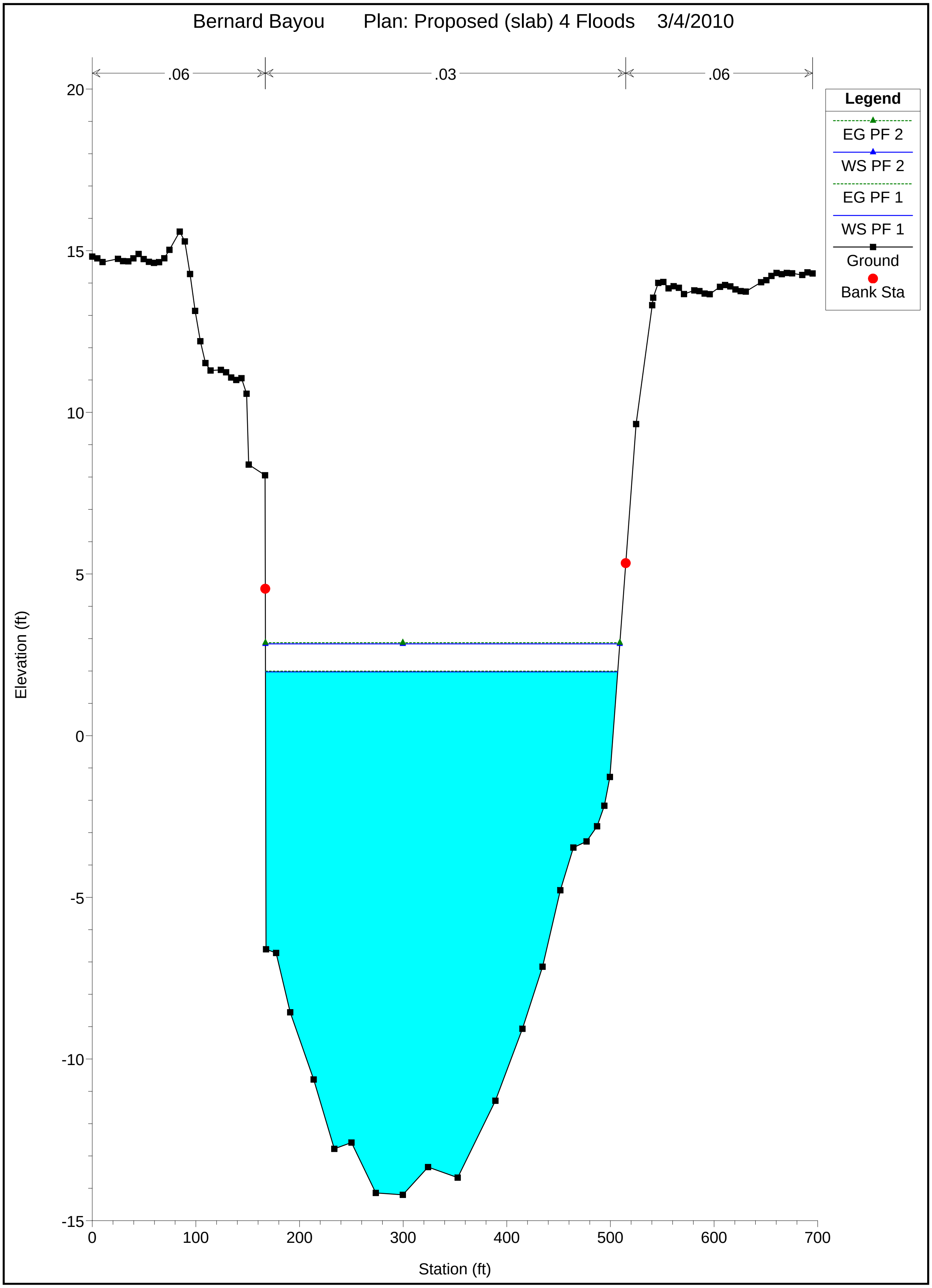
Bernard Bayou Plan: Proposed (slab) 4 Floods 3/4/2010
.06
.03
.06
Legend
Ground
Bank Sta
Elevation (ft)
Station (ft)
10
5
0
-5
-10
-15
-20
0
100
200
300
400
500
600



Bernard Bayou Plan: Proposed (slab) 4 Floods 3/4/2010
.06
.03
.1
Legend
Ground
Ineff
Bank Sta
Elevation (ft)
10
5
0
-5
-10
-15
-20
0
200
400
600
800
Station (ft)

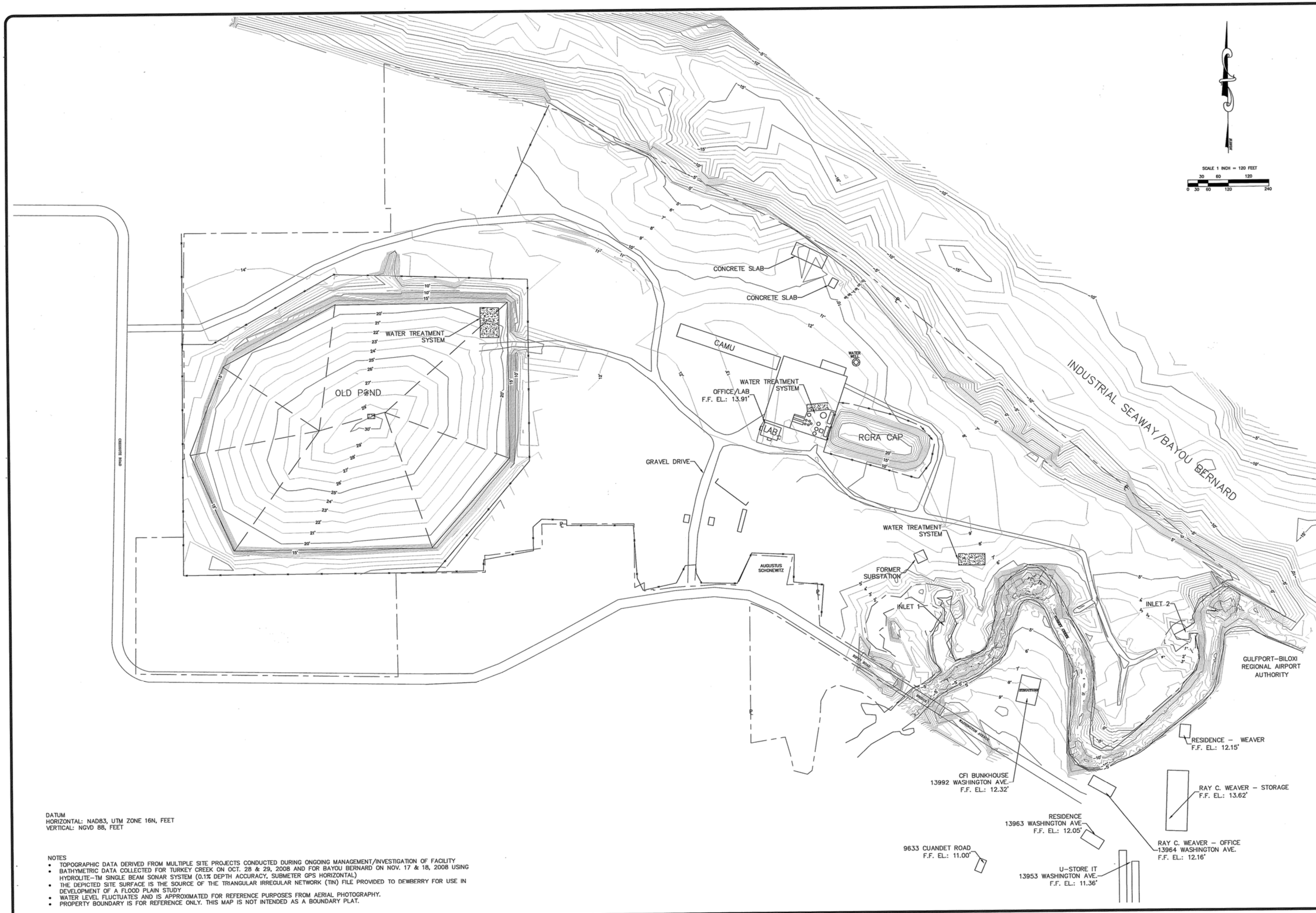


Bernard Bayou   Plan: Proposed (slab) 4 Floods   3/4/2010
.06
.03
.06
Legend
EG PF 2
WS PF 2
EG PF 1
WS PF 1
Ground
Bank Sta
15
10
5
0
-5
-10
-15
Elevation (ft)
0
200
400
600
800
Station (ft)



Bernard Bayou Plan: Proposed (slab) 4 Floods 3/4/2010
.06
.03
.06
Legend
EG PF 2
WS PF 2
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
20
15
10
5
0
-5
-10
-15
0
100
200
300
400
500
600
700

APPENDIX F
CERTIFIED PLANIMETRIC (BOUNDARY SURVEY)



DATUM
HORIZONTAL: NAD83, UTM ZONE 16N, FEET
VERTICAL: NGVD 88, FEET

NOTES
- TOPOGRAPHIC DATA DERIVED FROM MULTIPLE SITE PROJECTS CONDUCTED DURING ONGOING MANAGEMENT/INVESTIGATION OF FACILITY
- BATHYMETRIC DATA COLLECTED FOR TURKEY CREEK ON OCT. 28 & 29, 2008 AND FOR BAYOU BERNARD ON NOV. 17 & 18, 2008 USING HYDROLITE–TM SINGLE BEAM SONAR SYSTEM (0.1% DEPTH ACCURACY, SUBMETER GPS HORIZONTAL)
- THE DEPICTED SITE SURFACE IS THE SOURCE OF THE TRIANGULAR IRREGULAR NETWORK (TIN) FILE PROVIDED TO DEWBERRY FOR USE IN DEVELOPMENT OF A FLOOD PLAIN STUDY
- WATER LEVEL FLUCTUATES AND IS APPROXIMATED FOR REFERENCE PURPOSES FROM AERIAL PHOTOGRAPHY.
- PROPERTY BOUNDARY IS FOR REFERENCE ONLY. THIS MAP IS NOT INTENDED AS A BOUNDARY PLAT.

CAD FILE: 1 TOPO MAP
PROJECT: HAN008100
SCALE: 1" = 120'
DATE: 4/16/2010
CHECKED: C.J.
DRAWN BY: K.K.

CHRISTOPHER T. JOHNSON
LICENSED PROFESSIONAL ENGINEER AND SURVEYOR
PE-15761
PS-3129
STATE OF MISSISSIPPI

ENVIRONMENTAL
MANAGEMENT SERVICES, INC.
P.O. BOX 15369
HATTIESBURG, MS 39404

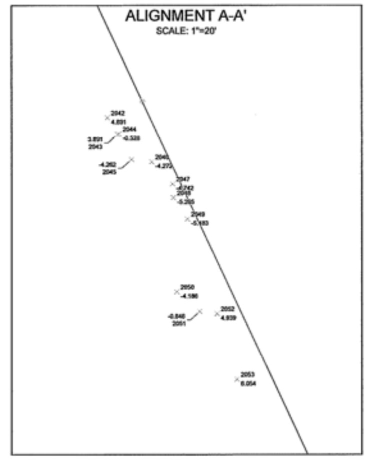
PREPARED FOR:
CAVENHAM FOREST INDUSTRIES
GULFPORT, MS

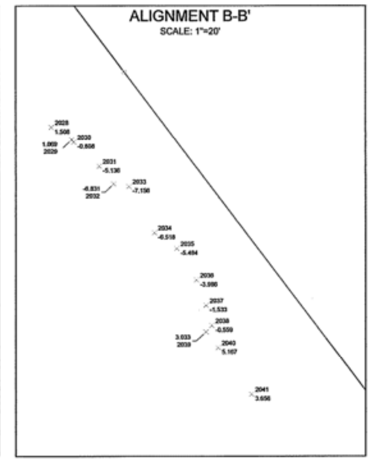
TOPOGRAPHIC SURVEY
TURKEY CREEK FLOODPLAIN EVALUATION

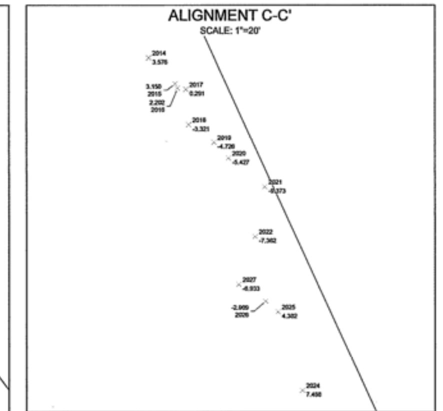
SHEET NO.
1

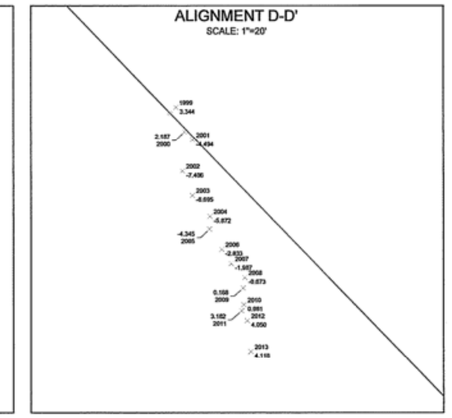
DATUM
HORIZONTAL: NAD83, MISSISSIPPI STATE PLANE EAST ZONE, US FOOT
VERTICAL: NGVD 88, FEET

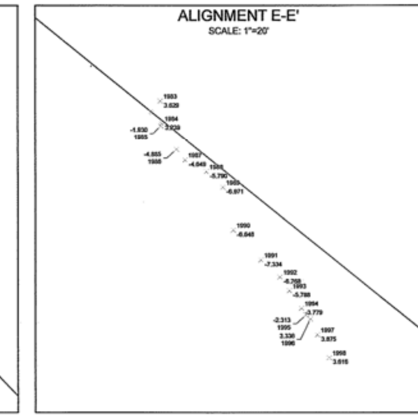
NOTES
- DEPICTED CROSS SECTIONS WERE PROVIDED TO EMS BY DEWBERRY TO ALLOW COLLECTION OF PERTINENT CROSS SECTIONS IN WATER INUNDATED AREAS ALONG TURKEY CREEK & BAYOU BERNARD.
- CROSS SECTIONS SURVEYED ON SEPT. 21 & 22, 2009 USING A COMBINATION OF RTK GPS AND TOTAL STATION TECHNIQUES.
- ACTUAL SURVEY POINTS HAVE BEEN PROJECTED ONTO EACH PROFILE LINE TO ALLOW A CROSS SECTION BEST REPRESENTING THE WIDTH AND DEPTH CHARACTERISTICS OF THE CREEK AND BAYOU ON FIGURE 3.
- ACTUAL SURVEY POINTS COLLECTED ARE SHOWN ON AND ARE CONTAINED IN THE DATA FILE: "CROSS SECTION POINTS.TXT" PROVIDED TO DEWBERRY WITH THIS DRAWING SET.

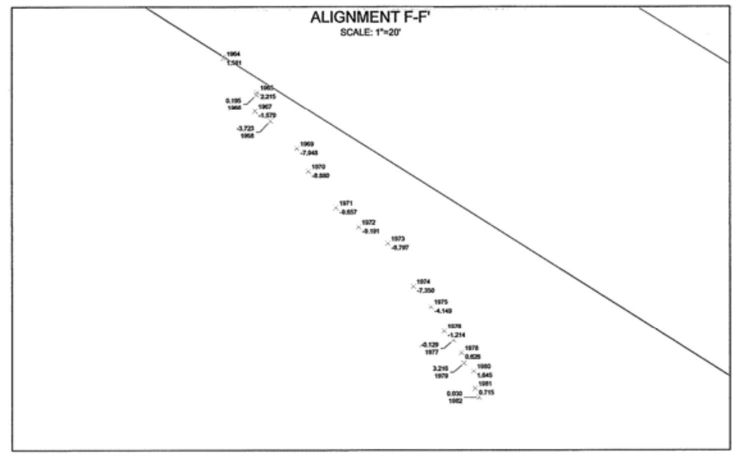


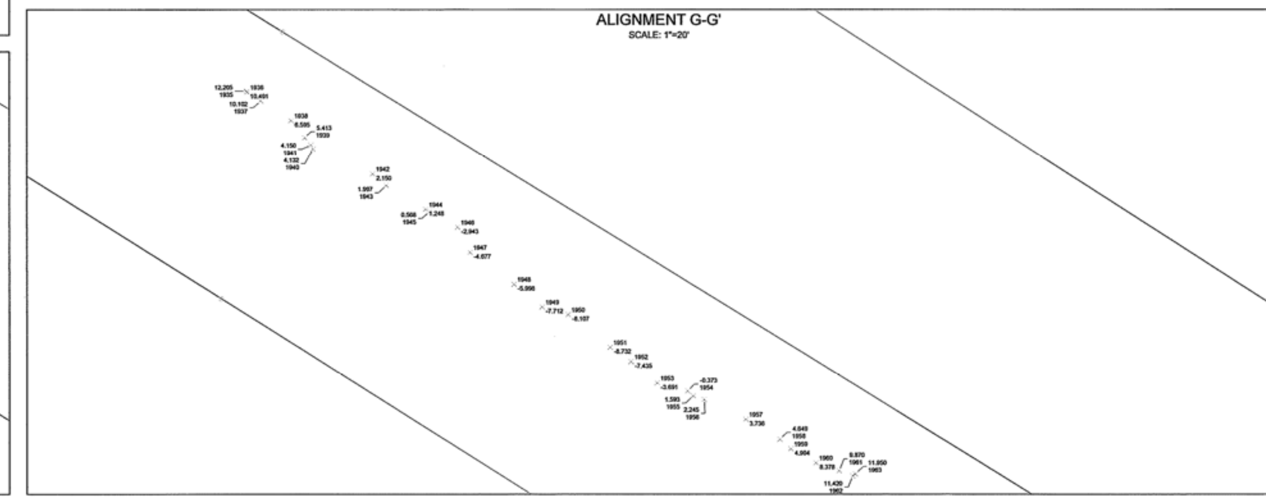


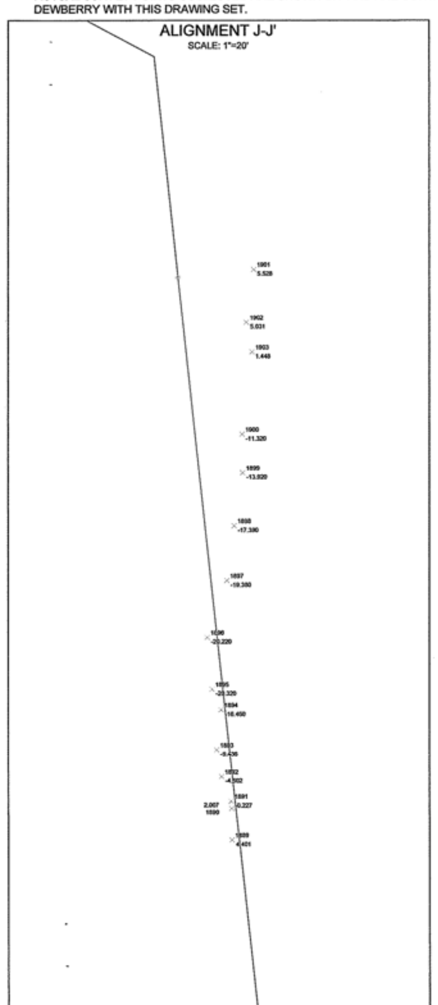


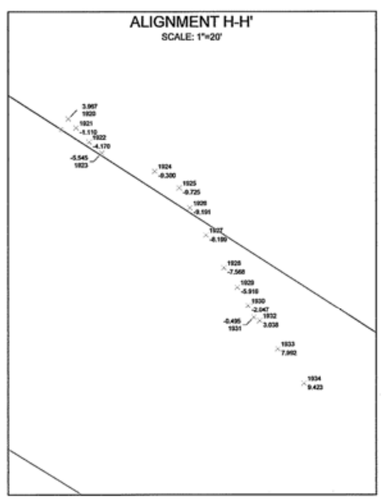


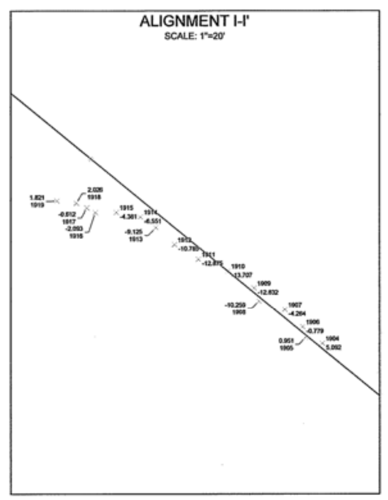


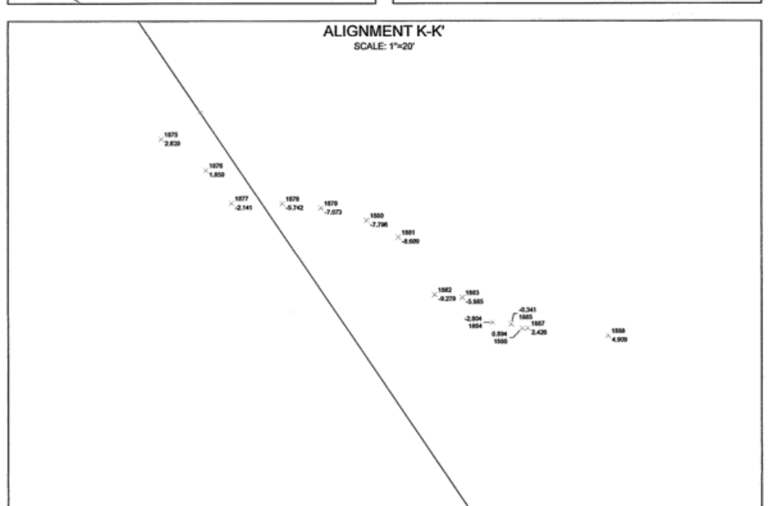


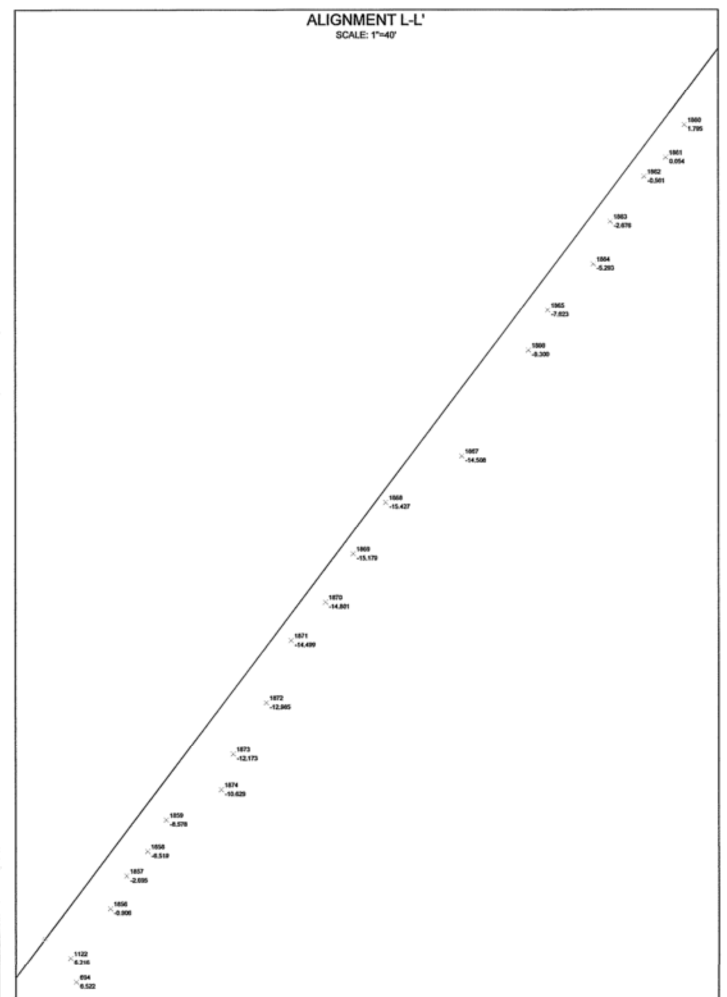


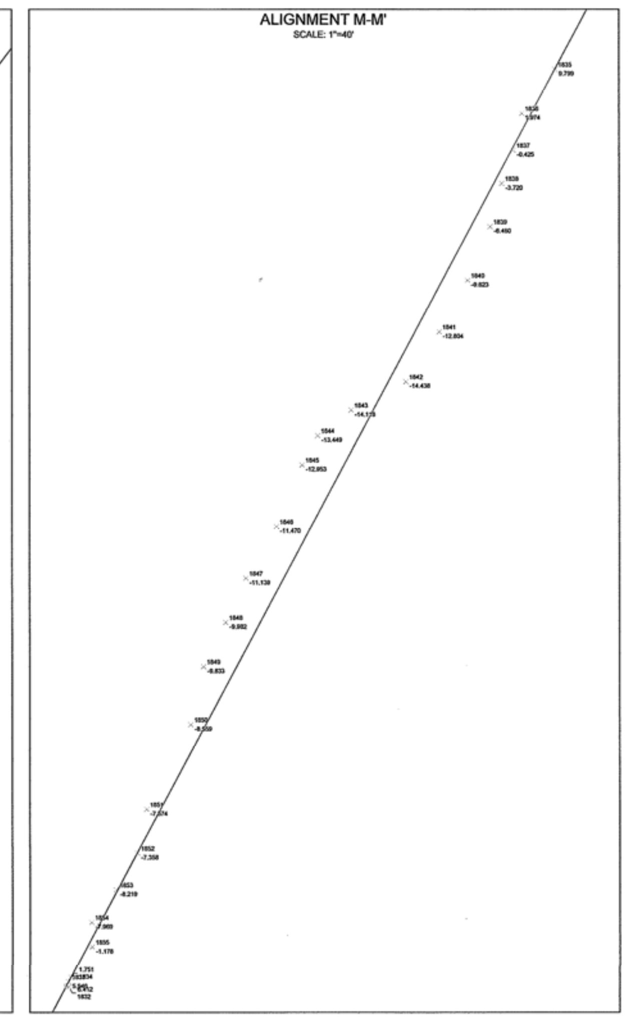


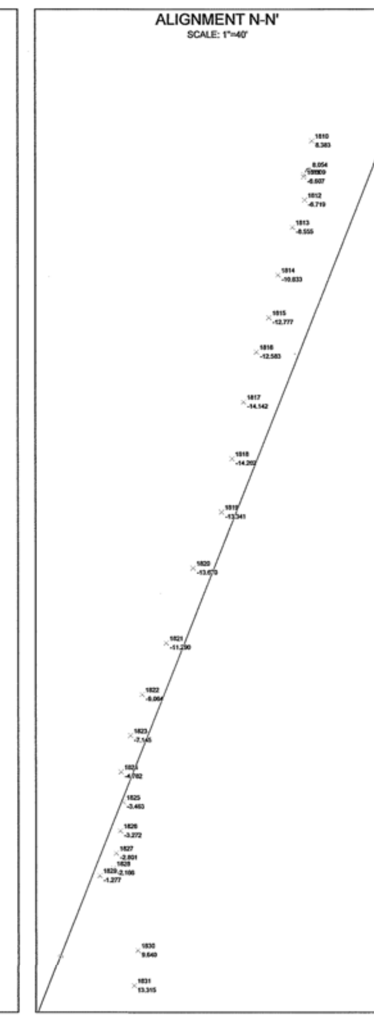












CAD FILE:	CROSS SECTIONS
PROJECT:	HAN0-08-100
SCALE:	AS SHOWN
DATE:	10/30/09
CHECKED:	C.J.
DRAWN BY:	P.D.M.

CHRISTOPHER T. JOHNSON
LICENSED PROFESSIONAL ENGINEER AND SURVEYOR
PE-15761
PS-3129
STATE OF MISSISSIPPI

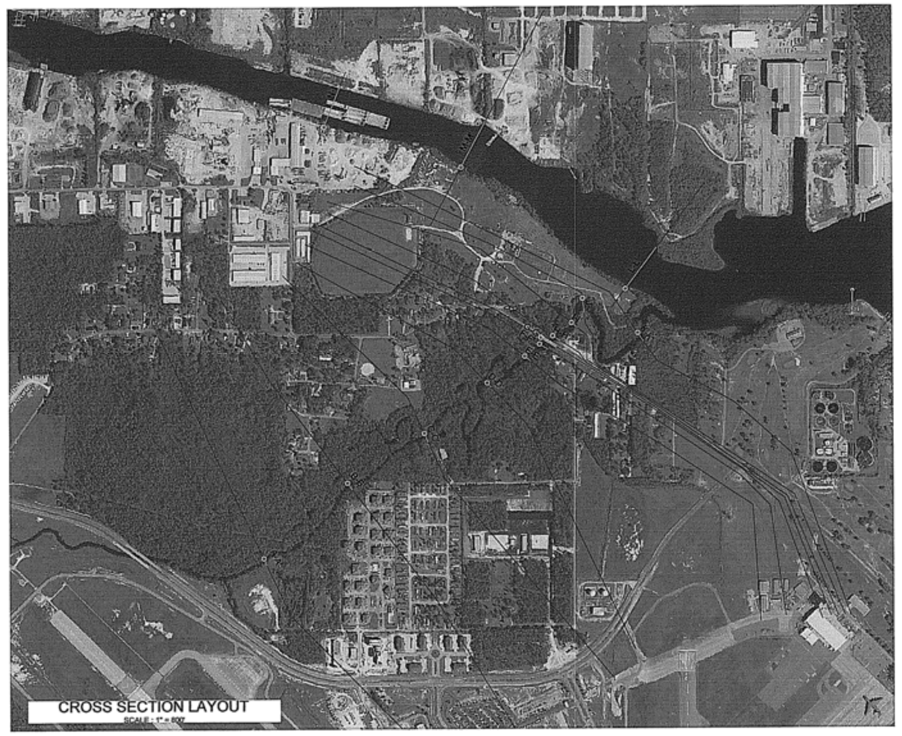
ENVIRONMENTAL
MANAGEMENT SERVICES, INC.
P.O. BOX 15369
HATTIESBURG, MS 39404

PREPARED FOR:
CAVENHAM FOREST INDUSTRIES, INC.
GULFPORT, MS

BAYOU BERNARD / TURKEY CREEK CROSS SECTIONS - PLAN VIEW

TURKEY CREEK FLOODPLAIN EVALUATION

SHEET NO.
2



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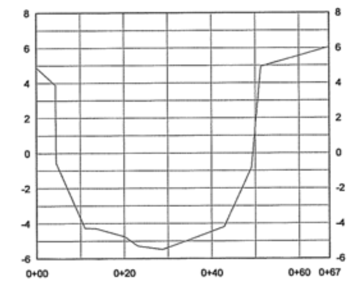

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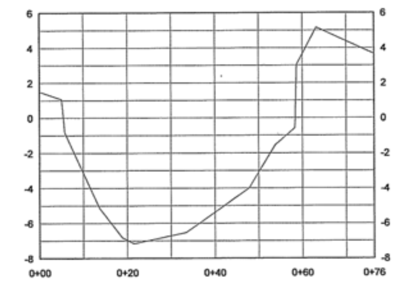

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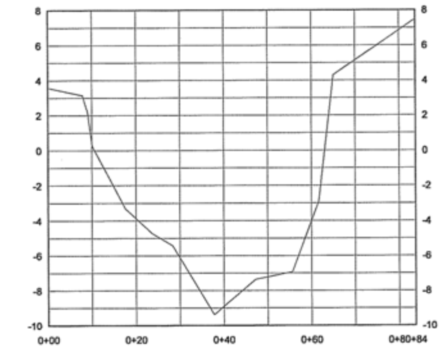

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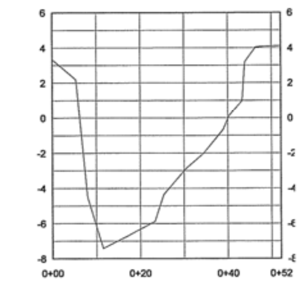

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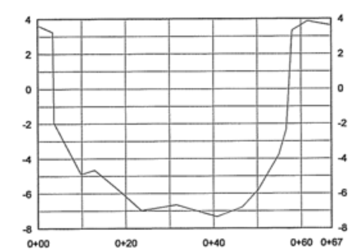

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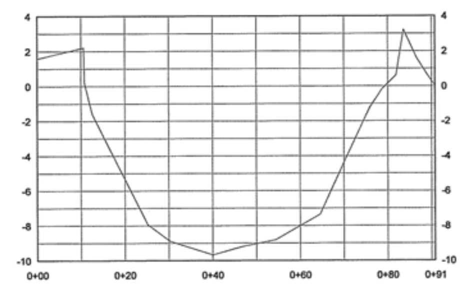

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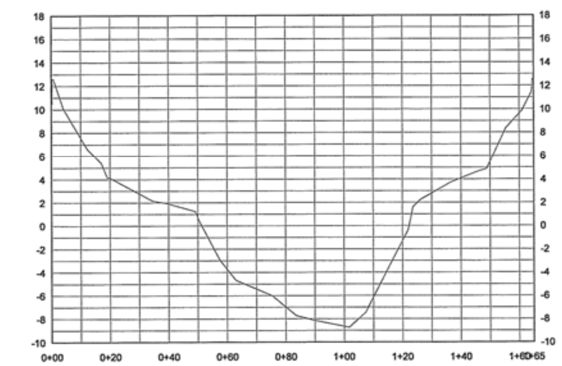

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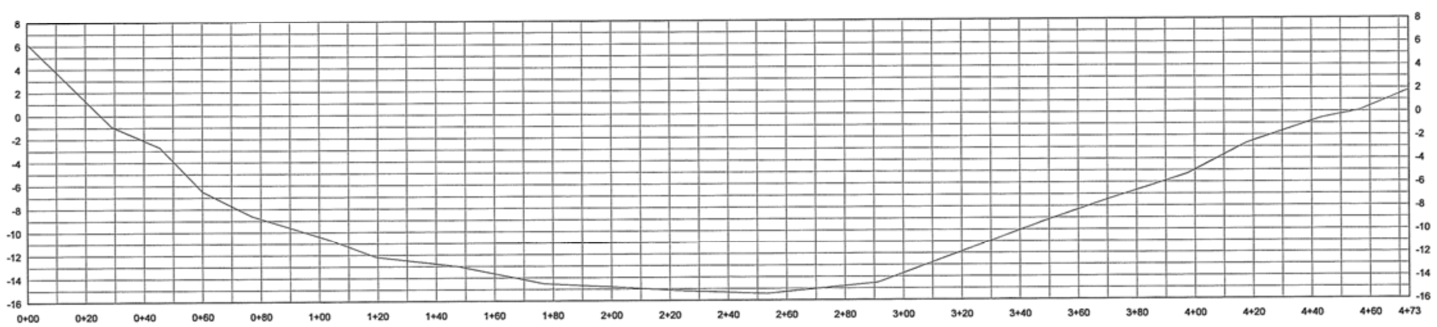

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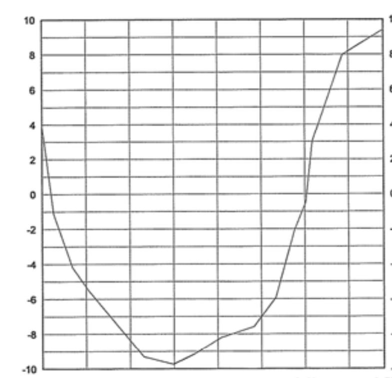

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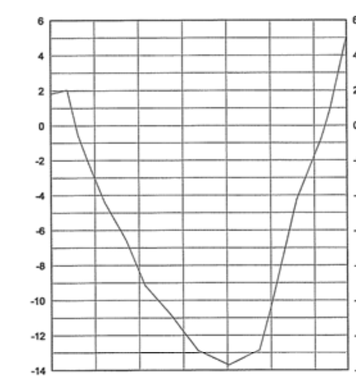

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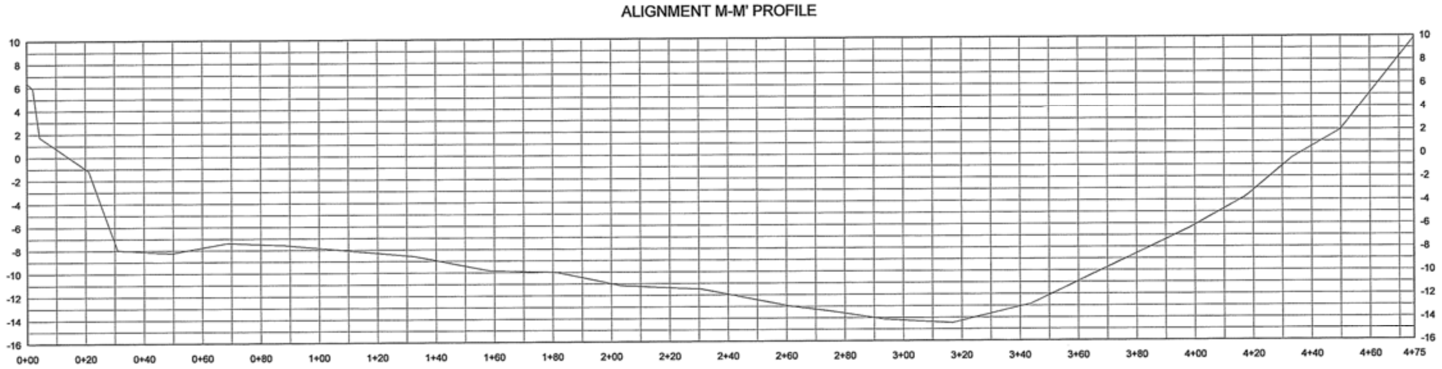

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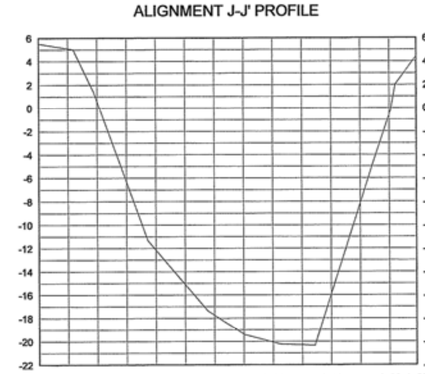

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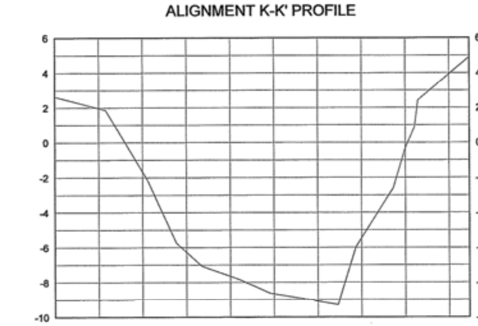
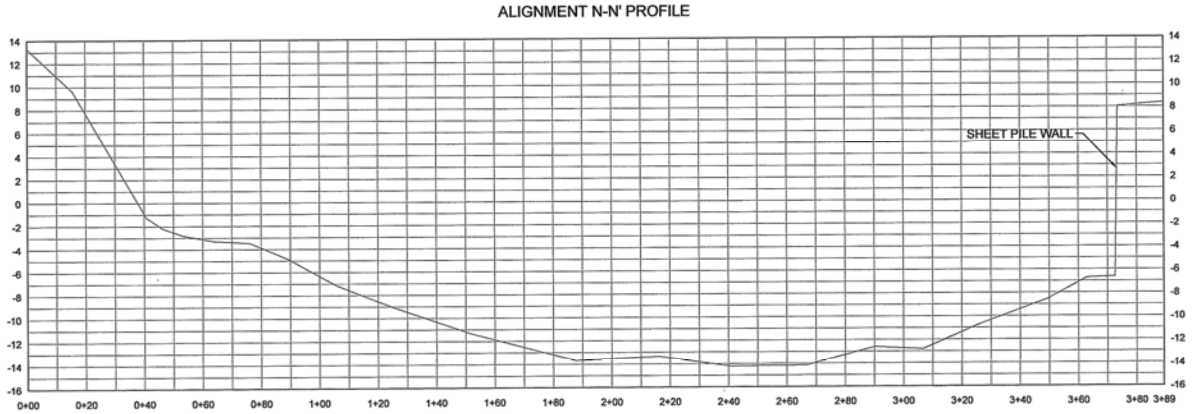


ALIGNMENT N-N' PROFILE



DATUM
HORIZONTAL: NAD83, MISSISSIPPI STATE PLANE EAST ZONE, US FOOT
VERTICAL: NGVD 88, FEET

NOTES
- DEPICTED CROSS SECTIONS WERE PROVIDED TO EMS BY DEWBERRY TO ALLOW COLLECTION OF PERTINENT CROSS SECTIONS IN WATER INUNDATED AREAS ALONG TURKEY CREEK & BAYOU BERNARD.
- CROSS SECTIONS SURVEYED ON SEPT. 21 & 22, 2009 USING A COMBINATION OF RTK GPS AND TOTAL STATION TECHNIQUES.
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CAD FILE:	3 CROSS SECTIONS.DWG
PROJECT:	HAN0-08-100
SCALE:	AS SHOWN
DATE:	10/30/09
CHECKED:	C.J.
DRAWN BY:	K.K.

CHRISTOPHER T. JOHNSON
LICENSED PROFESSIONAL ENGINEER AND SURVEYOR
STATE OF MISSISSIPPI

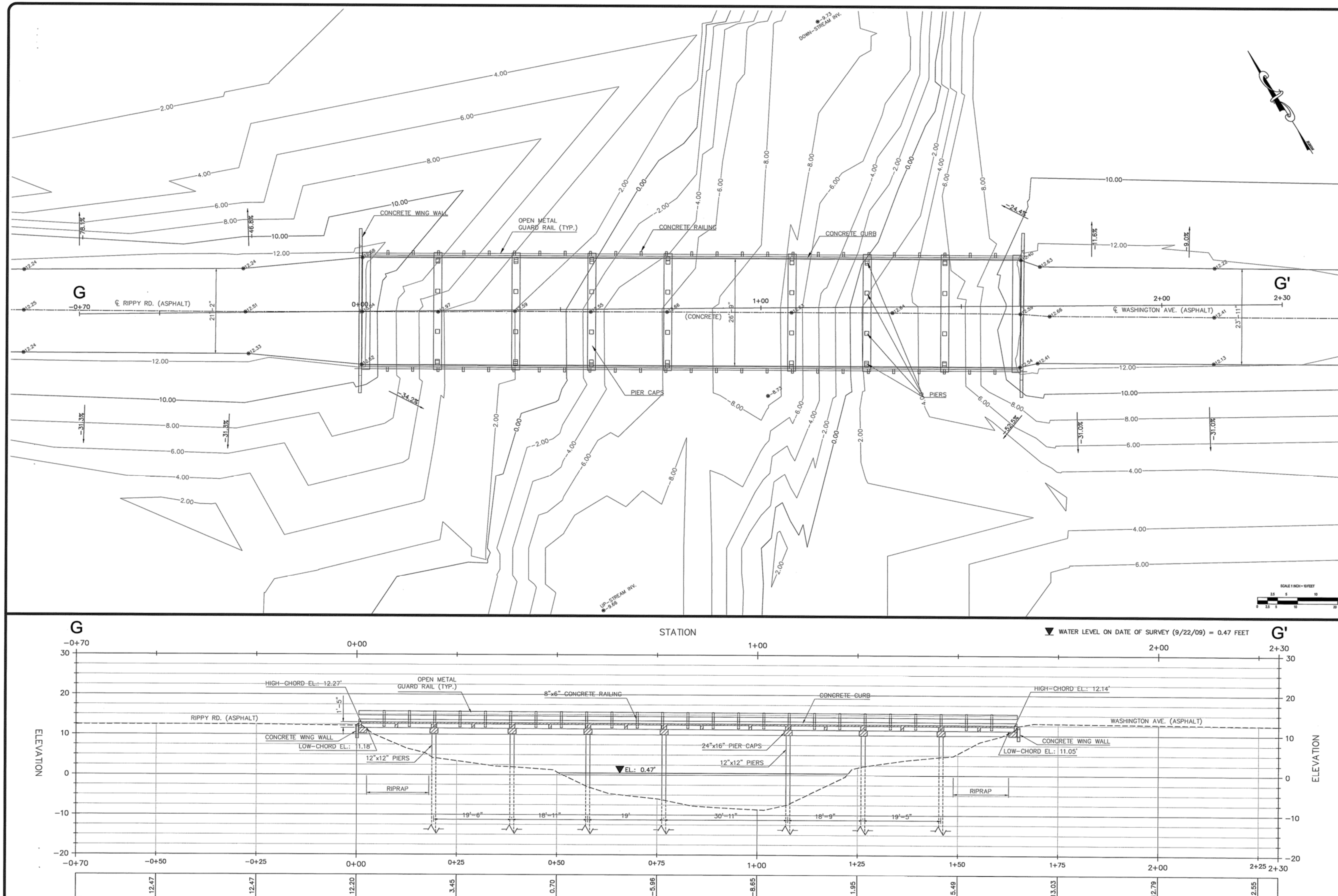
ENVIRONMENTAL
MANAGEMENT SERVICES, INC.
P.O. BOX 15369
HATTIESBURG, MS 39404

PREPARED FOR:
CAVENHAM FOREST INDUSTRIES, INC.
GULFPORT, MS

BAYOU BERNARD / TURKEY CREEK CROSS SECTIONS

TURKEY CREEK FLOODPLAIN EVALUATION

SHEET NO.
3



CAD FILE: BRIDGE X-SECTION
PROJECT: HAN0-08-100
SCALE: 1" = 10'
DATE: 10/21/09
CHECKED: C.J.
DRAWN BY: P.D.M.

CHRISTOPHER T. JOHNSON
LICENSED PROFESSIONAL ENGINEER AND SURVEYOR
PE-15761
PS-3129
STATE OF MISSISSIPPI

ENVIRONMENTAL
MANAGEMENT SERVICES, INC.
P.O. BOX 15369
HATTIESBURG, MS 39404

PREPARED FOR:
CAVENHAM FOREST INDUSTRIES, INC.
GULFPORT, MS

WASHINGTON AVE. / RIPPY ROAD BRIDGE DETAILS

TURKEY CREEK FLOODPLAIN EVALUATION

SHEET NO.
4

APPENDIX G
HARD COPIES OF ALL OUTPUT FILES

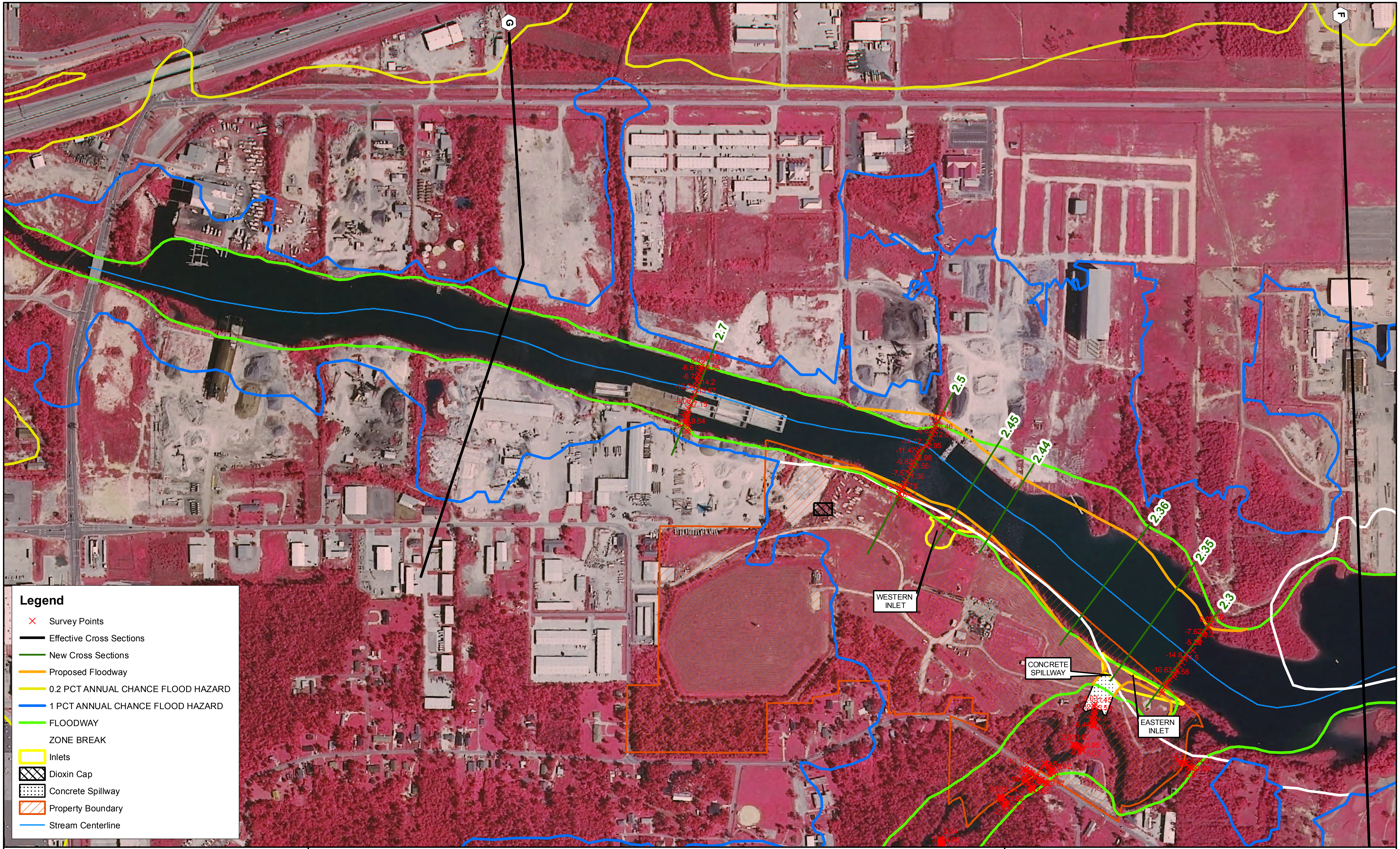
HEC-RAS Plan: CorEffFloodway River: Bernard Bayou Reach: Bernard Bayou

Reach	River Sta	W.S. Elev	Prof Delta WS	E.G. Elev	Top Wdth Act	Q Left	Q Channel	Q Right	Enc Sta L	Ch Sta L	Ch Sta R	Enc Sta R
		(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)
Bernard Bayou	5	5.02		6.04	124.00		9300.00			626.00	750.00	
Bernard Bayou	5	5.74	0.72	6.61	124.00		9300.00		626.00	626.00	750.00	750.00
Bernard Bayou	4	4.26		5.70	138.19	18.01	10179.09	2.90		626.00	750.00	
Bernard Bayou	4	5.17	0.91	6.36	124.00		10200.00		626.00	626.00	750.00	750.00
Bernard Bayou	3	4.36		4.45	432.79	21.56	10178.44			300.00	583.00	
Bernard Bayou	3	5.24	0.88	5.32	281.60		10200.00		300.00	300.00	583.00	583.00
Bernard Bayou	2.7	4.28		4.35	345.34		10200.00			167.00	514.80	
Bernard Bayou	2.7	5.17	0.89	5.24	347.43		10200.00		167.00	167.00	514.80	514.80
Bernard Bayou	2.5	4.23		4.28	454.31	1.34	10198.66			207.10	655.15	
Bernard Bayou	2.5	5.14	0.90	5.18	447.60		10200.00		207.10	207.10	655.15	655.15
Bernard Bayou	2.45	4.22		4.27	410.71		10188.83	11.17		180.04	562.30	
Bernard Bayou	2.45	5.13	0.90	5.17	379.32		10200.00		180.04	180.04	562.30	562.30
Bernard Bayou	2.44	4.21		4.26	381.85		10200.00			149.31	535.11	
Bernard Bayou	2.44	5.11	0.91	5.16	382.69		10200.00		149.31	149.31	535.11	535.11
Bernard Bayou	2.36	4.21		4.23	652.45		10200.00	0.00		114.60	775.69	
Bernard Bayou	2.36	5.11	0.91	5.14	661.09		10200.00		114.60	114.60	775.69	775.69
Bernard Bayou	2.35	4.19		4.22	685.30	26.31	10173.43	0.25		149.25	745.40	
Bernard Bayou	2.35	5.10	0.91	5.13	596.15		10200.00		149.25	149.25	745.40	745.40
Bernard Bayou	2.3	4.17		4.21	476.63		10200.00			84.75	570.61	
Bernard Bayou	2.3	5.08	0.91	5.12	481.23		10200.00		84.75	84.75	570.61	570.61
Bernard Bayou	2	4.15		4.18	746.84		14899.41	0.59		2450.00	3193.00	
Bernard Bayou	2	5.07	0.92	5.09	735.89		14900.00		2450.00	2450.00	3193.00	3193.00
Bernard Bayou	1	3.77		3.85	811.05		14898.06	1.94		2061.00	2811.00	
Bernard Bayou	1	4.77	1.00	4.83	749.59		14900.00		2061.00	2061.00	2811.00	2811.00

HEC-RAS Plan: PropFloodway River: Bernard Bayou Reach: Bernard Bayou

Reach	River Sta	W.S. Elev	Prof Delta WS	E.G. Elev	Top Wdth Act	Q Left	Q Channel	Q Right	Enc Sta L	Ch Sta L	Ch Sta R	Enc Sta R
		(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)
Bernard Bayou	5	5.02		6.04	124.00		9300.00			626.00	750.00	
Bernard Bayou	5	5.74	0.72	6.61	124.00		9300.00		626.00	626.00	750.00	750.00
Bernard Bayou	4	4.26		5.70	138.19	18.01	10179.09	2.90		626.00	750.00	
Bernard Bayou	4	5.17	0.91	6.36	124.00		10200.00		626.00	626.00	750.00	750.00
Bernard Bayou	3	4.36		4.45	432.78	21.56	10178.44			300.00	583.00	
Bernard Bayou	3	5.24	0.88	5.32	281.60		10200.00		300.00	300.00	583.00	583.00
Bernard Bayou	2.7	4.28		4.35	345.34		10200.00			167.00	514.80	
Bernard Bayou	2.7	5.17	0.89	5.24	347.43		10200.00		167.00	167.00	514.80	514.80
Bernard Bayou	2.5	4.23		4.28	454.31	1.34	10198.66			207.10	655.15	
Bernard Bayou	2.5	5.14	0.90	5.18	447.60		10200.00		207.10	207.10	655.15	655.15
Bernard Bayou	2.45	4.22		4.27	383.85		10197.11	2.89		180.04	562.30	
Bernard Bayou	2.45	5.13	0.90	5.17	379.32		10200.00		180.04	180.04	562.30	562.30
Bernard Bayou	2.44	4.21		4.26	381.85		10200.00			149.31	535.31	
Bernard Bayou	2.44	5.11	0.91	5.16	382.69		10200.00		149.31	149.31	535.31	535.11
Bernard Bayou	2.36	4.21		4.23	652.45		10200.00	0.00		114.60	775.69	
Bernard Bayou	2.36	5.11	0.91	5.14	661.09		10200.00		114.60	114.60	775.69	775.69
Bernard Bayou	2.35	4.19		4.22	690.30	26.30	10166.48	7.22		149.25	745.40	
Bernard Bayou	2.35	5.10	0.91	5.13	596.15		10200.00		149.25	149.25	745.40	745.40
Bernard Bayou	2.3	4.17		4.21	476.63		10200.00			84.75	570.61	
Bernard Bayou	2.3	5.08	0.91	5.12	481.23		10200.00		84.75	84.75	570.61	570.61
Bernard Bayou	2	4.15		4.18	746.84		14899.41	0.59		2450.00	3193.00	
Bernard Bayou	2	5.07	0.92	5.09	735.89		14900.00		2450.00	2450.00	3193.00	3193.00
Bernard Bayou	1	3.77		3.85	811.05		14898.06	1.94		2061.00	2811.00	
Bernard Bayou	1	4.77	1.00	4.83	749.59		14900.00		2061.00	2061.00	2811.00	2811.00

APPENDIX H
CERTIFIED WORKMAP BY DEWBERRY



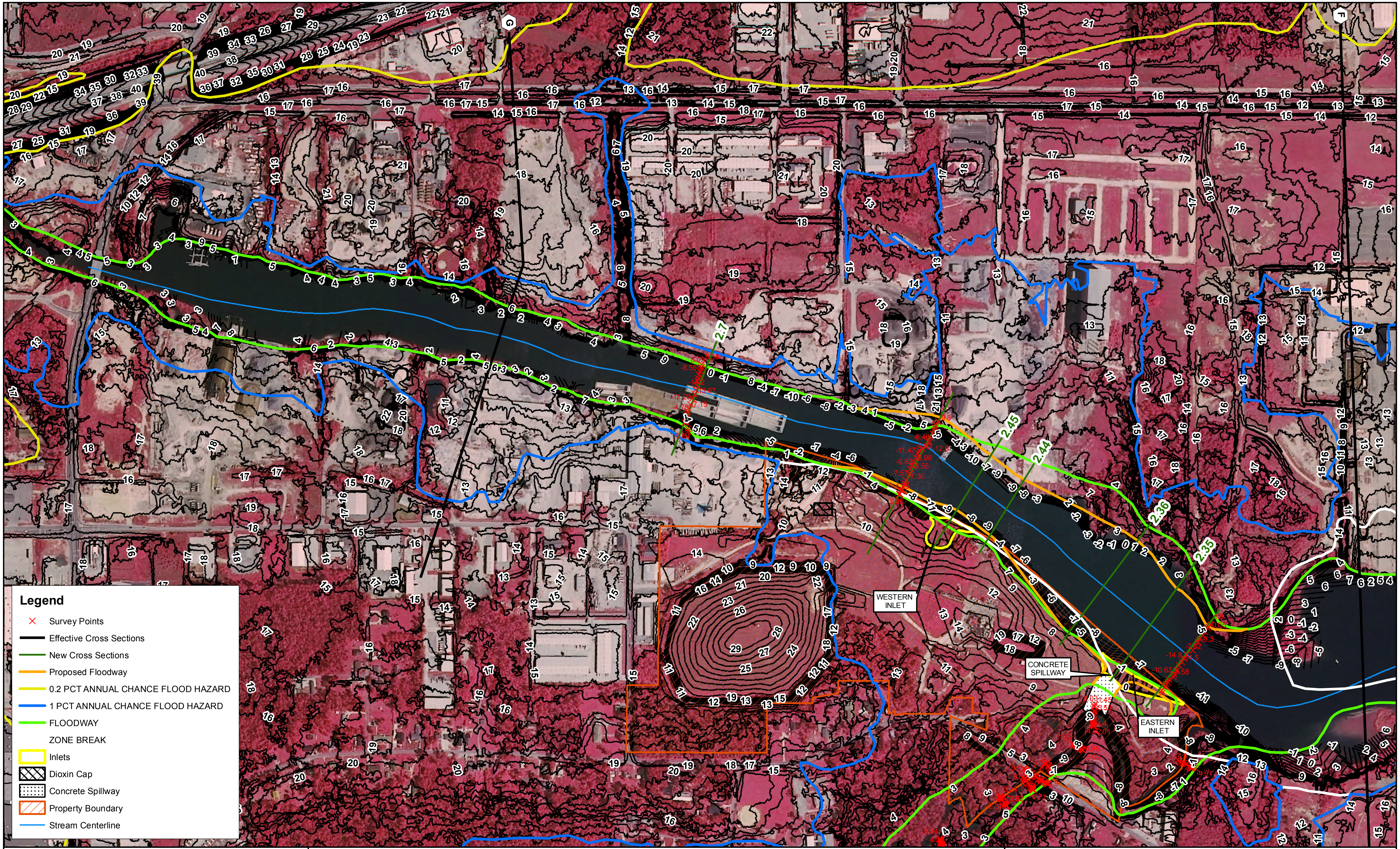
Cavenham Forest Industries, Inc.
Topographic Work Map
Turkey Creek & Bernard Bayou No Rise

Note: Property boundary based on extents shown in the Dioxin Cap Report

N

0 250 500 1,000 1,500 Feet

Dewberry®

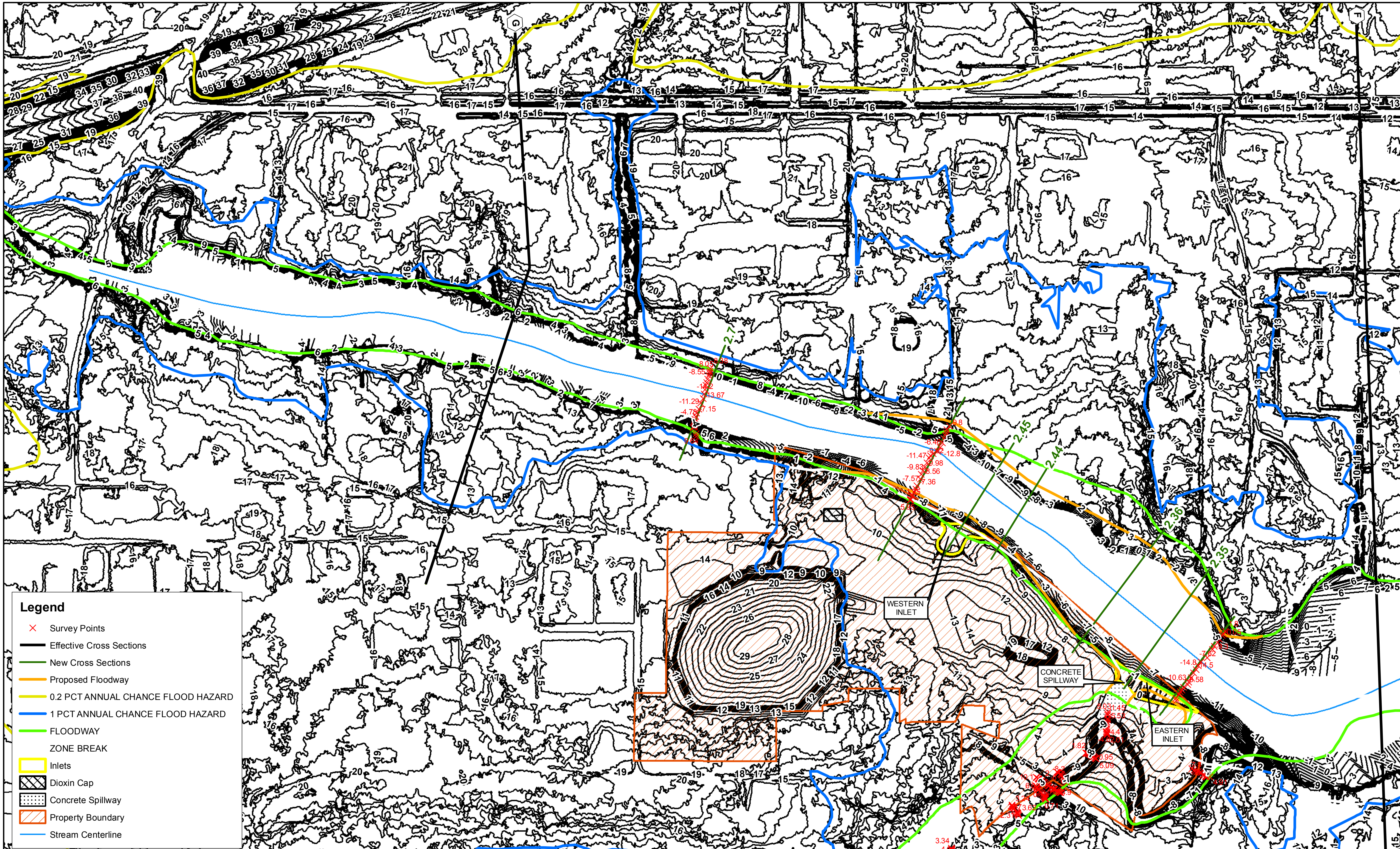


Cavenham Forest Industries, Inc.
Topographic Work Map
Turkey Creek & Bernard Bayou No Rise

Note: Property boundary based on extents shown in the Dioxin Cap Report

N
0 250 500 1,000 1,500 Feet

Dewberry



Cavenham Forest Industries, Inc.
Topographic Work Map
Turkey Creek & Bernard Bayou No Rise

Note: Property boundary based on extents shown in the Dioxin Cap Report

N

0 250 500 1,000 1,500 Feet

Dewberry®

APPENDIX I
ENGINEERING CERTIFICATION

GUIDANCE FOR "NO-RISE / NO-IMPACT" CERTIFICATION FOR PROPOSED DEVELOPMENTS IN REGULATORY FLOODWAYS

The National Flood Insurance Program (NFIP) floodplain management criterion that is adopted by all participating communities in their local ordinances, as described in Title 44 of the Code of Federal Regulations, Section 60.3(d)(3), states:

> "A community shall prohibit encroachments, including fill, new construction, substantial improvements, and other development within the adopted regulatory floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in flood levels within the community during the occurrence of the base flood discharge."

Prior to issuing any development permits involving activities in a regulatory floodway, the community must obtain a certification stating the proposed development will not impact the pre-project base flood elevations, regulatory floodway elevations, or regulatory floodway widths. The certification should be obtained from the permittee and be signed and sealed by a professional engineer in accordance with State Licensing Board specifications.

The engineering or "No-Rise / No-Impact" certification must be supported by technical data. The supporting technical data should be based upon the standard step-backwater hydraulic model utilized to develop the regulatory floodway shown on the community's effective Flood Insurance Rate Map (FIRM) or Flood Boundary and Floodway Map (FBFM) and the results tabulated in the community's Flood Insurance Study (FIS).

Communities are required to review and approve or disapprove the "No-Rise/No-Impact" submittals; however, they may request technical assistance and review from the FEMA regional office. If this alternative is chosen, the submittal will be treated as a Conditional Letter of Map Revision (CLOMR) by the National Service Provider, and will be subject to the same fees as such.

To support a "No-Rise / No-Impact" certification for proposed developments encroaching onto the regulatory floodway, a community will require that the following procedures be followed:

1. Currently Effective Model

Furnish a written request for the step-backwater hydraulic model for the specified stream and community, identifying the limits of the requested data. A fee will be assessed for providing the data. Send data requests to:

Federal Emergency Management Agency
http://www.fema.gov.fhm/st_order.shtm

or to:

MOD RMC Region 4
Faxed to (678) 459-1030 to the attention of:
"Back-up Technical Data Request"

2. Duplicate Effective Model

Upon receipt of the step-backwater hydraulic model, the engineer should run the effective hydraulic model to duplicate the data in the effective FIS.

3. Existing Conditions Model

Revise the duplicate effective model to reflect site-specific existing conditions by adding new cross-sections (two or more) in the area of the proposed development, without the proposed development in place. Regulatory floodway limits should be manually set at the new cross-section locations by measuring from the effective FIRM or FBFM. The cumulative reach lengths of the waterway should remain unchanged. The results of these analyses will indicate the base flood elevations and the regulatory floodway elevations for the effective hydraulic model revised to incorporate existing conditions at the proposed project site.

4. Proposed Conditions Model

Modify the existing conditions models to reflect the proposed development using the new cross-sections, while retaining the currently adopted regulatory floodway widths. The overbank roughness parameters should remain the same unless a valid explanation of how the proposed development will impact the roughness parameters is included with the supporting data. The results of this floodway hydraulic model will indicate the regulatory floodway elevations for proposed conditions at the project site. These results must indicate NO impact on the base flood elevations, regulatory floodway elevations, or regulatory floodway widths shown in the duplicate Effective Model or in the Existing Conditions Model (items 2 and 3 above, respectively).

The "no-impact" analysis along with supporting data and the original engineering certification must be reviewed by the appropriate community official prior to issuing a development permit. The original effective FIS model, the duplicate effective FIS model, the Existing Conditions Model, and the Proposed Conditions Model should be reviewed for any changes in the base flood elevations, regulatory floodway elevations and floodway widths.

The "No-Rise / No-Impact" supporting data should include, but may not be limited to:

(1) Copy of the currently effective FIS hydraulic models (legible hard copy and a disc (if available))

(2) Duplicate effective FIS hydraulic models (hard copy and a disc).

(3) Existing conditions hydraulic models (hard copy and a disc).

(4) Proposed conditions hydraulics models (hard copy and a disc)

(5) Annotated effective FIRM or FBFM and topographic map, showing regulatory floodplain and floodway boundaries, the additional cross-sections, and the site location along with the proposed topographic modifications.

(6) Documentation clearly stating analysis procedures. All modifications made to the duplicate effective hydraulic models to correctly represent existing conditions, as well as those made to the existing conditions models to represent proposed conditions should be well documented and submitted with all supporting data.

(7) Annotated effective Floodway Data Table (from the FIS report).

(8) Statement defining source of additional cross-sections, topographic data, and other supporting information.

(9) Cross-section plots of the additional cross sections for existing and proposed conditions hydraulic models.

(10) Certified planimetric (boundary survey) information indicating the location of structures on the property.

(11) Hard copy of all output files.

(12) Clear explanation of how roughness parameters were obtained (if different from those used in the effective hydraulic models).

(13) Engineering certification (sample attached).

The engineering "No-Rise / No-Impact" certification and supporting technical data must stipulate NO impact or NO changes to the base flood elevations, regulatory floodway elevations, or regulatory floodway widths at the new cross-sections and at all existing cross-sections anywhere in the model. Therefore, the revised computer model should be run for a sufficient distance upstream and downstream of the development site to insure proper "No-Rise / No-Impact" certifications.

Attached is a SAMPLE "No-Rise / No-Impact" certification form that can be completed by a registered professional engineer and supplied to the community along with the supporting technical data when applying for a development permit. This form does not have to be utilized to submit for a "No-Rise / No-Impact" certification. It is provided as a guide, if needed.

Note: Definitions of terms base flood, development, and regulatory floodway are same as those included in Title 44 of the Code of Federal Regulations, Section 59.1. Additional regulations pertaining to this certification are described in Title 44 of the Code of Federal Regulations, Section 65.3.

FLOODWAY "NO-RISE / NO-IMPACT" CERTIFICATION

This document is to certify that I am duly qualified engineer licensed to practice in the State of

Mississippi . It is to further certify that the attached technical data supports
(State)

the fact that proposed Cavenham Forest Industries, Inc. will not impact the base flood
(Name of Development)

elevations, floodway elevations, and floodway widths on Bernard Bayou at published
(Name of Stream)

cross sections in the Flood Insurance Study for, City of Gulfport , dated August 31, 2011
(Name of community) *(Date)*

and will not impact the base flood elevations, floodway elevations, and floodway widths at the unpublished cross-sections in the area of the proposed development.

18277

2011

SEAL, SIGNATURE AND DATE

Michael A. Hanson, P.E., LEED AP BD+C
Name

Senior Associate
Title

Dewberry & Davis, Inc. of Mississippi

8401 Arlington Blvd.
Fairfax, VA, 22031
Address

FOR COMMUNITY USE ONLY:		
Community Approval		
☐ Approved	☐ Disapproved	
Community Official's Name	Community Official's Signature	Title

APPENDIX H
No-Rise Certification and Report for Turkey Creek
Dewberry & Davis, Inc. of Mississippi

CAVENHAM FOREST INDUSTRIES, LLC

SITE REMEDIATION ACTIVITIES

"NO-RISE" CERTIFICATION AND REPORT

FOR

TURKEY CREEK

IN

GULFPORT, MISSISSIPPI

HARRISON COUNTY

BY

DEWBERRY & DAVIS, INC. OF MISSISSIPPI
8401 ARLINGTON BLVD.
FAIRFAX, VA
22031

SEPTEMBER 12, 2011

Table of Contents

1.0 Narrative

1.1 Project Overview

Dewberry has been requested to evaluate alternatives which would mitigate impacts associated with fill on the left overbank of Turkey creek just upstream of Bernard Bayou and a small portion of fill in the stream bed of Turkey Creek. The goal of the study is to find a viable alternative resulting in a no-rise. The no-rise study will be based on the (preliminary) Effective Flood Insurance Study (FIS) to the degree possible. Turkey Creek does not have an effective hydraulic model on file, but its modeling parameters (Manning's N range, effective cross section locations, and hydrology) are available in the (preliminary) Effective FIS dated November 15, 2007. The map number of interest is 28047C0262G and is on panel 262.

Several alternatives were evaluated to achieve the desired no-rise. The selected alternative was a concrete lined bypass channel with a 66 ft bottom width, 3:1 side slopes and a 2 to 4 ft depth (depending on existing grade tie location) to allow increased flow capacity for higher recurrence interval flows.

1.2 Site Description

The project area can be seen in Figure 1: Project Site – Turkey Creek, City of Gulfport, MS. The project site is located on the left overbank looking downstream and is bound by Washington Avenue on the upstream side and Bernard Bayou on the downstream side.

2.0 Data Acquisition

A data request was made for the effective information available for Turkey Creek. Unfortunately, no effective hydraulic model was found on file. As a result, the published FIS information was used to recreate a duplicate effective model and then it was updated to reflect existing conditions.

The survey for this study was conducted by the Environmental Management Services, Inc (EMS). The survey conducted by EMS includes but not limited to cross sections geometry survey, bridge survey, and topographic survey. In addition, EMS provided Dewberry the digital terrain data which was generated by integrating the LiDAR data with the existing and proposed conditions site data.

3.0 Data Analysis

3.1 Hydrology

There was no new hydrologic analysis performed for this study. The discharges were obtained from the published FIS ('Preliminary' FIS dated Nov 15, 2007) information. The discharge values used in the hydraulic model for this study are indicated in Table 1.

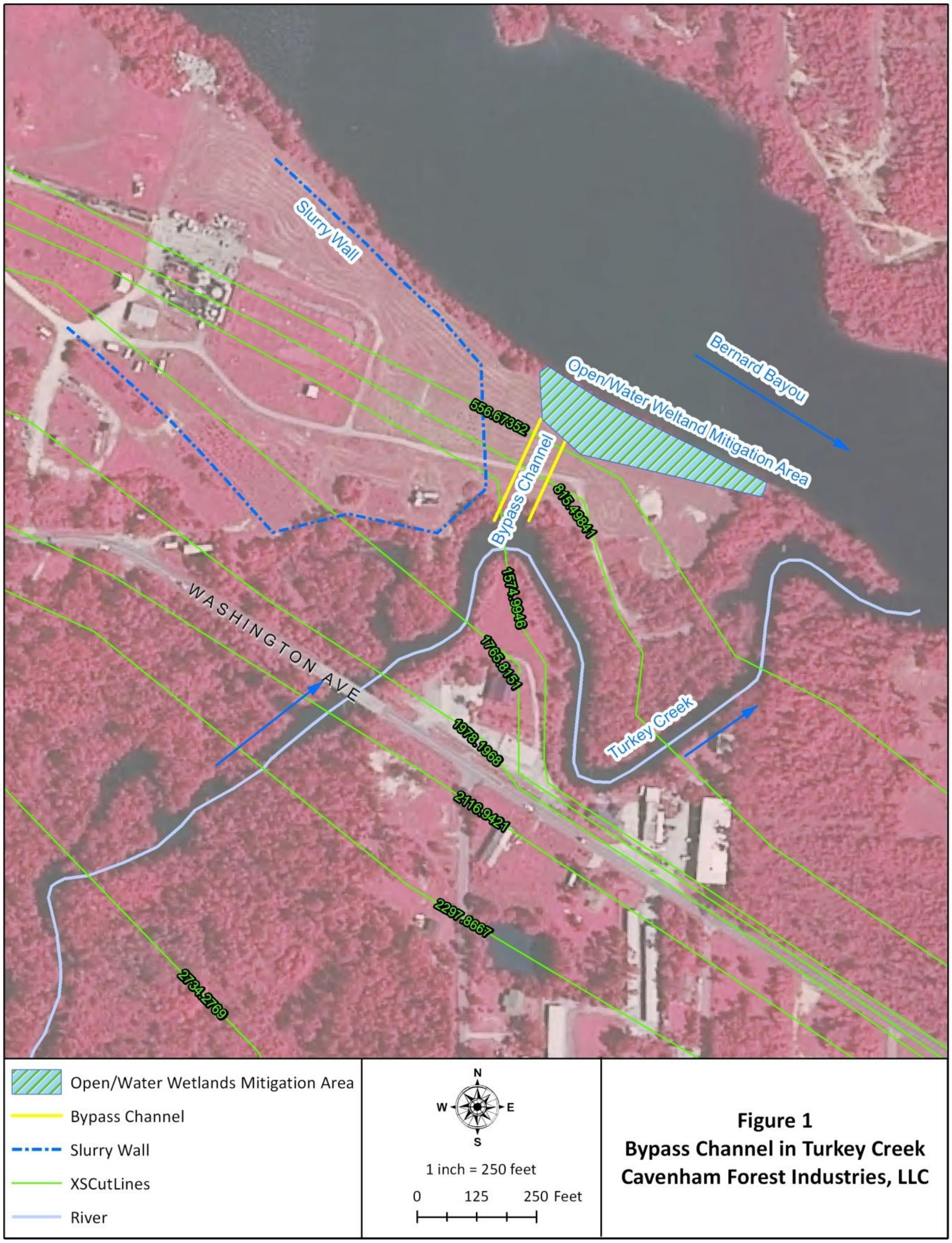


Figure 1: Proposed Bypass channel in Turkey Creek

Table 1: Discharges used in the study (from 'Preliminary' FIS dated Nov 15, 2007)

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs)			
		10-percent	2-percent	1-percent	0.2-percent
TURKEY CREEK					
At Washington Street	28.2	2,700	3,850	5,800	8,600

3.2 Hydraulics

Published Data

The published data consists of data contained in the Flood Insurance Study (FIS) for Harrison County, Mississippi which shows a 'Preliminary' FIS date of Nov 15, 2007 and FIRM panel number 262.

Effective Model

The Effective model was not available from FEMA. However, by using effective cross section locations of cross sections A and B as represented on FIRM panel 262 and other modeling parameters outlined in the FIS a duplicate effective model was able to be created. The model was run for 10, 50, 100, and 500 year flood event, as well as for 100-year floodway. A normal depth slope was selected for the downstream boundary condition. Similarly, the encroachment stationing and widths for the cross sections were obtained from the FIRM panel.

3.2.1 Duplicate Effective Model

The duplicate effective model is the reproduction of the effective hydraulic model used in the effective FIS and its creation was outlined in the effective model section.

3.2.2 Corrected Effective / Existing Conditions Model

This model is one that revises the duplicate effective model to reflect site-specific existing conditions by adding new cross sections in the area of the proposed development without the proposed development in place. The existing conditions model also allows the modeler to input any structures or features that were missing from the effective model. The following changes were made to the Duplicate Effective model thus creating the Corrected Effective Model:

- All cross sections downstream of effective cross section B (existing conditions cross section 6087) were removed and replaced with newly aligned cross sections to represent the existing topology and allow for comparison once the proposed conditions model is developed.
- The Washington Avenue Bridge was added to the model since it was omitted from the effective
- The Manning' n values were put in the newly added cross sections based on survey photos and aerials. All the Manning's n values in the model are within the range specified in the FIS (channel-0.035 to 0.055, overbanks-0.06 to 0.1)

- The model was first run using the floodway encroachment stations obtained from the FIRM. However, adjustments to the encroachment stations were made to amend the surcharges outside the acceptable limits and to account for the ineffective flow areas around the existing bridge. The cross sections where the encroachment stations were adjusted are: 557, 815, 1575, 1766, 1978 and 2117.

3.2.3 Proposed Conditions Model

The proposed conditions model will modify the existing conditions models to reflect the proposed development using the new cross sections. The following changes were made to the Corrected Effective/ Existing conditions model thus creating the Proposed Conditions Model:

- The Corrected Effective/ Existing conditions cross sections was modified to reflect the proposed fill conditions on site.
- The bypass channel to allow increased flow capacity for higher flows was placed just downstream of cross section 1766 that intersects cross sections 1575, 815, and 557. The channel dimensions for the bypass channel are represented in Table 2 below.
- Adjustments were made to the floodway encroachment stations from the corrected effective conditions model to amend the floodway surcharges outside the acceptable limits and to take into account the bypass channel. The cross sections where the encroachment stations were adjusted are: 557, 815, 1575, 1766, and 2298.
- Manning's n values on the overbanks have been changed to 0.013 in the area of proposed concrete bypass channel.

Table 2: Bypass Channel Dimensions

Stations	Invert Elev. (ft)	Side Slope (ft/ft)	Channel Depth (ft)	Bypass Channel Bottom Width (ft)	Bypass Channel Top Width (ft)
557	3.79	3:1	3	66	84
815	3.9	3:1	2.5	66	81
1575	4.15	3:1	2.5	66	81

4.0 Model Results

A comparison of the corrected effective and the proposed conditions model was made and the results are shown in Table 3. The 100 year proposed water surface elevations decreased when compared with the corrected effective water surface elevations at all cross sections. The smallest decrease being that of 0.04 ft at cross section 6087 and the maximum decrease is of 0.37 ft at cross section 1766. Floodway widths increased from the corrected effective model at some cross sections as indicated in Table 4. The floodway encroachment stations were revised from the corrected effective conditions model to place the bypass channel inside the floodway and to amend the surcharges which were outside the acceptable limits.

Table 3: Hydraulic Modeling Results (HEC-RAS 4.0) -100 Year Data
Vertical Datum: NAVD 88

Duplicate		Corrected		Proposed		Proposed-Corrected
River Station	W.S. ELEV (ft)	River Station	W.S. ELEV (ft)	River Station	W.S. ELEV (ft)	W.S. ELEV (ft)
5952	9.02	6087	11	6087	10.96	-0.04
		5008	10.7	5008	10.65	-0.05
		4167	9.84	4167	9.78	-0.06
		2734	8.69	2734	8.59	-0.1
		2298	8.39	2298	8.27	-0.12
2023	6.26	2117	7.93	2117	7.8	-0.13
		2076	Bridge	2076	Bridge	
		1978	7.04	1978	6.87	-0.17
		1766	7.03	1766	6.66	-0.37
		1575	7.04	1575	6.83	-0.21
		815	6.6	815	6.41	-0.19
		557	6.28	557	6.08	-0.2

Table 4: Hydraulic Modeling Results-Floodway Data

Duplicate				Corrected				Proposed				Proposed-Corrected		
River Station	Enc Station L (ft)	Enc Station R (ft)	Top Width (ft)	River Station	Enc Station L (ft)	Enc Station R (ft)	Top Width (ft)	River Station	Enc Station L (ft)	Enc Station R (ft)	Top Width (ft)	Enc Station L (ft)	Enc Station R (ft)	Top Width (ft)
5952	2152	2600	448	6087	2152	2600	448	6087	2152	2600	448	0	0	0
				5008	1800	2167	367	5008	1800	2167	367	0	0	0
				4167	1823	2046	223	4167	1823	2046	223	0	0	0
				2734	1869	2291	423	2734	1869	2291	423	0	0	0
				2298	2022	2346	324	2298	1950	2518	568	-72	172	244
2023	2300	2624	324	2117	2298	2485	186	2117	2298	2485	186	0	0	0
				2076	Bridge			2076	Bridge					
				1978	2298	2407	109	1978	2298	2407	109	0	0	0
				1766	2312	2603	291	1766	2238	2603	364	-74	0	73
				1575	2333	2577	244	1575	2288.8	2558	258	-44.24	-19	14
				815	2631	3166	535	815	2330	3166	831	-301	0	296
				557	2930	3143	213	557	2386	3143	747	-544	0	534

4.1 Alternative Analysis

There are three alternatives that were evaluated in addition to the selected 66 ft bottom width concrete lined bypass channel. The alternatives studied included the following:

1. Minimum sized concrete lined bypass channel
2. Maximum sized concrete lined bypass channel
3. Regional flood storage facility

The minimum sized bypass channel was a 48 ft top width concrete lined channel with deeper inverts that resulted in a no-rise. This alternative meet the criteria of mitigating the impacts of the fill associated with the project. However, it was discarded due to a desire to do more than just the minimum required.

The maximum sized bypass channel resulted in minor flood reduction benefit for a neighborhood of interest upstream. Due to the minor flood reduction benefit, added costs, and the fact that storm surge flooding actually controls this area, this alternative was discarded

A regional flood storage facility could provide flood stage reduction benefit for the entire area while providing a recreational facility for use during non-flood flows. However, benefits of this alternative exceed the needs of this project and the cost of this facility will likely require third party funding and community participation.

The bypass channel inverts were raised due to tidal concerns and a top width increase of 25% was added to the minimum bypass channel alternative and the results were evaluated. Ultimately this 66 ft bottom width channel was the selected alternative to mitigate project impacts.

5.0 Conclusion

The construction of the floodwater spillway from Turkey Creek to Bernard Bayou mitigates what would be considered adverse impacts due to the placement of fill in the 1% annual chance floodplain for site remediation activities. The placement of fill and then construction of the floodwater spillway allows for the placement of fill for site remediation activities without adversely affecting the 1% annual chance storm event water surface elevations.

It should be noted that the floodway was first modified in the corrected effective model to match the DFIRM and to show the constriction at the roadway. The floodway was further modified during the proposed conditions run to include the floodwater spillway and eliminate a negative surcharge upstream of the roadway.

The annotated FIRM shows the changes to the floodway and the riverine floodplain mapping. Please note that currently storm surge from the ocean controls flooding in this area and not the riverine floodplains as shown on the annotated FIRM. The floodway would be the only boundary revised on the FIRM.

It is recommended that a LOMR be completed to reflect the change in floodway at the time of project completion and that this study be kept on file as the no-rise study associated with the project so that the local community has record of this investigation.

Appendix 7 contains the Base Flood Elevation "No-Rise" Engineering Certification as required by FEMA for this case.

APPENDIX 1
EFFECTIVE FIRM MAP

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations (BFEs) shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was State Plane Mississippi East FIPS Zone 2301. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services, NOAA, N/NGS12
National Geodetic Survey SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242** or visit its website at http://www.ngs.noaa.gov/.

Base map information shown on this FIRM was provided in digital format by the State of Mississippi. This information was photogrammetrically compiled at a scale of 1:12,000 from aerial photography dated September 2004.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in *the Flood Insurance Study report (which contains authoritative hydraulic data)* may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

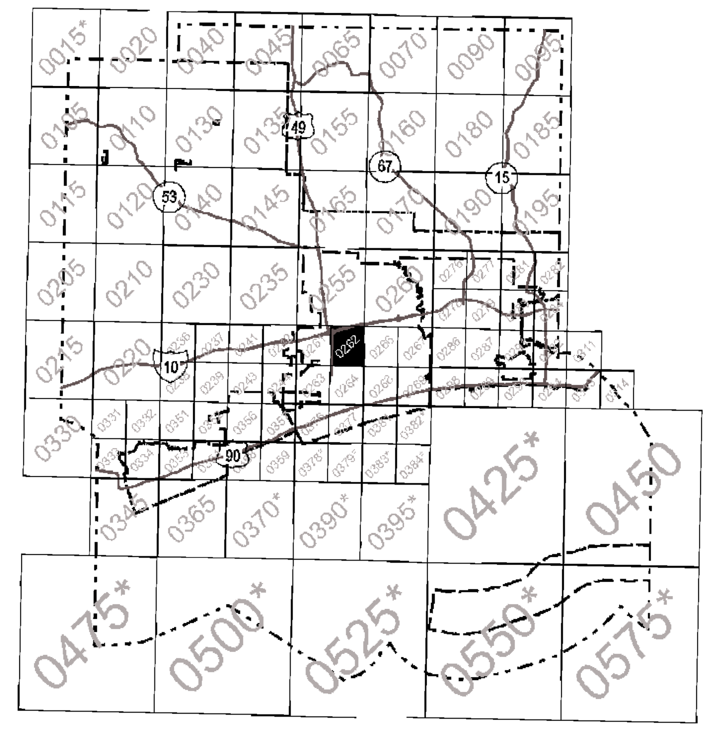
The AE Zone category has been divided by a **Limit of Moderate Wave Action (LiMWA)**. The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. Base flood conditions between the VE Zone and the LiMWA will be similar to, but less severe than those in the VE Zone.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a *Flood Insurance Study report*, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip/.

Elevation Reference Marks

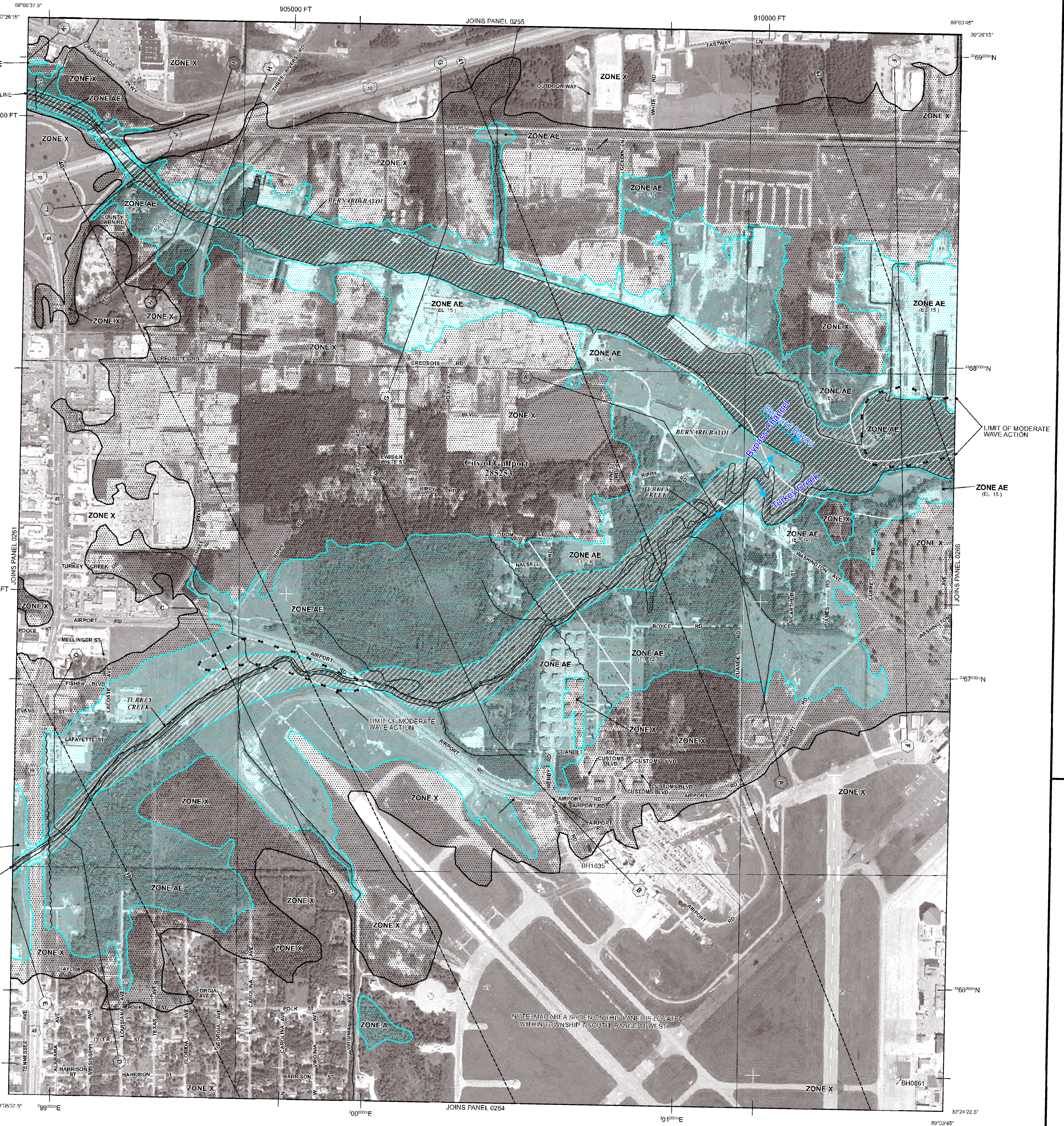
BH0861
BH1635



* PANEL NOT PRINTED

HARRISON COUNTY AND INCORPORATED COMMUNITIES FIRM PANEL LOCATOR

This map was produced through the Mississippi Flood Map Modernization Initiative, a cooperative partnership between the State of Mississippi and Department of Homeland Security - Federal Emergency Management Agency.



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Areas to be protected from 1% annual chance flood event by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary
0.2% annual chance floodplain boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities
Limit of Moderate Wave Action Delineation

513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

A — A	Cross section line
23 - - - 23	Transect line
97°07'30", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
4275000mE	1000-meter Universal Transverse Mercator grid ticks, zone 16
6000000 FT	5000-foot grid values: Mississippi State Plane coordinate system East Zone (FIPSZONE = 2301), Transverse Mercator projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
● M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

Annotated FIRM Legend

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 250 500 750 1,000 FEET
150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0262G

FIRM

FLOOD INSURANCE RATE MAP

HARRISON COUNTY, MISSISSIPPI

AND INCORPORATED AREAS

PANEL 262 OF 575

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GULFPORT, CITY OF	285253	0262	G

PRELIMINARY
NOV 15 2007

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
28047C0262G

EFFECTIVE DATE

Federal Emergency Management Agency

APPENDIX 2
ANNOTATED FIRM MAP

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

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Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was State Plane Mississippi East FIPS Zone 2301. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

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(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242** or visit its website at http://www.ngs.noaa.gov/.

Base map information shown on this FIRM was provided in digital format by the State of Mississippi. This information was photogrammetrically compiled at a scale of 1:12,000 from aerial photography dated September 2004.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables *in the Flood Insurance Study report (which contains authoritative hydraulic data)* may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

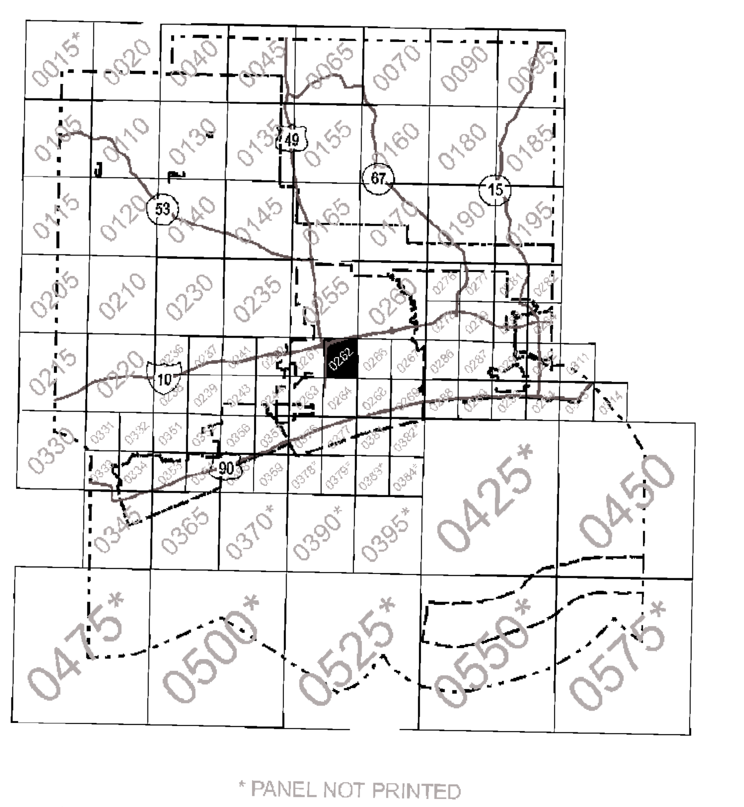
The AE Zone category has been divided by a **Limit of Moderate Wave Action (LiMWA)**. The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. Base flood conditions between the VE Zone and the LiMWA will be similar to, but less severe than those in the VE Zone.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, *a Flood Insurance Study report*, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip/.

Elevation Reference Marks

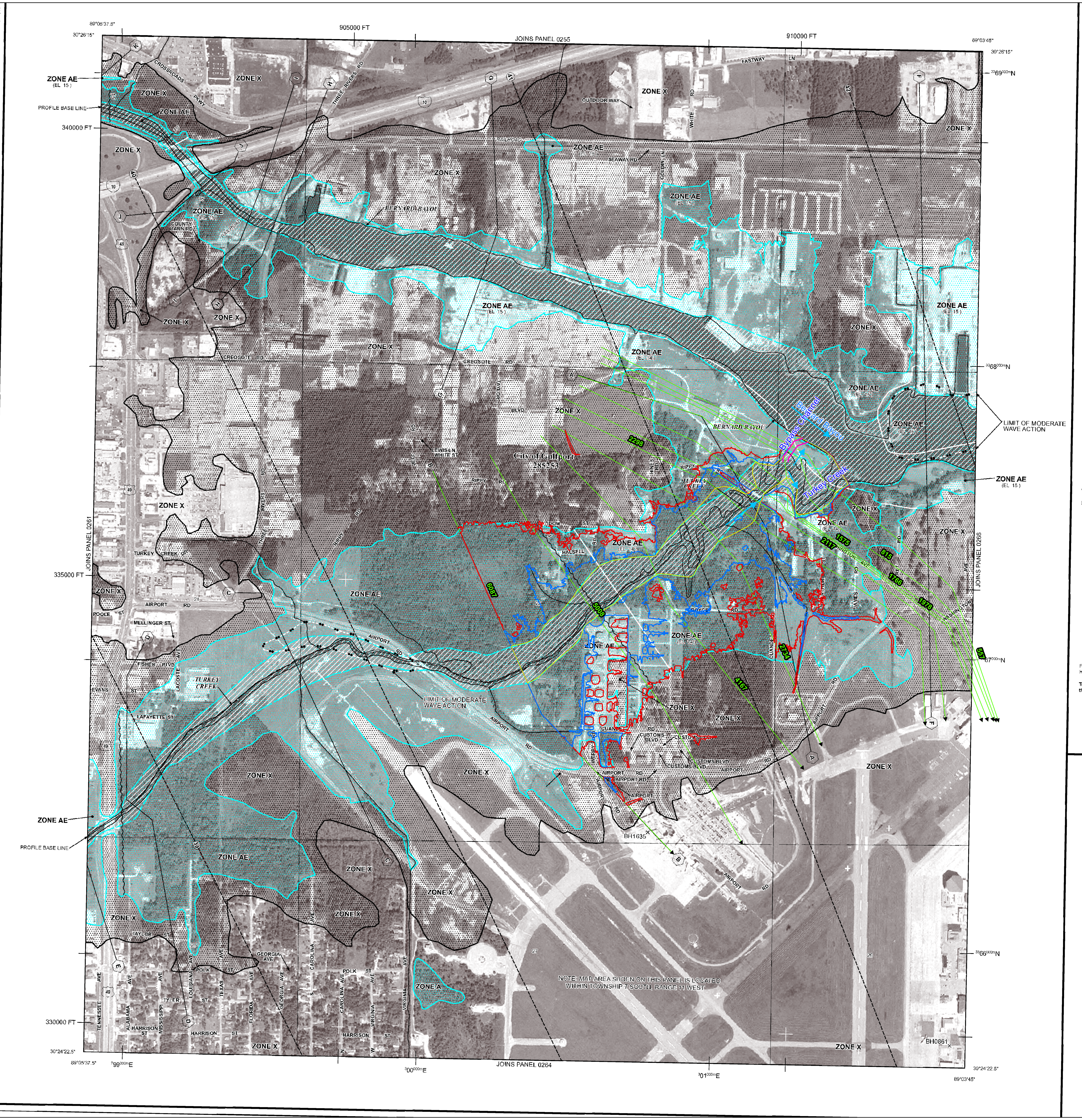
BH0861
BH1635



* PANEL NOT PRINTED

HARRISON COUNTY AND INCORPORATED COMMUNITIES FIRM PANEL LOCATOR

This map was produced through the Mississippi Flood Map Modernization Initiative, a cooperative partnership between the State of Mississippi and Department of Homeland Security - Federal Emergency Management Agency.



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Areas to be protected from 1% annual chance flood event by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary
0.2% annual chance floodplain boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities
Limit of Moderate Wave Action Delineation
513 Base Flood Elevation line and value; elevation in feet*
(EL 987) Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

Cross section line
Transect line
97°07'30", 32°22'30" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
4275000m E 1000-meter Universal Transverse Mercator grid ticks, zone 16
6000000 FT 5000-foot grid values: Mississippi State Plane coordinate system, East Zone (FIPSZONE = 2301), Transverse Mercator projection
DX5510 Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5 River Mile

MAP REPOSITORIES

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

NATIONAL FLOOD INSURANCE PROGRAM

NFIP

PANEL 0262G

FIRM

FLOOD INSURANCE RATE MAP

HARRISON COUNTY, MISSISSIPPI

AND INCORPORATED AREAS

PANEL 262 OF 575

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GULFPORT, CITY OF	285253	0262	G

PRELIMINARY
NOV 15 2007

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER 28047C0262G

EFFECTIVE DATE

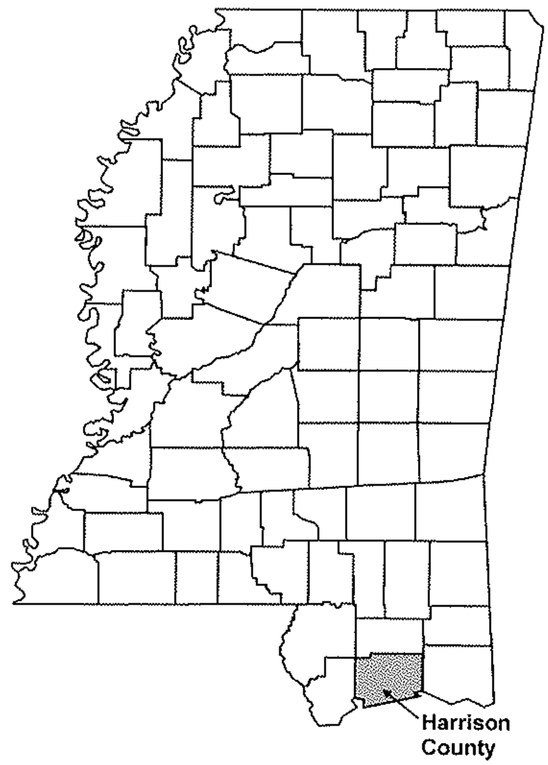
Federal Emergency Management Agency

APPENDIX 3
EFFECTIVE FIS REPORT DATA

FLOOD INSURANCE STUDY

HARRISON COUNTY, MISSISSIPPI
AND INCORPORATED AREAS

VOLUME 1 OF 3



COMMUNITY NAME	COMMUNITY NUMBER
BILOXI, CITY OF	285252
D'IBERVILLE, CITY OF	280336
GULFPORT, CITY OF	285253
HARRISON COUNTY (UNINCORPORATED AREAS)	285255
LONG BEACH, CITY OF	285257
PASS CHRISTIAN, CITY OF	285261

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
28047CV001A

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Countywide FIS Effective Date:

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FIGURES

TABLES

EXHIBITS

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EXHIBITS – continued

Table of Contents – Volume 2 – continued

EXHIBITS – continued

Exhibit 1 – Flood Profiles - continued

Exhibit 2 – 0.2% Annual Chance Wave Envelopes

Table of Contents – Volume 3

EXHIBITS – continued

Exhibit 2 – 0.2% Annual Chance Wave Envelopes

EXHIBITS – continued

FLOOD INSURANCE STUDY
HARRISON COUNTY, MISSISSIPPI AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and supersedes the FIS reports and/or Flood Insurance Rate Maps (FIRMs) in the geographic area of Harrison County, Mississippi, including the City of Biloxi, City of D'Iberville, City of Gulfport, City of Long Beach, City of Pass Christian, and unincorporated areas of Harrison County (hereinafter referred to collectively as Harrison County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates. This information will also be used by Harrison County to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), and by local and regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the NFIP are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some States or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this FIS report are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

This FIS was prepared to include the unincorporated areas of, and incorporated communities within, Harrison County in a countywide format. Information on the authority and acknowledgements for each jurisdiction included in this countywide FIS, as compiled from their previous printed FIS reports, is shown below.

Biloxi, City of:	The hydrologic and hydraulic analyses for the March 18, 1987 FIS, were performed by Gee & Jenson Engineers, Architects, Planners, Inc. (the study contractor) for the Federal Emergency Management Agency (FEMA), under contract No. EMW-C-0159. This study was completed in March 1985 (Reference 1).
Gulfport, City of:	For the July 4, 1988 FIS, the hydrologic and hydraulic analyses were prepared by Gee & Jenson Engineers, Architects, Planners, Inc., for FEMA, under Contract No. EMW-C-0159. That work was completed in August 1985.

For the October 4, 2002 FIS, a revision was performed to incorporate three Letters of Map Revision (LOMRs) effective May 25, 1990, February 13, 2001, and April 18, 2001, respectively. The May 25, 1990, LOMR reflected a revision to the floodway and stream alignment along Flat Branch. The hydraulic analysis was prepared by Neel-Schaffer, Inc. The February 13, 2001, LOMR reflected updated hydrologic and hydraulic analyses along Brickyard Bayou, prepared by URS Greiner Woodward Clyde under contract to FEMA under the Hazard Mitigation Technical Assistance Program. The April 19, 2001, LOMR reflected channelization along Bernard Bayou and Flat Branch and the construction of South Bridge at Crosswords Parkway along Bernard Bayou and North Bridge along Flat Branch. The hydraulic and hydrologic analyses were prepared by Jones & Carter, Inc. (Reference 2).

Harrison County, MS (Unincorporated Areas): For the August 4, 1988 FIS, the hydrologic and hydraulic analyses were prepared by Gee & Jenson Engineers, Architects, Planners, Inc., for FEMA, under Contract No. EMW-C-0159. That work was completed in March 1985.

For the October 4, 2002 FIS, a revision was performed to reflect updated corporate limits for the City of Gulfport, Mississippi, due to annexations and to incorporate a LOMR effective April 18, 2001. For this revision, no flooding sources have been revised (Reference 3).

Long Beach, City of: The coastal hydrologic and hydraulic analyses for the Mississippi Sound and the riverine analyses for the May 4, 1988 FIS were performed by Gee & Jenson Engineers, Architects, Planners, Inc., (the study contractor) for FEMA, under Contract No. EMW-C-0159. This study was completed in March 1985 (Reference 4).

Pass Christian, City of: The coastal hydrologic and hydraulic analyses for the Mississippi Sound and St. Louis Bay, and riverine analyses for the August 19, 1987 FIS, were performed by Gee & Jenson Engineers, Architects, Planners, Inc., (the study contractor) for FEMA, under Contract No. EMW-C-0159. This study was completed in March 1985 (Reference 5).

The hydrologic and hydraulic analyses for this countywide FIS were performed by the State of Mississippi for FEMA, under Contract No. EMA-2003-GR-5370. This study was completed in ________________.

Base map information shown on the FIRM was provided in digital format by the State of Mississippi. This information was photogrammetrically compiled at a scale of 1:12,000 from aerial photography dated September 2004.

The digital FIRM was produced using the State Plane Coordinate System, Mississippi East, FIPSZONE 2301. The horizontal datum was the North American Datum of 1983, GRS 80 spheroid. Distance units were measured in U.S. feet.

1.3 Coordination

An initial Consultation Coordination Officer's (CCO) meeting is held with representatives from FEMA, the community, and the study contractor to explain the nature and purpose of a FIS, and to identify the streams to be studied by detailed methods. A final CCO meeting is held with representatives from FEMA, the community, and the study contractor to review the results of the study.

The dates of the initial and final CCO meetings held for the communities within the boundaries of Harrison County are shown in Table 1, "CCO Meeting Dates."

TABLE 1. CCO MEETING DATES

Community Name	Initial CCO Date	Final CCO Date
Biloxi, City of	June 19, 1979	March 7, 1986
Gulfport, City of	April 16, 2001	*
Harrison County (Unincorporated Areas)	September 14, 2001	*
Long Beach, City of	*	July 8, 1986
Pass Christian, City of	June 19, 1979	*

* Data not available

For this FIS study, an initial Pre-Scoping Meeting was held on April 2, 2004. A Project Scoping Meeting was held on June, 11 2004, followed by a Post-Scoping Meeting on August 24, 2004. Attendees for these meetings included representatives from the Mississippi Department of Environmental Quality, Mississippi Emergency Management Agency, FEMA National Service Provider, Harrison County and the incorporated communities within Harrison County, and Mississippi Geographic Information, LLC, the State study contractor. Coordination with county officials and Federal, State, and regional agencies produced a variety of information pertaining to floodplain regulations, available community maps, flood history, and other hydrologic data. All problems raised in the meetings have been addressed.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS report covers the geographic area of Harrison County, Mississippi, including the incorporated communities listed in Section 1.1.

The March 18, 1987 FIS for the City of Biloxi covered the incorporated area of the City. The areas studied by detailed methods were the entire coastal area of Biloxi, including the Biloxi Bayou, the Back Bay of Biloxi, the Biloxi River, and the Tchoutacabouffa River. The study analysis included coastline flooding due to hurricane induced storm surge and riverine flooding from the Biloxi River and the Tchoutacabouffa River. Both the open coast surge and its inland propagation were studied; in addition, the added effects of wave heights were also considered. The results of the previous study remained unchanged except for the addition of floodways.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The areas studied were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through March 1990. The scope and methods of study were proposed to and agreed upon by FEMA and the City of Biloxi (Reference 1).

The July 4, 1988 FIS for the City of Gulfport covered the entire incorporated areas of the city. Flooding caused by the overflow of Bernard Bayou, Brickyard Bayou, and Turkey Creek, and the coastal analysis of Mississippi Sound were studied in detail within the corporate limits.

The October 4, 2002 revision for the City of Gulfport incorporated three previously issued LOMRs. The May 25, 1990, LOMR reflected updated hydraulic analysis and relocation of Flat Branch. The February 13, 2001, LOMR reflected updated hydrologic and hydraulic analyses along Brickyard Bayou. The April 18, 2001, LOMR reflected channelization along Bernard Bayou and Flat Branch and the construction of South Bridge at Crossroads Parkway along Bernard Bayou and North Bridge along Flat Branch. Annexations of land made by the City of Gulfport from the unincorporated areas of Harrison County resulted in the inclusion of detailed flood hazards for Biloxi River, Canal No. 1, Flat Branch, Fritz Creek, and Fritz Creek Tributary.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

All or portions or numerous streams were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the City of Gulfport (Reference 2).

The August 4, 1988 FIS for the unincorporated areas of Harrison County covered the unincorporated areas of the county. Riverine data obtained from the FIS for the unincorporated areas of Harrison County and the FIS for the unincorporated areas of Jackson County were used to merge with and extend the new study results upstream for the Tchoutacabouffa River and its backwater effects on Cypress Creek, Flat Branch, Bernard Bayou, Howard Creek, Parker Creek, Turkey Creek, and the Wolf River. Data from the afore-mentioned studies were also used to develop floodways for the following streams: Tuxachanie Creek, Choctaw Creek, Hog Branch, Palmer Creek, Saucier Creek, West Creek, Hickory Creek, Crow Creek, Pole Branch, Sandy Creek, Big Creek, Mill Creek, and Little Biloxi River.

Riverine data obtained from the U.S. Army Corps of Engineers (USACE) study titled, "Special Flood Hazard Information Report – Biloxi River, Harrison County, Mississippi" (Reference 6), was used to delineate flooding and to develop floodways for the Biloxi River.

For the October 4, 2002 revision, the LOMR dated April 18, 2001, was incorporated and annexations of land made by the City of Gulfport from the unincorporated areas of Harrison County are shown. The LOMR reflected channelization along Bernard Bayou and Flat Branch and the construction of South Bridge at Crossroads Parkway along Bernard Bayou and North Bridge along Flat Branch in the City of Gulfport. A small area of the revision along Flat Branch is currently in the unincorporated areas. Due to the annexations of land made by the City of Gulfport, Flat Branch, Fritz Creek, and Fritz Creek Tributary are now currently in the City of Gulfport and are shown on its FIRM.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The areas studied were selected with priority given to all known flood hazard areas and areas of projected development or porposed construction through March 1990. The scope and methods of study were proposed to and agreed upon by FEMA and Harrison County (Reference 3).

The May 4, 1988 FIS for the City of Long Beach covers the incorporated area of the city. Flooding caused by overflow of a portion of Canal No. 1 and Canal No. 3 was studied in detail within the community. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The remaining portions of Canal No. 1 and Canal No. 3 and an area along Canal No. 3 between Daugherty Road and Mitchell Road within the corporate limits were studied using approximate methods. The areas studied were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through March 1990. The scope and methods of study were proposed to and agreed upon by FEMA and the City of Long Beach (Reference 4).

The August 19, 1987 FIS for the City of Pass Christian covers the incorporated area of the City of Pass Christian. Flooding caused by overflow of Johnson Bayou (Canal No. 1) was studied in detail within the community. The areas studied were selected with priority given to all known flood hazard areas and areas of projected development of proposed construction through March 1990. The scope and methods of study were proposed to and agreed upon by FEMA and the City of Pass Christian (Reference 5).

Limited detailed analyses were used to study those areas having a low development potential or minimal flood hazards. For both Detailed and Limited Detailed studied streams, the scope and methods of study were proposed to, and agreed upon, by FEMA and the State of Mississippi. For this FIS study, the following table lists the streams which were restudied and/or newly studied by Detailed and Limited detailed methods:

TABLE 2. STREAMS STUDIED BY DETAILED AND LIMITED DETAILED METHODS

Stream	Limits of Revision/New Detailed and Limited Detailed Study
Bernard Bayou	From a point approximately 750 ft upstream of Mennonite Road to a point approximately 3,000 ft upstream of Mennonite Road.
Bernard Bayou Tributary 3	From the confluence with Bernard Bayou to a point approximately 1.1 mi upstream of Orange Grove Road.
Bernard Bayou Tributary 4	From the confluence with Bernard Bayou Tributary 3 to a point approximately 1,900 ft upstream of Lambrecht Road.
Bernard Bayou Tributary 5	From the confluence with Bernard Bayou Tributary 4 to a point approximately 850 ft upstream of Pheasant Drive.
Bernard Bayou Tributary 6	From the confluence with Bernard Bayou to a point approximately 300 ft upstream of Orange Grove Road.
Big Creek	From a point approximately 5.5 mi upstream of the confluence with Wolf River to a point approximately 6.1 mi upstream of the confluence with Wolf River.
Biloxi River	From a point approximately 250 ft upstream of Pete Hickman Road to the county boundary.
Brickyard Bayou	From just downstream of 25th Avenue to a point approximately 250 ft upstream of Stewart Avenue.
Crow Creek	From a point approximately 3.6 mi. upstream of the confluence with Biloxi River to a point approximately 4.7 mi upstream of the confluence with Biloxi River.
Flat Branch	From a point approximately 4,750' downstream of U. S. Highway 49 to a point approximately 2,750 ft upstream of Old Highway 49
	From the confluence with Flat Branch Tributary 2 to a point approximately 1.7 mi upstream of the confluence with Flat Branch Tributary 2.
Flat Brach Tributary 1	From a point approximately 1,450 ft downstream of Hamilton Street to a point approximately 3,900 ft upstream of Robinson Road.

TABLE 2. STREAMS STUDIED BY DETAILED AND LIMITED DETAILED METHODS – continued

Stream	Limits of Revision/New Detailed and Limited Detailed Study
Flat Branch Tributary 2	From the confluence with Flat Branch to a point approximately 2,450 ft upstream of the confluence with Flat Branch.
Fritz Creek	From a point approximately 500 ft downstream of O'Neal Road to a point approximately 850 ft upstream of Three Rivers Road.
Fritz Creek Tributary 1	From a point approximately 100 ft upstream of Three Rivers Road to a point approximately 1,100 ft downstream of O'Neal Road.
	From a point approximately 1,100 ft downstream of O'Neal Road to a point approximately 1,050 ft upstream of O'Neal Road.
Fritz Creek Tributary 2	From the confluence with Fritz Creek to a point approximately 1,650 ft upstream of Three Rivers Road.
Hickory Creek	From a point approximately 3,850 ft upstream of McHenry Road to a point approximately 1.5 mi upstream of McHenry Road.
Hog Branch	From a point approximately 2,400 ft downstream of White Plains Road to a point approximately 3,800 ft upstream of White Plains Road.
	From a point approximately 1,800 ft upstream of South Carr Bridge Road to a point approximately 1.9 mi upstream of South Carr Bridge Road.
Little Biloxi River	From a point approximately 100 ft downstream of McHenry Road to a point approximately 6,700 ft upstream of McHenry Road.
Shallow ponding between railroad tracks and Pass Road in the City of Biloxi and unincorporated Harrison County	Shallow ponding bounded by Beauvoir Road approximately 1 mile to the west, Hercules Street on the east, Pass Road on the north, and railroad tracks on the south.
Mill Creek	From a point approximately 4,900 ft upstream of State Highway 53 to a point approximately 1.7 mi upstream of State Highway 53.

TABLE 2. STREAMS STUDIED BY DETAILED AND LIMITED DETAILED METHODS – continued

Stream	Limits of Revision/New Detailed and Limited Detailed Study
Palmer Creek	From a point approximately 3,800 ft upstream of Wortham Road to a point approximately 9,200 ft upstream of Wortham Road.
Parker Creek	From a point approximately 1.2 mi upstream of State Highway 67 to a point approximately 1.8 mi upstream of State Highway 67.
Pole Branch	From a point approximately 300 ft downstream of Cable Bridge Road to a point approximately 3,200 ft upstream of Cable Bridge Road.
Sandy Creek	From a point approximately 1,200 ft downstream of Steel Bridge Road to a point approximately 2,500 ft upstream of Steel Bridge Road.
Saucier Creek	From a point approximately 1,200 ft upstream of State Highway 67 to just upstream of Martha Redmond Road.
Tchoutacabouffa River	From a point approximately 5,500 ft downstream of the confluence with Tchoutacabouffa River Tributary 3 to a point approximately 5,000 ft upstream of the confluence with Railroad Creek.
Tuxachanie Creek	From a point approximately 4,000 ft downstream of White Plains Road to a point approximately 1.6 mi downstream of North Carr Bridge Road.
	From a point approximately 1.4 mi downstream of Bethel Road to a point approximately 4.0 mi upstream of Bethel Road.
West Creek	From a point approximately 2,000 ft downstream of State Highway 67 to a point approximately 1.9 mi upstream of State Highway 67.

Also, floodplain boundaries of streams that have been previously studied by detailed methods were redelineated based on up-to-date topographic information.

All remaining flooding sources in the county were studied by approximate methods, and are the basis of the revised Zone A mappings included on the FIRMs.

This countywide FIS reflects a vertical datum conversion from the National Geodetic Vertical Datum of 1929 (NGVD29) to the North American Vertical Datum of 1988 (NAVD88).

2.2 Community Description

Harrison County encompasses approximately 585 square miles and is bounded on the north by Stone County, on the east by Jackson County, on the west by Hancock County, and on the south by the Mississippi Sound. It is located approximately 140 miles south of the City of Jackson, Mississippi; 60 miles northeast of the City of New Orleans, Louisiana; and 60 miles west of the City of Mobile, Alabama. Primary east-west traffic in Harrison County is served by Interstate Highway 10 and U.S. Highway 90. North-south access is provided by U.S. Highway 49, which reaches the gulf coast area in the City of Gulfport, Mississippi, at its intersection with U.S. Highway 90. Railroad service is provided by the CSX Transportation, which runs from Mobile, Alabama, across coastal Mississippi west to New Orleans, Louisiana. The Illinois Central Railroad also provides service to the north. According to the U.S. Census Bureau, the population has decreased from 189,601 in 2000 to 171,875 in 2006, a -9.3% decrease (Reference 7).

Harrison County, lying on the Mississippi Gulf Coast, is one of the state's principal resort and recreation areas in addition to having a nationwide reputation for its extensive fisheries. The county was formed by the State of Mississippi in 1841 and was named for the ninth President of the United States, William H. Harrison.

The historic key to the county's development can be found in Ship Island. The island served as a supply point for French explorers in early colonial years. It later became a thriving seaport, serving as a transfer depot for larger ocean-going vessels that were restricted by their size from entering the Mississippi Sound. Ship Island eventually diminished in importance as New Orleans developed into a primary gulf port. The construction of a channel from Ship Island to the mainland in 1902 allowed Harrison County to regain its status as a major gulf coast deep-water port.

Harrison County is typified by two distinct, easily recognized, physiographic divisions. The Gulf Coast Flatwoods is a distinctly low, level strip of coastal lowland, forming an irregular belt approximately 5 miles in width along the entire southern boundary of the county. The uplands of the Southern Lower Coastal Plain represent an older region, where erosion has cut deep valleys creating a much more uneven terrain than that of the coastal flatwoods area. The coastal flatwood region has elevations ranging from 0 to 50 feet above the National Geodetic Vertical Datum of 1929 (NGVD29). Elevations increase greatly moving northerly through the lower coastal plain, which exhibits elevations ranging from 90 to 200 feet NGVD29.

The climate in Harrison County is mild with mean annual temperatures in the upper 60 degrees Fahrenheit. Average winter temperatures range from 53 to 60 degrees Fahrenheit and average summer temperatures range from 75 to 82 degrees Fahrenheit. Rainfall averages approximately 62 inches annually with the majority of the accumulation in July through September. Winds in the area are generally southeasterly or southwesterly. Wind speeds usually remain under 10 miles per hour, but increase during storms. Thunderstorms occur between 70 and 80 days per year, many of which are accompanied by severe winds (Reference 8).

Three principle river systems drain Harrison County. The western portion of the county lies within the drainage basin of the Wolf River, which originates in Pearl River County and extends southward approximately 45 miles to its confluence with St. Louis Bay in the Mississippi Sound. The Little Biloxi and Big Biloxi Rivers flow from the north-central portion of the county in a southeasterly direction uniting 2.5 miles north of Wool Market to form the Biloxi River, which empties into the Back Bay of Biloxi. The Tchoutacabouffa River, which meanders along the eastern edge of the county from its origin at the confluence of Cypress Branch and Railroad Creek about 18 miles to the Back Bay of Biloxi, is the largest tributary in Harrison County.

The coastal strip of Harrison County is almost completely developed by both residential and commercial interest. Residential development extends northward to Interstate 10, beyond which woodlands exist containing individual residential home sites and small unincorporated communities. The recent completion of Interstate 10 is expected to increase development, both residential and commercial, along the northern boundaries of the coastal communities.

2.3 Principal Flood Problems

Coastal areas along the Mississippi Sound, St. Louis Bay, Biloxi Bay, and the Back Bay of Biloxi are primarily subject to coastal storm surge flooding and wave action as a result of hurricane and tropical storm activity in the gulf. The lower portions of the Biloxi, Wolf, and Tchoutacabouffa Rivers and other small streams and drainage-ways are subject to flooding from coastal storm surge. These streams are subject to riverine flooding during periods of heavy rainfall from frontal systems passing through or becoming stationary over the area. Severe rainfall can also cause flooding as a result of ponding in low-lying areas and areas with inadequate drainage.

Historical descriptions of past hurricanes and related damage are numerous for this area. During the 1800's, storms caused significant damage to the gulf coast (Reference 9).

Some of the more significant storms occurring in this century are as follows:

<u>1909 (September 10-21)</u>

Landfalling in Louisiana, the storm caused tides of 8 to 12 feet along the Mississippi coast. Three hundred and fifty lives were reported lost as a result of the storm (Reference 10).

1915 (September 22 – October 1)

This hurricane made landfall near the City of Grand Isle, Louisiana on September 29. Although the storm center passed well west of the Mississippi coast, a pressure of 28.02 inches of mercury (in. Hg) was recorded at the City of Biloxi. High-water elevations ranged from 11.8 feet NGVD29 at Bay St. Louis to 9.0 feet NGVD29 at the Cities of Gulfport and Biloxi. Two hundred and seventy-five lives were reportedly lost because of this storm (Reference 10).

1947 (September 4-21)

This hurricane entered the Gulf of Mexico after passing over Florida. Continuing across the gulf, the hurricane made landfall in southeastern Louisiana on September 19.

High-water marks surveyed after the storm showed elevations ranging from 8 feet NGVD29 at Pascagoula to 15 feet NGVD29 at the City of Bay St. Louis. Portions of the 28-mile seawall were breached during this storm. Fifty-one people were left dead in its wake with damages estimated at $100 million (Reference 10).

1965 Hurricane Betsy (August 27 – September 12)

Entering the Gulf of Mexico on September 8, Hurricane Betsy proceeded on a northwesterly track making landfall west of Grand Isle, Louisiana, on the evening of the ninth. Betsy left many sections of U.S. Highway 90 along the shoreline damaged as a result of wave action and surge. High-water elevations surveyed after the storm were about 12 feet NGVD29 in the vicinity of the Cities of Waveland, Bay St. Louis and Pass Christian. The tide gage at Biloxi recorded a peak surge of 8.6 feet NGVD29 (approximately a 4-percent-annual-chance recurrence interval) (References 11 and 12).

1969 Hurricane Camille (August 14-22)

Camille reached hurricane strength on the morning of August 15, with estimated wind speeds of 90 mph near the center of the storm. Its location was 75 miles off the extreme southwestern tip of Cuba. The storm continued to develop rapidly while traveling on a north-northwest track.

Camille was located 155 miles southeast of New Orleans at 1 pm, on Sunday, August 17, and was tracking to the north-northwest at 12 to 15 mph. Maximum wind speeds were estimated at 160 mph with Weather Bureau predictions of 190 mph for that same afternoon. The center of Camille passed east of the mouth of the Mississippi River and then made landfall at Waveland and Bay St. Louis, Mississippi, at 10:30 pm, August 17. The eye was estimated to be 10 to 12 miles in diameter and a central pressure of 26.85 in. Hg. was recorded in Bay St. Louis.

In Pascagoula, high-water marks up to 11.2 feet NGVD29 were surveyed after the storm (Reference 13). Wind gusts of 81 mph were recorded at the Ingalls Shipyard from the east-southeast during the storm (Reference 14). Camille ranked 5 on the Saffir Simpson Hurricane Scale of 1 to 5 and was the most intense storm to ever hit the United States mainland (Reference 15).

1979 Hurricane Frederic (August 30 – September 14)

Landfalling east of Pascagoula on September 12, 1979, Jackson County was spared from the right front quadrant of the storm and thus from serious flooding. However, with gusts recorded up to 110 knots, the county did sustain heavy damages (Reference 16). The tide gage at the Pascagoula Coast Guard Station peaked at noon on the following day at 5.8 feet NGVD29. This elevation represents approximately a 10-percent-annual-chance recurrence interval.

1985 Hurricane Elena (August 28 – September 4)

Elena, named on August 28 over central Cuba, strengthened into a hurricane on August 29 in the open waters of the southeast Gulf of Mexico. A decrease in forward speed and a turn to the east-northeast threatened the Florida panhandle. Elena eventually made an anti-cyclonic loop off Cedar Key, Florida and began accelerating towards the west-northwest. The storm reached a central pressure of 951 mb on September 1 about 100 mi south of Apalachicola, Florida. Elena weakened after that and made landfall near Biloxi, Mississippi with a central pressure of 959 mb. The highest tides and the storm surge reached about 8 ft in Biloxi and Gulfport, and 10 ft in the Pascagoula area. Several commercial structures were damaged by high winds, estimated at 60 to 105 mph in Gulfport and 90 to 115 mph in Pascagoula. During the period Elena threatened Gulf Coast areas, nearly a million people were evacuated, which may account for the fact that there were no deaths in the area of landfall. Four deaths were attributed to Elena by falling trees, automobile accidents, and heart attacks. The overall economic loss was estimated at over $1.25 billion.

1997 Hurricane Danny (July 16–26)

Danny became a tropical cyclone on July 16 off the southwestern coast of Louisiana. Danny continued to strengthen and became a hurricane early on July 18, but moved slowly and became nearly stationary at times. It finally made landfall just northwest of the Mississippi River Delta near Empire and Buras, Louisiana on July 18. Danny was back in the Gulf of Mexico later the same day and strengthened to Category 1 with 75 mph winds and a minimum central pressure of 984 mb. Danny moved east, then north-northeast near the mouth of Mobile Bay and passed over Dauphin Island before finally making landfall near Mullet Point, Alabama on July 19. The Mississippi coast experienced large amounts of rainfall and estimated winds of about 75 mph near the Mississippi-Alabama state line as Danny traveled toward landfall. Danny was responsible for five deaths in the region. The total reported damages were between $60 and $100 million.

1998 Hurricane Georges (September 15 – October 1)

Georges was named on September 15 while still a tropical storm. It continued to strengthen and reached category 4 status by September 19. Near-surface wind estimates indicated maximum winds of a strong Category 4 hurricane on September 20 about 300 mi east of Guadeloupe in the Lesser Antilles. After making several landfalls along its path from the eastern Atlantic Ocean to the Caribbean Sea, Georges intensified again and made landfall on September 25 in Key West, Florida with a minimum central pressure of 981 mb and maximum winds of 105 mph. The storm shifted eastward and made landfall again, near Biloxi, Mississippi, on the morning of September 28 with a sustained 1-min wind speed of 150 mph and a minimum central pressure of 964 mb. High water marks were taken on the U.S. mainland. Along the Mississippi coast, the range of stillwater marks was 6.9 to 12.1 ft. Similarly, the debris line heights ranged from 5.6 to 12.5 ft in Mississippi. A total of 602 deaths were attributed to Georges making it the 19th-deadliest storm in the Atlantic basin during the twentieth century to date. Most of the deaths were in the Dominican Republic and Haiti, due to flash flooding and subsequent mud slides. One death occurred in the United States—a freshwater drowning in Mobile, Alabama. Insured property damage estimates totaled $2.96 billion in the United States including Puerto Rico and the U.S. Virgin Islands. Based on the insured losses, the total estimated damage from Georges is $5.9 billion, of which $2.31 billion was outside the continental United States.

2005 Hurricane Katrina (August 23-30)

Katrina developed over the central Bahamas on the evening of August 23. The storm strengthened and reached hurricane status on the evening of August 25, less than 2 hours before it made landfall as a Category 1 storm near the border of Miami-Dade County and Broward County. Katrina continued moving west-southwest and entered the Gulf of Mexico early on August 26. The storm intensified to a Category 3 hurricane by noon on August 27 over 275 mi southeast of the mouth of the Mississippi River. Over the next day, Katrina doubled in size and turned toward the northwest. Katrina strengthened to a Category 5 in less than 12 hours and reached 160 mph winds by noon on August 28. Although Katrina did not make landfall near Buras, Louisiana until around noon on August 29 as a strong Category 3 storm (according to best estimates), the storm was large enough that hurricane force winds were reaching the coast as early as August 28.

Since most of the tide gauges failed along the coast and buildings were completely destroyed, it was difficult to determine the storm surge from Katrina. Post-storm assessments by FEMA estimate that the storm surge was 24 to 28 ft along the Mississippi coast across a swath about 20 miles wide, centered roughly on St. Louis Bay. For the eastern half of the Mississippi coast (roughly from Gulfport to Pascagoula), the storm surge was estimated to be 17 to 22 ft reaching up to 6 mi inland and up to 12 mi inland along bays and rivers. Compared to the 1969 storm (Hurricane Camille) that traveled along nearly the same path, Katrina was a weaker storm, but caused as much or more damage due to its large size. The radius of maximum winds was 25-30 n. mi. and hurricane force winds extended at least 75 n mi to the east from the center of the storm. Also, Katrina generated substantial wave setup along the northern Gulf coast while it was still a Category 4 and 5 before it made landfall.

Katrina was a powerful and deadly hurricane that ranks as one of the costliest and one of the five deadliest hurricanes to ever strike the United States. A total of 1,833 fatalities from Louisiana, Mississippi, Florida, Georgia and Alabama are directly and indirectly related to Katrina. Early estimates of the total damages place the losses at over $81 billion.

2.4 Flood Protection Measures

Following the storms of 1909 and 1915 which damaged much of the coastal highway, a 28 mile protective seawall was constructed to prevent future damage. Completed in 1927, the seawall was the longest single concrete structure of its time. According to the Harrison County Civil Defense, the seawall varies in elevation from 5 feet NGVD29 to 11 feet NGVD29 with the majority of the wall being at 11 feet NGVD29.

After September 1947 hurricane, a manmade beach was placed seaward of the seawall to further attenuate damage along the coast. The seawall and beach system have been effective in minimizing wave damage north of the coastal highway.

The west end of Deer Island has been extended with a breakwater. This structure affords wave protection to the eastern Biloxi Marina and commercial fishing area.

A seawall exists in the study area that provides the community with some degree of protection against flooding. However, it has been ascertained that this seawall may not protect the community from rare events such as the 1-percent-annual-chance flood. The criteria use to evaluate protection against the 1-percent-annual-chance flood are 1) adequate design, including freeboard, 2) structural stability, and 3) proper operation and maintenance. Levees that do not protect against the 1-percent-annual-chance flood are not considered in the hydraulic analysis of the 1-percent-annual-chance floodplain.

In the communities of Pass Christian and Biloxi, a storm drainage system consisting of natural and manmade ditches handles storm runoff for the less intense rainfall events.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 1-percent-annual-chance flood in any 50-year period is approximately 40 percent (4 in 10); for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for each flooding source studied by detailed methods affecting the community.

Pre-Countywide FIS Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each riverine flooding source studied in detail affecting the community.

The discharges were determined by the study contractor, and were based on a method presented in "Flood Frequency of Mississippi Streams" (Reference 17). These streams were Bernard Bayou, Brickyard Bayou, Canal No. 1, Canal No. 3, Cypress Creek, Howard Creek, Parker Creek, the Tchoutacabouffa River, Turkey Creek, and Wolf River. This report outlined methods of determining the 10-, 4-, and 1-percent-annual-chance discharges. The computed discharges for the 10-, 4-, and 1-percent-annual-chance frequencies were then graphically extrapolated on log-probability paper to determine the 0.2-percent-annual-chance discharges. The peak flows for the Biloxi River were based on the regional analysis (Reference 6). The regional analyses were made by using 104 gaging stations in the surrounding area. The hydrologic investigation was a part of the Special Flood Hazard Information Report for the Biloxi River (Reference 6).

The peak discharge for the remaining streams studied in detail was obtained by utilizing the U.S. Geological Survey (USGS) publication, "Floods in Mississippi, Magnitude and Frequency" (Reference 18).

This Countywide Analyses

Peak discharges for the streams studied by Limited detailed methods were calculated based on USGS regional regression equations (Reference 19).

For the discharges calculated based on regional regression equations, the rural regression values were updated to reflect urbanization as necessary.

A summary of the drainage area-peak discharge relationships for all the streams is shown in Table 3, "Summary of Discharges."

TABLE 3. SUMMARY OF DISCHARGES

Detailed Studied Streams

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. mi.)	PEAK DISCHARGES (cfs) 10-percent	2-percent	1-percent	0.2-percent
BERNARD BAYOU					
At confluence	75.9	7,600	*	15,400	21,500
Just downstream of Three Rivers Road	33.8	4,930	6,750	10,200	15,000
At Three Rivers Road	10.6	4,600	6,300	9,300	13,500
At U.S. Highway 49	9.7	2,700	3,700	5,460	7,600
Just upstream of Old U.S. Highway 49	15.4	*	*	5,808	*
Just downstream of Canal Road	11.5	*	*	5,327	*
Just upstream of County Road	9.6	*	*	5,384	*
Just downstream of County Road	5.6	*	*	3,634	*

*Data not available

TABLE 3. SUMMARY OF DISCHARGES - continued

Detailed Studied Streams - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. mi.)	PEAK DISCHARGES (cfs) 10-percent	2-percent	1-percent	0.2-percent
BERNARD BAYOU – continued					
Just downstream of Harrison County Farm Road	3.2	*	*	3,868	*
BILOXI RIVER					
At Three Rivers Road	240.3	17,000	26,000	31,000	43,800
Just upstream of the confluence of Little Biloxi River	163.1	13,900	21,500	25,200	36,500
Just downstream of the confluence of Saucier Creek	144.3	12,800	20,000	23,500	33,900
At U.S. Highway 49	96.6	10,200	15,700	19,000	27,200
At Lizana Saucier Road	83.3	9,300	14,800	17,500	25,800
BIG CREEK					
Approximately 1 mile upstream of the confluence with Wolf River	*	*	*	5,250	*
BRICKYARD BAYOU					
At Courthouse Road	5.5	1,370	1,960	2,190	2,780
At 37th Street	4.9	1,350	1,920	2,140	2,710
At 28th Street	3.7	1,230	1,720	1,920	2,400
At 25th Street	2.1	1,060	1,450	1,600	1,980
CANAL NO. 1					
At mouth	7.4	1,085	1,769	2,384	3,500
At Menge Road	6.1	947	1,541	2,121	3,150
At Espy Avenue	5.3	864	1,402	1,952	2,900
At Beatline Road	4.0	704	1,132	1,604	2,400
At Pineville Road	2.0	375	591	886	1,400
At Klondike Road	1.4	329	504	734	1,130
CANAL NO. 3					
At mouth	8.2	1,278	2,085	2,807	4,050
At Menge Road	5.4	1,005	1,619	2,210	3,270
At Espy Avenue	4.9	941	1,511	2,103	3,050
Approximately 0.5 mile upstream of Espy Avenue	4.1	783	1,253	1,782	2,630
At Beatline Road	2.7	532	843	1,221	1,750
At Daugherty Road	0.8	158	243	366	530

*Data not available

TABLE 3. SUMMARY OF DISCHARGES - continued

Detailed Studied Streams - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. mi.)	PEAK DISCHARGES (cfs) 10-percent	2-percent	1-percent	0.2-percent
CHOCTAW CREEK					
Just downstream of Forestry Road	6.7	2,258	2,915	4,134	5,936
CROW CREEK					
Approximately 2 miles upstream of the confluence with Biloxi River	8.7	2,264	3,424	4,911	6,955
CYPRESS CREEK					
At Ramset Springs Road	8.9	1,760	2,420	3,645	5,300
FLAT BRANCH					
At confluence	13.6	2,535	3,450	5,075	7,000
Just downstream of O'Neal Road	*	*	*	4,900	*
FRITZ CREEK					
At Interstate 10	7.8	1,910	3,040	3,740	5,600
Just upstream of the confluence with Unnamed Tributary	3.3	1,040	1,620	1,960	2,800
FRITZ CREEK TRIBUTARY					
Just upstream of confluence with Fritz Creek	2.2	725	1,110	1,370	2,050
HICKORY CREEK					
Approximately 1 mile upstream of the confluence with Biloxi River	7.1	1,971	2,556	3,645	5,130
Just downstream of McHenry Road	3.9	1,783	2,289	3,312	4,715
HOG BRANCH					
Just upstream of White Plains Road	6.7	1,810	2,329	3,315	4,760
Just upstream of South Carr Bridge Road	4.2	1,500	1,932	2,760	3,956
HOWARD CREEK					
At Old Highway 67	4.1	1,375	1,794	2,490	3,400
Approximately 3.3 miles upstream of the confluence with Choctaw Creek	1.7	1,112	1,427	2,106	2,984

*Data not available

TABLE 3. SUMMARY OF DISCHARGES - continued

Detailed Studied Streams - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. mi.)	PEAK DISCHARGES (cfs) 10-percent	2-percent	1-percent	0.2-percent
LITTLE BILOXI RIVER					
At confluence with Biloxi River	75.0	5,670	7,308	10,080	14,427
Approximately 2.8 miles upstream of the confluence with Biloxi River	71.6	5,775	7,392	10,230	14,652
Just downstream of Old Highway 49	64.7	5,658	7,245	10,143	14,490
Approximately 1 mile downstream of Harrison County Farm Road	59.2	5,616	7,200	10,080	14,328
Approximately 1.3 miles downstream Harrison County Farm Road	50.5	5,288	6,825	9,525	13,575
Just downstream of Lizana Saucier Road	45.3	5,280	6,800	9,520	13,600
Approximately 1 mile downstream of Herman Ladner Road	36.4	4,640	6,000	8,320	12,000
Just upstream of the confluence with Bully Creek	29.4	4,182	5,412	7,544	10,824
MILL CREEK					
Approximately 1.8 miles upstream of the confluence with Wolf River	*	*	*	4,870	*
PALMER CREEK					
Approximately 1 mile upstream of the confluence with Biloxi River	5.7	1,762	2,216	3,195	4,539
Approximately 0.5 mile upstream of Wortham Road	4.5	1,758	2,257	3,276	4,628
PARKER CREEK					
At Interstate 10	4.5	1,575	2,060	2,875	4,000
At Wolf Market Road	3.0	1,225	1,585	2,175	2,900
Approximately 0.6 mile upstream of U. S. Highway 67	1.48	720	1,075	1,565	2,232
Approximately 3.4 miles upstream of the confluence with Tchoutacabouffa River	0.77	785	988	1,496	2,128
POLE BRANCH					
Approximately 1 mile upstream of the confluence with Wolf River	*	*	*	485	*

*Data not available

TABLE 3. SUMMARY OF DISCHARGES - continued

Detailed Studied Streams - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. mi.)	PEAK DISCHARGES (cfs) 10-percent	2-percent	1-percent	0.2-percent
SANDY CREEK					
Just upstream of Sandy Ridge Cemetery Road	*	*	*	4,228	*
SAUCIER CREEK					
Just upstream of Wortham Road	40.2	5,828	7,520	10,434	15,040
Just upstream of Saucier Fairly Road	36.3	6,264	8,046	10,608	15,300
Just downstream of Bethel Road	12.8	2,688	3,440	4,902	7,052
TCHOUTACABOUFFA RIVER					
At mouth	241.6	15,600	21,420	31,280	44,000
Just upstream of the confluence with Tuxachanie Creek	78.8	8,832	11,424	15,840	22,560
Just upstream of the confluence with Unnamed Tributary	48.8	8,400	9,450	13,125	18,900
TURKEY CREEK					
At Canal Road	14.8	2,200	*	4,600	6,600
At Washington Street	28.2	2,700	3,850	5,800	8,600
At Illinois Central Railroad	25.2	2,600	3,650	5,500	7,950
At Tillman Road Extension	11.5	2,020	2,790	4,200	6,000
At Interstate 10	6.0	1,620	2,500	3,300	5,200
Approximately 1 mile upstream of Landon Road	*	*	*	3,200	*
TUXACHANIE CREEK					
Approximately 1 mile upstream of the confluence with Tchoutacabouffa River	24.9	7,650	9,825	13,650	19,500
Just downstream of Old Highway 15	23.8	7,700	10,010	13,860	19,866
Just downstream of State Highway 15	22.2	8,019	10,368	14,418	20,574
Just downstream of the confluence with Hog Branch	20.5	8,256	10,664	14,706	21,070
Just upstream of White Plains Road	19.4	7,783	9,976	13,846	19,780
Just downstream of Carr Bridge Road	16.0	6,930	8,910	12,420	17,820
Just downstream of the confluence of Choctaw Creek	13.2	7,000	9,100	12,500	18,000

*Data not available

TABLE 3. SUMMARY OF DISCHARGES - continued

Detailed Studied Streams - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. mi.)	PEAK DISCHARGES (cfs)			
		10-percent	2-percent	1-percent	0.2-percent
WEST CREEK					
Approximately 1 mile upstream of the confluence with Saucier Creek	15.9	3,337	4,277	6,110	8,648
WOLF RIVER					
At Interstate 10	348.2	16,380	21,150	27,860	38,400
Just downstream of the confluence with Big Creek	*	*	*	25,212	*
Approximately 3.25 miles upstream of the confluence with Sandy Creek	*	*	*	24,850	*

Limited Detailed Studied Streams

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. mi.)	PEAK DISCHARGES (cfs)			
		10-percent	2-percent	1-percent	0.2-percent
BERNARD BAYOU					
Approximately 750 ft upstream of Mennonite Road	1.0	*	*	916	*
BERNARD BAYOU TRIBUTARY 3					
Just upstream of the confluence with Bernard Bayou	2.8	*	*	2,376	*
Just upstream of the confluence with Bernard Bayou Tributary 4	1.5	*	*	1,391	*
Approximately 4,250 ft upstream of Orange Grove Road	1.0	*	*	1,140	*
BERNARD BAYOU TRIBUTARY 4					
Just upstream of the confluence with Bernard Bayou Tributary 3	1.3	*	*	1,371	*
Approximately 1,750 ft upstream of Orange Grove Road	1.0	*	*	1,165	*
Approximately 1,500 ft downstream of Robinson Road	0.3	*	*	399	*

*Data not available

TABLE 3. SUMMARY OF DISCHARGES - continued

Limited Detailed Studied Streams - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. mi.)	PEAK DISCHARGES (cfs) 10-percent	2-percent	1-percent	0.2-percent
BERNARD BAYOU TRIBUTARY 5					
Approximately 200 ft upstream of the confluence with Bernard Bayou Tributary 4	0.5	*	*	651	*
BERNARD BAYOU TRIBUTARY 6					
At the confluence with Bernard Bayou	0.3	*	*	589	*
BIG CREEK					
Approximately 4.5 miles upstream of the confluence with Wolf River	5.4	*	*	5,250	*
BILOXI RIVER					
Approximately 3,900 ft downstream of Pete Hickman Road	59.0	*	*	12,804	*
BRICKYARD BAYOU					
Just downstream of 21st Street	1.0	*	*	1,307	*
CROW CREEK					
Approximately 3.6 miles upstream of the confluence with Biloxi River	5.8	*	*	2,613	*
FLAT BRANCH					
At confluence with Flat Branch Tributary 2	4.2	*	*	2,293	*
Approximately 650 ft upstream of the confluence with Flat Branch Tributary 3	2.9	*	*	1,686	*
FLAT BRANCH TRIBUTARY 1					
At confluence with Flat Branch	1.6	*	*	1,844	*
Approximately 1,150 ft upstream of Saint Charles Street	1.1	*	*	1,390	*

*Data not available

TABLE 3. SUMMARY OF DISCHARGES - continued

Limited Detailed Studied Streams - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. mi.)	PEAK DISCHARGES (cfs)			
		10-percent	2-percent	1-percent	0.2-percent
FLAT BRANCH TRIBUTARY 2					
At confluence with Flat Branch	1.4	*	*	1,224	*
FRITZ CREEK					
Approximately 1,600 ft downstream of O'Neal Road	2.3	*	*	1,895	*
Approximately 5,000 ft upstream of O'Neal Road	1.3	*	*	1,386	*
FRITZ CREEK TRIBUTARY 1					
Approximately 800 ft downstream of O'Neal Road	0.2	*	*	408	*
FRITZ CREEK TRIBUTARY 2					
Approximately 300 ft upstream of the confluence with Fritz Creek	0.3	*	*	446	*
HOG BRANCH					
Approximately 0.6 mile upstream of South Carr Bridge Road	3.0	*	*	1,716	*
Approximately 1.9 miles upstream of South Carr Bridge Road	2.1	*	*	1,421	*
LITTLE BILOXI RIVER					
Approximately 750 ft downstream of McHenry Road	22.3	*	*	6,427	*
MILL CREEK					
Approximately 1.4 mi upstream of State Highway 53	3.9	*	*	4,870	*
PALMER BRANCH					
Approximately 2,400 ft upstream of Wortham Road	4.7	*	*	3,276	*
Approximately 6,100 ft upstream of Wortham Road	3.9	*	*	2,319	*

*Data not available

TABLE 3. SUMMARY OF DISCHARGES - continued

Limited Detailed Studied Streams - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. mi.)	PEAK DISCHARGES (cfs) 10-percent	2-percent	1-percent	0.2-percent
POLE BRANCH					
Just upstream of Cable Bridge Road	3.2	*	*	2,771	*
SAUCIER CREEK					
Approximately 3,200 ft upstream of State Highway 67	10.4	*	*	3,930	*
TCHOUTACABOUFFA RIVER					
At confluence with Hurricane Creek	21.8	*	*	7,991	**
Just upstream of the confluence with Railroad Creek	3.5	*	*	1,764	*
TUXACHANIE CREEK					
Approximately 1,800 ft downstream of Bethel Road	38.4	*	*	9,613	*
Just upstream of the confluence with Baymond Branch	27.8	*	*	7,589	*
Approximately 2.8 mi upstream of the confluence with Baymond Branch	21.1		*	6,622	*

*Data not available

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the Flood Insurance Rate Map (FIRM) represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data table in the FIS report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS report in conjunction with the data shown on the FIRM.

Pre-countywide FIS Analyses

Analyses of the hydraulic characteristics of flooding from the riverine sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sections for the water-surface elevation analyses of Bernard Bayou, the Biloxi River, portions of Canal No. 1, Canal No. 3, Cypress Creek, Howard Creek, Parker Creek, the Tchoutacabouffa River (Reference 20), Turkey Creek, and the Wolf River were obtained from field surveys. The remaining cross sections for Canal No. 1 were obtained from the U. S. Soil Conservation Service (SCS) in Jackson (References 21 and 22). All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry.

For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are shown on the FIRM (Exhibit 3).

Water-surface elevations of floods of the selected recurrence intervals were computed using the USACE HEC-2 step-backwater computer program (Reference 23). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations were calculated using the slope-area method with the exception of the 10- and 4-percent-annual-chance floods for Bernard Bayou, and the 10-percent-annual-chance flood for Brickyard Bayou and the Tchoutacabouffa River. For the 10-percent-annual-chance flood, a mean tide elevation of 0.15 foot NGVD29 was used as starting water-surface elevation because the slope-area method resulted in a water-surface elevation lower than the mean tide elevation.

Roughness factors (Manning's n) used in hydraulic computations were chosen based on field observations of the channel and overbank areas.

Water-surface elevations of each stream previously studied by the SCS were computed by establishing rating curves for each cross section. These elevations were plotted and connected to form flood profiles.

Water-surface elevations of floods of the selected recurrence intervals of the streams studied in detail were computed through use of the COE HEC-2 step-backwater computer program (Reference 23). The starting water-surface elevations for Old Fort Bayou were calculated using the slope-area method, with exception of the 10-percent-annual-chance frequency flood. The mean high tide elevation of 0.15 foot NGVD29 was used as the starting water-surface elevation for the 10-percent-annual-chance frequency flood because the water-surface elevation computed by the slope-area method was lower than this.

This Countywide Analyses

Cross section geometries were obtained from a combination of terrain data and field surveys. Bridges and culverts located within the Limited detailed study limits were field surveyed to obtain elevation data and structural geometry.

Downstream boundary conditions for the hydraulics models were set to normal depth using a starting slope calculated from values taken from topographic data, or where applicable, derived from the water-surface elevations of existing effective flood elevations or recalculated flood elevations. Water-surface profiles were computed through the use of USACE HEC-RAS version 3.1.2 computer program (Reference 24). The model was run for the 1-percent-annual-chance storm for the Limited detailed and approximate studies.

Manning's n values used in the hydraulic computations for both channel and overbank areas were based on recent digital orthophotography and field investigations.

Table 4, "Summary of Roughness Coefficients," shows the ranges of the channel and overbank roughness factors used in the computations for all of the streams studied by Detailed and Limited detailed methods.

TABLE 4. SUMMARY OF ROUGHNESS COEFFICIENTS

Detailed Studied Streams

FLOODING SOURCE	CHANNEL "N"	OVERBANK "N"
Bernard Bayou	0.035-0.080	0.030-0.100
Biloxi River	0.050-0.120	0.080-0.310
Brickyard Bayou	0.035-0.060	0.050-0.100
Canal No. 1	0.040-0.070	0.100-0.150
Canal No. 3	0.050-0.070	0.090-0.150
Cypress Creek	0.050-0.070	0.120-0.150
Flat Branch	0.040-0.045	0.080
Fritz Creek	0.040-0.045	0.075-0.080
Fritz Creek Tributary 1	0.020-0.055	0.075-0.080
Howard Creek	0.050-0.070	0.120-0.150
Parker Creek	0.012-0.060	0.075-0.150
Tchoutacabouffa River	0.030	0.070-0.120
Turkey Creek	0.035-0.055	0.060-0.100
Wolf River	0.030	0.070-0.120

Limited Detailed Studied Streams

FLOODING SOURCE	CHANNEL "N"	OVERBANK "N"
Bernard Bayou	0.045	0.080
Bernard Bayou Tributary 3	0.045	0.080
Bernard Bayou Tributary 4	0.045	0.080
Bernard Bayou Tributary 5	0.030 - 0.040	0.120
Bernard Bayou Tributary 6	0.045	0.080
Big Creek	0.050	0.120-0.130
Biloxi River	0.050	0.120
Brickyard Bayou	0.040-060	0.080 - 0.150
Crow Creek	0.050	0.120
Flat Branch	0.045	0.080
Flat Branch Tributary 1	0.018 - 0.045	0.100 - 0.150
Flat Branch Tributary 2	0.045	0.080
Fritz Creek	0.050	0.080
Fritz Creek Tributary 1	0.050	0.080 - 0.100

TABLE 4. SUMMARY OF ROUGHNESS COEFFICIENTS - continued

Limited Detailed Studied Streams - continued		
FLOODING SOURCE	CHANNEL "N"	OVERBANK "N"
Fritz Creek Tributary 2	0.050	0.080
Hickory Creek	0.060	0.150
Hog Branch	0.050	0.100
Little Biloxi River	0.050	0.150
Mill Creek	0.050	0.150
Palmer Branch	0.050	0.150
Parker Creek	0.050	0.120
Pole Branch	0.050	0.100 - 0.120
Sandy Creek	0.040	0.120
Saucier Creek	0.050	0.150
Tchoutacabouffa River	0.050	0.150
Tuxachanie Creek	0.050	0.100
West Creek	0.050	0.150

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the FIRM (Exhibit 3).

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the Flood Profiles (Exhibit 1) are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to NAVD88.

Coastal Analysis

The hydraulic characteristics of flooding from the sources studied were analyzed to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown in the coastal data tables and flood profiles in the FIS report.

Storm Surge Analysis and Modeling

For areas subject to tidal inundation, the 10-, 2-, 1-, and 0.2-percent-annual-chance stillwater elevations and delineations were taken directly from a detailed storm surge study documented in the Technical Study Data Notebook (TSDN) for this new Mississippi coastal flood hazard study.

The Advanced Circulation model for Coastal Ocean Hydrodynamics (ADCIRC) (Reference 25), developed by the USACE, was selected to develop the stillwater elevations or storm surge levels for coastal Mississippi. ADCIRC uses an unstructured grid and is a finite-element long wave model. ADCIRC has the capability to simulate tidal circulation and storm surge propagation over large areas and is able to provide highly detailed resolution along the shorelines and areas of interest along the open coast and inland bays. It solves three dimensional equations of motion, including tidal potential, Coriolis, and nonlinear terms of the governing equations. The model is formulated from the depth averaged shallow water equations for conservation of mass and momentum which results in the generalized wave continuity equation.

The coastal wave model Simulating Waves Nearshore (SWAN) (Reference 26) is used to calculate the nearshore wave fields required for the addition of wave setup effects. This numerical model is a third-generation (phase-averaged) wave model for the simulation of waves in waters of extreme, intermediate, and finite depths. Model characteristics include the capping of the atmospheric drag coefficient, dynamic adjustment of bathymetry for changing water levels, and specification of the required save points. Three nested grids are used to obtain sufficient nearshore resolution to represent the radiation stress gradients required as ADCIRC inputs. Radiation stress fields output from the SWAN inner grids are used by ADCIRC to estimate the contribution of breaking waves (wave setup effects) to the total storm surge water level.

In order to model storm surge and wave fields using ADCIRC and SWAN, wind and pressure fields are required for input. A model called the Planetary Boundary Layer model (PBL), developed by V.J. Cardone (Reference 27), uses the parameters from a hurricane or storm to simulate the event and develop wind and pressure fields. The PBL model simulates hurricane induced wind and pressure fields by applying the vertically integrated equations of motion. Oceanweather Inc. provided support to run the PBL model and provide wind and pressure fields for each of the selected storms events.

The Joint Probability Method (JPM) was used to develop the stillwater frequency curves for the 10-, 2-, 1-, and 0.2-percent-annual-chance stillwater elevations. The original JPM application, while not called JPM, was developed by Larry Russell (Reference 28). The JPM approach is a simulation methodology that relies on the development of statistical distributions of key hurricane input variables such as central pressure, radius to maximum wind speed, maximum wind speed, translation speed, track heading, etc., and sampling from these distributions to develop model hurricanes. The resulting simulation results in a family of modeled storms that preserve the relationships between the various input model components, but provides a means to model the effects and probabilities of storms that historically have not occurred. The JPM approach was modified for this coastal study based on updated statistical methods developed by FEMA and the USACE for Mississippi and Louisiana. Further details on the JPM approach are included in the Technical Support Data Notebook (TSDN).

An existing ADCIRC grid mesh developed by the USACE was refined along the shoreline of Mississippi and surrounding areas using bathymetric and topographic data from various sources. Bathymetric data consisted of ETOPO5 and Digital Nautical Charts databases in the offshore regions, and was supplemented with NOAA hydrographic surveys. In the nearshore regions, bathymetric data came from the Northern Gulf Littoral Initiative, Naval Oceanographic Office multi-beam and single-beam bathymetry, NOAA bathymetric surveys, and NOAA charts. The topographic portion of the ADCIRC mesh was populated with topographic light detection and ranging (LIDAR) from several sources. For areas inland of the debris line from Hurricane Katrina, pre-Katrina LIDAR collected by EarthData International was used. For areas seaward of the debris line from Hurricane Katrina, post-Katrina LIDAR collected by Woolpert Inc. was used. For the offshore barrier islands, topographic data was taken from LIDAR collected by the USACE. For rivers, channel bottom elevations were taken from riverine profiles from effective FISs. All bathymetric and topographic data were brought to the NAVD88 datum for input to ADCIRC and SWAN. Further details about the terrain data and how it was processed can be found in the TSDN for this study.

The completed ADCIRC grid mesh resulted in a finite element model coded with over 900,000 grid nodes. The NOAA high definition vector shoreline was used to define the change between water and land elements. The grid includes other features, such as islands, roads, bridges, open waters, bays, and rivers. Field reconnaissance detailed the significant drainage and road features, and documentation of coastal structures in the form of seawalls, bulkheads, harbors, and casinos along the beachfront areas. The National Land Cover Dataset was used to define Manning's n values for bottom roughness coefficients input at each node in the mesh. A directional surface wind roughness value was also applied. Further details about the ADCIRC mesh creation and grid development process can be found in the TSDN.

Predicted tidal cycles were used to calibrate the ADCIRC model and refine the grid. Tidal boundary conditions were obtained from the EastCoast2001 tidal database, a digital tidal constituent database. Six tidal constituents were used (K1, O1, M2, S2, N2, and K2). The simulated water-surface elevation time series was compared to measured tides from tide gauge stations for over a 30-day period. Model validation, which tests the model hydraulics and ability to reproduce events, was performed against Hurricanes Katrina (2005), Betsy (1965), and Camille (1969). Simulated water levels for each event were compared to observed water levels from NOAA tidal gauges, as well as available high water marks. Hurricanes Georges and Katrina were used to validate the SWAN model. Modeled wave heights were compared to available historic wave data from NOAA wave buoys.

The SWAN model, used to calculate the wave setup component, used the same topographic and bathymetry data as the ADCIRC grid. The model is forced with wind and pressure fields and deepwater waves calculated by the WAM model from Oceanweather Inc. Results from the SWAN model, run on a low resolution grid, are input to a low resolution ADCIRC grid. Then the water level and wave effects results from ADCIRC are input to a high resolution SWAN grid to obtain the final radiation stress input for a high resolution ADCIRC grid. This process is repeated for the production run of each of the hundreds of synthetic hurricane simulations. The final radiation stress files are also modified to decrease the magnitude of wave radiation stress in vegetated areas before being input to ADCIRC.

Statistical Analysis

Due to the excessive number of simulations required for the traditional JPM method, the Joint Probability Method-Optimum Sampling (JPM-OS) was utilized to determine the stillwater elevations associated with tropical events. JPM-OS is a modification of the JPM method developed cooperatively by FEMA and the USACE for Mississippi and Louisiana coastal flood studies that were being performed simultaneously, and is intended to minimize the number of synthetic storms that are needed as input to the ADCIRC model. The methodology entails sampling from a distribution of model storm parameters (e.g., central pressure, radius to maximum wind speed, maximum wind speed, translation speed, and track heading) whose statistical properties are consistent with historical storms impacting the region, but whose detailed tracks differ. The methodology inherently assumes that the hurricane climatology over the past 60 to 65 years (back to 1940) is representative of the past and future hurricanes likely to occur along the Mississippi coast.

Production runs were carried out with SWAN and ADCIRC on a set of hypothetical storm tracks and storm parameters in order to obtain the maximum water levels for input to the statistical analysis. The hypothetical (synthetic) population of storms was divided into two groups, one for hurricanes of Saffir-Simpson scale Category 3 and 4 strength or "greater storms" and another set for hurricanes of Category 2 strength or "lesser storms." The parameters for each group of the greater storms and lesser storms are provided in Table 5, "Parameter Values for Surge Elevations." A total of 228 individual storms with different tracks and various combinations of the storm parameters were chosen for the production run set of synthetic hurricane simulations. Each storm was run for at least 3 days of simulation and did not include tidal forcing. Wind and pressure fields obtained from the PBL model and wave radiation stress from the SWAN model were input to the ADCIRC model for each production storm. All stillwater results for this study include the effects of wave setup; stillwater without wave effects was not simulated with ADCIRC. Stations for maximum water-surface output were selected on a 500-meter grid with additional stations along drainage features. This resulted in a total of 4,205 stations where the JPM-OS method was applied to obtain return periods of the stillwater elevation. Further details about the production run process can be found in the TSDN.

Stillwater Elevations

The results of the ADCIRC model, as described above, provided stillwater elevations, including wave setup effects that are statistically analyzed to produce probability curves. The JPM-OS is applied to obtain the return periods associated with tropical storm events. The approach involves assigning statistical weights to each of the simulated storms and generating the flood hazard curves using these statistical weights. The statistical weights are chosen so that the effective probability distributions associated with the selected greater and lesser storm populations reproduce the modeled statistical distributions derived from all historical storms.

Stillwater elevations for each of the respective coastal counties of Mississippi (Hancock, Harrison, and Jackson Counties), obtained using the ADCIRC and JPM-OS models, are provided for JPM and ADCIRC grid node locations for the 10-, 2-, 1-, or 0.2-percent-annual-chance return period stillwater elevations in the "Summary of Stillwater Elevations" table in the TSDN. The location of these JPM and ADCIRC grid node stations for each set of return period elevations are listed by their geographic (longitude, latitude) coordinates for reference. A detailed accounting of the statistical analysis and final return period elevations are included in the TSDN.

TABLE 5. PARAMETER VALUES FOR SURGE ELEVATIONS (Greater Storms)

Track:	Holland's B Offshore	Holland's B Landfall	Radius of the scale pressure profile (Nmi) Offshore	Radius of the scale pressure profile (Nmi) Landfall	Sea level pressure (mb) Offshore	Sea level pressure (mb) Landfall	Forward Speed (m/s)	Storm Direction (Degree)	Pre-Filling Model	Post-Filling Model	Prob.	Annual Rate (#Storm/Km/year)
1	1.27	1.00	18.61	24.20	933.70	946.31	6.047	-38.91	R	V	1.33E-01	1.32E-03
2	1.27	1.00	39.82	51.80	937.80	955.83	6.047	-13.49	R	V	1.20E-01	2.55E-03
3	1.27	1.00	22.93	29.80	946.30	963.28	6.047	-38.92	R	V	1.33E-01	1.63E-03
4	1.27	1.00	10.83	14.40	950.80	955.83	6.047	-13.49	R	V	1.20E-01	6.94E-04
5	1.27	1.00	20.77	27.00	941.10	955.83	6.047	56.66	R	V	1.08E-01	1.19E-03
6	1.27	1.00	14.70	19.10	911.30	920.05	5.943	-12.81	R	V	3.42E-02	2.68E-04
7	1.27	1.00	30.80	40.00	916.40	934.41	6.014	-12.82	R	V	5.34E-02	8.77E-04
8	1.27	1.00	16.56	21.50	923.80	934.41	4.349	47.33	R	V	4.20E-02	3.71E-04
9	1.27	1.00	8.90	8.90	934.40	934.41	6.014	-12.82	R	V	5.34E-02	2.54E-04
10	1.27	1.00	16.56	21.50	923.80	934.41	14.540	-12.86	R	V	3.49E-02	3.08E-04
11	1.27	1.00	17.98	23.40	931.00	942.98	5.943	-12.82	R	V	3.42E-02	3.28E-04
12	1.27	1.00	16.56	21.50	923.80	934.41	4.346	-71.04	R	V	4.20E-02	3.71E-04
13	1.27	1.00	11.66	15.20	878.60	884.30	5.943	-12.81	R	V	1.06E-02	6.58E-05
14	1.27	1.00	25.30	32.90	891.30	909.30	6.014	-12.82	R	V	1.65E-02	2.23E-04
15	1.27	1.00	13.60	17.70	901.70	909.30	4.349	47.33	R	V	1.30E-02	9.44E-05
16	1.27	1.00	7.31	7.30	909.30	909.30	6.014	-12.82	R	V	1.65E-02	6.44E-05
17	1.27	1.00	13.60	17.70	901.70	909.30	14.540	-12.86	R	V	1.08E-02	7.83E-05
18	1.27	1.00	14.53	18.90	910.00	918.53	5.943	-12.82	R	V	1.06E-02	8.20E-05
19	1.27	1.00	13.60	17.70	901.70	909.30	4.346	-71.04	R	V	1.30E-02	9.43E-05

TABLE 5. PARAMETER VALUES FOR SURGE ELEVATIONS (Lesser Storms)

Track:	Holland's B Offshore	Holland's B Landfall	Radius of the scale pressure profile (Nmi) Offshore	Radius of the scale pressure profile (Nmi) Landfall	Sea level pressure (mb) Offshore	Sea level pressure (mb) Landfall	Forward Speed (m/s)	Storm Direction (Degree)	Pre-Filling Model	Post-Filling Model	Prob.	Annual Rate (#Storm/Km/year)
1	1.27	1.00	41.59	54.10	948.60	966.62	5.42	8.76	R	V	7.29E-02	1.80E-03
2	1.27	1.00	53.63	69.70	957.20	975.25	3.00	23.55	R	V	6.45E-02	2.05E-03
3	1.27	1.00	21.64	28.10	953.10	968.72	3.40	63.87	R	V	7.18E-02	9.23E-04
4	1.27	1.00	12.72	16.50	965.60	972.29	4.93	-9.32	R	V	9.11E-02	6.88E-04
5	1.27	1.00	44.24	57.50	963.20	981.22	4.88	-11.27	R	V	6.85E-02	1.80E-03
6	1.27	1.00	17.19	22.40	969.70	980.89	6.10	31.22	R	V	4.98E-02	5.08E-04
7	1.27	1.00	24.32	31.60	960.30	978.33	6.94	-71.07	R	V	7.55E-02	1.09E-03
8	1.27	1.00	16.94	22.00	954.50	965.47	4.38	-31.63	R	V	5.07E-02	5.10E-04
9	1.27	1.00	27.82	36.20	952.90	970.91	3.71	-59.19	R	V	1.18E-01	1.95E-03
10	1.27	1.00	24.31	31.60	960.30	978.33	2.46	-5.25	R	V	7.55E-02	1.09E-03
11	1.27	1.00	21.64	28.10	953.10	968.72	10.50	-13.83	R	V	7.18E-02	9.23E-04
12	1.27	1.00	53.63	69.70	957.20	975.25	7.89	-45.75	R	V	6.45E-02	2.05E-03
13	1.27	1.00	29.79	38.70	958.00	975.96	6.64	46.64	R	V	1.26E-01	2.22E-03

Wave Height Analysis

Areas of coastline subject to significant wave attack are referred to as coastal high hazard zones. The USACE has established the 3-foot breaking wave as the criterion for identifying the limit of coastal high hazard zones (Reference 29). The 3-foot wave has been established as the minimum size wave capable of causing major damage to conventional wood frame and brick veneer structures.

Figure 1 shows a profile for a typical transect illustrating the effects of energy dissipation and regeneration on a wave as it moves inland. This figure shows the wave crest elevations being decreased by obstructions, such as buildings, vegetation, and rising ground elevations, and being increased by open, unobstructed wind fetches. Figure 1 also illustrates the relationship between the local stillwater elevation, the ground profile, and the location of the V/A boundary. This inland limit of the coastal high hazard area is delineated to ensure that adequate insurance rates apply and appropriate construction standards are imposed, should local agencies permit building in this coastal high hazard area.

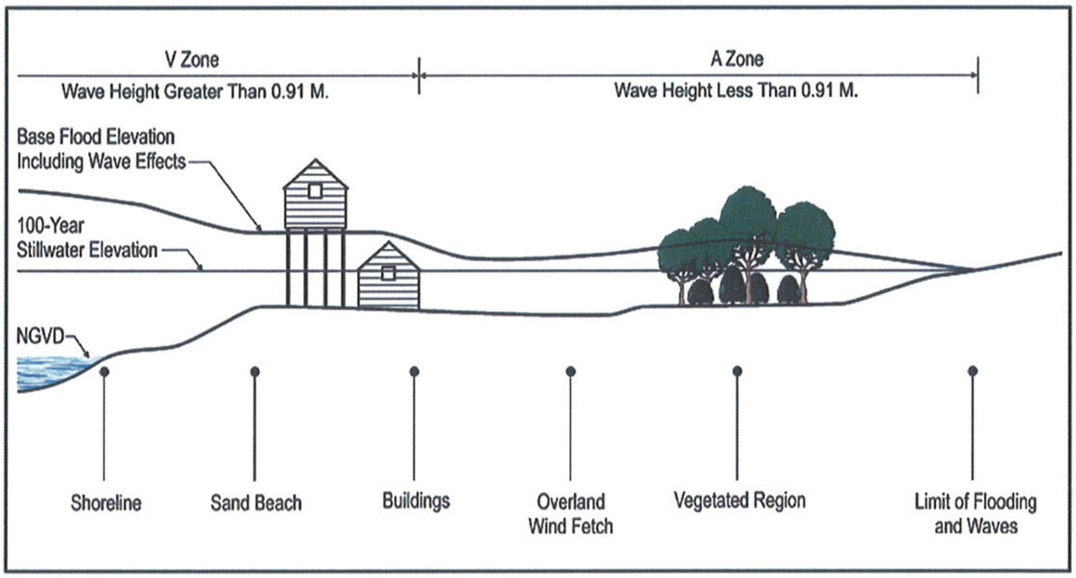

FIGURE 1. TRANSECT SCHEMATIC

Offshore wave characteristics representing a 1- and 0.2-percent-annual-chance flood event were determined using the SWAN 2-D wave model previously used for the wave setup modeling. The results from SWAN modeling for the storm surge study were used to apply a statistical analysis on the wave heights. Mean wave characteristics were determined as specified in the FEMA guidance for V-Zone mapping:

$$H_{bar} = (h_s)(0.625)$$
$$T_{bar} = (T_s)(0.85)$$

Wave H_{bar} is the average wave height of all waves, H_s is the significant wave height or the average over the highest one third of waves, T_{bar} is the average wave period, and T_s is the significant wave associated with the significant wave height.

The wave transects for this study were located considering the physical and cultural characteristics of the land so that they would closely represent conditions in their locality. Transects were spaced close together in areas of complex topography and dense development. In areas having more uniform characteristics, the transects were spaced at larger intervals. Transects are also located in areas where unique flooding existed and in areas where computer wave heights varied significantly between adjacent transects. Transects are shown on the respective FIRM panels for incorporated areas and unincorporated areas of Harrison, Hancock, and Jackson Counties.

The transect profiles were obtained using bathymetric and topographic data from various sources. Bathymetric data consisted of the Northern Gulf Littoral Initiative (NGLI), which reflects data gathered by multiple Federal and State agencies, universities, and private contractors. The NGLI data were augmented, where necessary, by NOAA navigation charts. The topographic data sources included pre-Hurricane Katrina LIDAR data, which were collected between 2003 and 2005 by the State of Mississippi and the NOAA, and were merged with post-Katrina (September-October 2005) LIDAR data collected along the coast by the USACE. All bathymetric and topographic data were brought to the NAVD88.

Post-Katrina aerial imagery was also utilized. This imagery, dated September 15, 2005, originated from the U.S. Department of Agriculture and was used to define features such as buildings, forested vegetation, and mash grass for input to the wave height models. Detailed information about the features, such as building types and density and vegetation types was gathered during a ground field reconnaissance performed along each transect.

Standard erosion methods defined by FEMA are typically applied to new coastal studies. However, since post-Katrina topographic LIDAR is being used for the transect profiles, it was assumed that the topographic data already represented eroded conditions (post-Katrina) that match that of a 1-percent annual chance event. Thus, no storm-induced erosion analysis was performed for this study. Primary frontal dune mapping was only applied along a segment of the coast in Jackson County, but was not applied anywhere else along the coast of Mississippi due to post-Katrina erosion impacts.

Wave height calculation used in this study follows the methodology described in the Appendix D of the 2003 FEMA Guidelines and Specifications for Flood Hazard Mapping Partners (Reference 30). WHAFIS 4.0 was used to calculate overland wave height propagation and establish base flood elevations. In addition to the 1-percent-annual-chance event, the 0.2-percent-annual-chance event was also modeled with WHAFIS 4.0. The 0.2-percent wave height results are not included on the FIRMs but are provided as wave transect profiles in this FIS.

Stillwater elevations were applied to each ground station along a transect and input to WHAFIS. The stillwater elevations were obtained from the storm surge study at each station where return periods were calculated and values were interpolated between stations to the transects locations. Wave setup was not calculated separately because wave setup was included in the base stillwater elevations from the storm surge analysis.

Wave runup was calculated at selected transects where the slope was steeper than 1 on 10. FEMA "Procedure Memorandum No. 37" (Reference 31) now recommends the use of the 2-percent wave runup for determining base flood elevations. The 2-percent wave runup was determined using the Technical Advisory Committee for Water Retaining Structures (TAW) method (Reference 32). For wave runup at the crest of a slope that transitions to a plateau or downslope, runup values were determined using the "Methodology for wave runup on a hypothetical slope" as described in Appendix D of the 2003 FEMA Guidelines and Specifications for Flood Hazard Mapping Partners (Reference 30).

Along each transect, wave envelopes were computed considering the combined effects of changes in ground elevation, vegetation, and physical features. Between transects, elevations were interpolated using topographic maps, land-use and land-cover data, and engineering judgment to determine the aerial extent of flooding. The results of the calculations are accurate until local topography, vegetation, or cultural developments within the community undergo major changes. The transect data for Harrison County is presented in Table 6, "Coastal Data Table," where the flood hazard zone and base flood elevations for each transect flooding source is provided. This table also describes the location of each transect, and provides the 10-, 2-, 1-, and 0.2-percent-annual-chance stillwater elevations at the start of the transect and the range found along the length of the transect.

3.3 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD29). With the finalization of the North American Vertical Datum of 1988 (NAVD88), many FIS reports and FIRMs are being prepared using NAVD88 as the referenced vertical datum.

Qualifying bench marks within a given jurisdiction that are cataloged by the National Geodetic Survey (NGS) and entered into the National Spatial Reference System (NSRS) as First or Second Order Vertical and have a vertical stability classification of A, B, or C are shown and labeled on the FIRM with their 6-character NSRS permanent Identifier.

Bench marks cataloged by the NGS and entered into the NSRS vary widely in vertical stability classification. NSRS vertical stability classifications are as follows:

Stability A: Monuments of the most reliable nature, expected to hold position/elevation well (e.g., mounted in bedrock)

Stability B: Monuments which generally hold their position/elevation well (e.g., concrete bridge abutment)

Stability C: Monuments which may be affected by surface ground movements (e.g., concrete monuments below frost line)

Stability D: Mark of questionable or unknown vertical stability (e.g., concrete monument above frost line, or steel witness post)

TABLE 6. COASTAL DATA TABLE

Community Name	Transect	Description	Latitude & Longitude at Start of Transect	Starting Stillwater Elevations (feet NAVD 88) Range of Stillwater Elevations (feet NAVD88)				Zone Designation and BFE (feet NAVD 88)
				10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	
Unincorporated Harrison County	1	St. Louis Bay/Gulf of Mexico at Pine Hills Blvd	(30.3739, -89.3334)	5.6 5.6-5.6	15.7 15.7-15.8	18.6 18.6-18.8	23.6 23.6-23.8	VE 21-26 AE 19-21
Unincorporated Harrison County	2	St. Louis Bay/Gulf of Mexico at Pine Hills Road	(30.3748, -89.3198)	5.6 5.5-5.6	15.7 15.7-15.9	18.7 18.6-18.8	23.6 23.6-23.9	VE 21-26 AE 19-21
Unincorporated Harrison County	3	St. Louis Bay/Gulf of Mexico east of Pine Hills Road	(30.3747, -89.3122)	5.6 5.5-5.6	15.6 15.6-15.9	18.4 18.1-18.7	23.6 23.6-24.0	VE 21-26 AE 18-21
Unincorporated Harrison County	4	St. Louis Bay/Gulf of Mexico south of Kiln Delisle Rd	(30.3664, -89.3001)	5.6 5.6-5.6	15.4 15.4-15.8	18.2 17.8-18.4	23.4 23.4-23.8	VE 20-25 AE 18-20
Unincorporated Harrison County	5	St. Louis Bay/Gulf of Mexico south of Kiln Delisle Rd	(30.3658, -89.2935)	5.6 5.6-5.6	15.3 15.3-15.6	18.1 18.1-18.5	23.3 23.3-23.8	VE 21-25 AE 18-21

TABLE 6 COASTAL DATA TABLE (Cont.)

Community Name	Transect	Description	Latitude & Longitude at Start of Transect	Starting Stillwater Elevations (feet NAVD 88) Range of Stillwater Elevations (feet NAVD88)				Zone Designation and BFE (feet NAVD 88)
				10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	
Unincorporated Harrison County	6	St. Louis Bay/Gulf of Mexico south of Kiln Delisle Rd	(30.3611, -89.2882)	5.6 5.6-5.6	15.2 15.2-15.5	18.0 18.0-18.4	23.2 23.2-23.8	VE 21-25 AE 18-20
Unincorporated Harrison County	7	St. Louis Bay/Gulf of Mexico west of Wittman Road	(30.3474, -89.2763)	5.6 5.6-5.6	15.0 15.0-15.4	17.8 17.8-18.2	22.9 22.9-23.8	VE 20-24 AE 18-20
Unincorporated Harrison County	8	Gulf of Mexico/Mississippi Sound at 1st Street	(30.3061, -89.2936)	5.6 5.6-5.6	15.0 14.8-15.0	17.7 17.6-17.8	22.8 22.6-23.0	VE 20-26 AE 19-20
Unincorporated Harrison County	9	Gulf of Mexico/Mississippi Sound at 4th Street	(30.3123, -89.2508)	5.7 5.6-5.7	15.1 14.8-15.2	17.9 17.6-18.2	23.0 23.0-23.9	VE 20-26 AE 18-20
Unincorporated Harrison County	10	Gulf of Mexico/Mississippi Sound at Lady Mary Ave	(30.3145, -89.2426)	5.7 5.6-5.7	15.1 14.8-15.1	17.9 17.6-17.9	23.1 22.6-23.8	VE 20-26 AE 18-20

TABLE 6 COASTAL DATA TABLE (Cont.)

Community Name	Transect	Description	Latitude & Longitude at Start of Transect	Starting Stillwater Elevations (feet NAVD 88) Range of Stillwater Elevations (feet NAVD88)				Zone Designation and BFE (feet NAVD 88)
				10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	
Pass Christian, City of Harrison County	11	Gulf of Mexico/Mississippi Sound east of Brown Ave	(30.3169, -89.2352)	5.8 5.6-5.8	15.1 14.8-15.2	17.9 17.6-17.9	23.2 22.5-23.2	VE 20-26 AE 18-20
Pass Christian, City of Harrison County	12	Gulf of Mexico/Mississippi Sound at Jackson Ave	(30.3196, -89.2279)	5.8 5.5-5.8	15.2 14.8-15.3	17.9 17.6-18.2	23.2 22.6-23.4	VE 20-26 AE 18-20
Pass Christian, City of Harrison County	13	Gulf of Mexico/Mississippi Sound at Clarence Ave	(30.3225, -89.2207)	5.8 5.4-5.8	15.2 14.8-15.3	18.4 17.6-18.4	23.2 22.6-23.5	VE 20-27 AE 18-20
Pass Christian, City of Harrison County	14	Gulf of Mexico/Mississippi Sound east of Church St	(30.3245, -89.2131)	5.9 5.3-5.9	15.2 14.8-15.4	18.4 17.5-18.4	23.6 22.5-23.6	VE 20-27 AE 18-20
Pass Christian, City of Harrison County	15	Gulf of Mexico/Mississippi Sound west of Davis Ave	(30.3265, -89.2055)	5.9 5.4-5.9	15.2 14.7-15.3	18.0 17.4-18.0	23.6 22.5-23.6	VE 20-26 AE 18-20

TABLE 6 COASTAL DATA TABLE (Cont.)

Community Name	Transect	Description	Latitude & Longitude at Start of Transect	Starting Stillwater Elevations (feet NAVD 88) Range of Stillwater Elevations (feet NAVD88)				Zone Designation and BFE (feet NAVD 88)
				10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	
Pass Christian, City of Harrison County	16	Gulf of Mexico/Mississippi Sound at Seal Ave	(30.3285, -89.1980)	5.9 5.4-5.9	15.1 14.7-15.2	18.0 17.4-18.2	23.4 22.5-23.5	VE 20-26 AE 18-20
Pass Christian, City of Harrison County	17	Gulf of Mexico/Mississippi Sound at Courtenay Ave	(30.3305, -89.1904)	5.9 5.5-5.9	15.1 14.7-15.1	18.0 17.4-18.0	23.4 22.5-23.4	VE 20-26 AE 18-20
Pass Christian, City of Harrison County	18	Gulf of Mexico/Mississippi Sound east of Lang Ave	(30.3320, -89.1827)	5.9 5.2-5.9	15.1 14.5-15.1	18.0 17.3-18.1	24.1 22.3-24.1	VE 20-26 AE 17-20
Pass Christian, City of Harrison County	19	Gulf of Mexico/Mississippi Sound east of Menge Rd	(30.3349, -89.1755)	6.0 5.2-6.0	15.1 14.5-15.1	18.0 17.3-18.0	23.5 22.4-23.6	VE 20-26 AE 17-20
Pass Christian, City of Harrison County	20	Gulf of Mexico/Mississippi Sound at Wisteria Dr	(30.3376, -89.1682)	6.0 4.9-6.0	15.1 14.4-15.1	18.0 17.2-18.0	23.8 22.3-23.8	VE 20-26 AE 17-20

TABLE 6 COASTAL DATA TABLE (Cont.)

Community Name	Transect	Description	Latitude & Longitude at Start of Transect	Starting Stillwater Elevations (feet NAVD 88) Range of Stillwater Elevations (feet NAVD88)				Zone Designation and BFE (feet NAVD 88)
				10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	
Pass Christian, City of Harrison County	21	Gulf of Mexico/Mississippi Sound at Least Tern Dr	(30.3400, -89.1608)	6.0 6.0-6.0	15.3 14.3-15.3	18.0 17.0-18.0	23.5 21.9-23.7	VE 20-26 AE 17-20
Pass Christian, City of Harrison County	22	Gulf of Mexico/Mississippi Sound at Hayden Ave	(30.3427, -89.1535)	6.0 4.5-6.0	15.3 14.3-15.3	18.0 17.2-18.0	23.7 21.9-24.1	VE 20-26 AE 17-20
Long Beach, City of Harrison County	23	Gulf of Mexico/Mississippi Sound at White Harbor Rd	(30.3447, -89.1459)	6.0 6.0-6.0	15.1 14.3-15.3	18.0 17.9-18.0	23.5 21.1-23.6	VE 20-26 AE 18-20
Long Beach, City of Harrison County	24	Gulf of Mexico/Mississippi Sound at Arbor Station Dr	(30.3477, -89.1391)	6.0 3.9-6.0	15.2 14.1-15.2	18.0 17.6-18.0	23.6 20.0-23.5	VE 20-26 AE 18-20
Long Beach, City of Harrison County	25	Gulf of Mexico/Mississippi Sound at Boggs Dr	(30.3511, -89.1320)	6.0 6.0-6.0	15.3 13.9-15.3	18.0 17.5-18.4	23.5 20.6-23.5	VE 20-26 AE 18-20

TABLE 6 COASTAL DATA TABLE (Cont.)

Community Name	Transect	Description	Latitude & Longitude at Start of Transect	Starting Stillwater Elevations (feet NAVD 88) Range of Stillwater Elevations (feet NAVD88)				Zone Designation and BFE (feet NAVD 88)
				10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	
Long Beach, City of Harrison County	26	Gulf of Mexico/Mississippi Sound at West Ave	(30.3541, -89.1249)	6.0 6.0-6.0	15.3 13.6-15.9	18.0 17.8-19.8	23.5 21.5-24.0	VE 20-25 AE 18-20
Long Beach, City of Harrison County	27	Gulf of Mexico/Mississippi Sound at Russell Ave	(30.3556, -89.1173)	6.0 6.0-6.0	15.4 13.3-15.8	18.4 18.3-19.6	23.9 22.5-23.9	VE 20-26 AE 18-20
Long Beach, City of Harrison County	28	Gulf of Mexico/Mississippi Sound west of S. Burke Ave	(30.3583, -89.1100)	6.0 6.0-6.0	15.3 15.3-15.4	18.4 18.1-18.4	23.8 21.7-23.7	VE 20-26 AE 18-20
Long Beach, City of Harrison County	29	Gulf of Mexico/Mississippi Sound at S. Nicholson Ave	(30.3612, -89.1029)	6.0 6.0-6.0	15.2 15.2-15.4	18.0 17.9-18.0	23.6 23.1-23.5	VE 20-26 AE 18-20
Long Beach, City of Harrison County	30	Gulf of Mexico/Mississippi Sound east of Beach Park Place	(30.3610, -89.0936)	6.0 6.0-6.0	15.2 15.2-15.4	18.0 17.8-18.0	23.7 23.0-23.7	VE 20-26 AE 18-20

TABLE 6 COASTAL DATA TABLE (Cont.)

Community Name	Transect	Description	Latitude & Longitude at Start of Transect	Starting Stillwater Elevations (feet NAVD 88) Range of Stillwater Elevations (feet NAVD88)				Zone Designation and BFE (feet NAVD 88)
				10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	
Long Beach, City of Harrison County	31	Gulf of Mexico/Mississippi Sound at Central Ave	(30.3613, -89.0849)	6.0 6.0-6.0	15.3 15.3-15.4	18.3 18.3-18.3	23.9 23.9-23.9	VE 20-25 AE 18-20
Gulfport, City of Harrison County	32	Gulf of Mexico/Mississippi Sound at Fournieu Rd	(30.3687, -89.0810)	6.0 6.0-6.0	15.2 15.2-15.3	18.2 18.2-18.2	23.8 23.3-24.0	VE 20-25 AE 18-20
Gulfport, City of Harrison County	33	Gulf of Mexico/Mississippi Sound at 41st Street	(30.3708, -89.0734)	6.0 6.0-6.0	15.3 15.1-15.3	18.0 18.0-18.0	24.0 24.0-24.0	VE 20-25 AE 18-20
Gulfport, City of Harrison County	34	Gulf of Mexico/Mississippi Sound between 36th Ave and 33rd Ave	(30.3731, -89.0660)	5.9 4.8-5.9	15.0 14.7-15.0	18.0 18.0-18.0	23.7 23.7-23.8	VE 20-25 AE 18-20
Gulfport, City of Harrison County	35	Gulf of Mexico/Mississippi Sound at Copa Blvd	(30.3761, -89.0506)	5.4 4.8-5.6	15.2 15.2-15.2	18.1 18.1-18.1	23.5 17.6-23.9	VE 20-25 AE 18-20

TABLE 6 COASTAL DATA TABLE (Cont.)

Community Name	Transect	Description	Latitude & Longitude at Start of Transect	Starting Stillwater Elevations (feet NAVD 88) Range of Stillwater Elevations (feet NAVD88)				Zone Designation and BFE (feet NAVD 88)
				10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	
Gulfport, City of Harrison County	36	Gulf of Mexico/Mississippi Sound at 20th Ave	(30.3778, -89.0432)	5.8 5.6-5.8	15.0 9.8-15.3	18.2 18.2-18.2	23.4 17.6-24.3	VE 20-27 AE 18-20
Gulfport, City of Harrison County	37	Gulf of Mexico/Mississippi Sound west of Pratt Ave	(30.3794, -89.0356)	5.8 5.8-5.8	15.1 14.9-15.1	18.3 18.3-18.3	24.2 17.6-24.2	VE 20-25 AE 18-20
Gulfport, City of Harrison County	38	Gulf of Mexico/Mississippi Sound at Hill Place	(30.3810, -89.0279)	6.0 6.0-6.0	15.0 9.8-15.0	18.2 11.6-18.2	24.2 17.6-24.2	VE 20-27 AE 14-20
Gulfport, City of Harrison County	39	Gulf of Mexico/Mississippi Sound east of Evans Ave	(30.3830, -89.0204)	6.1 6.1-6.1	15.1 9.8-15.1	18.0 11.7-18.0	24.1 17.7-24.1	VE 20-25 AE 14-20
Gulfport, City of Harrison County	40	Gulf of Mexico/Mississippi Sound at Alfonso Dr	(30.3847, -89.0127)	6.0 6.0-6.0	15.2 9.8-15.3	18.1 12.4-18.1	24.1 17.3-24.1	VE 20-26 AE 12-20

TABLE 6 COASTAL DATA TABLE (Cont.)

Community Name	Transect	Description	Latitude & Longitude at Start of Transect	Starting Stillwater Elevations (feet NAVD 88) Range of Stillwater Elevations (feet NAVD88)				Zone Designation and BFE (feet NAVD 88)
				10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	
Gulfport, City of Harrison County	41	Gulf of Mexico/Mississippi Sound west of Arkansas Ave	(30.3862, -89.0049)	6.0 5.0-6.1	15.2 10.7-15.3	18.3 13.7-18.3	23.6 18.0-23.6	VE 20-26 AE 14-20
Gulfport, City of Harrison County	42	Gulf of Mexico/Mississippi Sound at Courthouse Rd	(30.3873, -88.9971)	6.0 6.0-6.0	15.1 12.3-15.3	18.2 14.3-18.2	23.3 18.4-23.3	VE 20-26 AE 14-20
Gulfport, City of Harrison County	43	Gulf of Mexico/Mississippi Sound at Tegarden Rd	(30.3884, -88.9893)	6.0 5.2-6.0	15.2 12.3-15.2	18.2 14.3-18.2	23.4 18.3-24.4	VE 20-26 AE 14-20
Gulfport, City of Harrison County	44	Gulf of Mexico/Mississippi Sound at Laurel Rd	(30.3915, -88.9579)	6.0 5.2-6.0	15.0 12.3-15.1	18.1 14.3-18.1	23.3 18.2-23.4	VE 20-25 AE 14-20
Gulfport, City of Harrison County	45	Gulf of Mexico/Mississippi Sound at Allan Dr	(30.3924, -88.9342)	6.0 5.3-6.0	14.9 12.4-14.9	17.8 14.4-17.8	23.2 18.3-23.2	VE 20-26 AE 14-20

TABLE 6 COASTAL DATA TABLE (Cont.)

Community Name	Transect	Description	Latitude & Longitude at Start of Transect	Starting Stillwater Elevations (feet NAVD 88) Range of Stillwater Elevations (feet NAVD88)				Zone Designation and BFE (feet NAVD 88)
				10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	
Gulfport, City of Harrison County	46	Gulf of Mexico/Mississippi Sound west of Southern Circle	(30.3938, -88.9105)	6.0 5.3-6.0	14.7 12.4-14.7	17.7 14.5-17.7	23.2 18.4-23.2	VE 20-25 AE 15-20
Gulfport, City of Harrison County	47	Gulf of Mexico/Mississippi Sound at Venetian Gardens	(30.3913, -88.8887)	6.0 4.6-6.0	14.8 11.5-14.8	17.7 13.7-17.7	23.2 17.6-23.2	VE 20-25 AE 14-20
Biloxi, City of Harrison County	48	Gulf of Mexico/Mississippi Sound at Gateway Dr	(30.3931, -88.8799)	6.0 5.0-6.0	14.7 12.5-14.9	17.9 14.6-17.9	23.5 16.8-23.5	VE 20-25 AE 15-20
Biloxi, City of Harrison County	49	Gulf of Mexico/Mississippi Sound east of Edgewater Gulf Dr	(30.3919, -88.8718)	5.9 5.4-5.9	14.6 12.4-14.7	17.6 14.6-17.6	23.5 18.6-23.5	VE 17-25 AE 15-17
Biloxi, City of Harrison County	50	Gulf of Mexico/Mississippi Sound at Briarfield Ave	(30.3837, -88.8699)	5.9 5.3-5.9	14.6 12.4-14.9	17.8 14.5-17.8	23.1 18.6-23.1	VE 20-25 AE 15-20

TABLE 6 COASTAL DATA TABLE (Cont.)

Community Name	Transect	Description	Latitude & Longitude at Start of Transect	Starting Stillwater Elevations (feet NAVD 88) Range of Stillwater Elevations (feet NAVD88)				Zone Designation and BFE (feet NAVD 88)
				10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	
Biloxi, City of Harrison County	51	Gulf of Mexico/Mississippi Sound west of Beauvoir Ave	(30.3805, -88.8622)	5.9 5.2-5.9	14.7 12.4-14.7	17.4 14.5-17.4	23.0 19.0-23.0	VE 17-25 AE 15-17
Biloxi, City of Harrison County	52	Gulf of Mexico/Mississippi Sound at Sadler Beach Dr	(30.3032, -89.2877)	5.9 5.3-5.9	14.5 12.1-14.5	17.4 14.7-17.4	23.1 18.9-23.1	VE 17-24 AE 15-17
Biloxi, City of Harrison County	53	Gulf of Mexico/Mississippi Sound west of Camellia St	(30.3038, -89.2798)	5.9 5.3-5.9	14.3 12.5-14.3	17.3 14.9-17.3	23.2 19-23.2	VE 17-24 AE 15-17
Biloxi, City of Harrison County	54	Gulf of Mexico/Mississippi Sound west of Veterans Ave	(30.3054, -89.2721)	5.8 5.3-5.8	14.2 12.7-14.2	17.2 13.1-17.2	23.1 19.1-23.1	VE 17-24 AE 14-17
Biloxi, City of Harrison County	55	Gulf of Mexico/Mississippi Sound west of Travis St	(30.3078, -89.2647)	5.8 5.2-5.8	14.3 12.6-14.3	17.2 13.3-17.2	23.0 19.1-23.0	VE 17-24 AE 14-17

TABLE 6 COASTAL DATA TABLE (Cont.)

Community Name	Transect	Description	Latitude & Longitude at Start of Transect	Starting Stillwater Elevations (feet NAVD 88) Range of Stillwater Elevations (feet NAVD88)				Zone Designation and BFE (feet NAVD 88)
				10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	
Biloxi, City of Harrison County	56	Gulf of Mexico/Mississippi Sound at Iberville Dr	(30.3103, -89.2573)	5.8 5.6-5.8	14.2 12.6-14.3	17.2 15.6-17.2	22.9 20.2-22.9	VE 18-24 AE 16-18
Biloxi, City of Harrison County	57	Gulf of Mexico/Mississippi Sound at St. George St	(30.3891, - 88.9814)57	5.8 5.6-5.8	14.1 13.1-14.1	17.1 15.7-17.1	22.8 20.4-22.8	VE 18-24 AE 16-18
Gulfport, City of Harrison County	58	Gulf of Mexico/Mississippi Sound at Chalmers St	(30.4017, -88.9832)	5.8 5.7-5.8	14.1 13.2-14.1	17.0 15.9-17.0	22.6 20.8-22.5	VE 18-24 AE 16-18
Biloxi, City of Harrison County	59	Gulf of Mexico/Mississippi Sound at White Ave	(30.3904, -88.9737)	5.7 5.7-5.7	14.0 13.4-14.0	17.0 16.2-17.0	22.5 21.2-22.5	VE 18-24 AE 16-18
Biloxi, City of Harrison County	60	Gulf of Mexico/Mississippi Sound at Porter Ave	(30.3910, -88.9658)	5.7 5.7-5.7	14.0 13.5-14.0	16.9 16.2-16.9	22.1 21.0-22.0	VE 18-23 AE 16-18

TABLE 6 COASTAL DATA TABLE (Cont.)

Community Name	Transect	Description	Latitude & Longitude at Start of Transect	Starting Stillwater Elevations (feet NAVD 88) Range of Stillwater Elevations (feet NAVD88)				Zone Designation and BFE (feet NAVD 88)
				10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	
Biloxi, City of Harrison County	61	Gulf of Mexico/Mississippi Sound at Seal Ave	(30.3918, -88.9500)	5.7 5.7-5.8	13.9 13.5-13.9	16.8 16.2-16.8	22.1 21.4-22.1	VE 18-23 AE 16-18
Gulfport, City of Harrison County	62	Gulf of Mexico/Mississippi Sound at G.E. Ohr St	(30.3923, - 88.9421)	5.7 5.7-5.8	13.7 13.6-14.4	16.7 16.5-17.2	21.8 21.6-22.8	VE 19-24 AE 17-19
Biloxi, City of Harrison County	63	Gulf of Mexico/Mississippi Sound at Lee St	(30.3933, -88.9263)	5.7 5.7-5.8	13.7 13.7-13.8	16.7 16.5-16.7	22.2 21.8-22.2	VE 19-24 AE 17-19
Biloxi, City of Harrison County	64	Gulf of Mexico/Mississippi Sound at Kuhn St	(30.3938, -88.9184)	5.7 5.7-5.8	13.7 13.6-13.8	16.6 16.6-16.8	21.9 21.9-22.0	VE 19-23 AE 17-19
Unincorporated Harrison County	65	Gulf of Mexico/Mississippi Sound on Deer Island	(30.3937, -88.9026)	5.6 5.6-5.7	13.5 13.4-13.8	16.3 16.3-16.7	21.8 21.8-22.0	VE 19-23 AE 17-19

TABLE 6 COASTAL DATA TABLE (Cont.)

Community Name	Transect	Description	Latitude & Longitude at Start of Transect	Starting Stillwater Elevations (feet NAVD 88) Range of Stillwater Elevations (feet NAVD88)				Zone Designation and BFE (feet NAVD 88)
				10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	
Unincorporated Harrison County	66	Gulf of Mexico on Deer Island	(30.3938, -88.8970)	5.5 5.5-5.7	13.3 13.3-13.8	16.2 16.2-16.6	21.4 21.4-21.9	VE 19-23 AE 17-19
Biloxi, City of Harrison County	67	Gulf of Mexico at Cadet St	(30.3937, -88.8577)	5.7 5.7-5.7	13.7 13.7-13.8	16.5 16.5-16.7	21.8 21.8-22.0	VE 19-21 AE 17-19
Unincorporated Harrison County	68	Gulf of Mexico at Michael Blvd	(30.4034, -88.8585)	5.7 5.7-5.7	13.6 13.6-13.7	16.5 16.5-16.7	22.0 21.9-22.0	VE 19-20 AE 17-19

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD88. Structure and ground elevations in the community must, therefore, be referenced to NAVD88. It is important to note that adjacent communities may be referenced to NGVD29. This may result in differences in Base Flood Elevations (BFEs) across the corporate limits between the communities.

The elevations shown in the FIS report and on the FIRM for Harrison County are referenced to NAVD88. Ground, structure, and flood elevations may be compared and/or referenced to NGVD29 by applying a conversion factor. To convert elevations from NAVD88 to NGVD29, add -0.01 feet to the NGVD29 elevation. The -0.01 feet value is an average for the entire County. The BFEs shown on the FIRM represent whole-foot rounded values. For example, a BFE of 12.4 feet will appear as 12 feet on the FIRM, and 12.6 feet as 13 feet. Users who wish to convert the elevations in this FIS report to NGVD29 should apply the stated conversion factor to elevations shown on the Flood Profiles and supporting data tables in the FIS report, which are shown at a minimum to the nearest 0.1 foot.

To obtain current elevation, description, and/or location information for bench marks shown on the FIRM for this jurisdiction, or for information regarding conversion between the NGVD29 and NAVD88, see the FEMA publication entitled *Converting the National Flood Insurance Program to the North American Vertical Datum of* 1988 (FEMA, June 1992), or contact the Vertical Network Branch, National Geodetic Survey, Coast and Geodetic Survey, National Oceanic and Atmospheric Administration, Rockville, Maryland 20910 (Internet address http://www.ngs.noaa.gov).

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with the FIS report and FIRM for this community. Interested individuals may contact FEMA to access these data.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each FIS provides 1-percent-annual-chance flood elevations and delineations of the 1- and 0.2-percent-annual-chance floodplain boundaries and 1-percent-annual-chance floodway to assist communities in developing floodplain management measures. This information is presented on the FIRM and in many components of the FIS report, including Flood Profiles and Floodway Data Table. Users should reference the data presented in the FIS report as well as additional information that may be available at the local map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent-annual-chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent-annual-chance flood is employed to indicate additional areas of flood risk in the community. For each stream studied by detailed methods, the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated using the flood elevations determined at each cross section.

For this study, LIDAR data from Earthdata International was used to delineate floodplain boundaries. The 1- and 0.2-percent-annual-chance floodplain boundaries are shown on the FIRM (Exhibit 3). On this map, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, AH, AO, and VE), and the 0.2-percent-annual-chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-percent-annual-chance floodplain boundaries are close together, only the 1-percent-annual-chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by Limited detailed and approximate methods, only the 1-percent-annual-chance floodplain boundary is shown on the FIRM (Exhibit 3).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent-annual-chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1-percent-annual-chance flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodway presented in this FIS report and on the FIRM was computed for certain stream segments on the basis of equal-conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations have been tabulated for selected cross sections of detailed study streams (Table 7). In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 7, "Floodway Data," for certain downstream cross sections are lower than the regulatory flood elevations in that area, which must take into account the 1-percent-annual-chance flooding due to backwater from other sources.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Bernard Bayou								
A	3,000	989	3,527	2.0	*	1.9[2]	2.9	1.0
B	9,450	816	3,446	2.0	*	2.4[2]	3.3	0.9
C	10,684	1,130	7,870	0.9	*	2.5[2]	3.4	0.9
D	19,584	979	2,103	3.3	*	3.0[2]	3.7	0.7
E	25,334	750	7,464	2.0	*	3.8[2]	4.8	1.0
F	33,059	736	11,381	1.3	*	4.1[2]	5.0	0.9
G	39,234	282	4,459	2.3	*	4.3[2]	5.2	0.9
H	41,634	124	1,166	8.7	*	4.2[2]	5.1	0.9
I	41,923	130	1,533	6.1	*	6.2[2]	7.1	0.9
J	42,623	218	1,966	4.7	*	7.5[2]	7.9	0.4
K	44,427	162	2,036	4.6	14.7	10.4[2]	10.6	0.2
L	46,282	100	636	8.6	15.0	11.6[2]	11.6	0.0
M	46,934	330	4,004	1.4	15.4	13.1[2]	13.5	0.4
N	47,199	80	778	7.0	15.4	13.1[2]	13.1	0.0
O	49,699	60	855	6.4	19.1	18.9[2]	19.8	0.9
P	50,849	397	3,066	1.9	22.0	21.9[2]	22.9	1.0
Q	59,499	530	2,741	1.9	30.0	30.0	31.0	1.0
R	69,149	573	2,950	1.8	43.8	43.8	44.8	1.0
S	76,999	596	2,811	1.3	56.5	56.5	57.5	1.0
T	87,599	542	2,815	1.4	73.6	73.6	74.6	1.0

[1] Feet above confluence with Back Bay of Biloxi
[2] Elevation computed without consideration of storm surge effects from Back Bay of Biloxi
* BFE determined by coastal storm surge flooding

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
HARRISON COUNTY, MS
AND INCORPORATED AREAS

FLOODWAY DATA

BERNARD BAYOU

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Big Creek								
A	20,360[1]	588	3,274	1.6	54.1	54.1	55.1	1.0
Biloxi River								
A	13,675[2]	1,623	15,251	2.0	*	6.6[3]	7.6	1.0
B	20,117[2]	2,422	17,406	1.7	*	8.9[3]	9.7	0.8
C	24,605[2]	1,973	16,760	1.8	15.2	11.6[3]	12.0	0.4
D	36,168[2]	3,144	47,348	0.7	18.9	18.5[3]	19.5	1.0
E	40,498[2]	2,691	42,389	0.7	20.0	19.8[3]	20.8	1.0
F	49,421[2]	3,166	44,794	0.7	22.2	22.1[3]	23.1	1.0
G	55,440[2]	4,310	51,161	0.6	23.6	23.6	24.6	1.0
H	60,403[2]	3,736	48,790	0.6	25.4	25.4	26.4	1.0
I	71,122[2]	3,451	35,714	0.7	27.8	27.8	28.8	1.0
J	76,824[2]	1,750	15,049	1.7	29.7	29.7	30.7	1.0
K	80,256[2]	1,726	15,798	1.6	32.1	32.1	33.1	1.0
L	85,906[2]	2,778	19,287	1.3	35.2	35.2	36.1	0.9
M	89,443[2]	1,614	14,058	1.8	37.4	37.4	38.3	0.9
N	98,314[2]	1,541	16,056	1.5	43.4	43.4	44.3	0.9
O	105,283[2]	549	8,496	2.2	47.7	47.7	48.6	0.9
P	111,830[2]	1,663	13,938	1.4	51.6	51.6	52.6	1.0

[1] Feet above confluence with Wolf River
[2] Feet above confluence with Back Bay of Biloxi
[3] Elevation computed without consideration of storm surge effects from Back Bay of Biloxi
* BFE determined by coastal storm surge flooding

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
HARRISON COUNTY, MS
AND INCORPORATED AREAS

FLOODWAY DATA

BIG CREEK - BILOXI RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Biloxi River (continued)								
Q	112,886[1]	1,104	11,372	1.7	52.6	52.6	53.6	1.0
R	121,070[1]	1,431	15,285	1.2	57.0	57.0	57.9	0.9
S	129,571[1]	1,668	5,789	3.3	63.8	63.8	64.6	0.8
T	136,594[1]	2,000	12,102	1.4	73.2	73.2	73.8	0.6
Brickyard Bayou								
A	930[2]	140	1,443	1.5	*	3.4[3]	4.4	1.0
B	1,120[2]	134	1,335	1.6	*	3.4[3]	4.4	1.0
C	1,531[2]	248	1,641	1.3	*	3.6[3]	4.6	1.0
D	2,671[2]	280	1,580	1.4	*	4.1[3]	4.9	0.8
E	3,721[2]	382	1,215	1.8	*	4.8[3]	5.3	0.5
F	4,135[2]	350	1,651	1.3	*	5.3[3]	5.7	0.4
G	6,395[2]	150	775	2.8	*	6.4[3]	6.5	0.1
H	6,671[2]	230	1,104	1.9	*	6.9[3]	7.0	0.1
I	7,784[2]	165	1,066	2.0	*	8.2[3]	8.2	0.0
J	8,259[2]	90	635	3.4	*	8.2[3]	8.2	0.0
K	8,648[2]	80	568	3.8	*	8.5[3]	8.5	0.0
L	9,968[2]	166	859	2.5	*	9.1[3]	9.5	0.4

[1] Feet above confluence with Back Bay of Biloxi
[2] Feet above confluence with Bernard Bayou
[3] Elevation computed without consideration of storm surge effects from Back Bay of Biloxi
* BFE determined by coastal storm surge flooding

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
HARRISON COUNTY, MS
AND INCORPORATED AREAS

FLOODWAY DATA

BILOXI RIVER - BRICKYARD BAYOU

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Brickyard Bayou (continued)								
M	10,182	170	981	2.0	*	9.3[2]	9.7	0.4
N	11,337	232	1,708	1.1	*	9.5[2]	9.8	0.3
O	11,634	139	915	2.1	*	9.5[2]	9.8	0.3
P	13,064	125	704	2.7	*	9.9[2]	10.2	0.3
Q	13,371	125	930	2.1	13.0	10.3[2]	10.6	0.3
R	16,171	755	2,132	0.9	13.0	10.8[2]	11.2	0.4
S	18,246	133	631	3.1	13.0	11.2[2]	11.9	0.7
T	18,464	230	1,006	1.9	13.0	11.5[2]	12.2	0.7
U	20,344	90	597	3.2	13.0	12.7[2]	13.1	0.4
V	20,528	85	852	2.3	13.5	13.0[2]	13.5	0.5
W	21,328	65	482	4.0	13.5	13.1[2]	13.7	0.6
X	21,496	90	535	3.0	14.8	14.5[2]	15.1	0.6

[1] Feet above confluence with Bernard Bayou
[2] Elevation computed without consideration of storm surge effects from Back Bay of Biloxi
* BFE determined by coastal storm surge flooding

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
HARRISON COUNTY, MS
AND INCORPORATED AREAS

FLOODWAY DATA

BRICKYARD BAYOU

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Canal No. 1								
A	8,840	630	2,331	1.0	*	5.5[2]	6.5	1.0
B	15,240	185	1,071	2.0	*	8.2[2]	8.5	0.3
C	16,370	239	1,398	1.5	*	8.9[2]	9.4	0.5
D	18,090	342	1,139	1.9	*	10.2[2]	10.9	0.7
E	19,990	266	1,125	1.7	*	12.2[2]	13.0	0.8
F	20,890	386	1,086	1.8	*	13.6[2]	14.4	0.8
G	22,710	415	846	2.3	17.6	16.0[2]	17.0	1.0
H	24,650	118	724	2.2	18.7	18.2[2]	19.2	1.0
I	26,230	731	3,705	0.4	19.0	18.6[2]	19.6	1.0
J	27,330	365	2,359	0.7	19.0	18.7[2]	19.7	1.0
K	29,430	325	1,863	0.9	19.4	19.2[2]	20.2	1.0
L	31,530	385	1,736	0.9	19.9	19.8[2]	20.8	1.0
M	34,330	760	3,856	0.4	20.2	20.2	21.2	1.0
N	35,930	400	1,829	0.5	20.4	20.4	21.4	1.0
O	37,730	316	930	1.0	20.7	20.7	21.7	1.0
P	39,630	493	1,861	0.4	21.2	21.2	22.2	1.0
Q	40,530	415	1,330	0.6	21.3	21.3	22.3	1.0
R	41,330	350	1,061	0.7	21.6	21.6	22.6	1.0

[1] Feet above confluence with Saint Louis Bay
[2] Elevation computed without consideration of storm surge effects from Saint Louis Bay/ Mississippi Sound
* BFE determined by coastal storm surge flooding

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
HARRISON COUNTY, MS
AND INCORPORATED AREAS

FLOODWAY DATA

CANAL NO. 1

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Canal No. 3								
A	5,650[1]	327	1,494	1.9	*	2.7[3]	3.7	1.0
B	9,330[1]	572	2,249	1.2	*	4.4[3]	5.4	1.0
C	12,830[1]	73	589	3.8	*	6.4[3]	7.4	1.0
D	16,430[1]	100	955	2.3	*	9.7[3]	10.7	1.0
E	16,974[1]	100	1,015	2.2	*	10.3[3]	11.3	1.0
F	19,475[1]	183	1,078	2.1	*	12.4[3]	13.3	0.9
G	20,615[1]	96	695	3.2	17.1	13.9[3]	14.8	0.9
H	21,310[1]	202	978	2.1	17.2	15.0[3]	16.0	1.0
I	22,550[1]	486	1,904	1.1	17.5	16.1[3]	16.9	0.8
J	23,120[1]	450	2,036	1.0	17.7	16.3[3]	17.2	0.9
K	24,350[1]	365	990	1.8	18.0	17.0[3]	18.0	1.0
L	25,705[1]	232	1,436	1.2	18.6	18.1[3]	19.1	1.0
M	28,195[1]	336	1,086	1.1	20.1	20.0[3]	20.9	0.9
N	29,825[1]	404	1,988	0.6	20.3	20.3	21.3	1.0
O	30,520[1]	395	1,961	0.6	20.4	20.4	21.4	1.0
P	31,330[1]	172	875	0.4	20.5	20.5	21.5	1.0
Q	33,195[1]	138	429	0.9	21.1	21.1	22.1	1.0
R	34,545[1]	150	516	0.7	21.4	21.4	22.4	1.0
Choctaw Creek								
A	6,680[2]	383	2,114	2.0	85.3	85.3	86.3	1.0

[1] Feet above confluence with Saint Louis Bay
[2] Feet above confluence with Tuxachanie Creek
[3] Elevation computed without consideration of storm surge effects from Saint Louis Bay
* BFE determined by coastal storm surge flooding

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
HARRISON COUNTY, MS
AND INCORPORATED AREAS

FLOODWAY DATA

CANAL NO. 3 - CHOCTAW CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Crow Creek								
A	11,450[1]	220	1,841	2.7	90.1	90.1	91.1	1.0
Cypress Creek								
A	2,500[2]	200	1,648	2.2	13.8	5.6[4]	6.5	0.9
Flat Branch								
A	1,050[3]	118	866	5.9	14.9	8.6[5]	9.0	0.4
B	1,276[3]	138	1,002	5.1	15.4	13.9[5]	14.2	0.3
C	4,131[3]	139	607	5.0	18.5	18.4[5]	18.4	0.0
D	4,299[3]	139	589	4.9	18.7	18.5[5]	18.5	0.0
E	12,794[3]	143	2,085	2.4	35.7	35.7	35.8	0.1
F	13,714[3]	59	723	6.8	35.7	35.7	35.9	0.2
G	16,000[3]	553	3,395	1.4	41.2	41.2	42.0	0.8
H	18,000[3]	364	2,331	2.1	42.3	42.3	43.1	0.8
I	21,055[3]	129	4,053	4.4	48.8	48.8	49.0	0.2
J	25,000[3]	500	4,621	1.1	52.9	52.9	53.9	1.0

[1] Feet above confluence with Biloxi River
[2] Feet above confluence with Tchoutacabouffa River
[3] Feet above confluence with Bernard Bayou
[4] Elevation computed without consideration of storm surge effects from Back Bay of Biloxi
[5] Elevation computed without consideration of storm surge effects from Bernard Bayou

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

HARRISON COUNTY, MS

AND INCORPORATED AREAS

FLOODWAY DATA

CROW CREEK - CYPRESS CREEK - FLAT BRANCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Fritz Creek								
A	4,578[1]	300	2,077	1.8	*	6.2[4]	7.2	1.0
B	8,808[1]	276	1,932	1.9	*	8.0[4]	9.0	1.0
C	10,808[1]	156	1,028	3.2	*	9.1[4]	9.8	0.7
D	14,908[1]	205	943	3.5	15.7	14.6[4]	15.3	0.7
E	18,208[1]	358	1,086	1.8	22.2	22.2	22.8	0.6
F	22,108[1]	88	477	4.1	28.9	28.9	29.8	0.9
Fritz Creek Tributary 1								
A	4,024[2]	164	621	2.2	27.0	27.0	27.9	0.9
B	11,624[2]	117	397	3.4	52.0	52.0	52.8	0.8
C	13,596[2]	250	1,178	1.2	53.1	53.1	54.0	0.9
Hickory Creek								
A	4,600[1]	170	1,040	3.5	78.0	75.4[5]	76.4	1.0
B	18,800[1]	256	1,689	2.0	108.1	108.1	109.1	1.0
Hog Branch								
A	4,500[3]	550	3,318	1.1	43.8	43.8	44.7	0.9
B	5,900[3]	415	1,670	2.0	55.2	55.2	56.2	1.0
C	16,300[3]	268	1,453	1.9	75.4	75.4	76.4	1.0

[1] Feet above confluence with Biloxi River
[2] Feet above confluence with Fritz Creek
[3] Feet above confluence with Tuxachanie Creek
[4] Elevation computed without consideration of storm surge effects from Back Bay of Biloxi
[5] Elevation computed without consideration of backwater effects from Biloxi River
* BFE determined by coastal storm surge flooding

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
HARRISON COUNTY, MS
AND INCORPORATED AREAS

FLOODWAY DATA

FRITZ CREEK - FRITZ CREEK TRIBUTARY 1 - HICKORY CREEK - HOG BRANCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Howard Creek								
A	3,930[1]	77	663	3.8	*	9.0[4]	9.9	0.9
B	6,330[1]	145	575	4.3	15.1	13.4[4]	14.2	0.8
C	8,730[1]	278	935	2.7	23.3	23.3	23.9	0.6
D	17,180[1]	587	3,410	0.6	62.4	62.4	63.4	1.0
Little Biloxi River								
A	6,350[2]	632	4,289	2.4	26.2	26.2	27.2	1.0
B	14,700[2]	774	6,209	1.6	32.1	32.1	33.1	1.0
C	30,100[2]	464	3,983	2.5	40.6	40.6	41.6	1.0
D	45,550[2]	677	4,041	2.5	54.8	54.8	55.8	1.0
E	62,850[2]	730	5,257	1.8	68.5	68.5	69.5	1.0
F	74,450[2]	704	4,784	2.0	79.8	79.8	80.8	1.0
G	83,250[2]	635	4,505	1.8	89.6	89.6	90.6	1.0
H	95,800[2]	789	4,915	1.5	100.2	100.2	101.2	1.0
Mill Creek								
A	9,500[3]	418	1,840	2.6	103.3	103.3	104.3	1.0
Palmer Creek								
A	5,130[2]	233	1,639	1.9	51.6	51.6	52.6	1.0
B	11,920[2]	210	1,454	2.3	72.9	72.9	73.9	1.0

[1] Feet above confluence with Tchoutacabouffa River
[2] Feet above confluence with Biloxi River
[3] Feet above confluence with Wolf River
[4] Elevation computed without consideration of storm surge effects from Back Bay of Biloxi
* BFE determined by coastal storm surge flooding

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
HARRISON COUNTY, MS
AND INCORPORATED AREAS

FLOODWAY DATA

HOWARD CREEK - LITTLE BILOXI RIVER - MILL CREEK - PALMER CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Parker Creek								
A	3,000[1]	240	1,762	1.6	*	7.4[4]	8.3	0.9
B	3,830[1]	404	3,110	0.9	*	7.8[4]	8.8	1.0
C	7,430[1]	94	550	4.0	*	12.6[4]	13.4	0.8
D	13,220[1]	67	495	3.2	32.0	32.0	33.0	1.0
E	17,880[1]	238	738	2.0	66.4	66.4	67.4	1.0
Pole Branch								
A	5,620[2]	230	**	**	53.8	53.8	54.8	1.0
Sandy Creek								
A	8,430[2]	160	**	**	49.0	49.0	50.0	1.0
Saucier Creek								
A	11,400[3]	680	**	**	48.4	48.4	49.4	1.0
B	27,550[3]	620	**	**	63.0	63.0	64.0	1.0
C	42,250[3]	103	1,268	3.9	88.9	88.9	89.9	1.0

[1] Feet above confluence with Tchoutacabouffa River
[2] Feet above confluence with Wolf River
[3] Feet above confluence with Biloxi River
[4] Elevation computed without consideration of storm surge effects from Back Bay of Biloxi
* BFE determined by coastal storm surge flooding
** Data not Available

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
HARRISON COUNTY, MS
AND INCORPORATED AREAS

FLOODWAY DATA

PARKER CREEK - POLE BRANCH - SANDY CREEK - SAUCIER CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Tchoutacabouffa River								
A	4,100[1]	1,226	10,326	3.0	*	3.7[3]	4.7	1.0
B	14,900[1]	1,000	8,960	3.5	*	5.7[3]	6.6	0.9
C	21,764[1]	1147	11741	2.7	*	7.0[3]	7.9	0.9
D	25,464[1]	580	11788	2.7	*	7.6[3]	8.5	0.9
E	38,014[1]	384	9312	3.4	*	8.3[3]	9.2	0.9
F	52,464[1]	300	6546	4.8	13.9	11.1[3]	11.7	0.6
G	55,914[1]	292	4161	7.5	13.9	11.9[3]	12.6	0.7
H	71,514[1]	108	1408	11.2	15.2	14.6[3]	15.6	1.0
I	107,264[1]	204	3057	4.3	37.1	37.1	38.1	1.0
Turkey Creek								
A	2,680[2]	297	2,053	2.8	*	9.5[3]	10.3	0.8
B	7,730[2]	435	3,452	1.7	14.2	11.4[3]	12.4	1.0
C	10,430[2]	495	4,186	1.4	14.2	12.2[3]	13.2	1.0
D	12,830[2]	200	1,398	3.9	14.6	13.2[3]	14.2	1.0
E	13,530[2]	263	2,671	2.1	14.8	13.9[3]	14.8	0.9
F	14,570[2]	735	5,821	0.9	15.4	14.4[3]	15.4	1.0
G	21,430[2]	129	898	5.4	16.6	16.3[3]	17.2	0.9
H	25,230[2]	500	3,111	1.6	20.4	20.3[3]	21.3	1.0
I	28,330[2]	1,006	4,362	1.1	21.7	21.7	22.6	0.9
J	31,685[2]	798	1,770	2.6	24.9	24.9	25.8	0.9

[1] Feet above confluence with Biloxi River
[2] Feet above confluence with Bernard Bayou
[3] Elevation computed without consideration of storm surge effects from Back Bay of Biloxi
* BFE determined by coastal storm surge flooding

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
HARRISON COUNTY, MS
AND INCORPORATED AREAS

FLOODWAY DATA

TCHOUTACABOUFFA RIVER - TURKEY CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Turkey Creek (continued)								
K	34,285[1]	1,767	9,435	0.4	25.6	25.6	26.6	1.0
L	37,845[1]	1,369	7,388	0.6	25.8	25.8	26.7	0.9
M	40,245[1]	2,622	8,968	0.5	26.0	26.0	26.9	0.9
N	41,805[1]	1,705	9,180	0.5	26.1	26.1	27.0	0.9
O	45,745[1]	277	1,163	2.8	26.6	26.6	27.5	0.9
P	47,005[1]	600	2,682	1.2	27.7	27.7	28.4	0.7
Q	62,100[1]	529	1,484	2.2	44.5	44.5	45.5	1.0
Tuxachanie Creek								
A	7,350[2]	395	3,756	3.6	14.6	12.7[3]	13.4	1.0
B	13,400[2]	91	1,474	9.4	17.5	17.5	18.5	1.0
C	24,200[2]	157	2,230	6.5	24.8	24.8	25.8	1.0
D	32,350[2]	194	2,864	5.1	30.6	30.6	31.6	1.0
E	36,338[2]	195	3,290	4.5	32.0	32.0	33.0	1.0
F	38,500[2]	184	5,704	4.4	34.3	34.3	35.2	0.9
G	43,500[2]	429	8,292	1.7	38.0	38.0	38.4	0.4
H	47,500[2]	362	5,127	3.3	40.5	40.5	41.2	0.7
I	53,000[2]	139	3,187	4.3	45.5	45.5	46.1	0.6
J	61,500[2]	410	4,298	3.2	51.6	51.6	52.3	0.7
K	67,500[2]	438	6,094	2.3	56.5	56.5	57.3	0.8
L	82,050[2]	157	2,338	5.3	69.7	69.7	70.7	1.0

[1] Feet above confluence with Bernard Bayou
[2] Feet above confluence with Tchoutacabouffa River
[3] Elevation computed without consideration of storm surge effects from Tchoutacabouffa River

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
HARRISON COUNTY, MS
AND INCORPORATED AREAS

FLOODWAY DATA

TURKEY CREEK - TUXACHANIE CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
West Creek								
A	4,200[1]	77	1283	4.8	79.5	79.5	80.5	1.0
Wolf River								
A	3,600[2]	3,160	16127	1.7	**	3.6[3]	4.6	1.0
B	9,327[2]	2,928	17213	1.6	**	5.0[3]	5.8	0.8
C	24,749[2]	1,999	15039	1.9	**	8.0[3]	8.5	0.5
D	31,549[2]	1,950	12482	2.2	**	10.7[3]	11.2	0.5
E	38,389[2]	2,200	18595	1.5	**	13.2[3]	13.9	0.7
F	43,855[2]	1,714	11879	2.3	**	14.8[3]	15.8	1.0
G	51,655[2]	1,220	12856	2.2	20.2	18.9[3]	19.6	0.7
H	54,855[2]	1,077	8446	3.3	21.0	20.2[3]	21.0	0.8
I	65,185[2]	1,108	*	*	24.6	24.4[3]	25.4	1.0
J	119,855[2]	196	*	*	51.2	51.2	52.2	1.0

[1] Feet above confluence with Saucier Creek
[2] Feet above confluence with Saint Louis Bay
[3] Elevation computed without consideration of storm surge effects from Saint Louis Bay
* Floodway data not computed
** BFE determined by coastal storm surge flooding

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
HARRISON COUNTY, MS
AND INCORPORATED AREAS

FLOODWAY DATA

WEST CREEK - WOLF RIVER

Encroachment into areas subject to inundation by floodwaters having hazardous velocities aggravates the risk of flood damage, and heightens potential flood hazards by further increasing velocities. For detailed study streams, a listing of stream velocities at selected cross sections is provided in Table 7. In order to reduce the risk of property damage in areas where the stream velocities are high, the county may wish to restrict development in areas outside the floodway.

The area between the floodway and 1-percent-annual-chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 1-percent-annual-chance flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

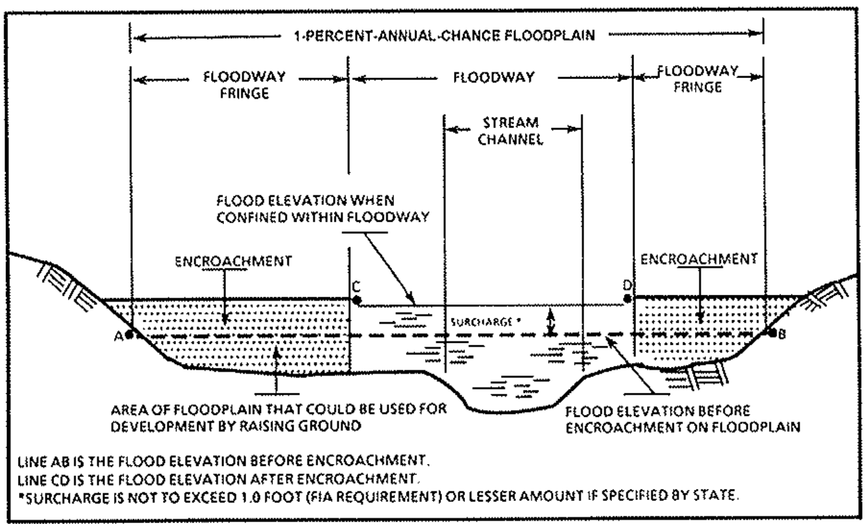

FIGURE 2. FLOODWAY SCHEMATIC

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance risk zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base (1-percent-annual-chance) flood elevations (BFEs), or base flood depths are shown within this zone.

Zone AE

Zone AE is the flood insurance risk zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS by detailed methods. In most instances, whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance risk zone that corresponds to the areas of the 1-percent-annual-chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance risk zone that corresponds to the areas of the 1-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot base flood depths derived from the detailed hydraulic analyses are shown within this zone.

Zone V

Zone V is the flood insurance risk zone that corresponds to the 1-percent-annual-chance coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no BFEs are shown within this zone.

Zone VE

Zone VE is the flood insurance risk zone that corresponds to the 1-percent-annual-chance coastal floodplains that have additional hazards associated with storm waves. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance risk zone that corresponds to areas outside the 0.2-percent-annual-chance floodplain, areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the base flood by levees. No BFEs or depths are shown within this zone.

Zone D

Zone D is the flood insurance risk zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance risk zones as described in Section 5.0 and, in the 1-percent-annual-chance floodplains that were studied by detailed methods, shows selected whole-foot BFEs or average depths. Insurance agents use the zones and BFEs in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 1- and 0.2-percent-annual-chance floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

The countywide FIRM presents flooding information for the entire geographic area of Harrison County. Previously, FIRMs were prepared for each incorporated community and the unincorporated areas of the County identified as flood-prone. This countywide FIRM also includes flood-hazard information that was presented separately on Flood Boundary and Floodway Maps (FBFMs), where applicable. Historical data relating to the maps prepared for each community up to and including this countywide FIS are presented in Table 8, "Community Map History."

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Biloxi, City of	June 27, 1970	None	June 30, 1970	July 1, 1974 April 16, 1976 August 8, 1980 March 15, 1984 March 18, 1987
D'Iberville, City of	September 18, 1970[1]	July 1, 1974[1]	June 15, 1978[1]	June 20, 1980[1] October 1, 1983[1] June 15, 1984[1] October 4, 2002[1]
Gulfport, City of	May 26, 1970	None	May 29, 1970	July 1, 1974 February 20, 1976 November 16, 1983 July 4, 1988 October 4, 2002
Harrison County (Unincorporated Areas)	September 18, 1970	July 17, 1974	June 15, 1978	June 20, 1980 October 1, 1983 June 15, 1984 August 4, 1988 August 18, 1992 October 4, 2002

[1] This community did not have its own FIRM prior to August 4, 1988. The land area for this community was previously shown on the FIRM for the unincorporated areas of Harrison County, but was not identified as a separate NFIP community. Therefore, the dates for this community were taken from the FIRM for Harrison County.

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

HARRISON COUNTY, MS

AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Long Beach, City of	July 17, 1970	None	June 19, 1970	July 1, 1974 October 17, 1975 November 16, 1983 May 4, 1988
Pass Christian, City of	May 26, 1970	None	May 29, 1970	July 1, 1974 October 17, 1975 November 16, 1983 August 19, 1987

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

HARRISON COUNTY, MS

AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

This is a multi-volume FIS. Each volume may be revised separately, in which case it supersedes the previously printed volume. Users should refer to the Table of Contents in Volume 1 for the current effective date of each volume; volumes bearing these dates contain the most up-to-date flood hazard data.

An FIS has been prepared for the City of Biloxi, the City of Gulfport, the City of Long Beach, the City of Pass Christian, and Harrison County Unincorporated areas.

This FIS report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the NFIP.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting Federal Insurance and Mitigation Division, FEMA Region IV, Koger-Center — Rutgers Building, 3003 Chamblee Tucker Road, Atlanta, GA 30341.

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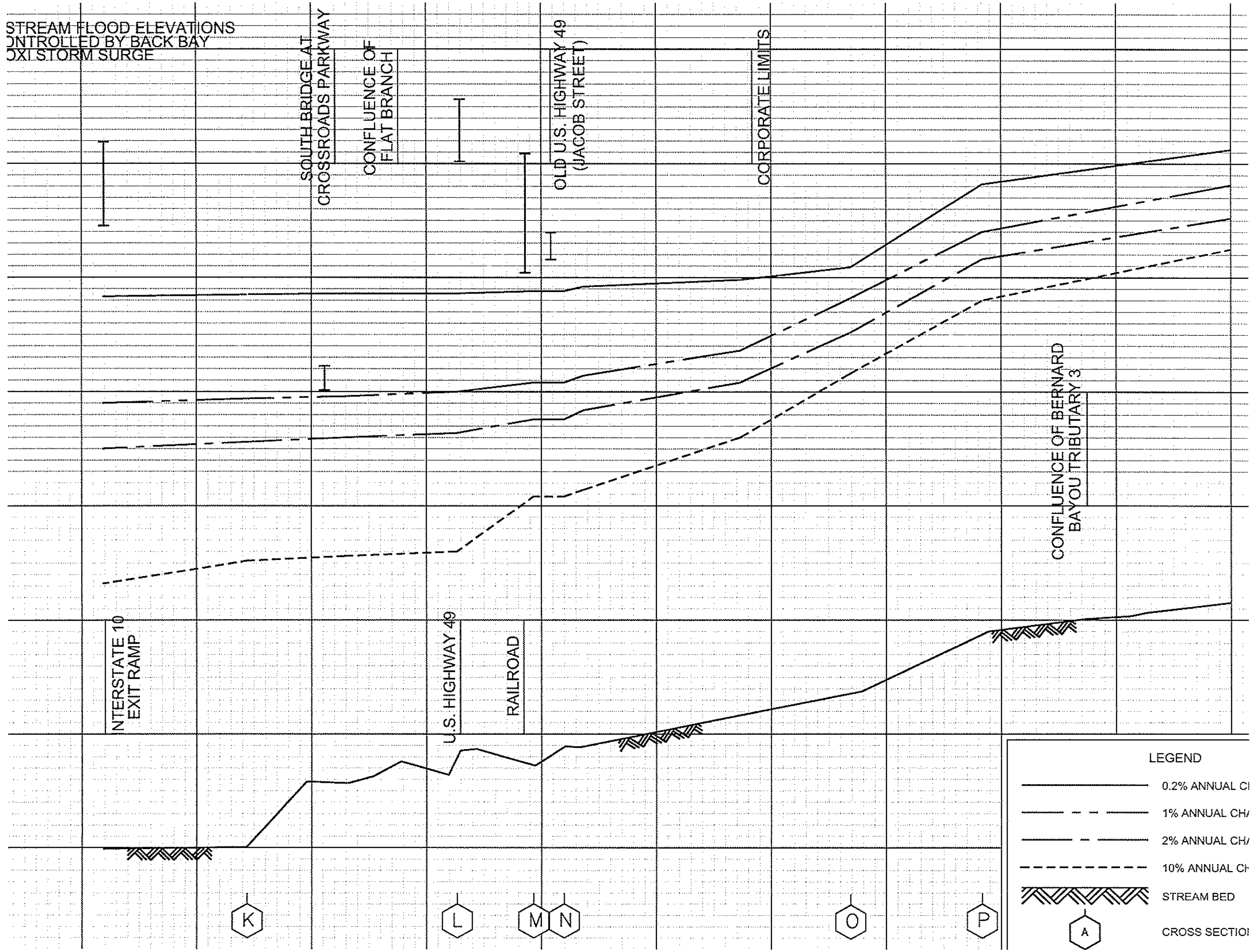

STREAM FLOOD ELEVATIONS
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SOUTH BRIDGE AT CROSSROADS PARKWAY
CONFLUENCE OF FLAT BRANCH
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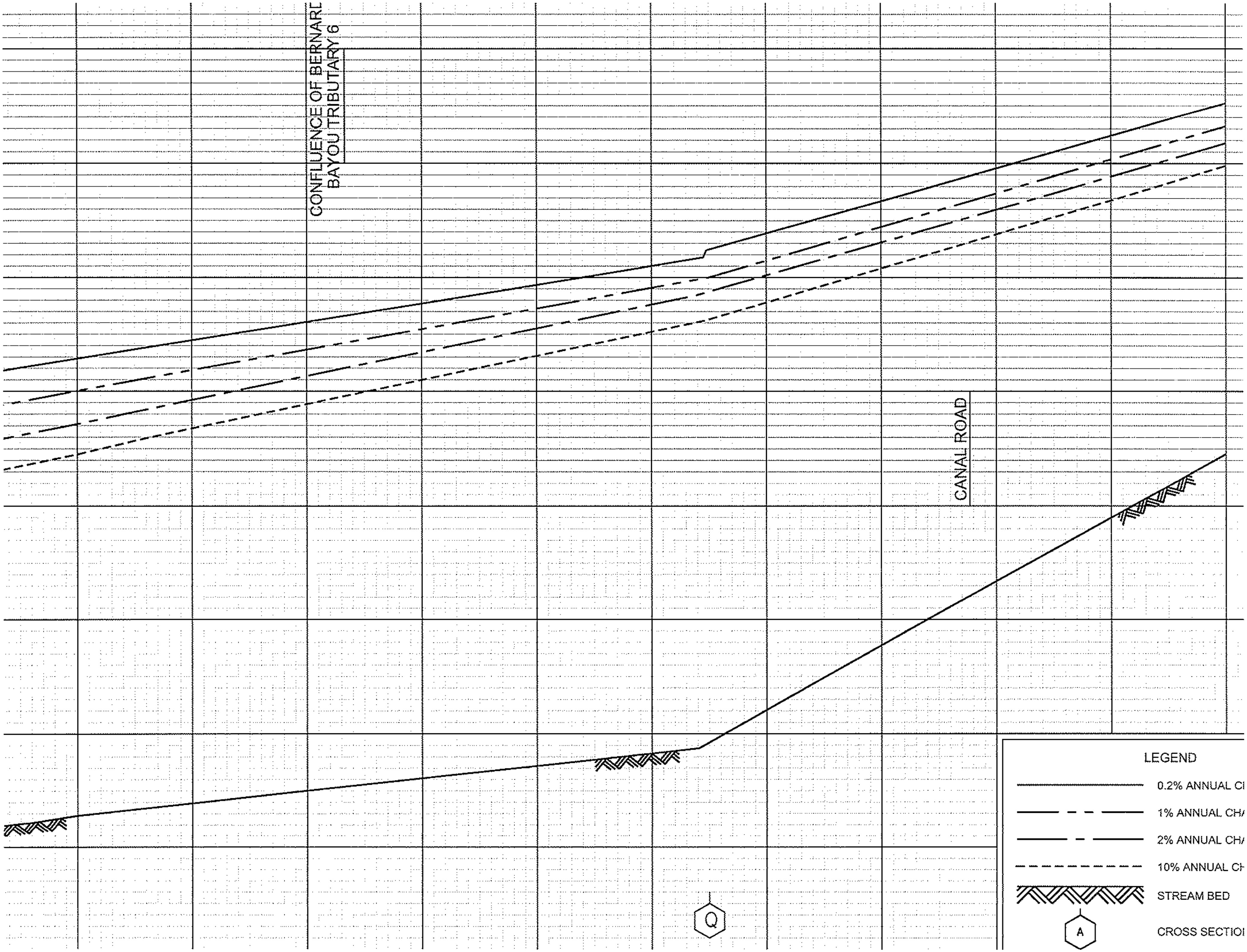
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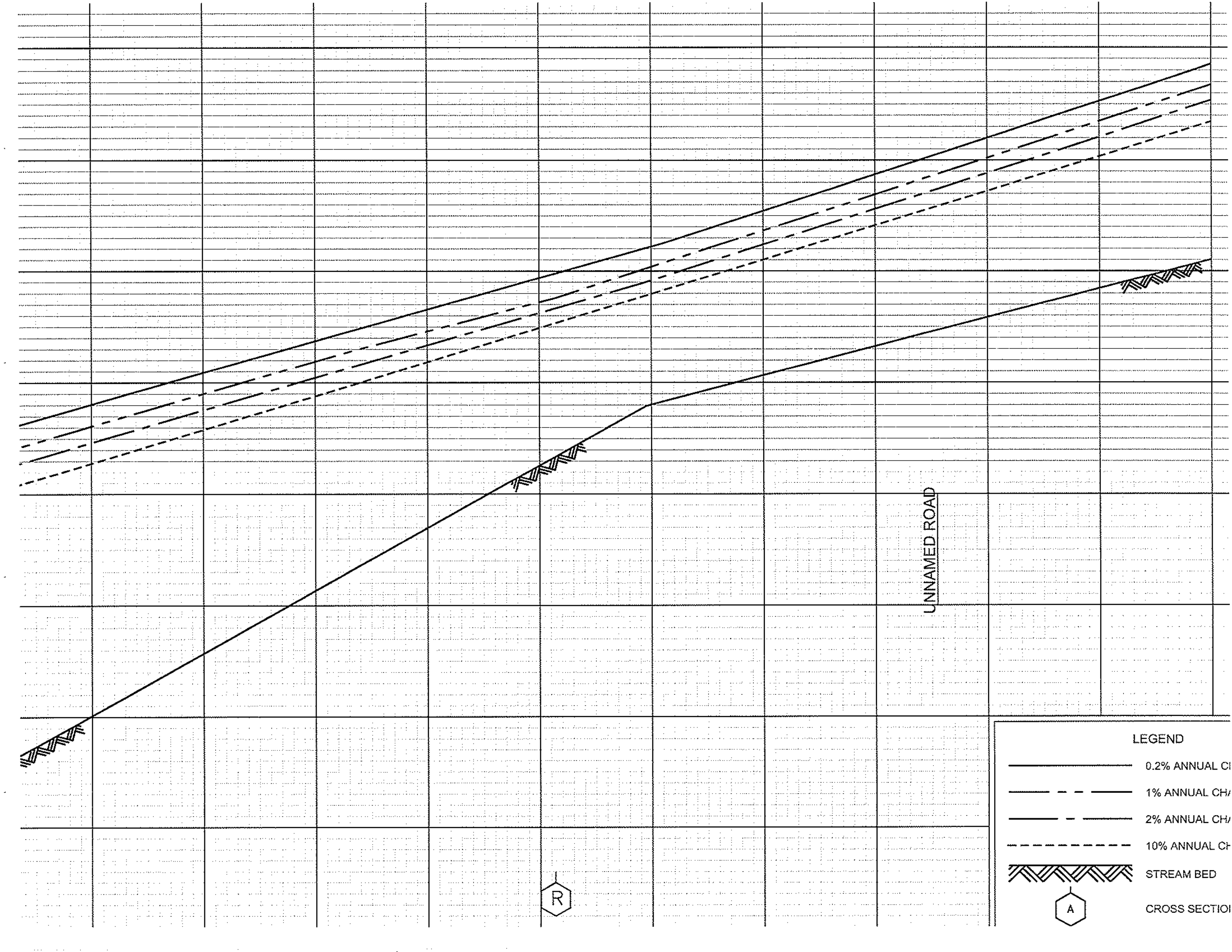
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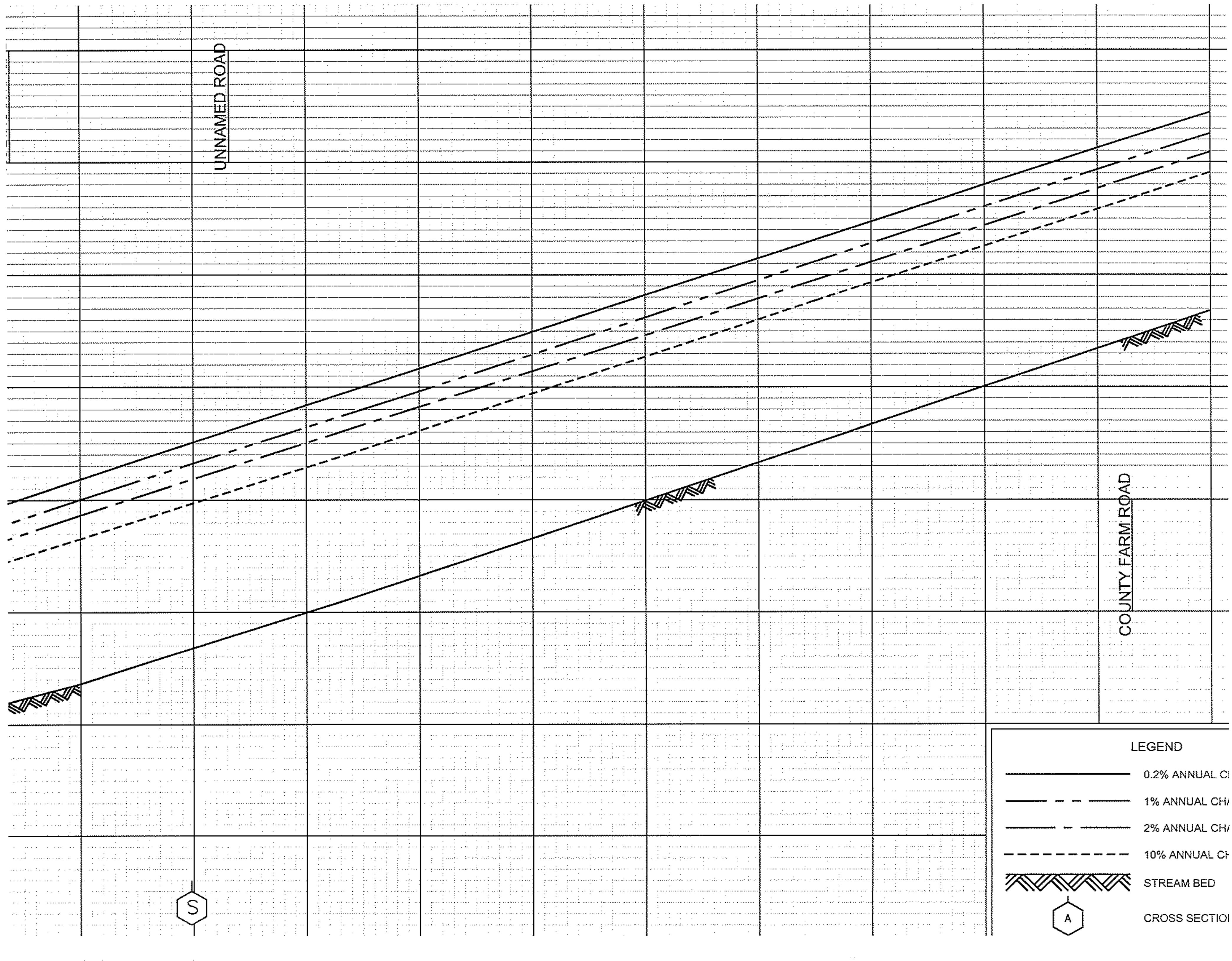
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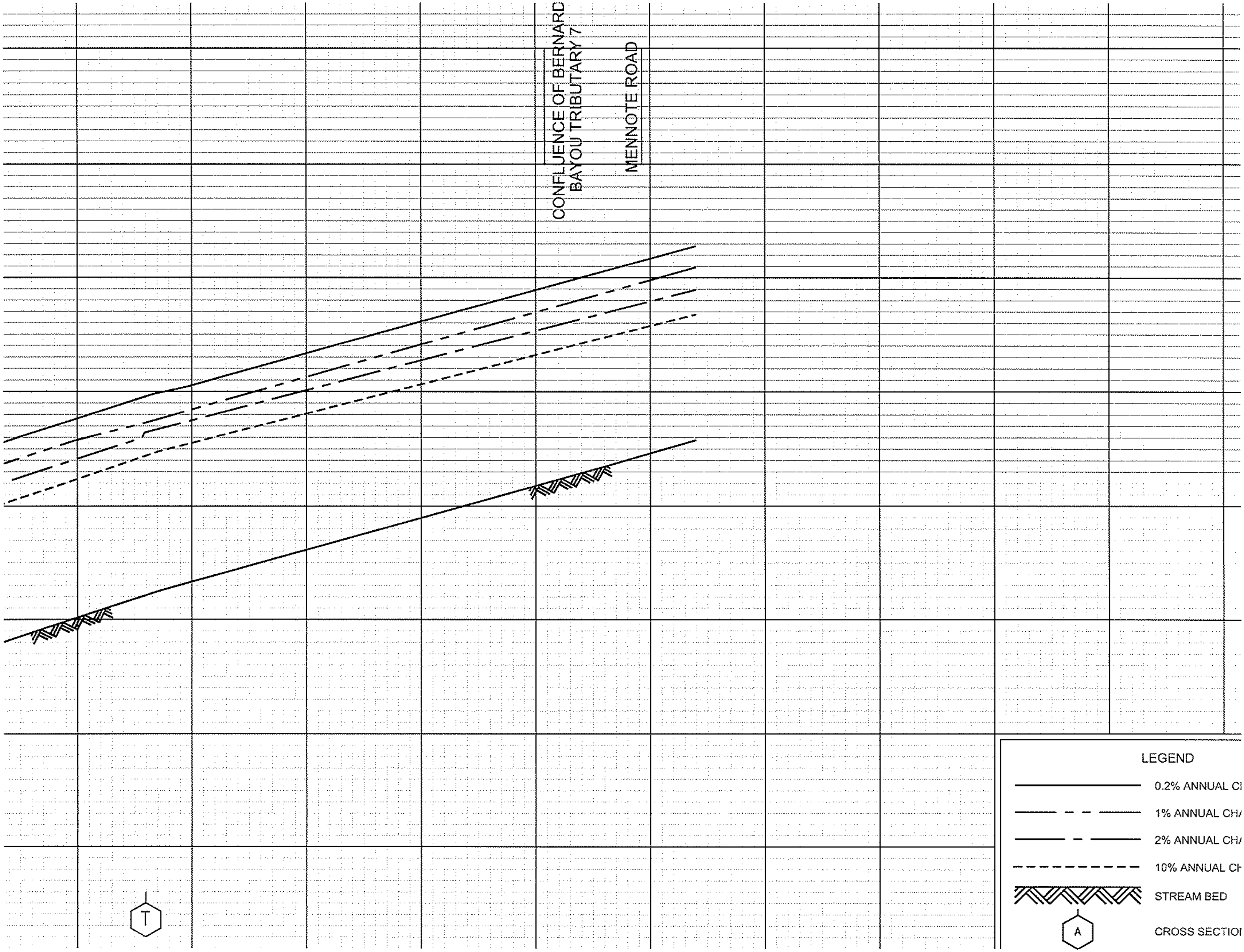
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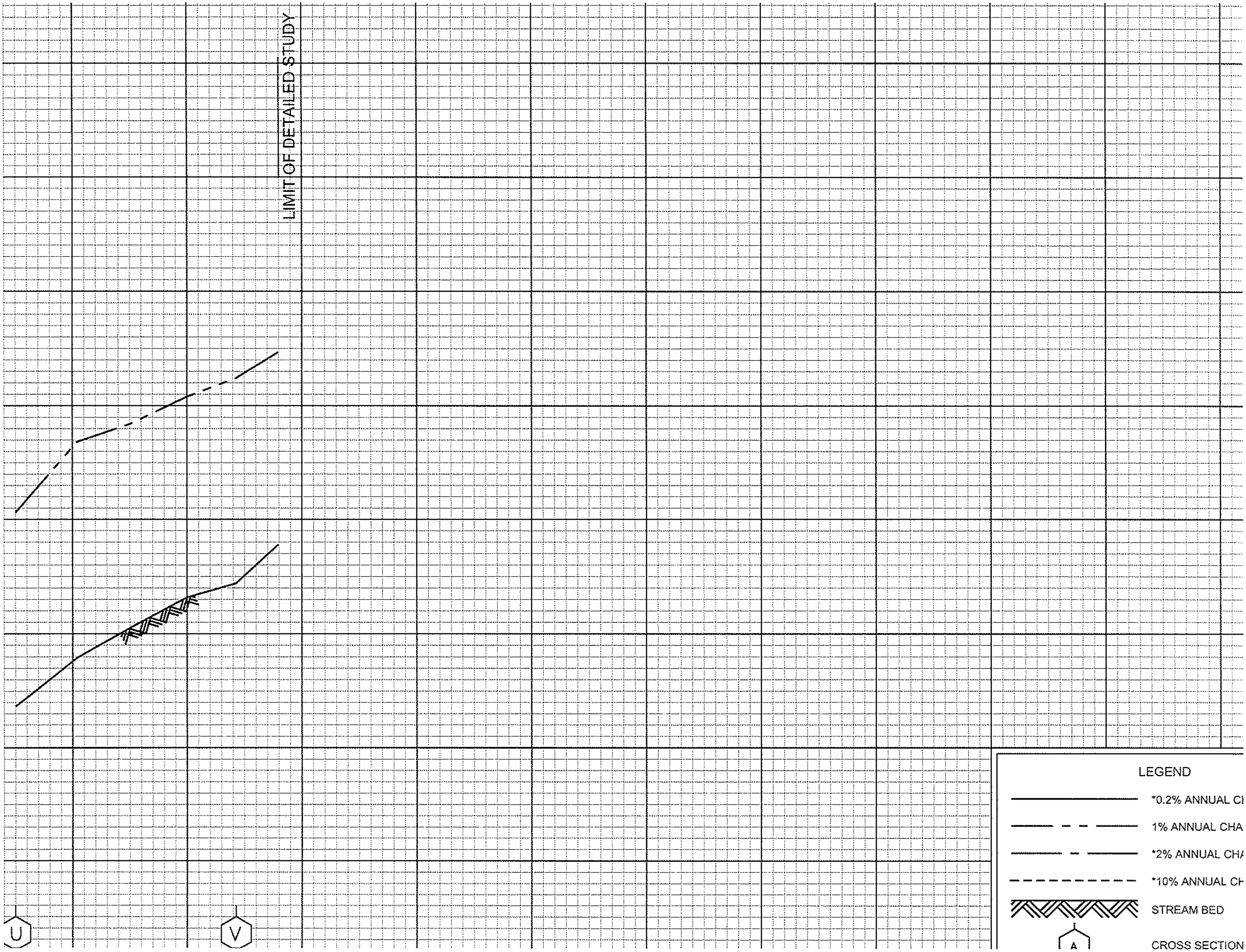
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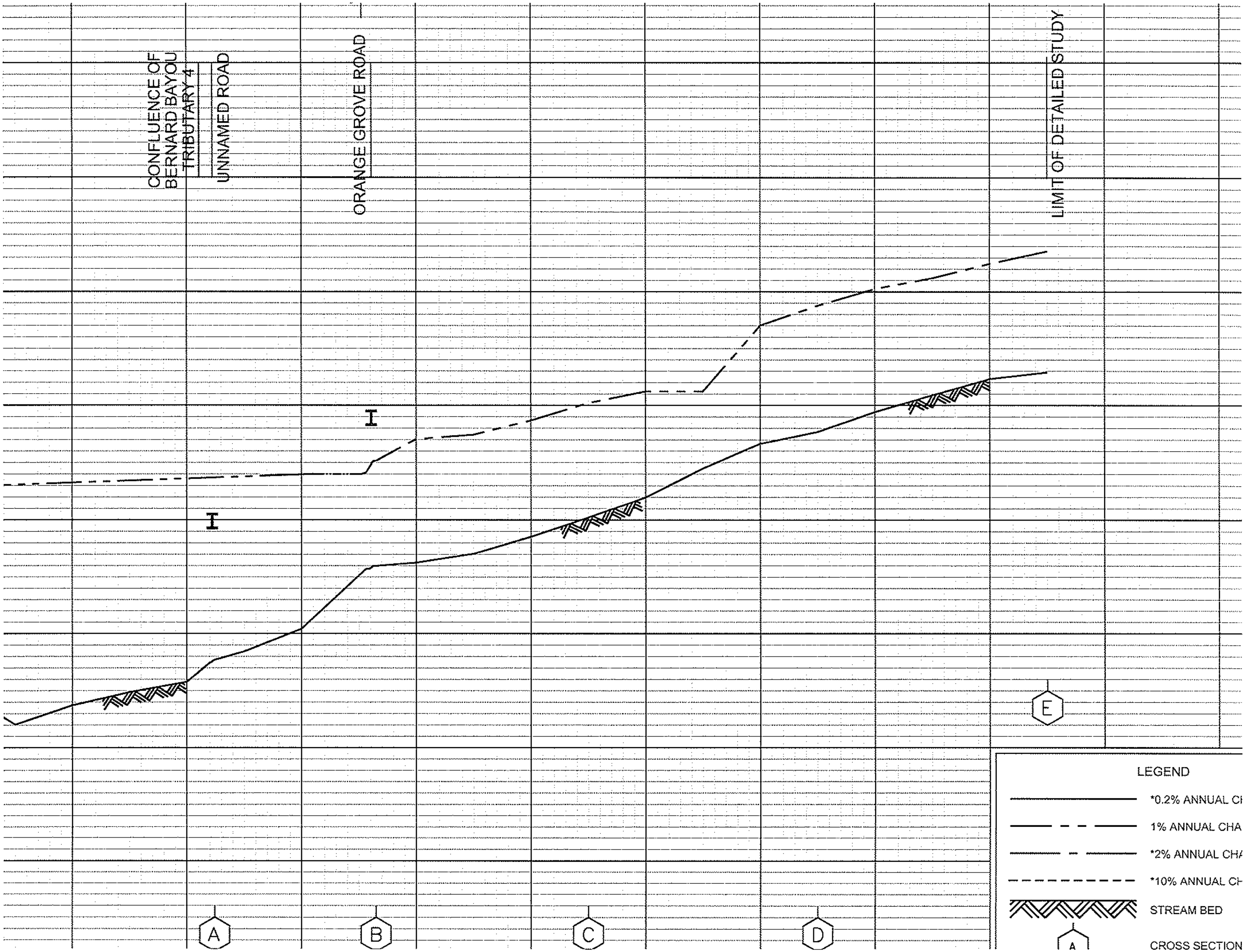

CONFLUENCE OF BERNARD BAYOU TRIBUTARY 4
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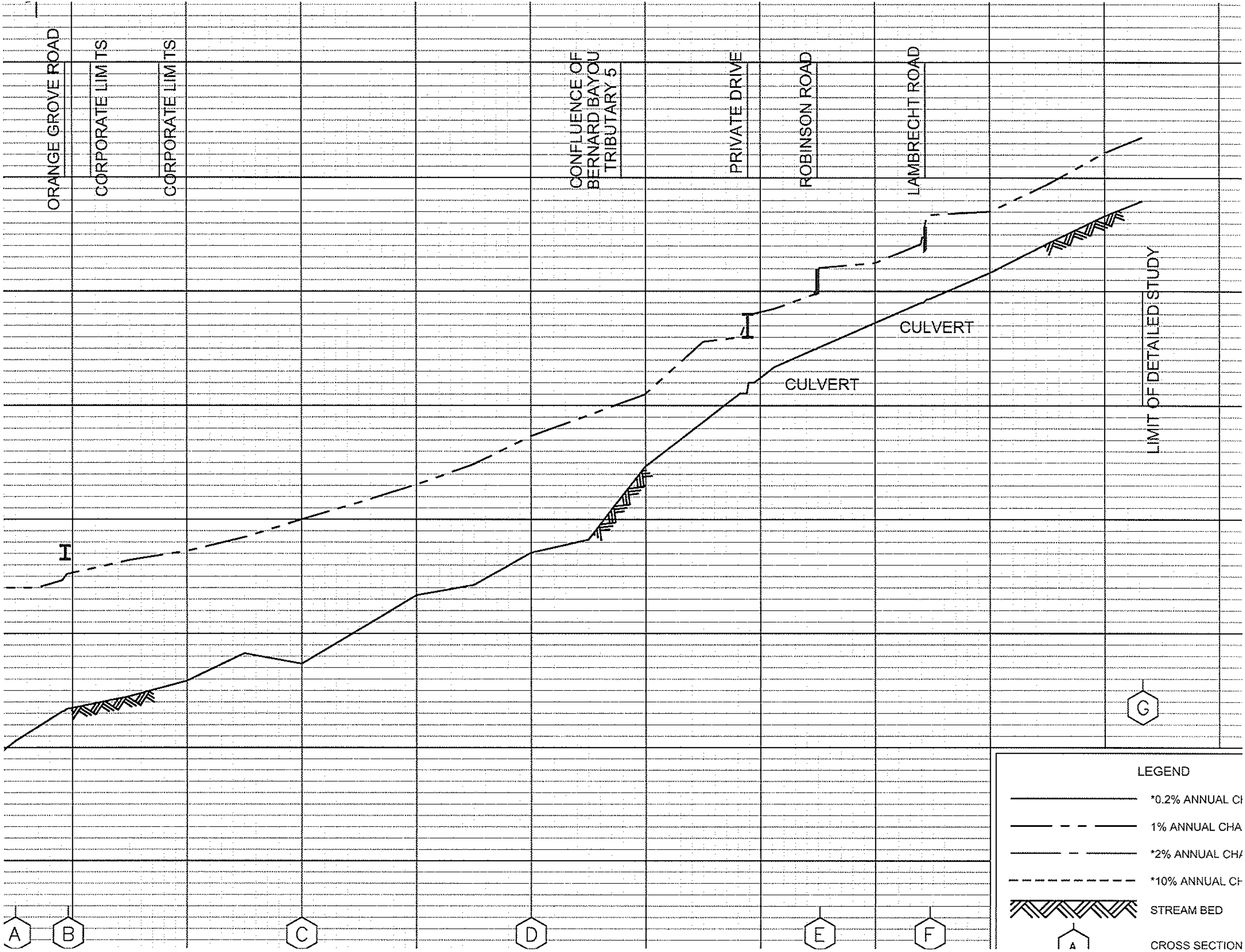
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CORPORATE LIMITS
CORPORATE LIMITS
CONFLUENCE OF BERNARD BAYOU TRIBUTARY 5
PRIVATE DRIVE
ROBINSON ROAD
LAMBRECHT ROAD
CULVERT
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LIMIT OF DETAILED STUDY
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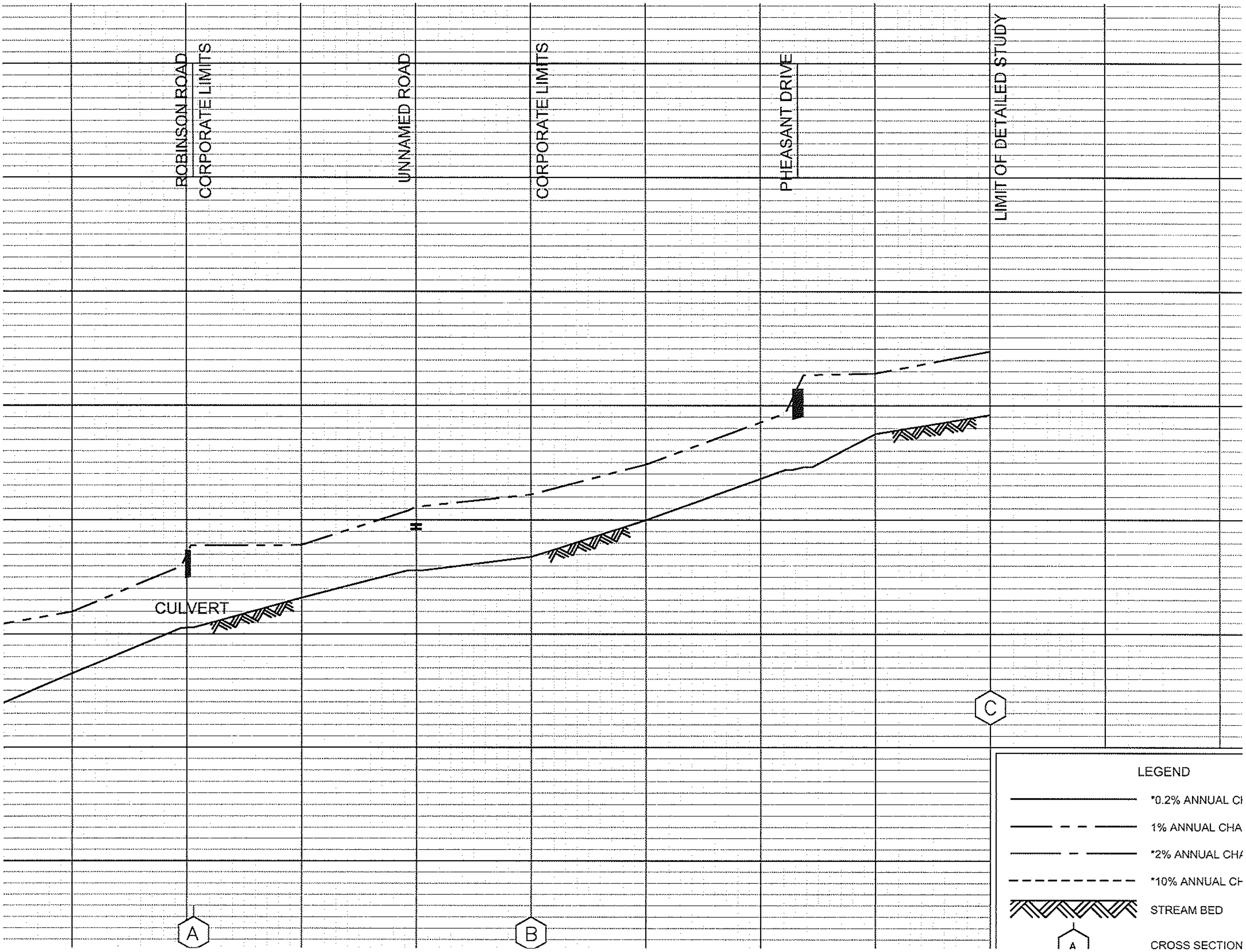
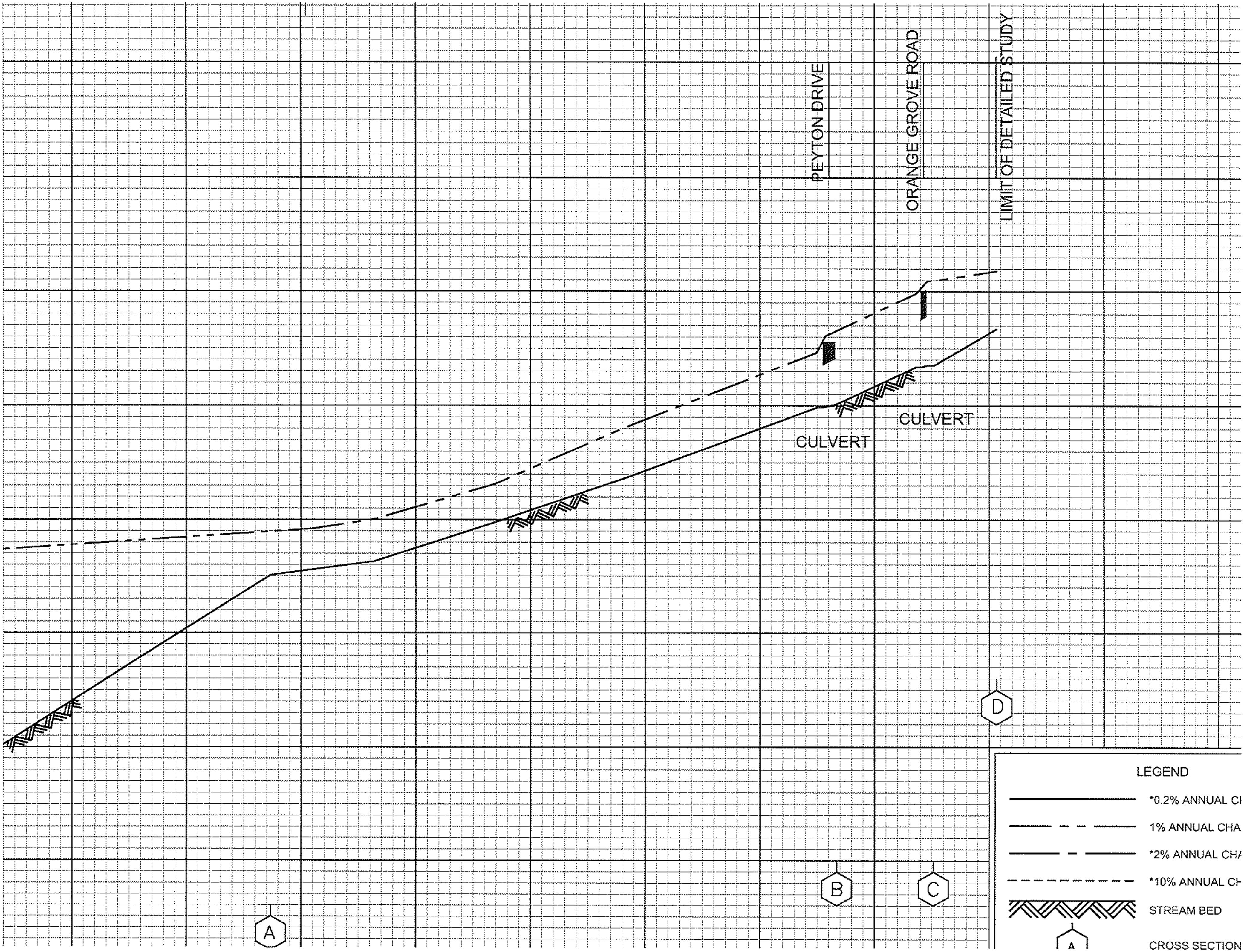
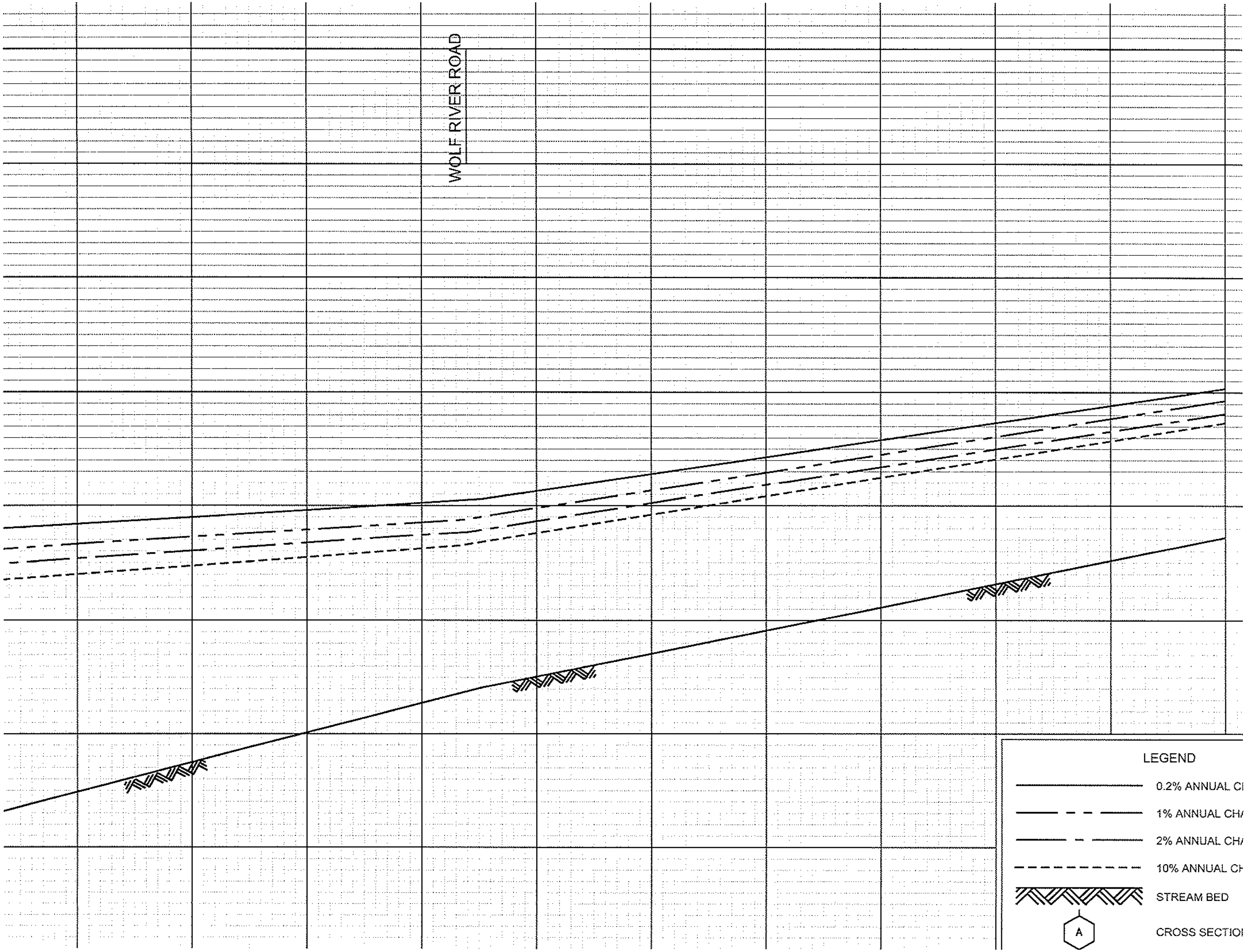
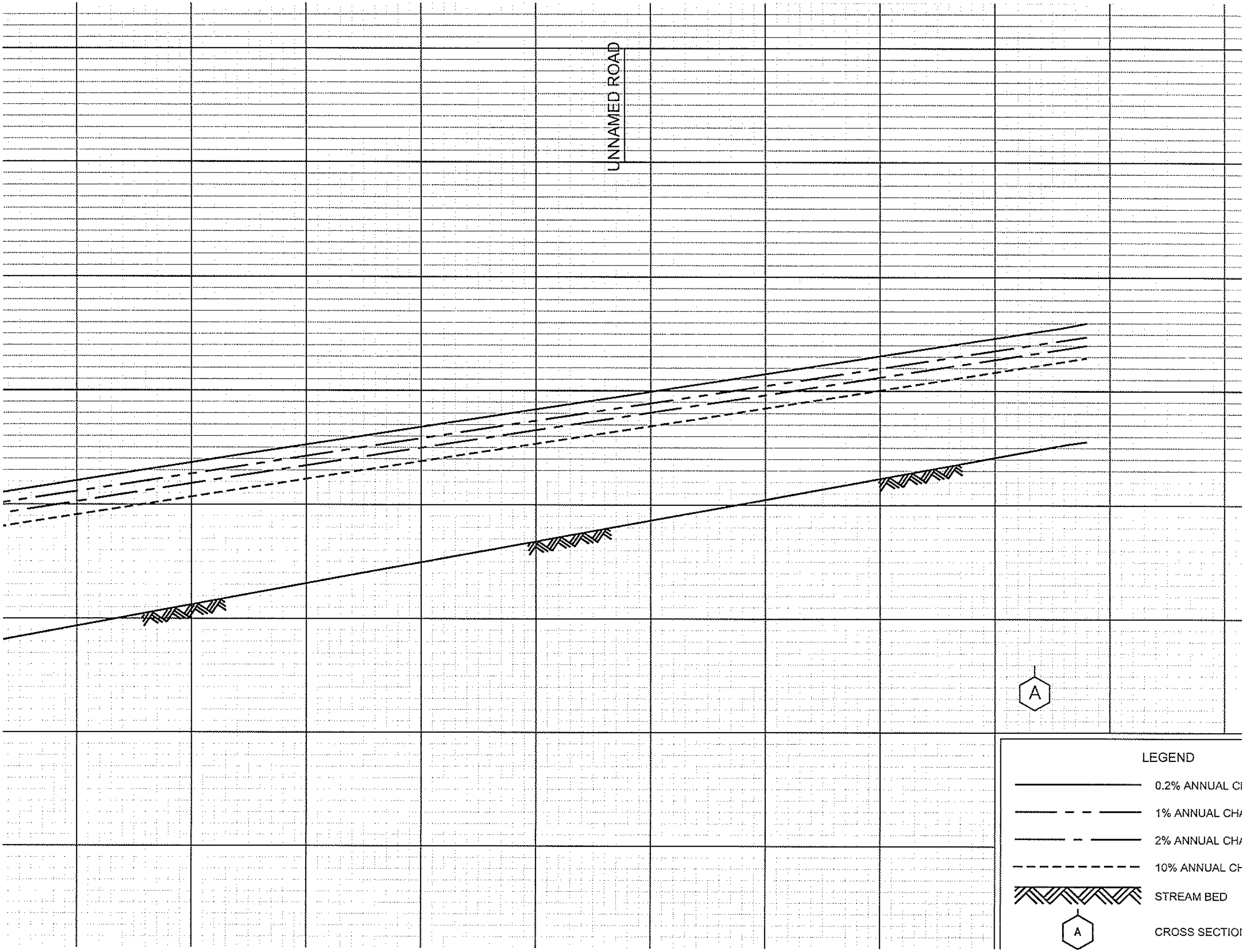
1% ANNUAL CHA
*2% ANNUAL CHA
*10% ANNUAL CH
STREAM BED
A
CROSS SECTION

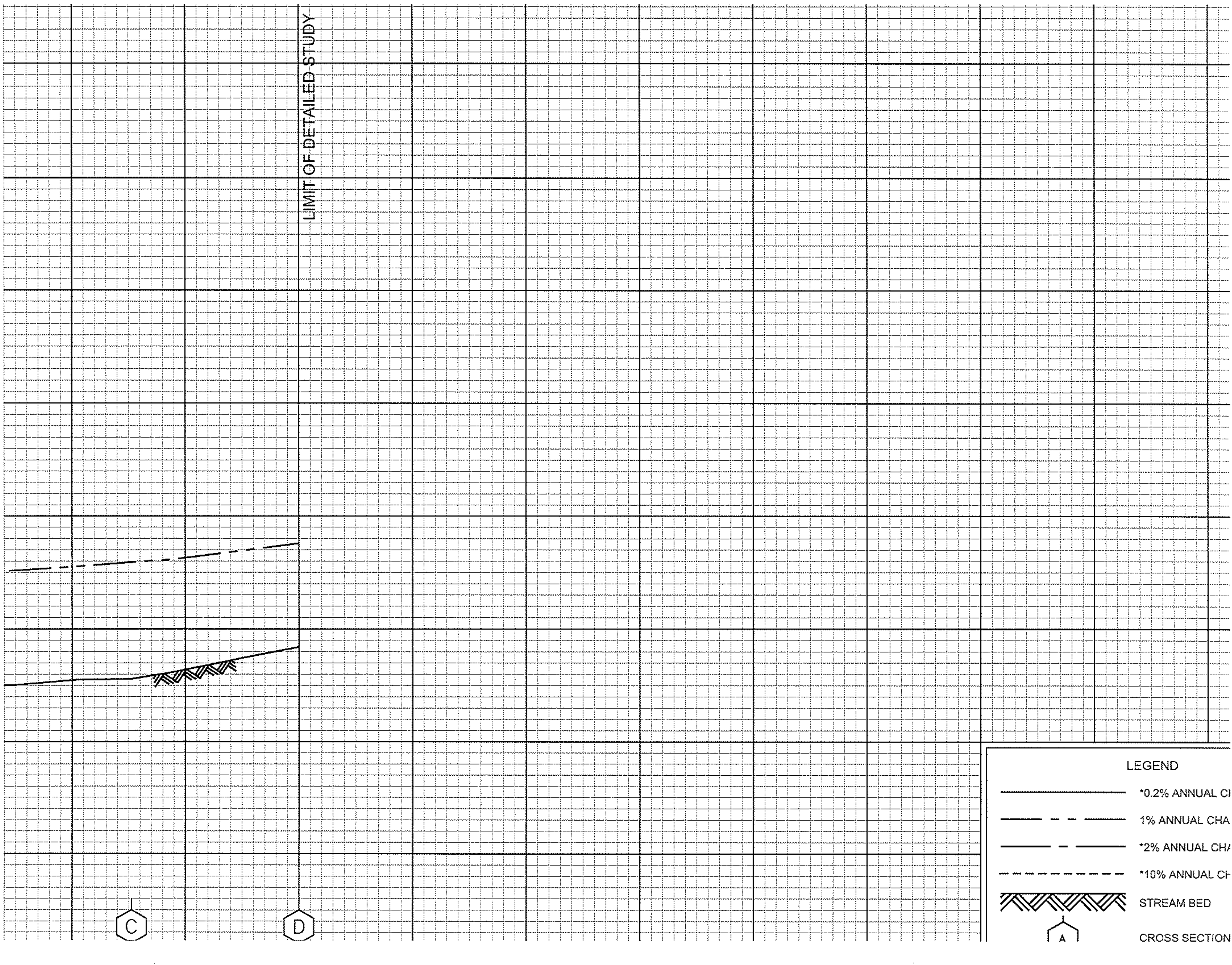

ROBINSON ROAD
CORPORATE LIMITS
UNNAMED ROAD
CORPORATE LIMITS
PHEASANT DRIVE
LIMIT OF DETAILED STUDY
CULVERT
A
B
C
LEGEND
*0.2% ANNUAL CH
1% ANNUAL CHA
*2% ANNUAL CHA
*10% ANNUAL CH
STREAM BED
A
CROSS SECTION

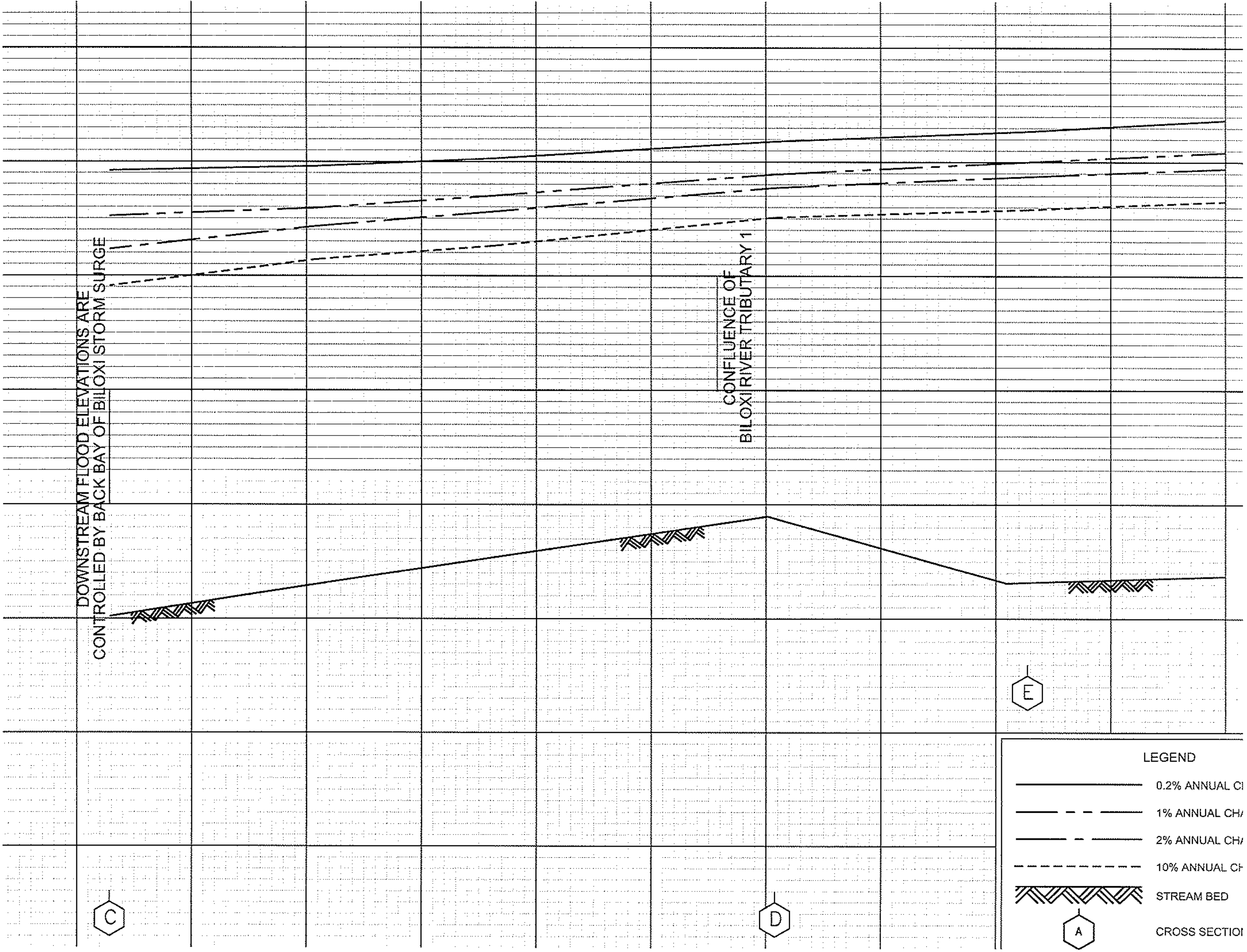


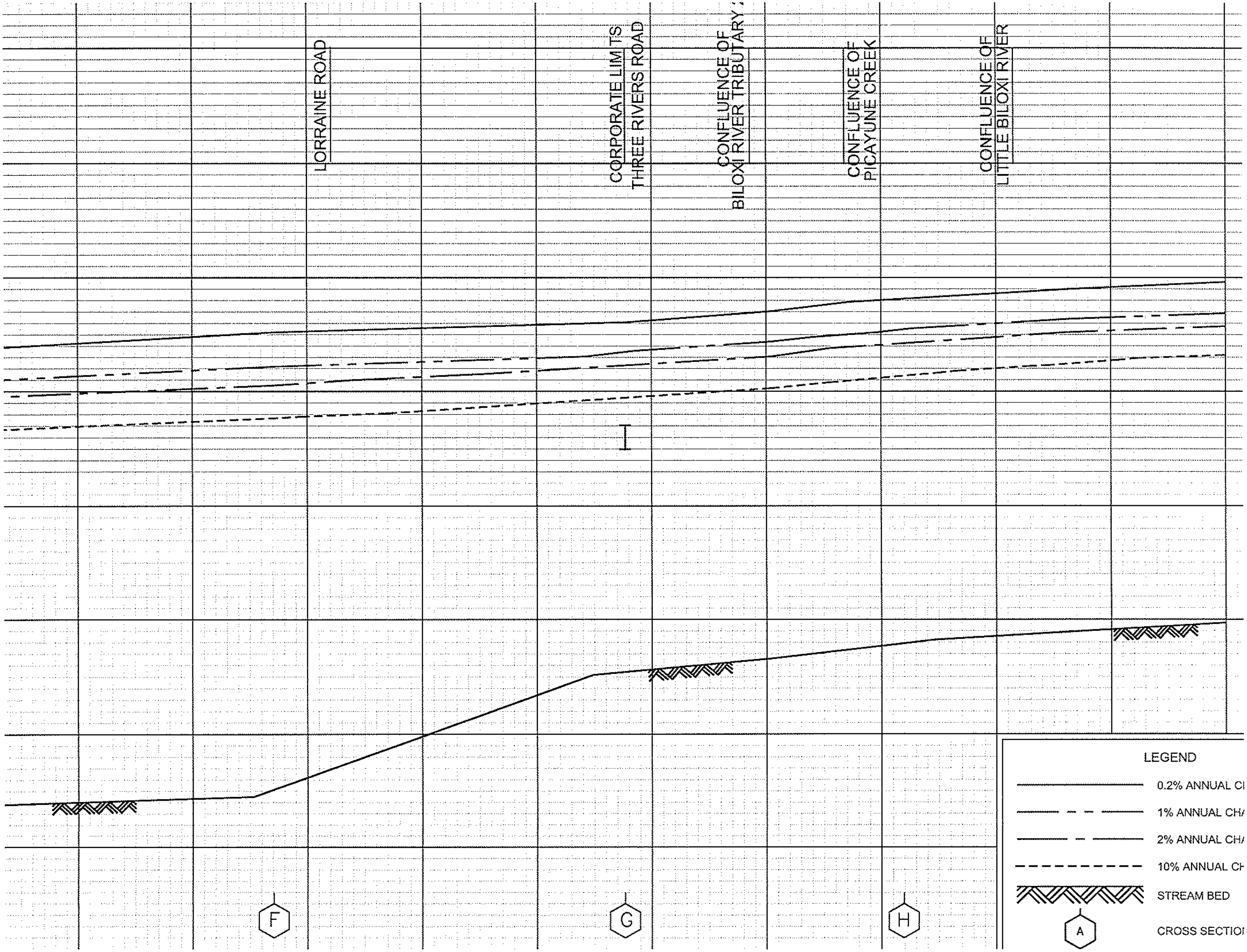
PEYTON DRIVE
ORANGE GROVE ROAD
LIMIT OF DETAILED STUDY
CULVERT
CULVERT
A
B
C
D
LEGEND
*0.2% ANNUAL CH
1% ANNUAL CHA
*2% ANNUAL CHA
*10% ANNUAL CH
STREAM BED
A
CROSS SECTION


WOLF RIVER ROAD
LEGEND
0.2% ANNUAL CI
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTIOI

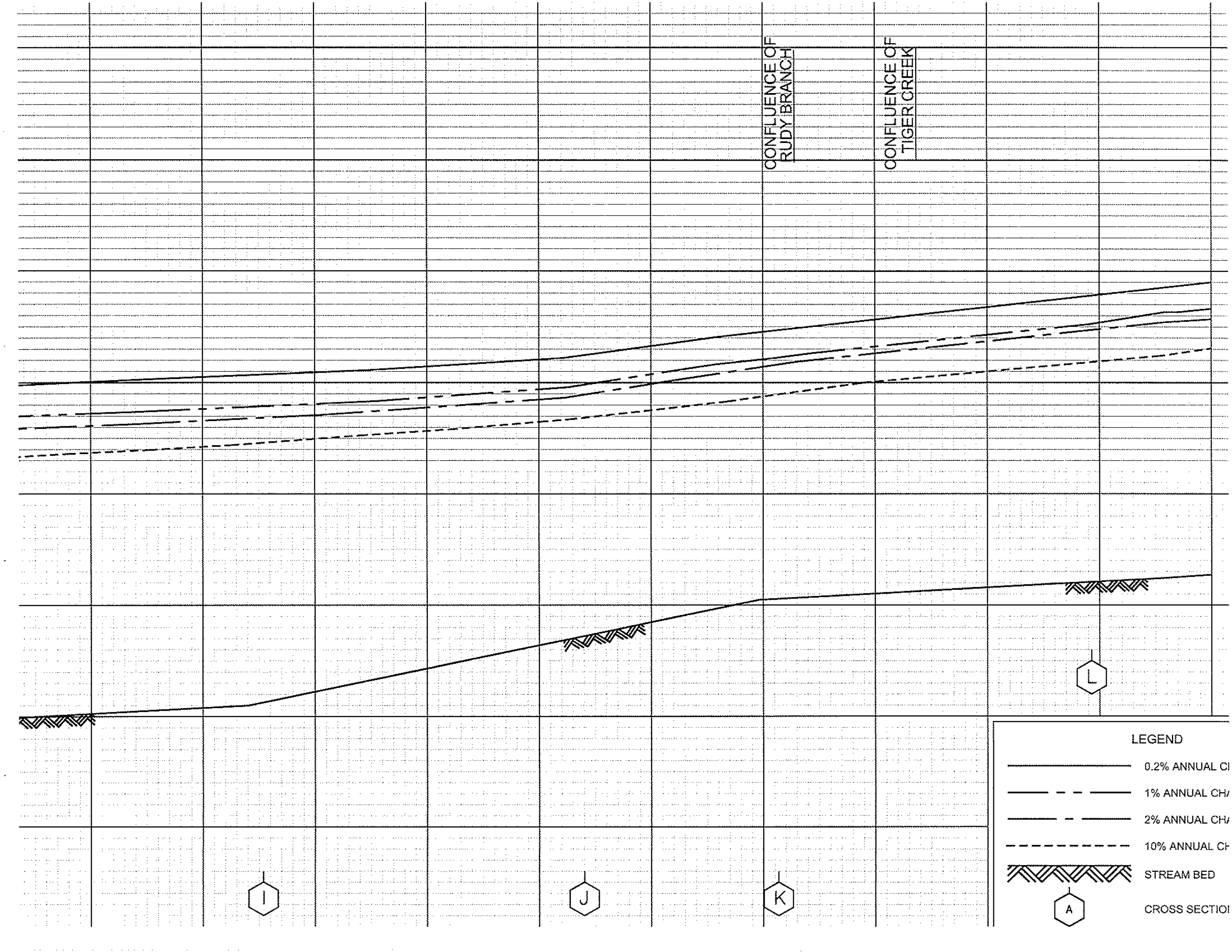

UNNAMED ROAD
A
LEGEND
0.2% ANNUAL CI
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTIO


LIMIT OF DETAILED STUDY
C
D
LEGEND
*0.2% ANNUAL CI
1% ANNUAL CHA
*2% ANNUAL CHA
*10% ANNUAL CH
STREAM BED
A
CROSS SECTION

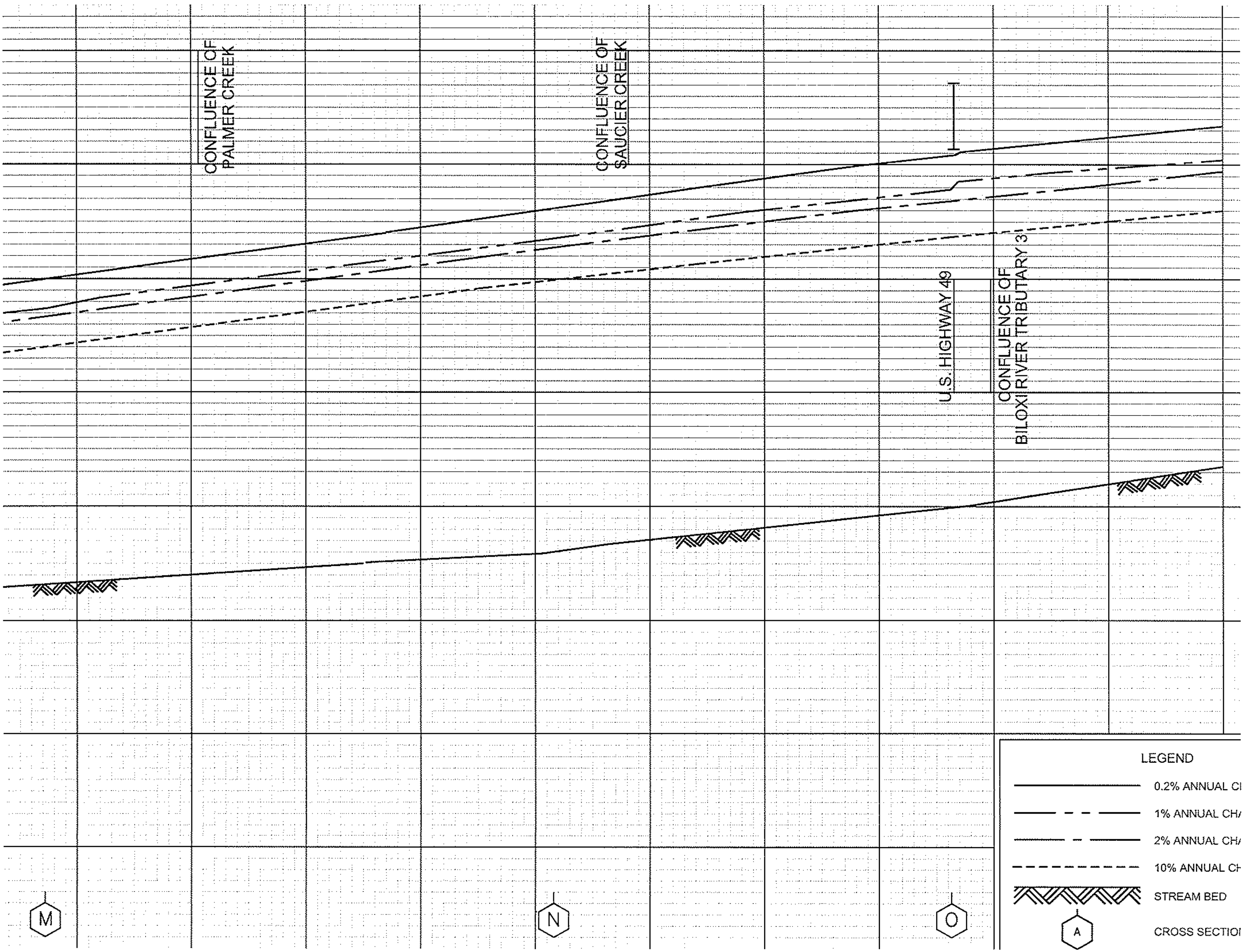

DOWNSTREAM FLOOD ELEVATIONS ARE CONTROLLED BY BACK BAY OF BILOXI STORM SURGE
CONFLUENCE OF BILOXI RIVER TRIBUTARY 1
C
D
E
LEGEND
0.2% ANNUAL C
1% ANNUAL CH
2% ANNUAL CH
10% ANNUAL C
STREAM BED
A
CROSS SECTIO

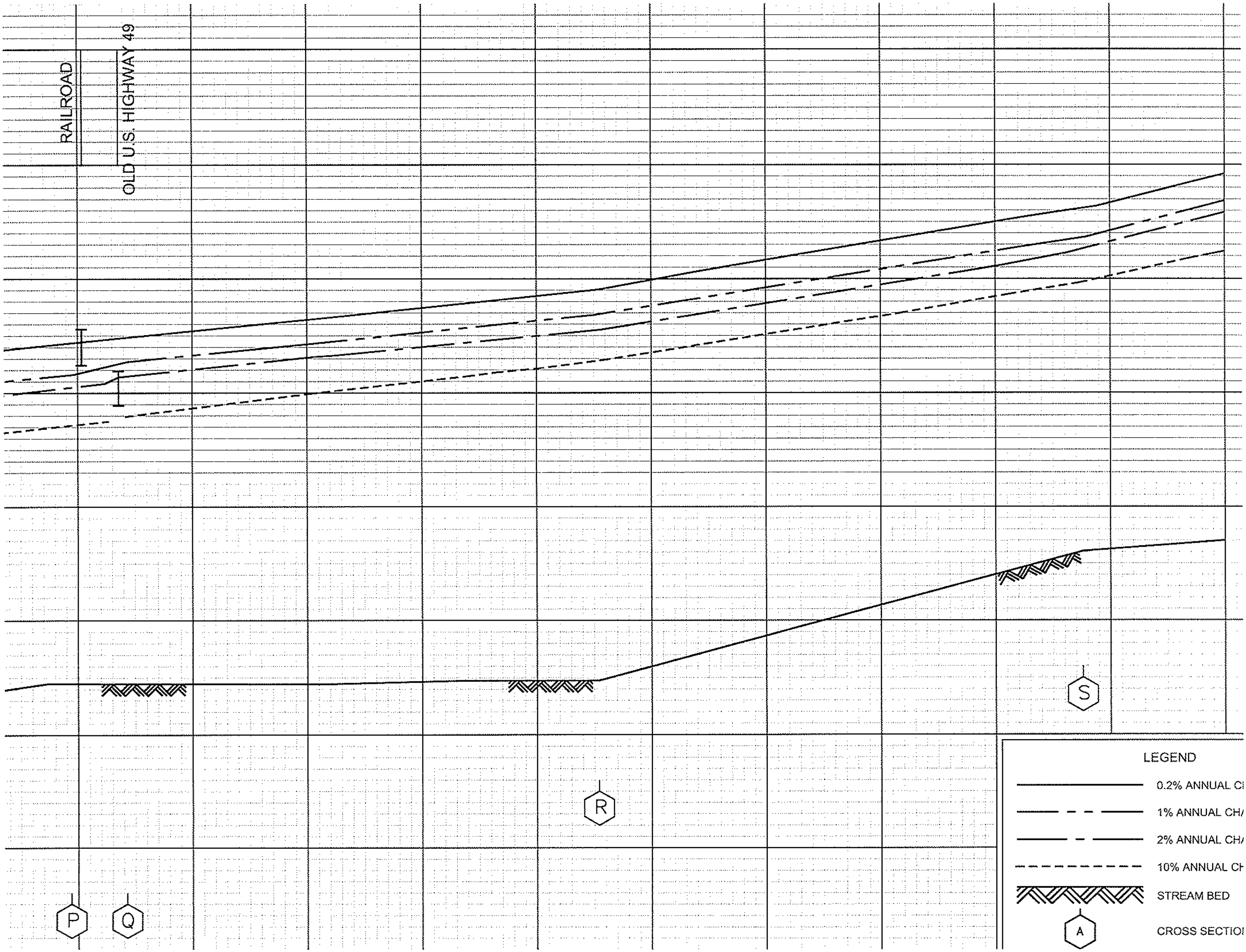


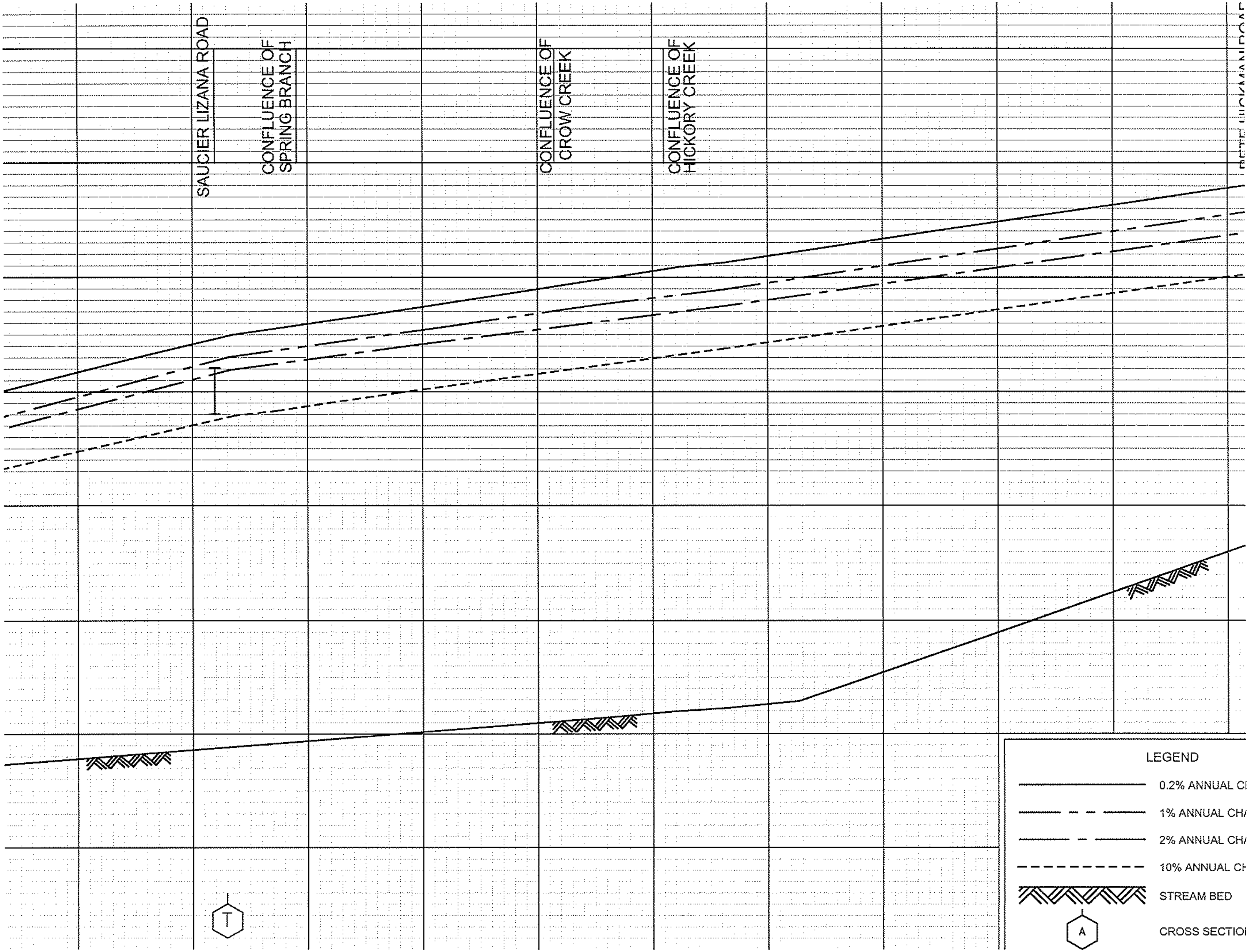
LORRAINE ROAD
CORPORATE LIMITS
THREE RIVERS ROAD
CONFLUENCE OF
BILOXI RIVER TRIBUTARY
CONFLUENCE OF
PICAYUNE CREEK
CONFLUENCE OF
LITTLE BILOXI RIVER
F
G
H
LEGEND
0.2% ANNUAL C
1% ANNUAL CH
2% ANNUAL CH
10% ANNUAL CH
STREAM BED
A
CROSS SECTIO



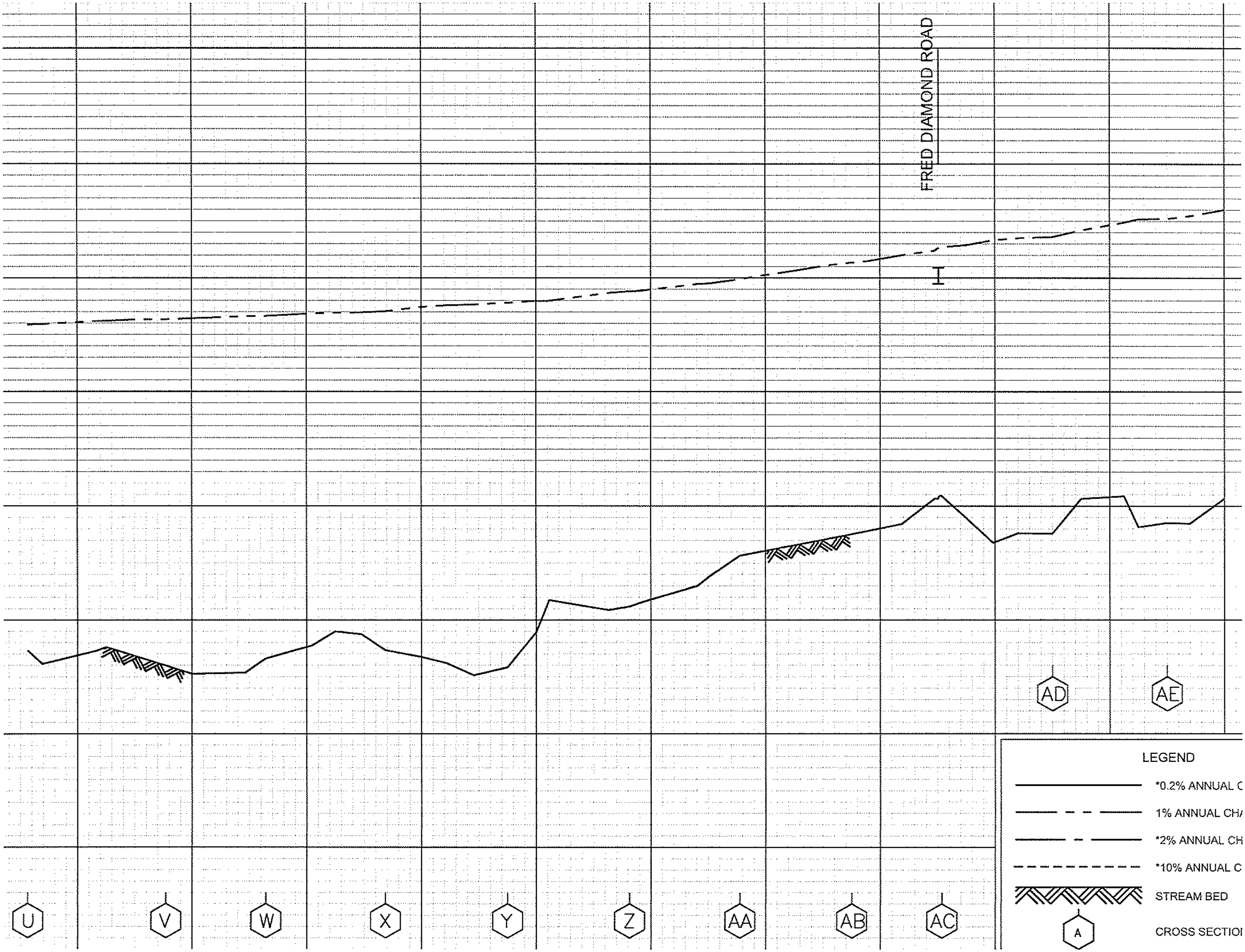
CONFLUENCE OF RUDY BRANCH
CONFLUENCE OF TIGER CREEK
I
J
K
L
LEGEND
0.2% ANNUAL CI
1% ANNUAL CH
2% ANNUAL CH
10% ANNUAL CH
STREAM BED
A
CROSS SECTIO

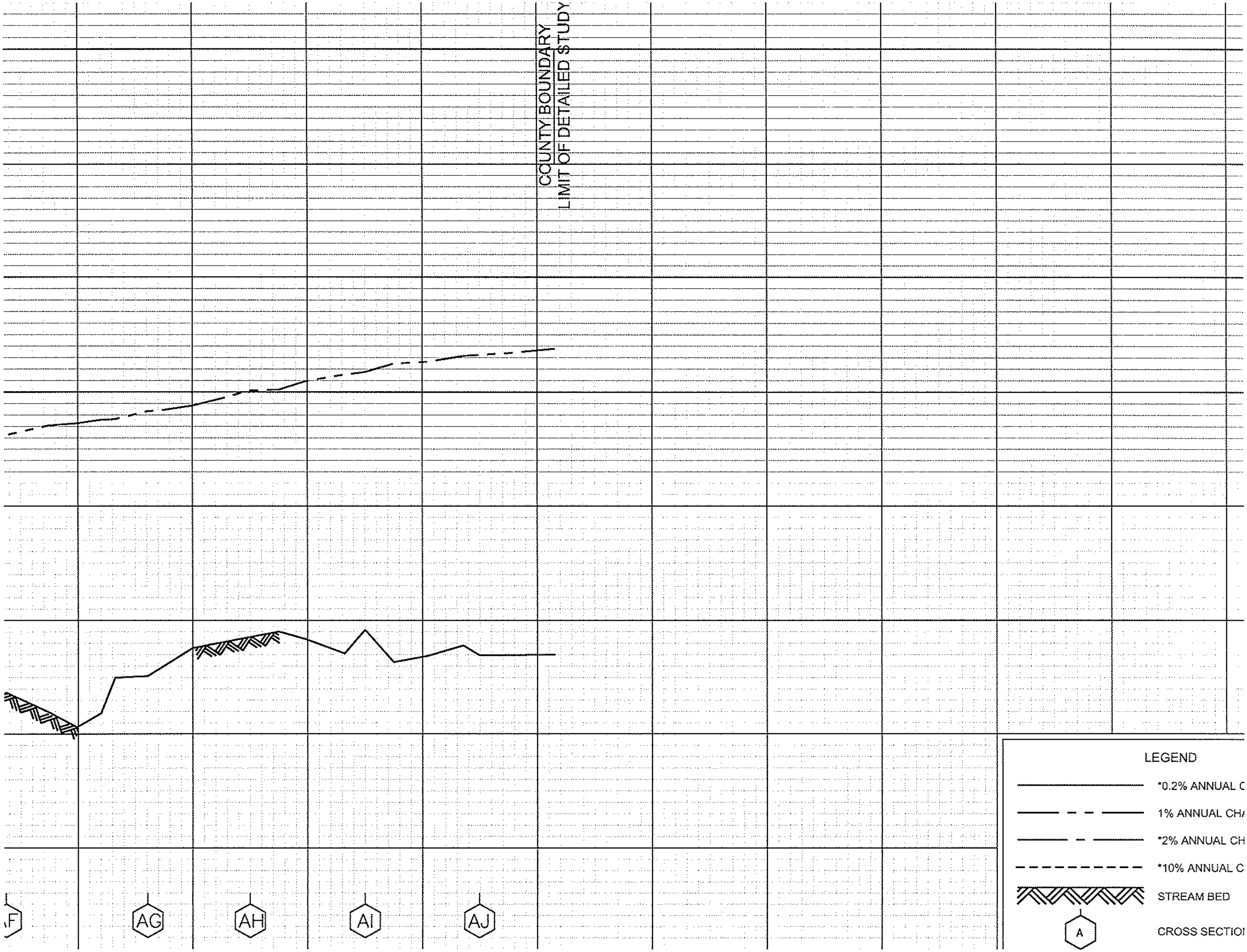

CONFLUENCE OF PALMER CREEK
CONFLUENCE OF SAUCIER CREEK
U.S. HIGHWAY 49
CONFLUENCE OF BILOXI RIVER TRIBUTARY 3
LEGEND
0.2% ANNUAL C
1% ANNUAL CH
2% ANNUAL CH
10% ANNUAL C
STREAM BED
A
CROSS SECTIO
M
N
O


RAILROAD
OLD U.S. HIGHWAY 49
P
Q
R
S
LEGEND
0.2% ANNUAL CH
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTIO



SAUCIER LIZANA ROAD
CONFLUENCE OF SPRING BRANCH
CONFLUENCE OF CROW CREEK
CONFLUENCE OF HICKORY CREEK
T
LEGEND
0.2% ANNUAL C
1% ANNUAL CH
2% ANNUAL CH
10% ANNUAL C
STREAM BED
A
CROSS SECTIO


FRED DIAMOND ROAD
U
V
W
X
Y
Z
AA
AB
AC
AD
AE
LEGEND
*0.2% ANNUAL C
1% ANNUAL CH
*2% ANNUAL CH
*10% ANNUAL C
STREAM BED
CROSS SECTIO

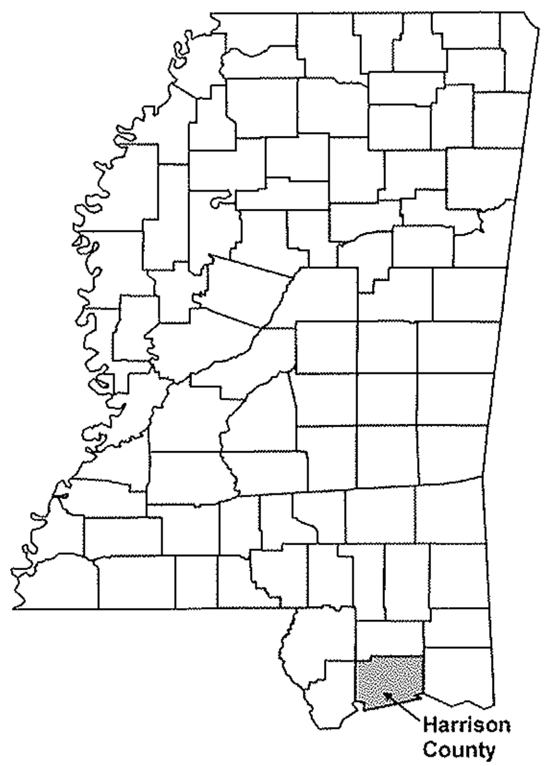

COUNTY BOUNDARY
LIMIT OF DETAILED STUDY
AF
AG
AH
AI
AJ
LEGEND
*0.2% ANNUAL C
1% ANNUAL CHA
*2% ANNUAL CH
*10% ANNUAL C
STREAM BED
A
CROSS SECTIO

FLOOD INSURANCE STUDY

HARRISON COUNTY, MISSISSIPPI
AND INCORPORATED AREAS

VOLUME 2 OF 3

COMMUNITY NAME	COMMUNITY NUMBER
BILOXI, CITY OF	285252
D'IBERVILLE, CITY OF	280336
GULFPORT, CITY OF	285253
HARRISON COUNTY (UNINCORPORATED AREAS)	285255
LONG BEACH, CITY OF	285257
PASS CHRISTIAN, CITY OF	285261



Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
28047CV002A

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Countywide FIS Effective Date:

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EXHIBITS – continued

Exhibit 1 – Flood Profiles - continued

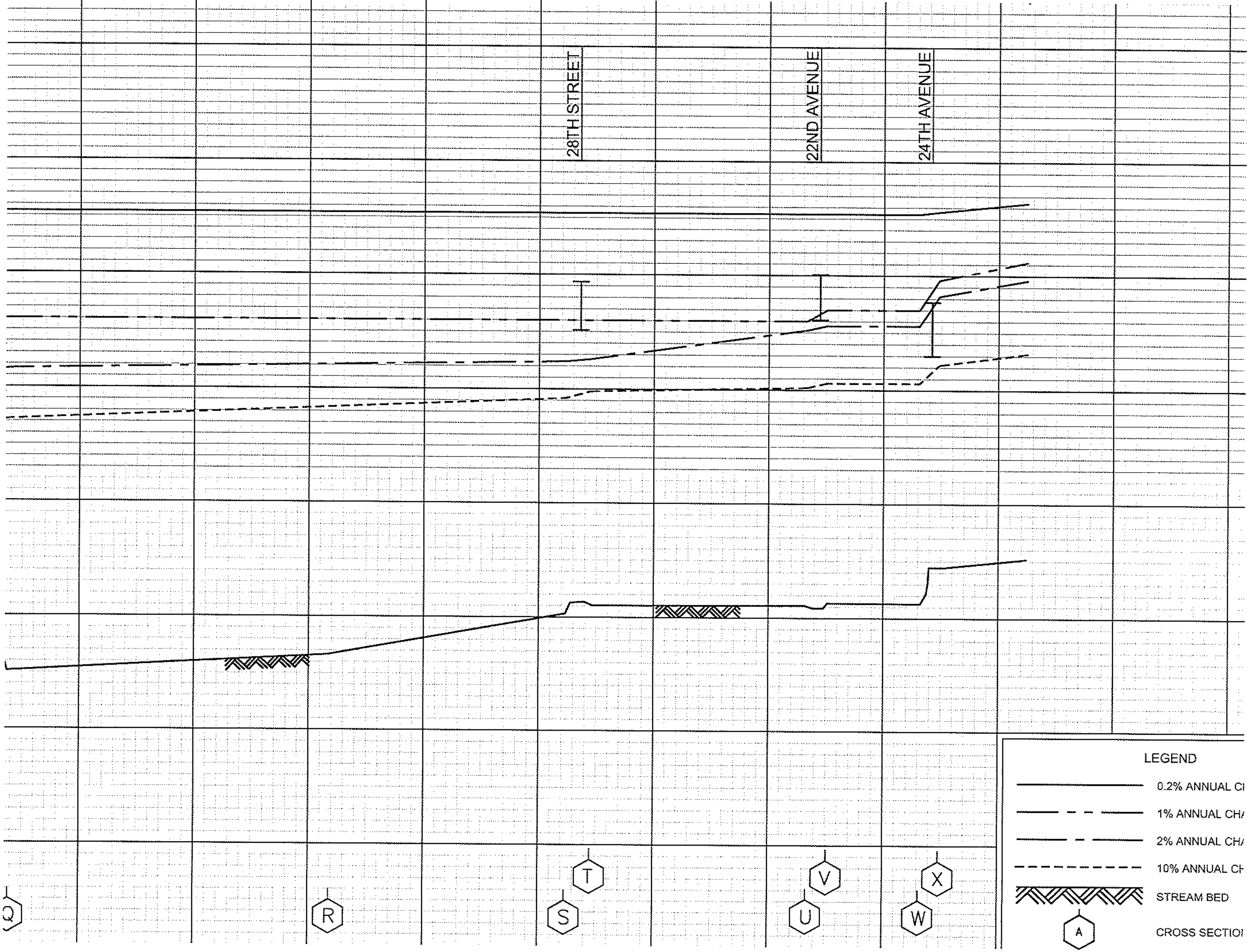
Exhibit 2 – 0.2% Annual Chance Wave Envelopes

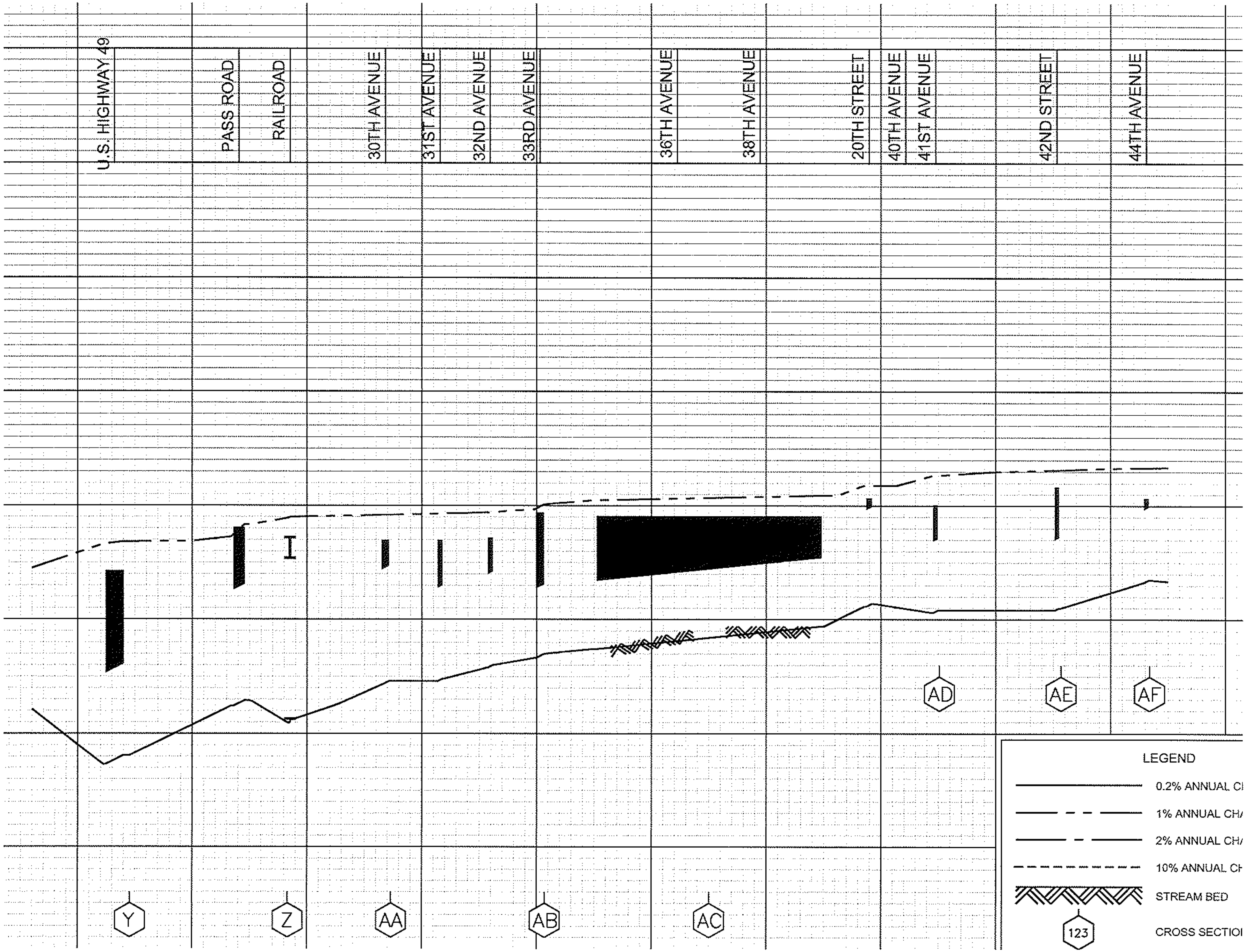
Table of Contents – Volume 3

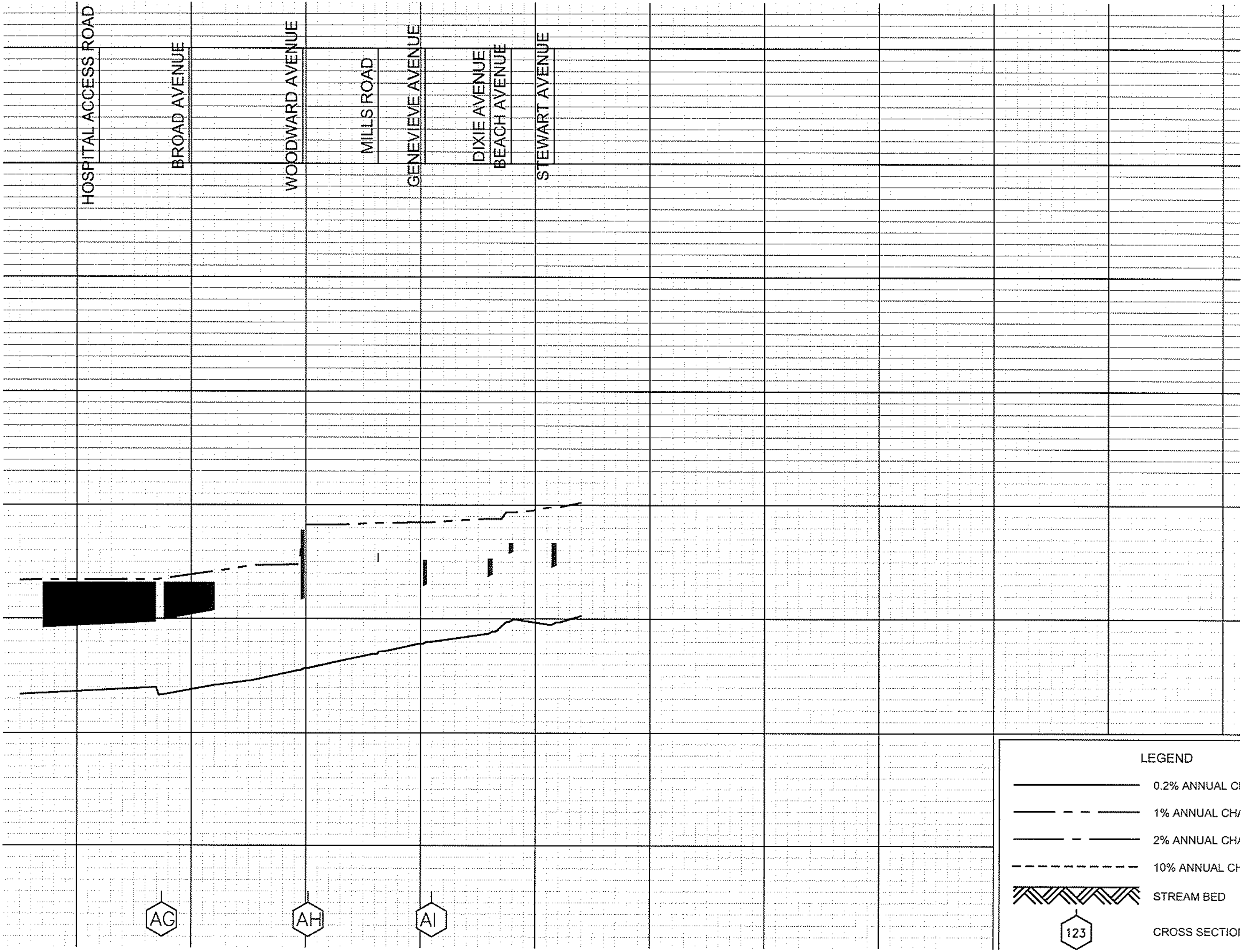
EXHIBITS – continued

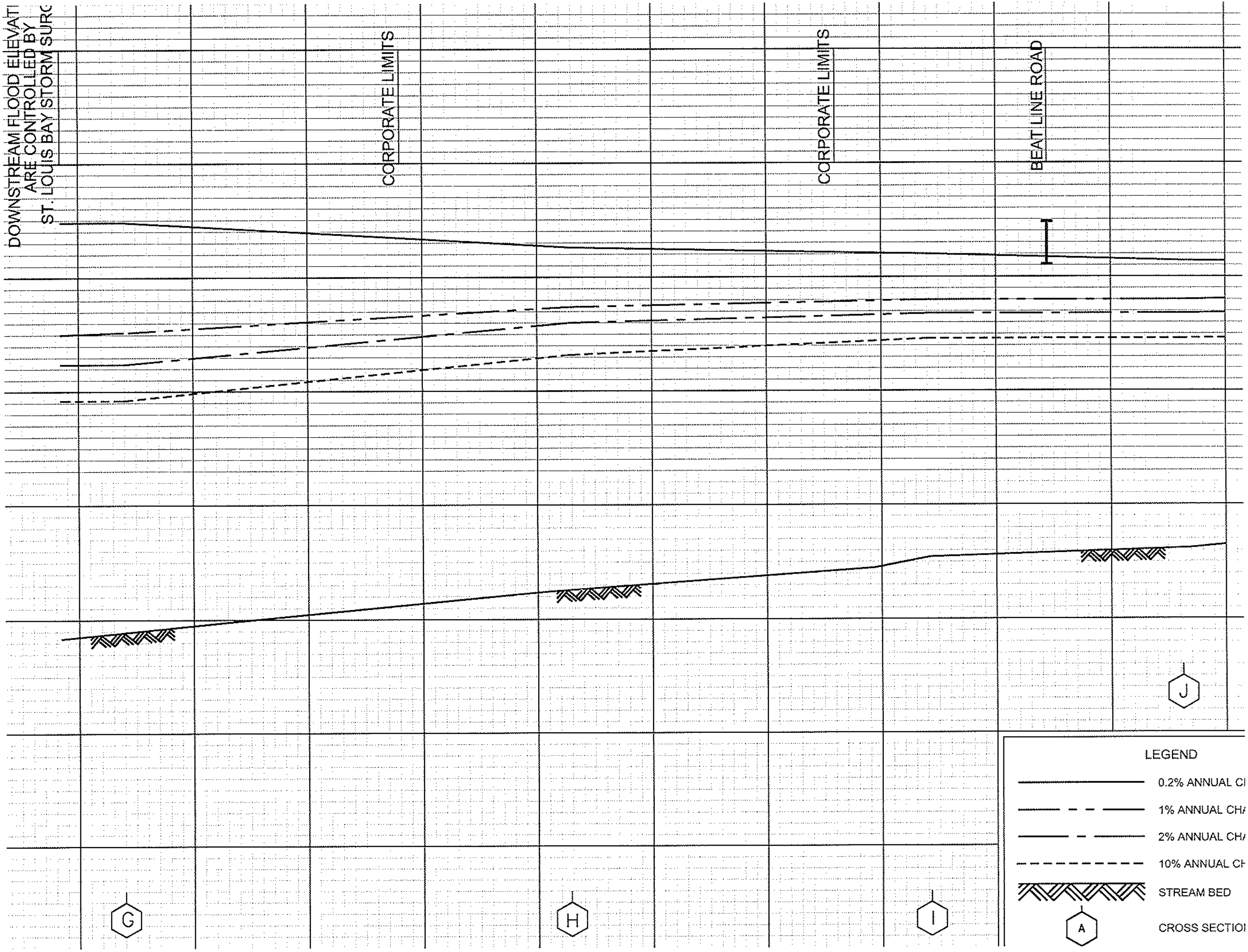
Exhibit 2 – 0.2% Annual Chance Wave Envelopes

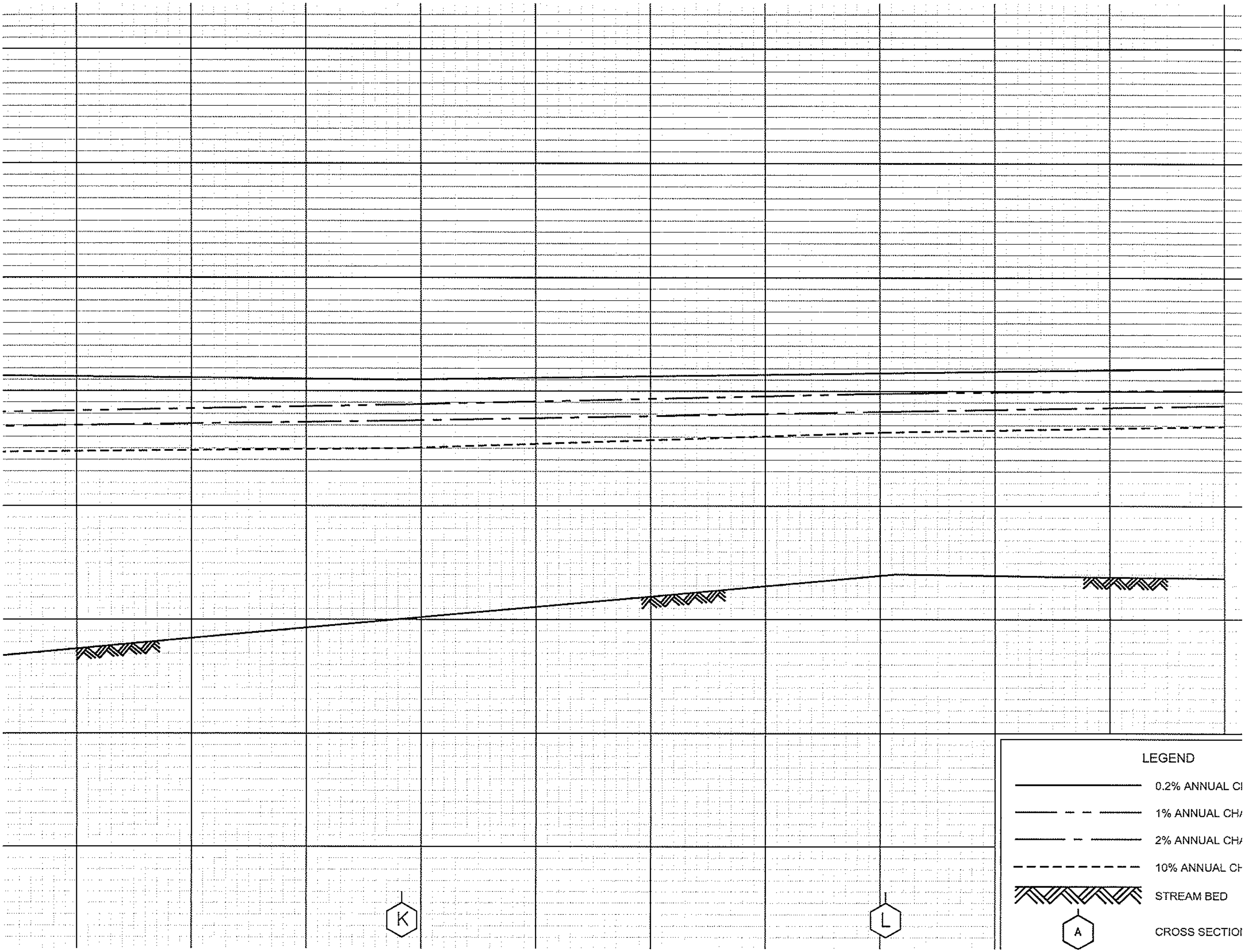
EXHIBITS – continued

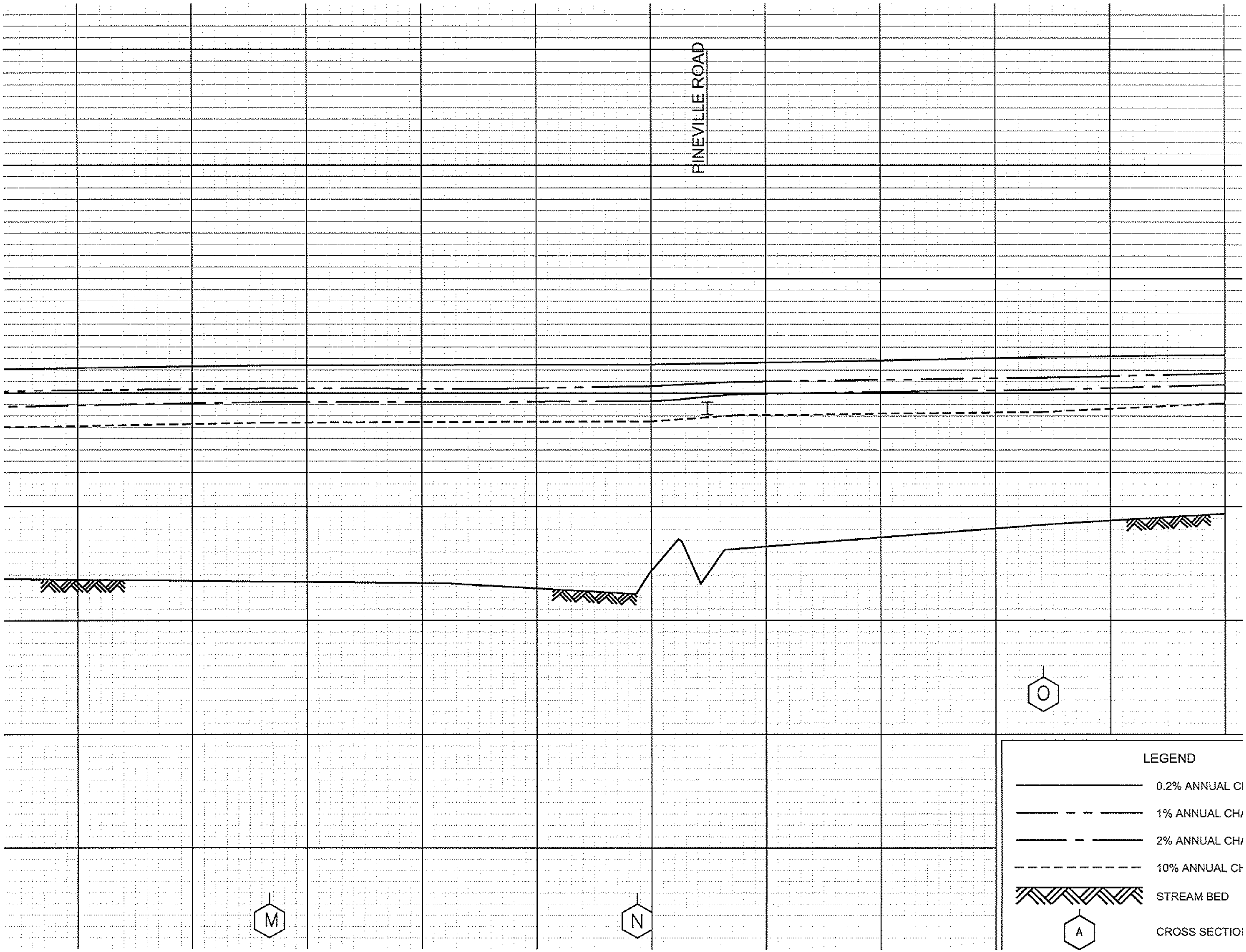

28TH STREET
22ND AVENUE
24TH AVENUE
LEGEND
0.2% ANNUAL C
1% ANNUAL CH
2% ANNUAL CH
10% ANNUAL C
STREAM BED
CROSS SECTIO
A
Q
R
S
T
U
V
W
X

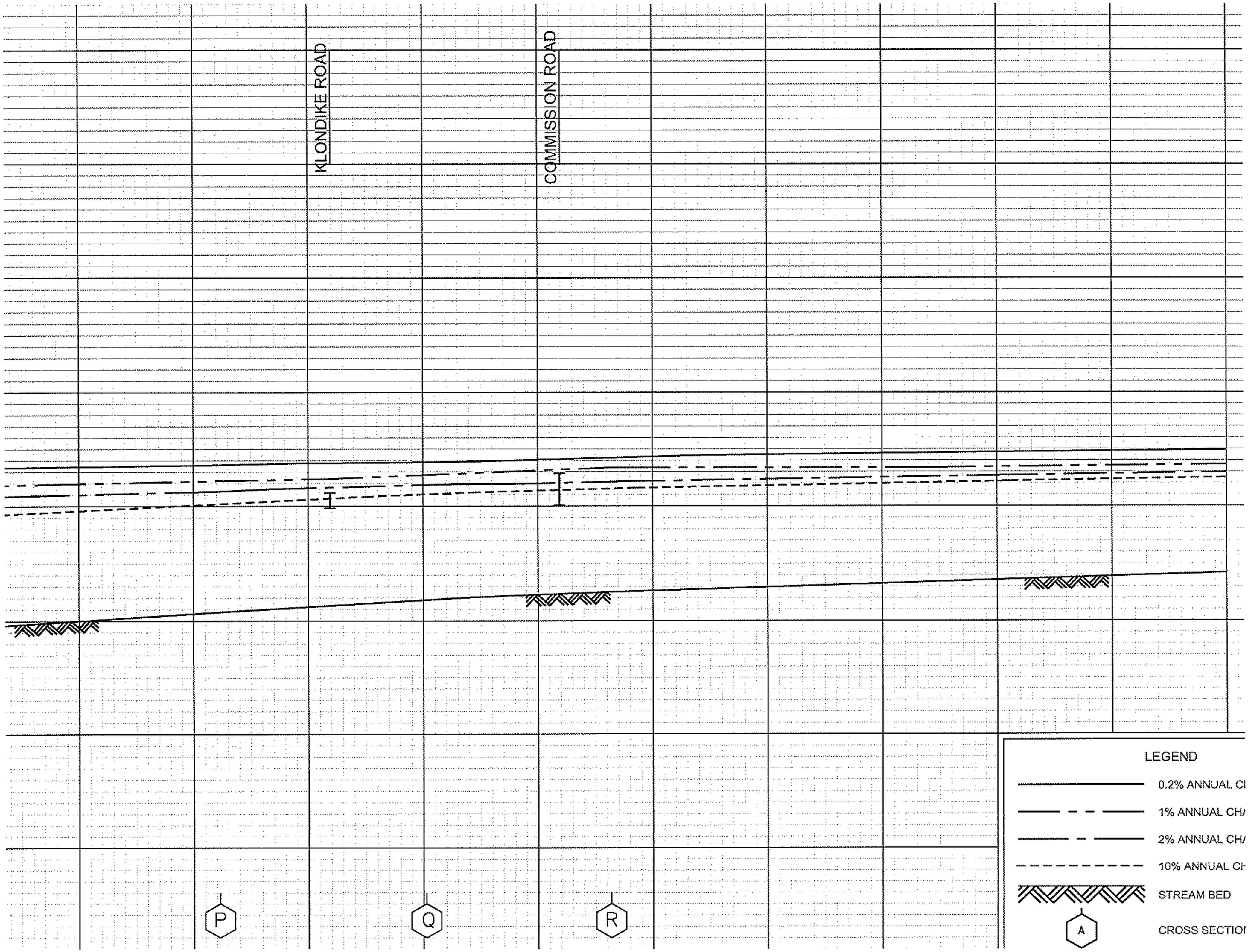

U.S. HIGHWAY 49
PASS ROAD
RAILROAD
30TH AVENUE
31ST AVENUE
32ND AVENUE
33RD AVENUE
36TH AVENUE
38TH AVENUE
20TH STREET
40TH AVENUE
41ST AVENUE
42ND STREET
44TH AVENUE
Y
Z
AA
AB
AC
AD
AE
AF
LEGEND
0.2% ANNUAL C
1% ANNUAL CH
2% ANNUAL CH
10% ANNUAL C
STREAM BED
123
CROSS SECTIO

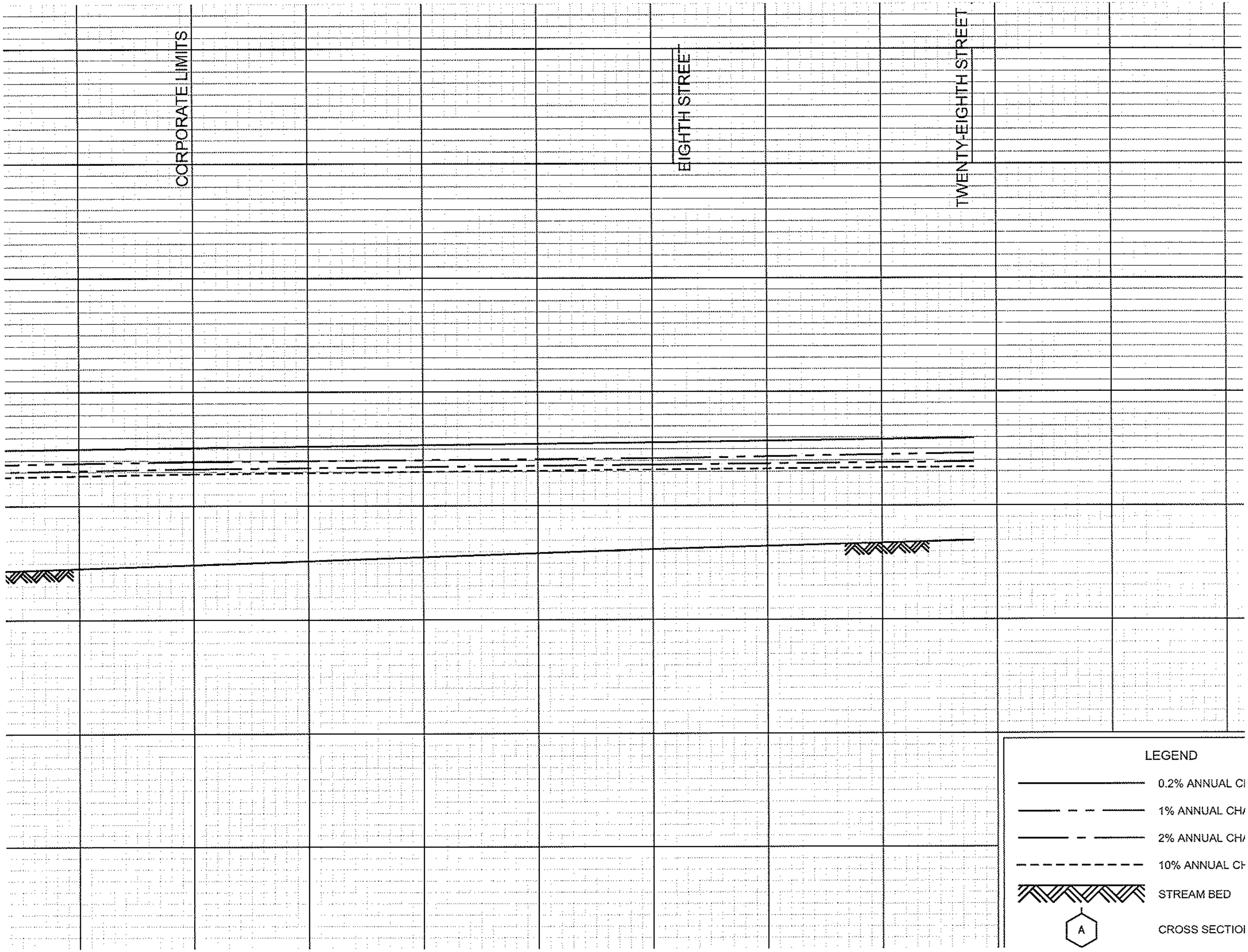

HOSPITAL ACCESS ROAD
BROAD AVENUE
WOODWARD AVENUE
MILLS ROAD
GENEVEVE AVENUE
DIXIE AVENUE
BEACH AVENUE
STEWART AVENUE
AG
AH
AI
LEGEND
0.2% ANNUAL CI
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
123
CROSS SECTIOI

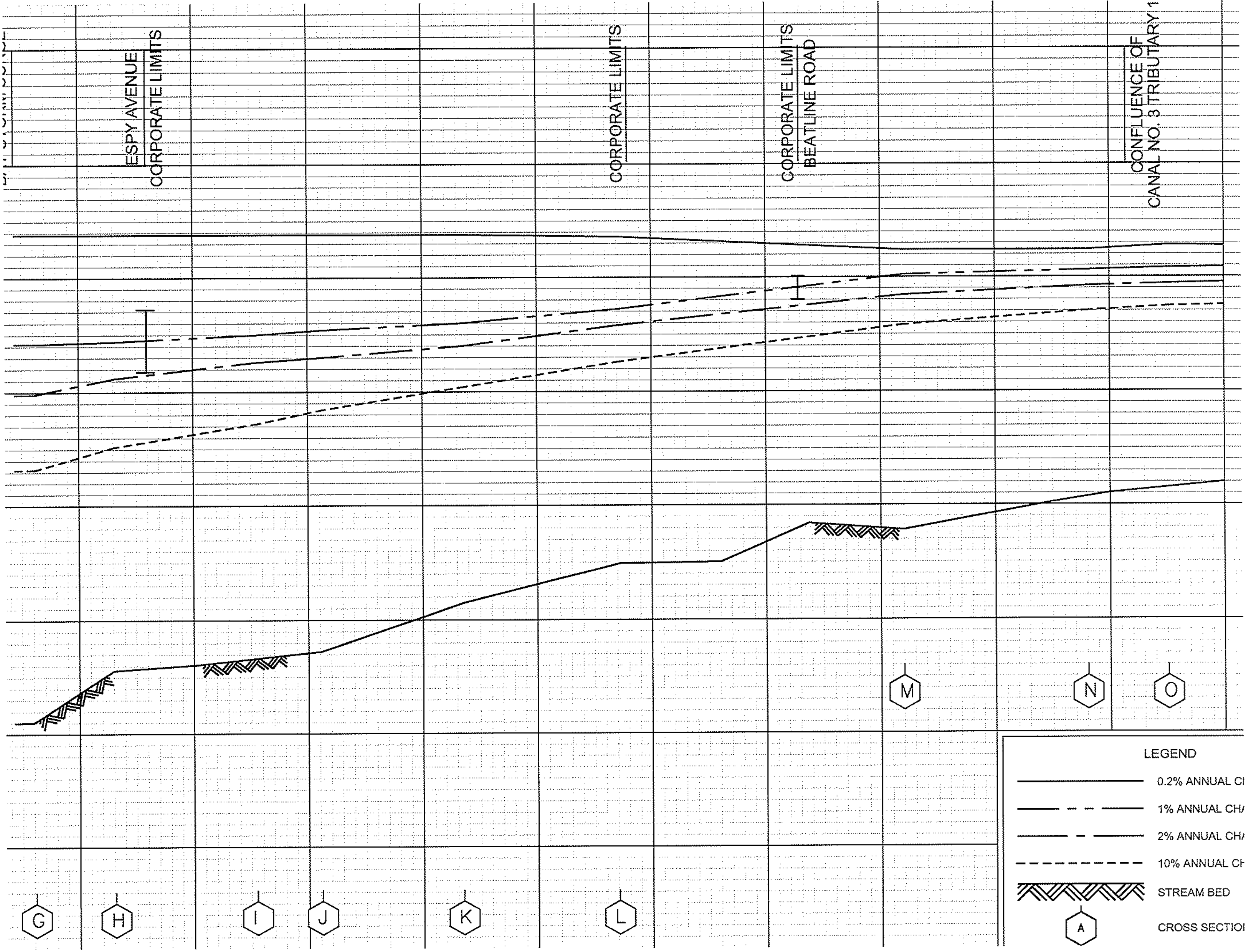

DOWNSTREAM FLOOD ELEVATI
ARE CONTROLLED BY
ST. LOUIS BAY STORM SURG
CORPORATE LIMITS
CORPORATE LIMITS
BEAT LINE ROAD
G
H
I
J
LEGEND
0.2% ANNUAL CI
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTIOI


K
L
LEGEND
0.2% ANNUAL C
1% ANNUAL CH
2% ANNUAL CH
10% ANNUAL C
STREAM BED
A
CROSS SECTIO

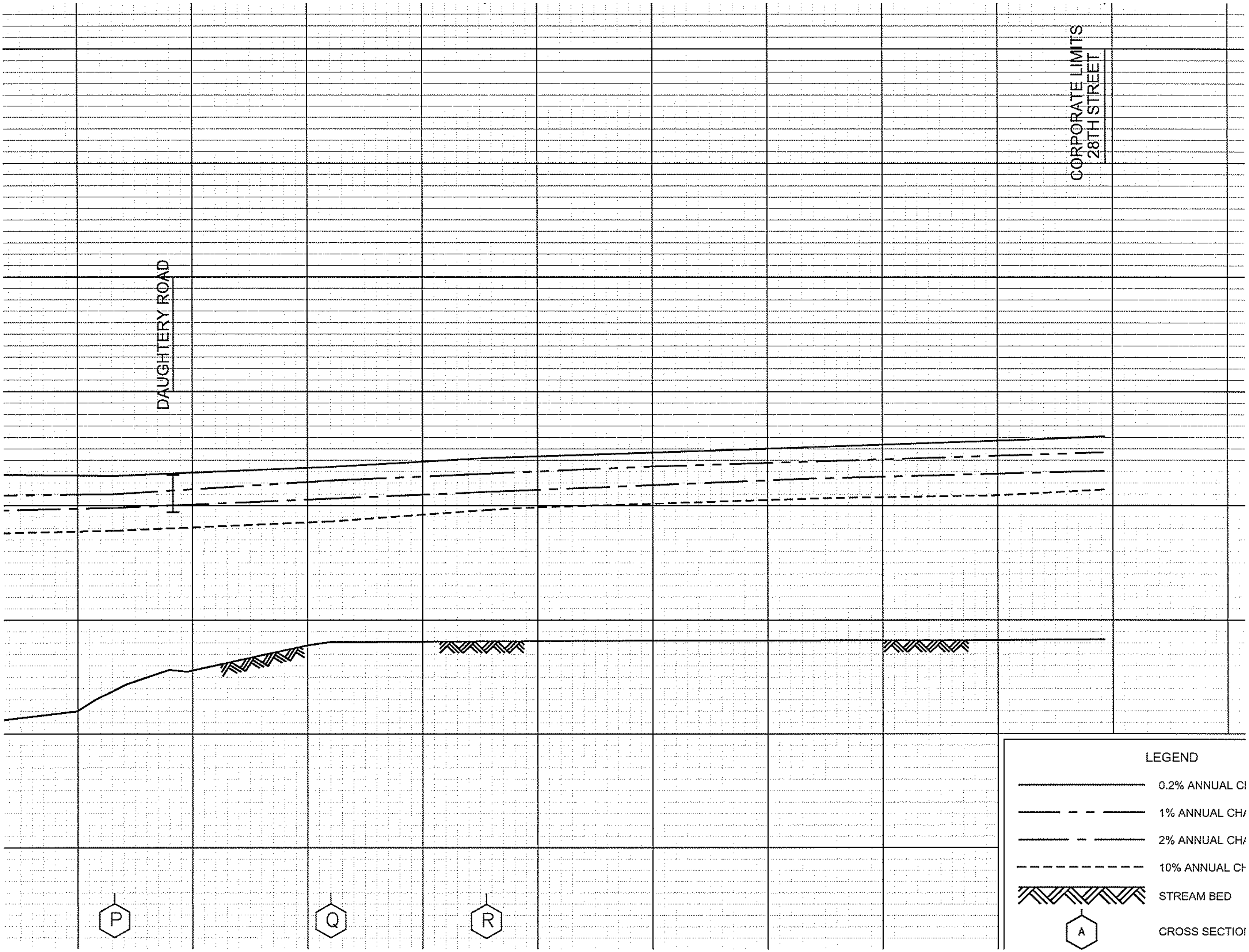

PINEVILLE ROAD
M
N
O
LEGEND
0.2% ANNUAL C
1% ANNUAL CH
2% ANNUAL CH
10% ANNUAL C
STREAM BED
CROSS SECTIO


KLONDIKE ROAD
COMMISSION ROAD
P
Q
R
LEGEND
0.2% ANNUAL CI
1% ANNUAL CH/
2% ANNUAL CH/
10% ANNUAL CI
STREAM BED
A
CROSS SECTIOI

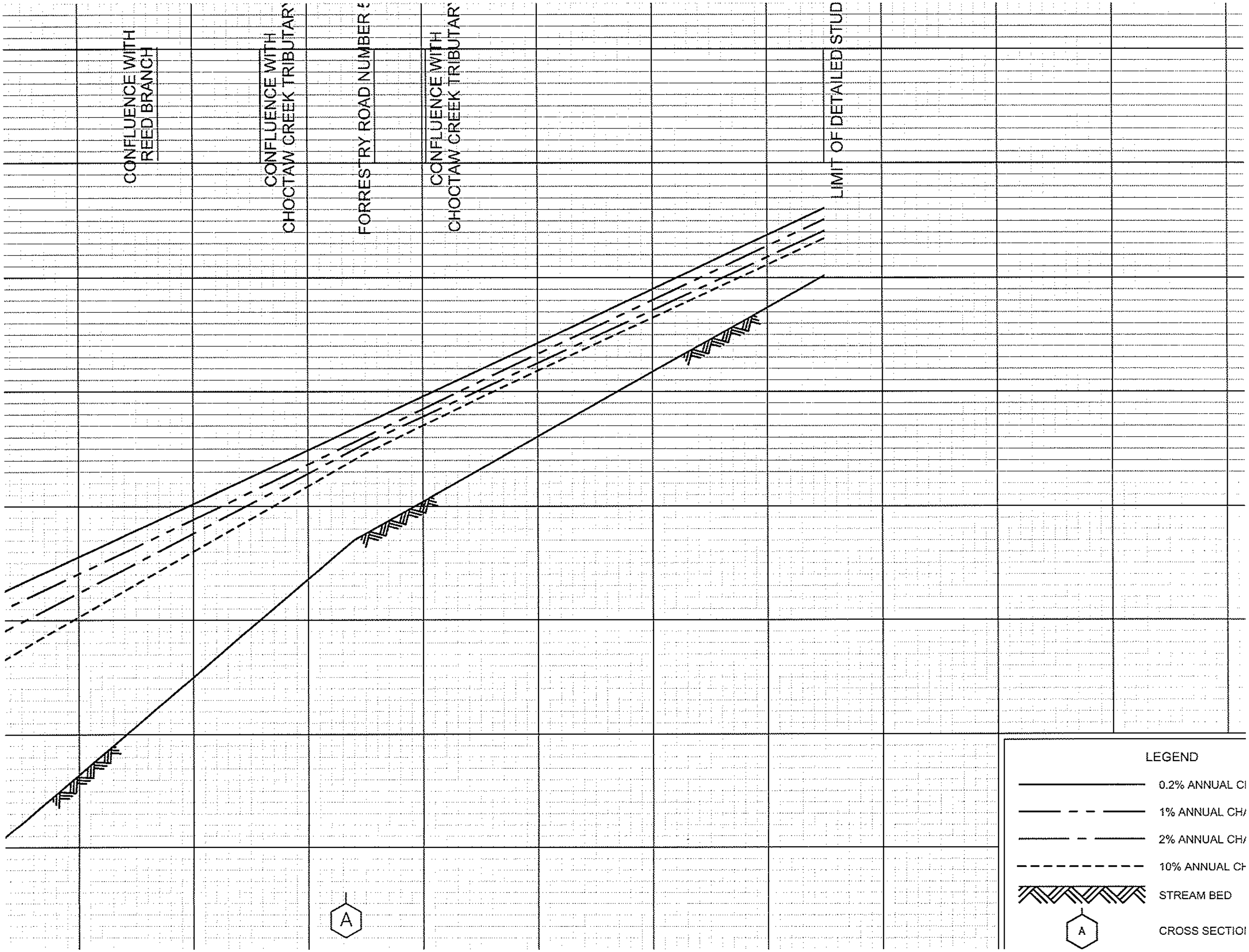

CORPORATE LIMITS
EIGHTH STREET
TWENTY-EIGHTH STREET
LEGEND
0.2% ANNUAL CI
1% ANNUAL CH/
2% ANNUAL CH/
10% ANNUAL CH
STREAM BED
A
CROSS SECTIOI



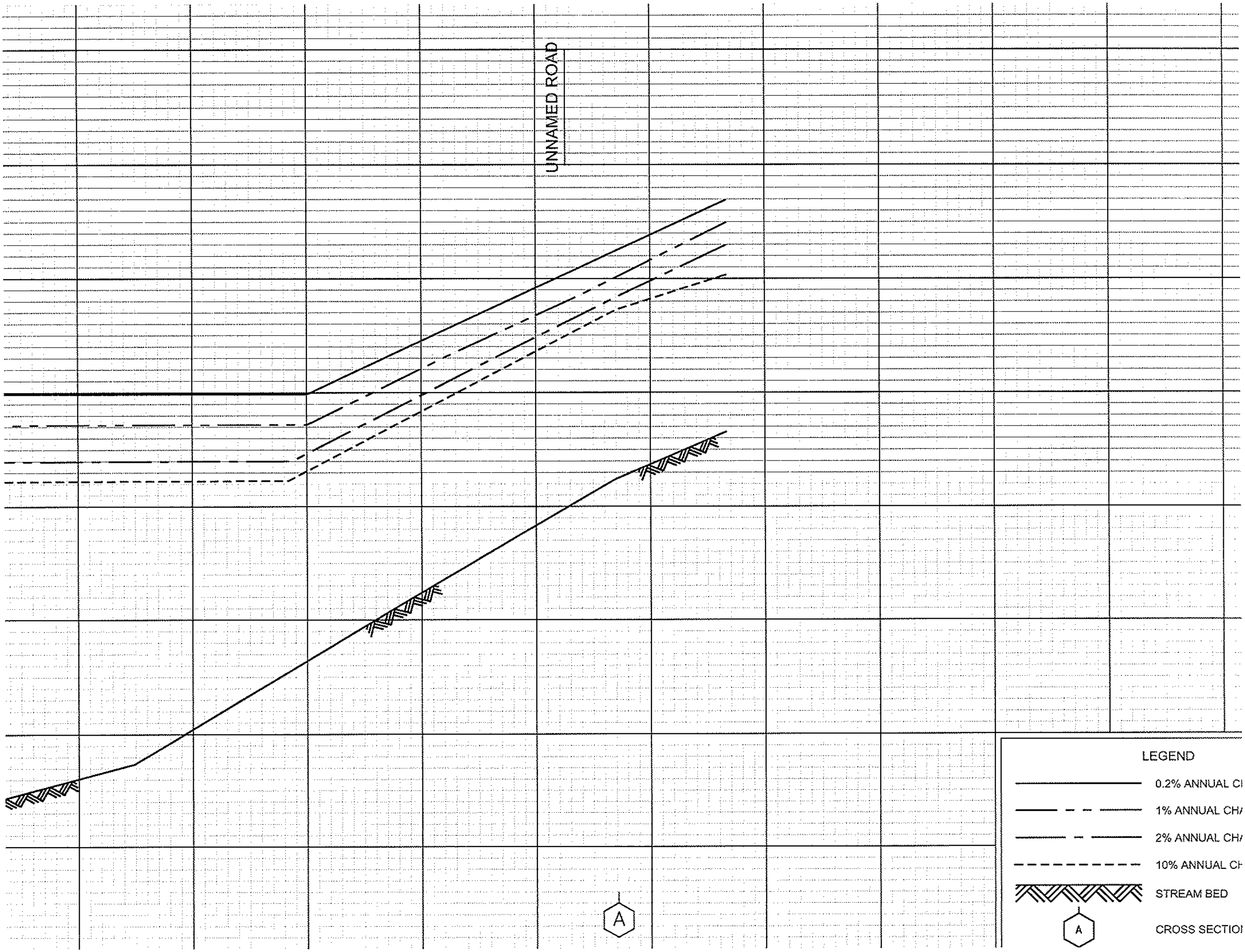
ESPY AVENUE
CORPORATE LIMITS
CORPORATE LIMITS
CORPORATE LIMITS
BEATLINE ROAD
CONFLUENCE OF
CANAL NO. 3 TRIBUTARY 1
G
H
I
J
K
L
M
N
O
LEGEND
0.2% ANNUAL CI
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTIO



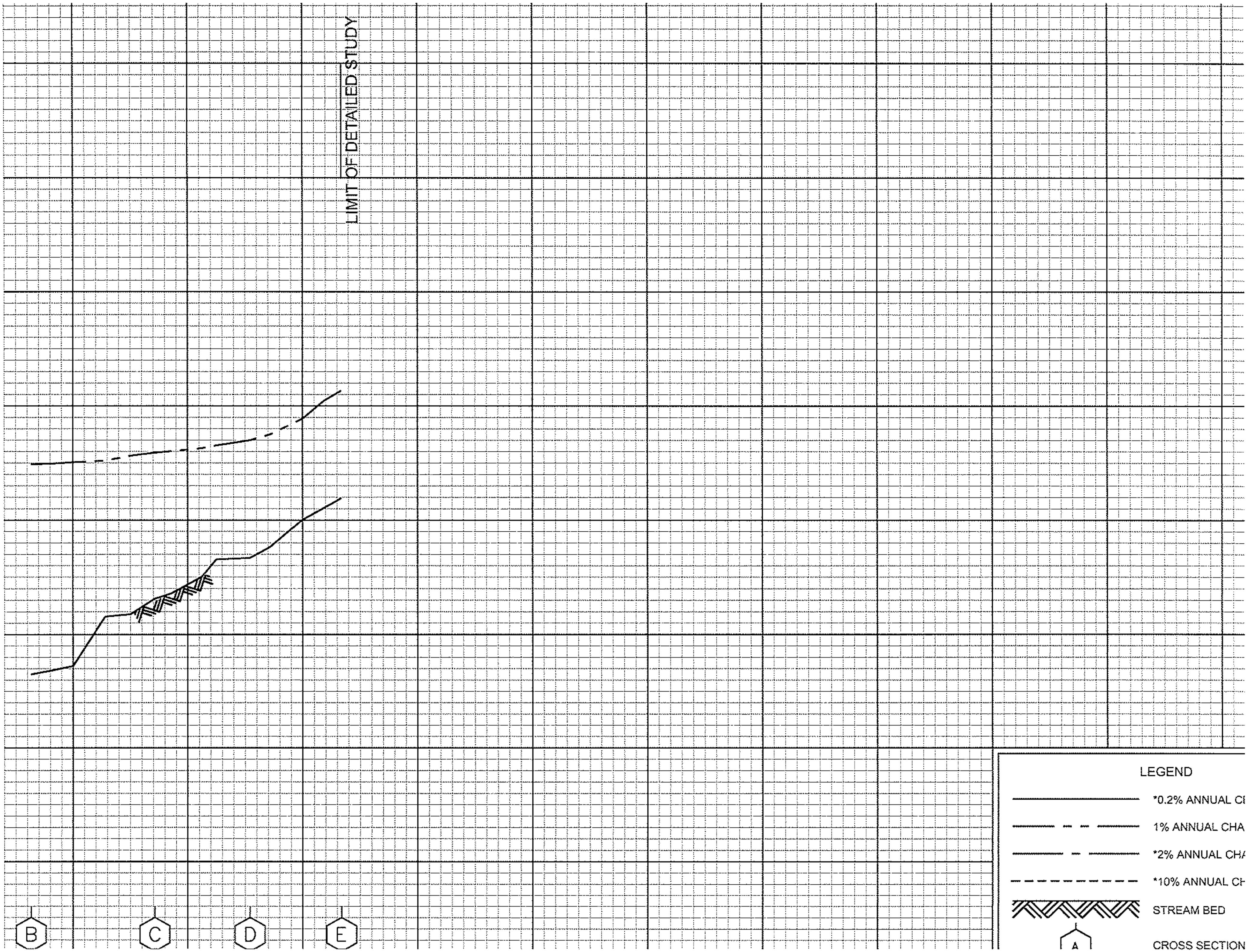
DAUGHTERY ROAD
CORPORATE LIMITS
28TH STREET
P
Q
R
LEGEND
0.2% ANNUAL C
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL C
STREAM BED
A
CROSS SECTIO



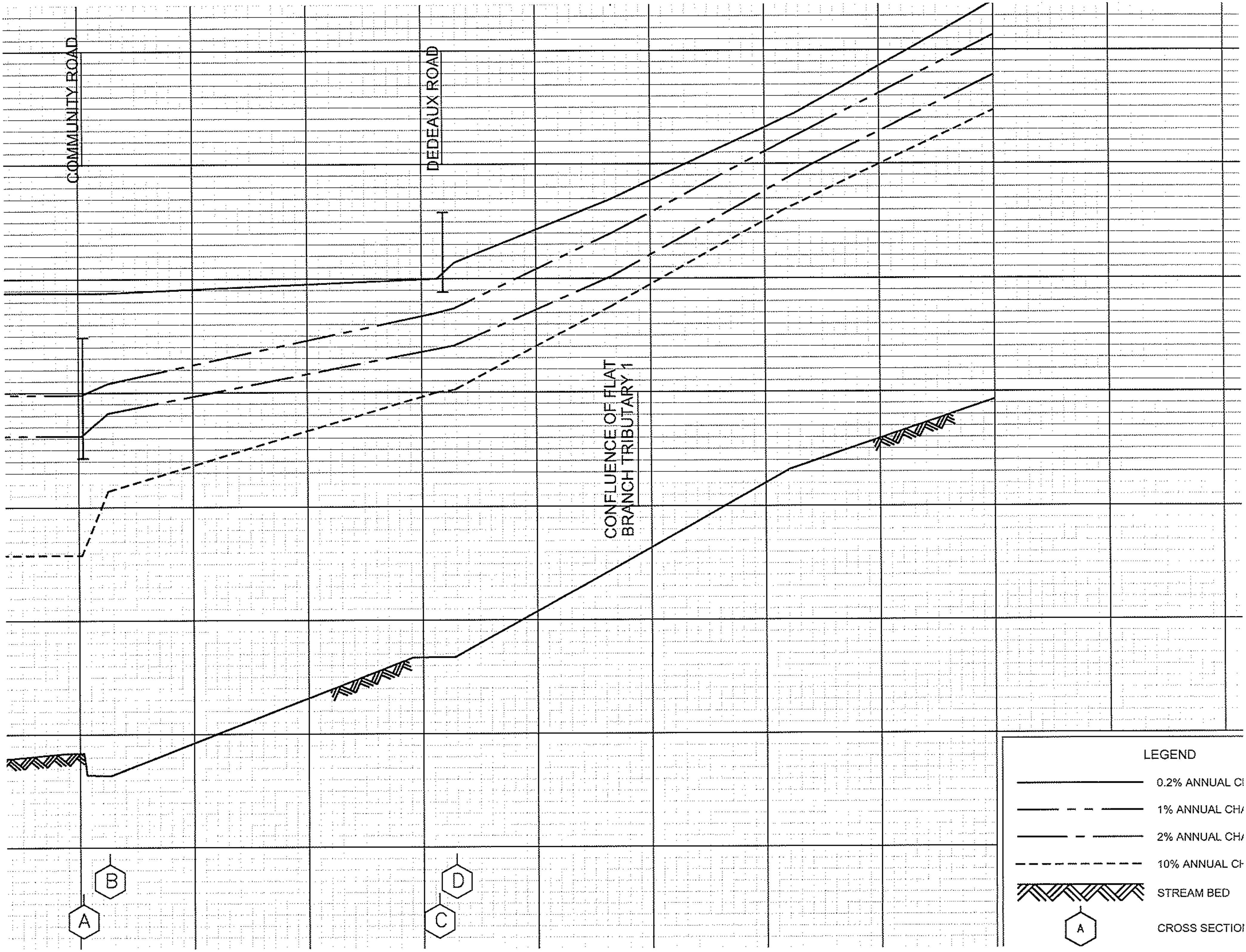
CONFLUENCE WITH REED BRANCH
CONFLUENCE WITH CHOCTAW CREEK TRIBUTARY
FORRESTRY ROAD NUMBER 5
CONFLUENCE WITH CHOCTAW CREEK TRIBUTARY
LIMIT OF DETAILED STUD
A
LEGEND
0.2% ANNUAL CH
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTIO



UNNAMED ROAD
A
LEGEND
0.2% ANNUAL CH
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
CROSS SECTION



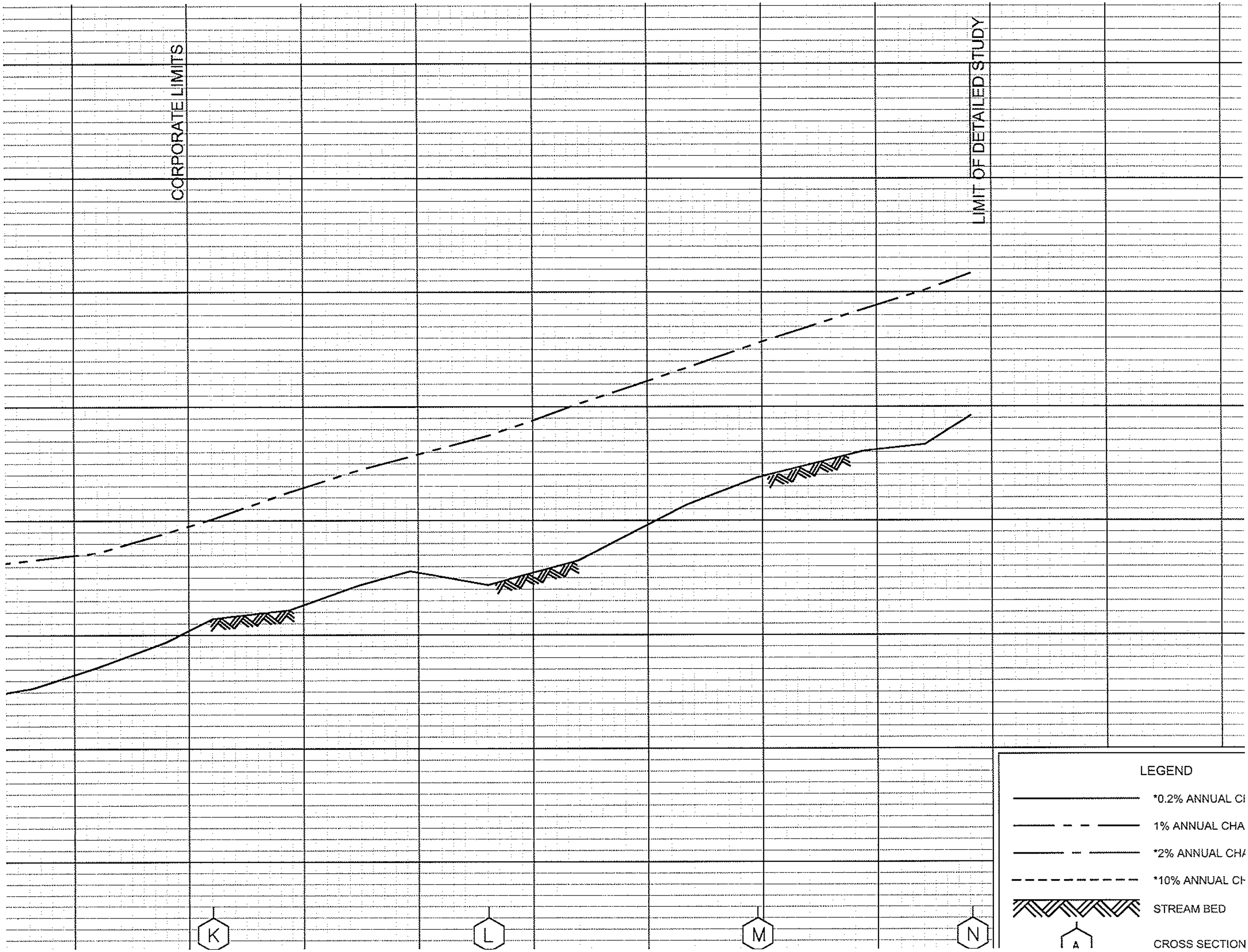
LIMIT OF DETAILED STUDY
B
C
D
E
LEGEND
*0.2% ANNUAL C
1% ANNUAL CHA
*2% ANNUAL CHA
*10% ANNUAL CH
STREAM BED
A
CROSS SECTION



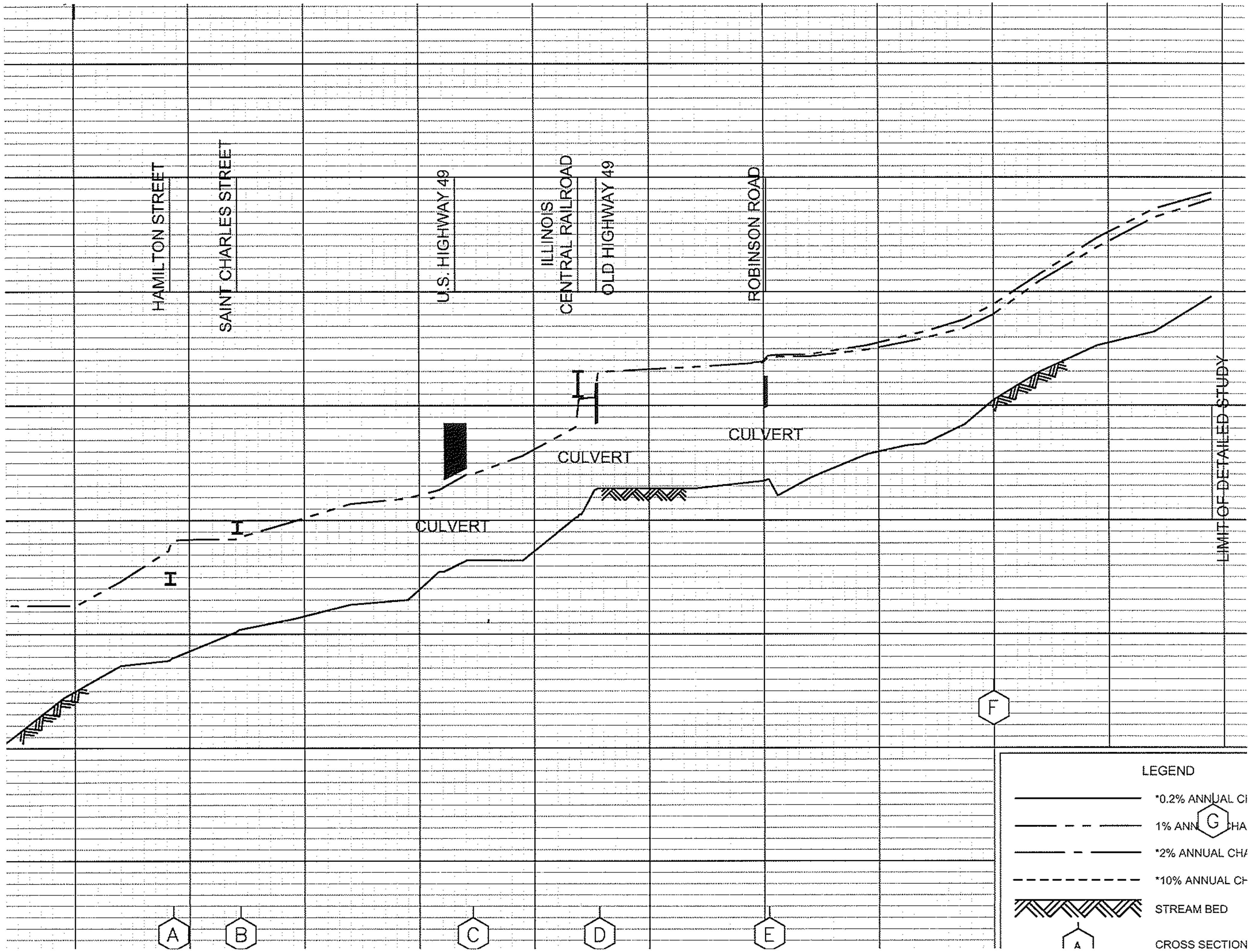
COMMUNITY ROAD
DEDEAUX ROAD
CONFLUENCE OF FLAT BRANCH TRIBUTARY 1
A
B
C
D
LEGEND
0.2% ANNUAL CI
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
CROSS SECTIO

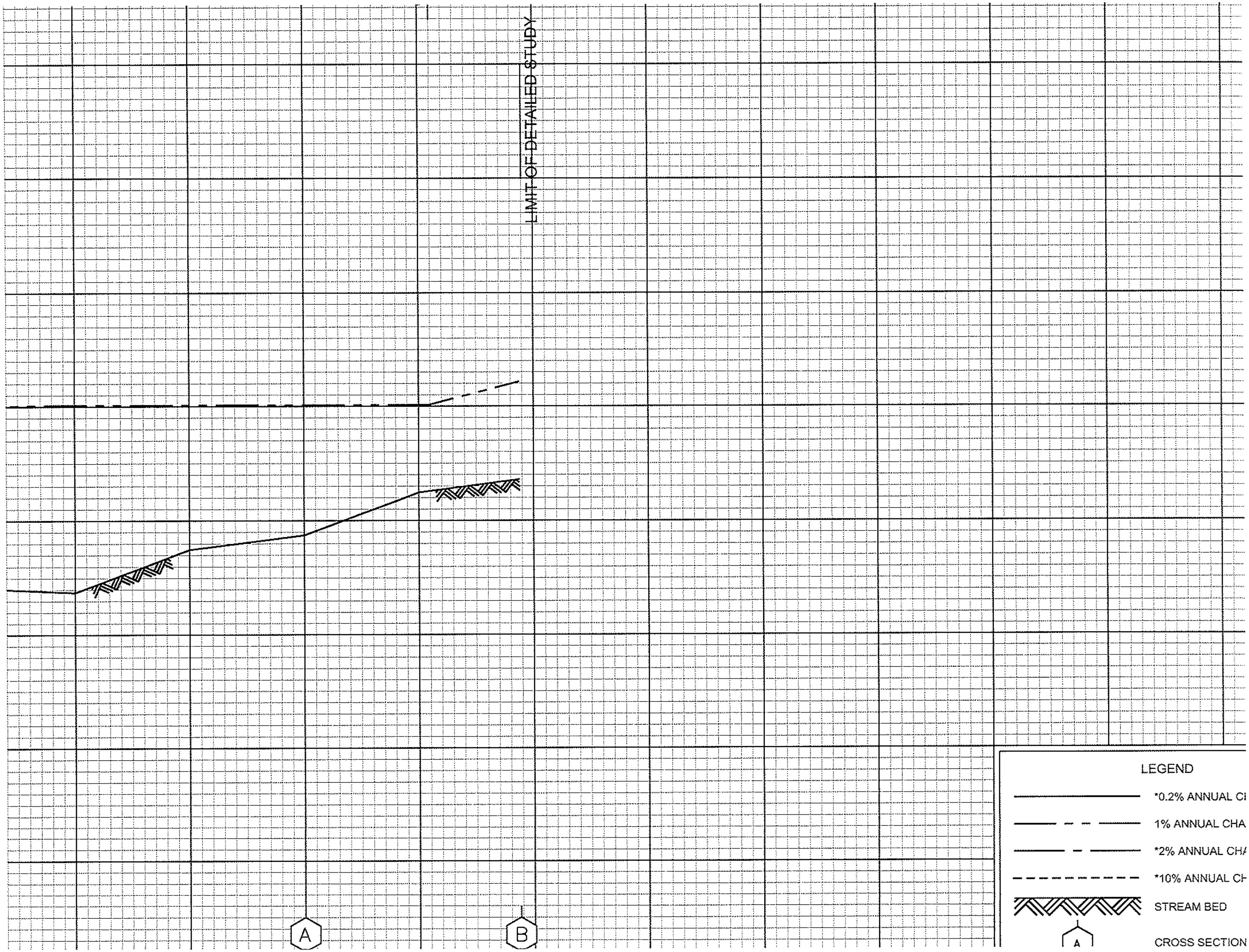

O'NEAL ROAD
E
F
LEGEND
0.2% ANNUAL CI
1% ANNUAL CH/
2% ANNUAL CH/
10% ANNUAL CH
STREAM BED
A
CROSS SECTIOI

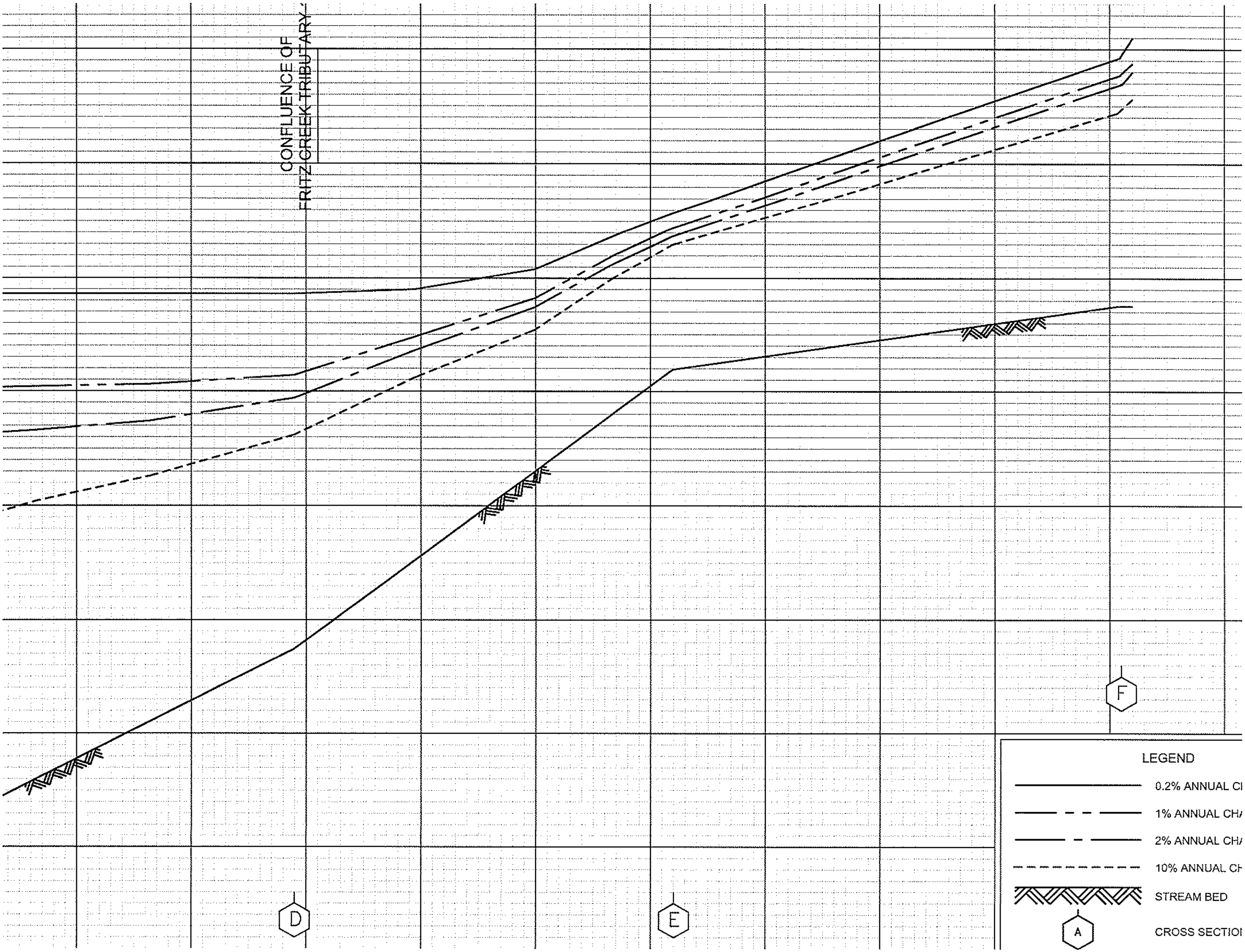
STATE ROAD 49
RAILROAD
OLD HIGHWAY 49
CONFLUENCE OF FLAT BRANCH TRIBUTARY 2
H
I
LEGEND
0.2% ANNUAL CH
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTION



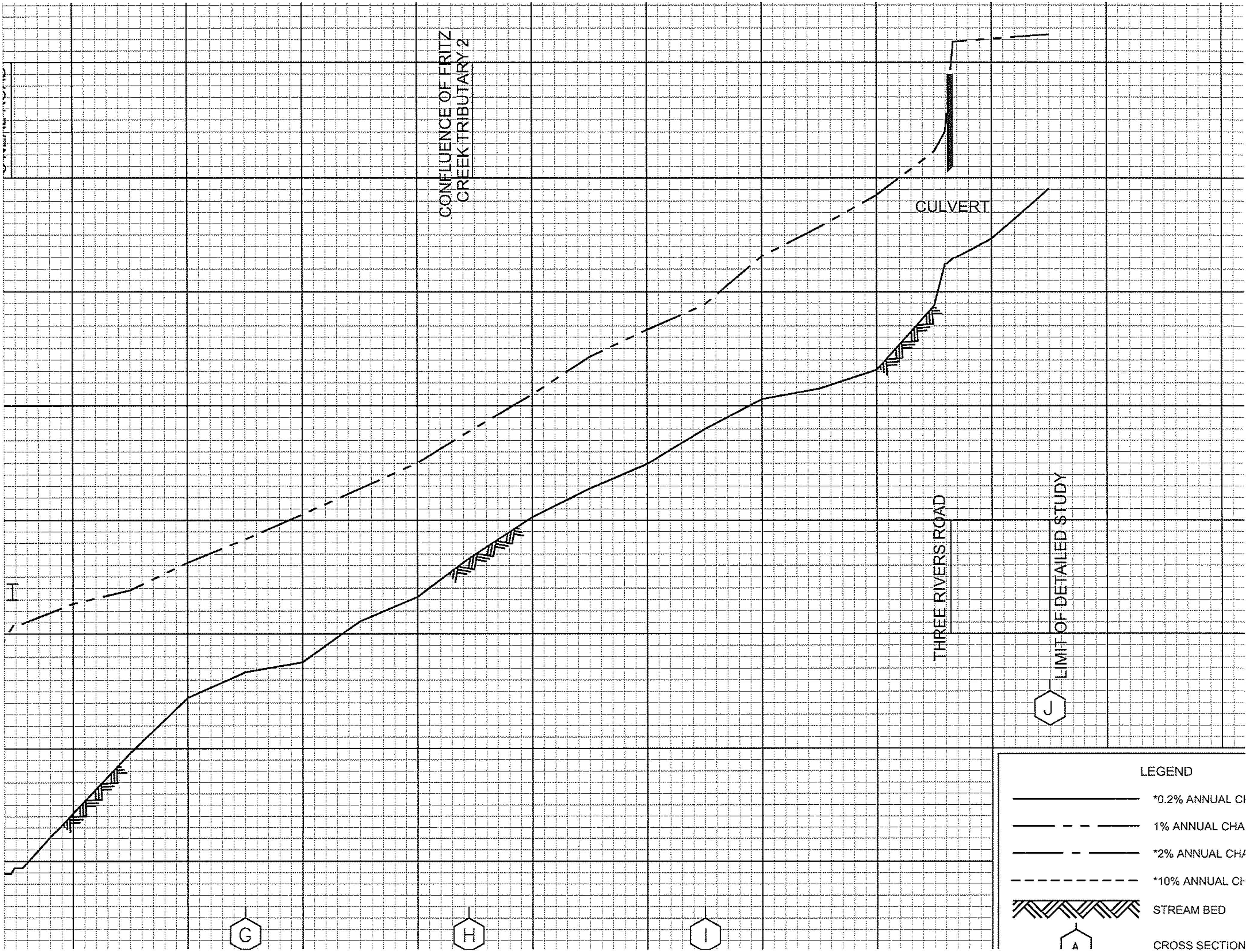
CORPORATE LIMITS
LIMIT OF DETAILED STUDY
K
L
M
N
LEGEND
*0.2% ANNUAL CI
1% ANNUAL CHA
*2% ANNUAL CHA
*10% ANNUAL CH
STREAM BED
A
CROSS SECTION

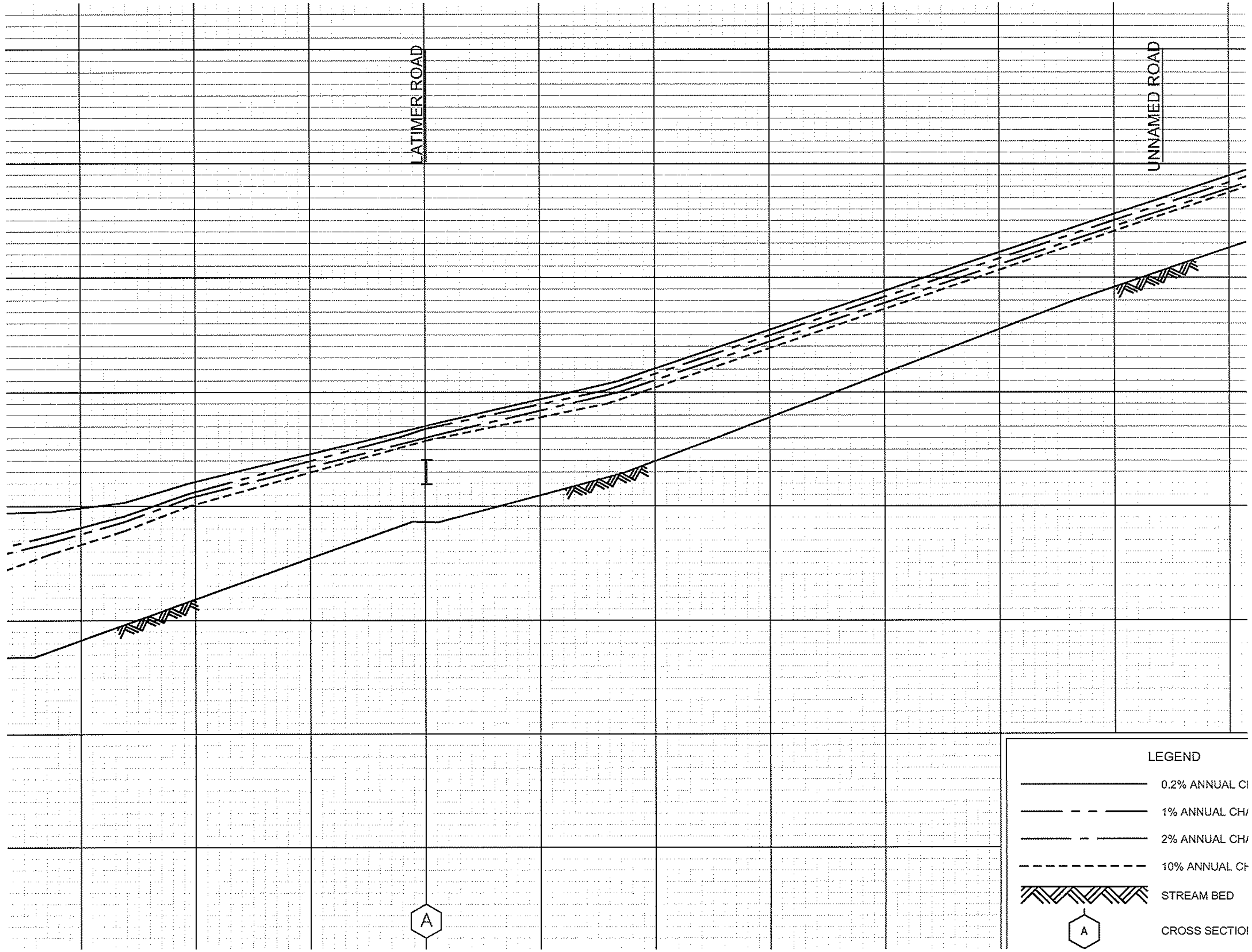

HAMILTON STREET
SAINT CHARLES STREET
U.S. HIGHWAY 49
ILLINOIS CENTRAL RAILROAD
OLD HIGHWAY 49
ROBINSON ROAD
CULVERT
CULVERT
CULVERT
LIMIT OF DETAILED STUDY
A
B
C
D
E
F
G
LEGEND
*0.2% ANNUAL CI
1% ANN CHA
*2% ANNUAL CHA
*10% ANNUAL CH
STREAM BED
CROSS SECTION

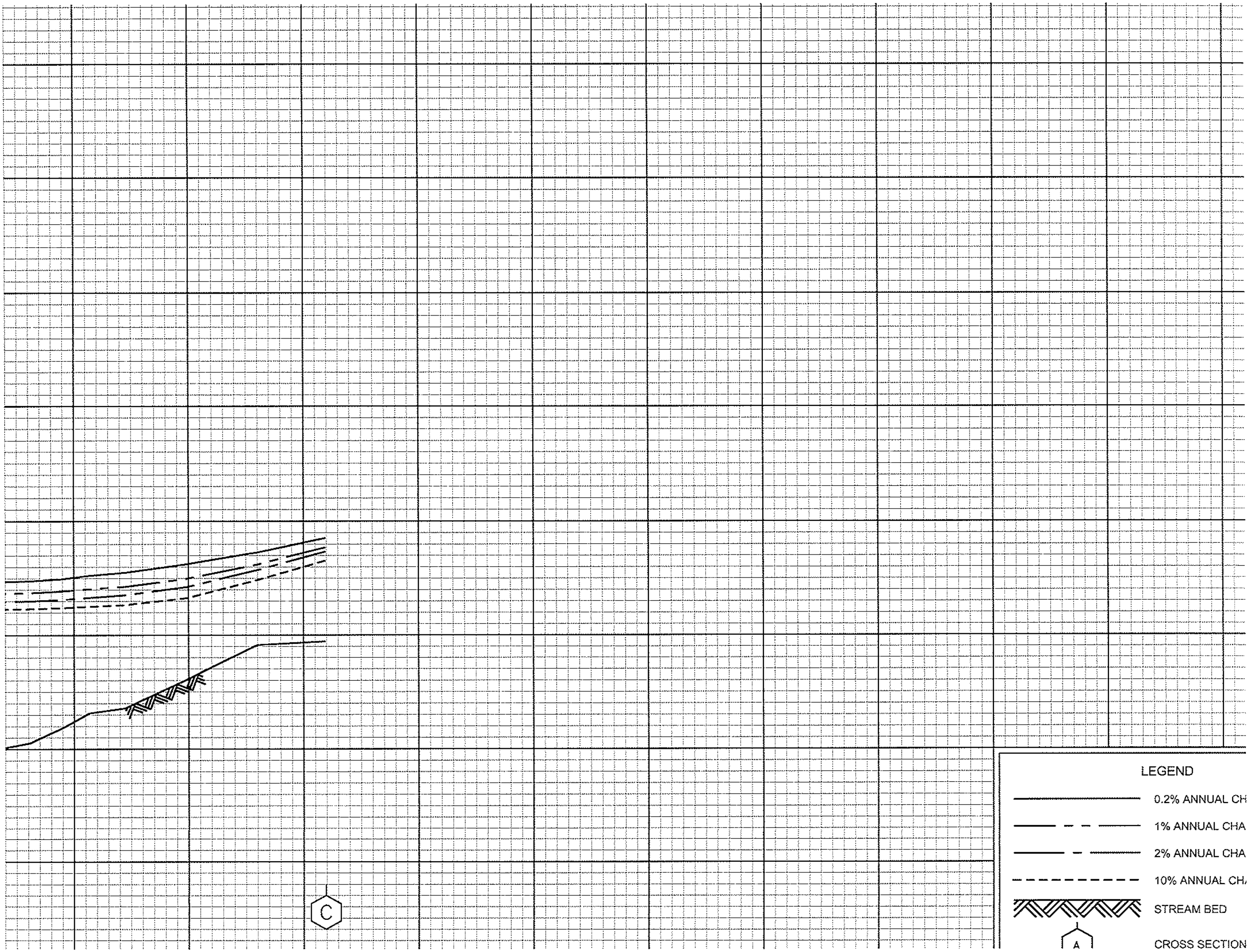

LIMIT OF DETAILED STUDY
A
B
LEGEND
*0.2% ANNUAL CI
1% ANNUAL CHA
*2% ANNUAL CHA
*10% ANNUAL CH
STREAM BED
A
CROSS SECTION



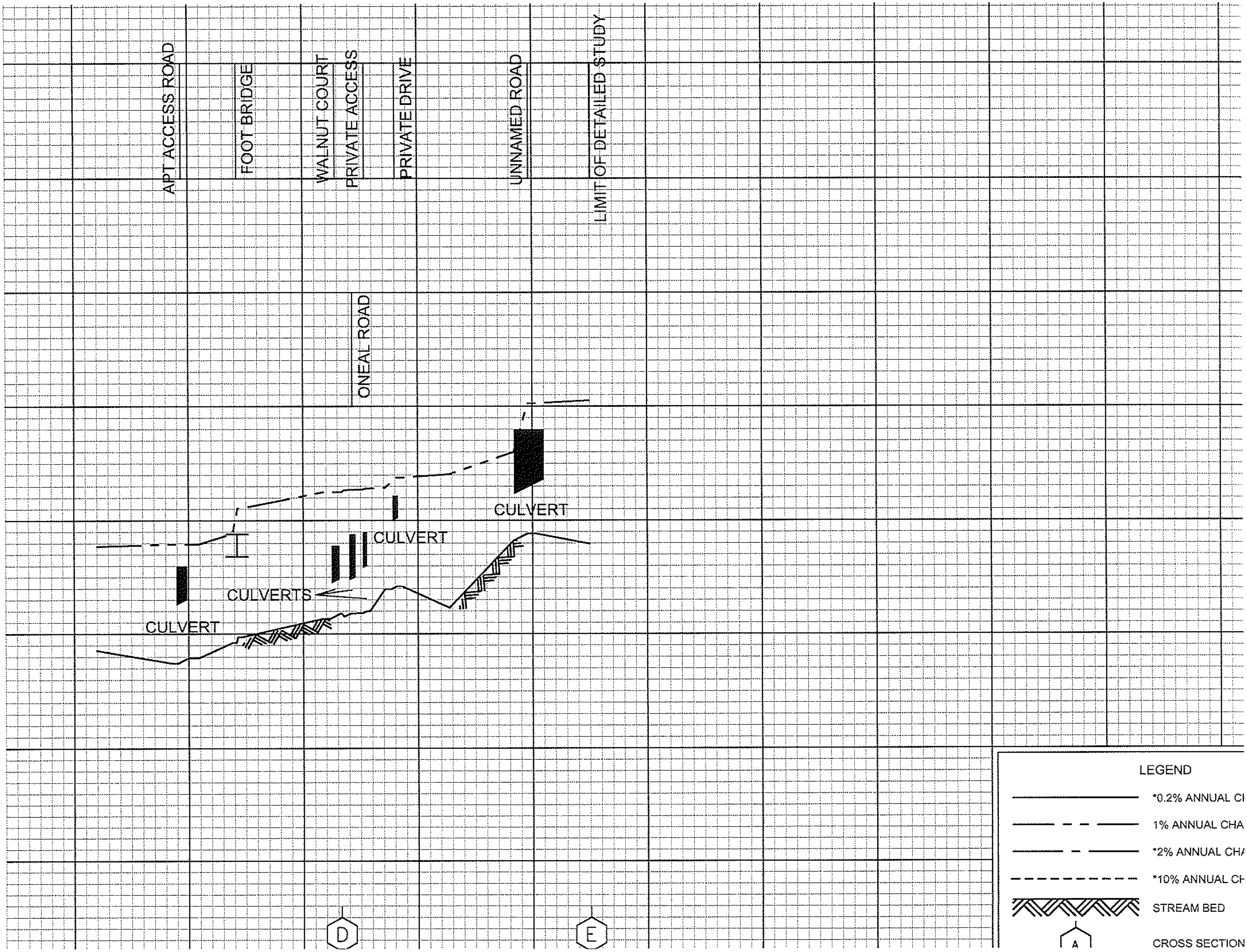
CONFLUENCE OF
FRITZ CREEK TRIBUTARY
D
E
F
LEGEND
0.2% ANNUAL CI
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTIO


CONFLUENCE OF FRITZ CREEK TRIBUTARY 2
CULVERT
THREE RIVERS ROAD
LIMIT OF DETAILED STUDY
G
H
I
J
LEGEND
*0.2% ANNUAL CI
1% ANNUAL CHA
*2% ANNUAL CHA
*10% ANNUAL CH
STREAM BED
A
CROSS SECTION

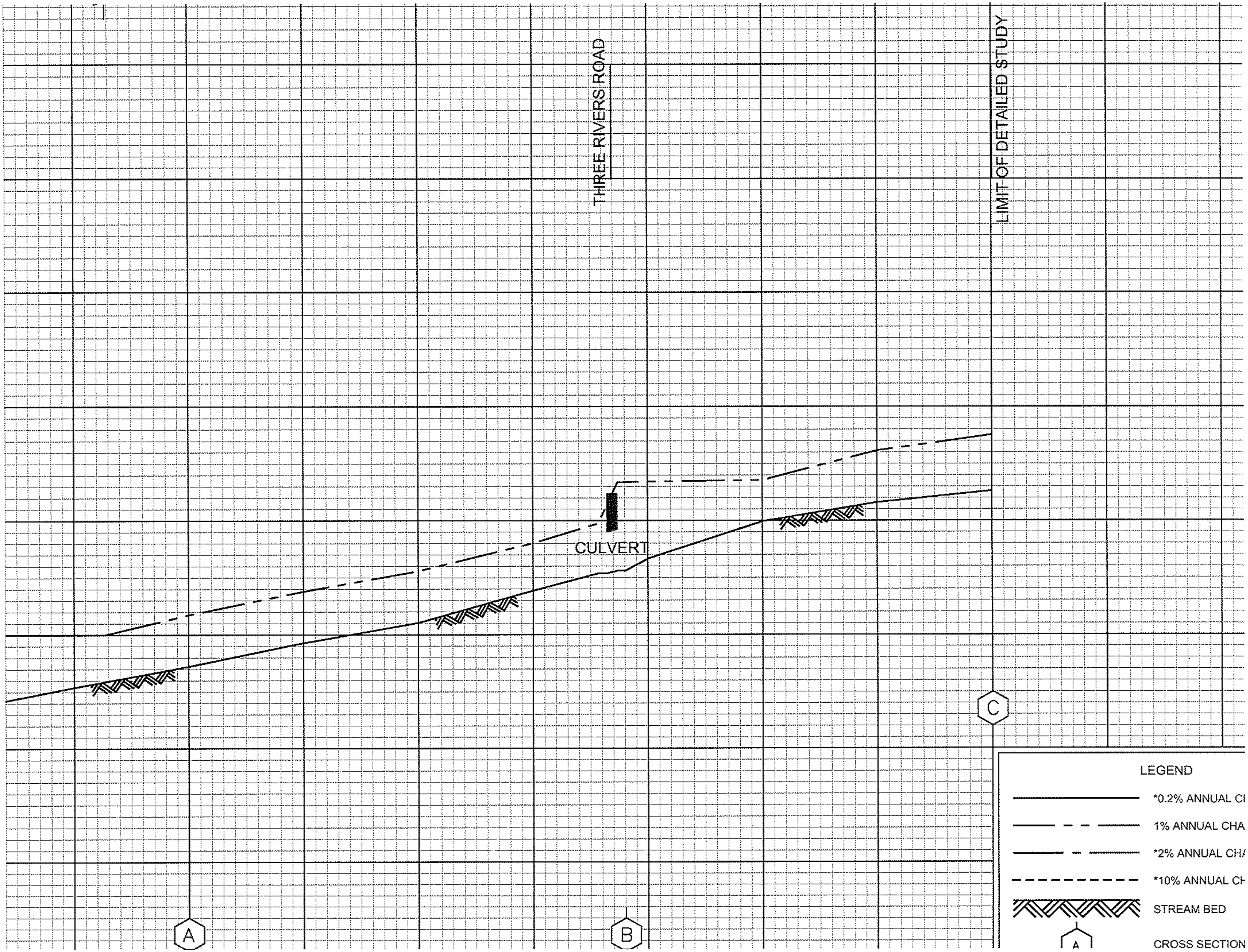

LATIMER ROAD
UNNAMED ROAD
A
LEGEND
0.2% ANNUAL C
1% ANNUAL CH
2% ANNUAL CH
10% ANNUAL C
STREAM BED
A
CROSS SECTIO

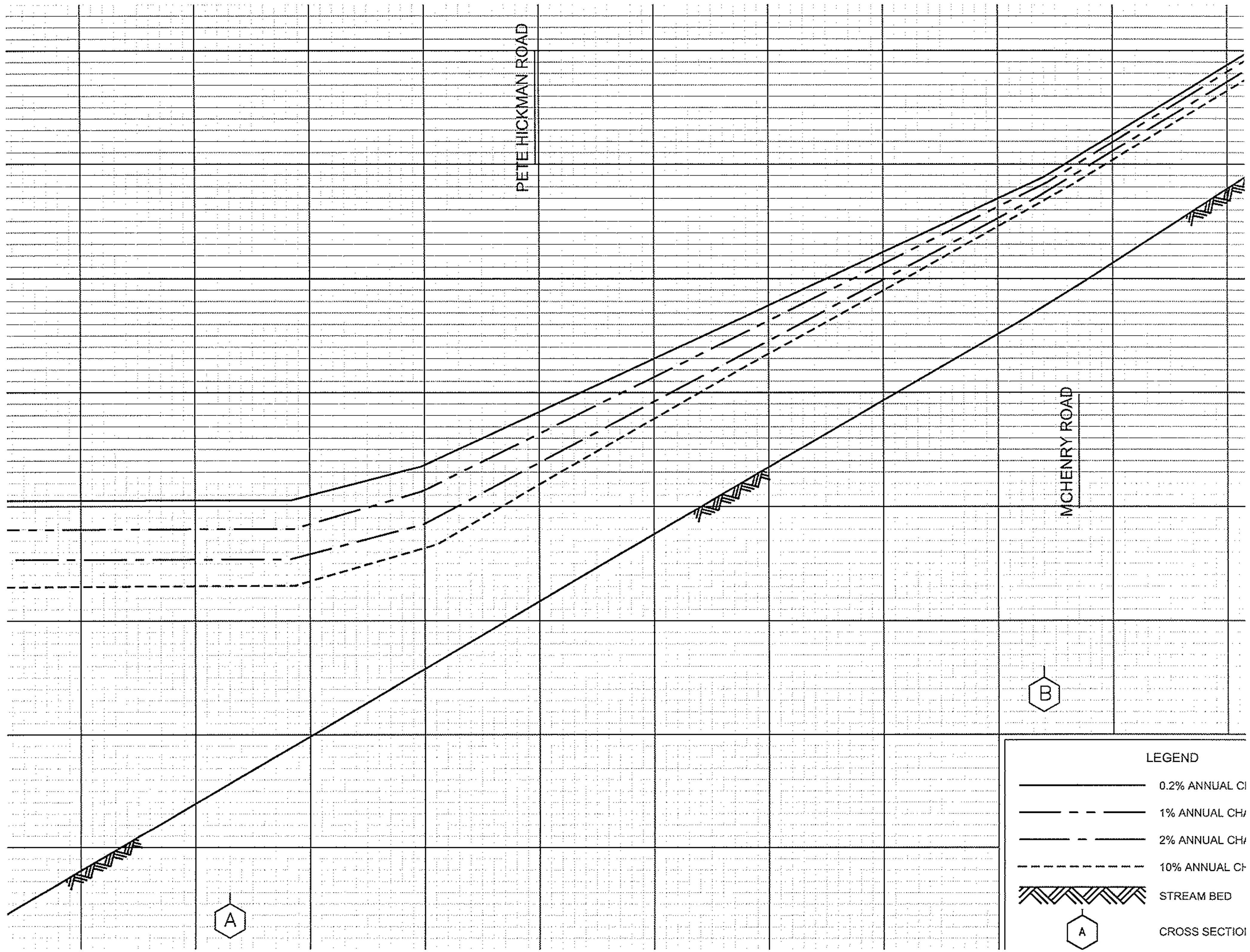


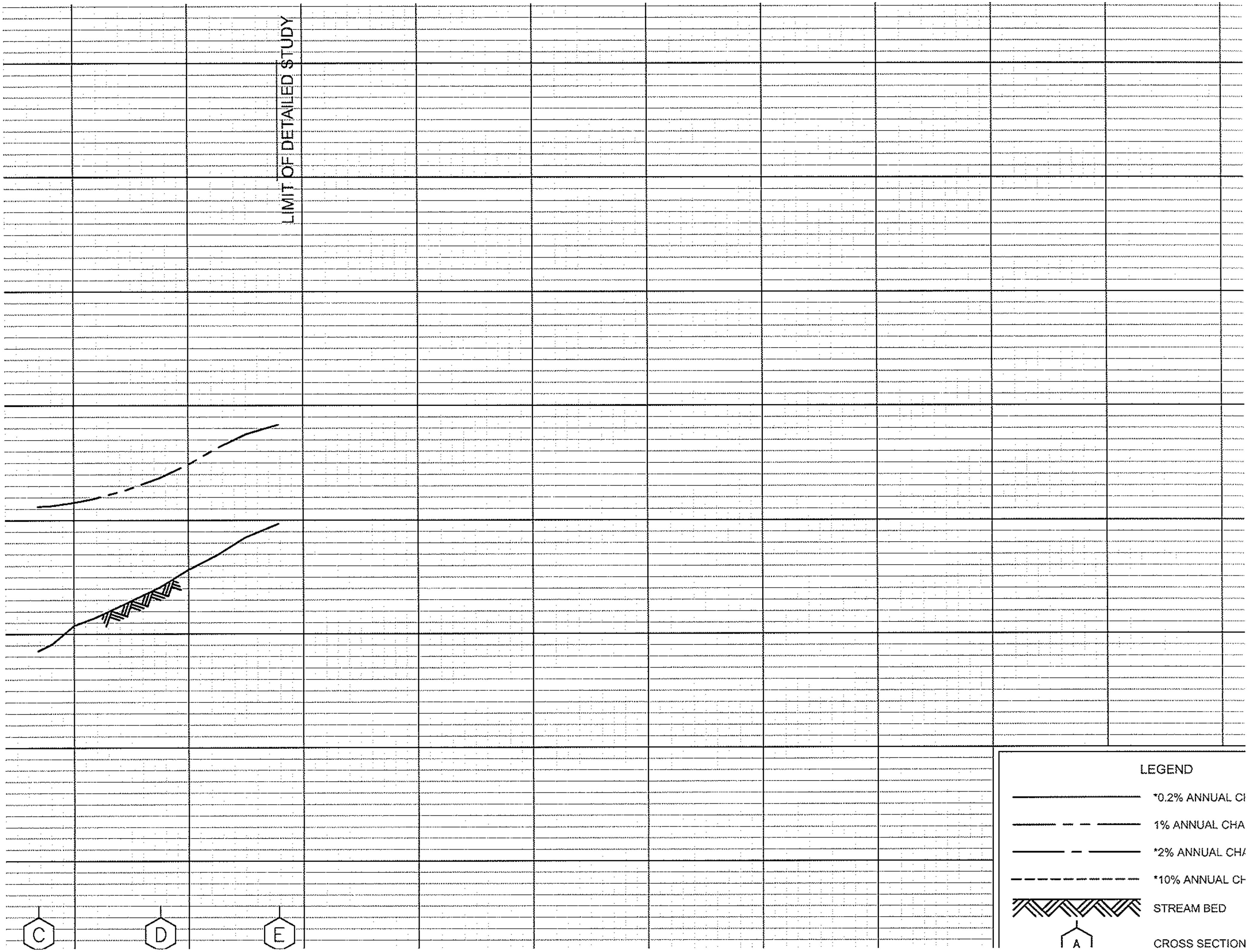
C
LEGEND
0.2% ANNUAL CH
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTION



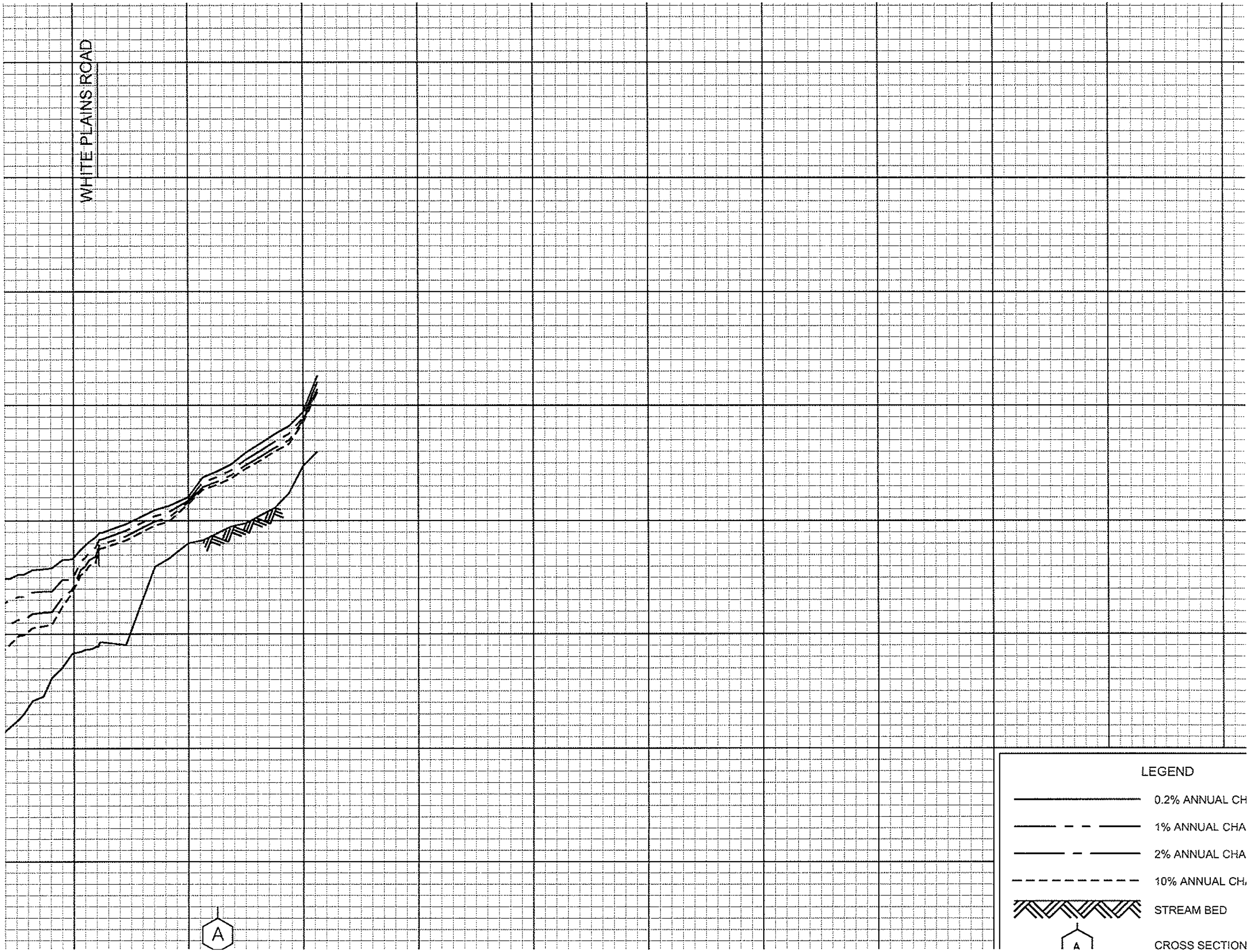
APT ACCESS ROAD
FOOT BRIDGE
WALNUT COURT
PRIVATE ACCESS
PRIVATE DRIVE
UNNAMED ROAD
LIMIT OF DETAILED STUDY
ONEAL ROAD
CULVERT
CULVERT
CULVERTS
CULVERT
D
E
LEGEND
*0.2% ANNUAL CI
1% ANNUAL CHA
*2% ANNUAL CHA
*10% ANNUAL CH
STREAM BED
A
CROSS SECTION

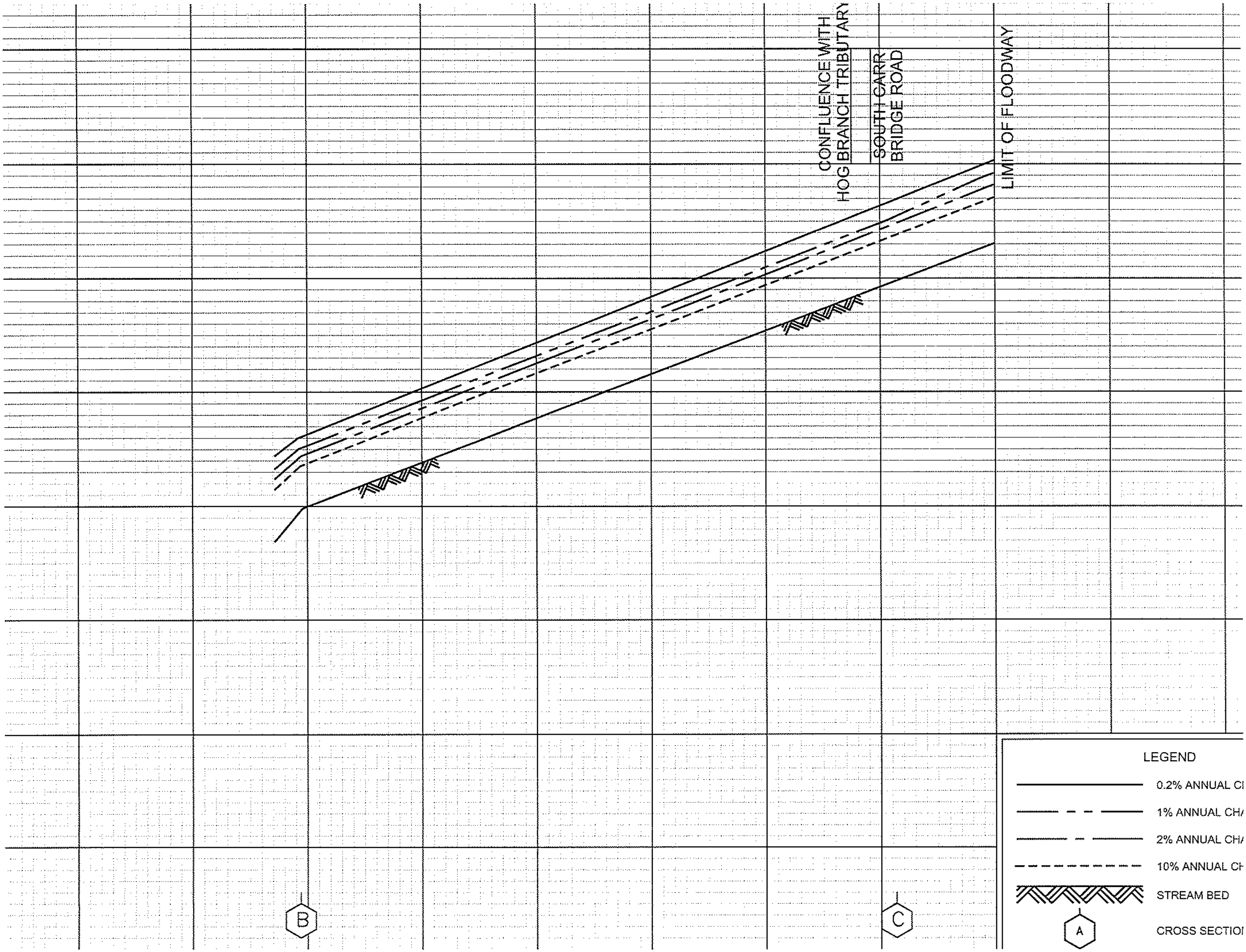

THREE RIVERS ROAD
LIMIT OF DETAILED STUDY
CULVERT
A
B
C
LEGEND
*0.2% ANNUAL C
1% ANNUAL CHA
*2% ANNUAL CHA
*10% ANNUAL CH
STREAM BED
CROSS SECTION
A

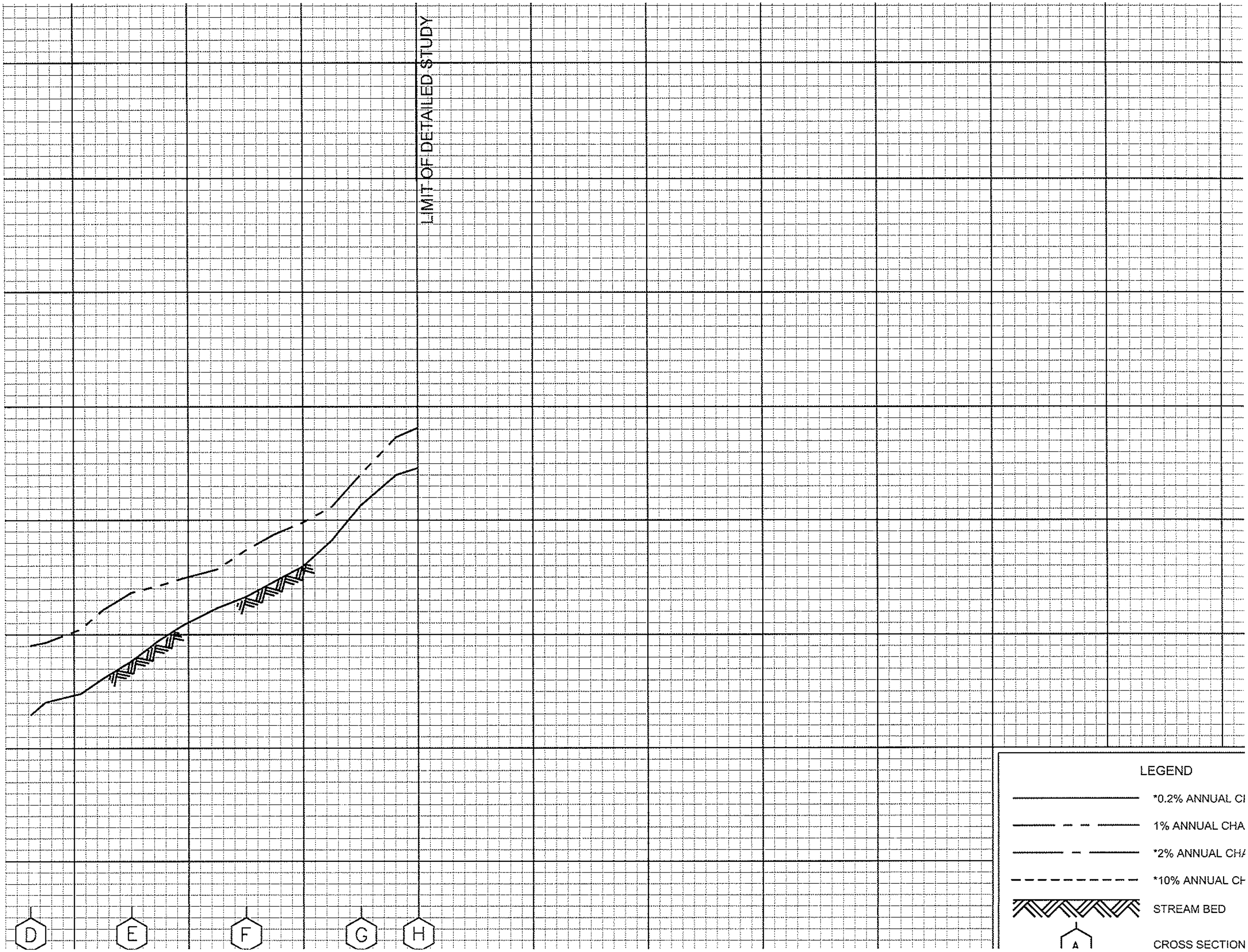

PETE HICKMAN ROAD
MCHENRY ROAD
B
A
LEGEND
0.2% ANNUAL C
1% ANNUAL CH
2% ANNUAL CH
10% ANNUAL C
STREAM BED
CROSS SECTIO



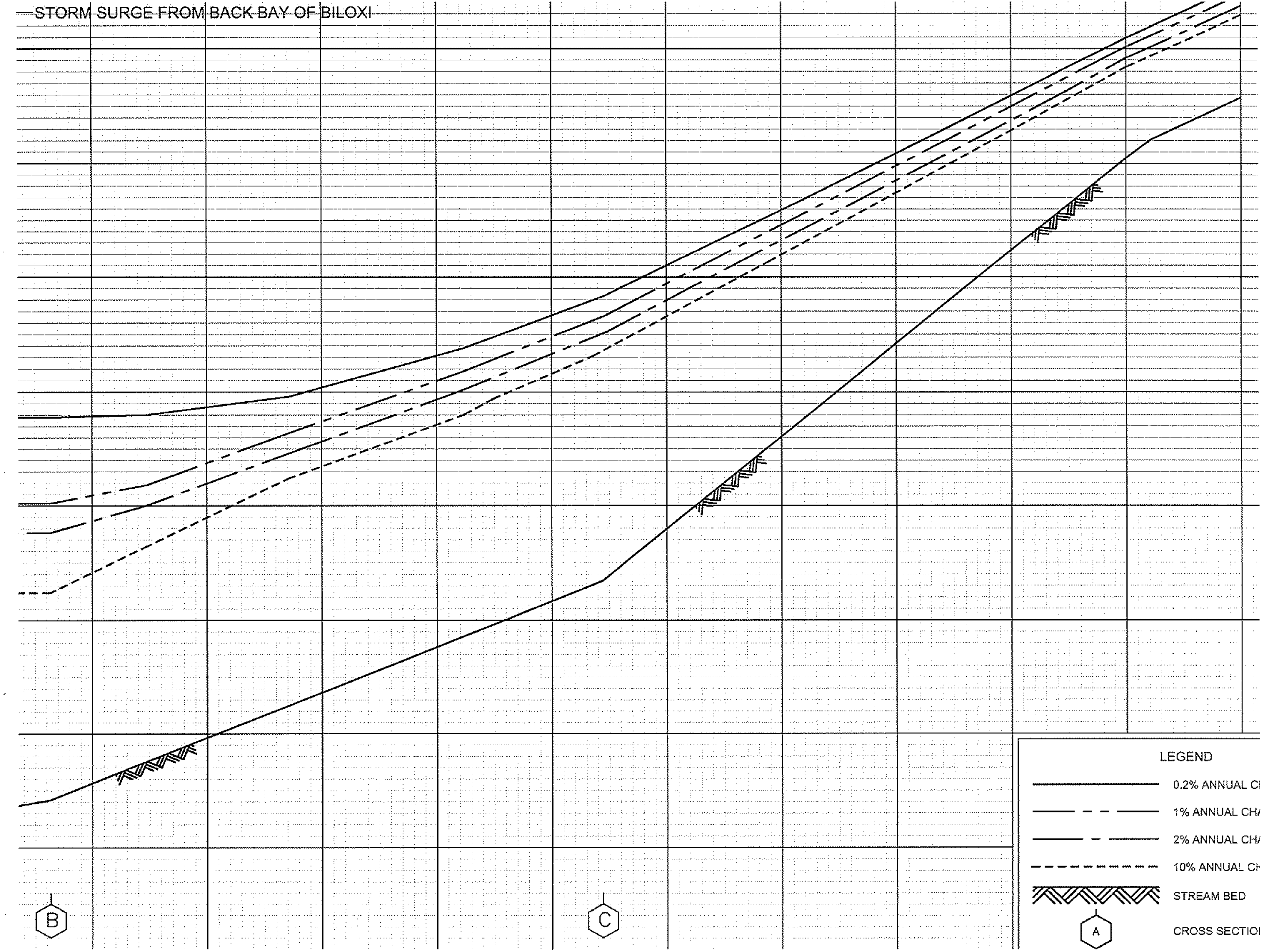
LIMIT OF DETAILED STUDY
C
D
E
LEGEND
*0.2% ANNUAL CI
1% ANNUAL CHA
*2% ANNUAL CHA
*10% ANNUAL CH
STREAM BED
A
CROSS SECTION

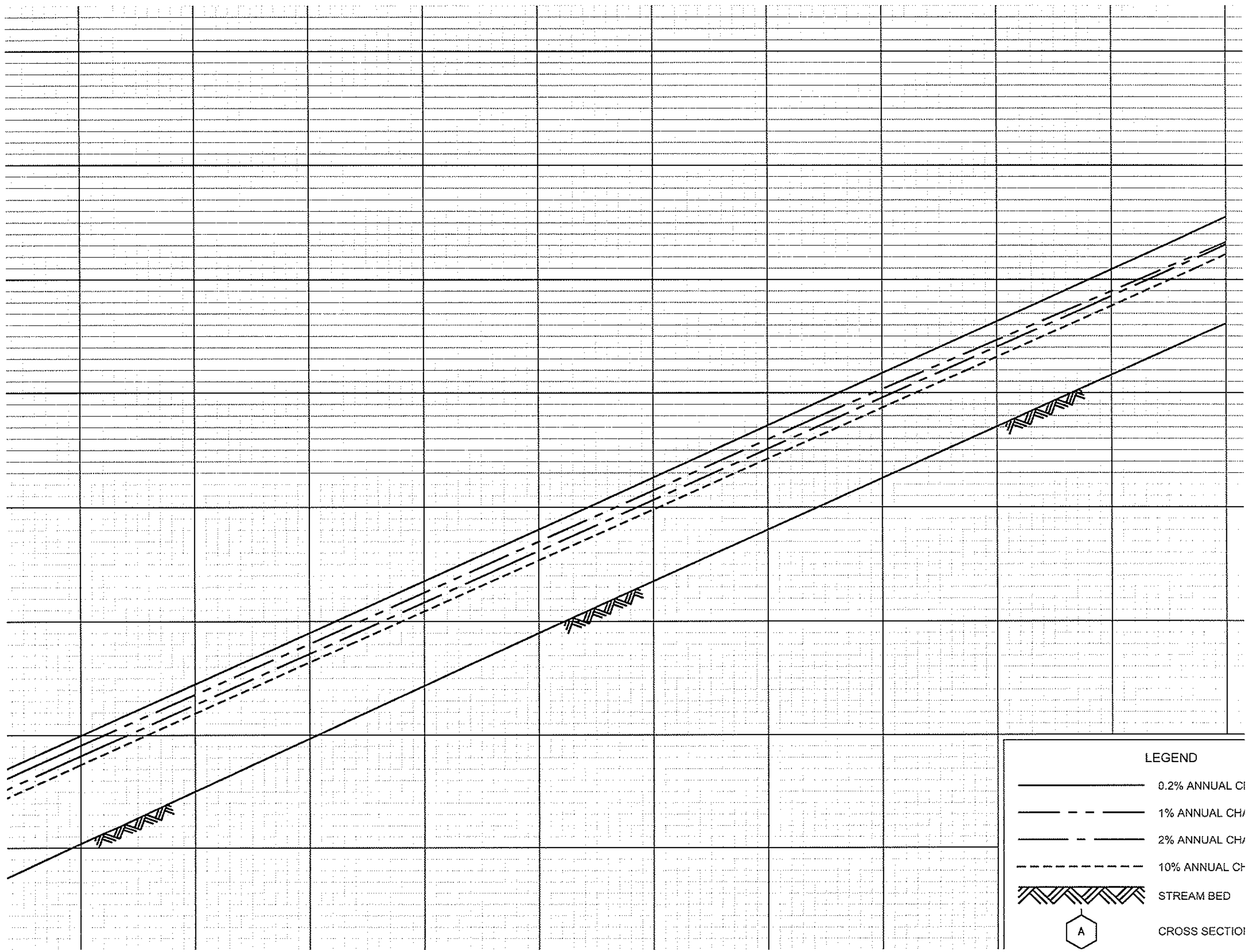

WHITE PLAINS ROAD
A
LEGEND
0.2% ANNUAL CH
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
CROSS SECTION

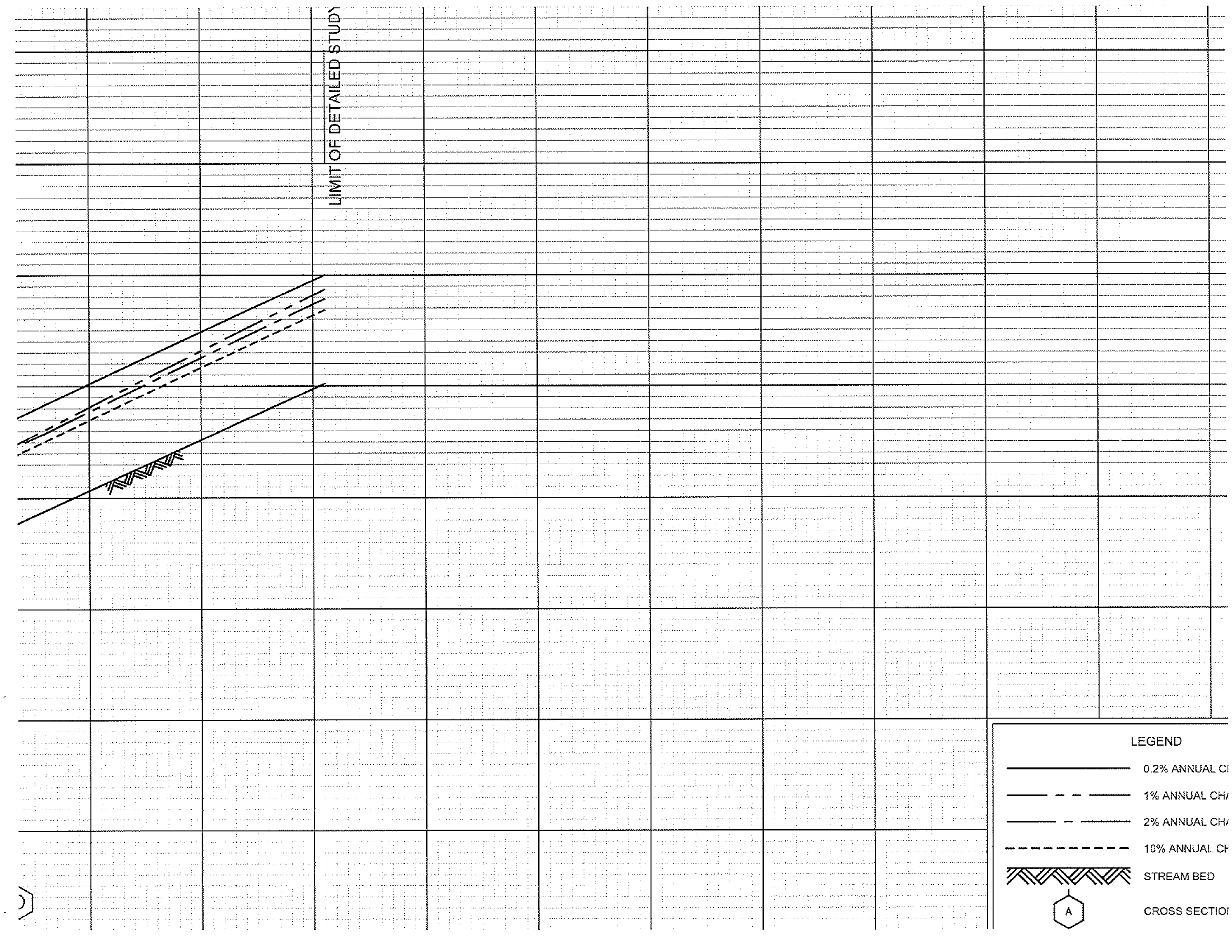

CONFLUENCE WITH
HOG BRANCH TRIBUTARY
SOUTH CARR
BRIDGE ROAD
LIMIT OF FLOODWAY
B
C
LEGEND
0.2% ANNUAL CI
1% ANNUAL CH
2% ANNUAL CH
10% ANNUAL CH
STREAM BED
A
CROSS SECTIO



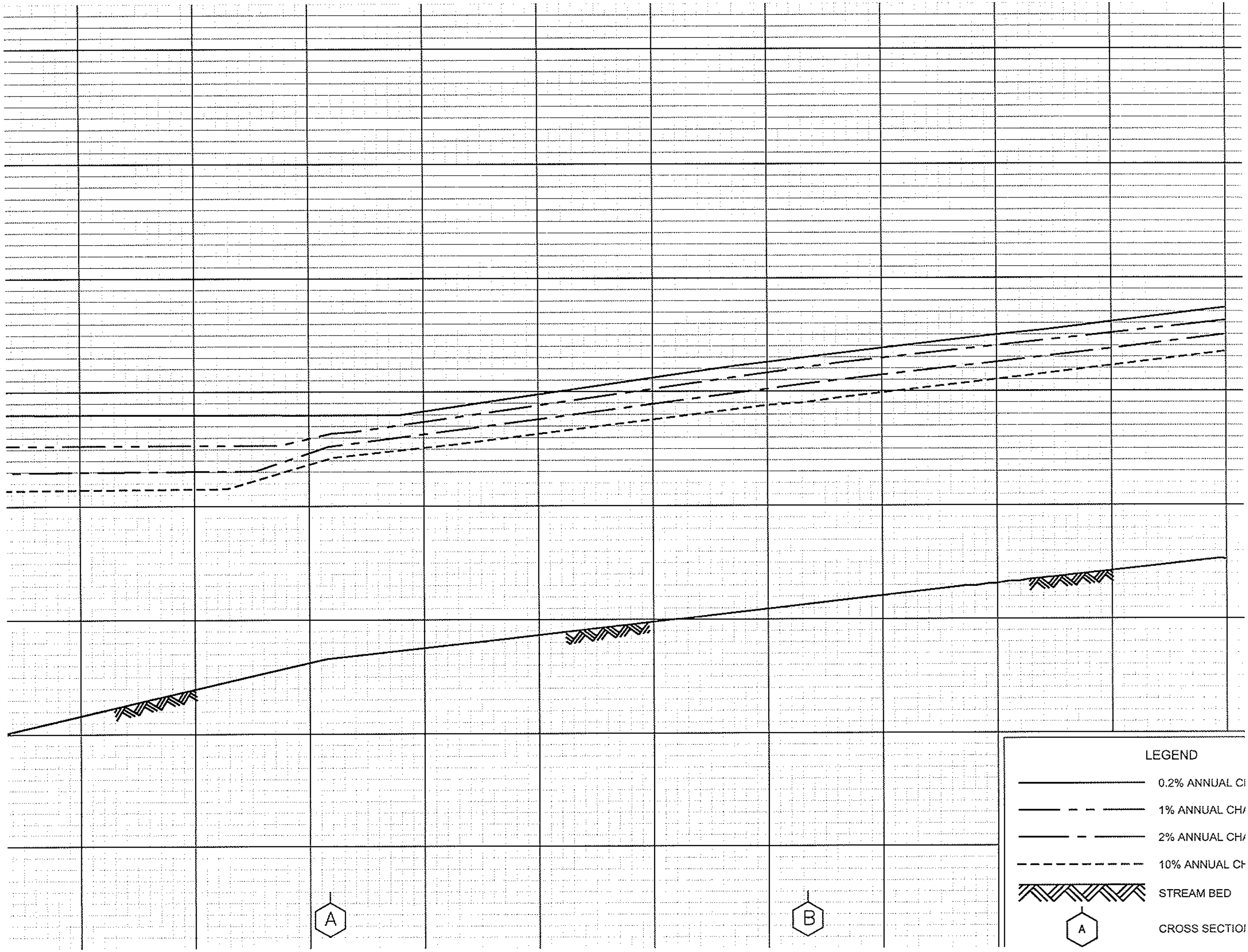
LIMIT OF DETAILED STUDY
D
E
F
G
H
LEGEND
*0.2% ANNUAL C
1% ANNUAL CHA
*2% ANNUAL CH
*10% ANNUAL C
STREAM BED
A
CROSS SECTION

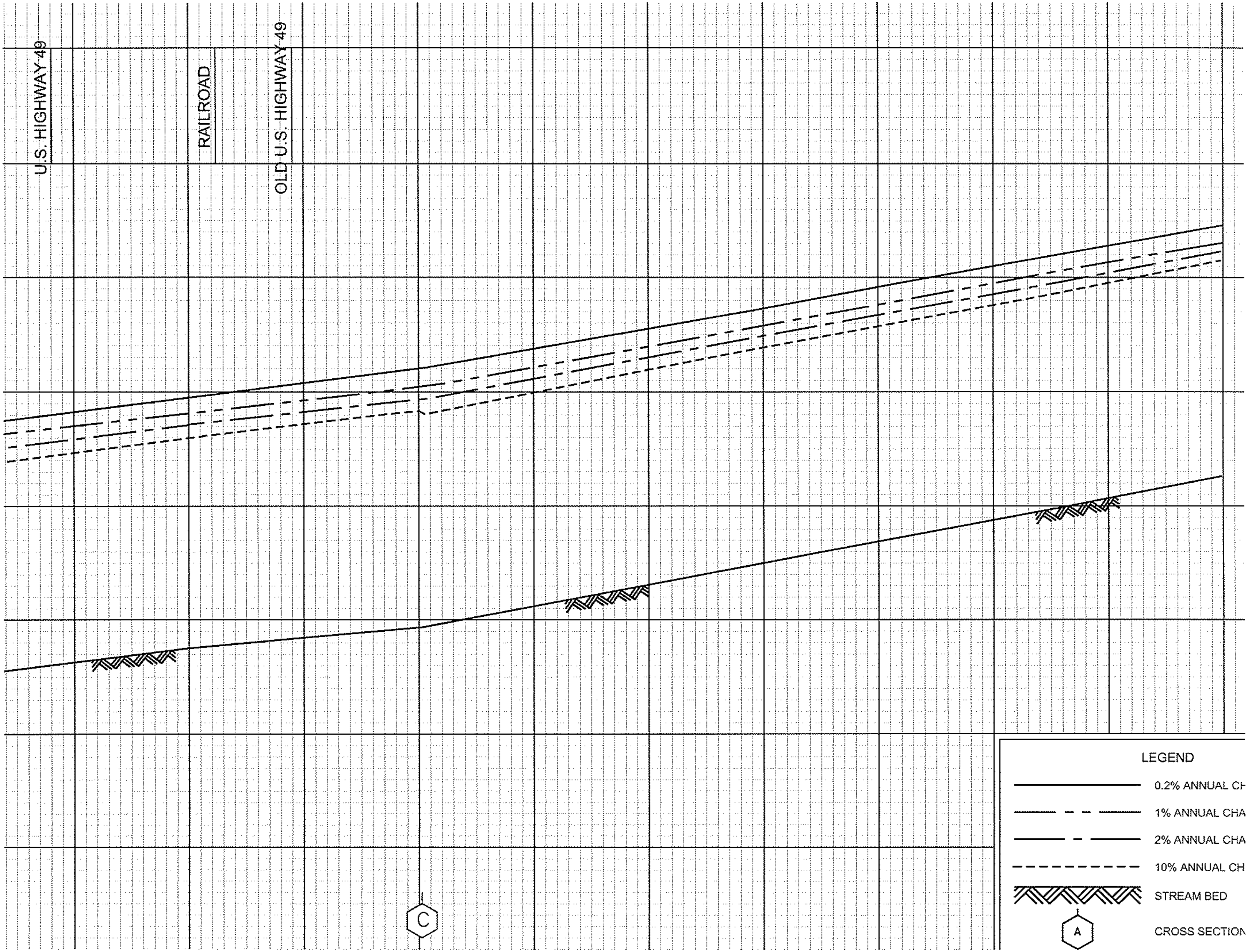

STORM SURGE FROM BACK BAY OF BILOXI
B
C
LEGEND
0.2% ANNUAL C
1% ANNUAL CH
2% ANNUAL CH
10% ANNUAL C
STREAM BED
A
CROSS SECTIO

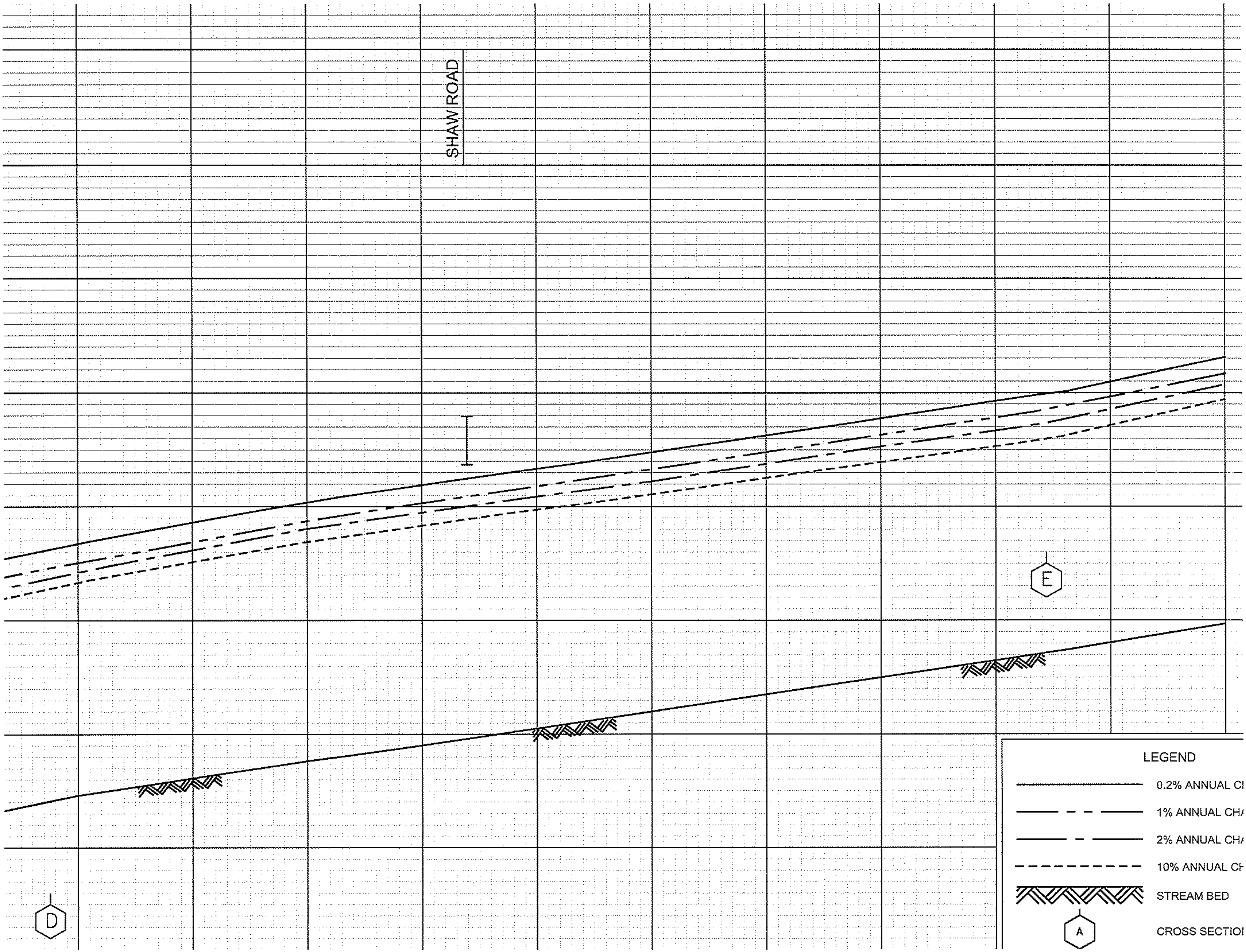

LEGEND
0.2% ANNUAL CI
1% ANNUAL CH/
2% ANNUAL CH/
10% ANNUAL CH
STREAM BED
A
CROSS SECTIOI

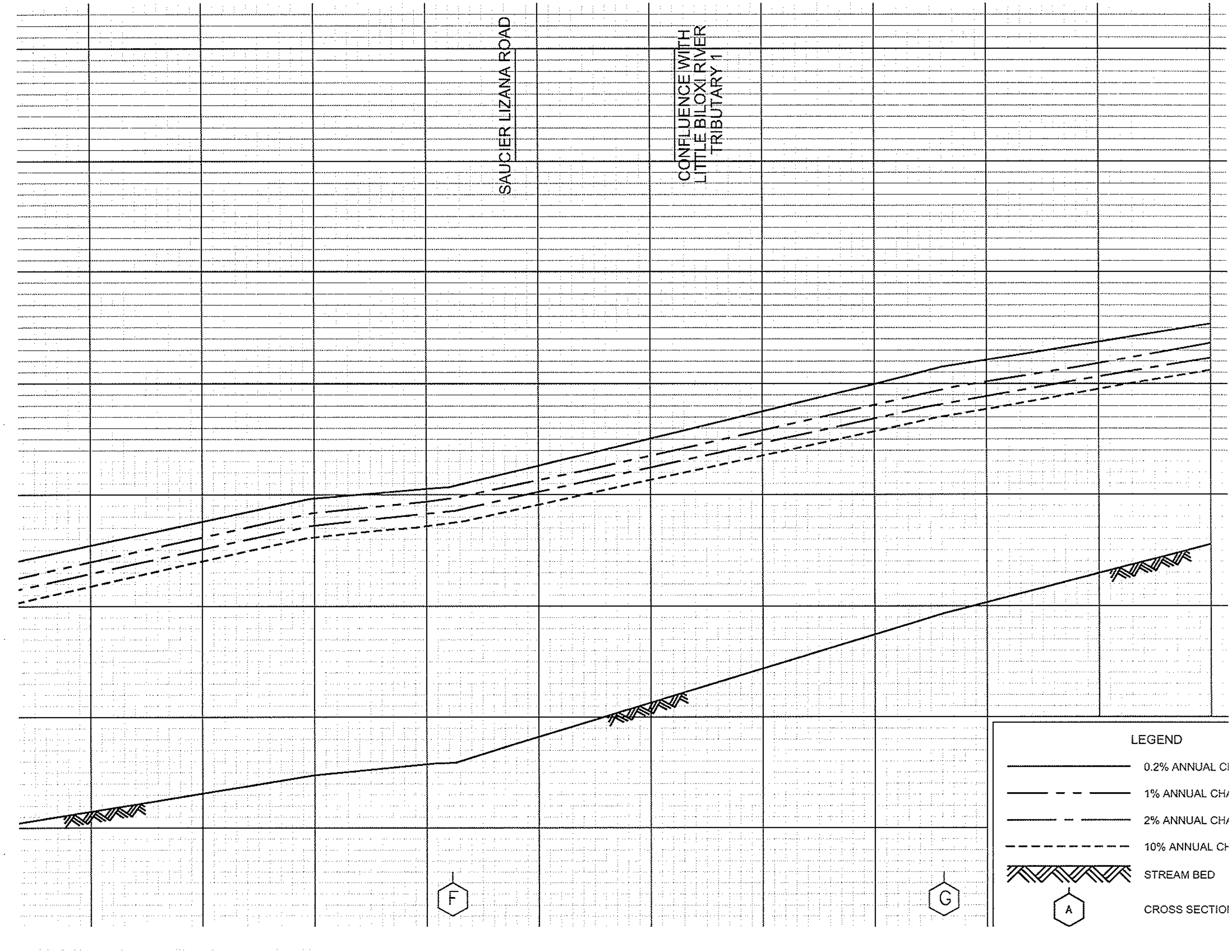


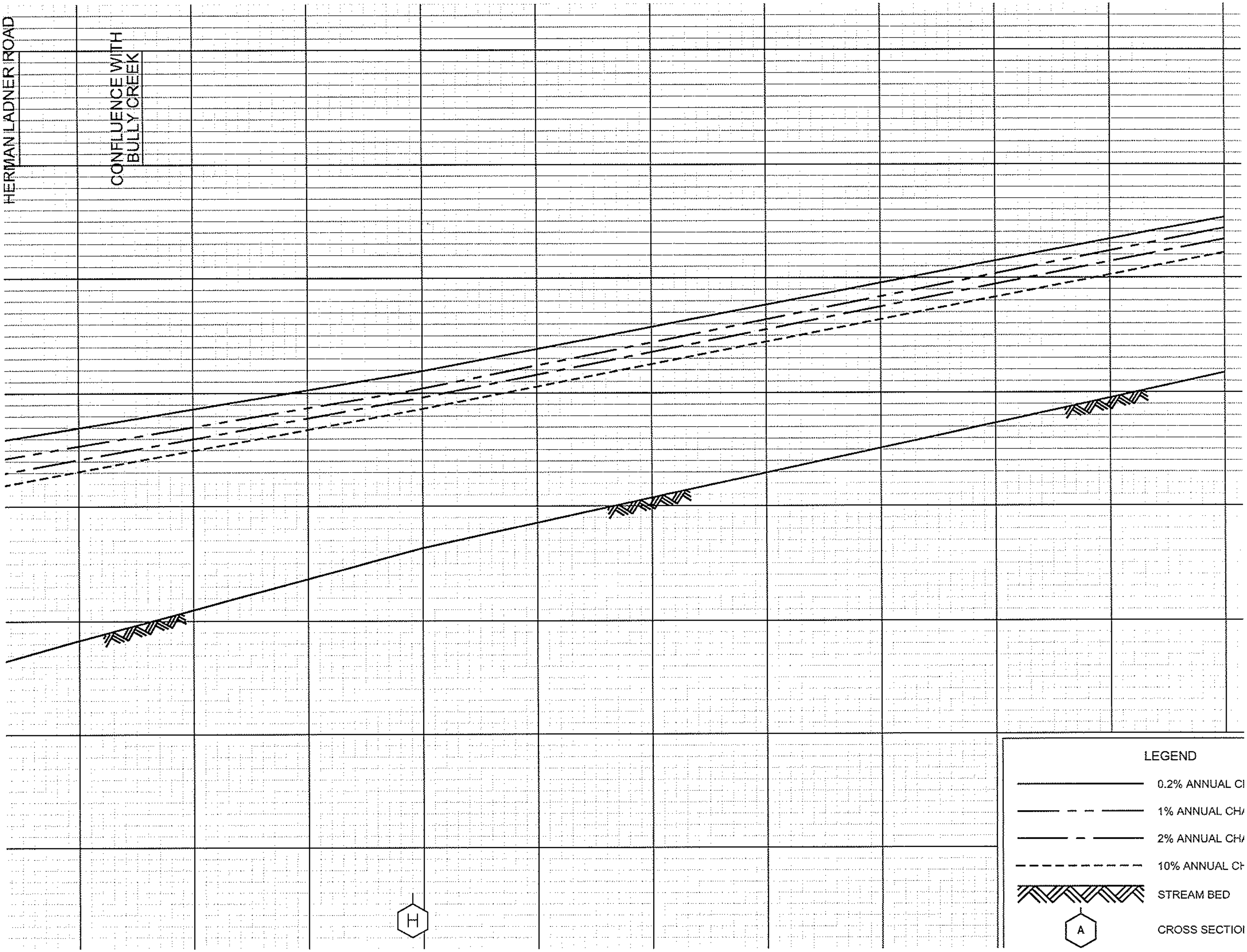
LIMIT OF DETAILED STUDY
LEGEND
0.2% ANNUAL CI
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTIOI

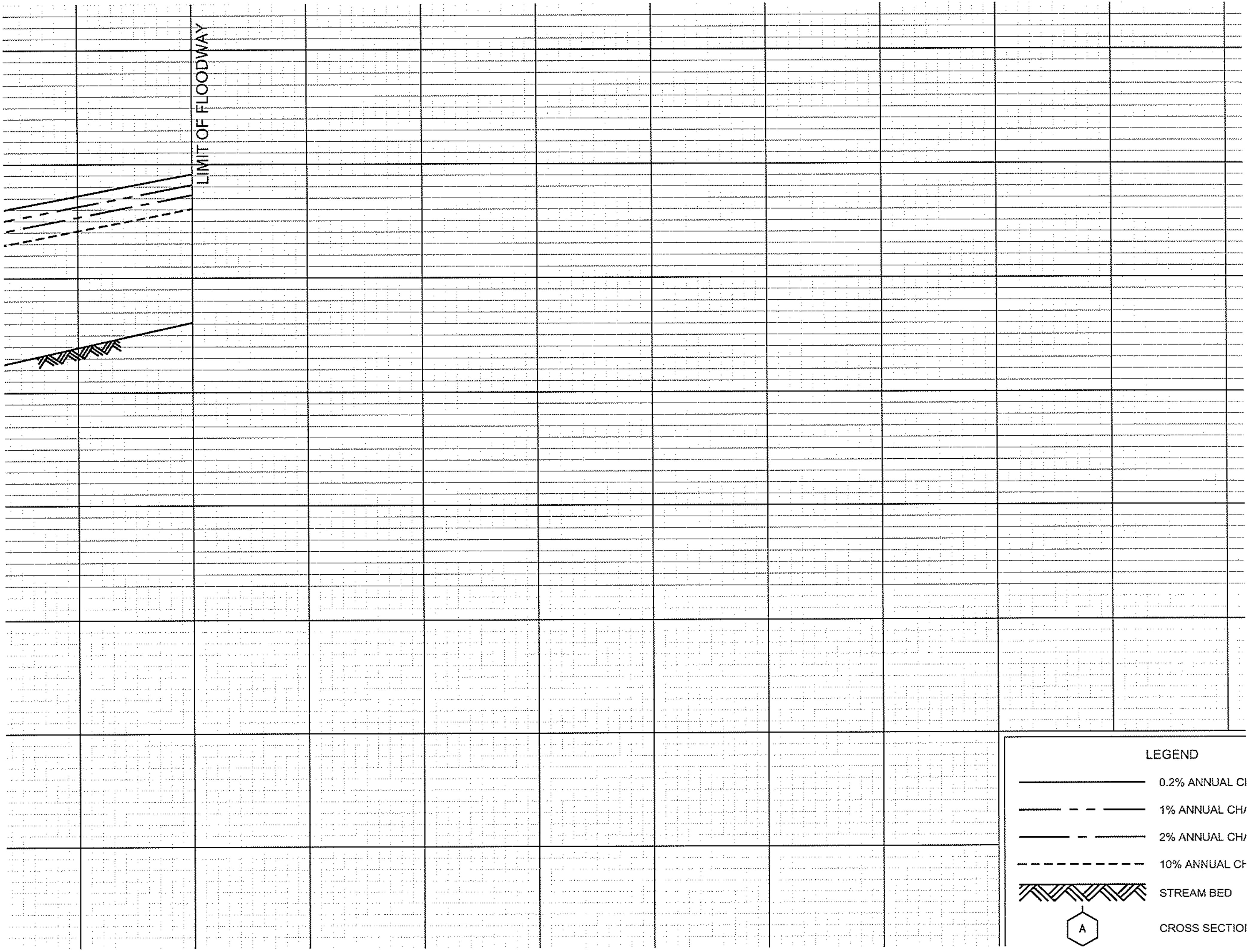

A
B
LEGEND
0.2% ANNUAL CI
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTIOI

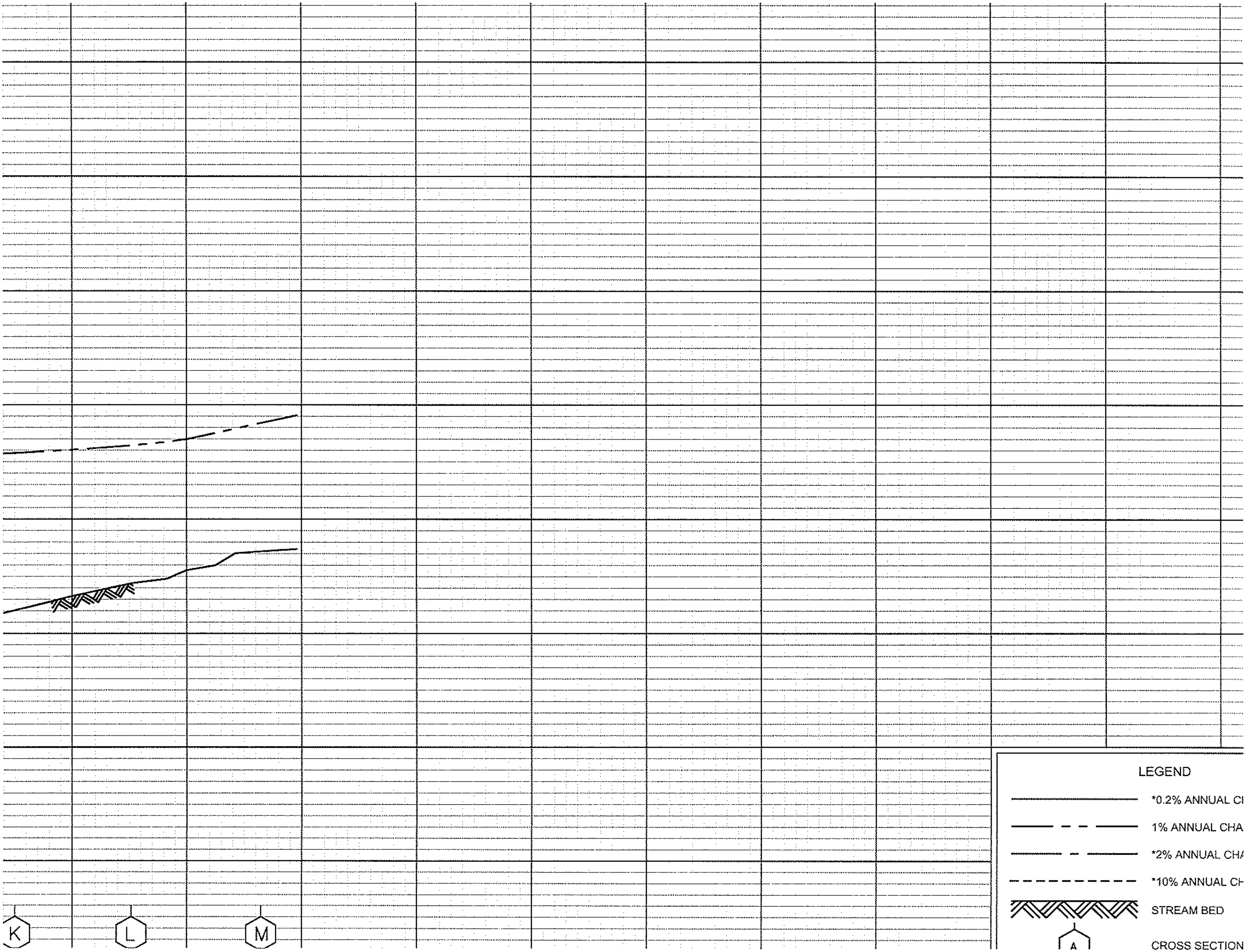

U.S. HIGHWAY 49
RAILROAD
OLD U.S. HIGHWAY 49
C
LEGEND
0.2% ANNUAL CH
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTION


SHAW ROAD
E
D
LEGEND
0.2% ANNUAL C
1% ANNUAL CH
2% ANNUAL CH
10% ANNUAL C
STREAM BED
A
CROSS SECTIO

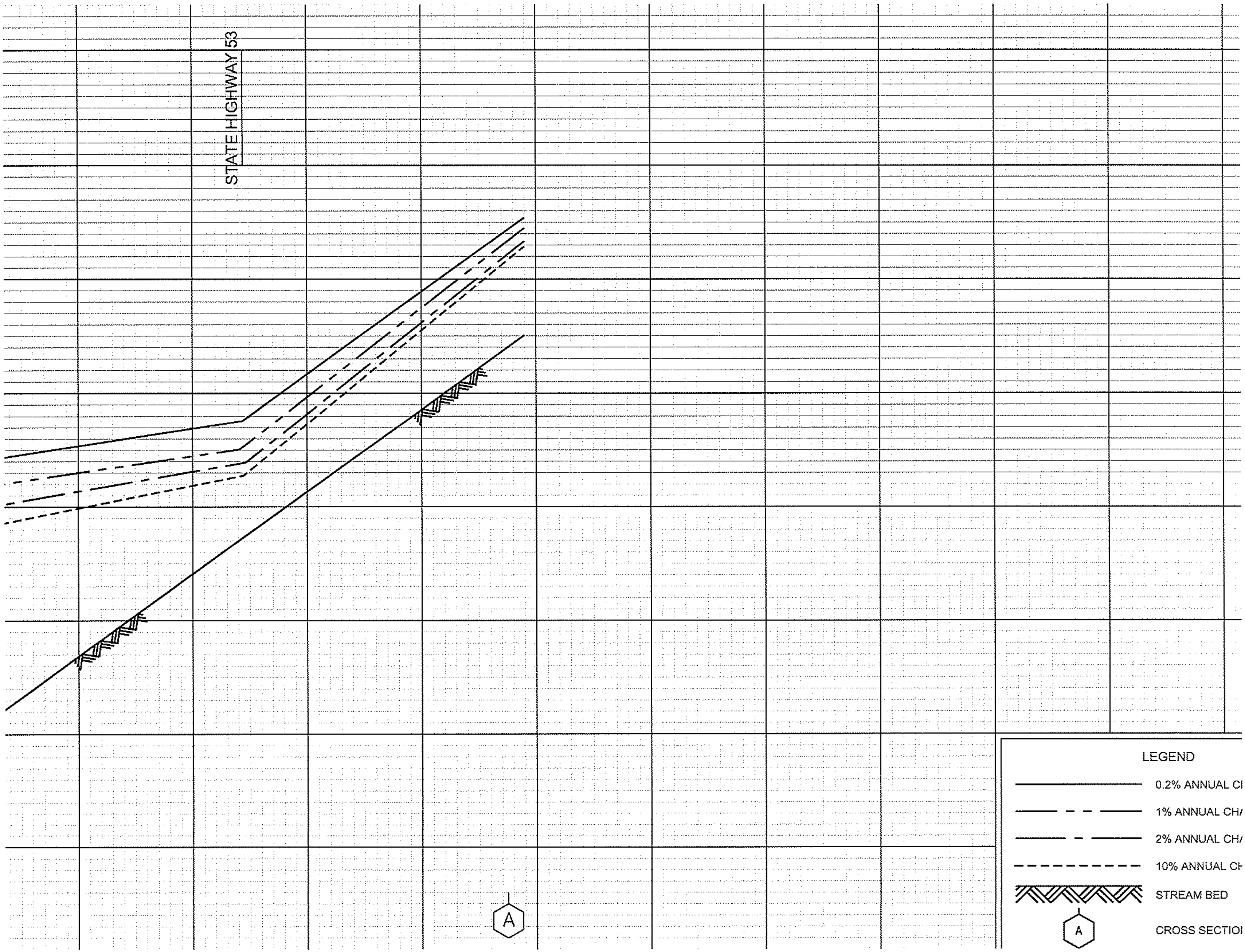

SAUCIER LIZANA ROAD
CONFLUENCE WITH
LITTLE BILOXI RIVER
TRIBUTARY 1
F
G
LEGEND
0.2% ANNUAL CI
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTIOI


HERMAN LADNER ROAD
CONFLUENCE WITH BULLY CREEK
H
LEGEND
0.2% ANNUAL CI
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTIO

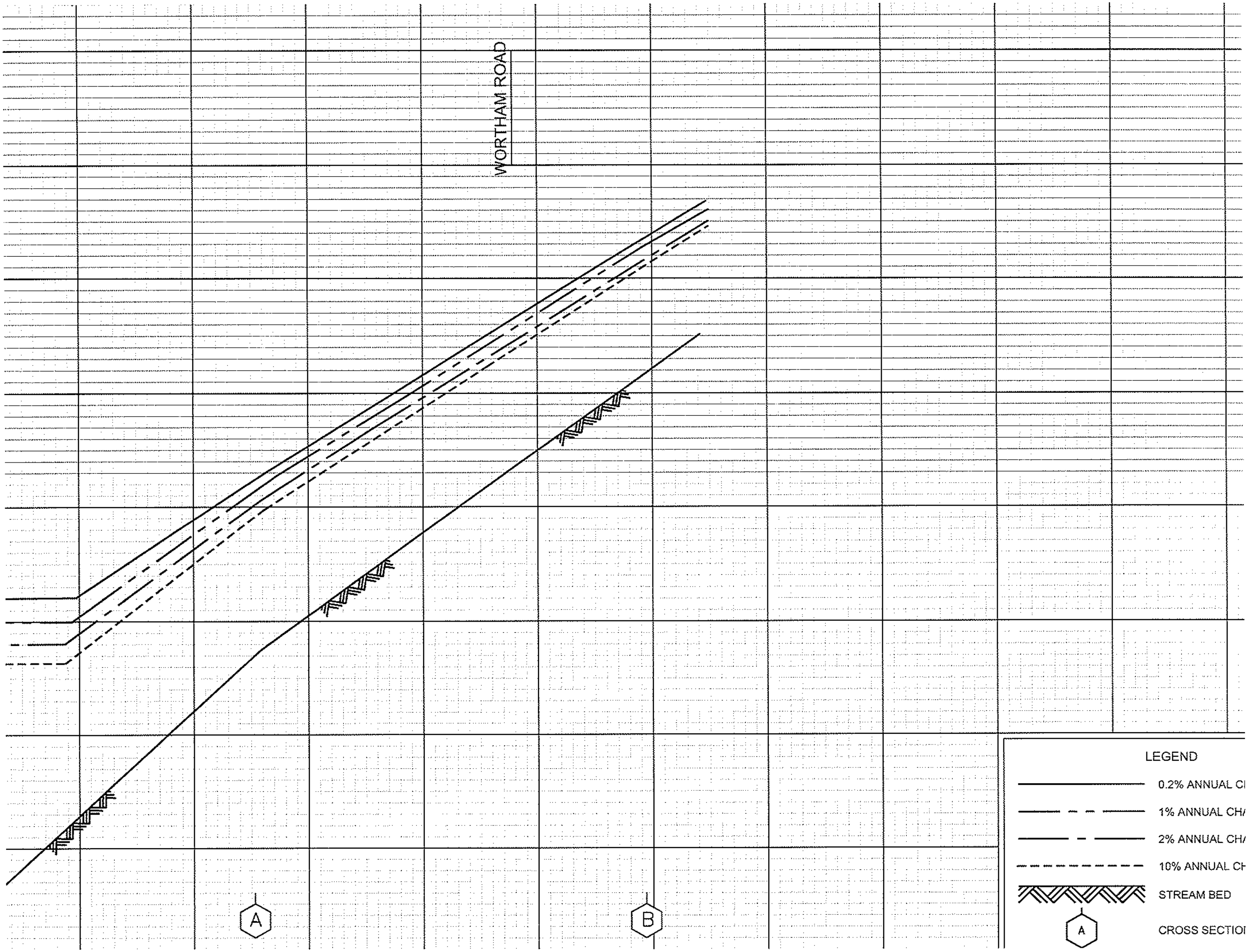

LIMIT OF FLOODWAY
LEGEND
0.2% ANNUAL CI
1% ANNUAL CH/
2% ANNUAL CH/
10% ANNUAL CI
STREAM BED
A
CROSS SECTIOI

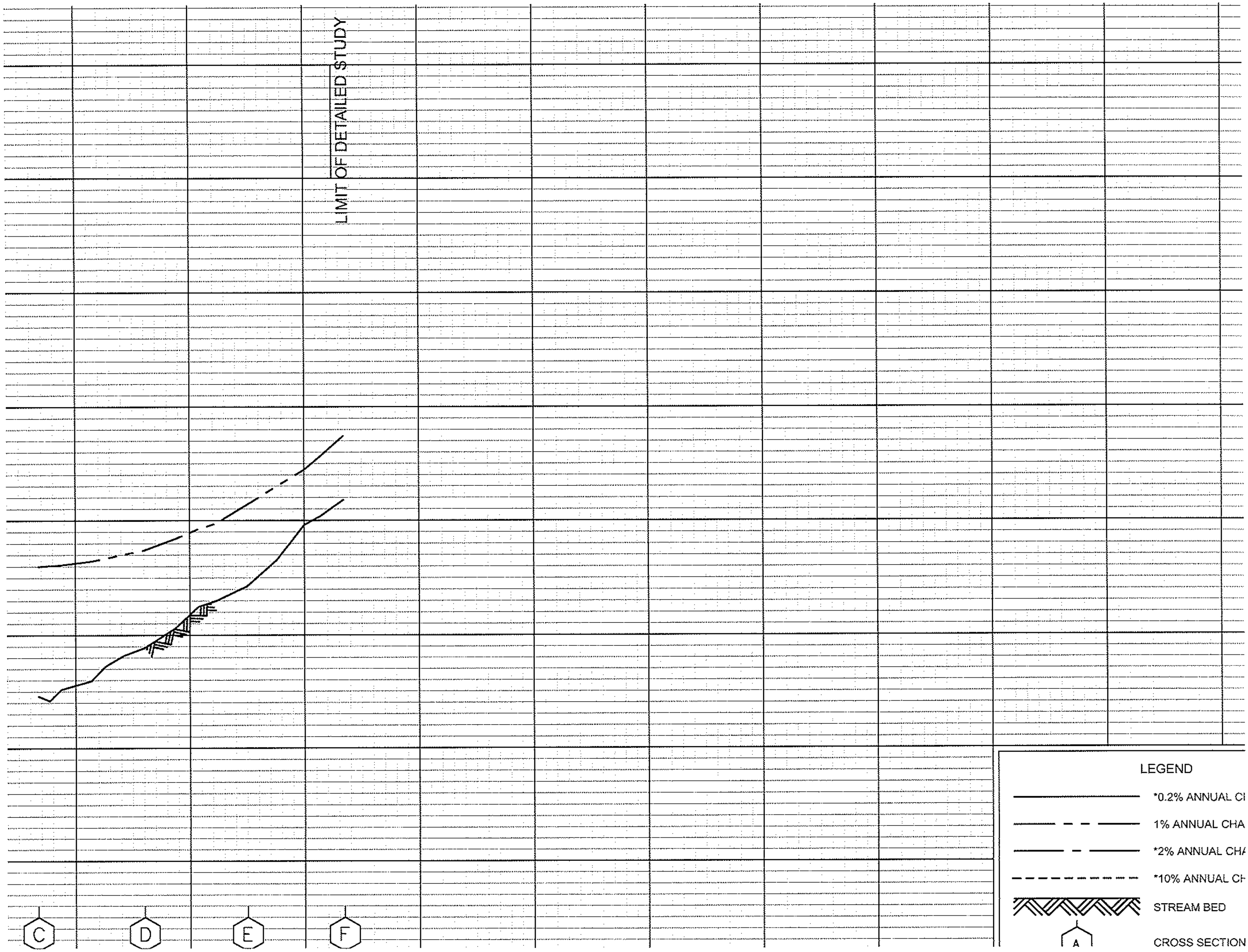


K
L
M
LEGEND
*0.2% ANNUAL CI
1% ANNUAL CHA
*2% ANNUAL CHA
*10% ANNUAL CH
STREAM BED
A
CROSS SECTION

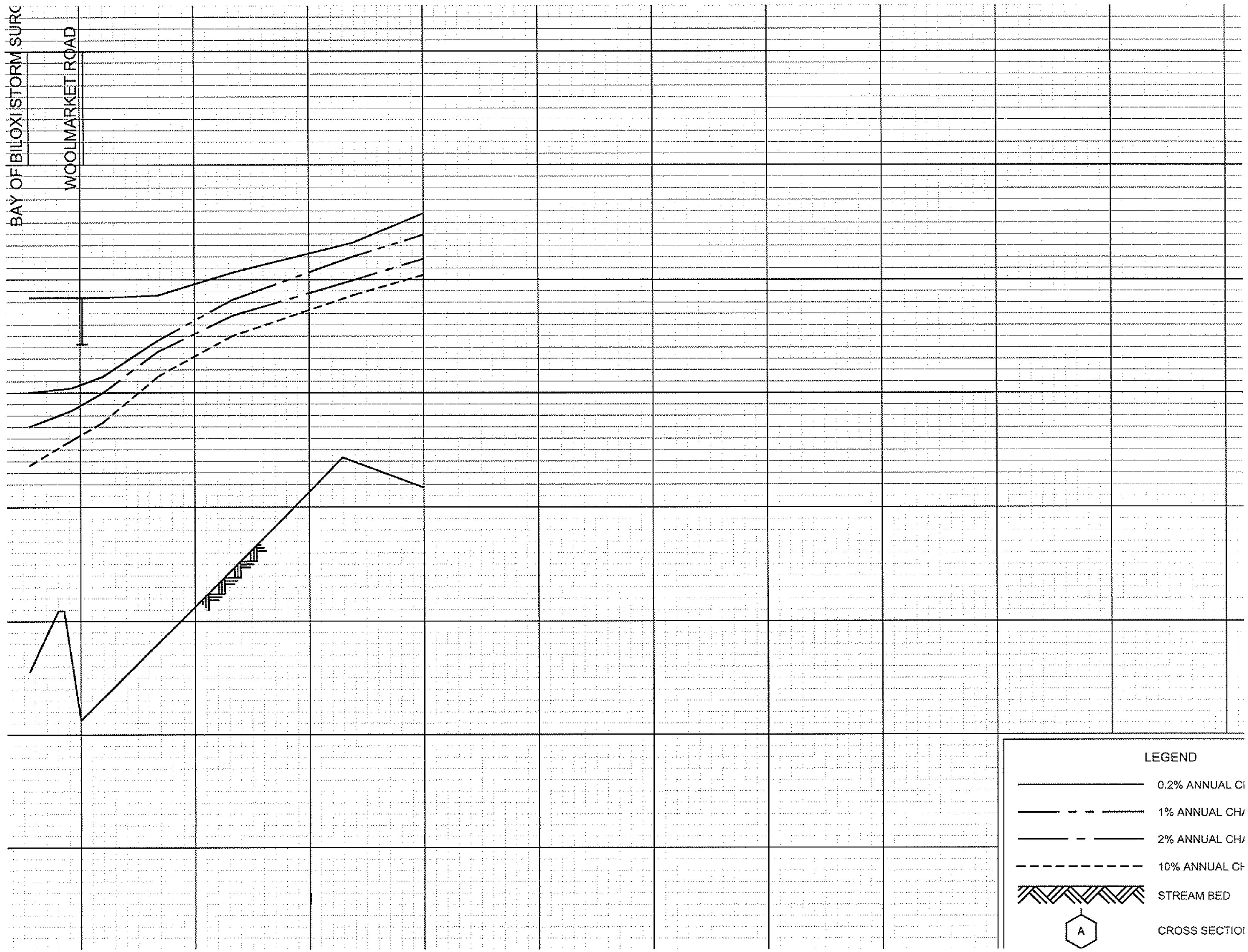

STATE HIGHWAY 53
A
LEGEND
0.2% ANNUAL CI
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
CROSS SECTIO

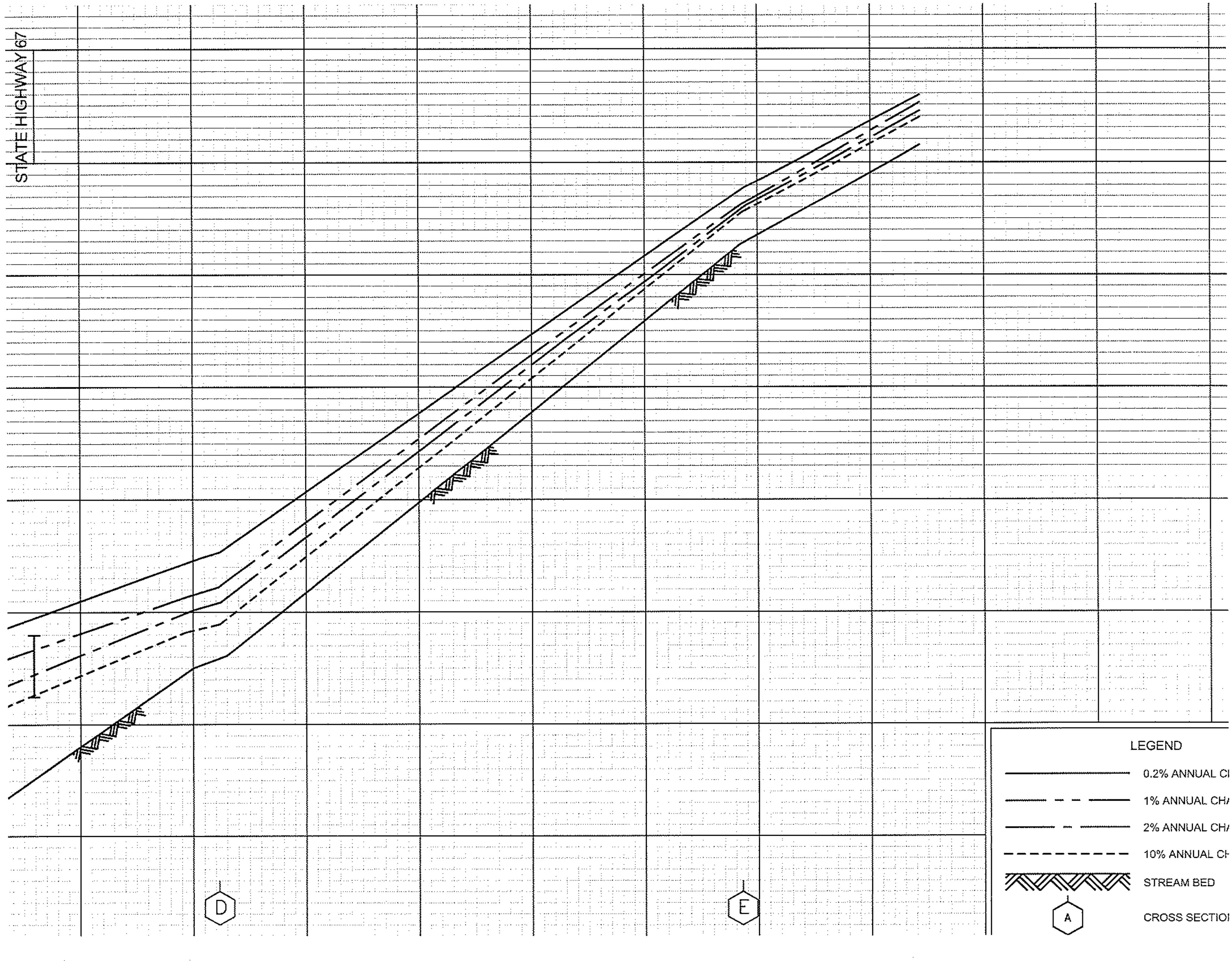

LIMIT OF DETAILED STUDY
LEGEND
*0.2% ANNUAL C
1% ANNUAL CH
*2% ANNUAL CH
*10% ANNUAL C
STREAM BED
CROSS SECTIO
A
B
C
D

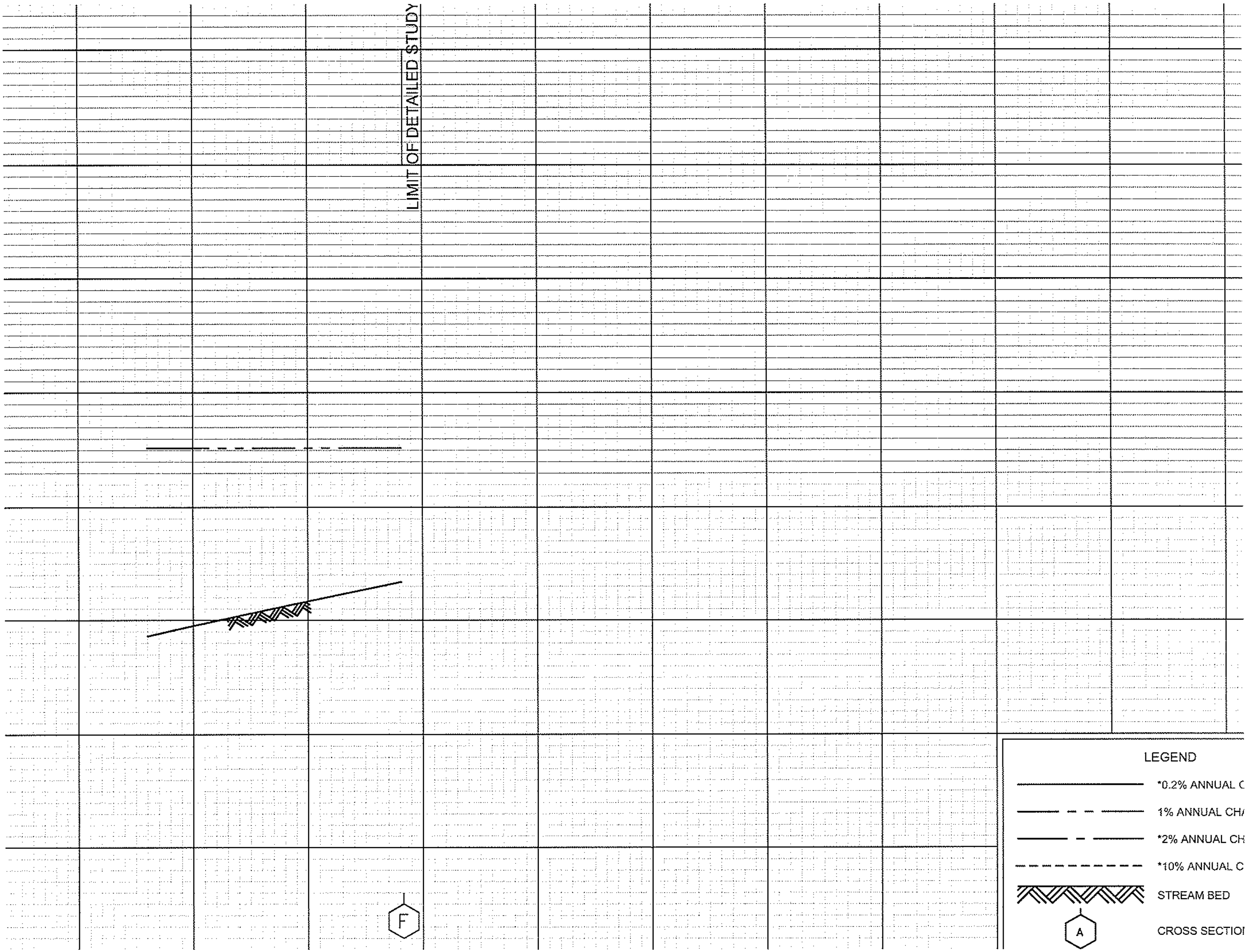

WORTHAM ROAD
A
B
LEGEND
0.2% ANNUAL CI
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTIOI

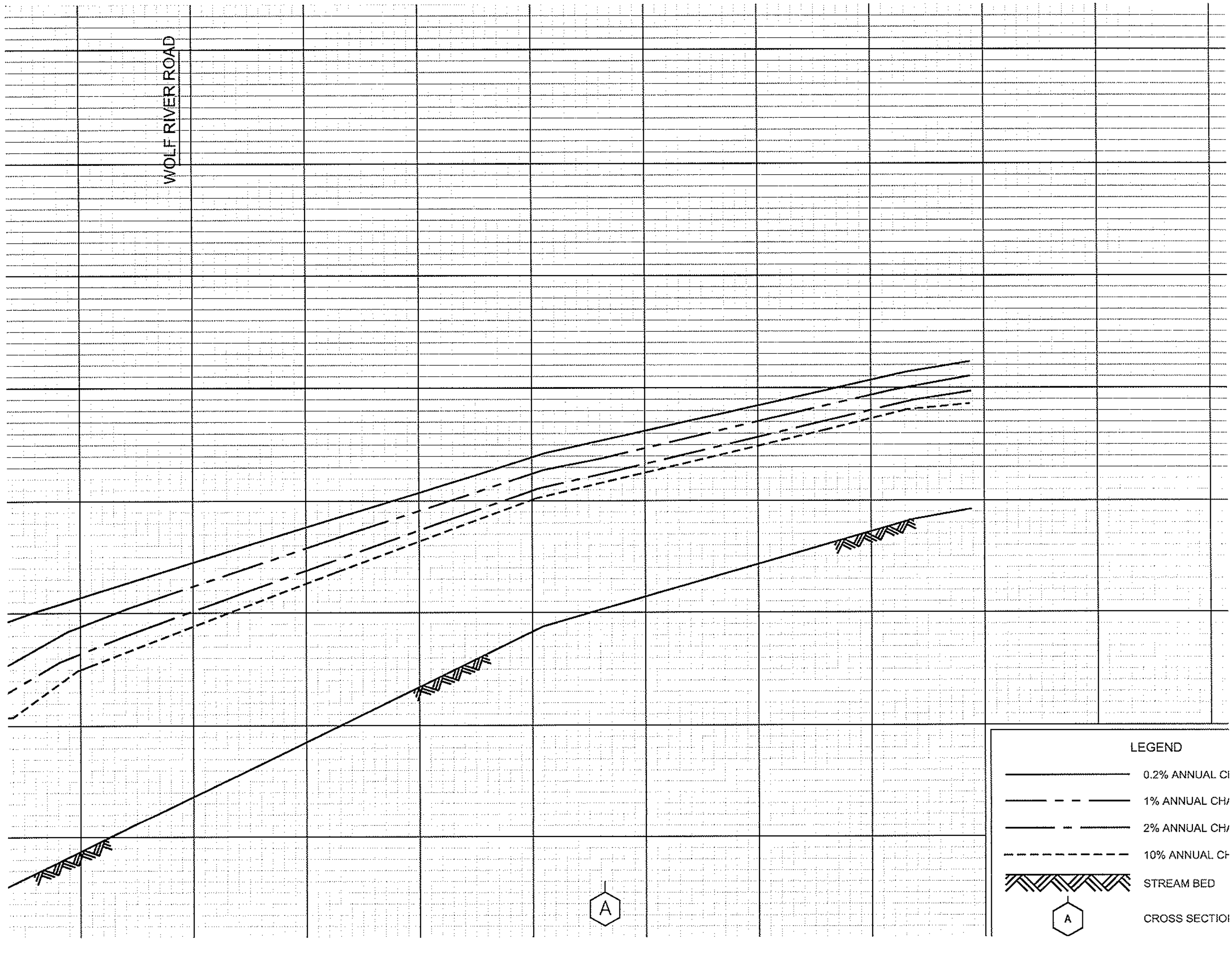


LIMIT OF DETAILED STUDY
C
D
E
F
LEGEND
*0.2% ANNUAL CI
1% ANNUAL CHA
*2% ANNUAL CHA
*10% ANNUAL CH
STREAM BED
A
CROSS SECTION

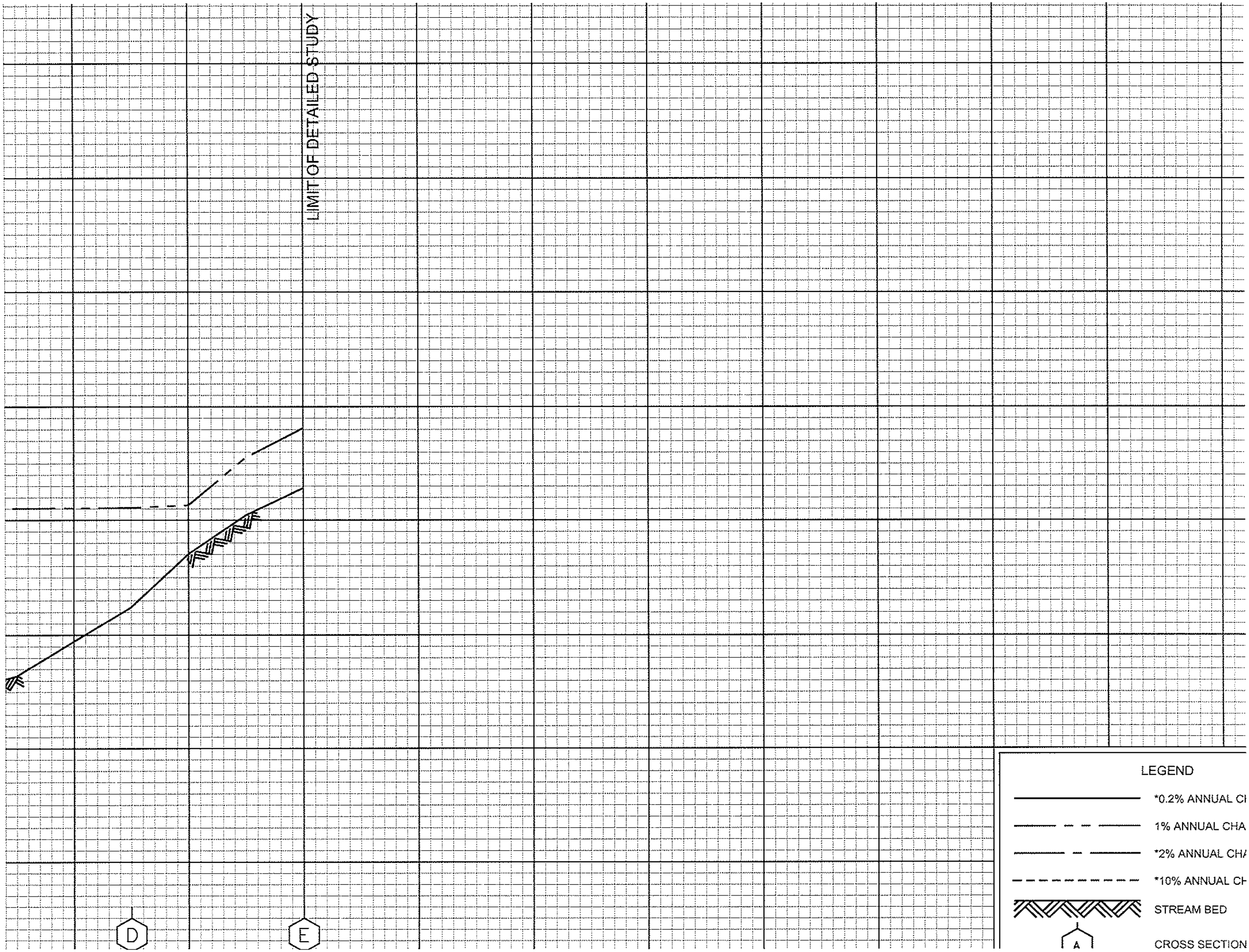

BAY OF BILOXI STORM SURG
WOOLMARKET ROAD
LEGEND
0.2% ANNUAL C
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTIO

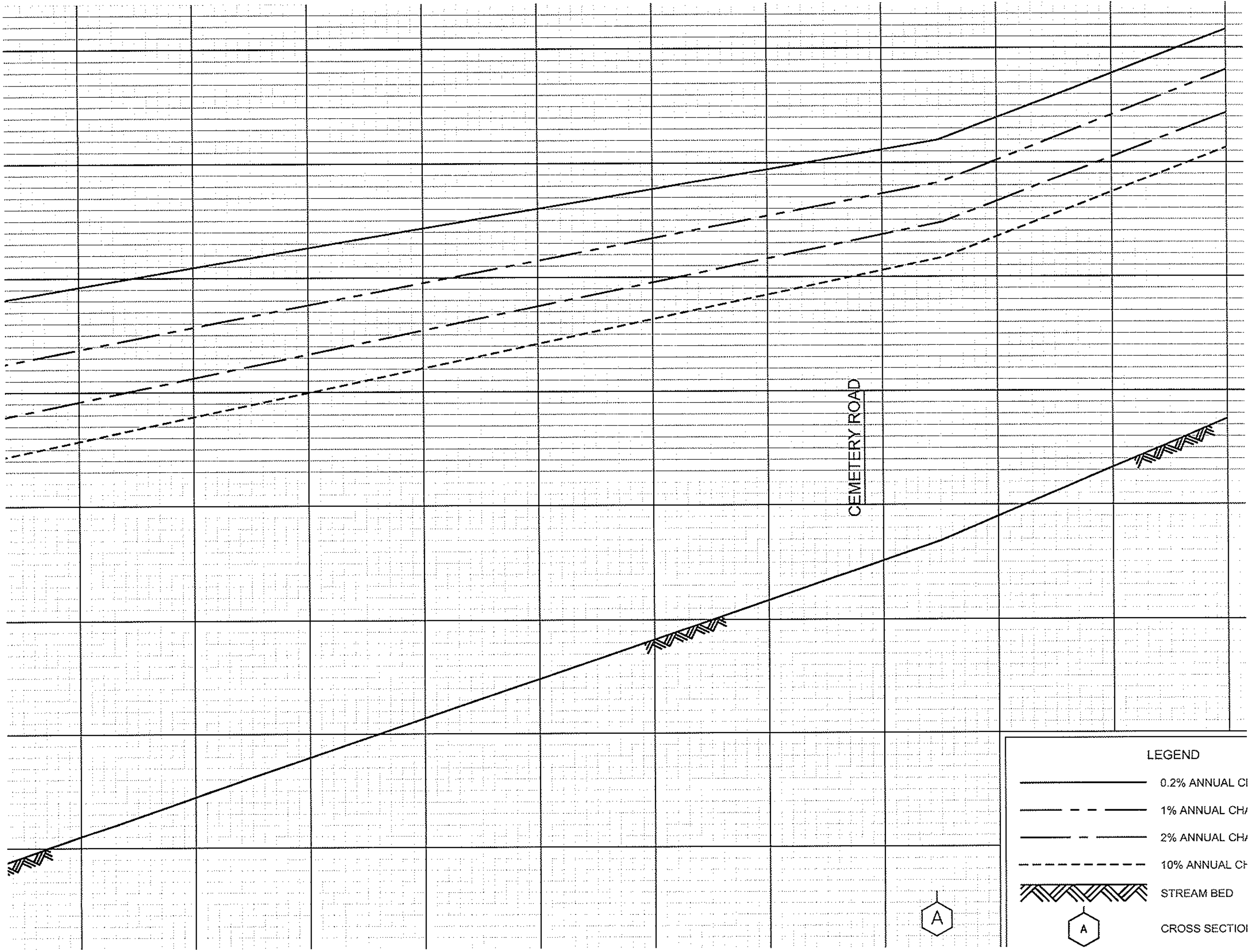

STATE HIGHWAY 67
D
E
LEGEND
0.2% ANNUAL CI
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTIO

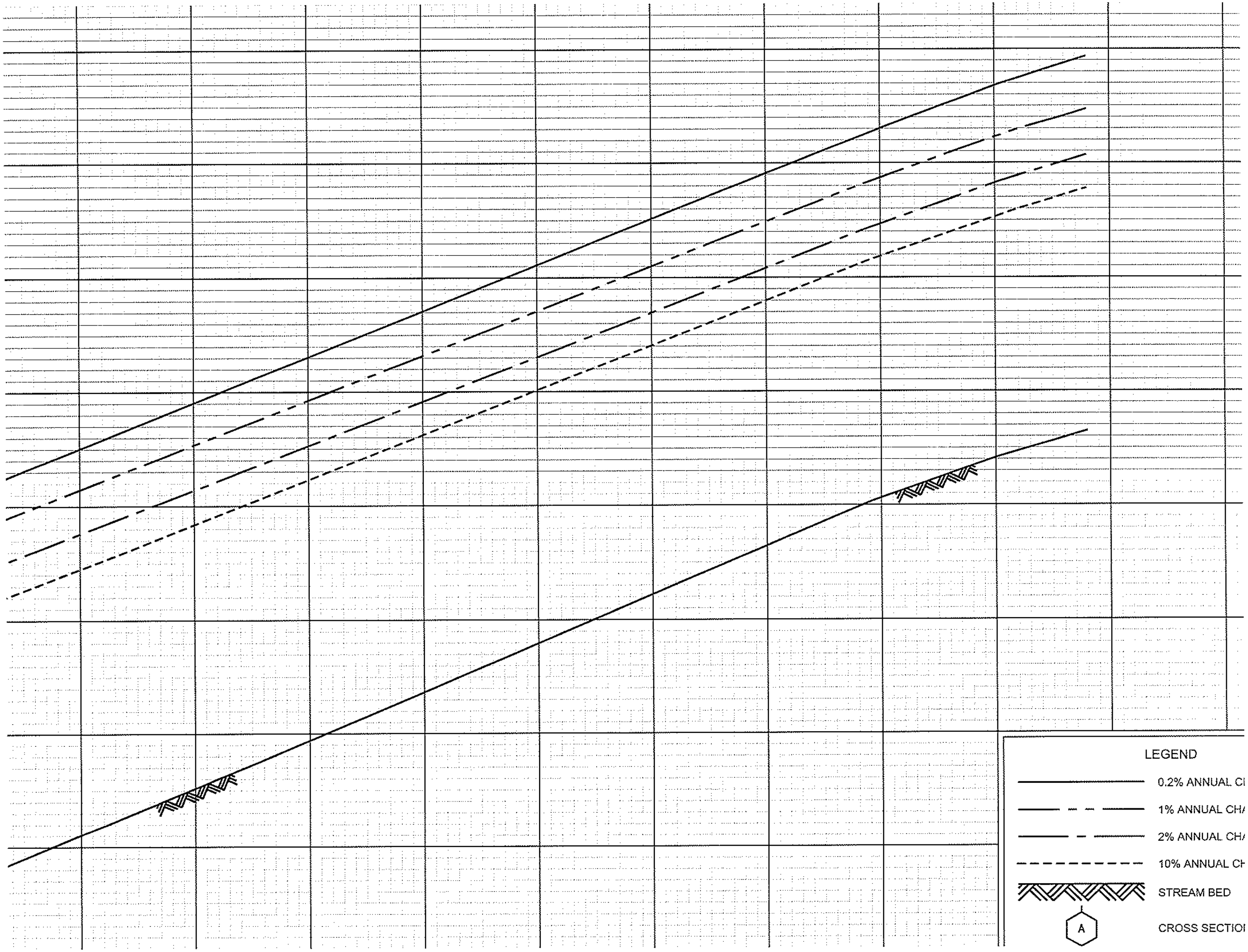

LIMIT OF DETAILED STUDY
F
LEGEND
*0.2% ANNUAL C
1% ANNUAL CH
*2% ANNUAL CH
*10% ANNUAL C
STREAM BED
A
CROSS SECTIO



WOLF RIVER ROAD
A
LEGEND
0.2% ANNUAL C
1% ANNUAL CH
2% ANNUAL CH
10% ANNUAL C
STREAM BED
A
CROSS SECTIO

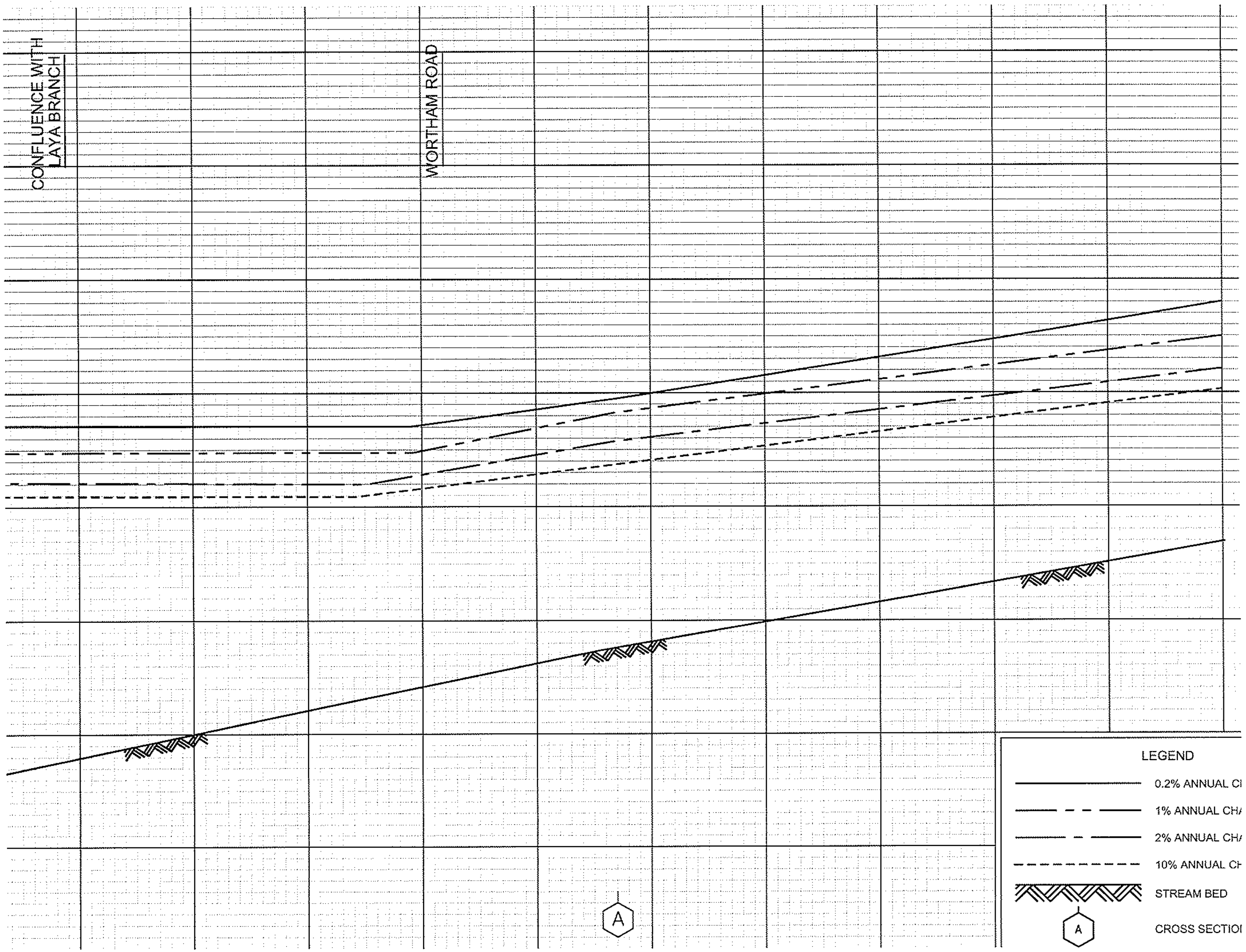

LIMIT OF DETAILED STUDY
D
E
LEGEND
*0.2% ANNUAL CI
1% ANNUAL CHA
*2% ANNUAL CHA
*10% ANNUAL CH
STREAM BED
A
CROSS SECTION

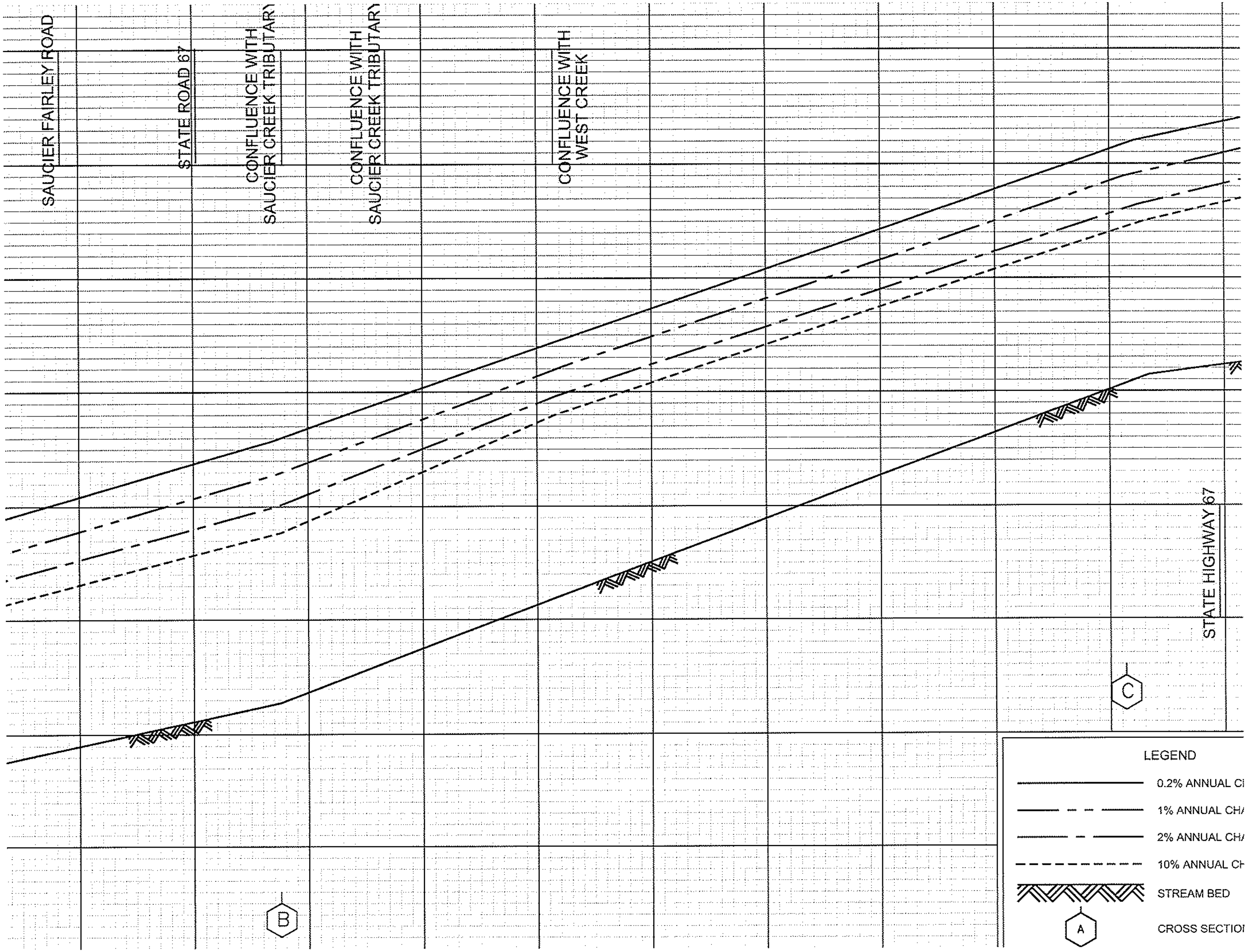

CEMETERY ROAD
A
LEGEND
0.2% ANNUAL CI
1% ANNUAL CH/
2% ANNUAL CH/
10% ANNUAL CH
STREAM BED
A
CROSS SECTIOI



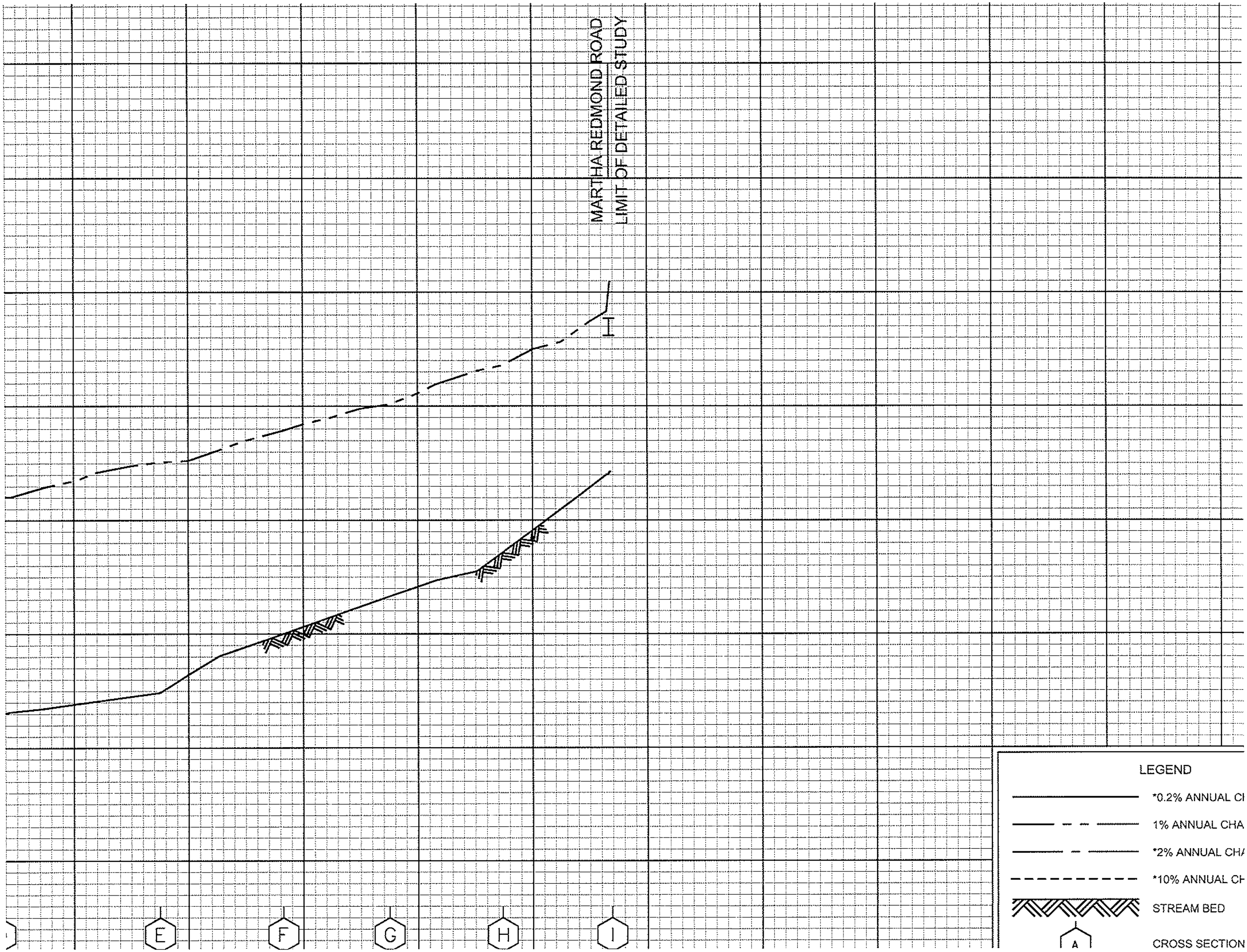
LEGEND
0.2% ANNUAL CI
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTIOI

STEEL BRIDGE ROAD
LIMIT OF DETAILED STUDY
C
D
LEGEND
*0.2% ANNUAL CI
1% ANNUAL CHA
*2% ANNUAL CHA
*10% ANNUAL CH
STREAM BED
A
CROSS SECTION

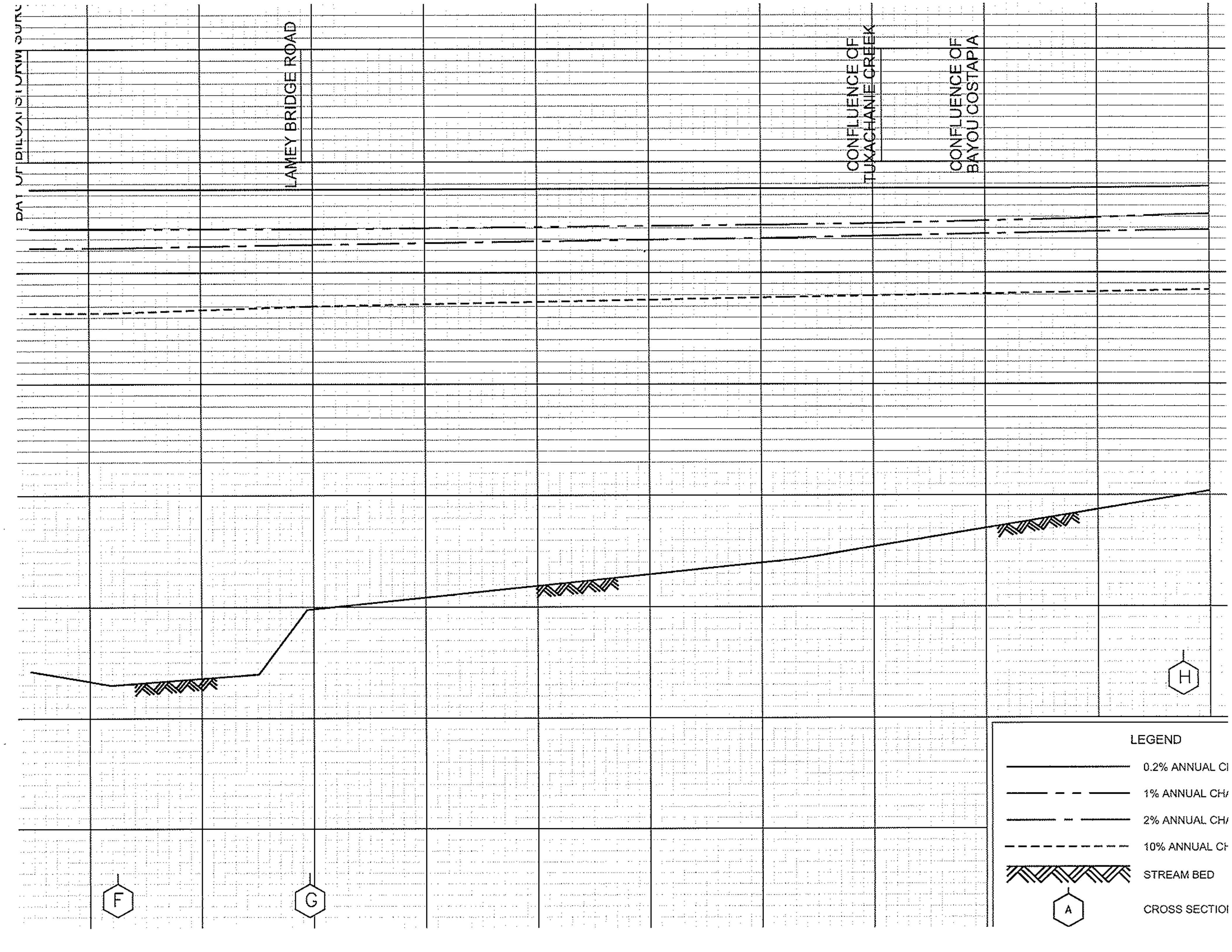

CONFLUENCE WITH
LAYA BRANCH
WORTHAM ROAD
A
LEGEND
0.2% ANNUAL CI
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTIO



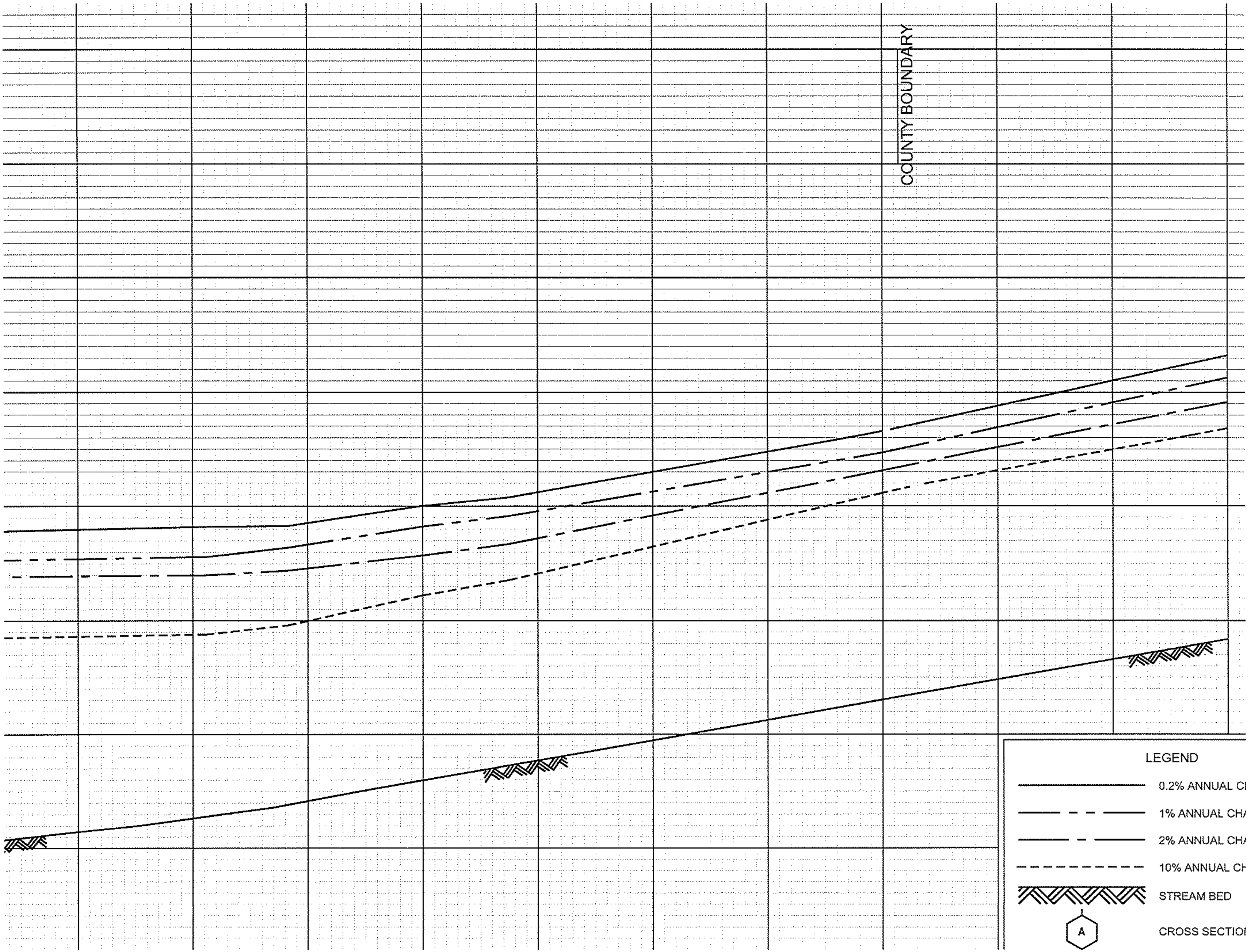
SAUCIER FAIRLEY ROAD
STATE ROAD 67
CONFLUENCE WITH SAUCIER CREEK TRIBUTARY
CONFLUENCE WITH SAUCIER CREEK TRIBUTARY
CONFLUENCE WITH WEST CREEK
STATE HIGHWAY 67
C
B
LEGEND
0.2% ANNUAL C
1% ANNUAL CH
2% ANNUAL CH
10% ANNUAL CH
STREAM BED
A
CROSS SECTIO

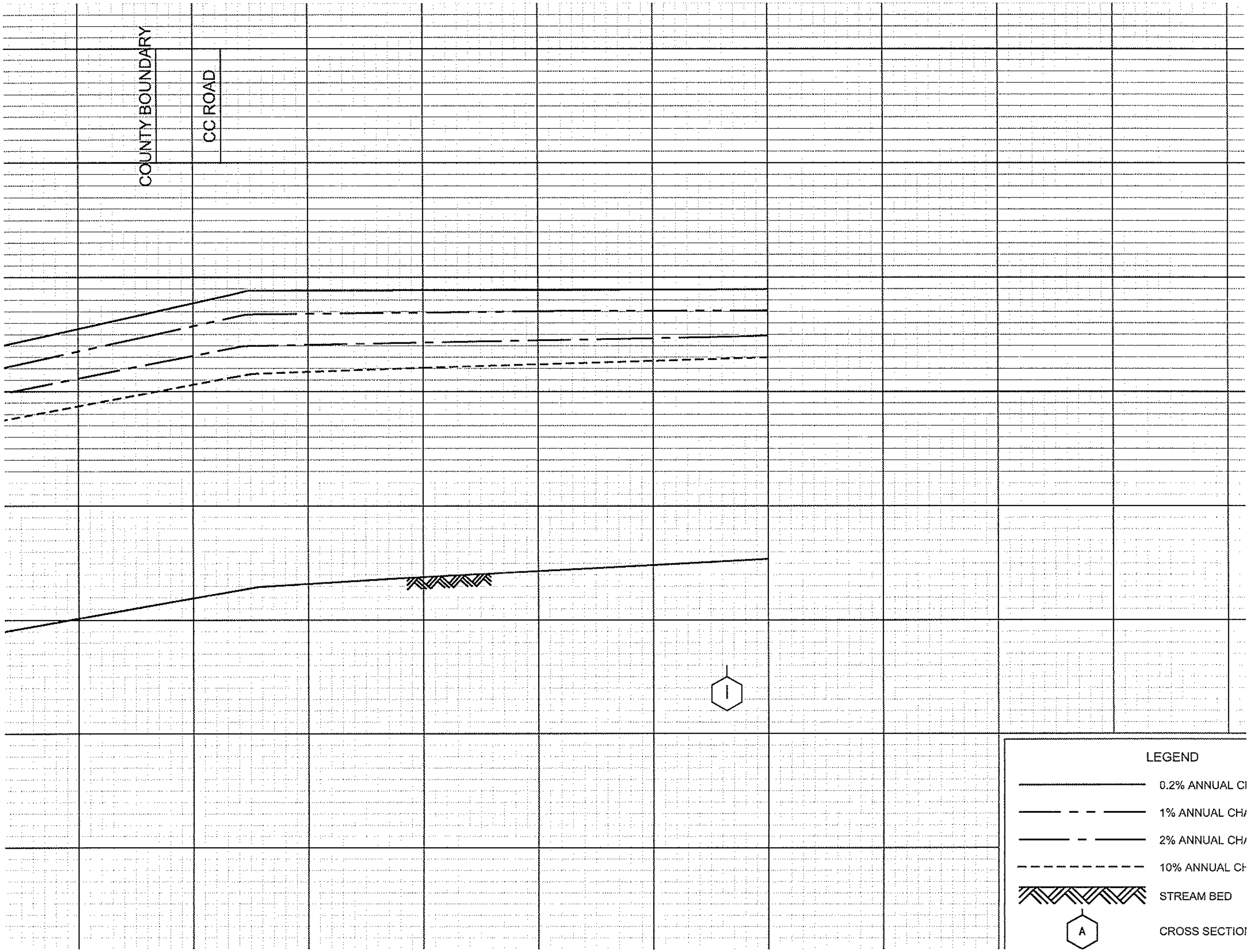


MARTHA REDMOND ROAD
LIMIT OF DETAILED STUDY
E
F
G
H
I
LEGEND
*0.2% ANNUAL CI
1% ANNUAL CHA
*2% ANNUAL CHA
*10% ANNUAL CH
STREAM BED
A
CROSS SECTION

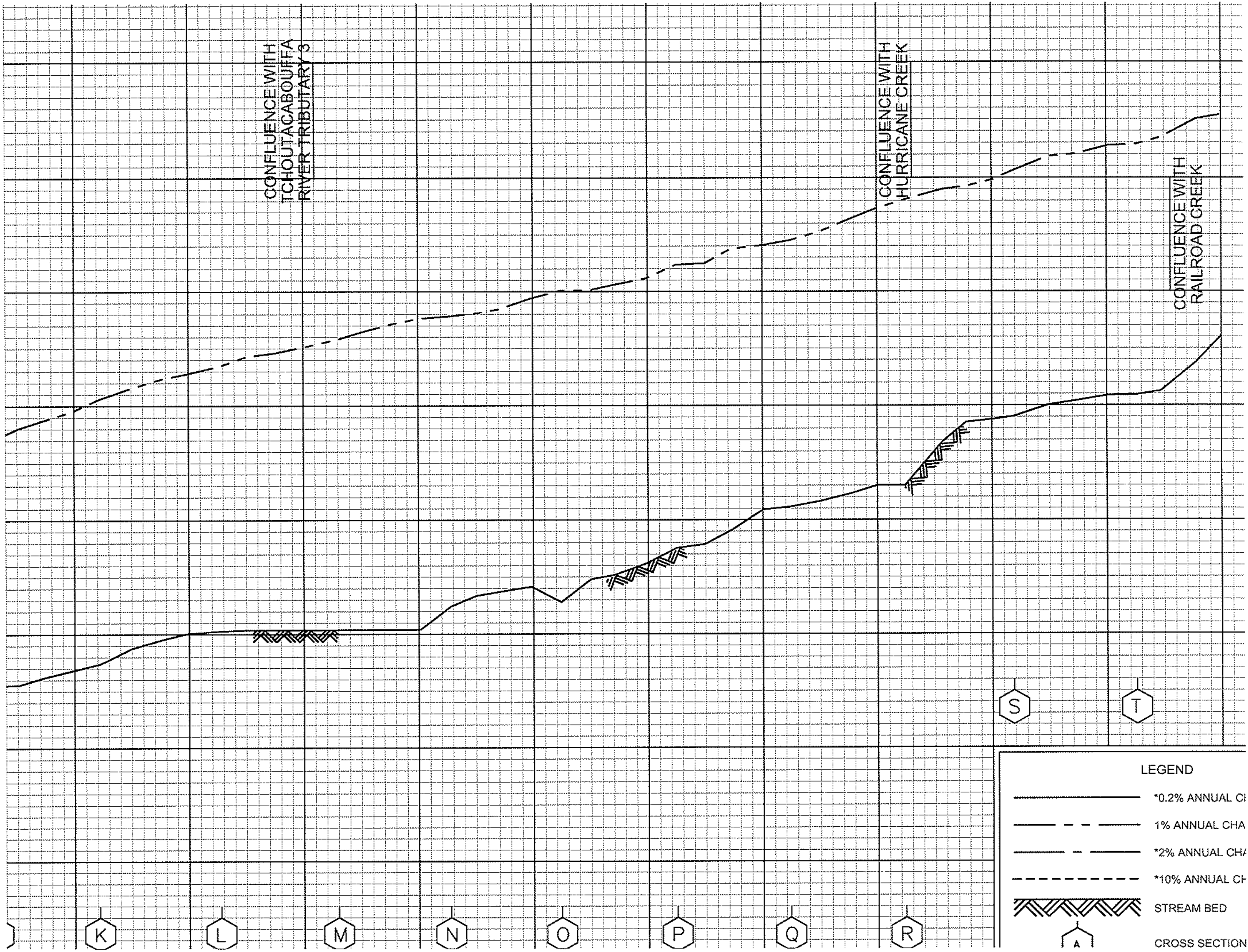


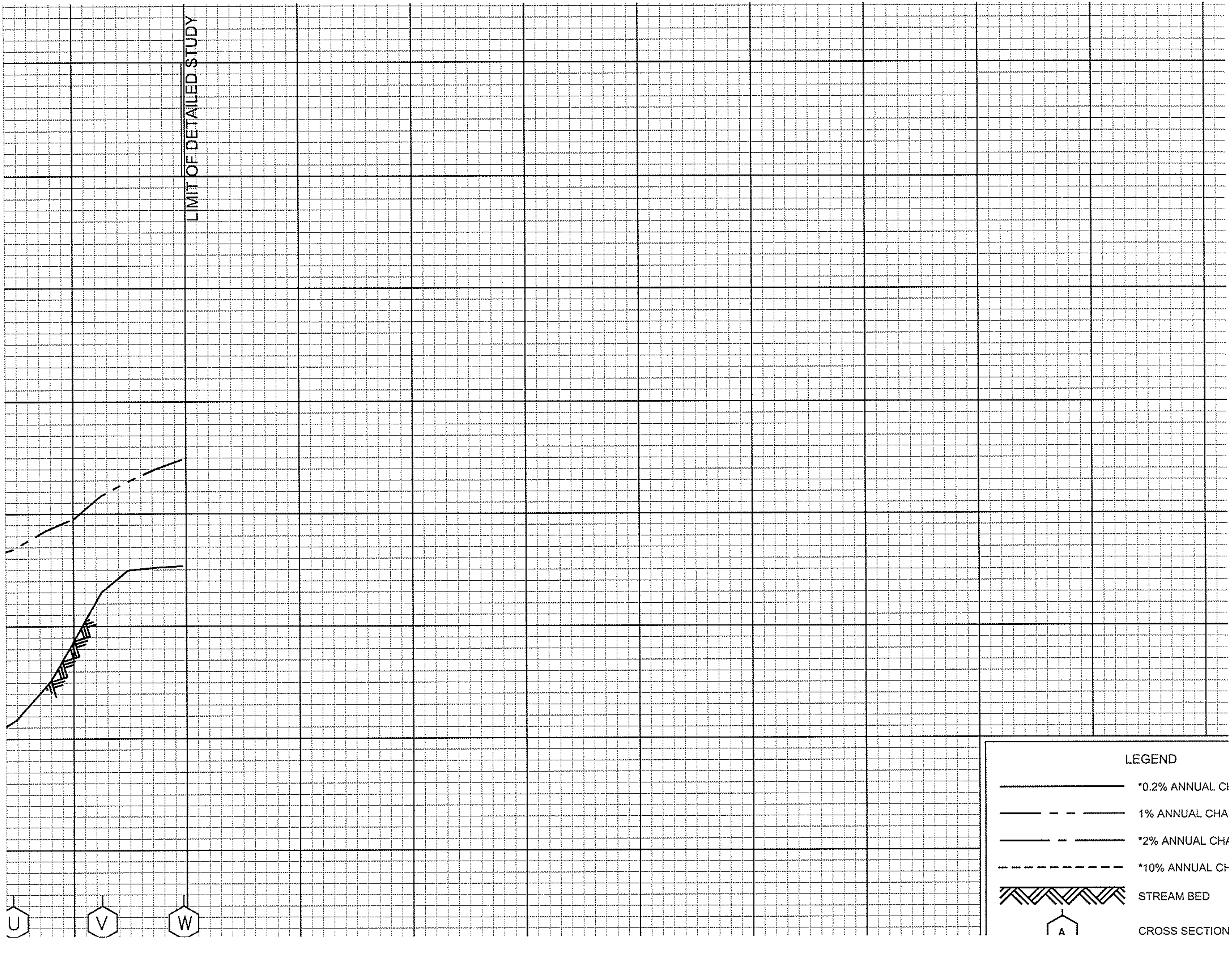
BAY OF BILOXI STORM SURG
LAMEY BRIDGE ROAD
CONFLUENCE OF TUXACHANIE CREEK
CONFLUENCE OF BAYOU COSTAPIA
F
G
H
LEGEND
0.2% ANNUAL C
1% ANNUAL CH
2% ANNUAL CH
10% ANNUAL C
STREAM BED
A
CROSS SECTIO

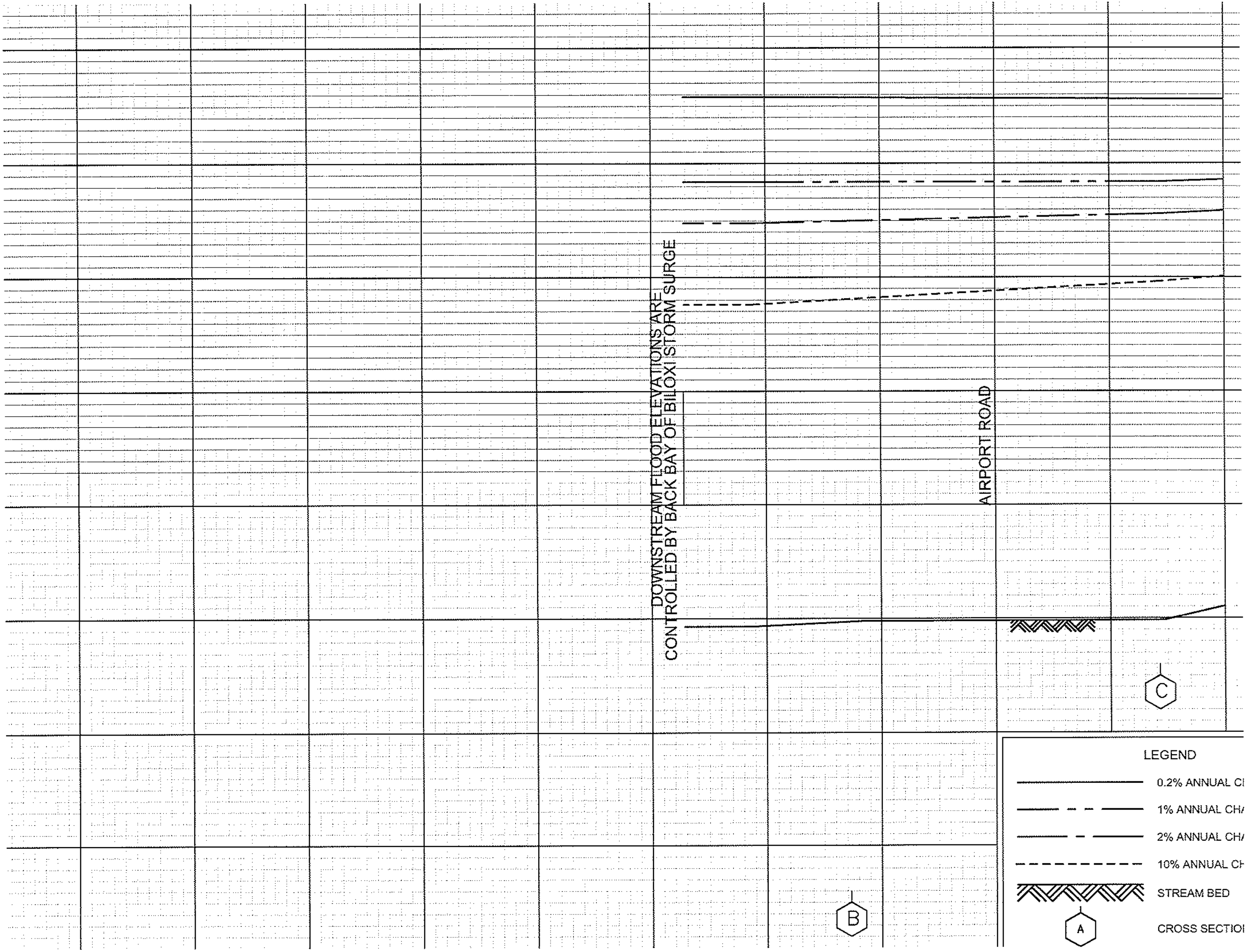

COUNTY BOUNDARY
LEGEND
0.2% ANNUAL C
1% ANNUAL CH
2% ANNUAL CH
10% ANNUAL CH
STREAM BED
A
CROSS SECTIO



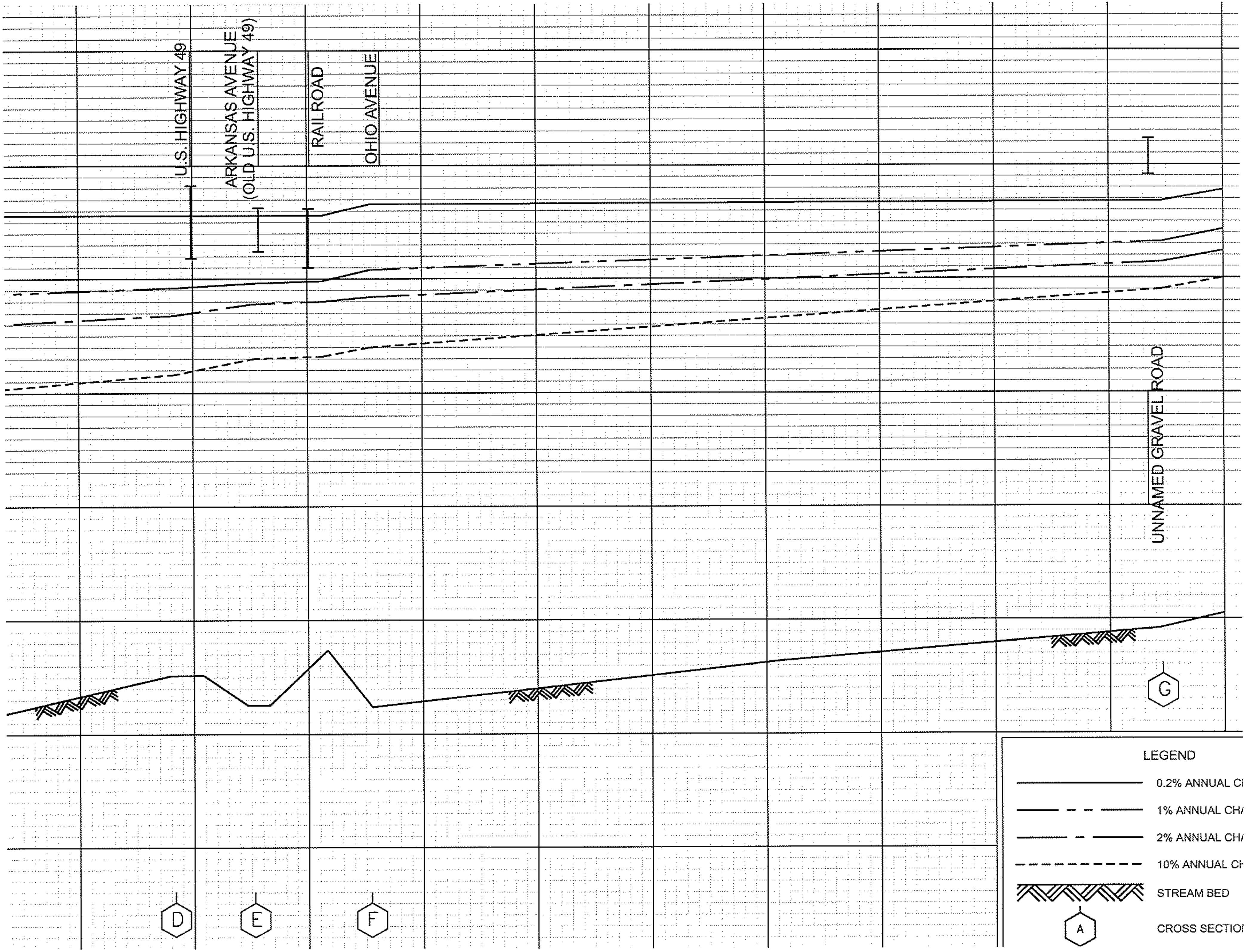
COUNTY BOUNDARY
CC ROAD
I
LEGEND
0.2% ANNUAL CI
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTIOI

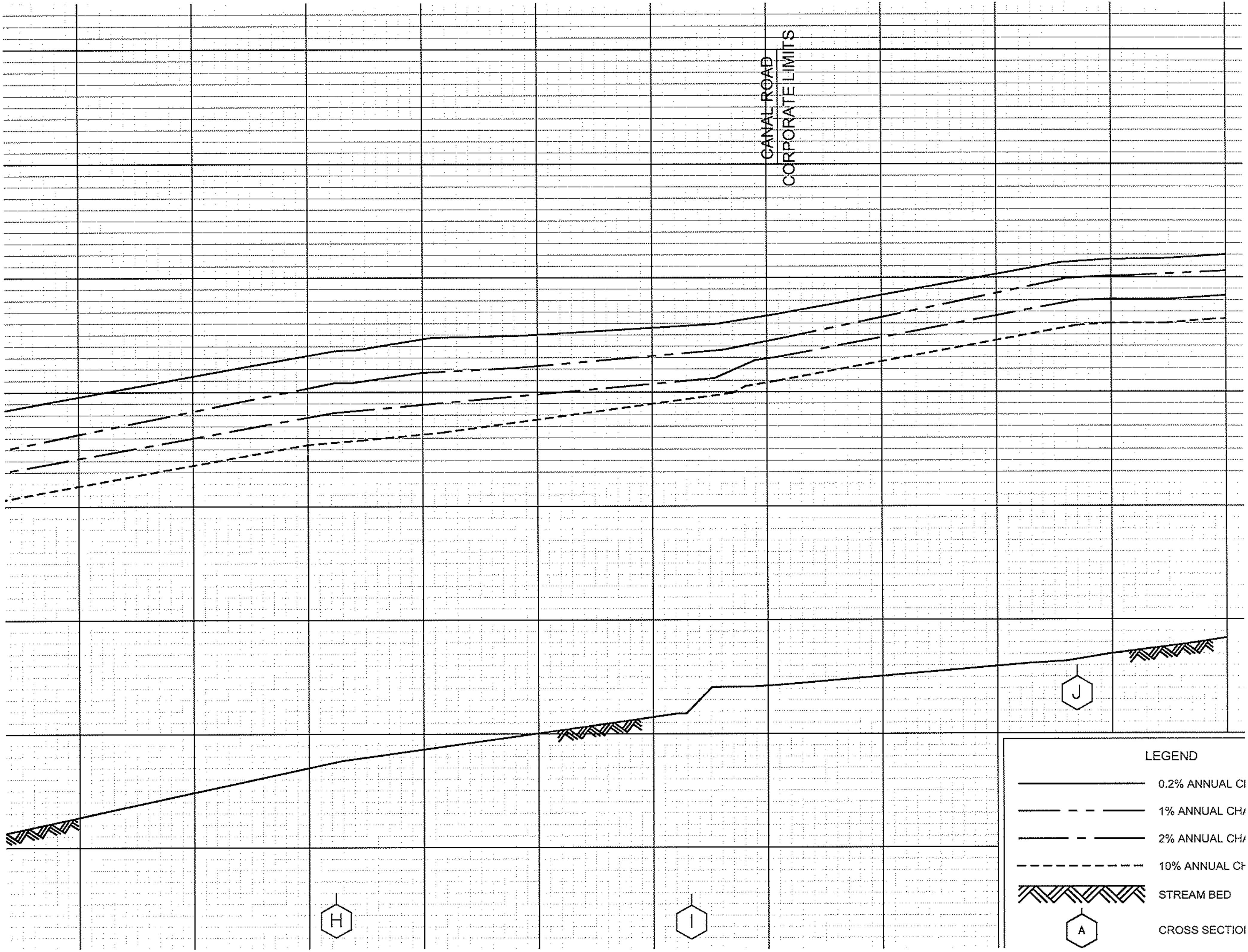

CONFLUENCE WITH
TCHOUTACABOUFFA
RIVER TRIBUTARY 3
CONFLUENCE WITH
HURRICANE CREEK
CONFLUENCE WITH
RAILROAD CREEK
K
L
M
N
O
P
Q
R
S
T
LEGEND
*0.2% ANNUAL CH
1% ANNUAL CHA
*2% ANNUAL CHA
*10% ANNUAL CH
STREAM BED
A
CROSS SECTION

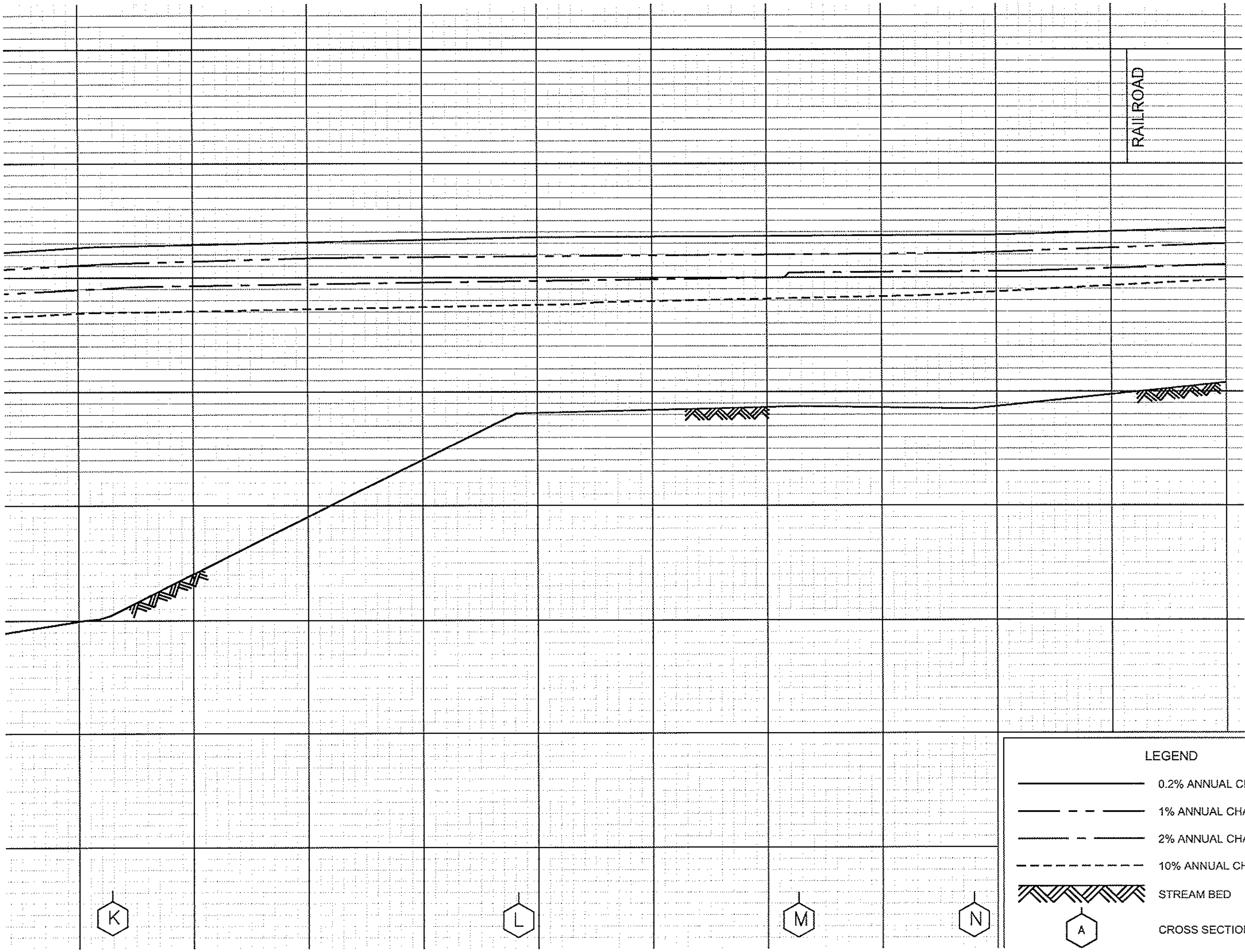

LIMIT OF DETAILED STUDY
U
V
W
LEGEND
*0.2% ANNUAL CH
1% ANNUAL CHA
*2% ANNUAL CHA
*10% ANNUAL CH
STREAM BED
A
CROSS SECTION

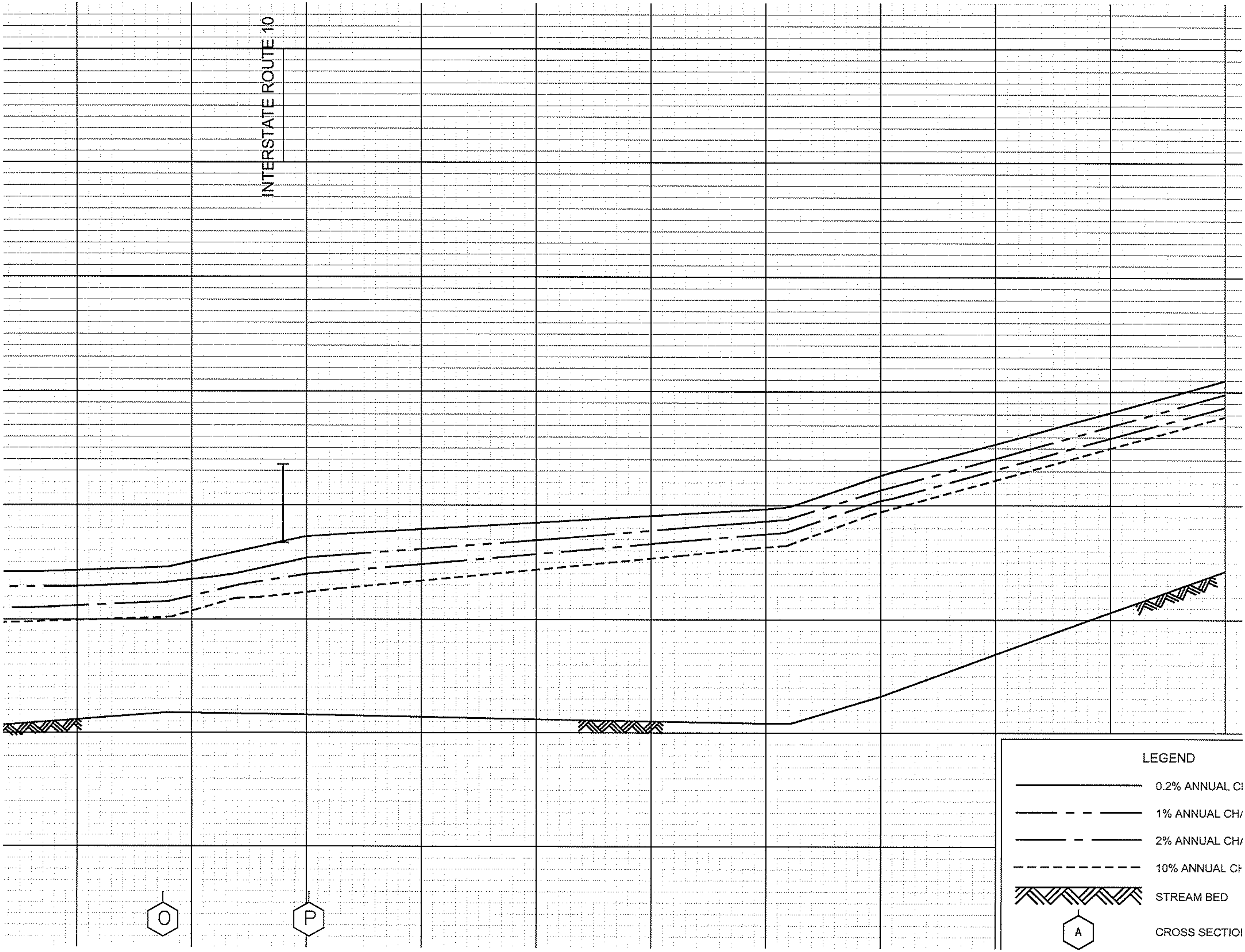


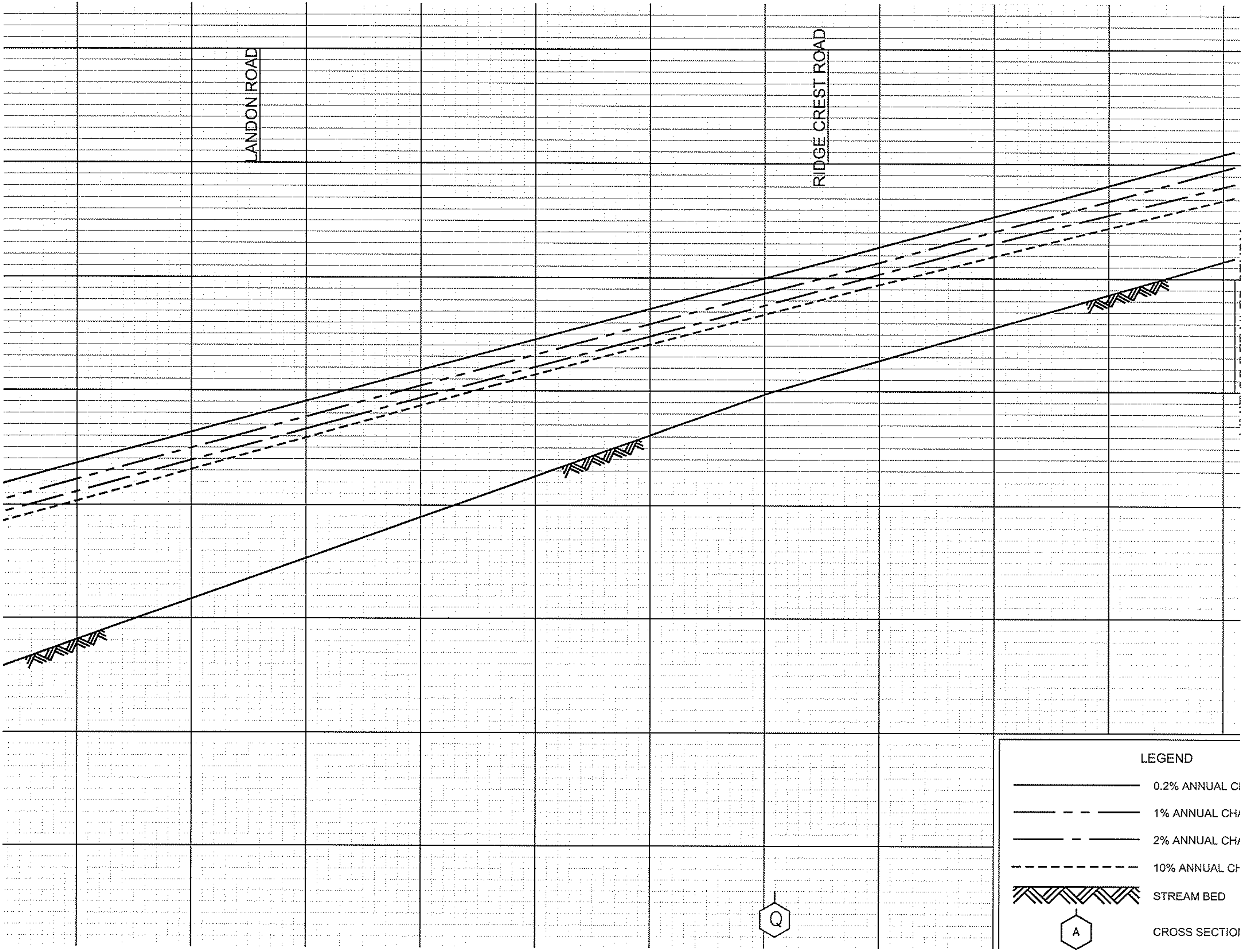
DOWNSTREAM FLOOD ELEVATIONS ARE
CONTROLLED BY BACK BAY OF BILOXI STORM SURGE
AIRPORT ROAD
C
B
LEGEND
0.2% ANNUAL CI
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTIOI


U.S. HIGHWAY 49
ARKANSAS AVENUE
(OLD U.S. HIGHWAY 49)
RAILROAD
OHIO AVENUE
UNNAMED GRAVEL ROAD
D
E
F
G
LEGEND
0.2% ANNUAL C
1% ANNUAL CH
2% ANNUAL CH
10% ANNUAL C
STREAM BED
A
CROSS SECTIO

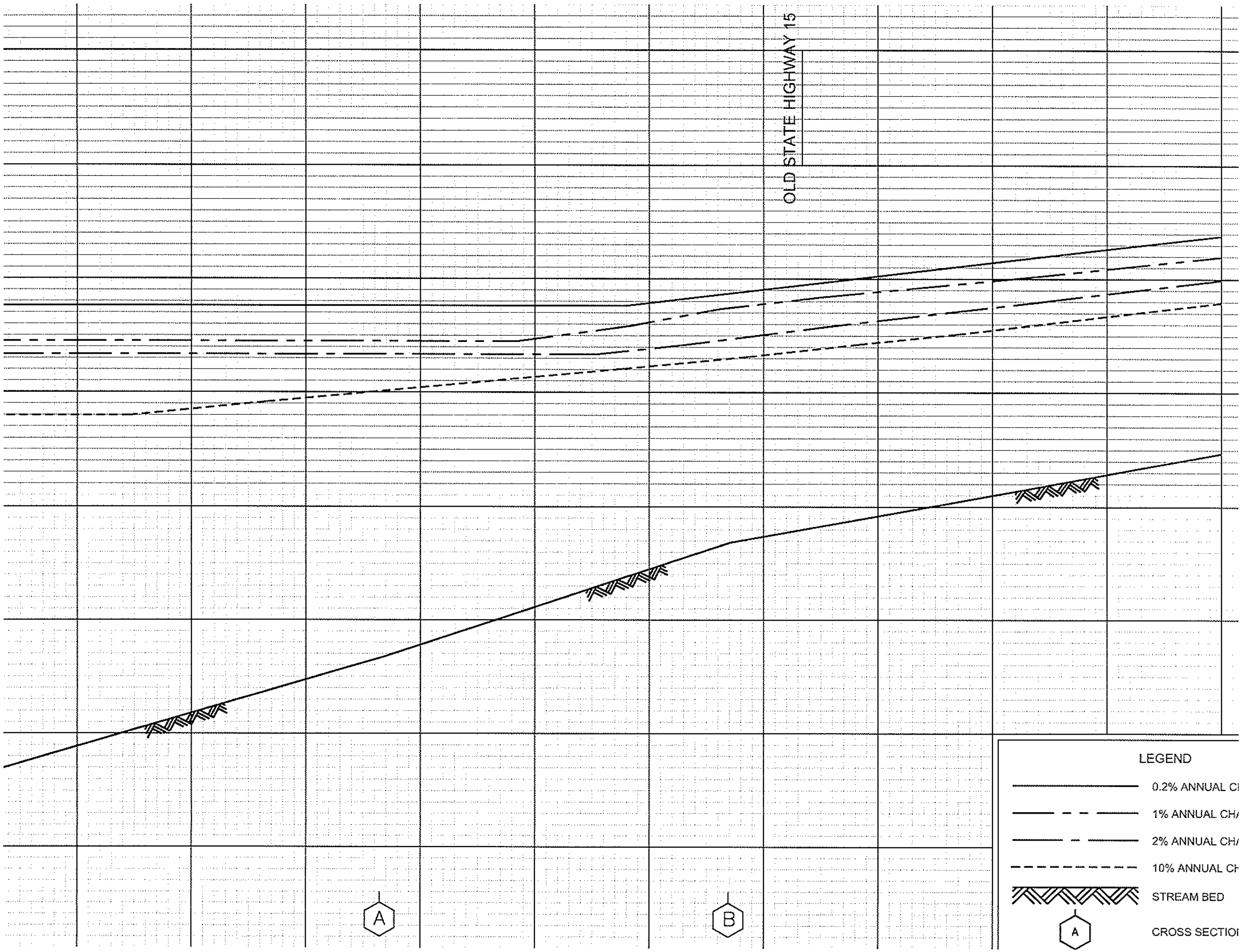

CANAL ROAD
CORPORATE LIMITS
H
I
J
LEGEND
0.2% ANNUAL CI
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTIOI


RAILROAD
LEGEND
0.2% ANNUAL CH
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
CROSS SECTION
K
L
M
N
A

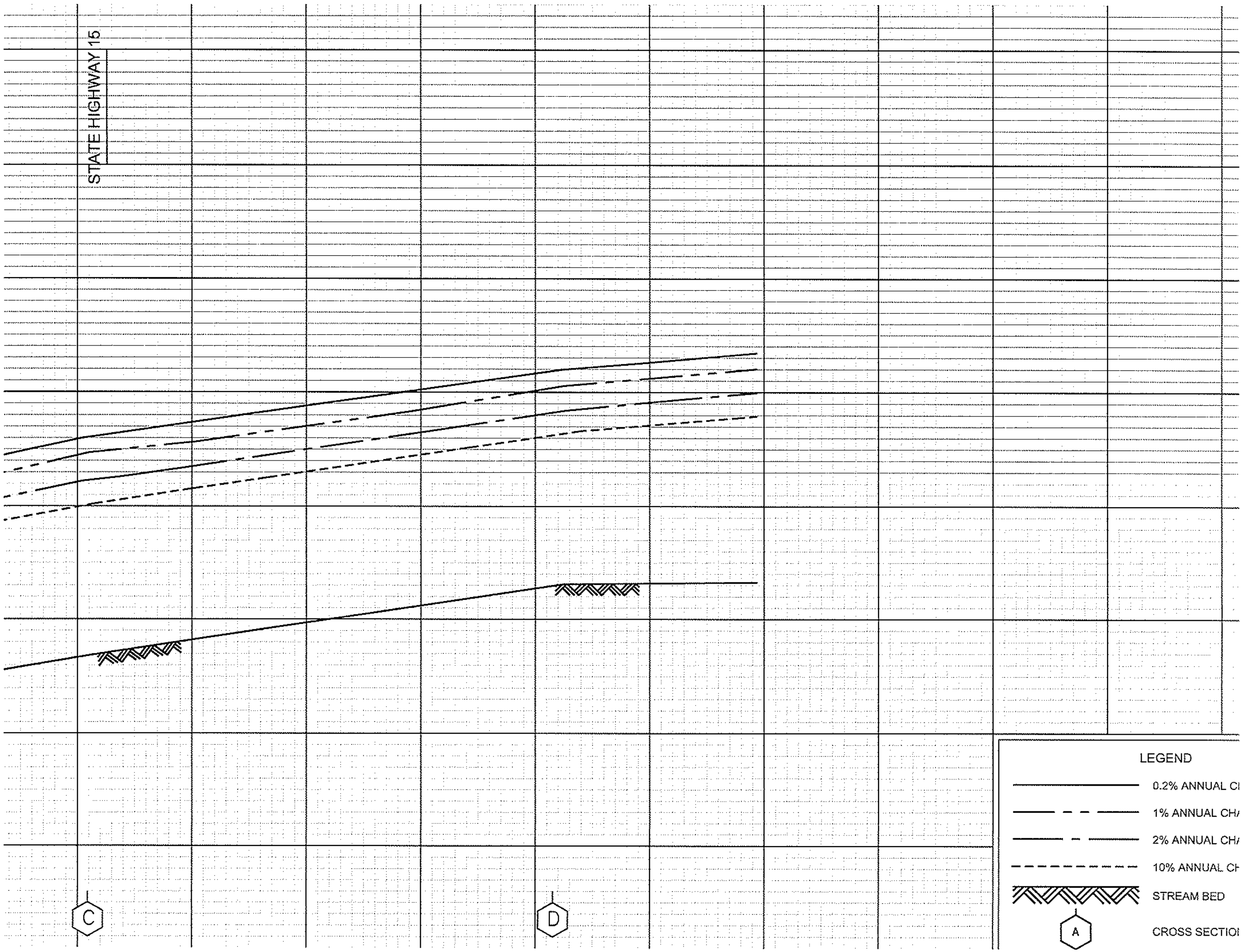

INTERSTATE ROUTE 10
O
P
LEGEND
0.2% ANNUAL CH
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTIO



LANDON ROAD
RIDGE CREST ROAD
Q
LEGEND
0.2% ANNUAL CI
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTIOI

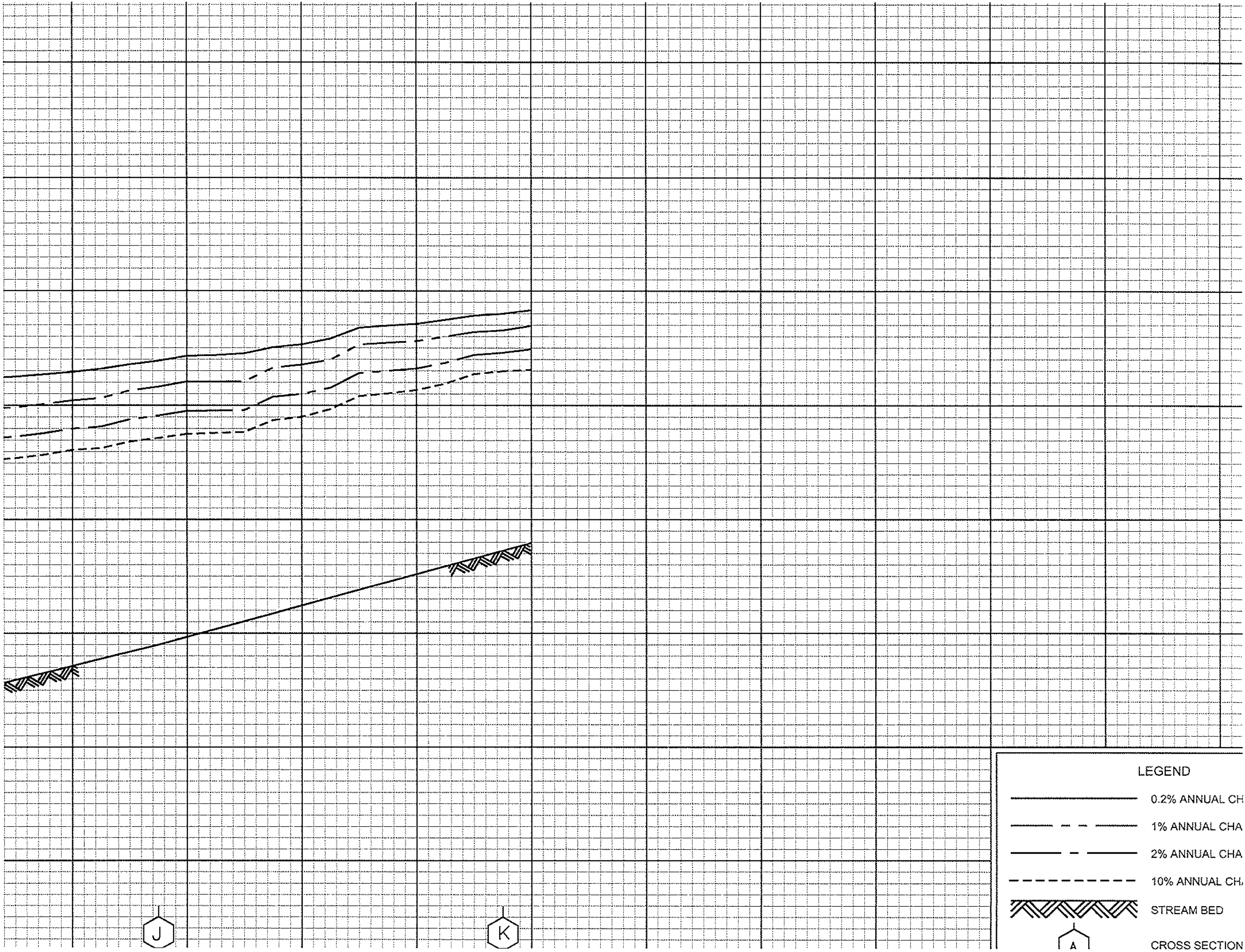


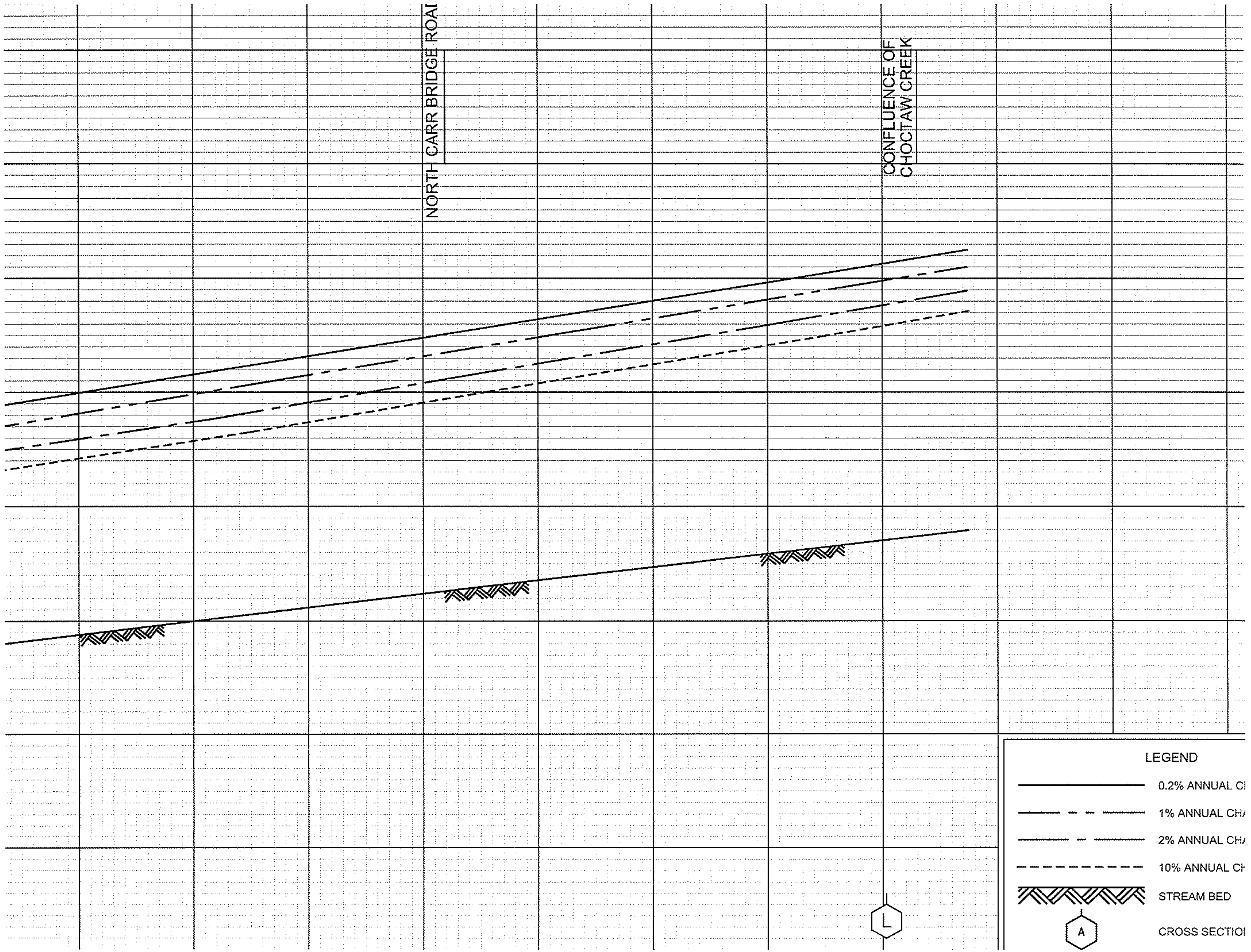
OLD STATE HIGHWAY 15
A
B
LEGEND
0.2% ANNUAL CI
1% ANNUAL CH/
2% ANNUAL CH/
10% ANNUAL CH
STREAM BED
A
CROSS SECTIOI



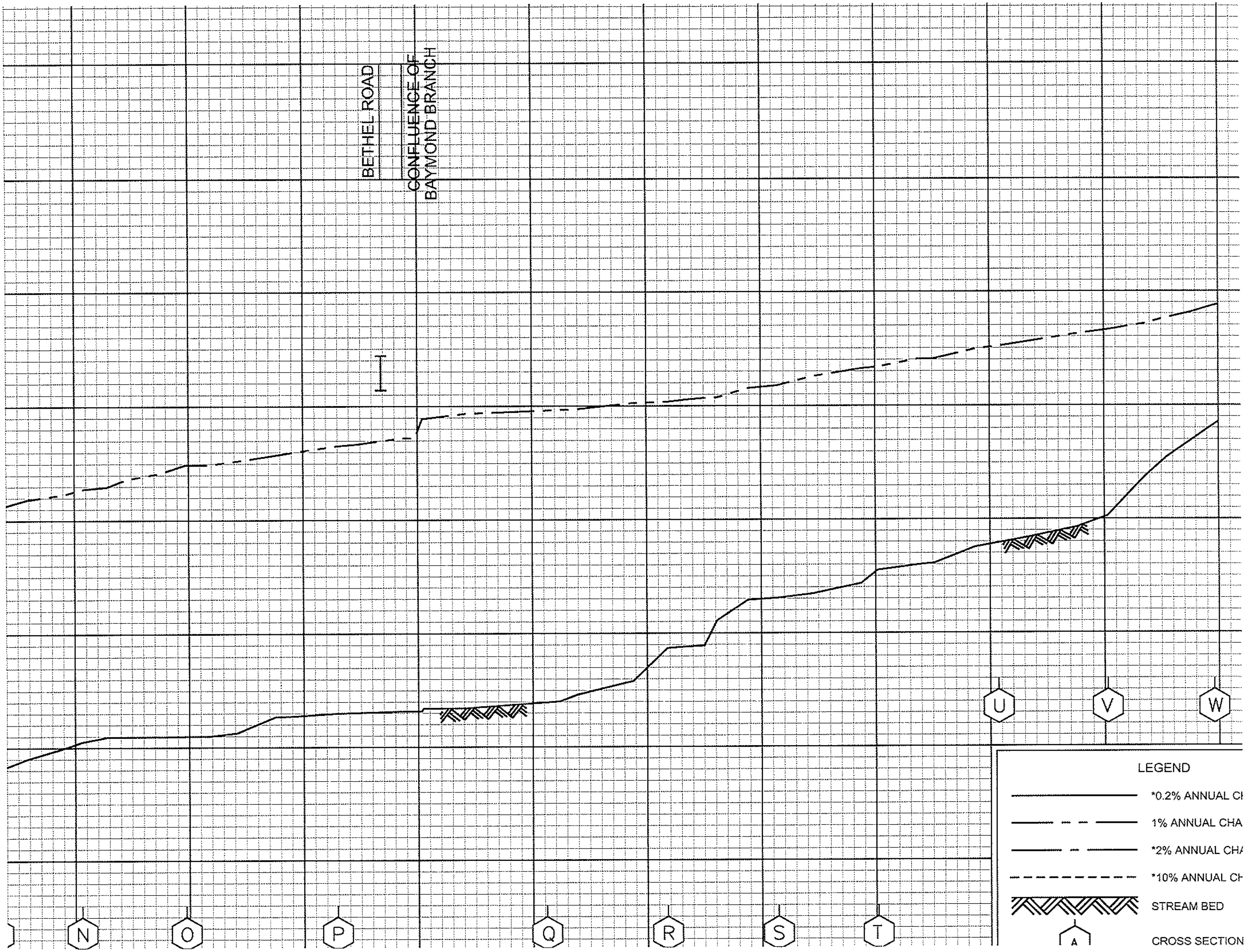
STATE HIGHWAY 15
C
D
LEGEND
0.2% ANNUAL CI
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTIOI

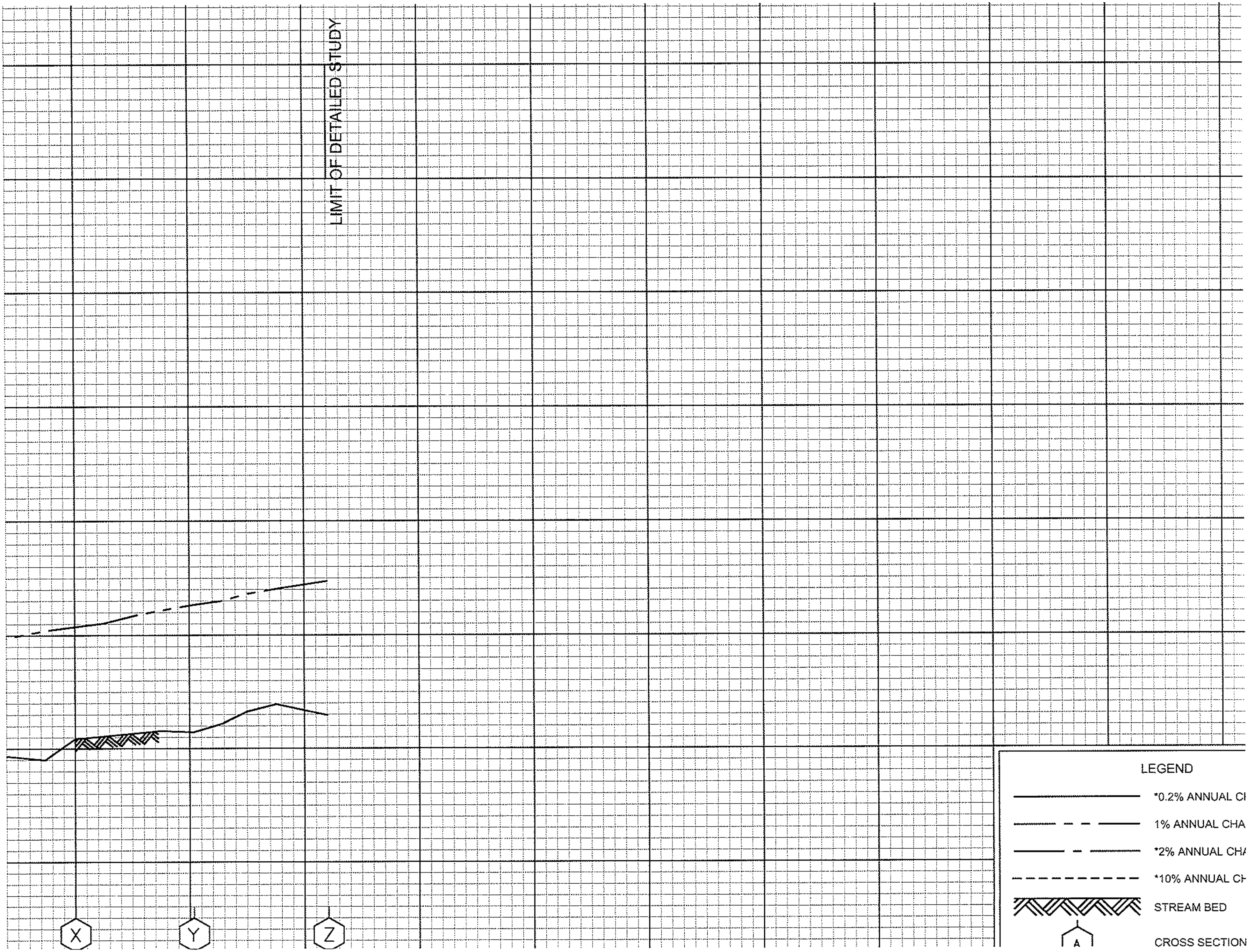

HOG BRANCH
WHITE PLAINS ROAD
F
G
H
I
LEGEND
0.2% ANNUAL CH
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTION


J
K
LEGEND
0.2% ANNUAL CH
1% ANNUAL CHA
2% ANNUAL CHA
10% ANNUAL CH
STREAM BED
A
CROSS SECTION



NORTH CARR BRIDGE ROAI
CONFLUENCE OF
CHOCTAW CREEK
L
LEGEND
0.2% ANNUAL CI
1% ANNUAL CH/
2% ANNUAL CH/
10% ANNUAL CI
STREAM BED
A
CROSS SECTIOI


BETHEL ROAD
CONFLUENCE OF
BAYMOND BRANCH
N
O
P
Q
R
S
T
U
V
W
LEGEND
*0.2% ANNUAL CH
1% ANNUAL CHA
*2% ANNUAL CHA
*10% ANNUAL CH
STREAM BED
A
CROSS SECTION


LIMIT OF DETAILED STUDY
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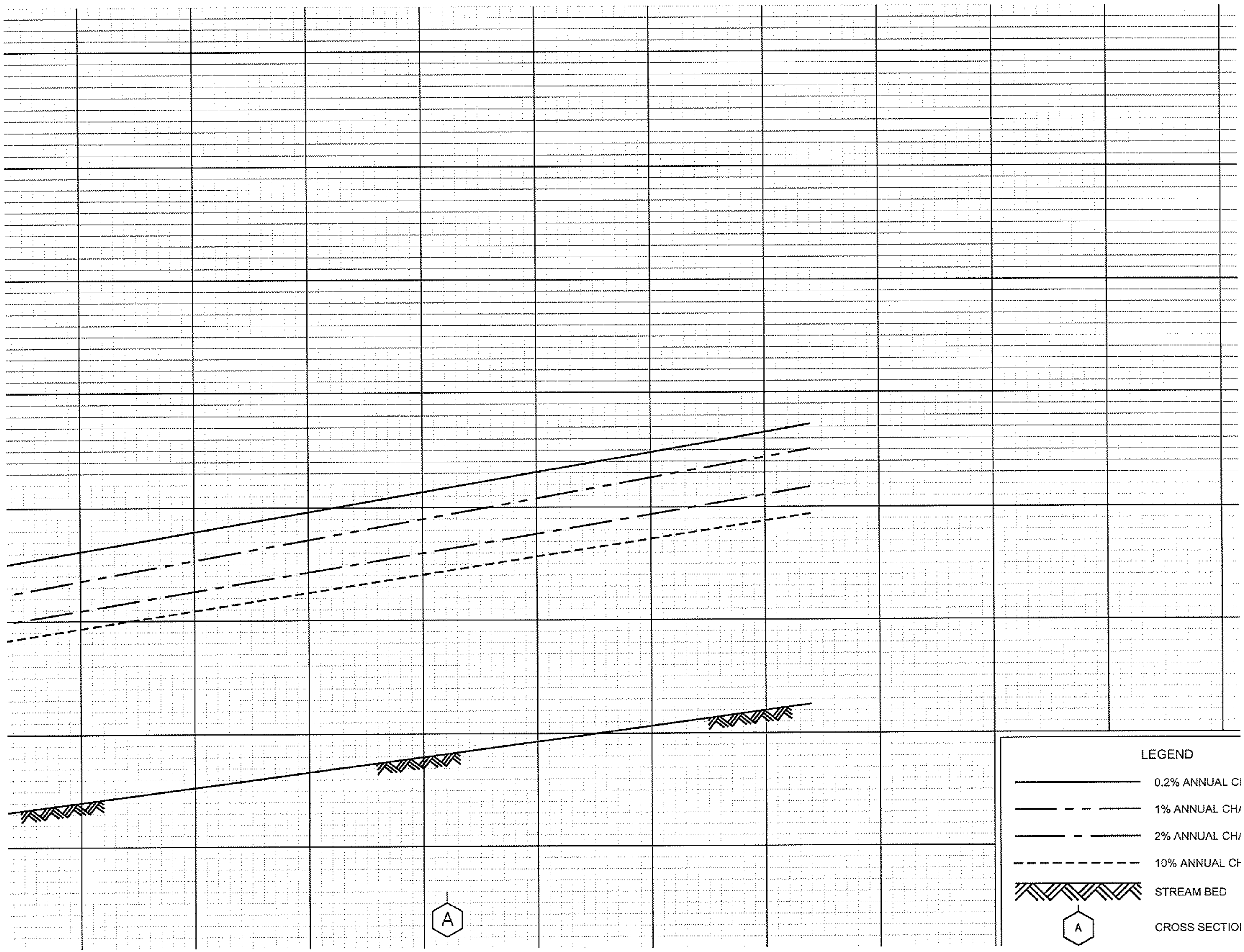
STREAM BED
A
CROSS SECTION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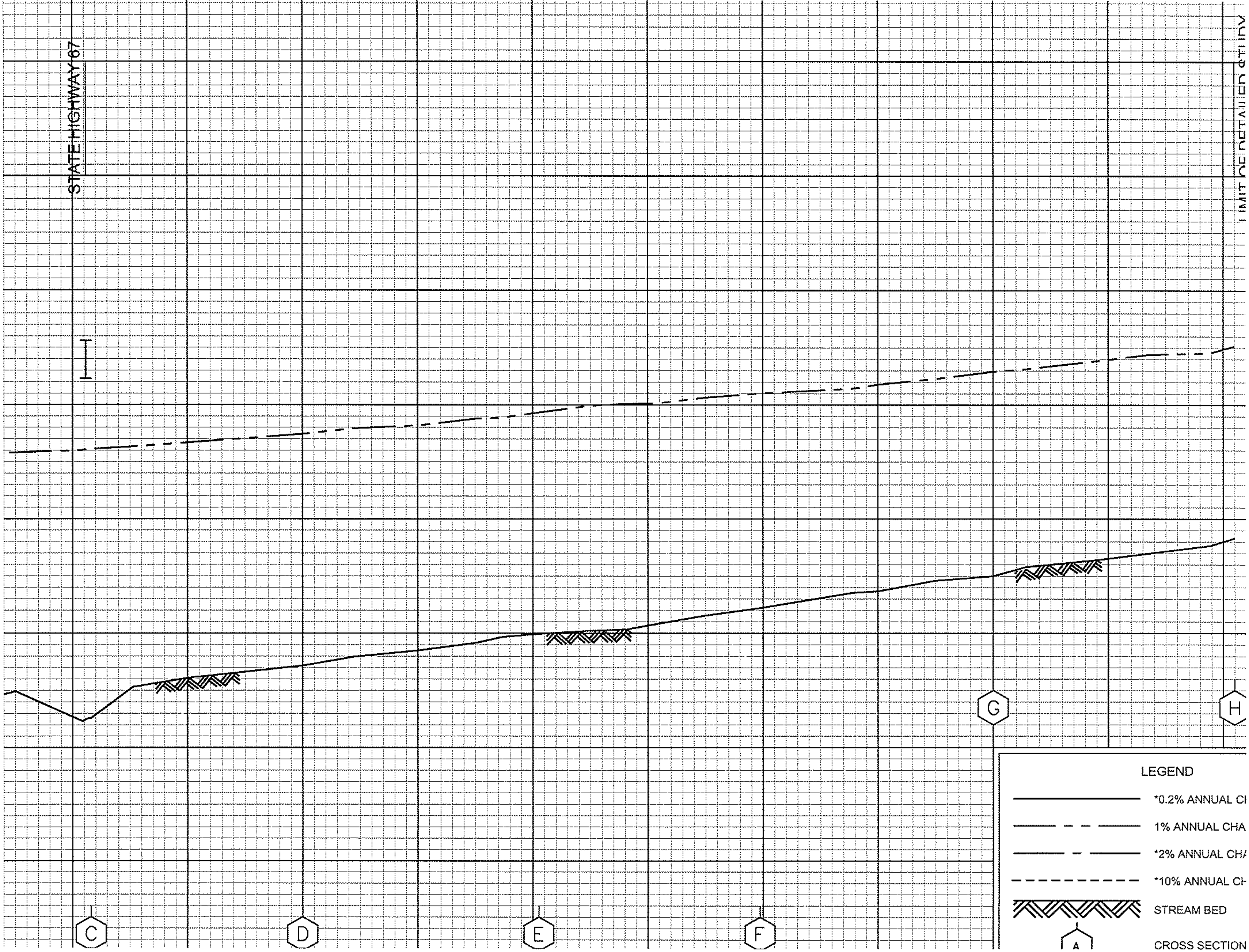

STATE HIGHWAY 67
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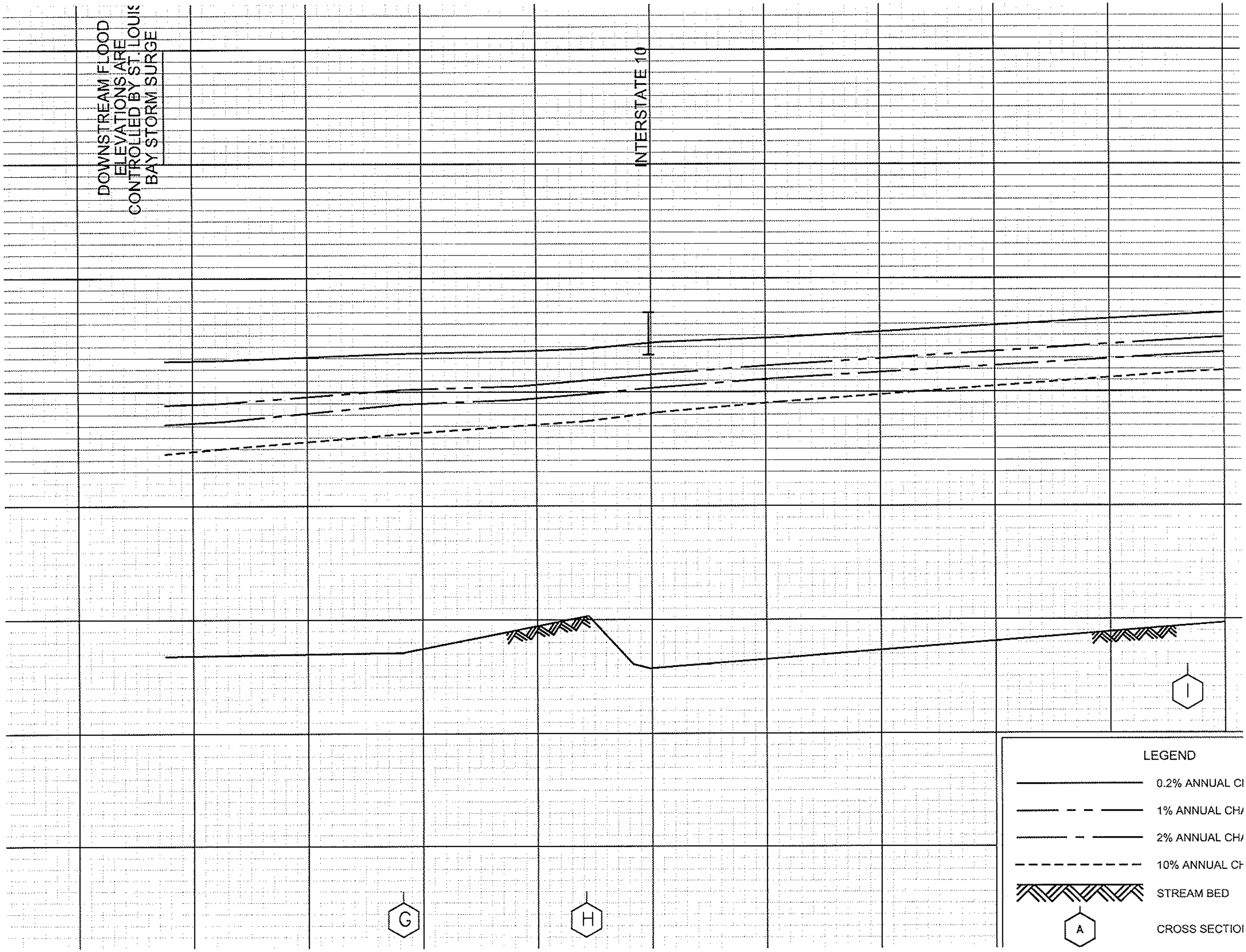
DOWNSTREAM FLOOD
ELEVATIONS ARE
CONTROLLED BY ST. LOUIS
BAY STORM SURGE
INTERSTATE 10
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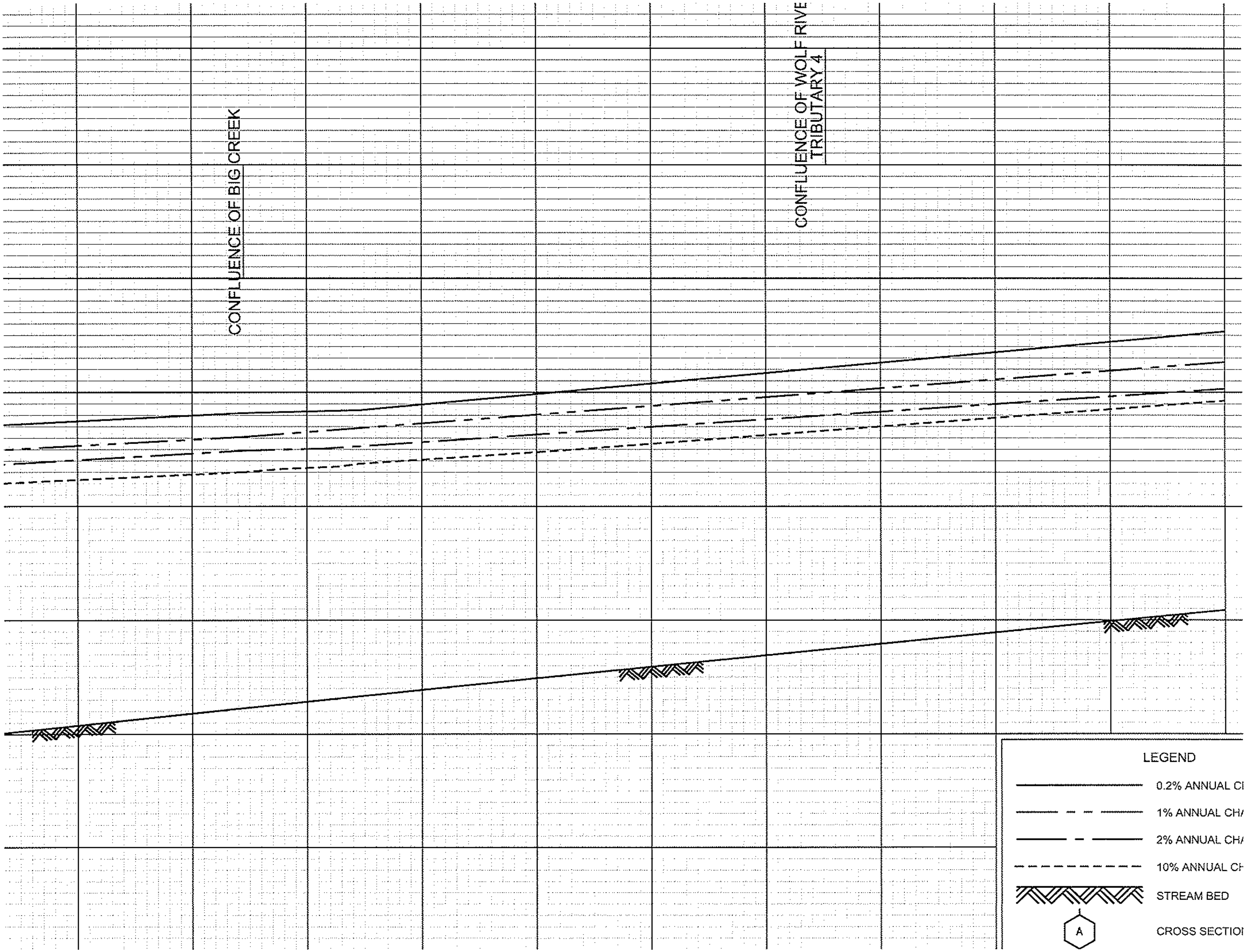
CONFLUENCE OF BIG CREEK
CONFLUENCE OF WOLF RIVE
TRIBUTARY 4
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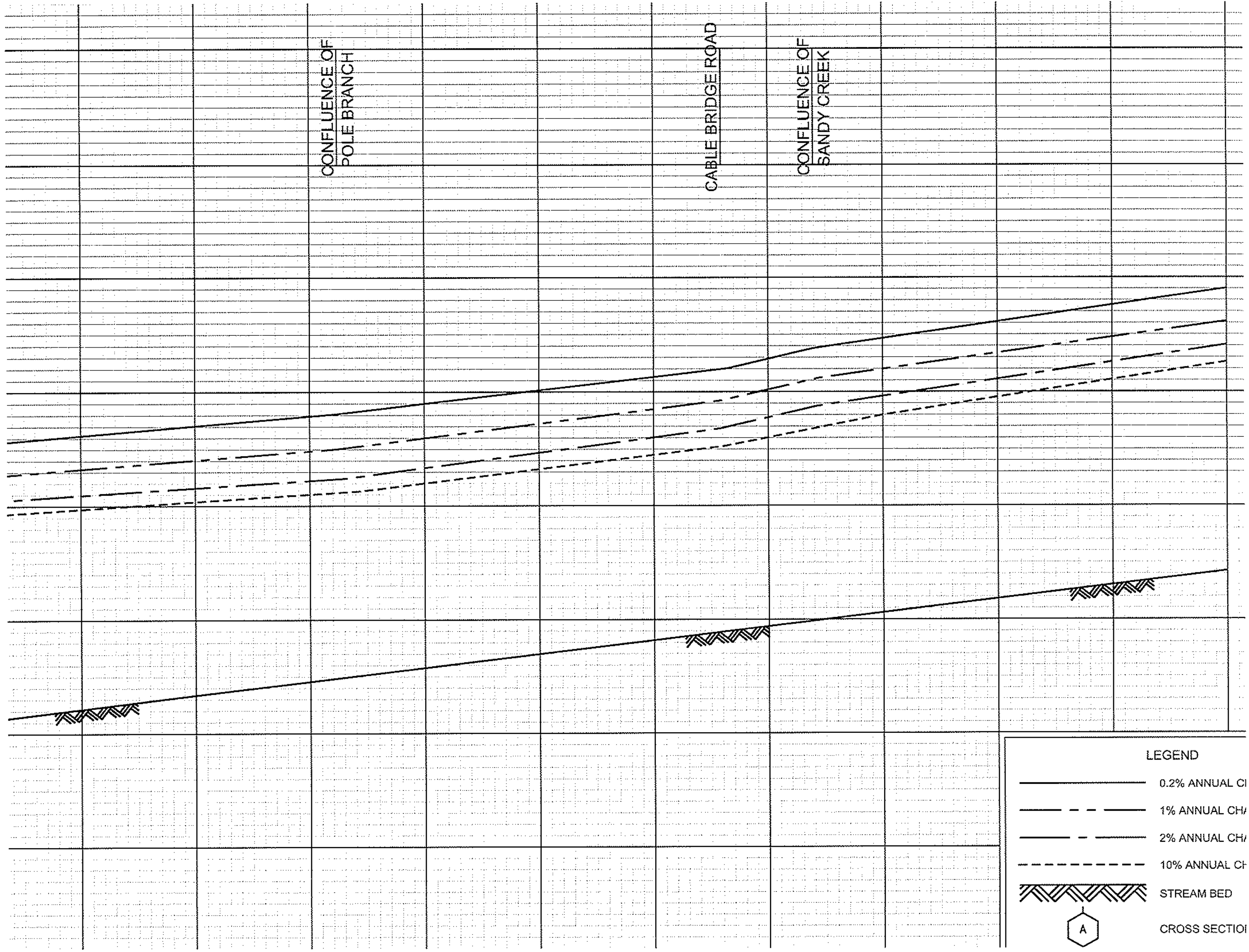
CROSS SECTIO



CONFLUENCE OF POLE BRANCH
CABLE BRIDGE ROAD
CONFLUENCE OF SANDY CREEK
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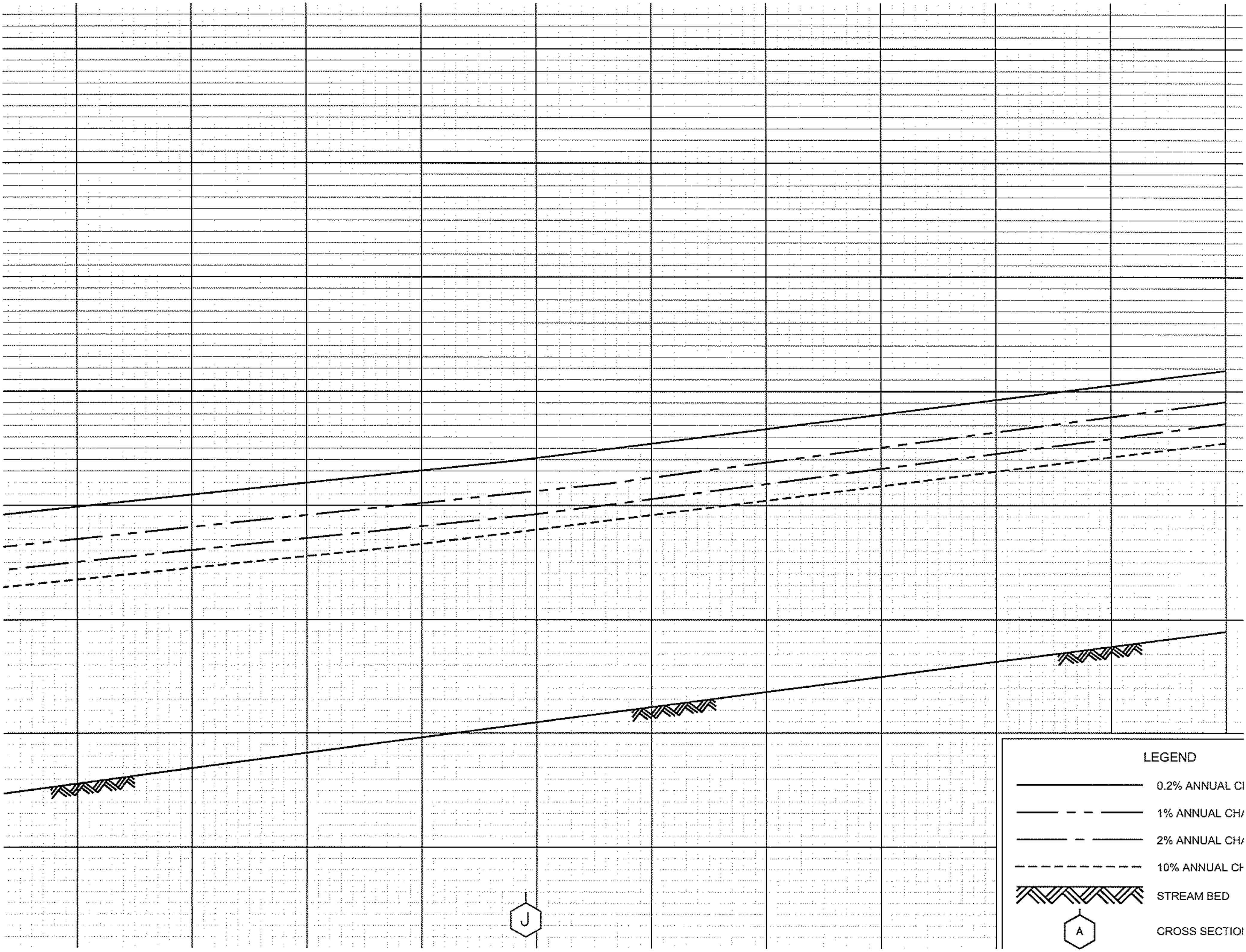
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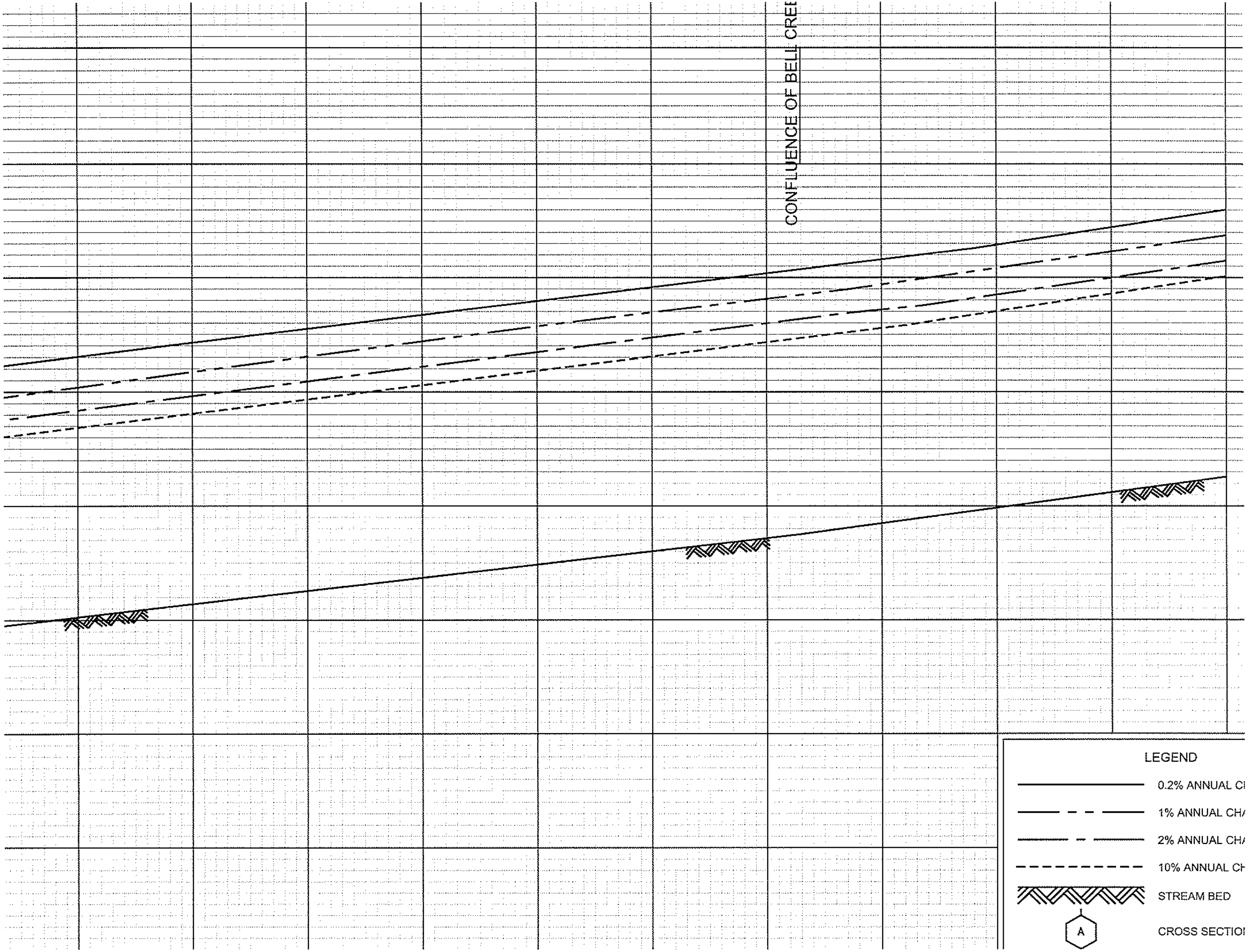
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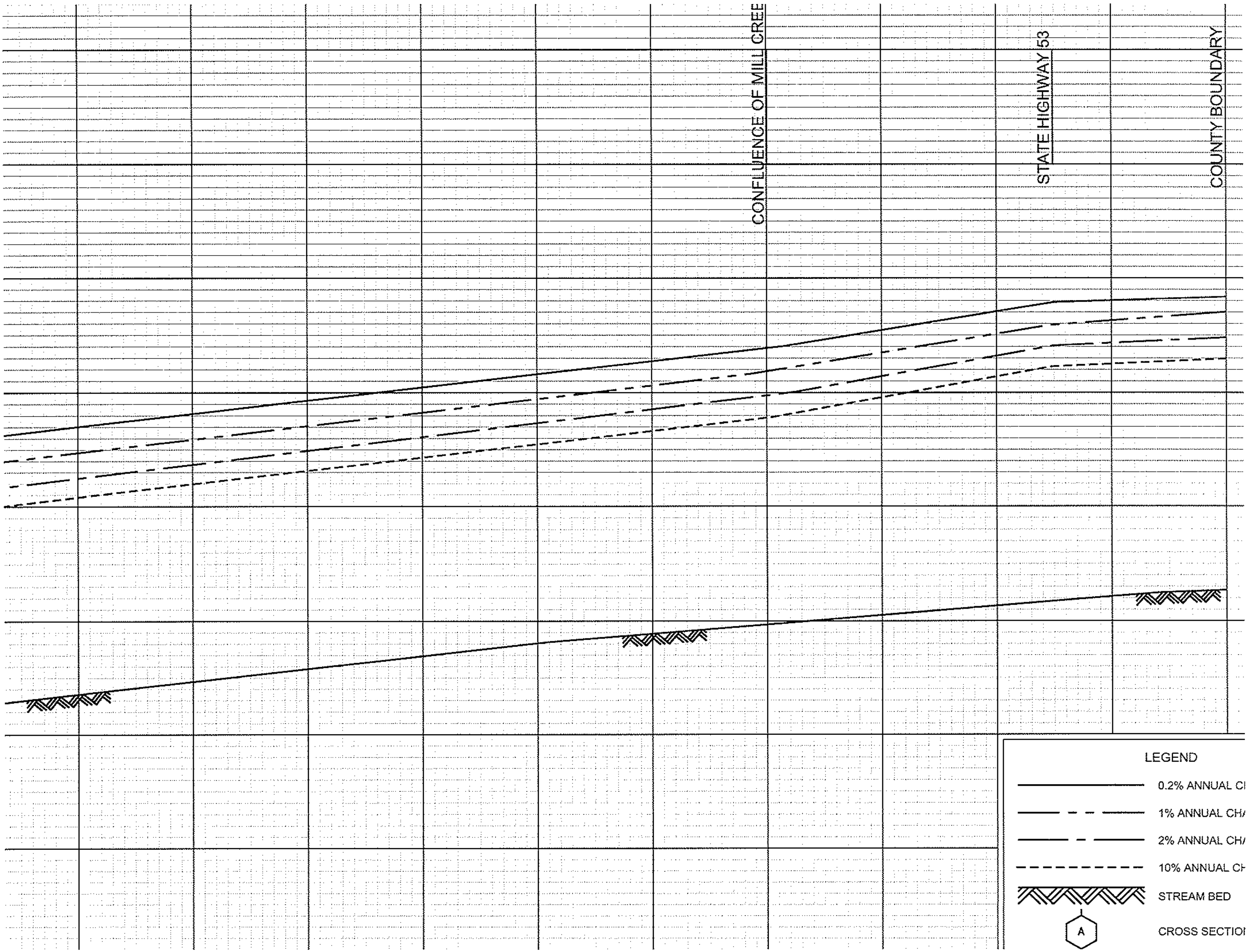
CONFLUENCE OF MILL CREE
STATE HIGHWAY 53
COUNTY BOUNDARY
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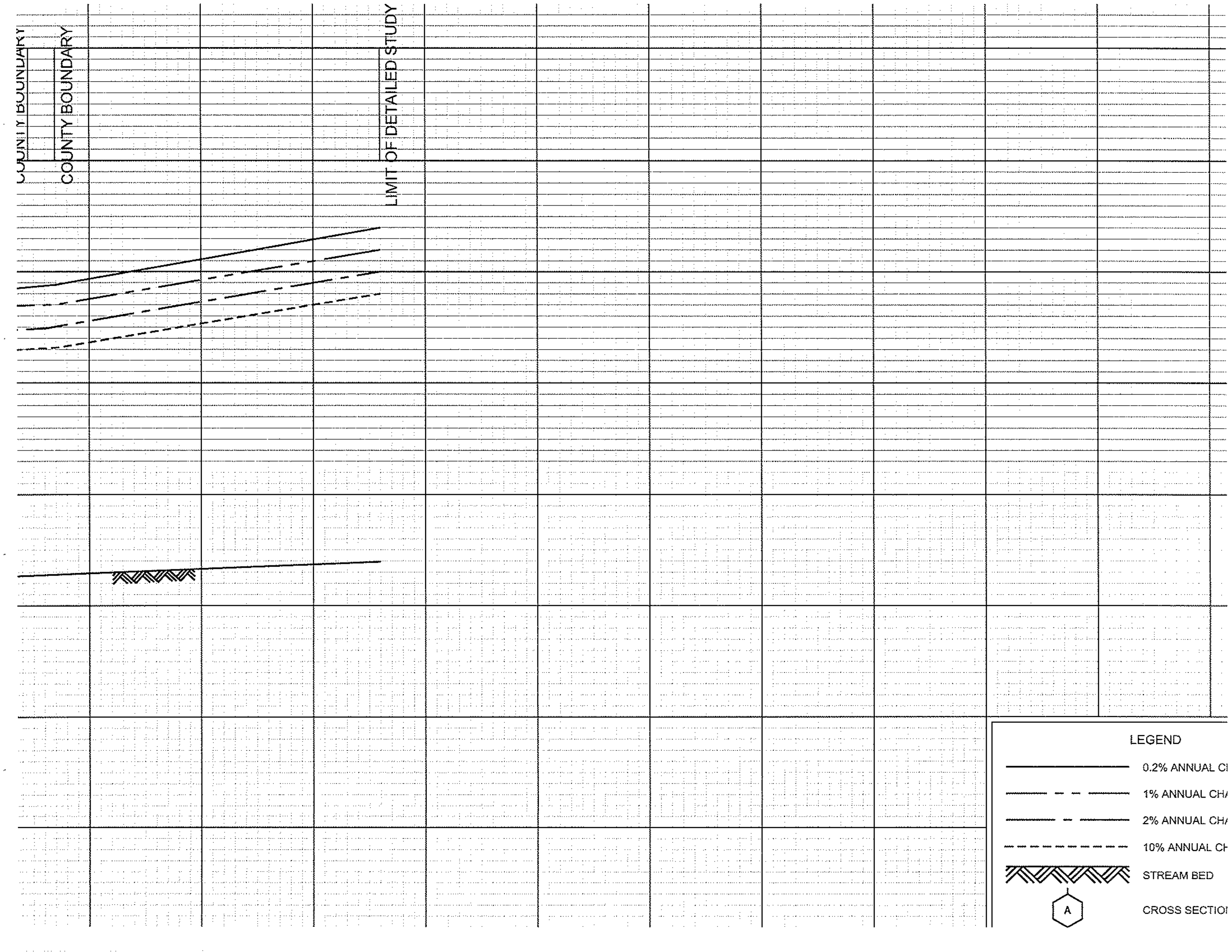
COUNTY BOUNDARY
COUNTY BOUNDARY
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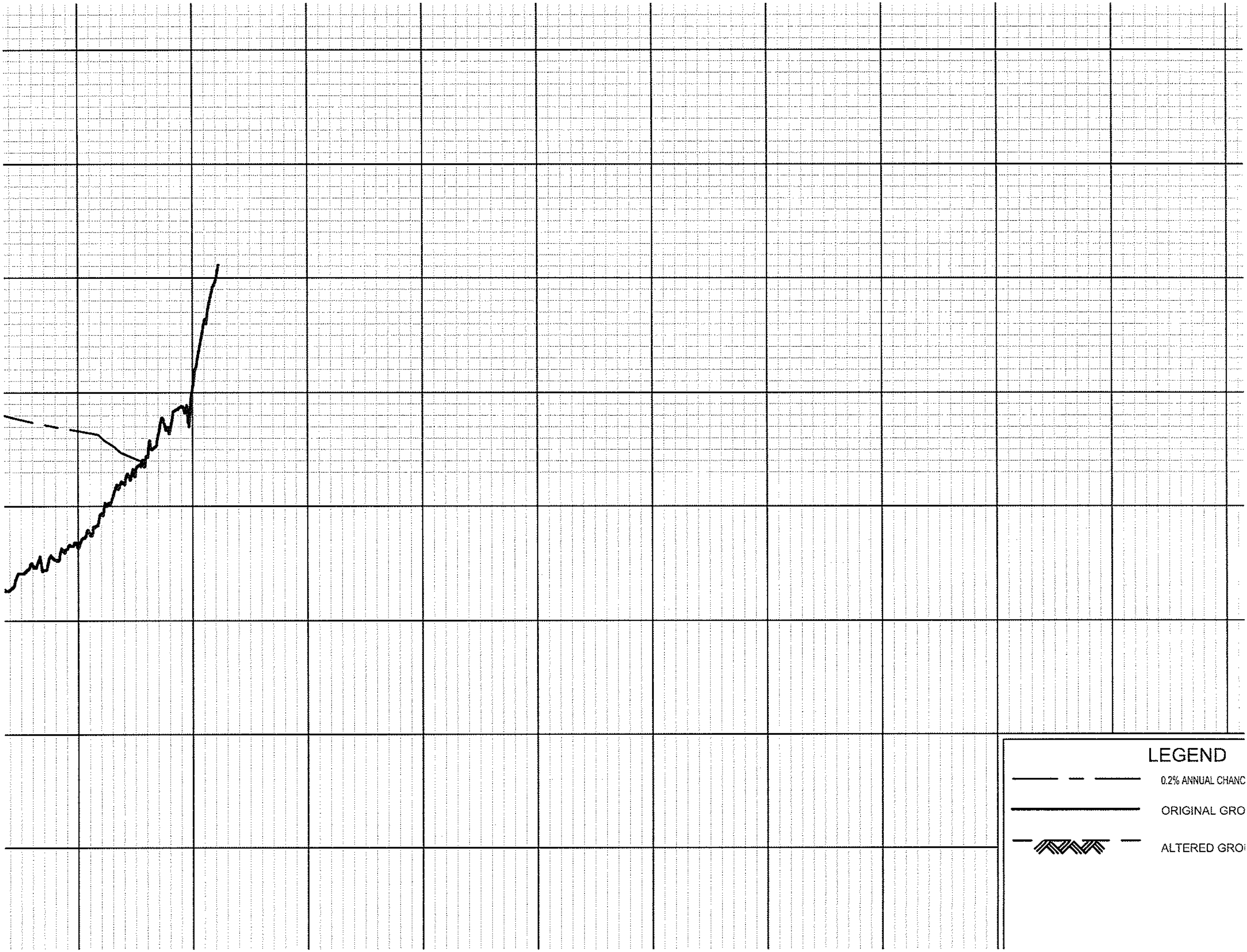
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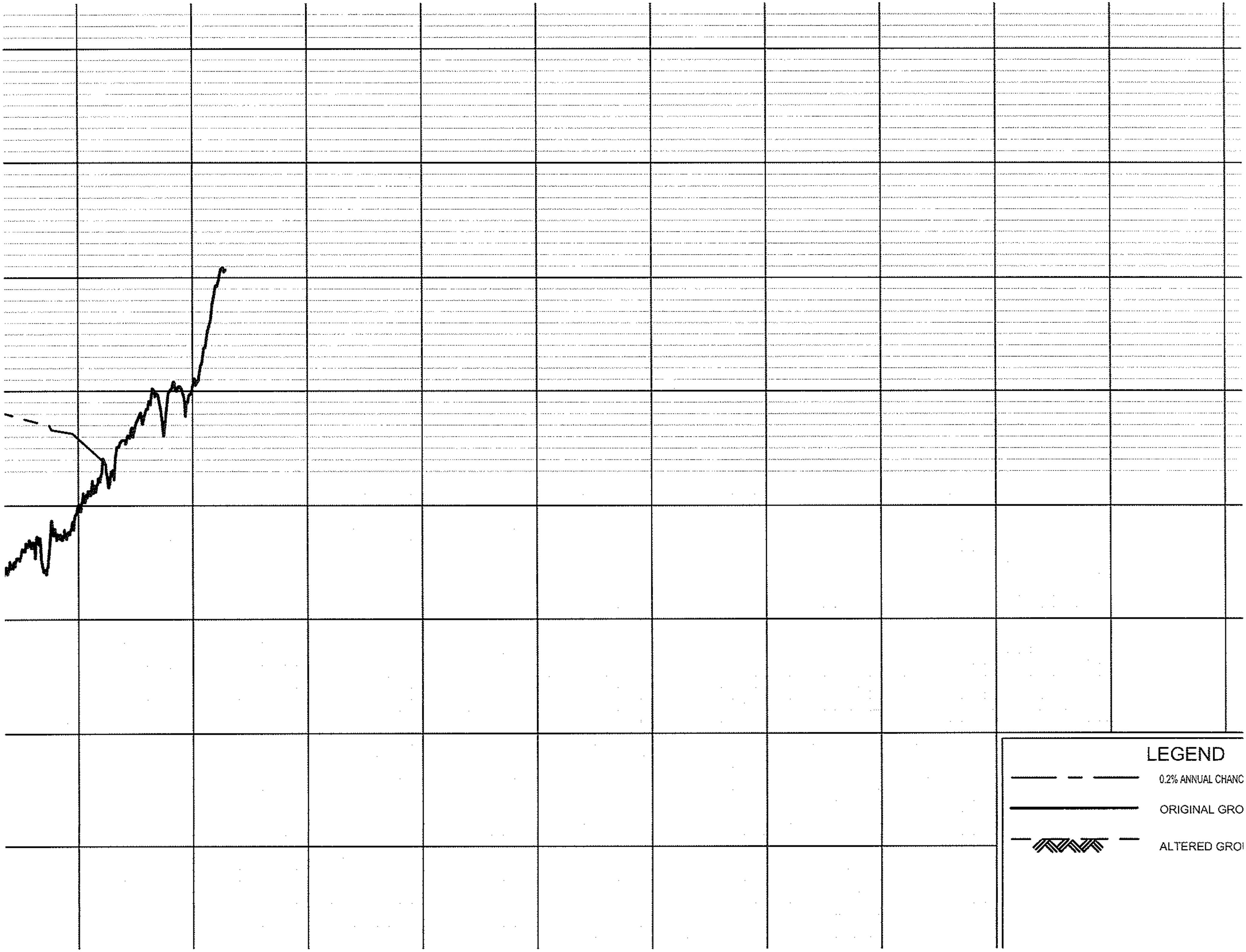
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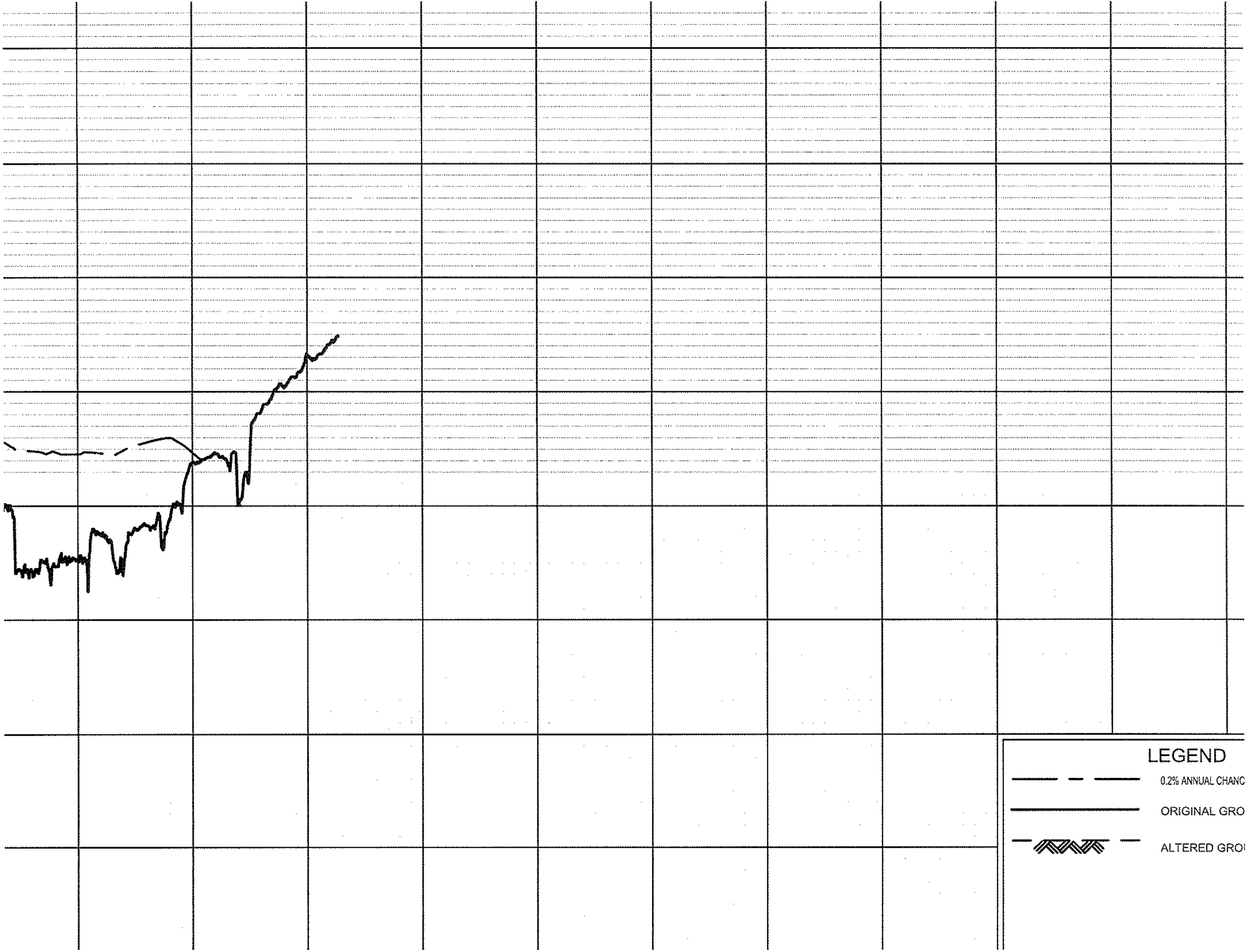
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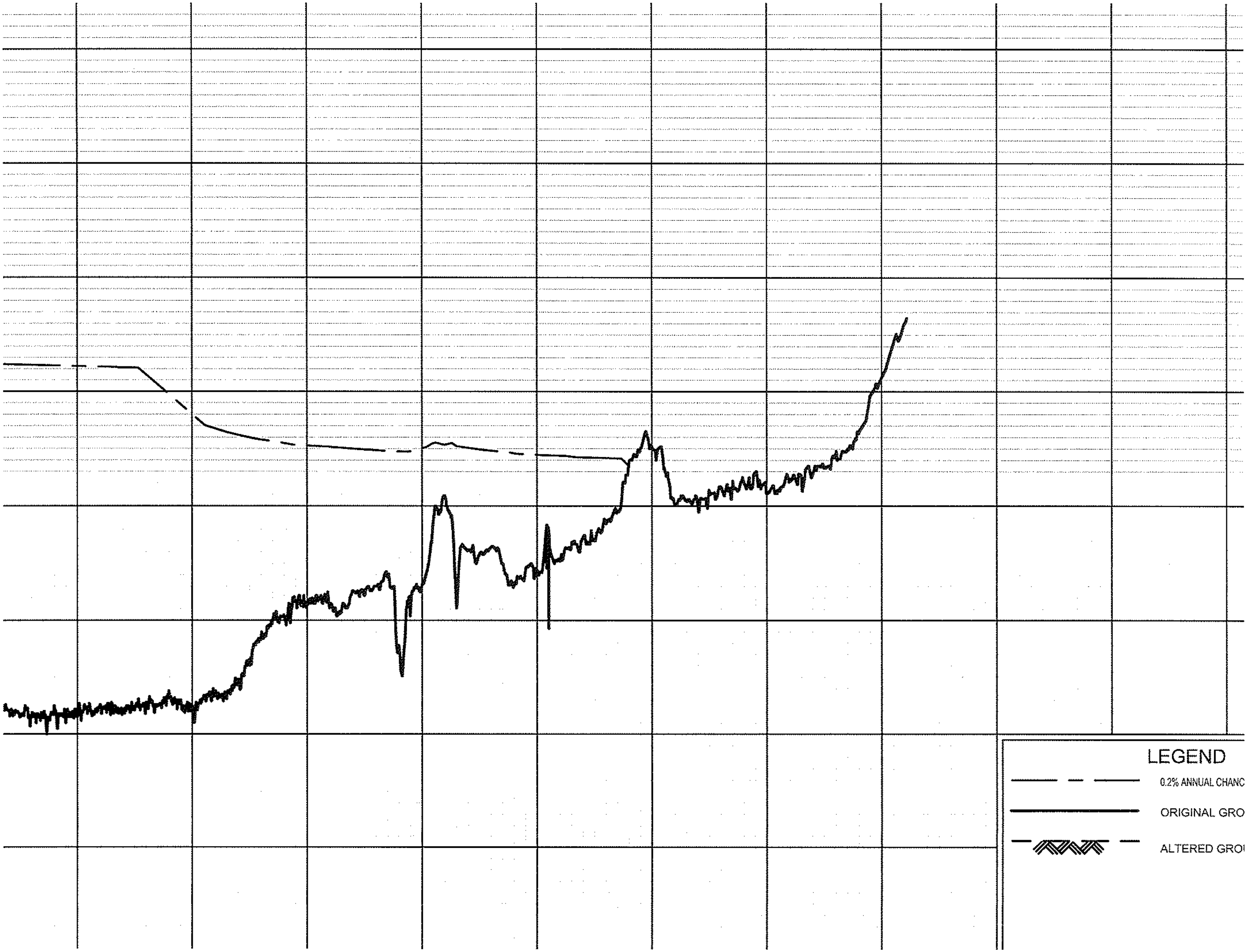

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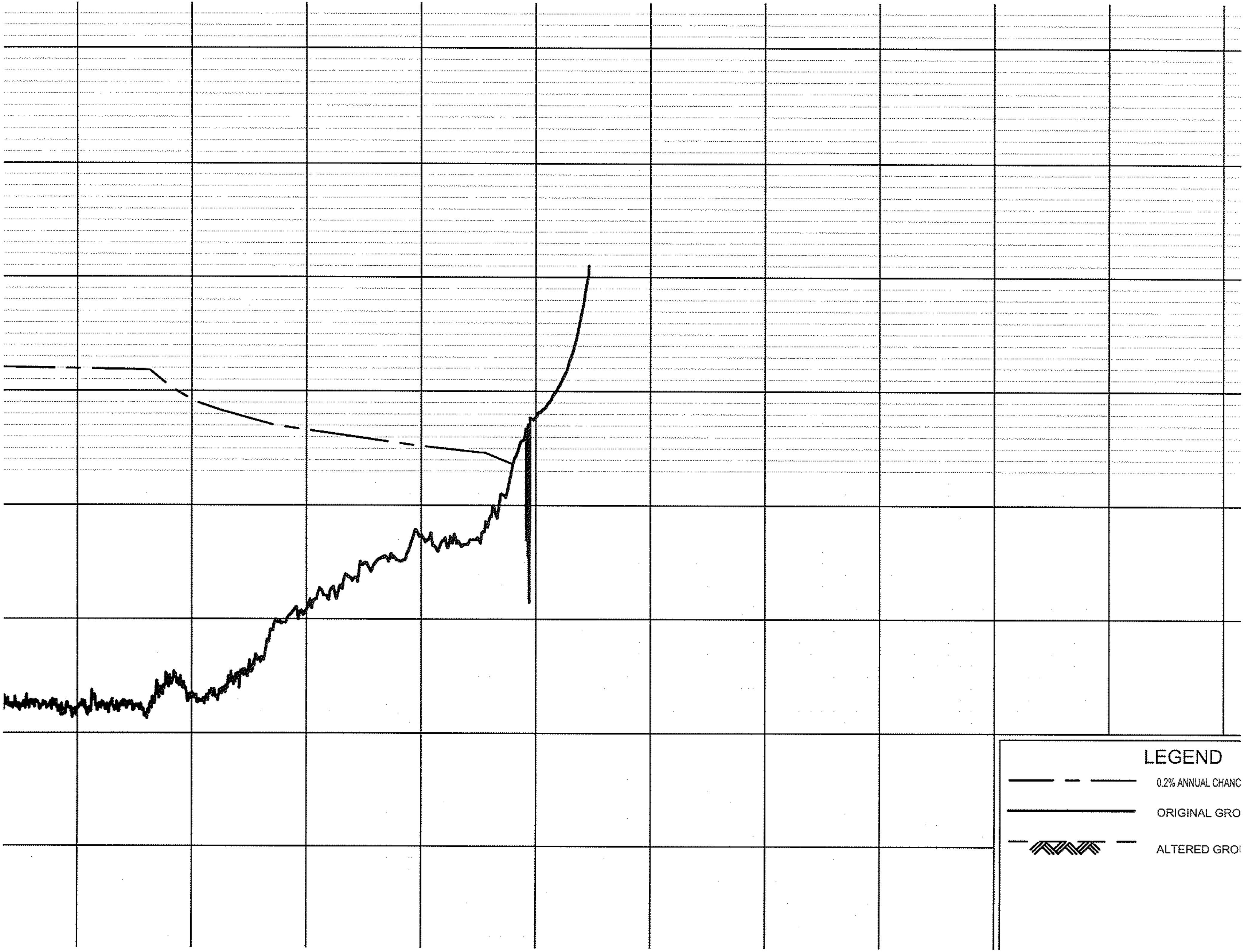

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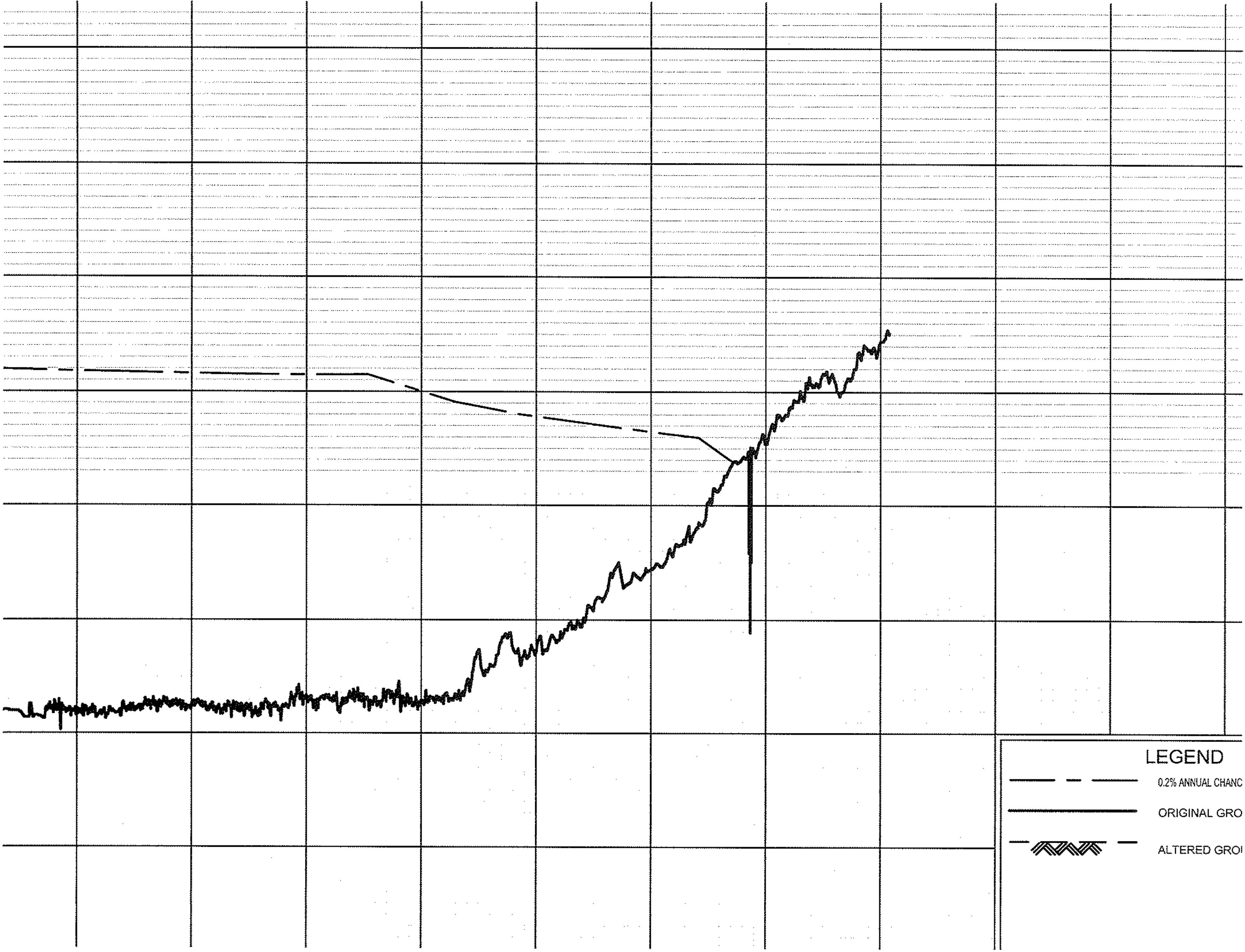

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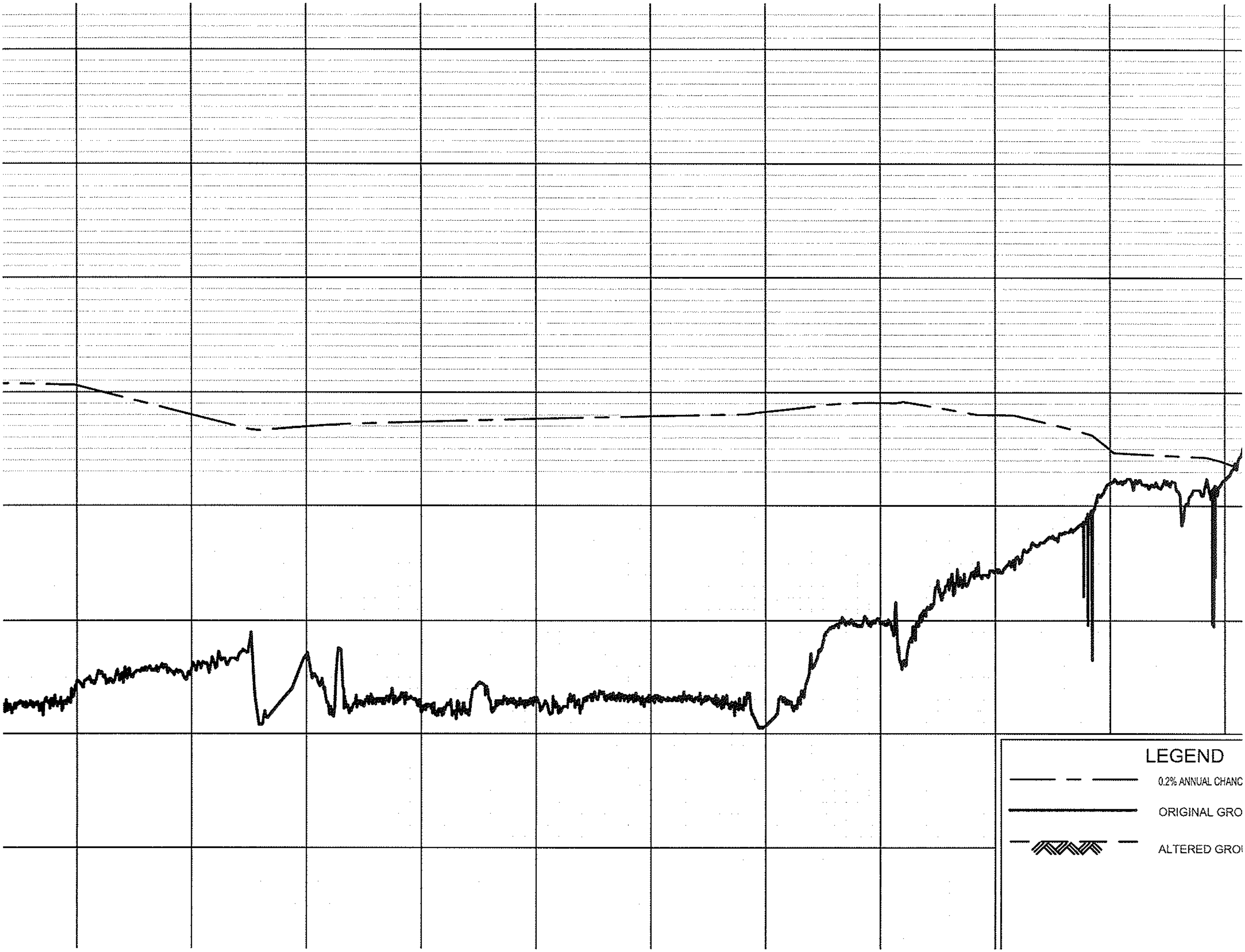

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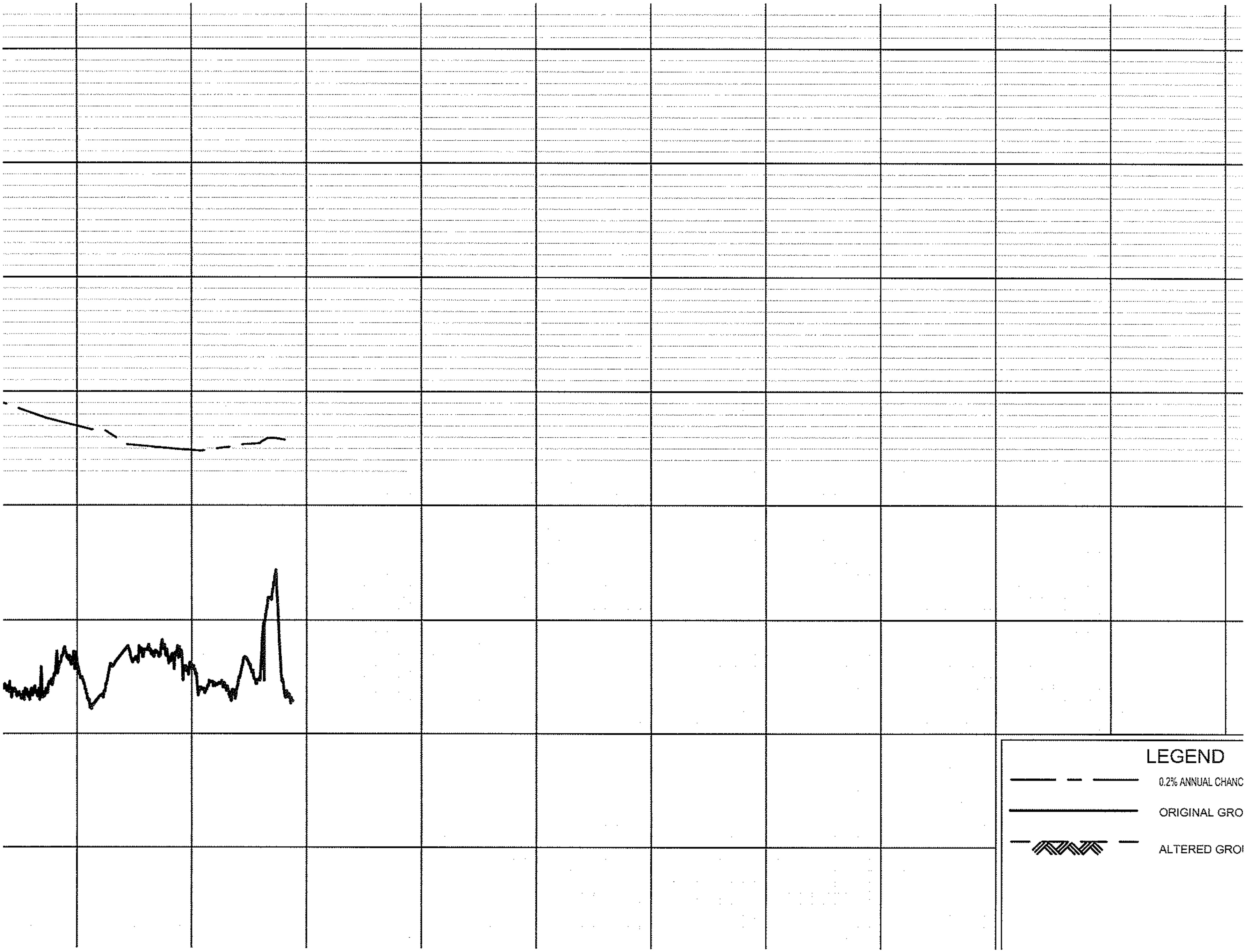
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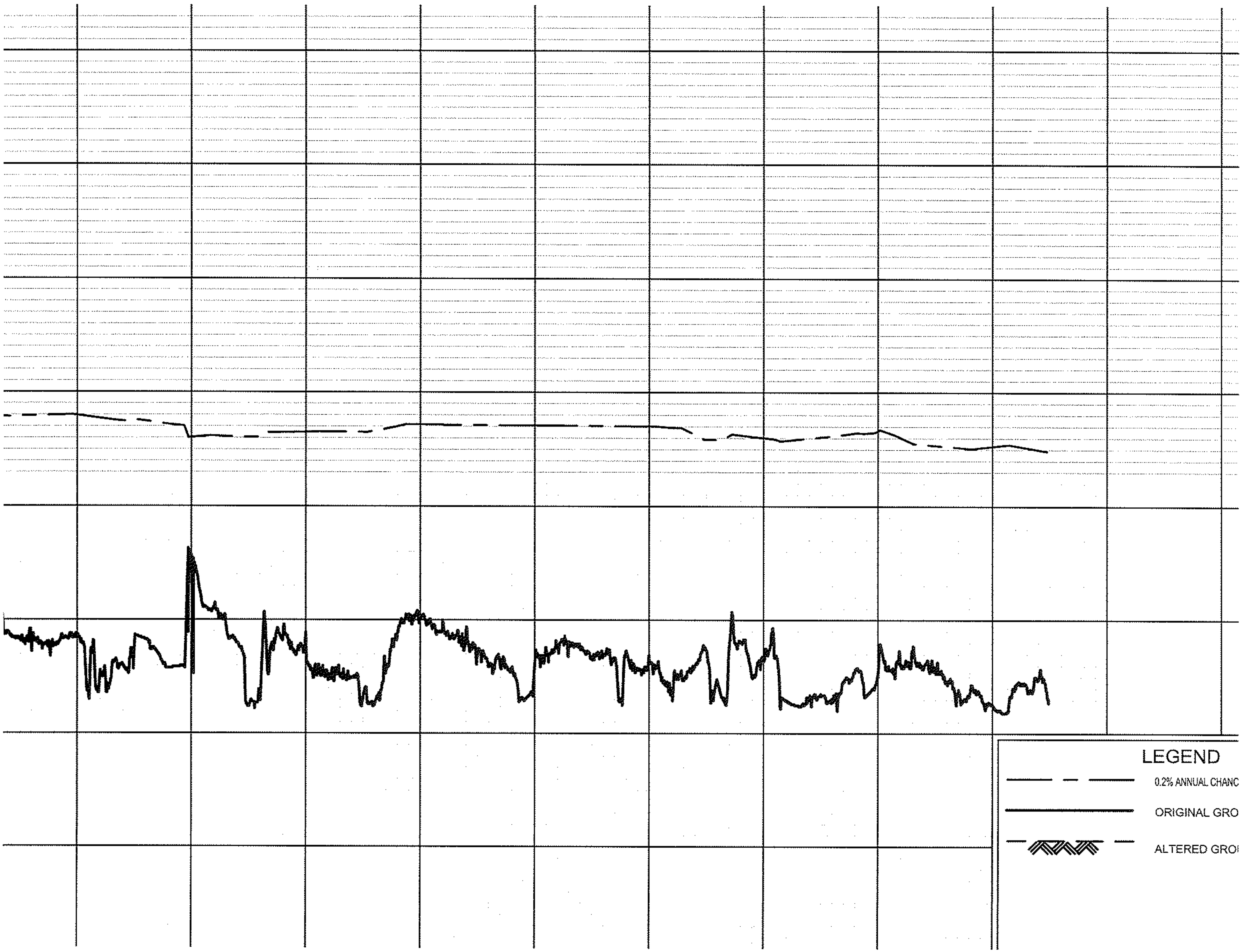

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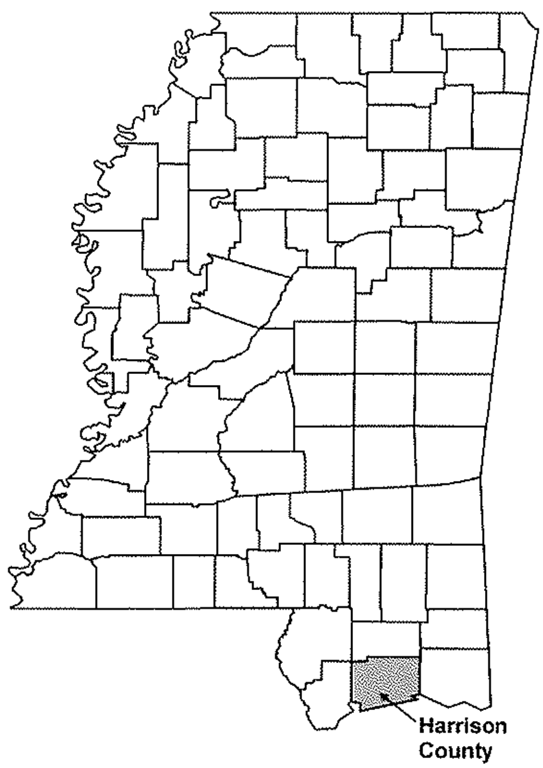
FLOOD INSURANCE STUDY

HARRISON COUNTY, MISSISSIPPI
AND INCORPORATED AREAS

VOLUME 3 OF 3



COMMUNITY NAME	COMMUNITY NUMBER
BILOXI, CITY OF	285252
D'IBERVILLE, CITY OF	280336
GULFPORT, CITY OF	285253
HARRISON COUNTY (UNINCORPORATED AREAS)	285255
LONG BEACH, CITY OF	285257
PASS CHRISTIAN, CITY OF	285261

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
28047CV003A

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Countywide FIS Effective Date:

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EXHIBITS – continued

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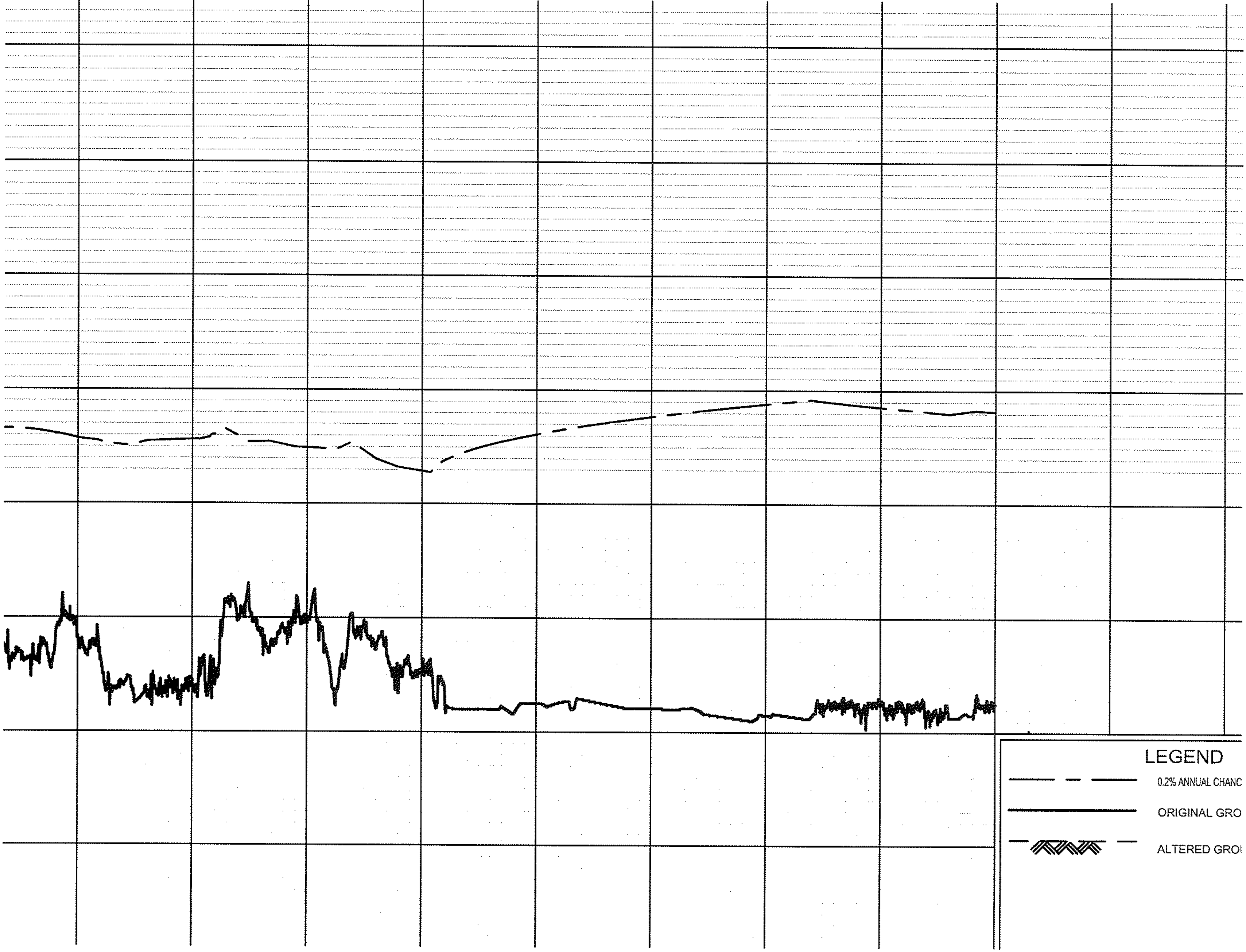
Exhibit 2 – 0.2% Annual Chance Wave Envelopes

Table of Contents – Volume 3

EXHIBITS – continued

Exhibit 2 – 0.2% Annual Chance Wave Envelopes

EXHIBITS – continued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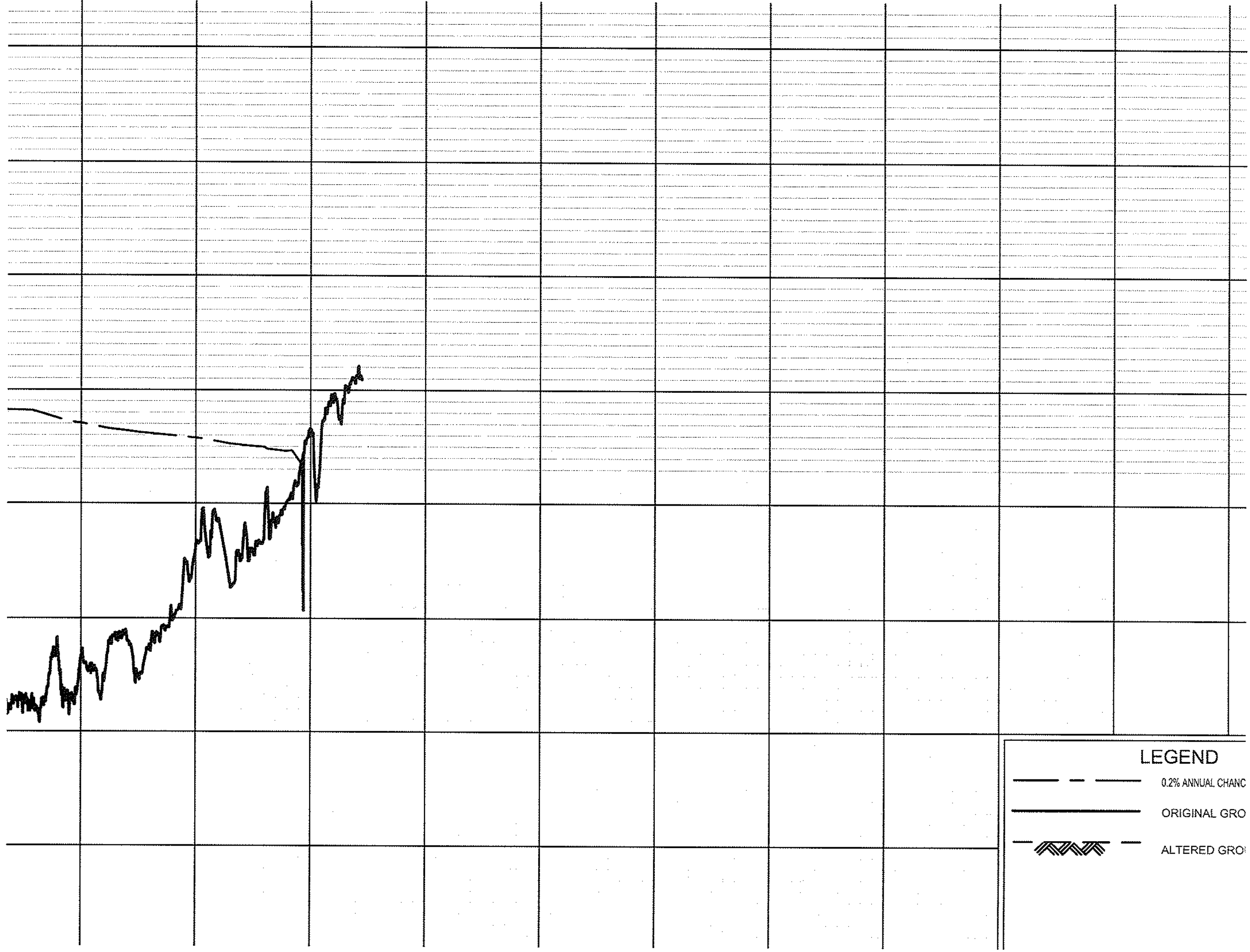
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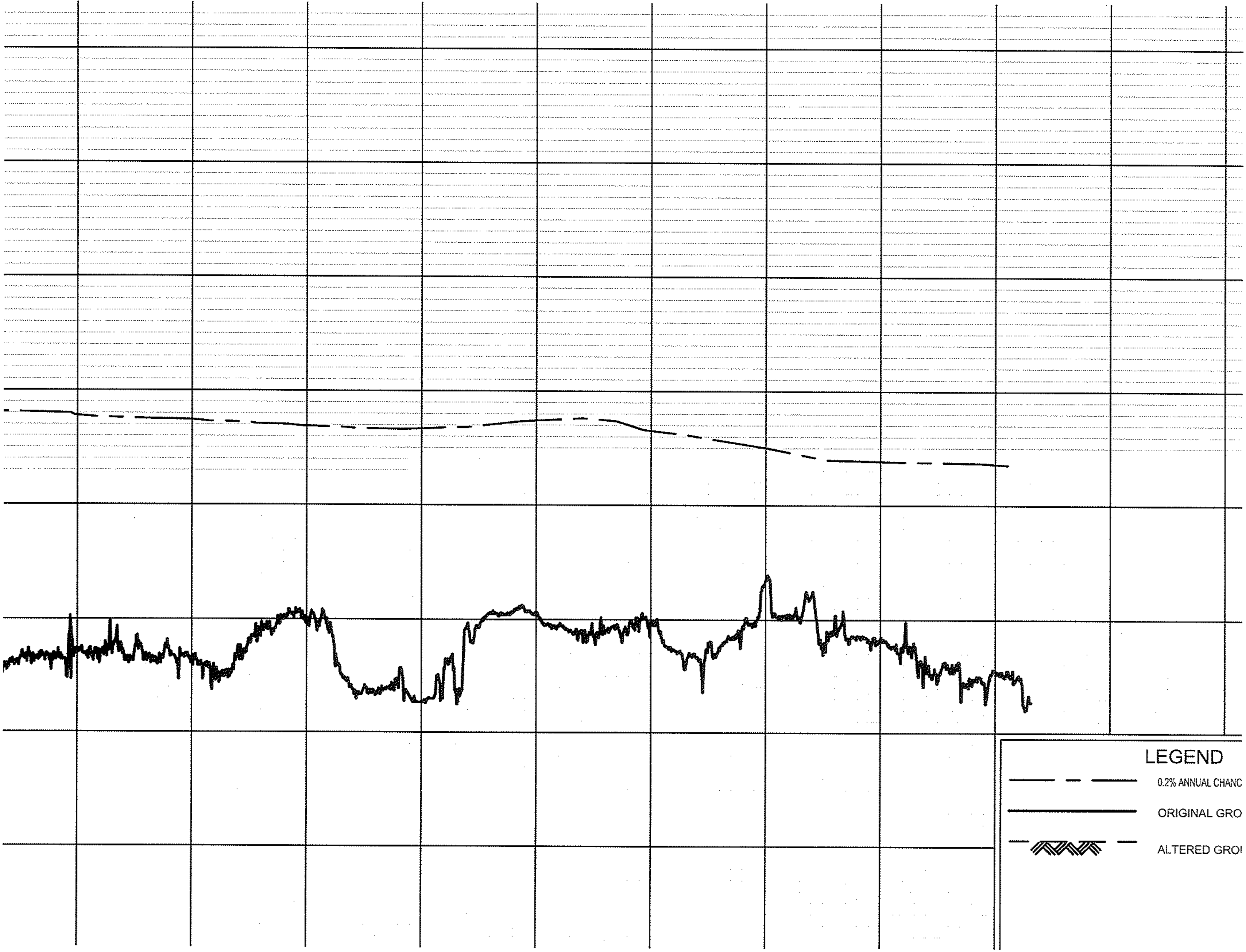
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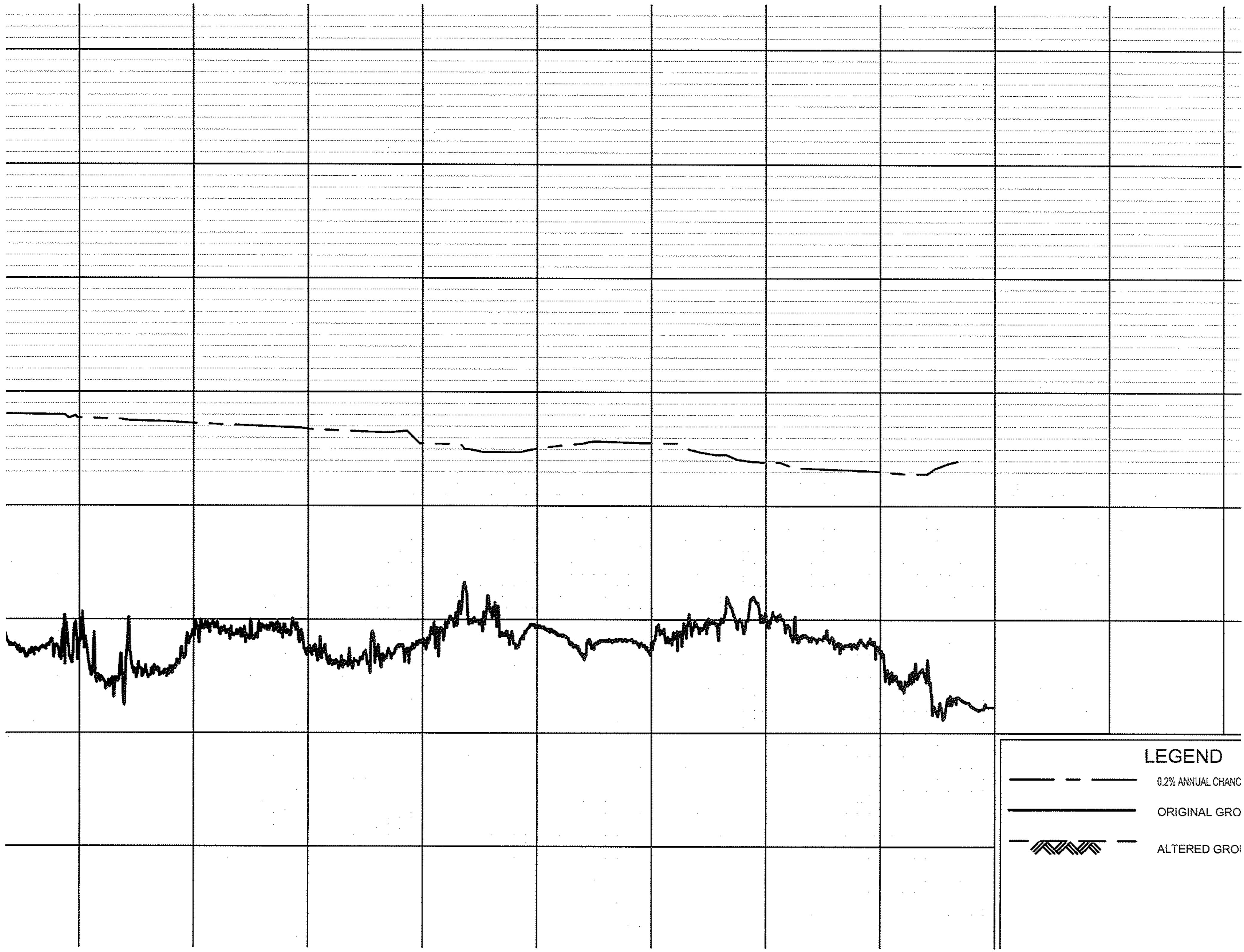
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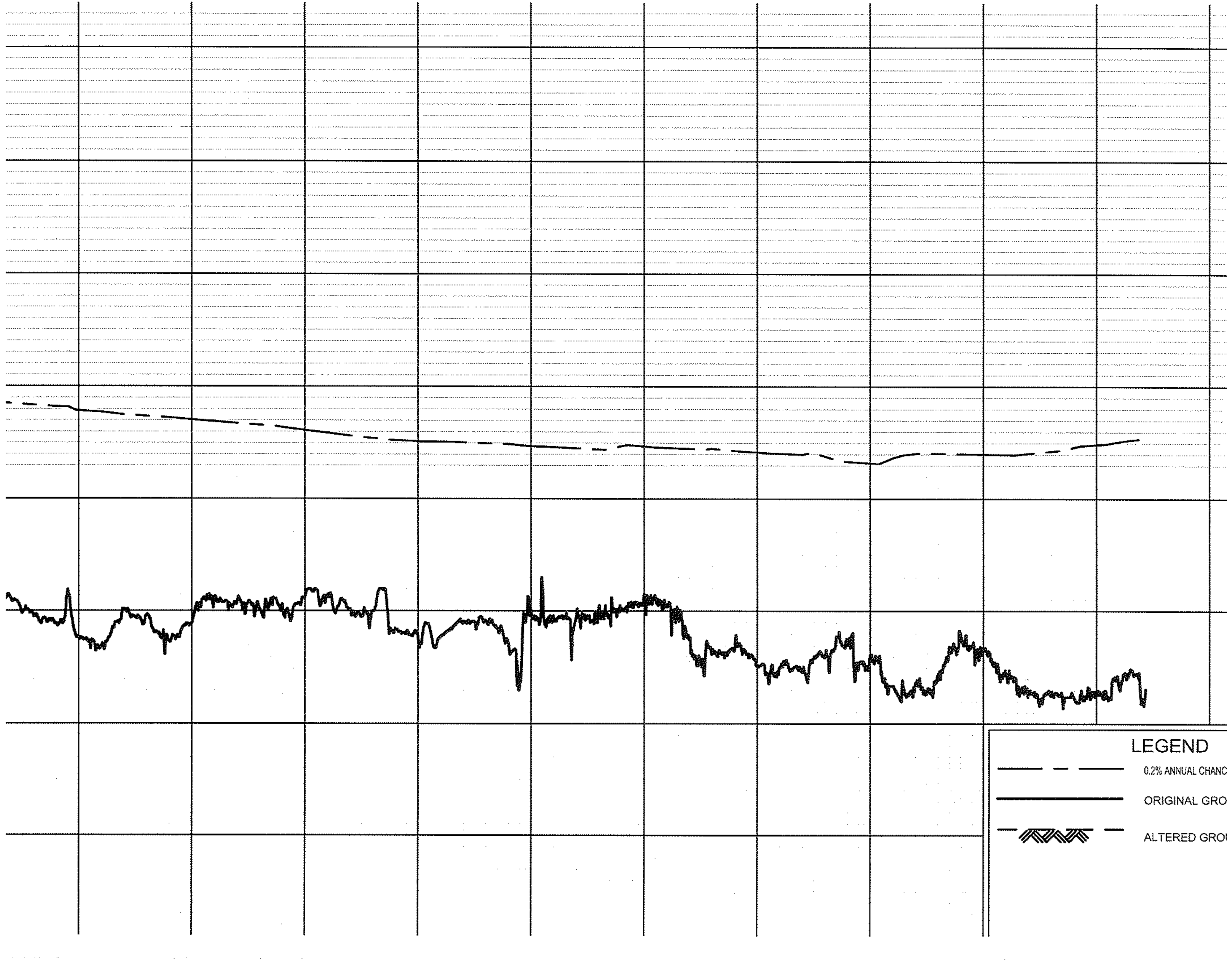
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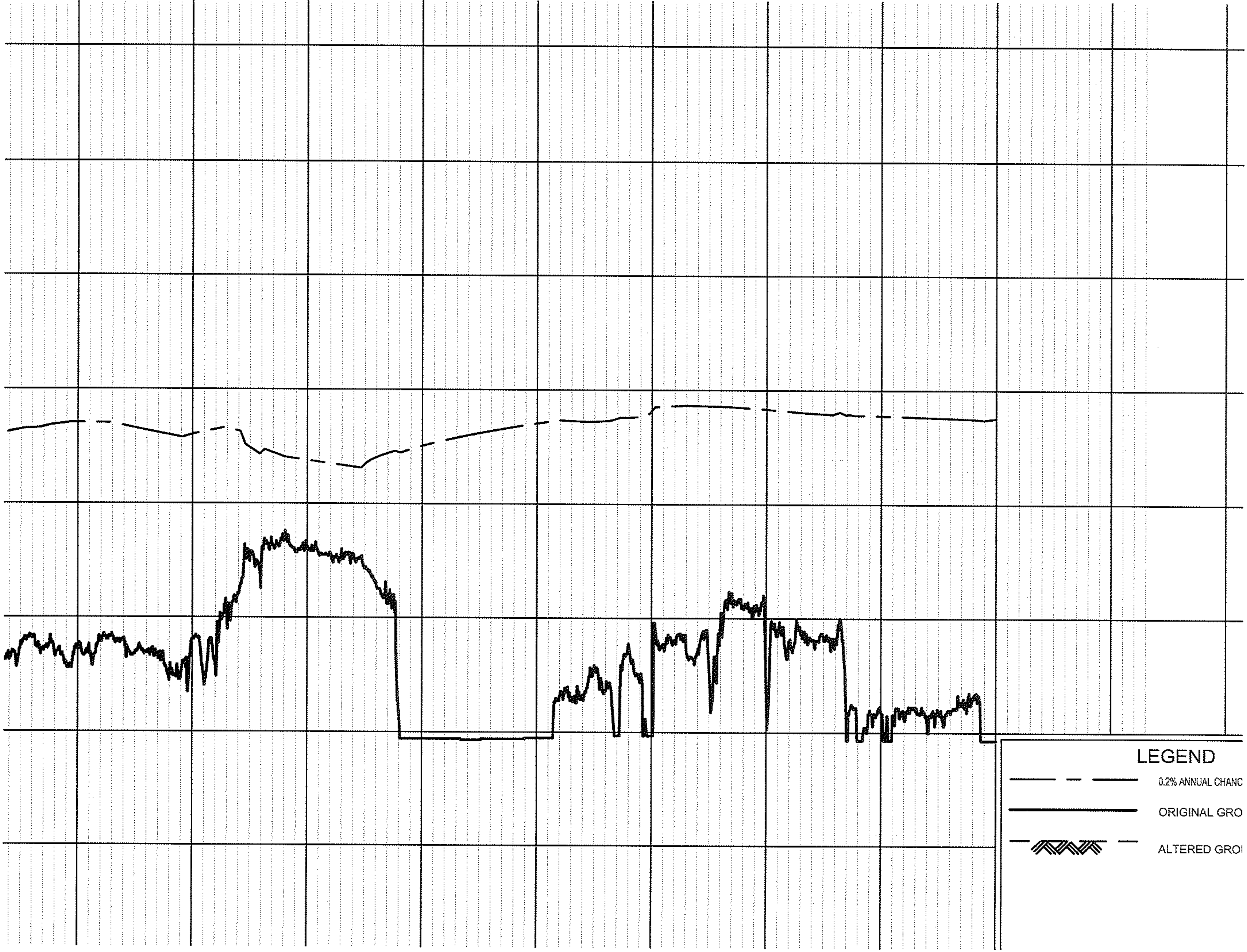

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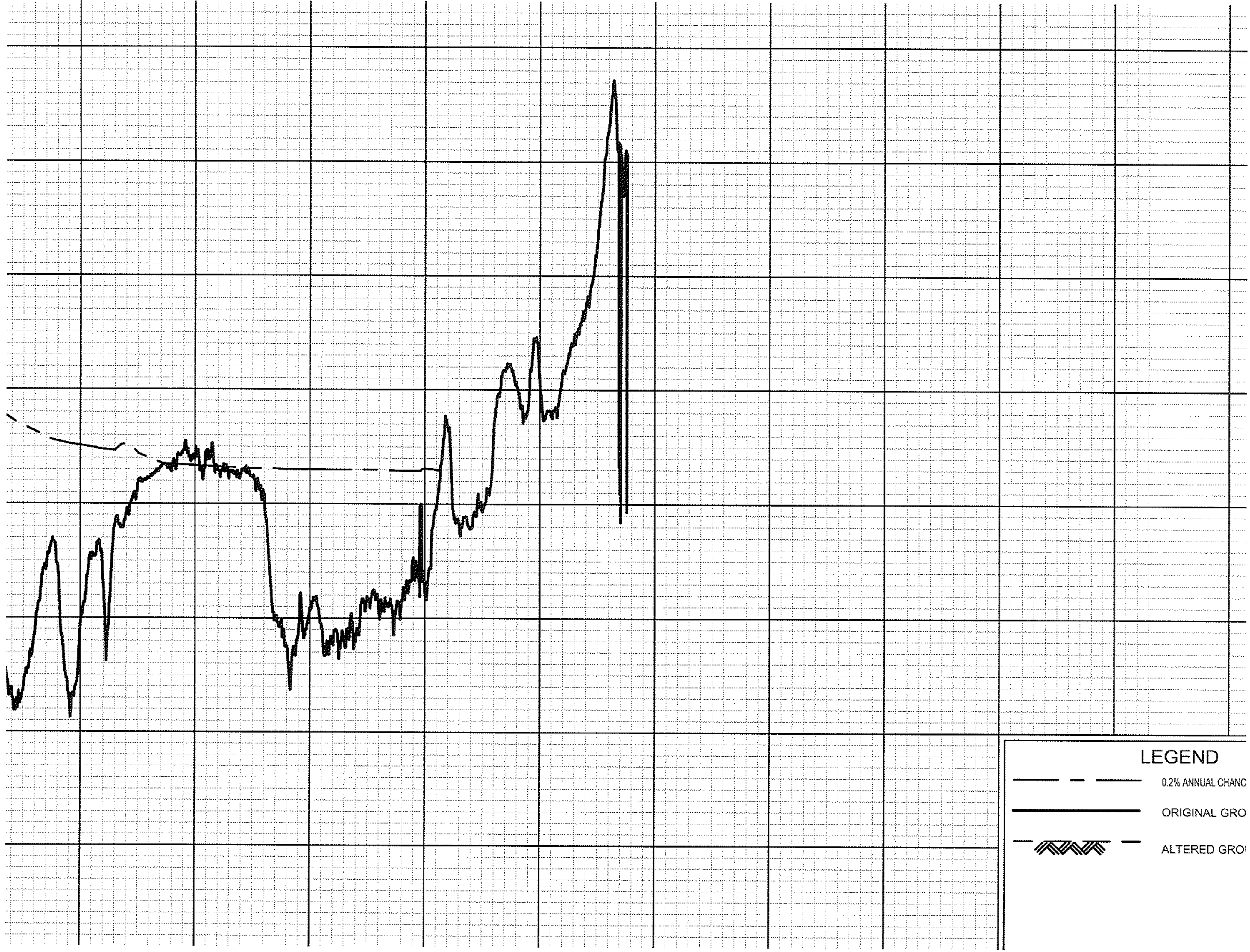
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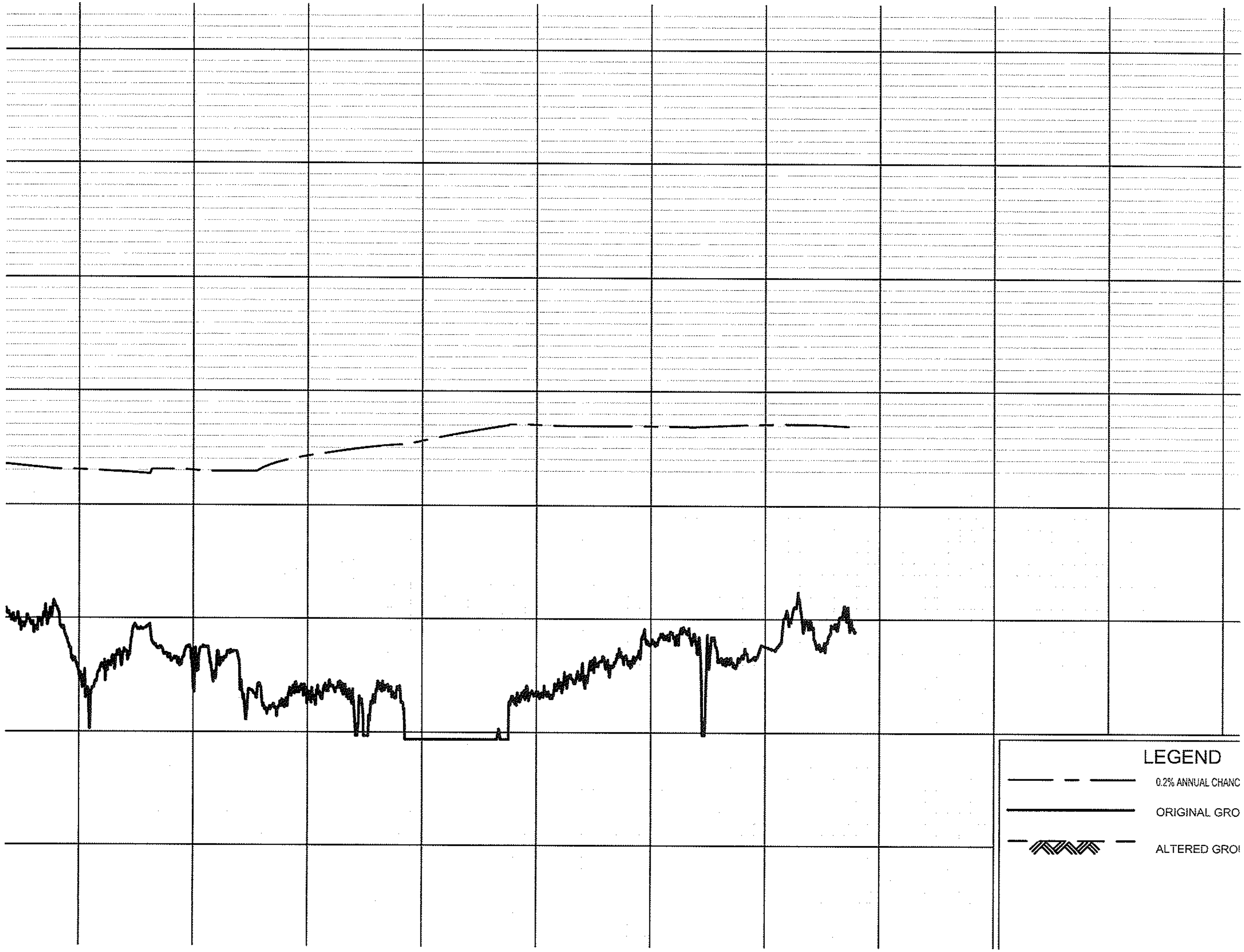
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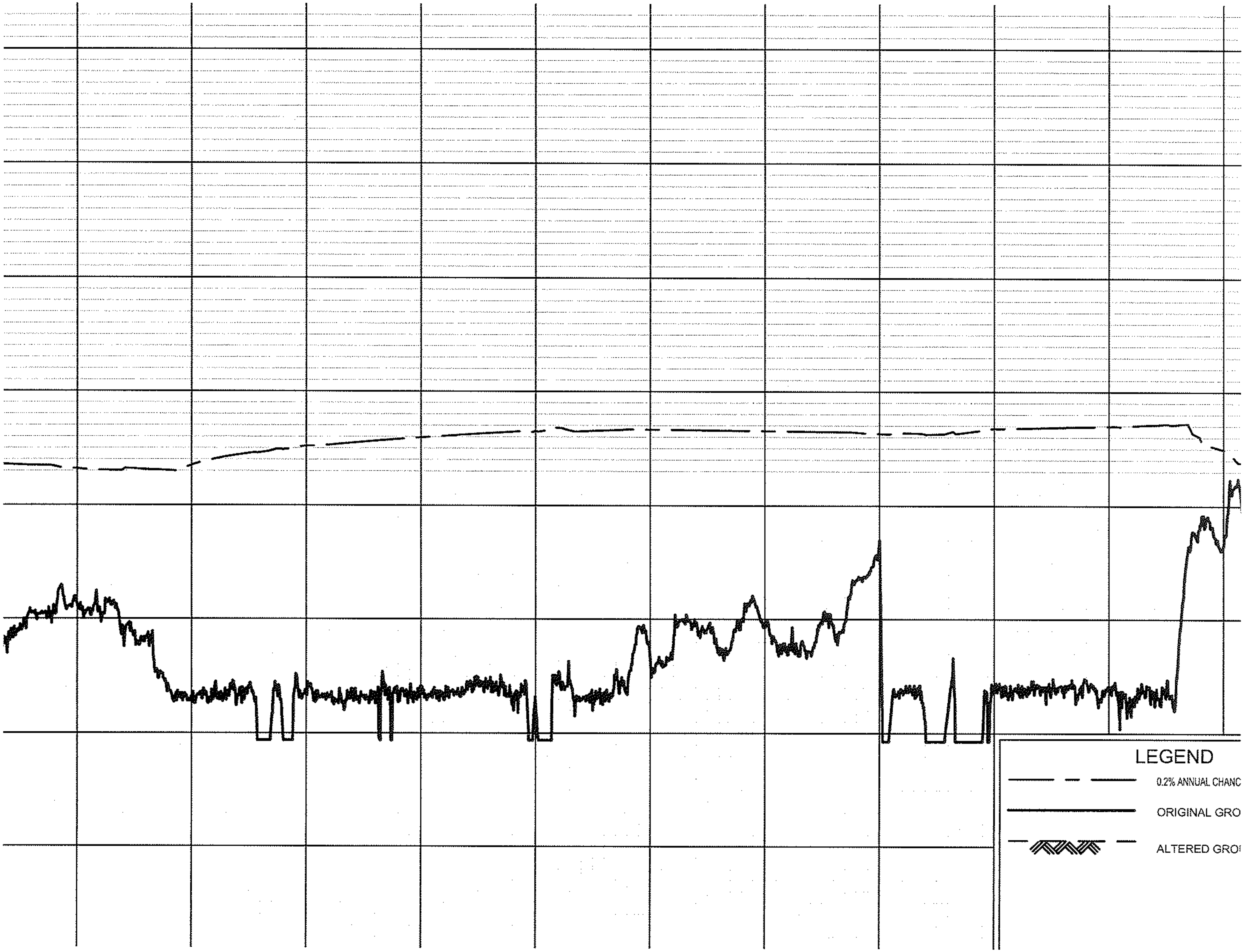
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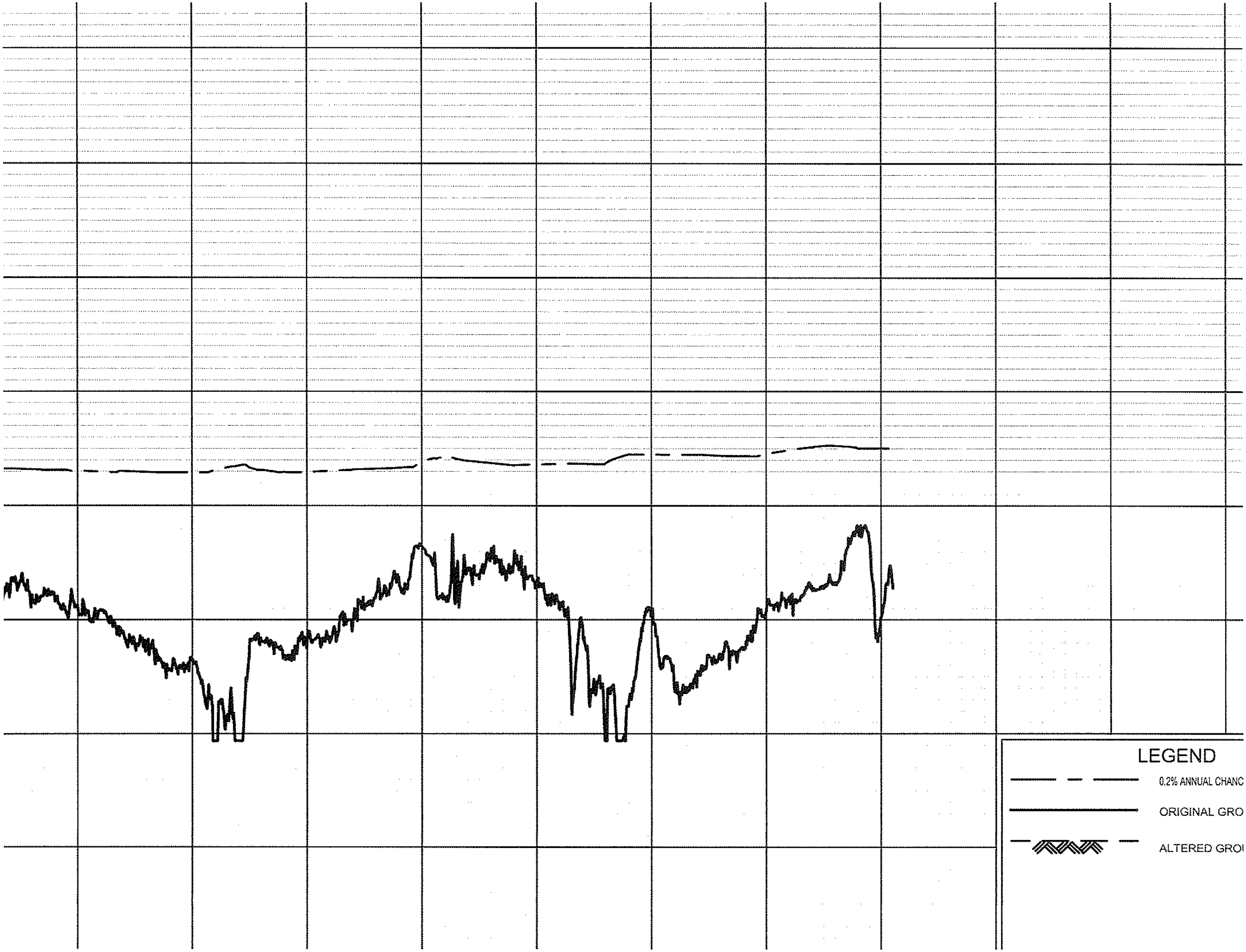
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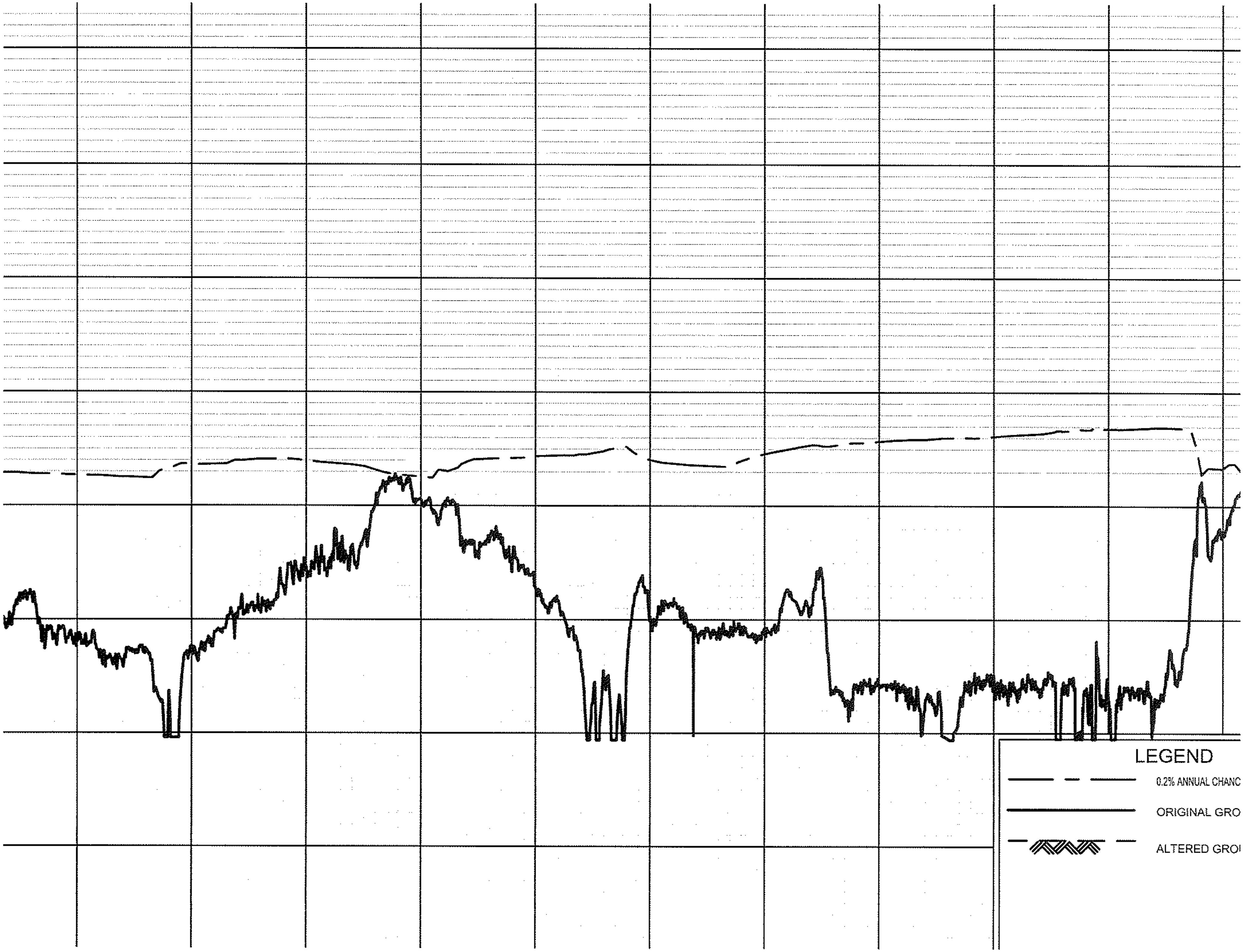
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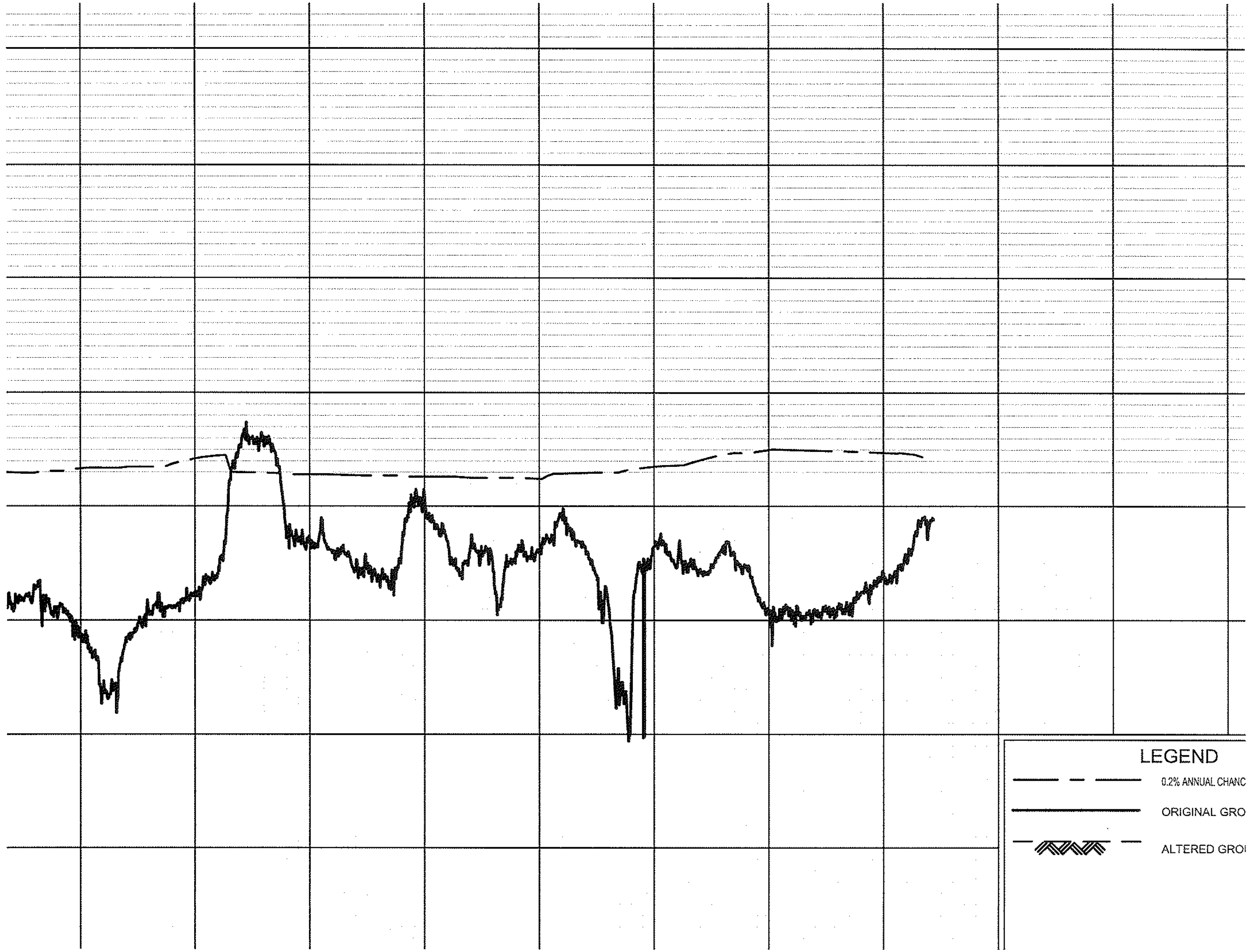

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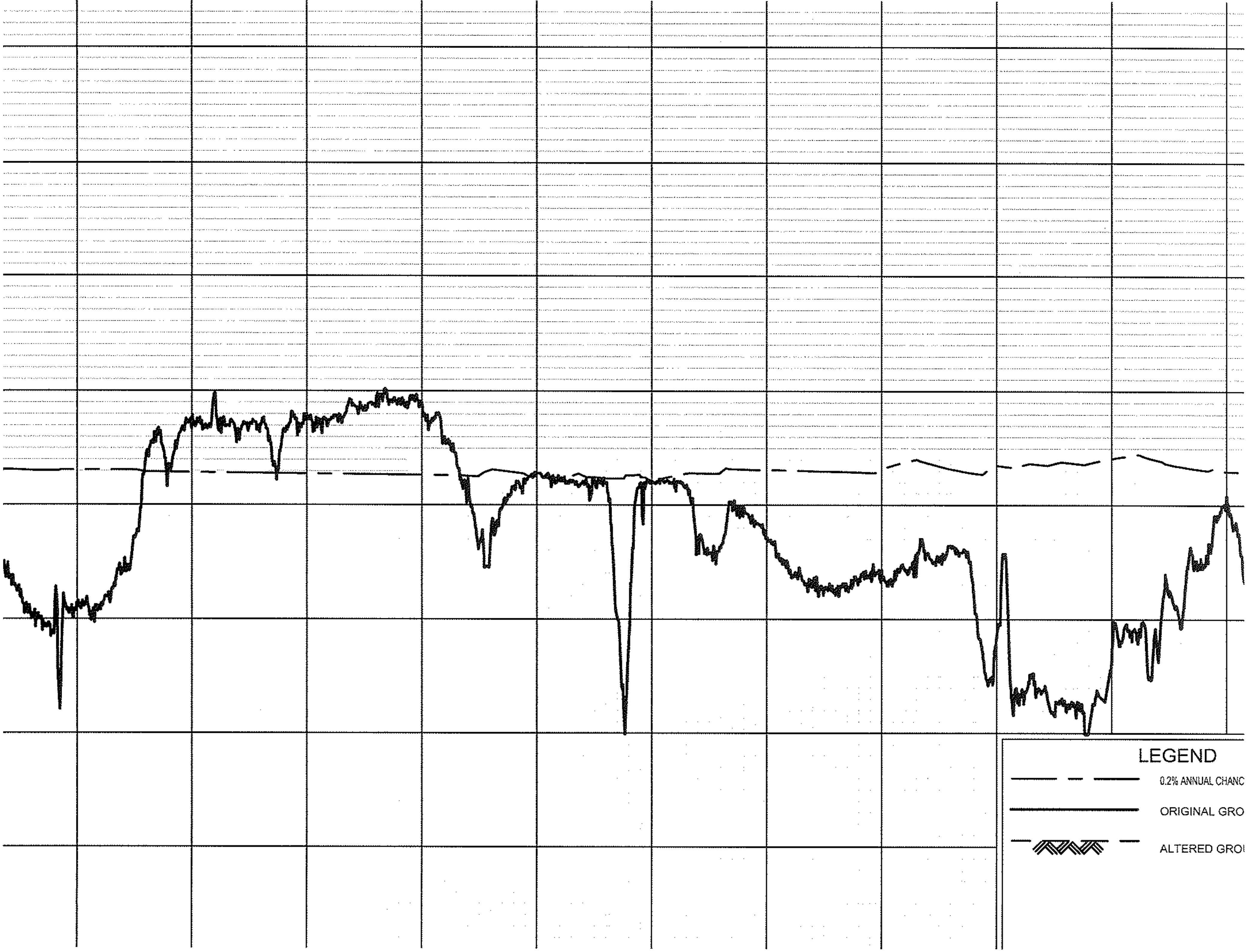
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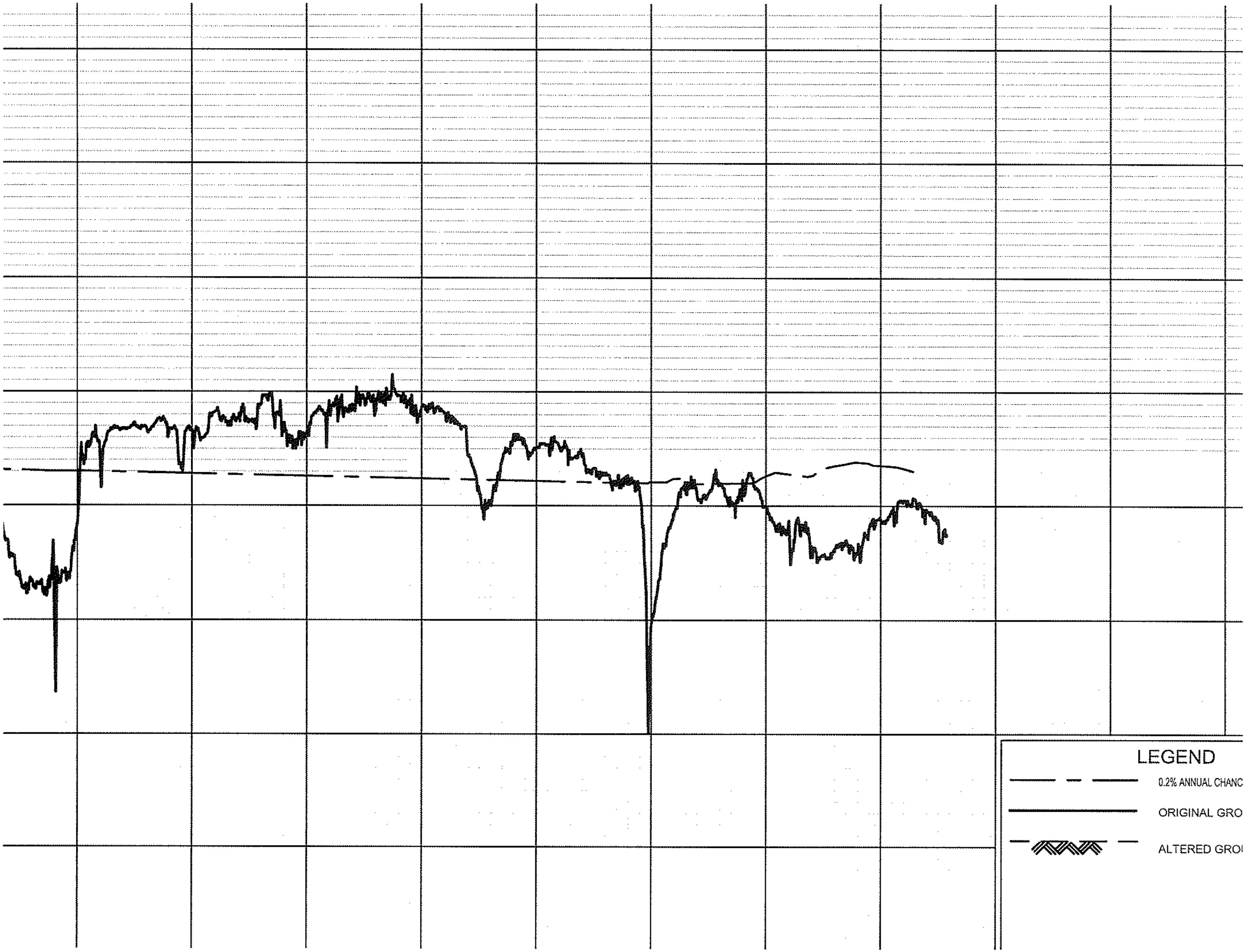
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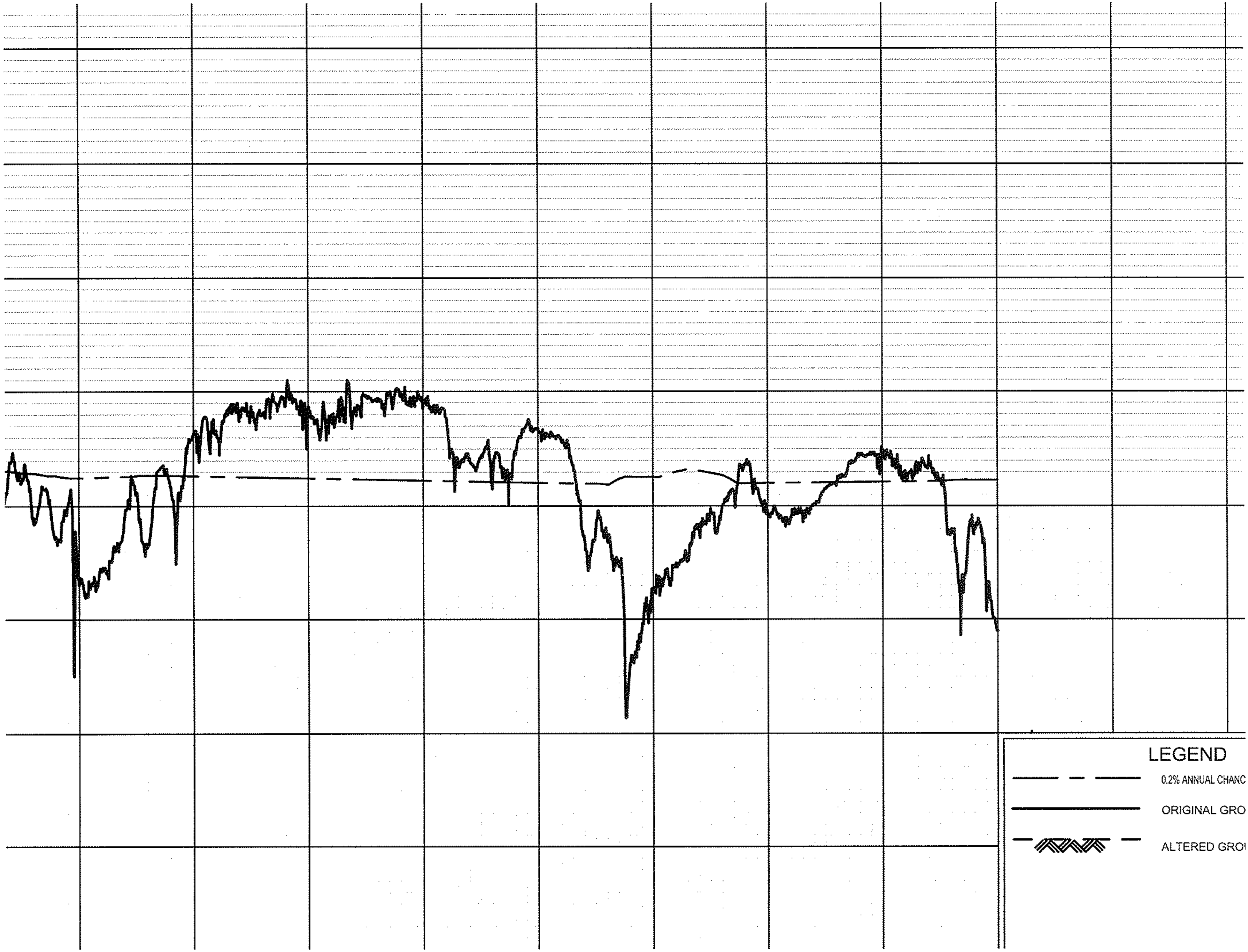

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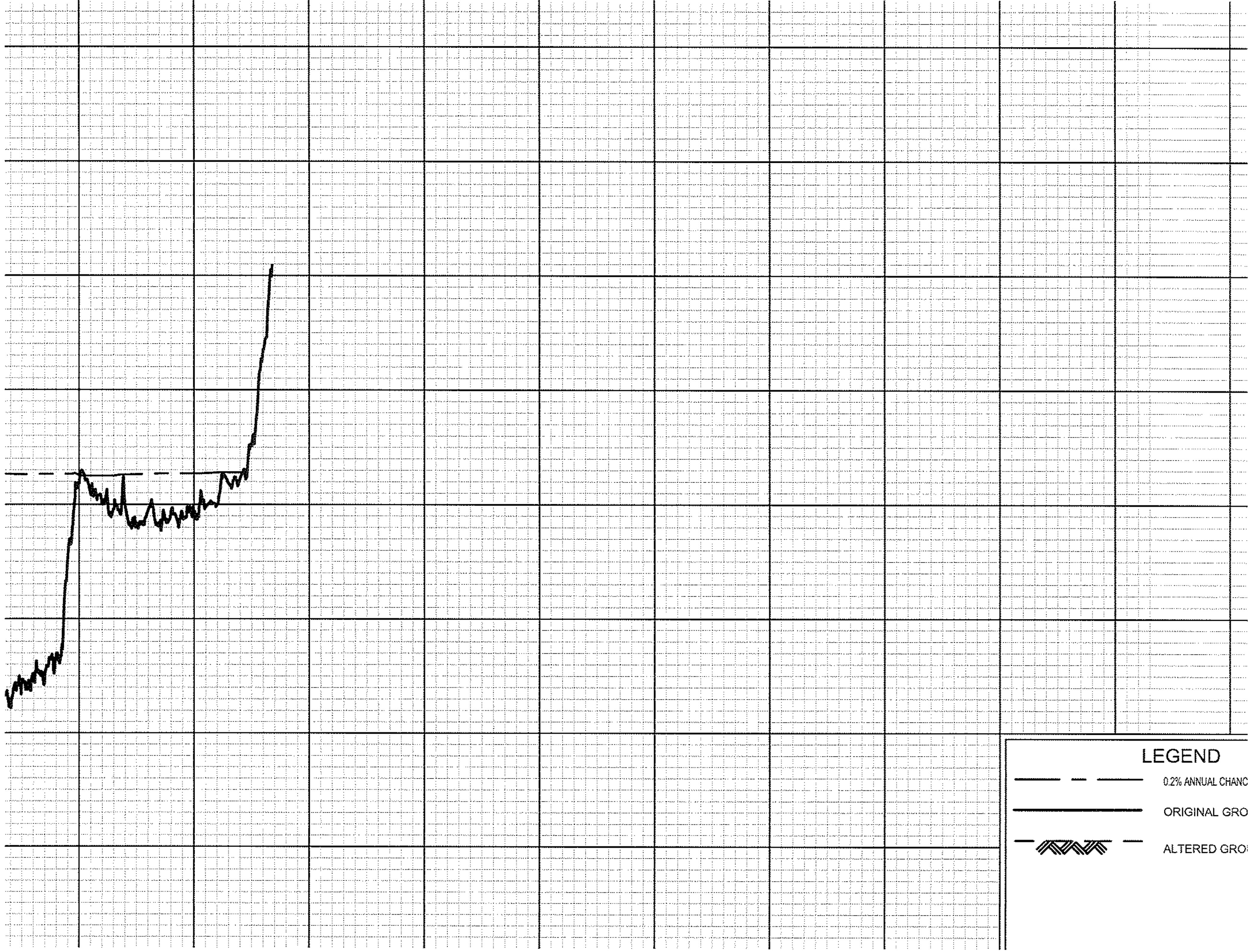
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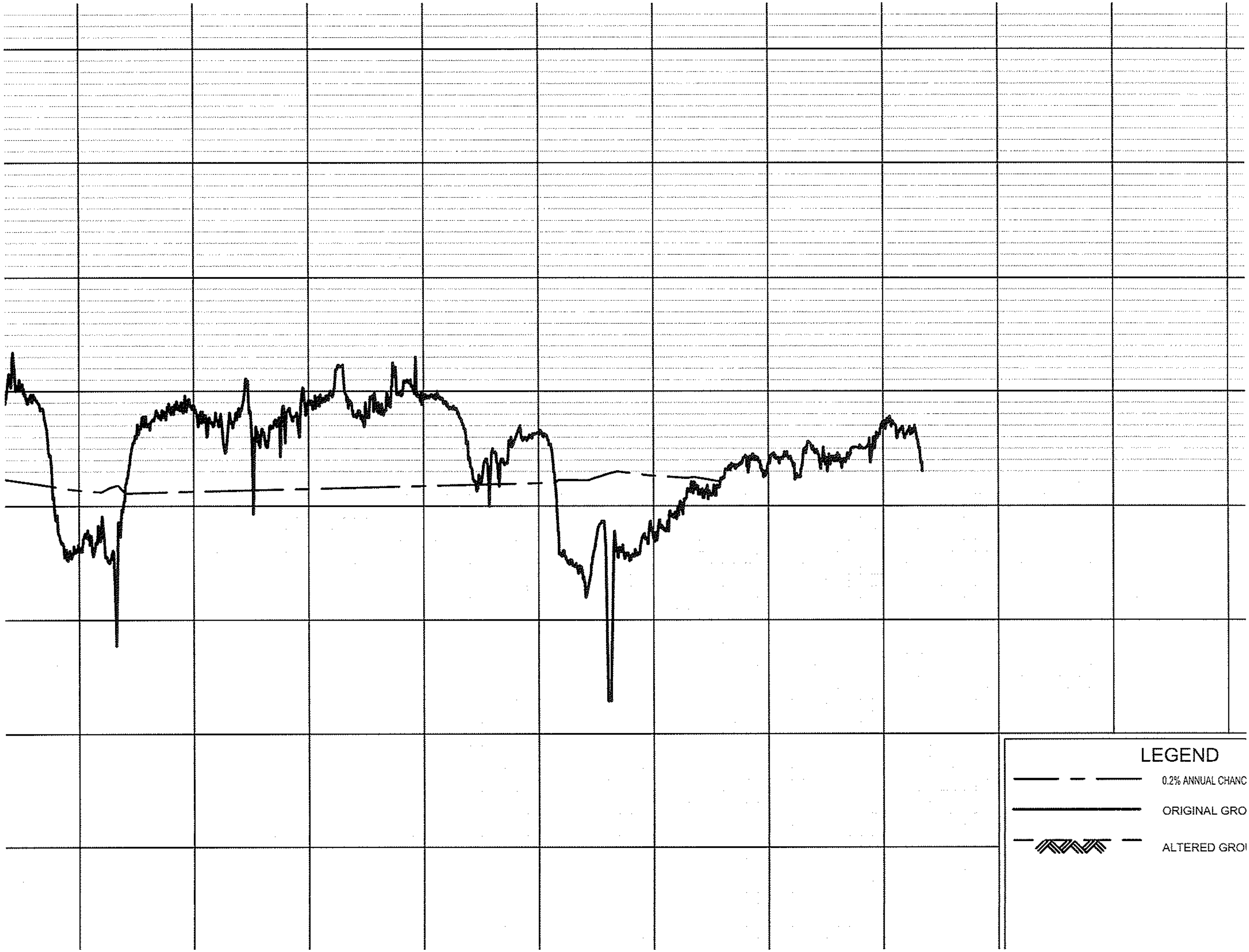
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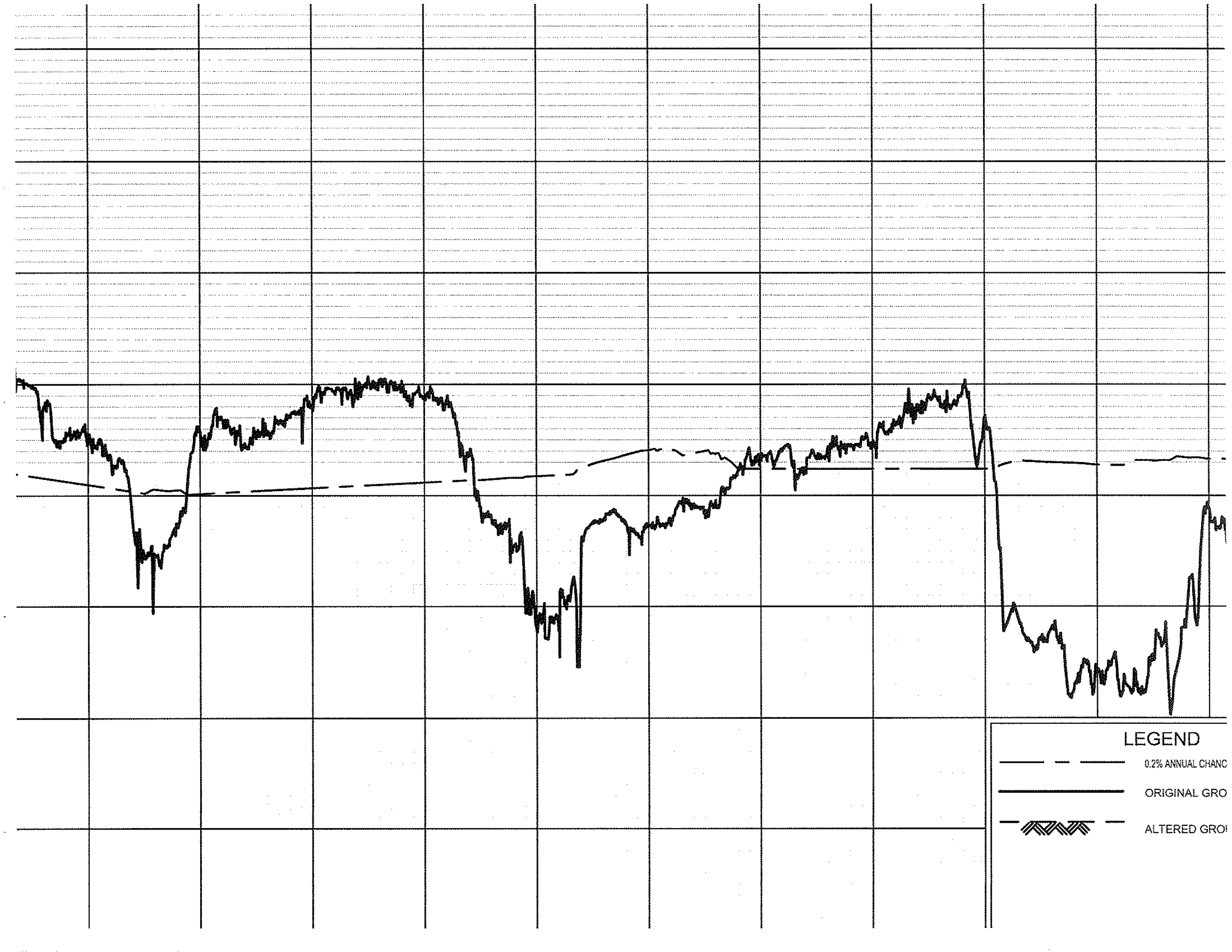
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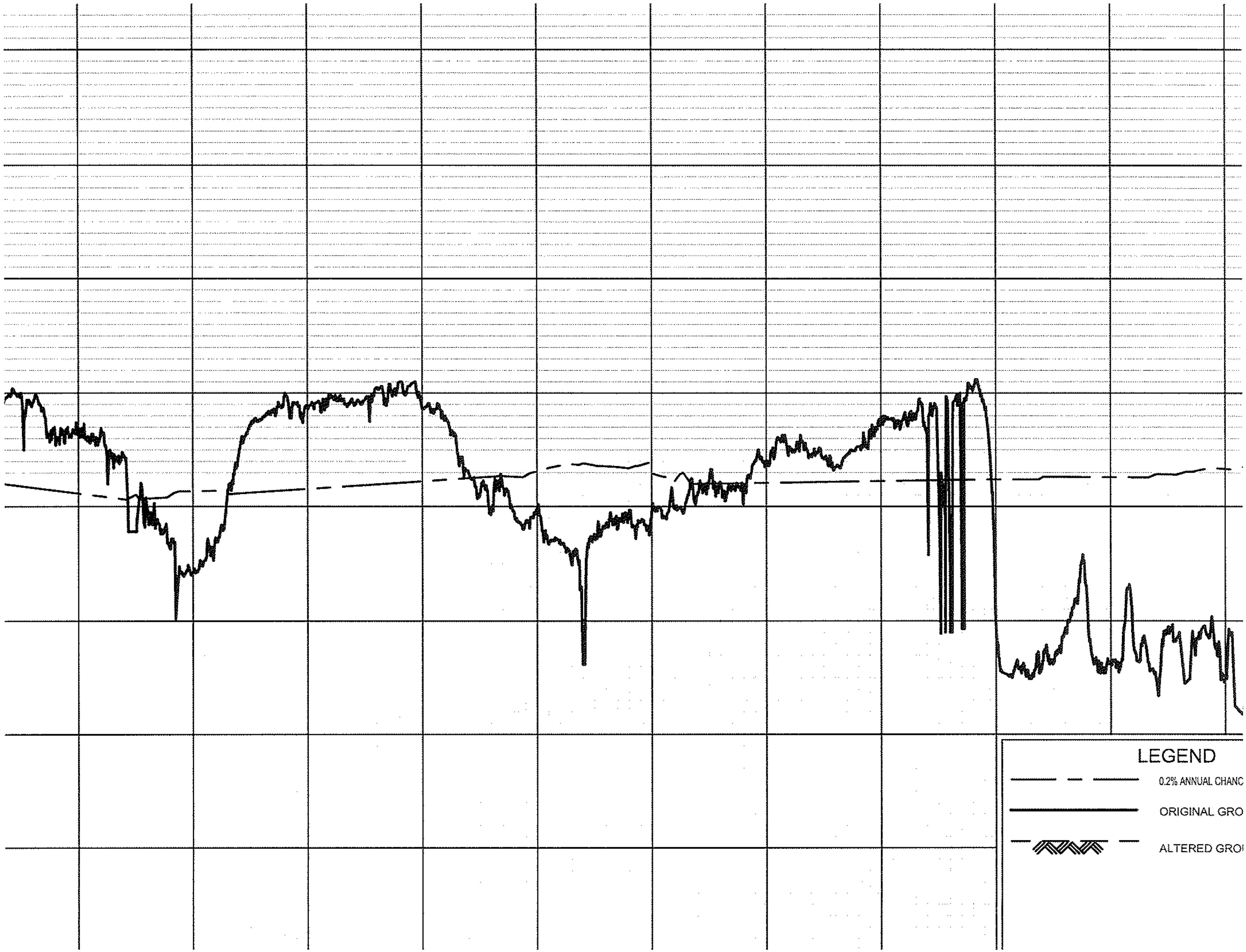

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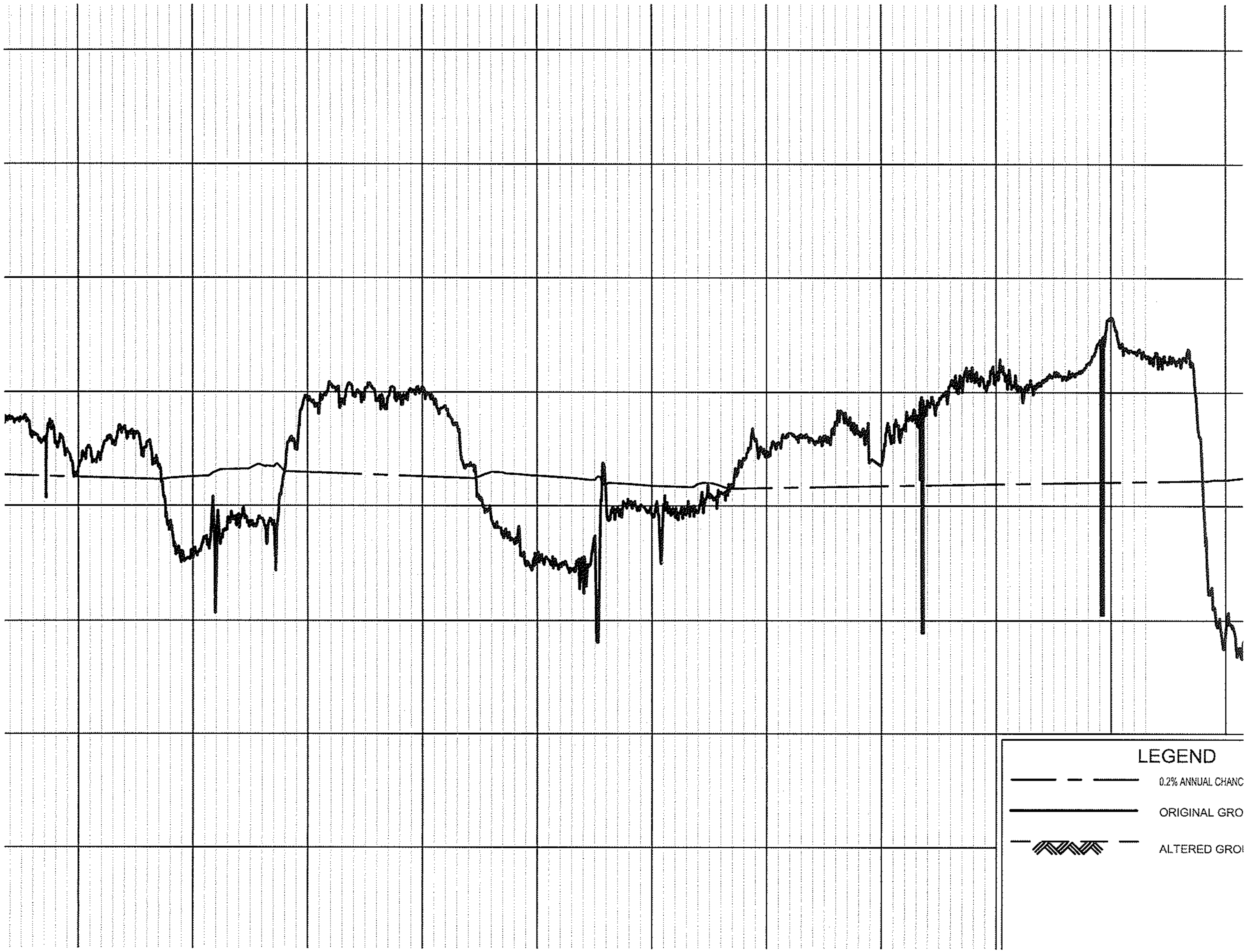

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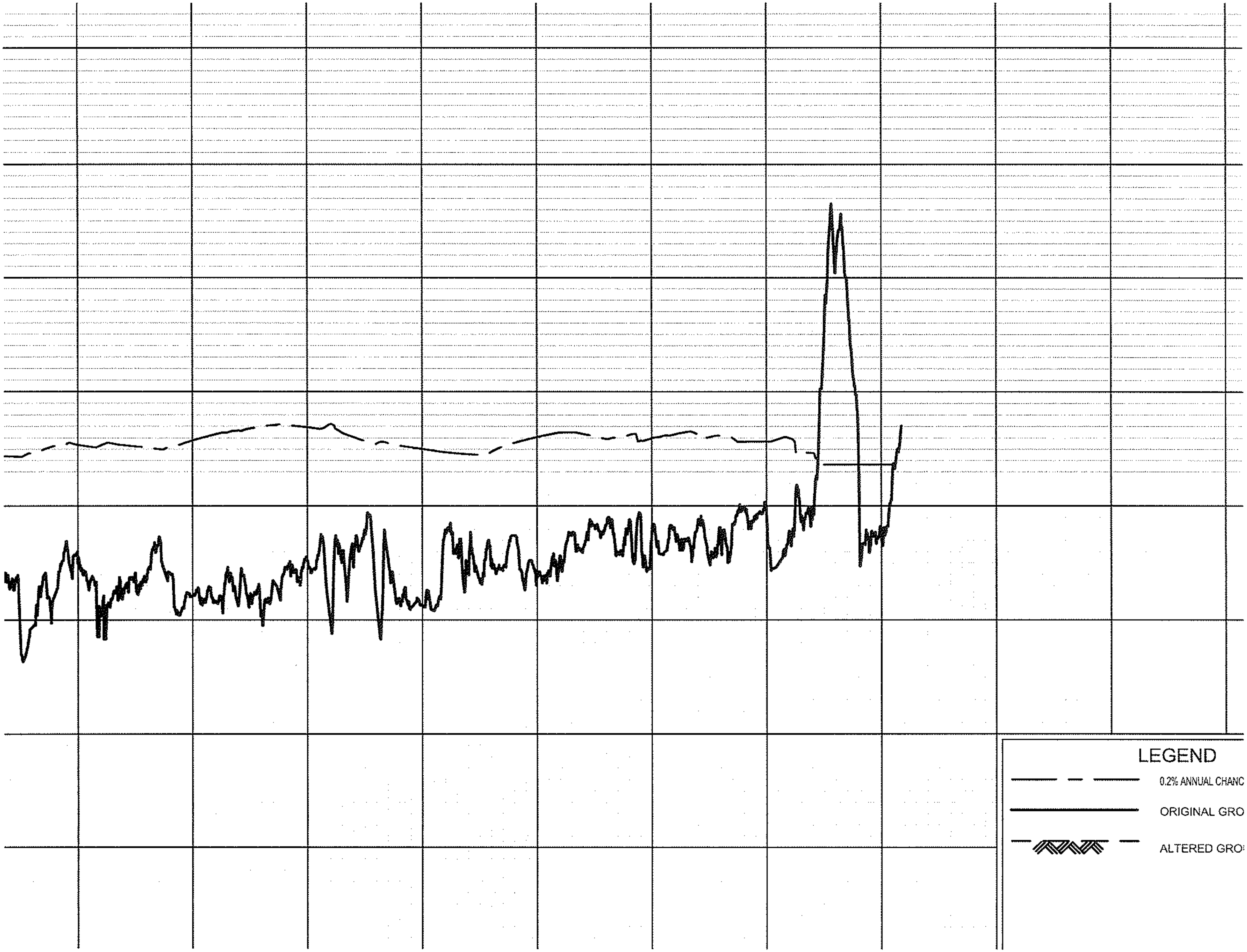

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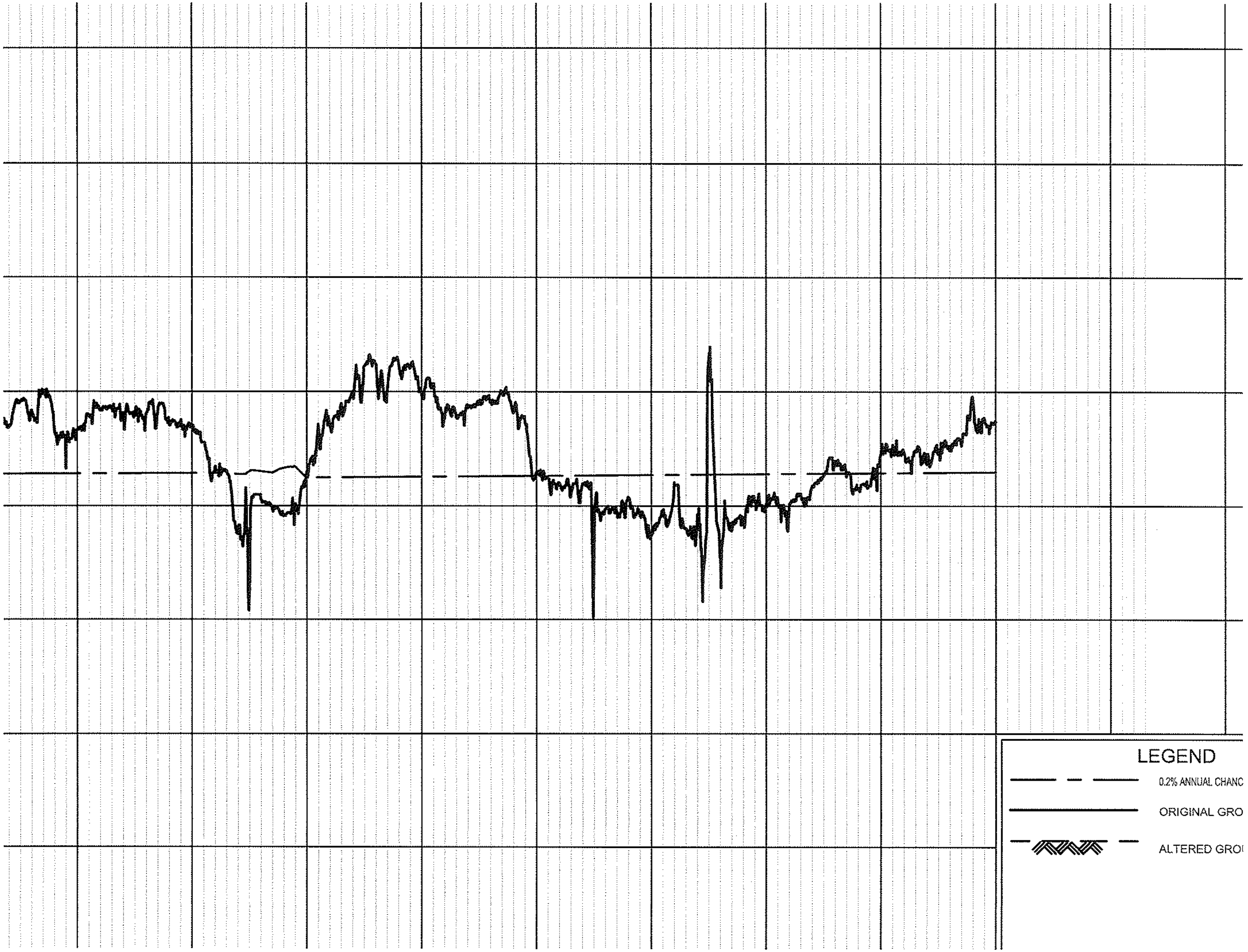
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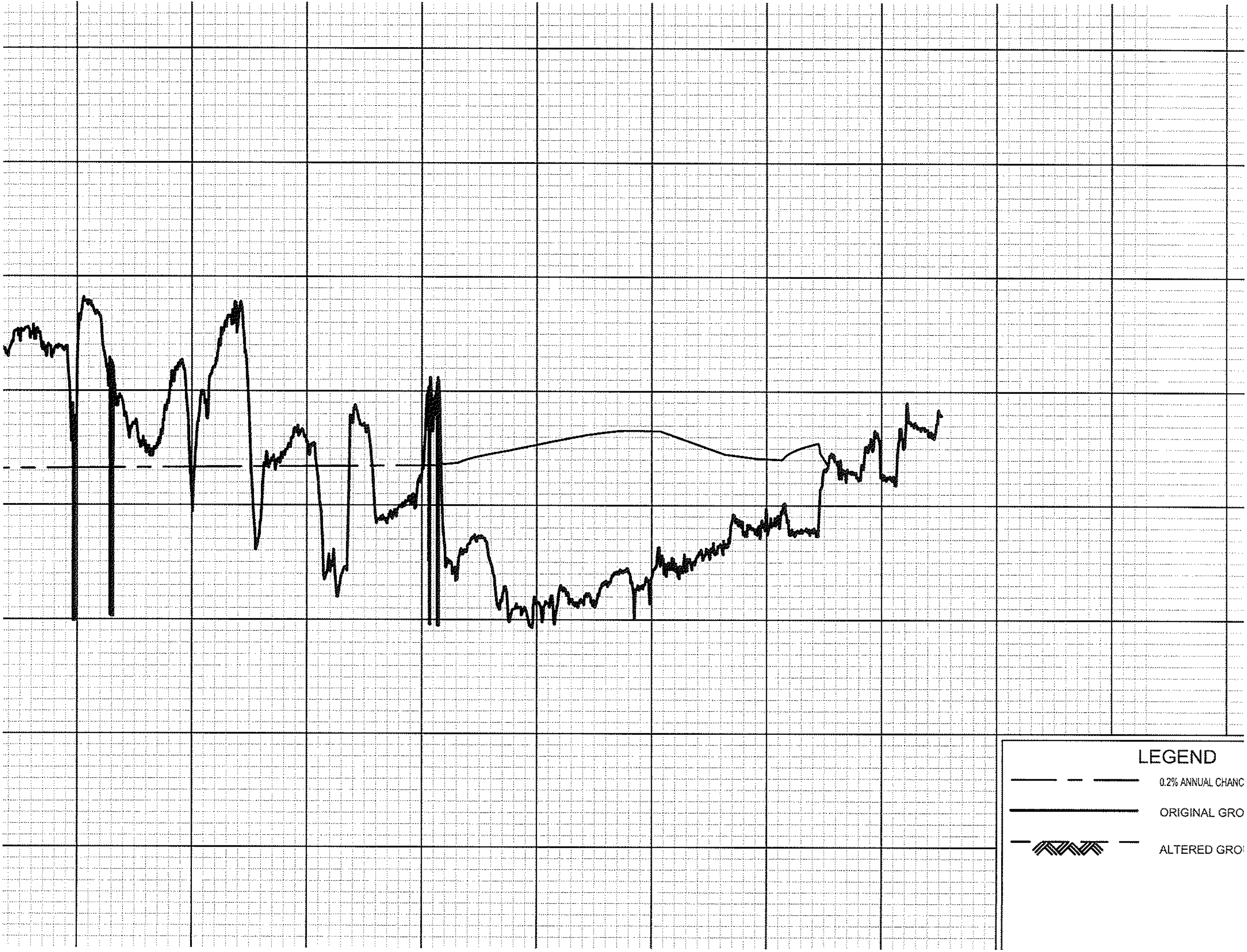
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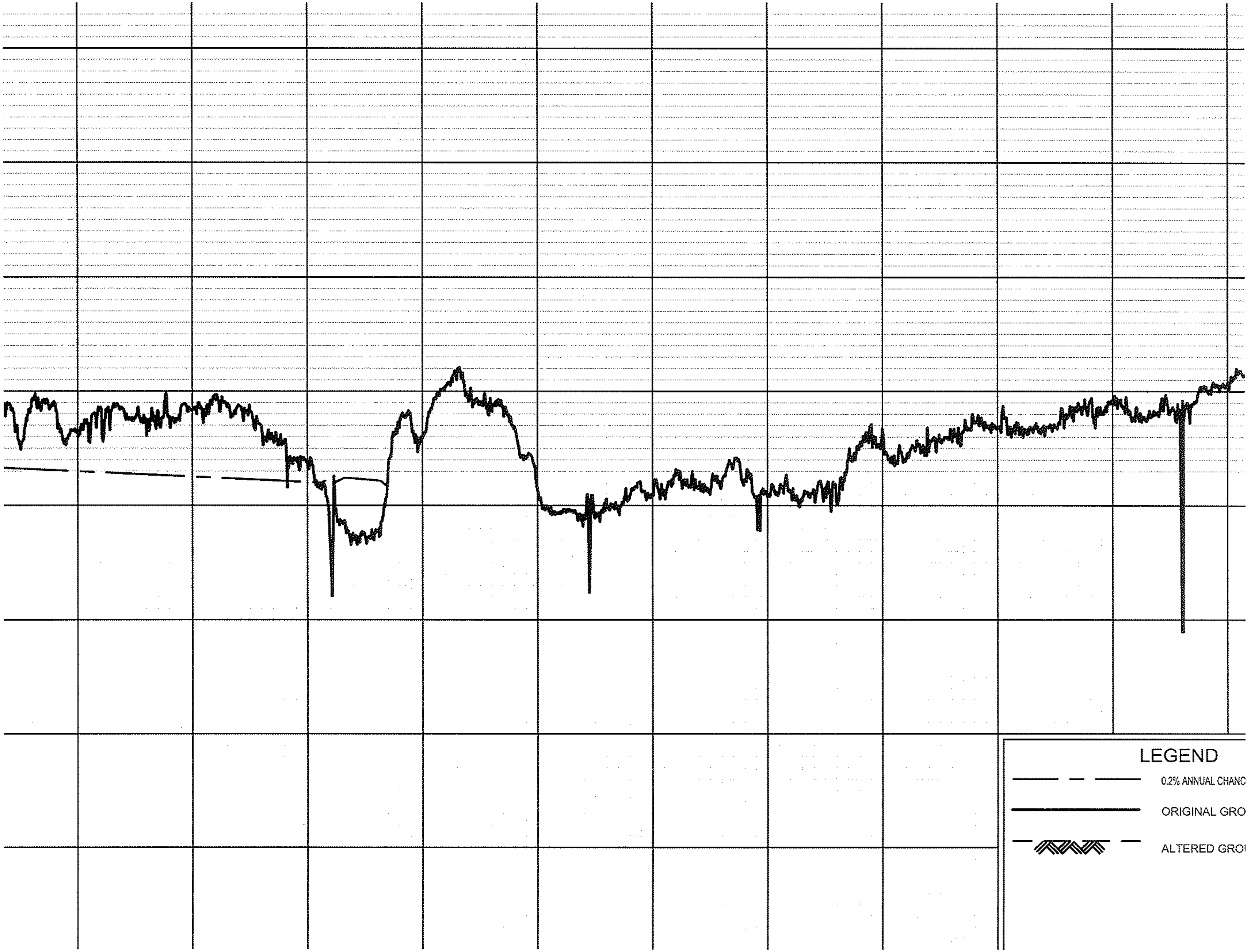

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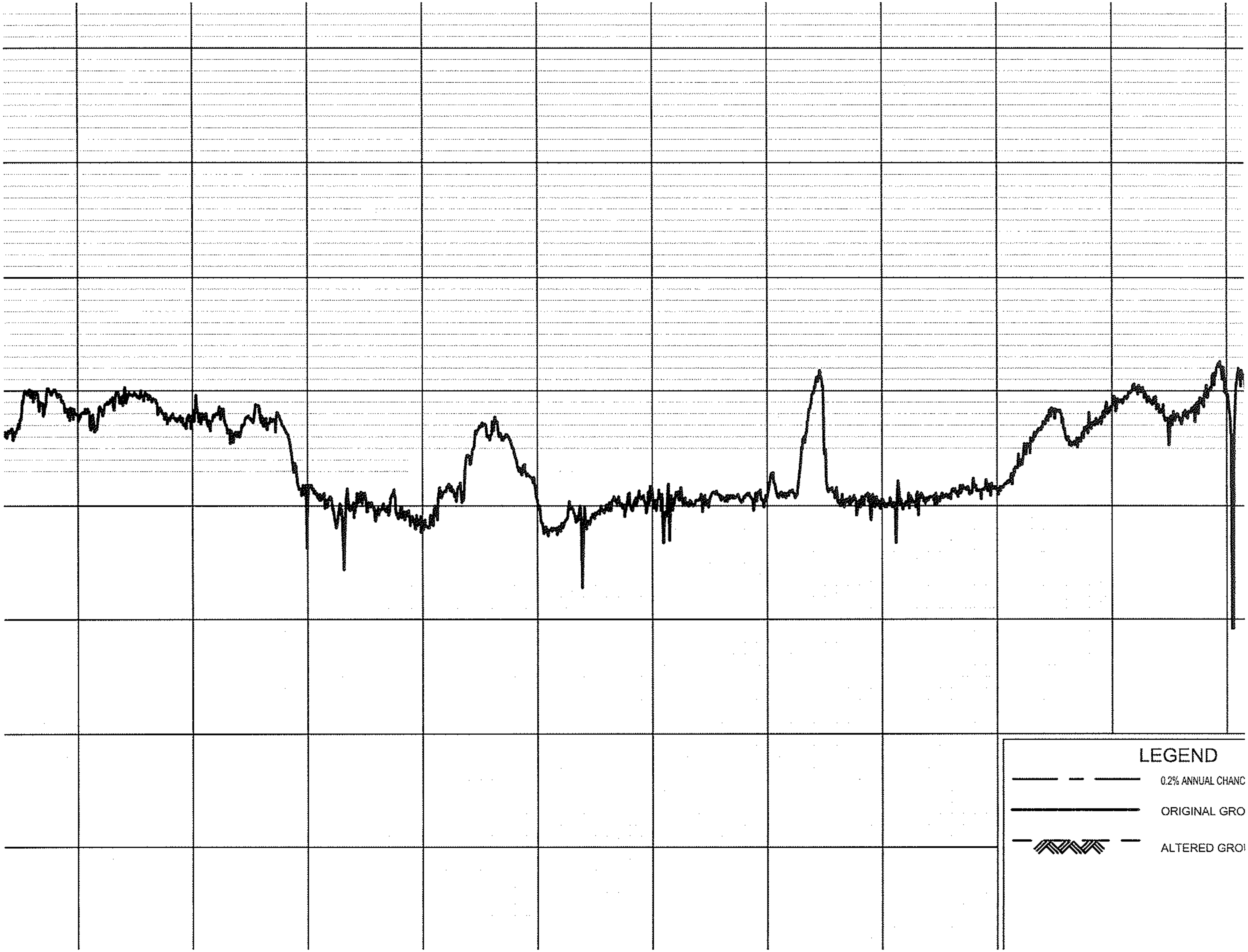

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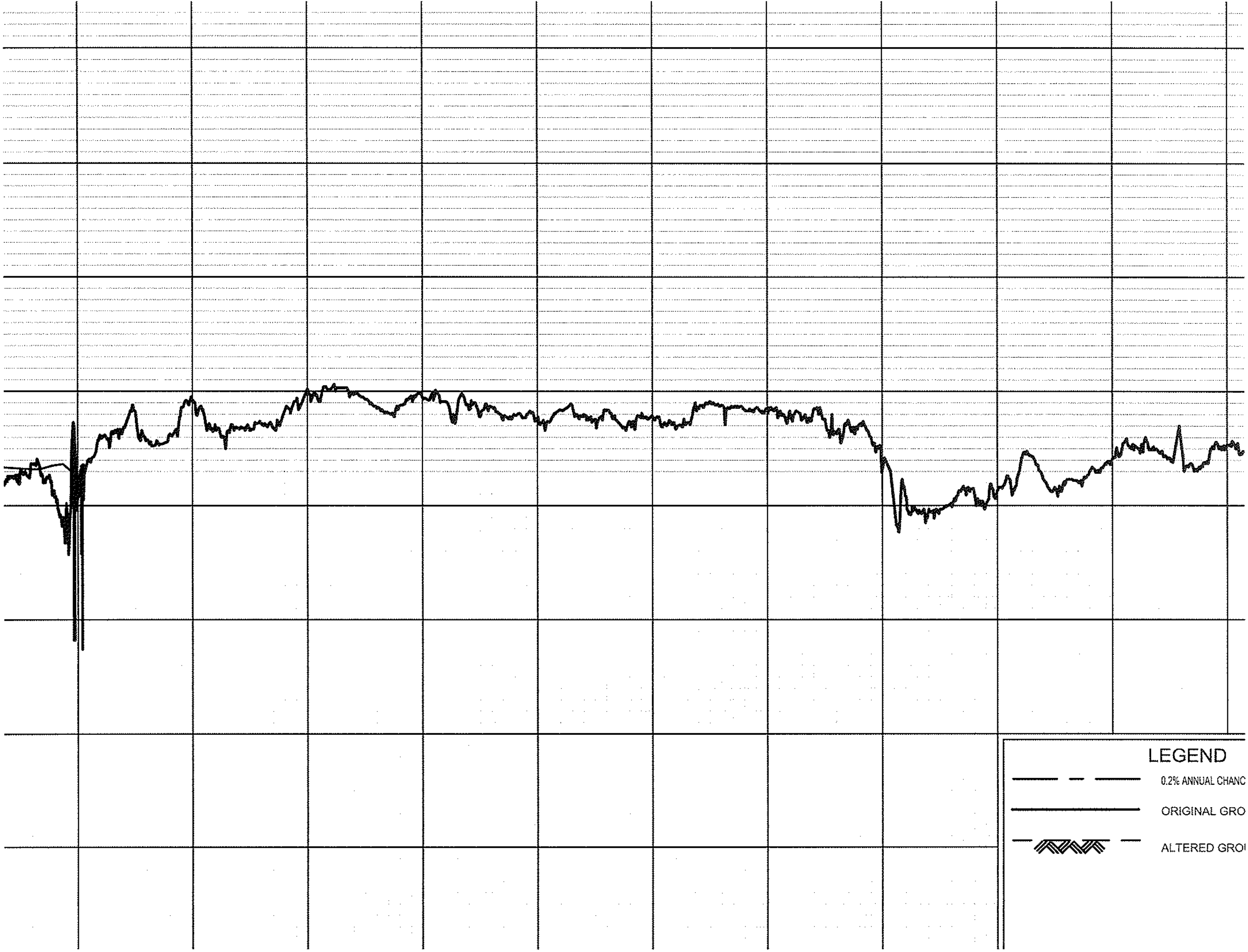

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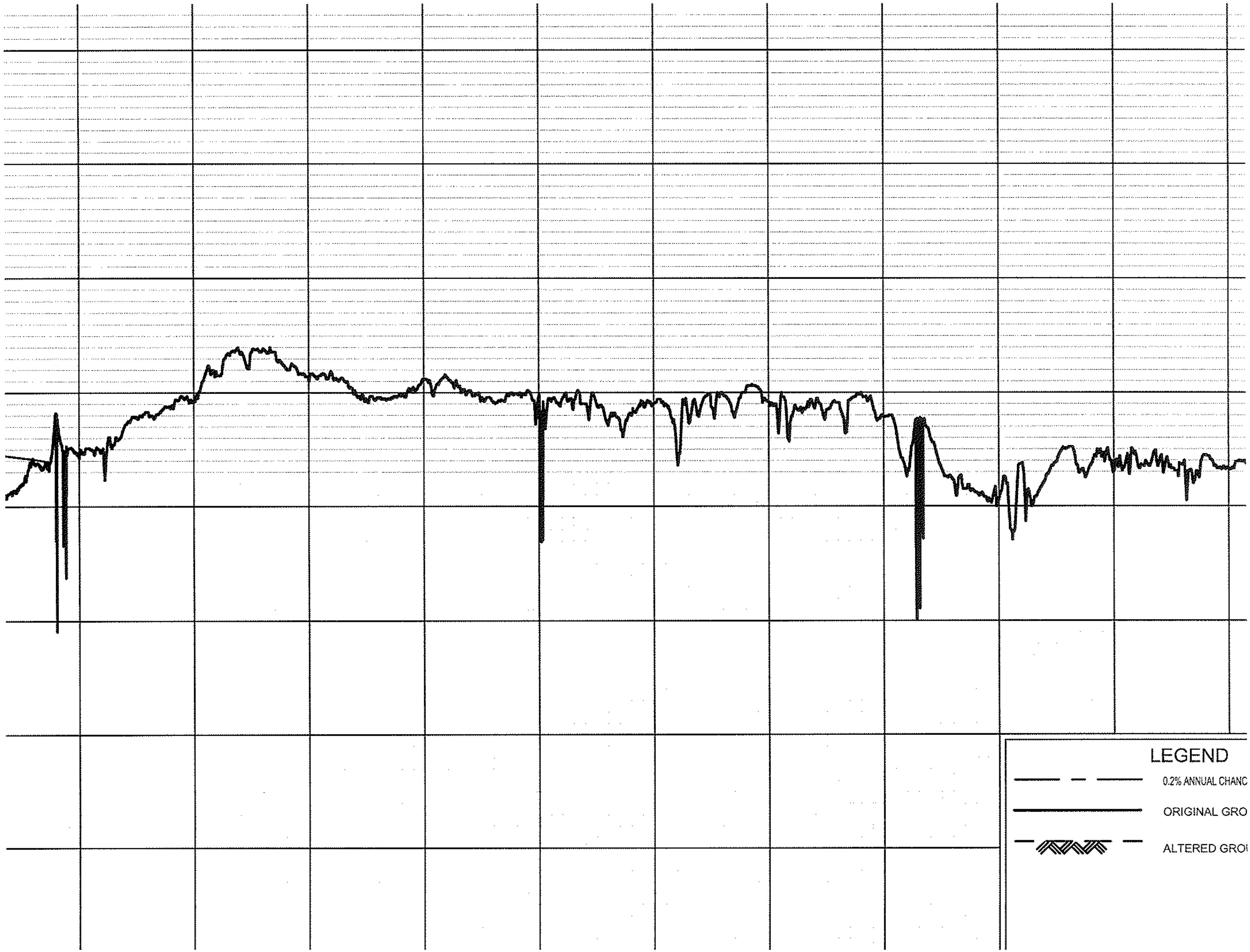
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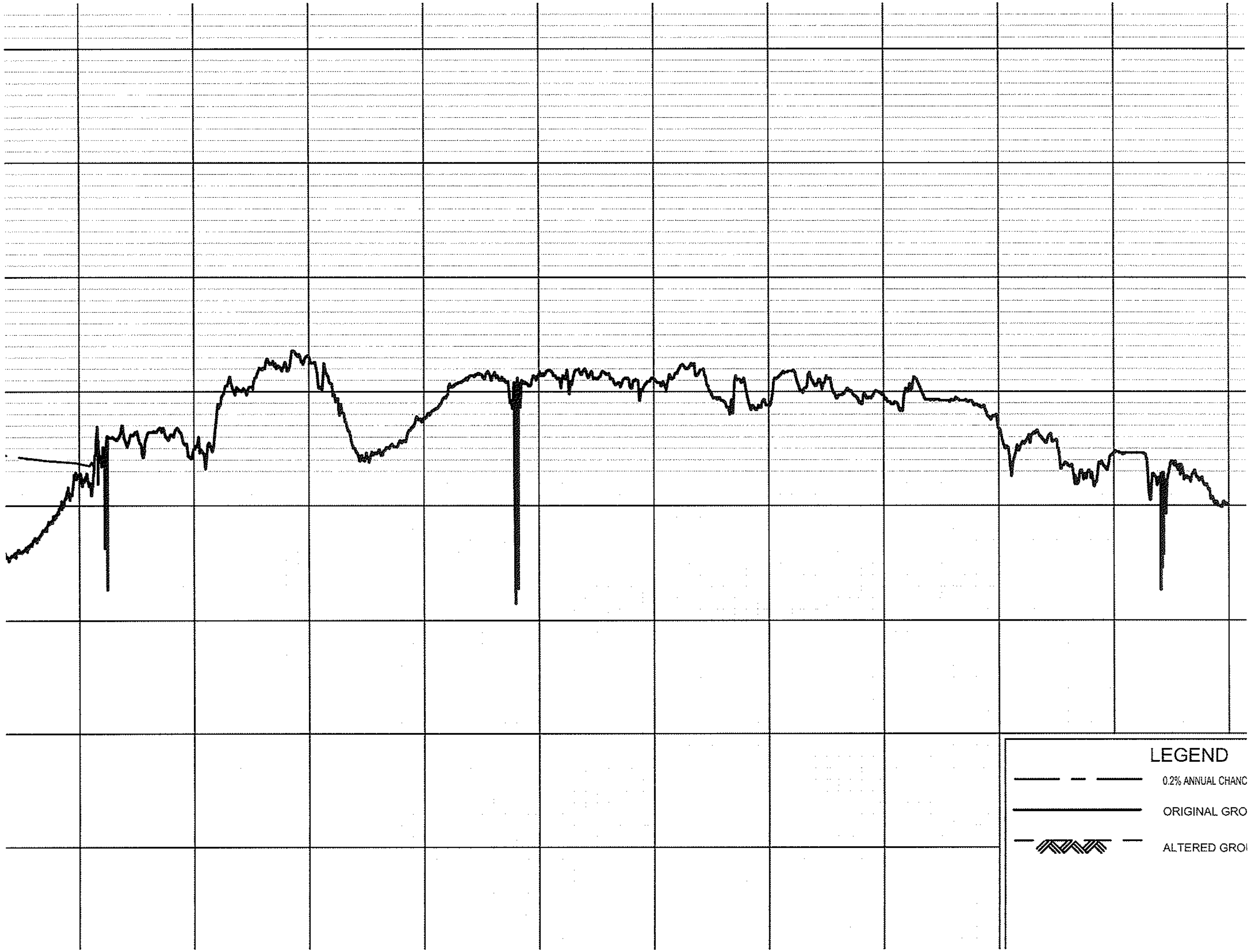
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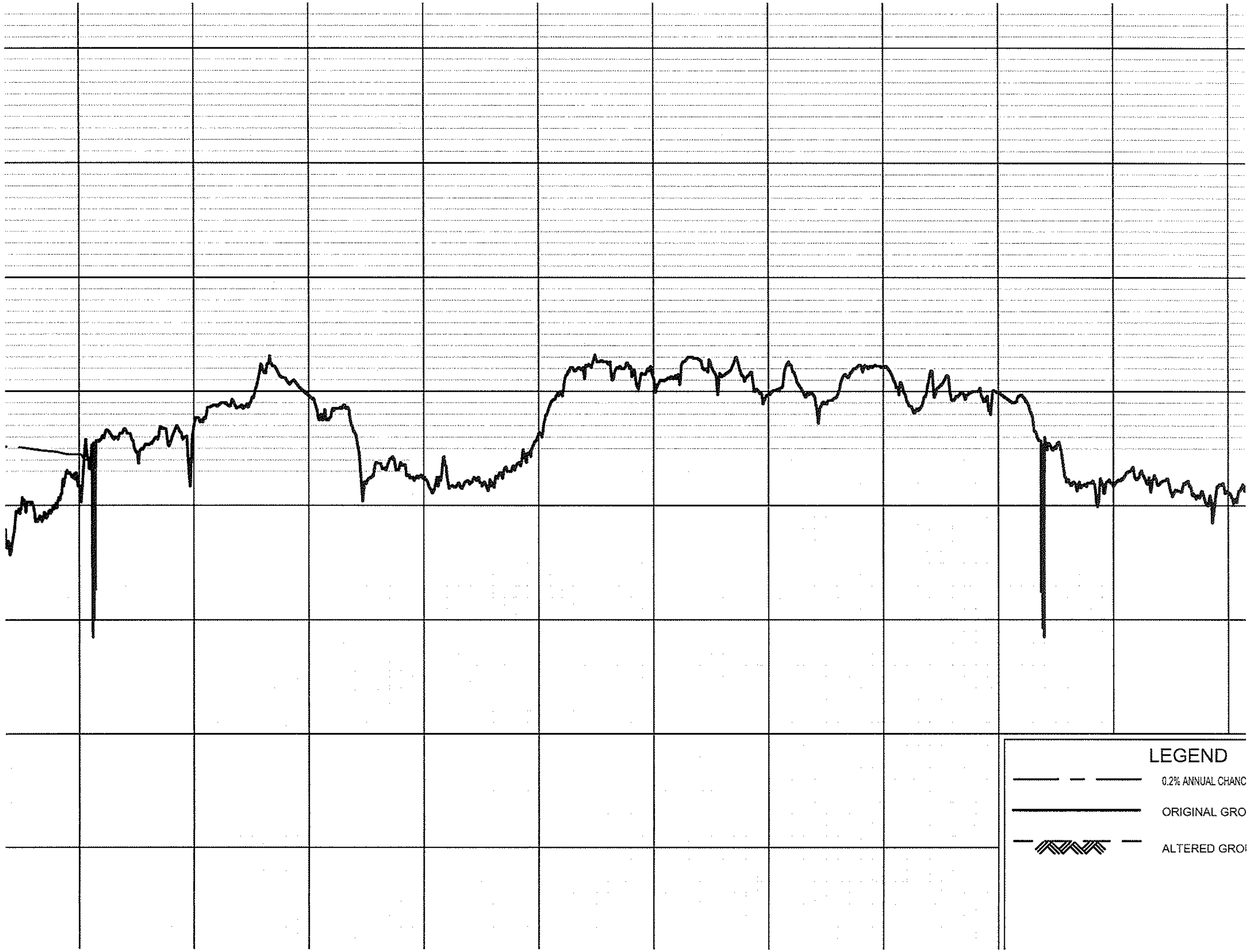
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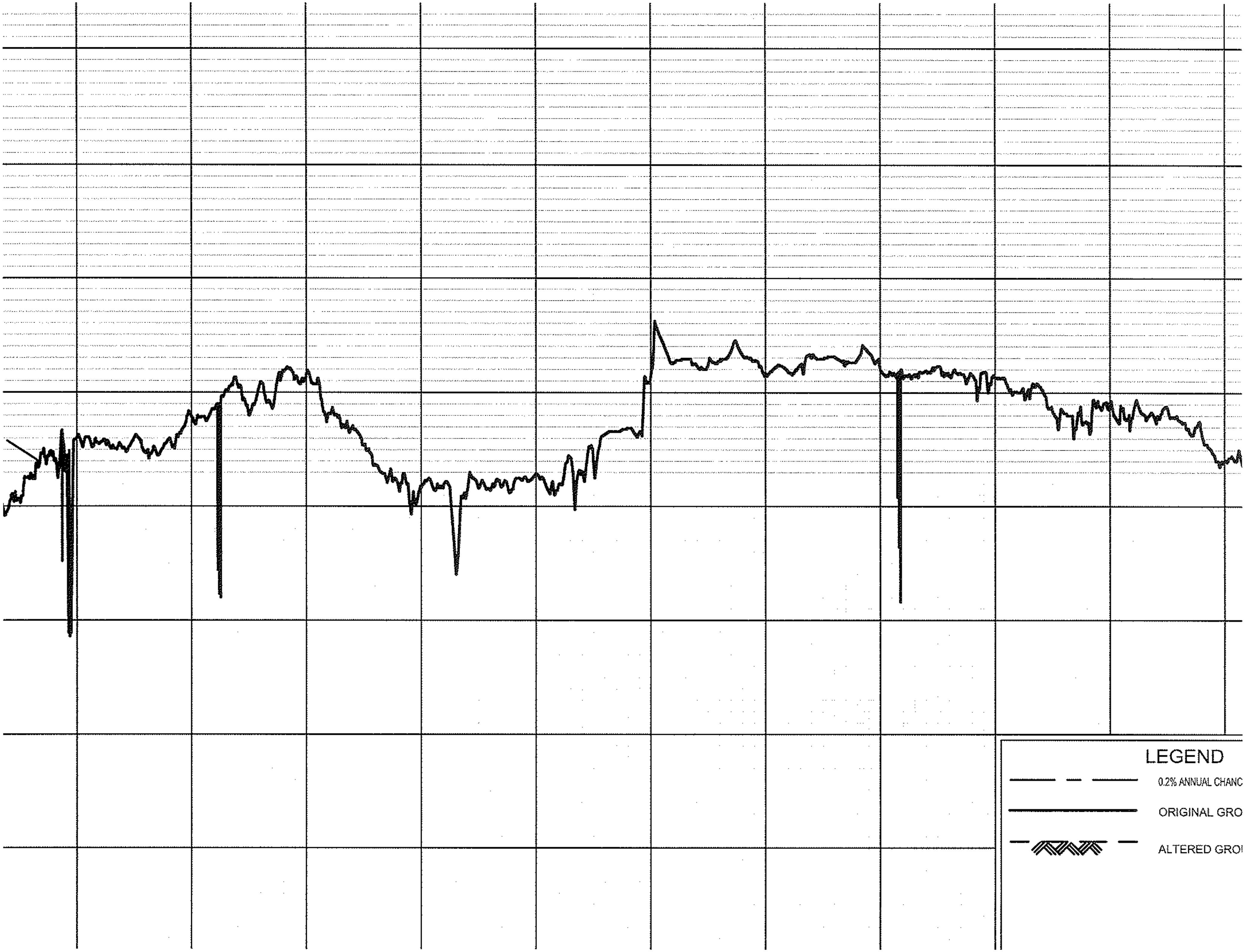
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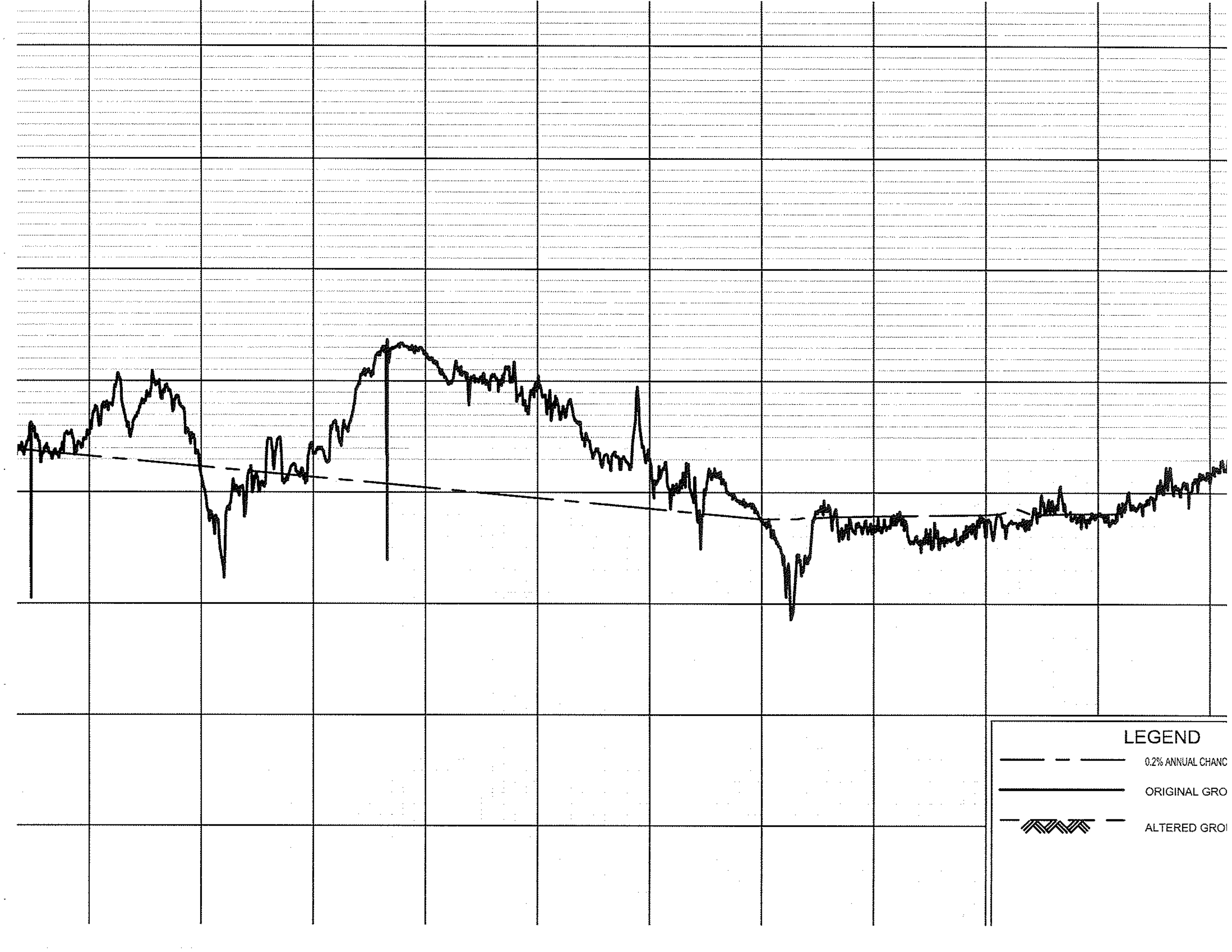

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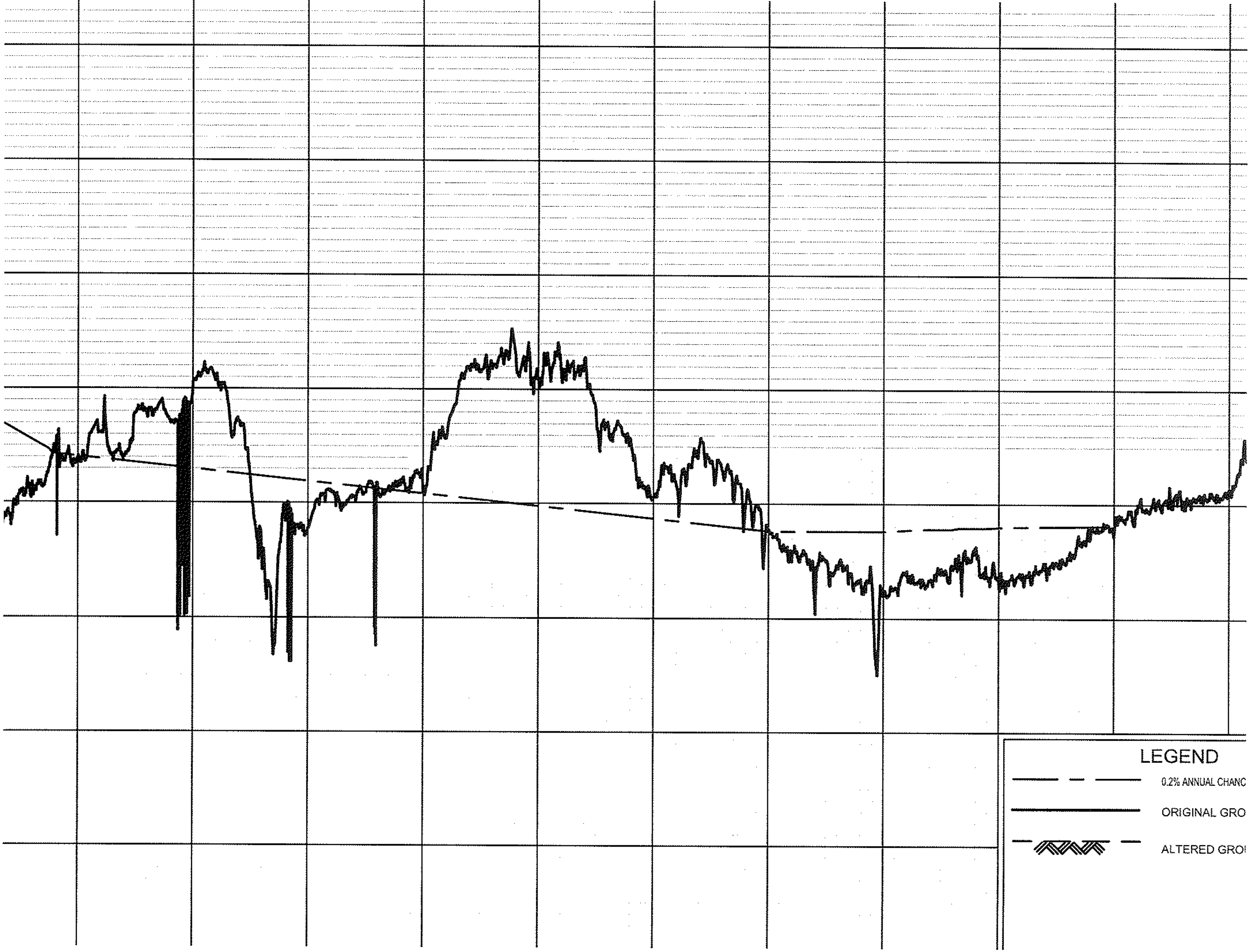
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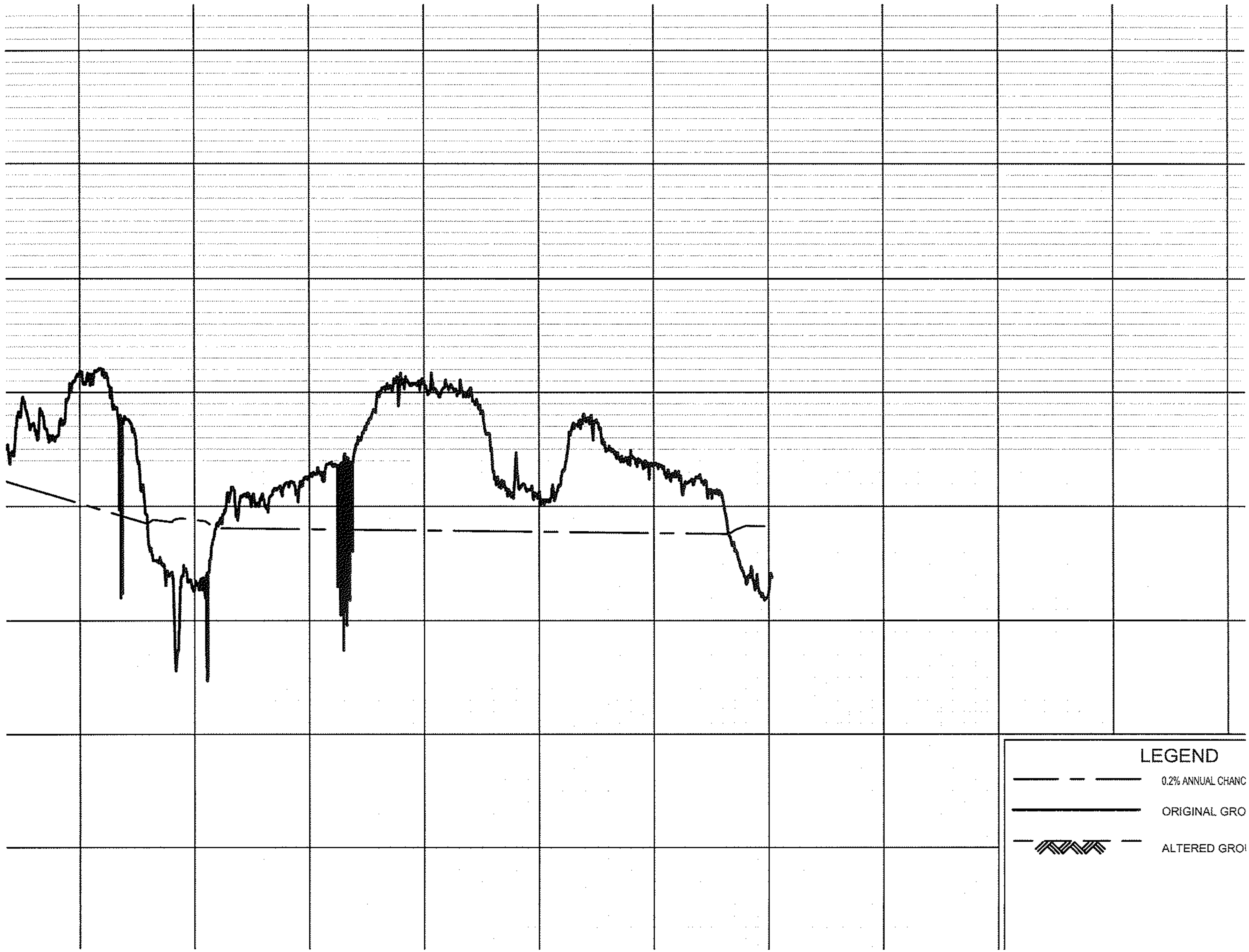
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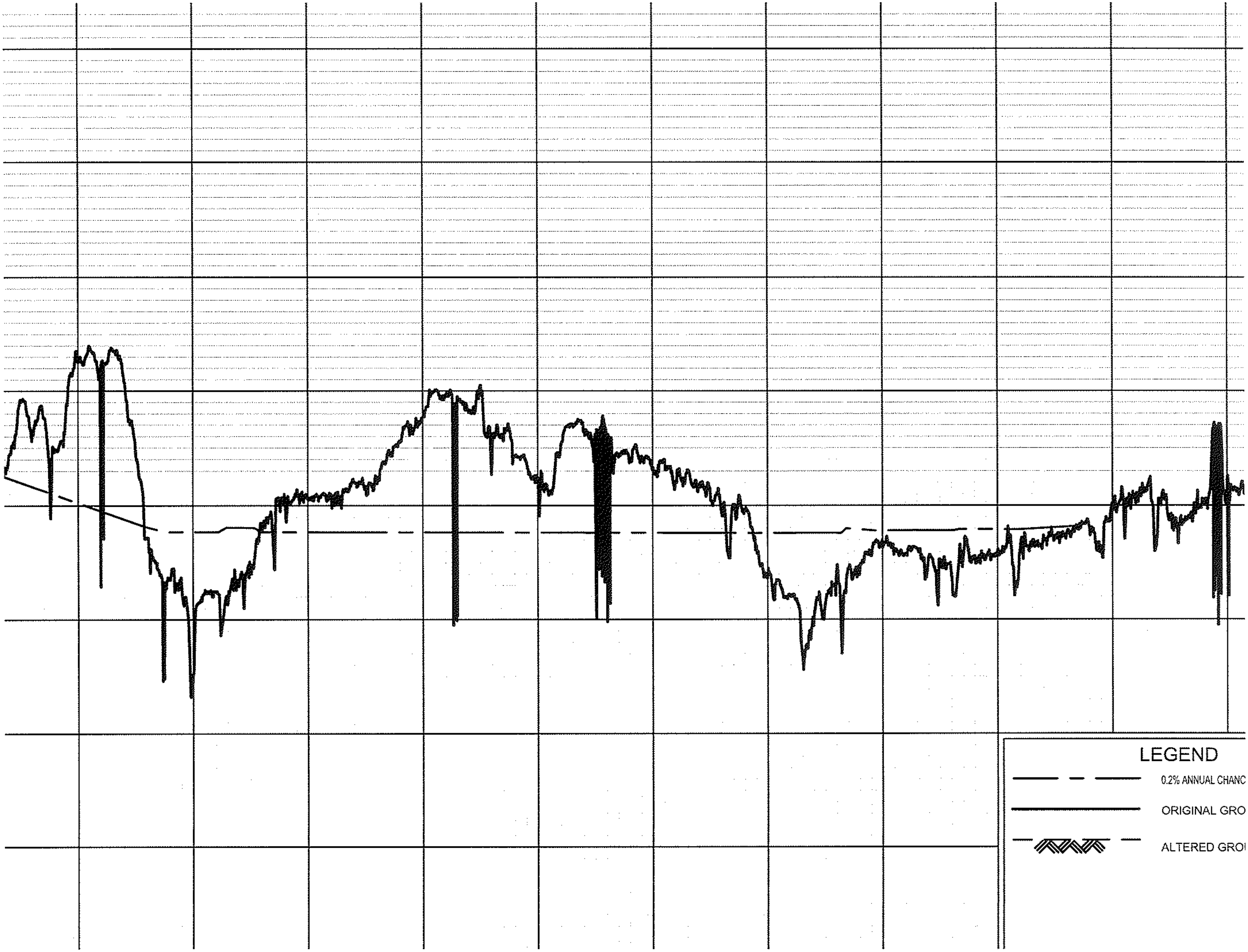

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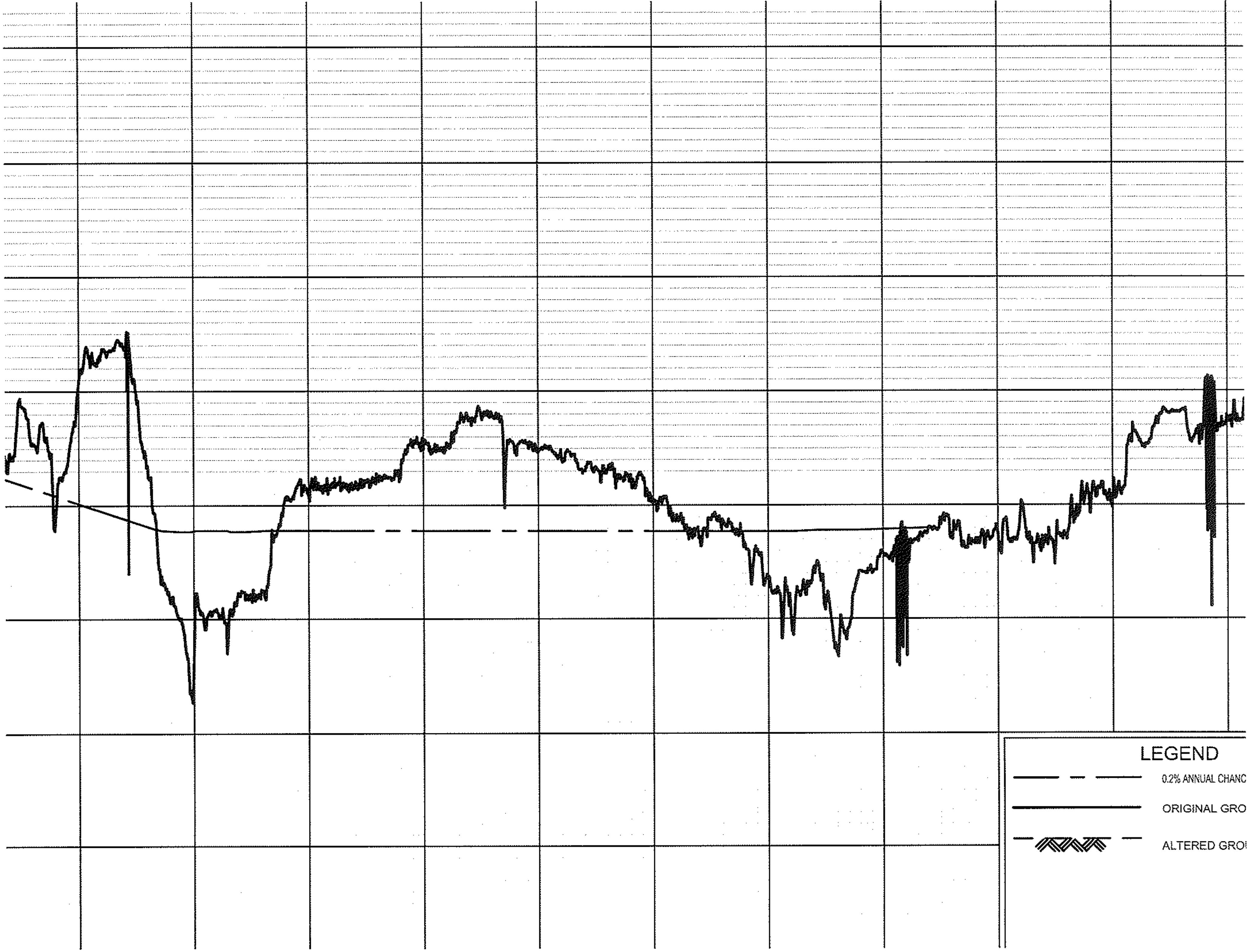
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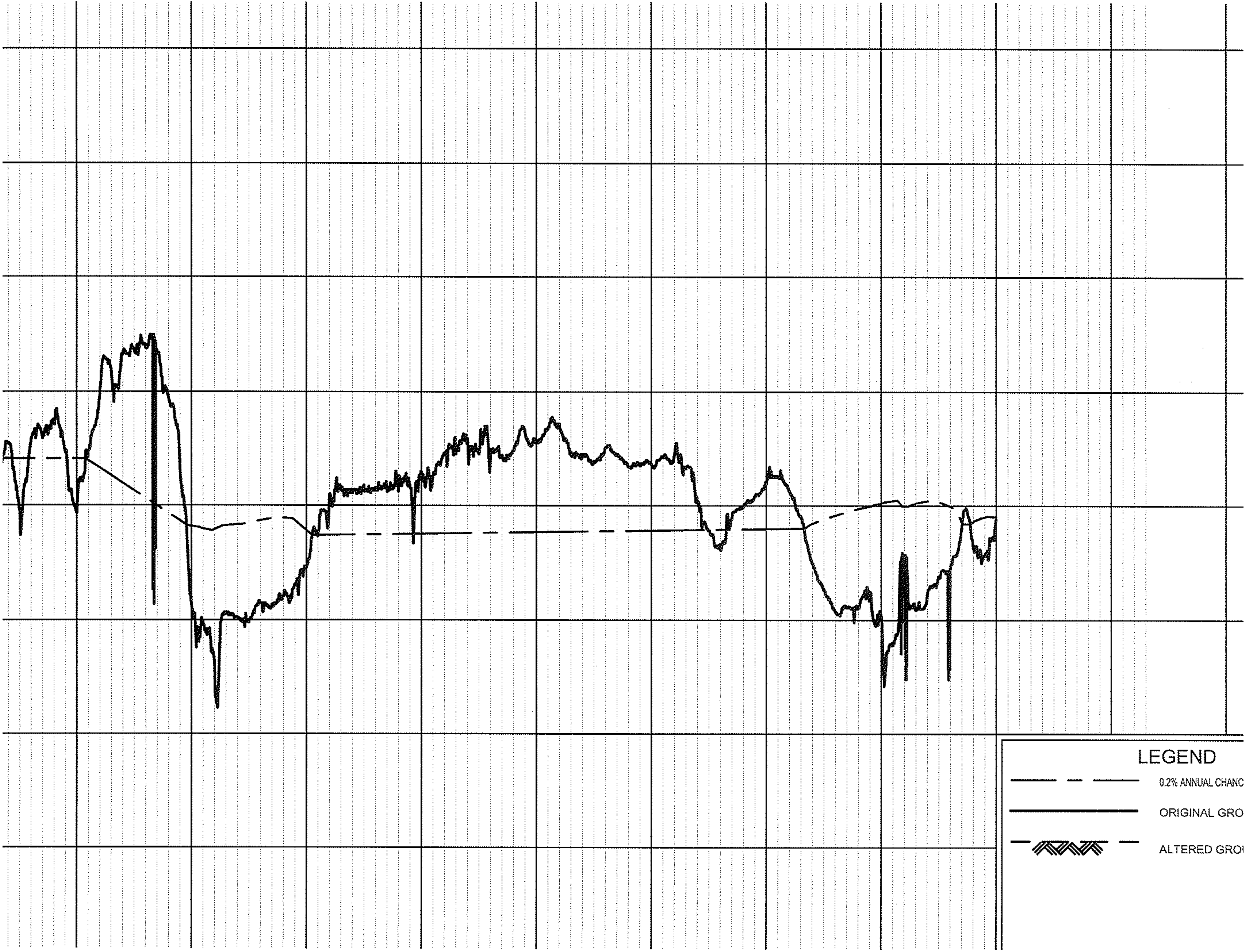

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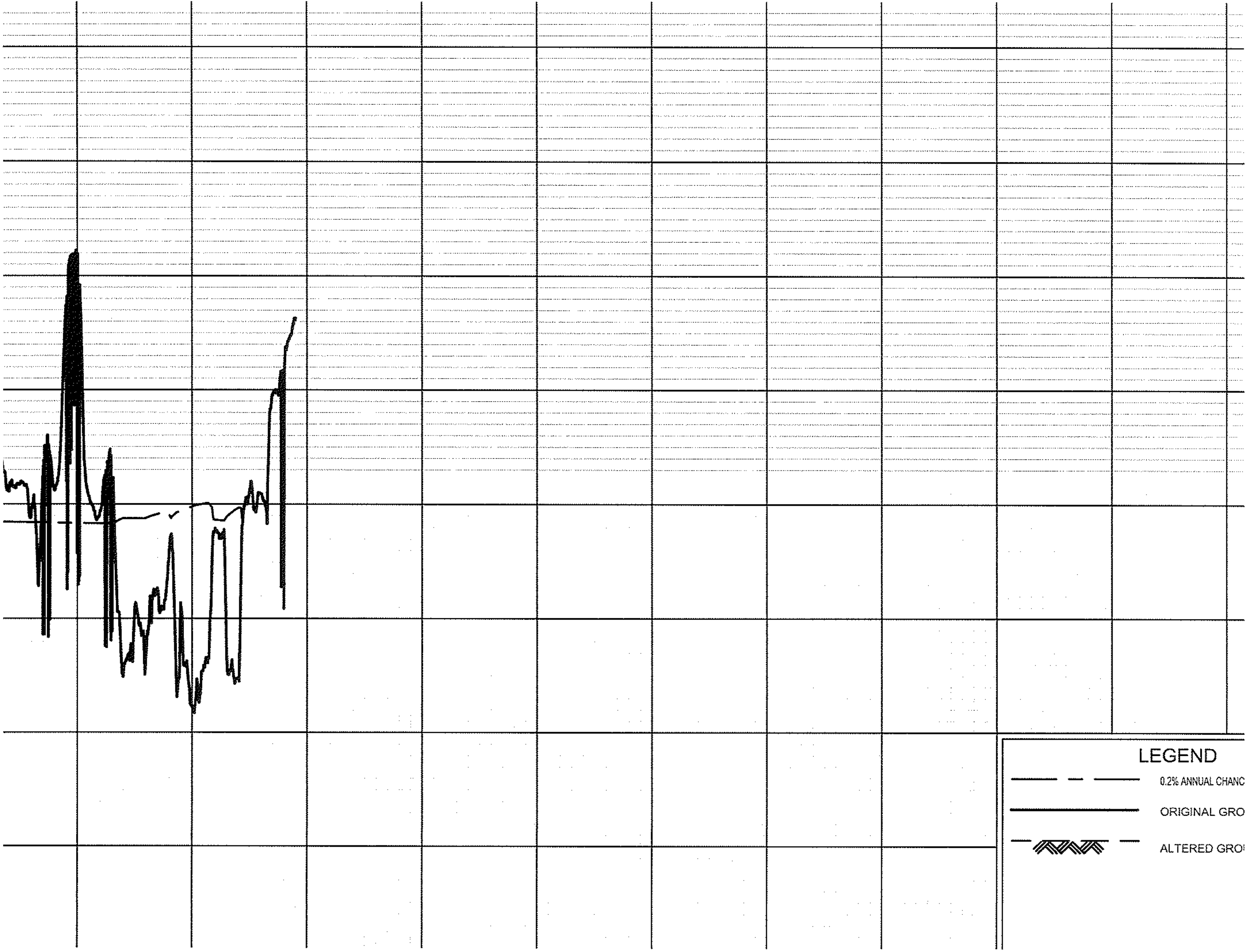
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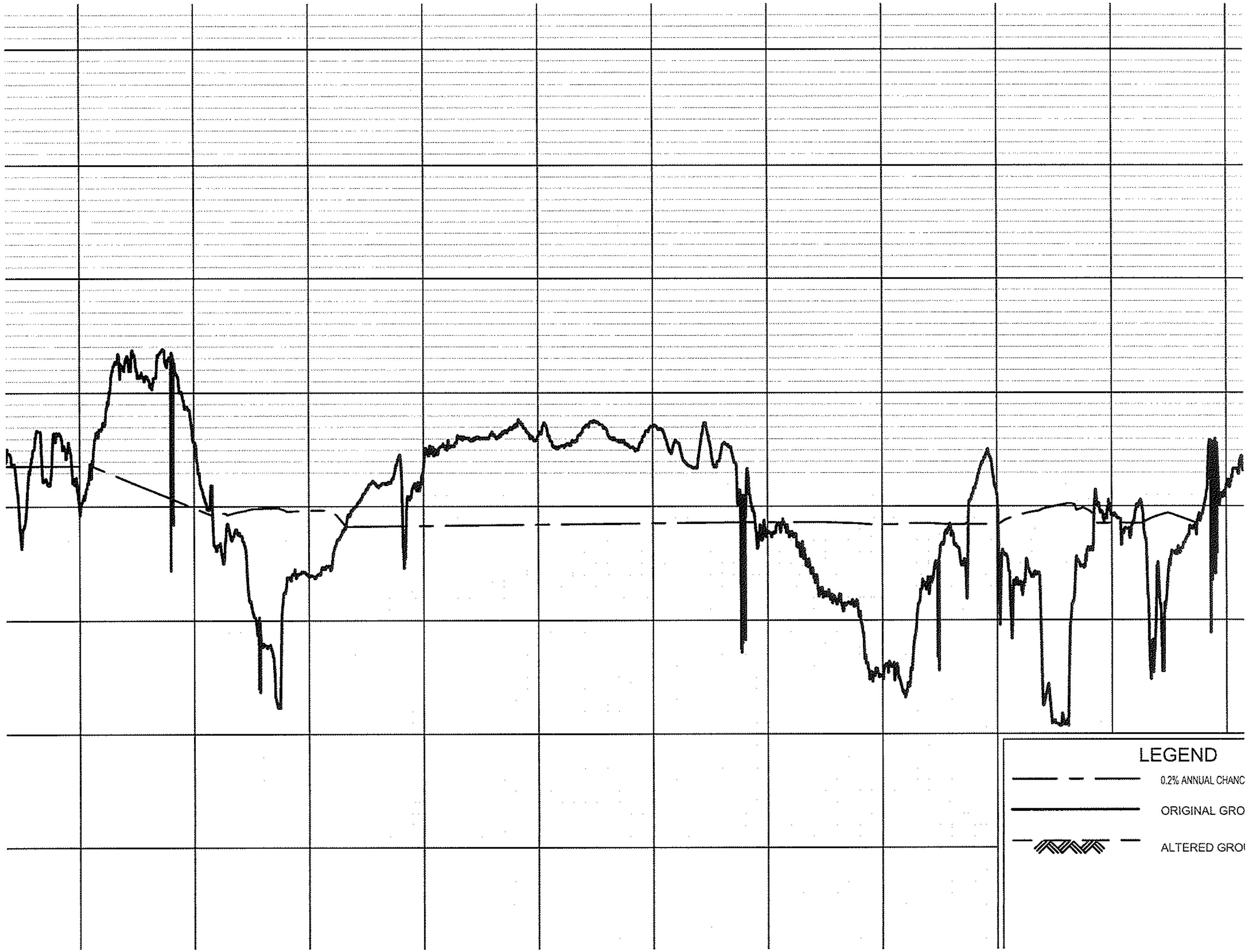
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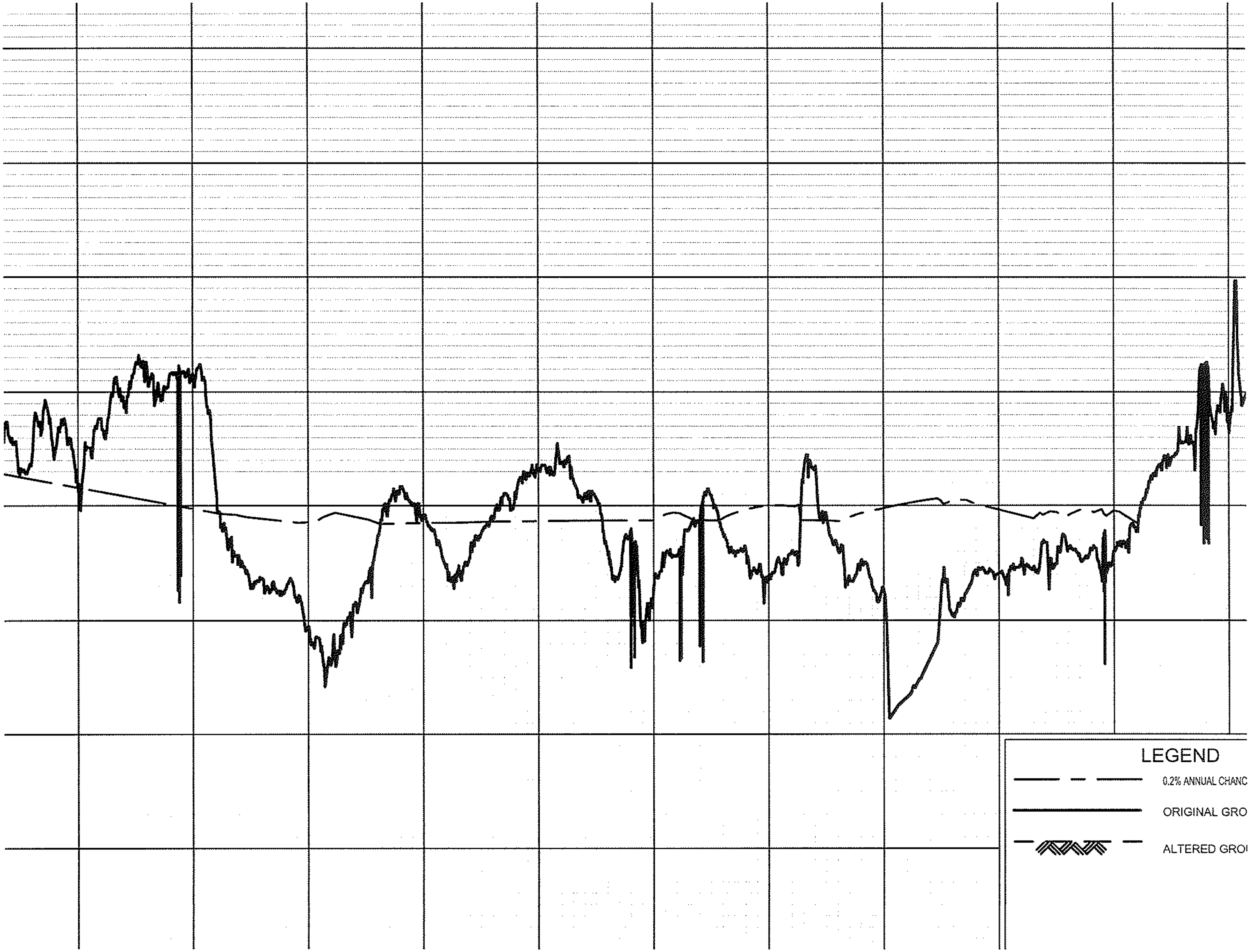

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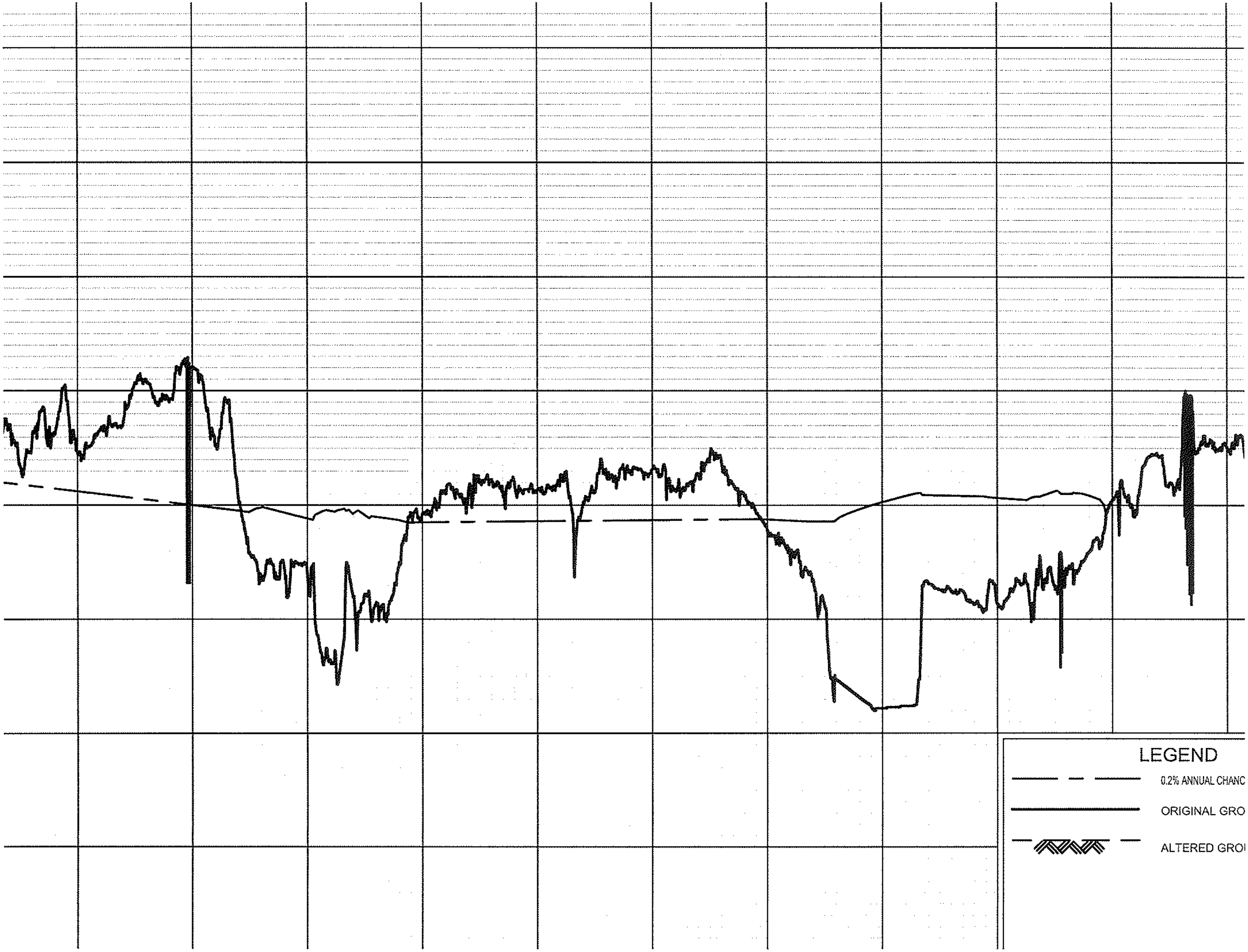
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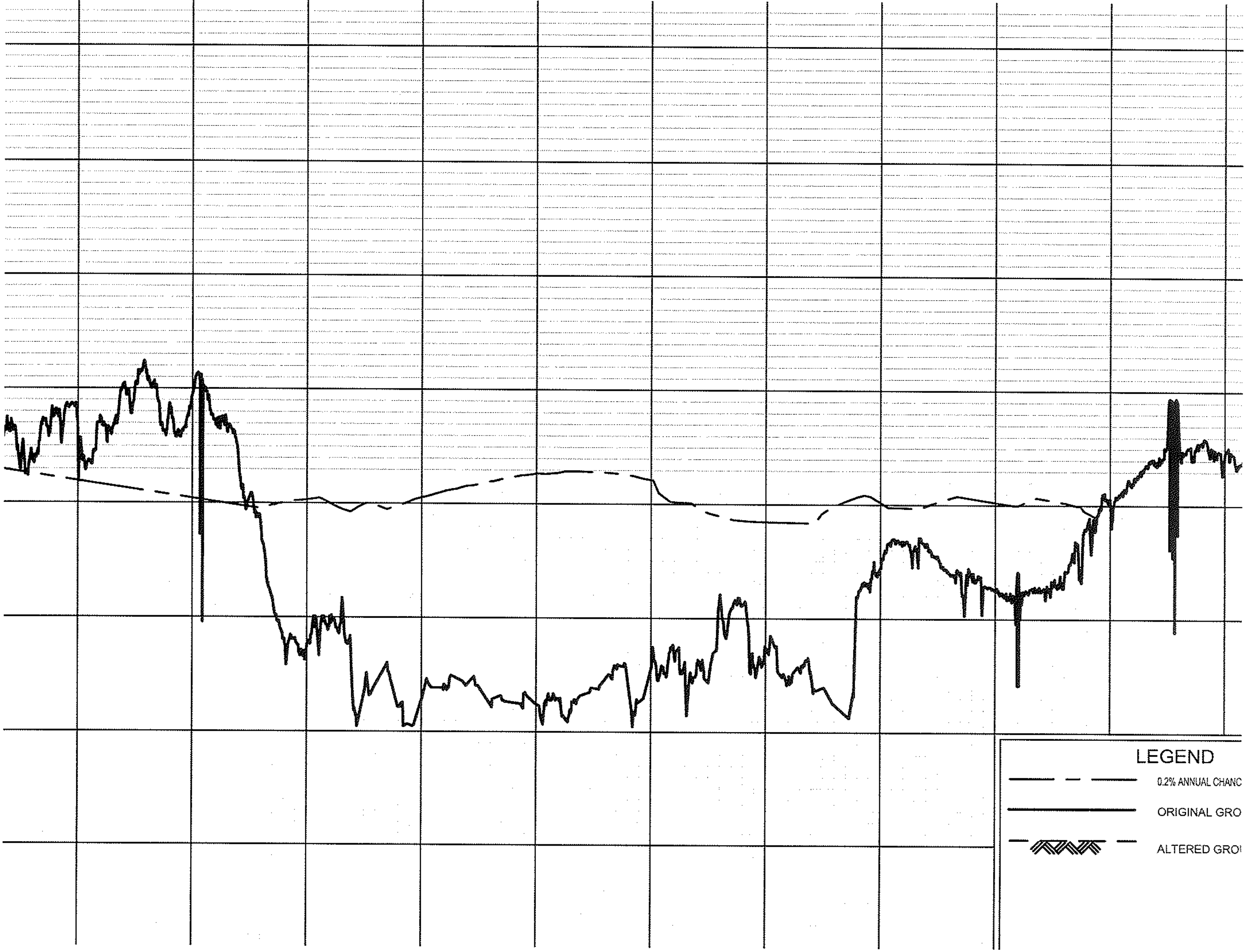
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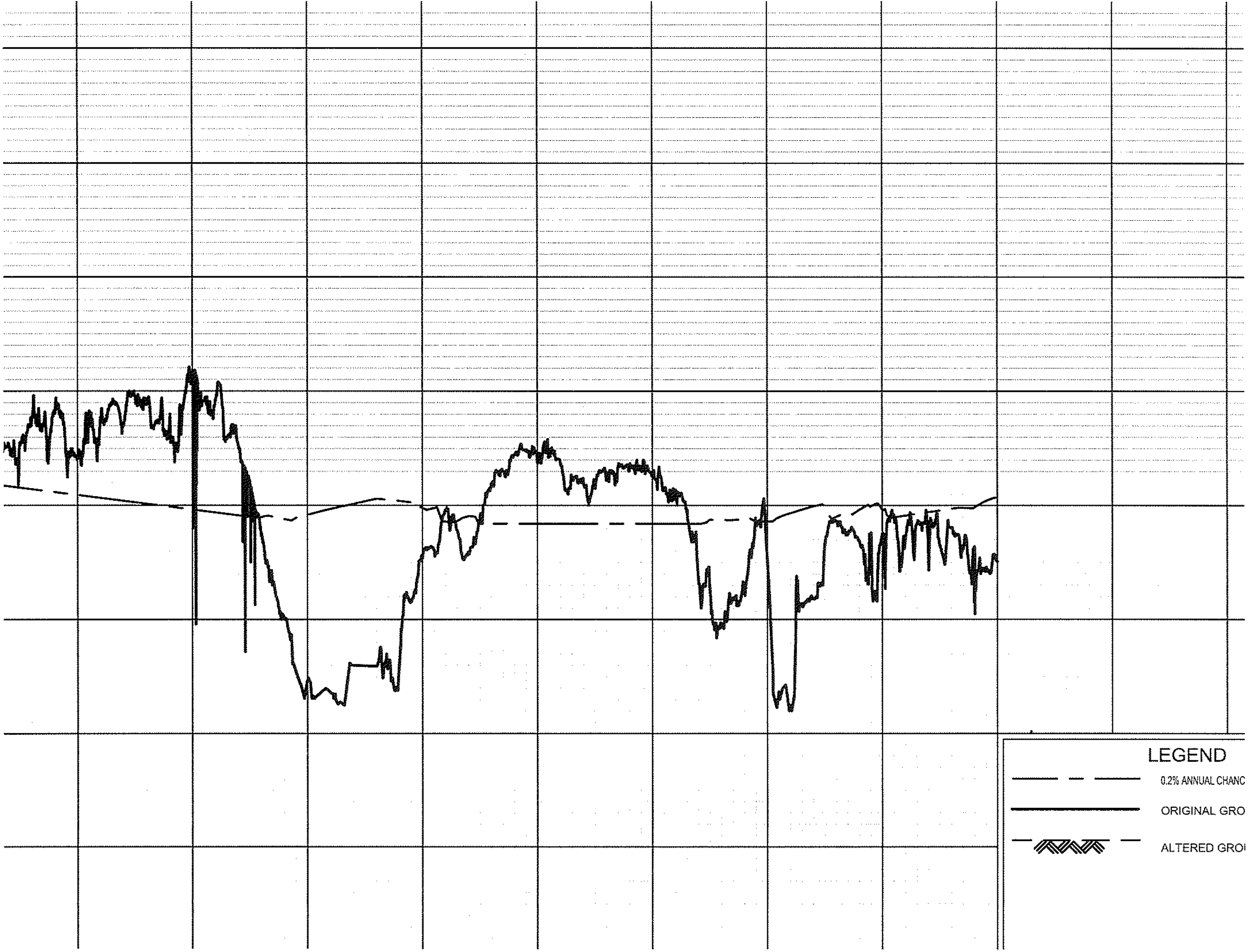
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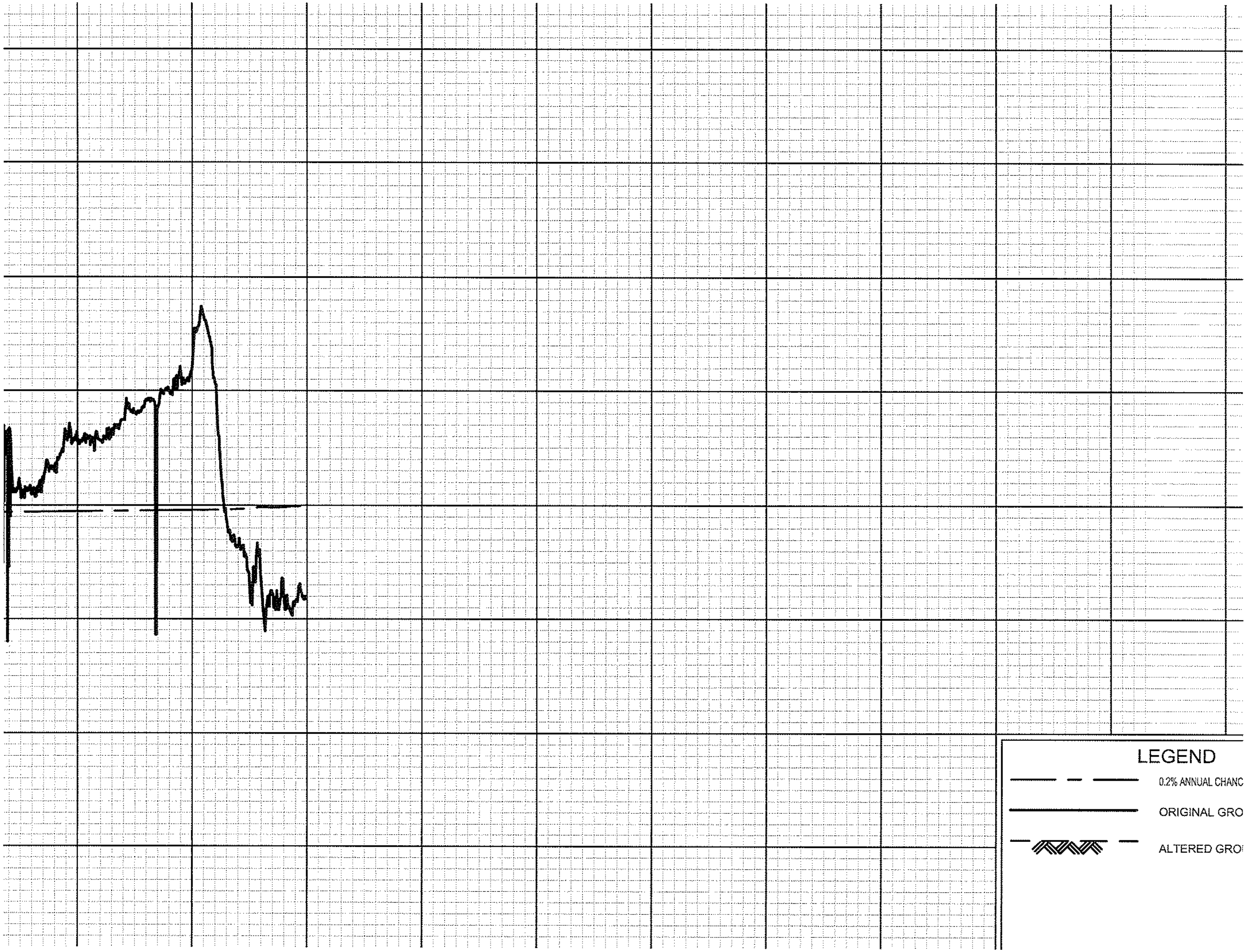
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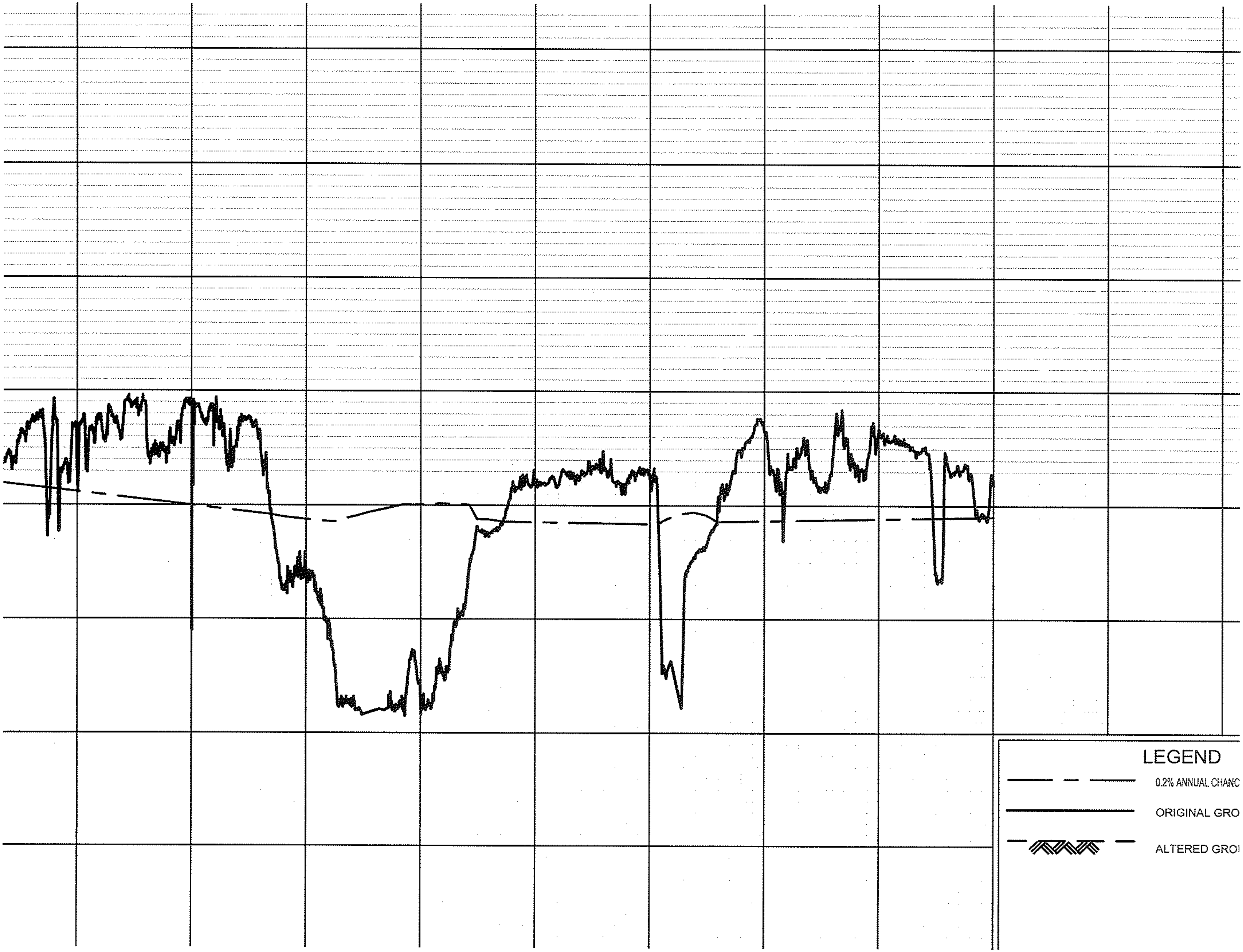
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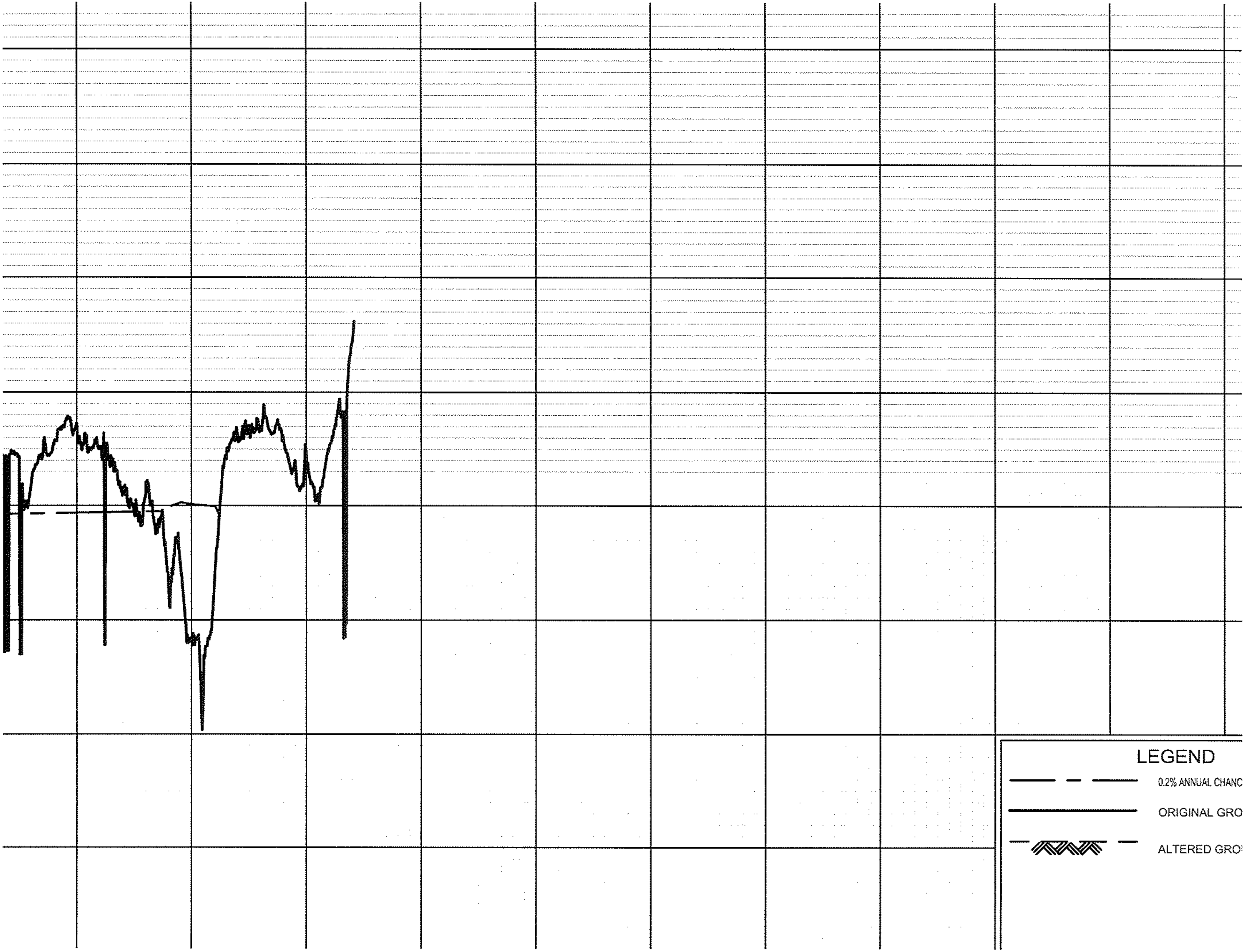

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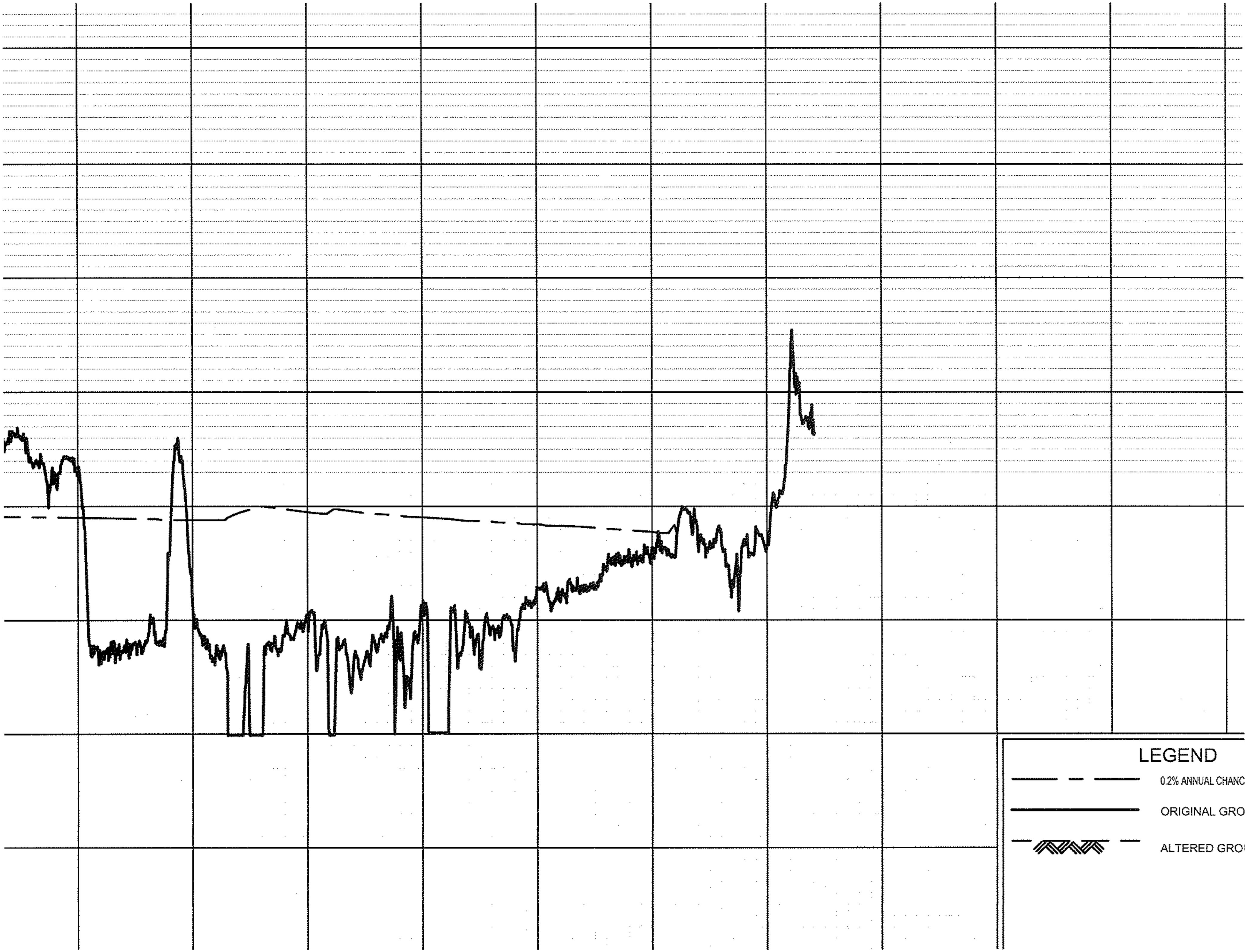

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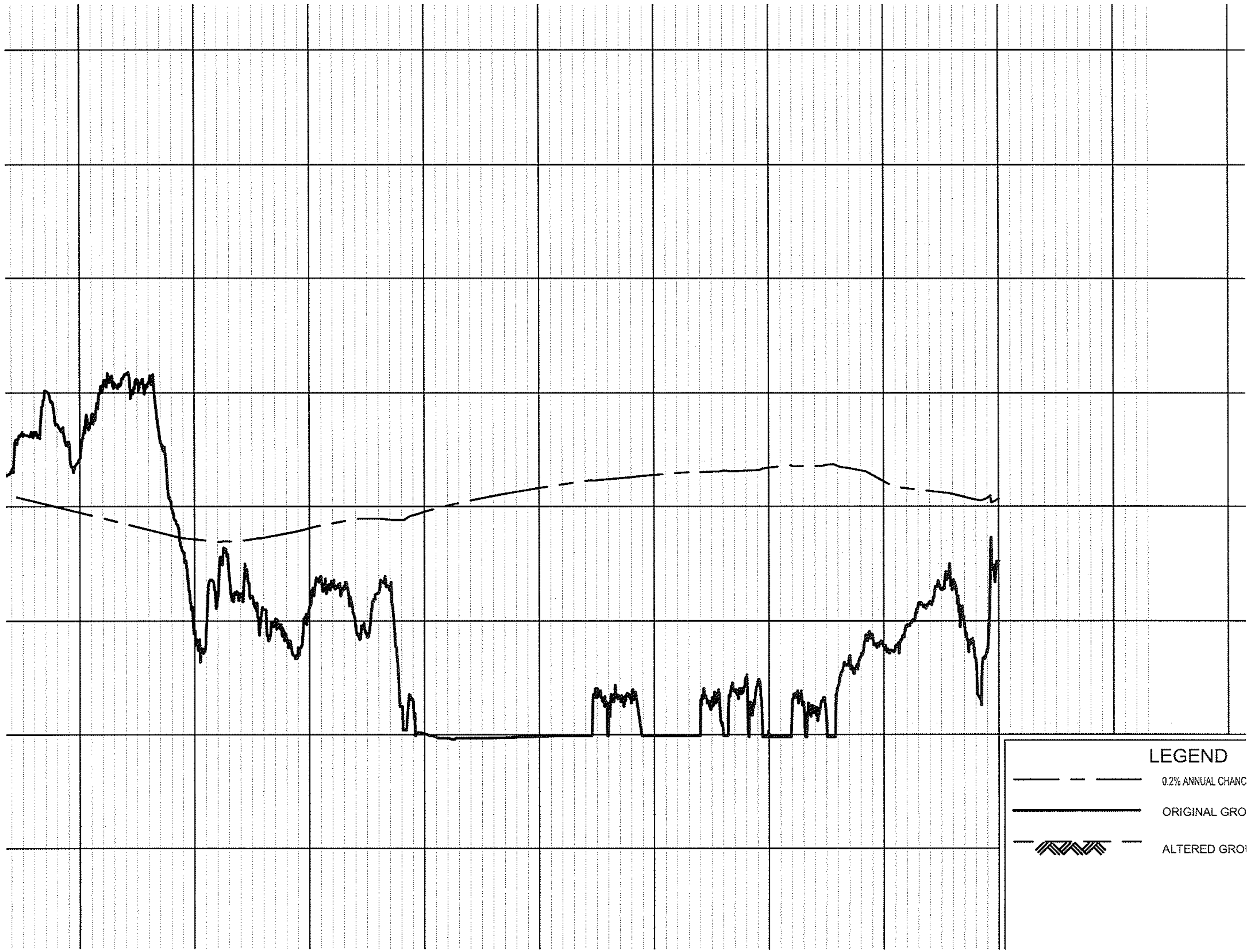
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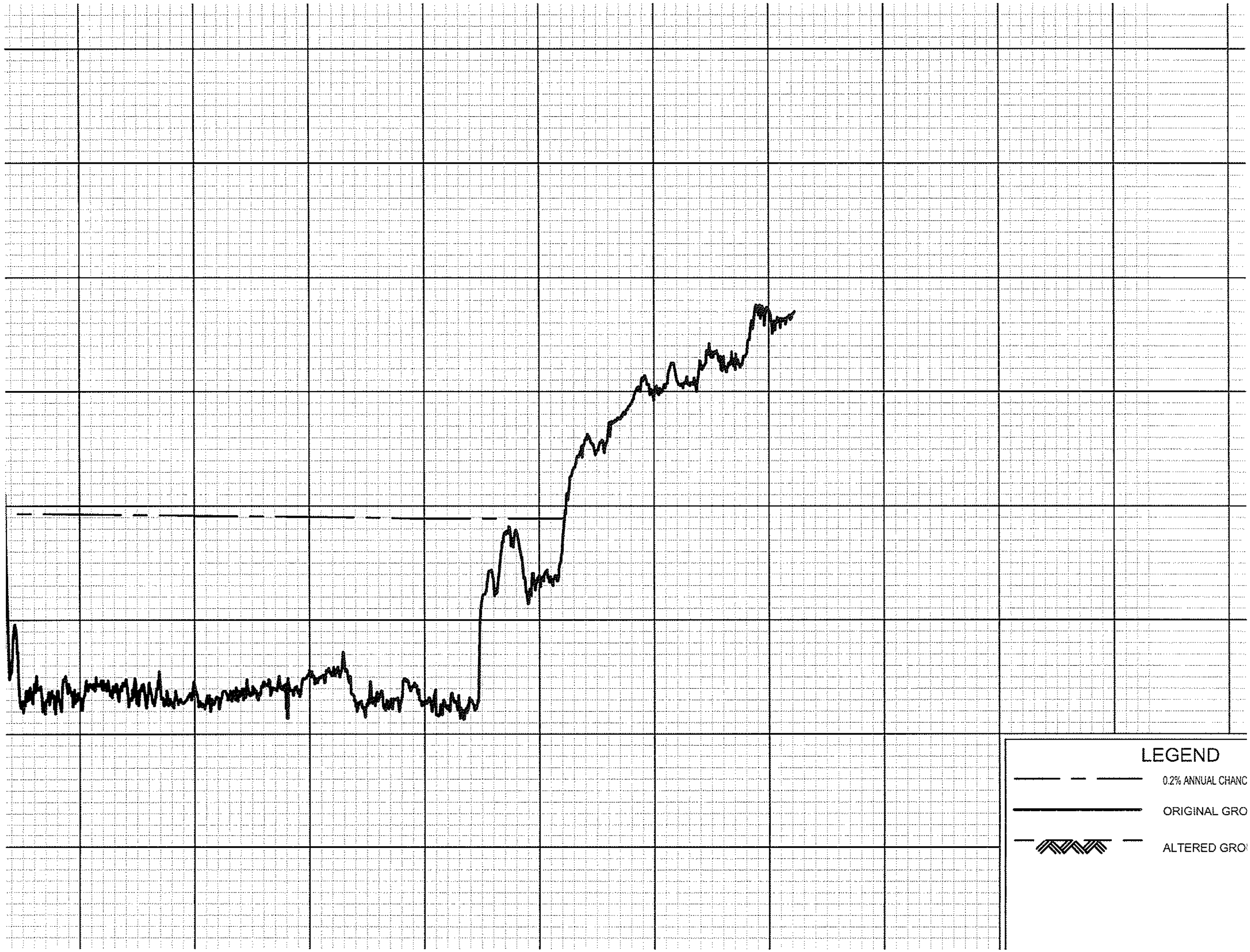
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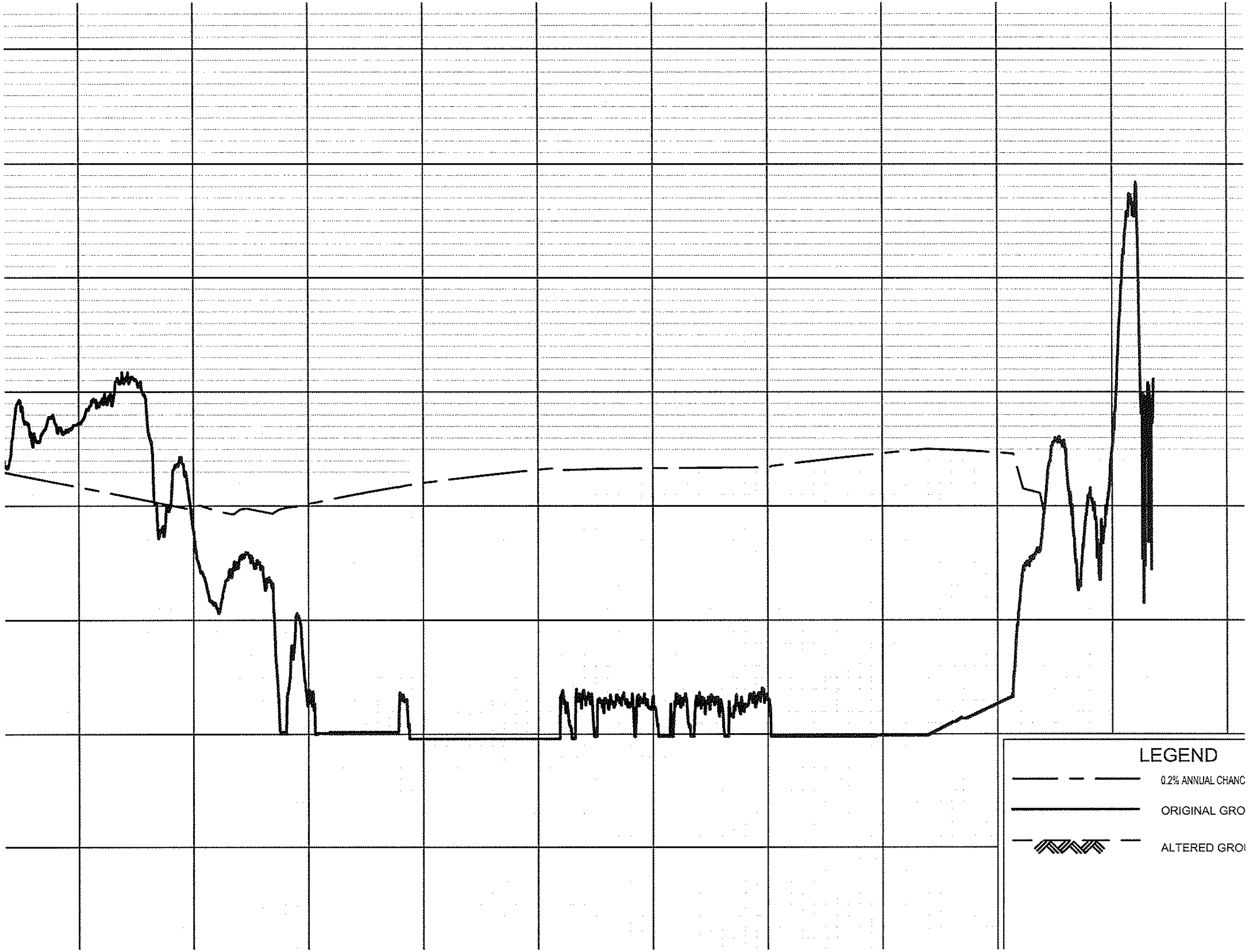

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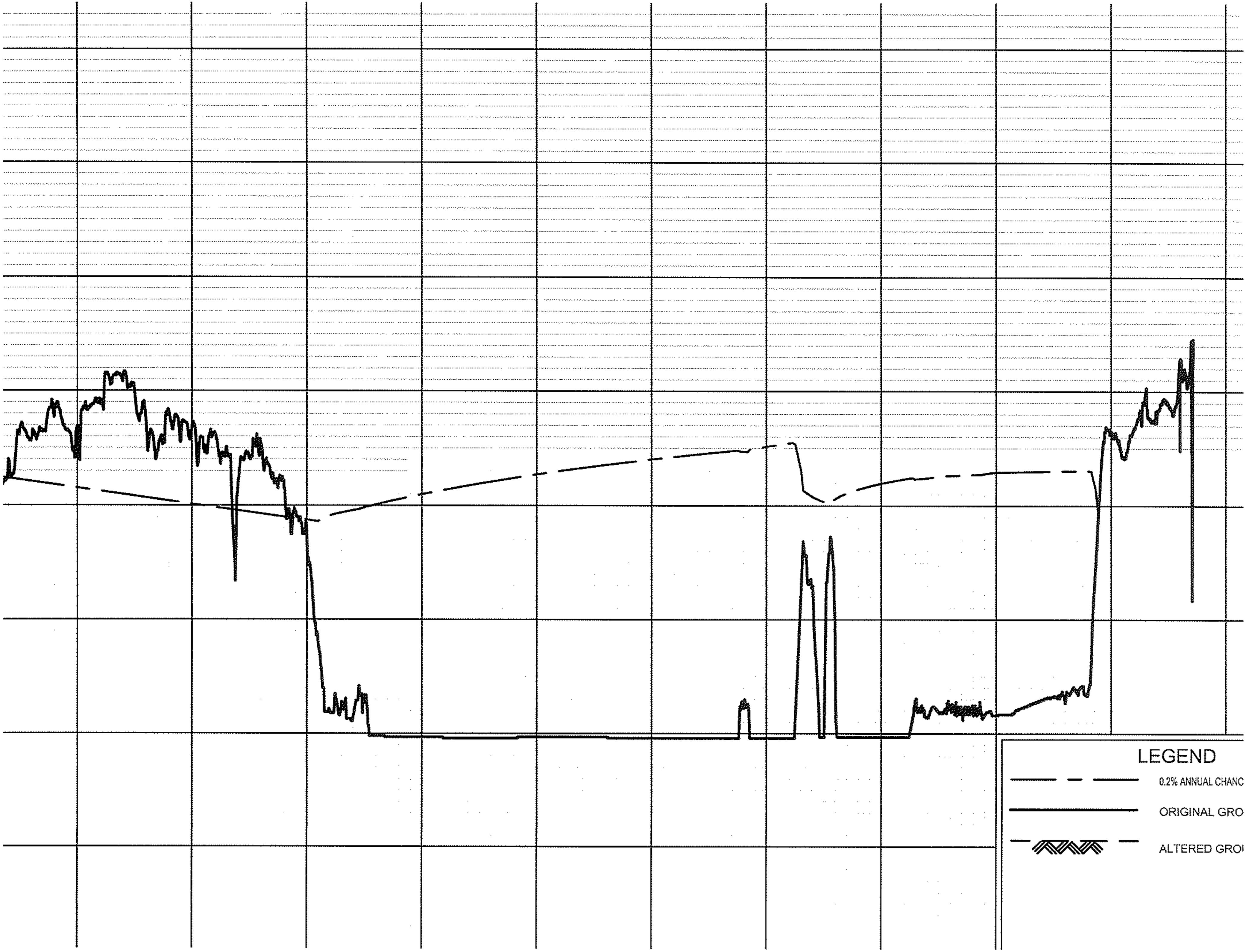

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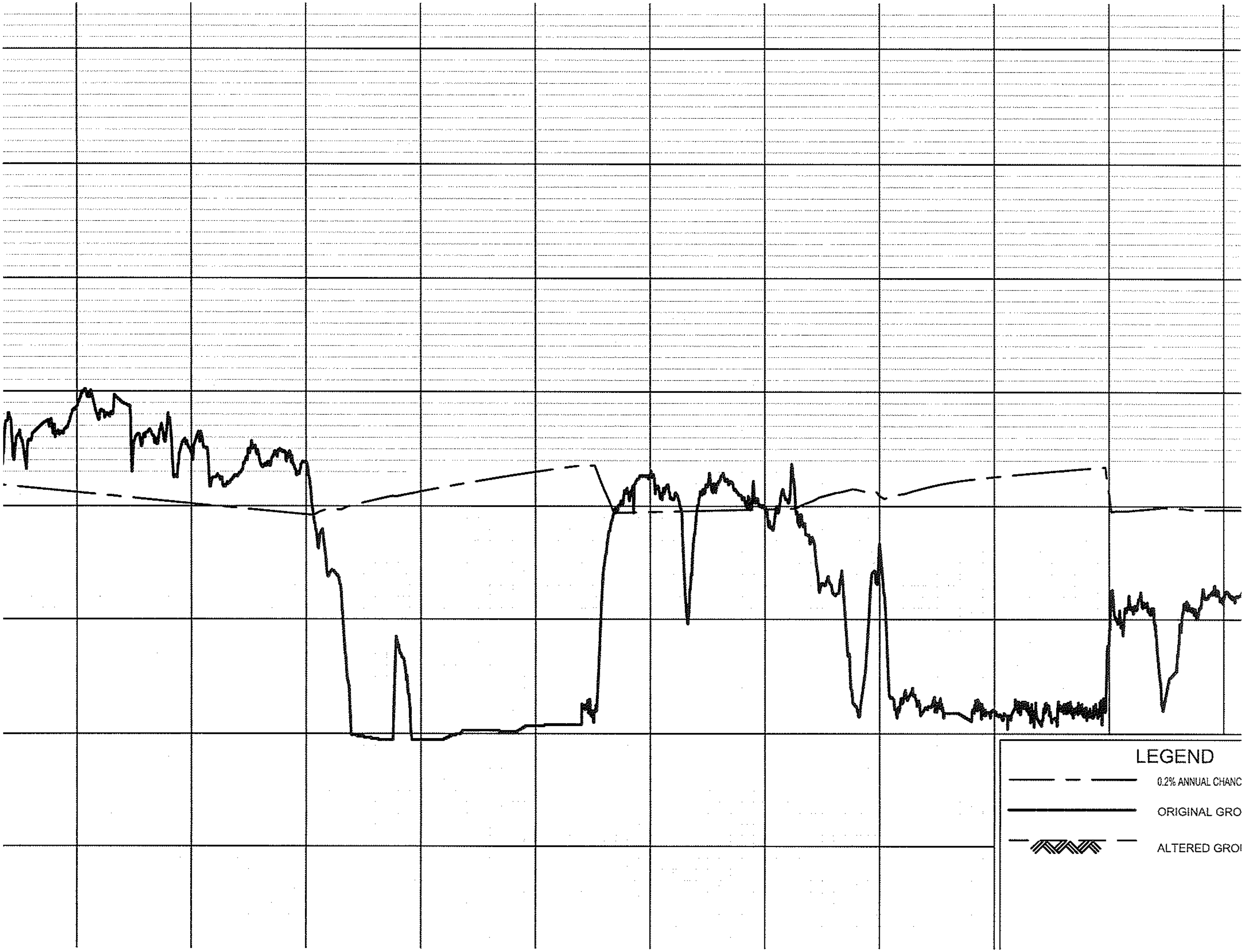
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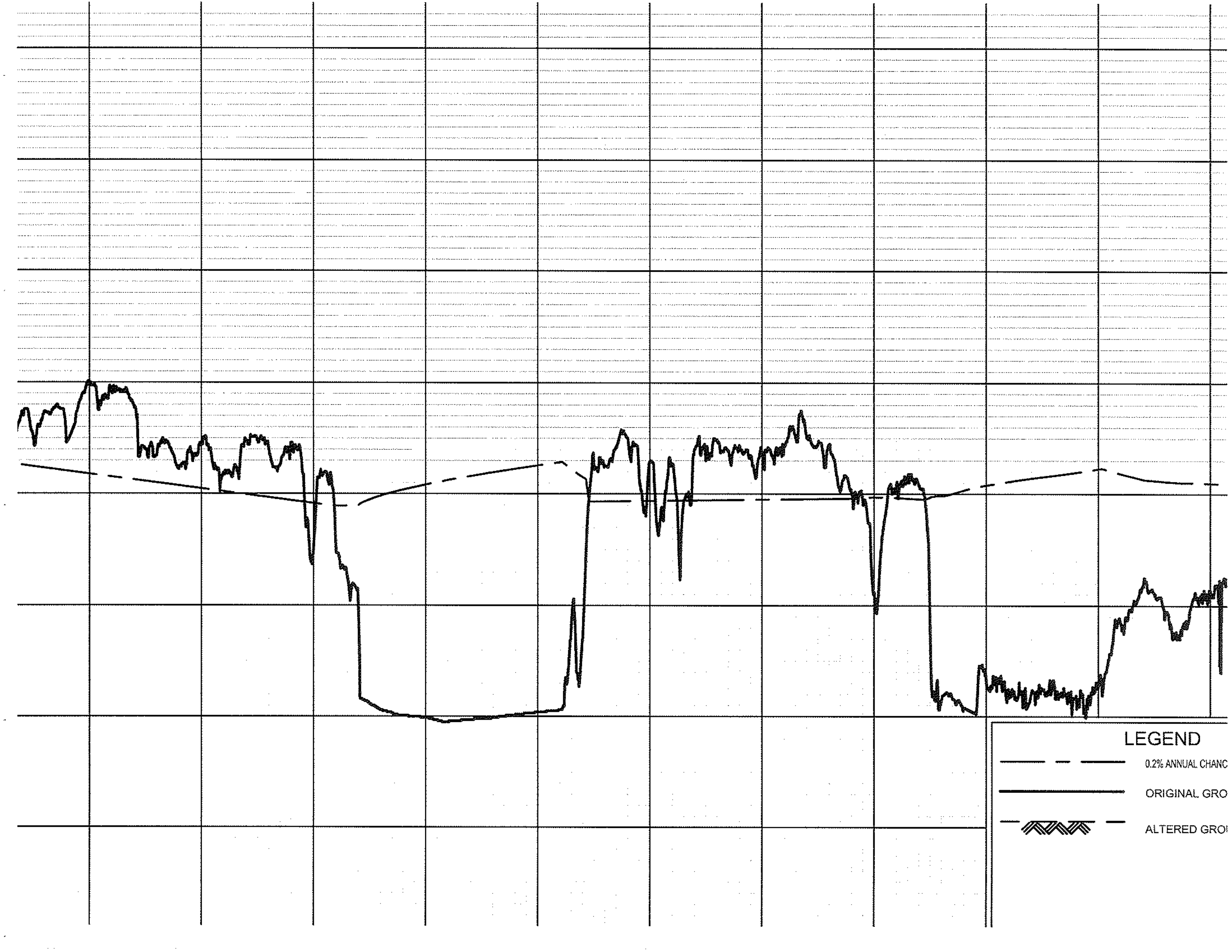
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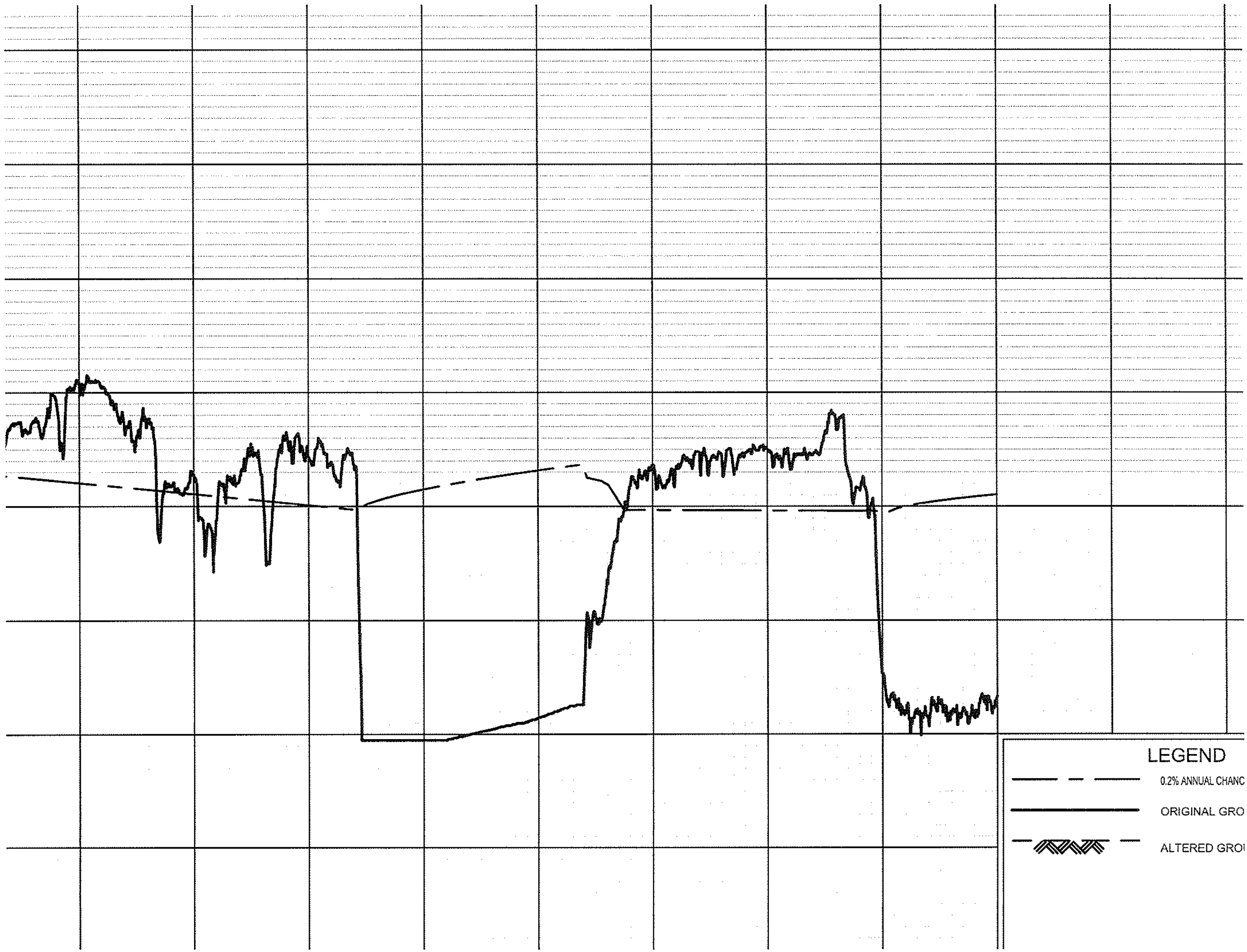
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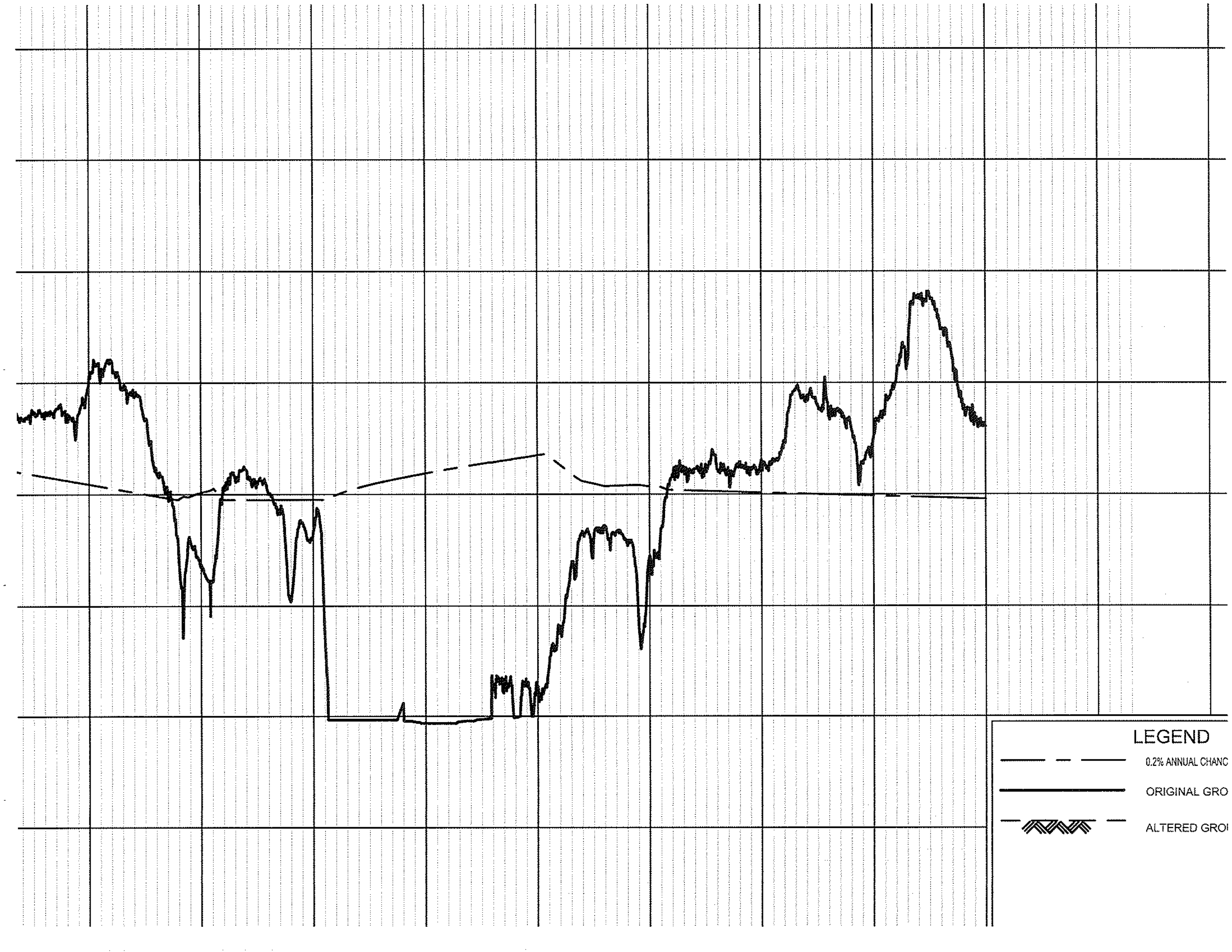

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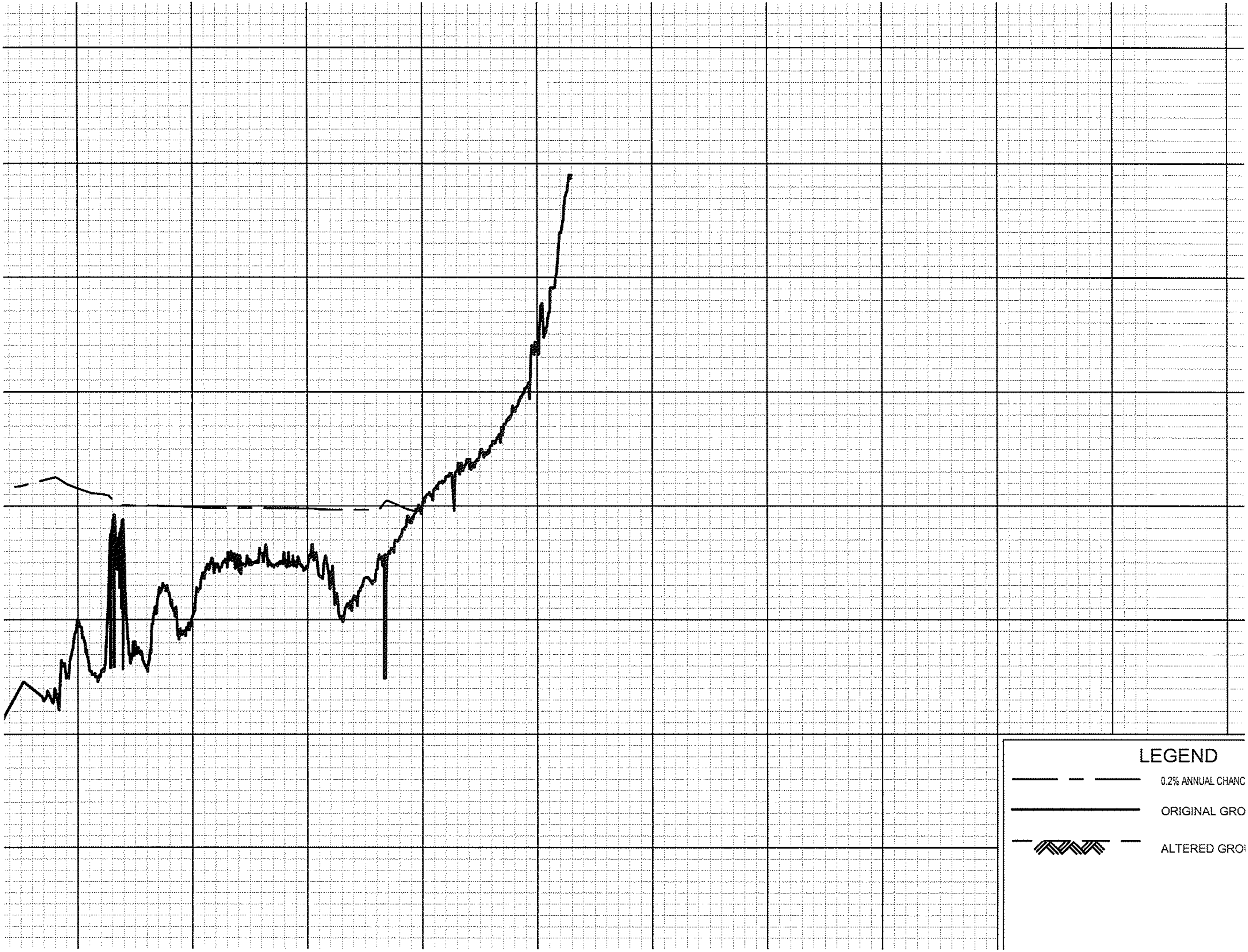
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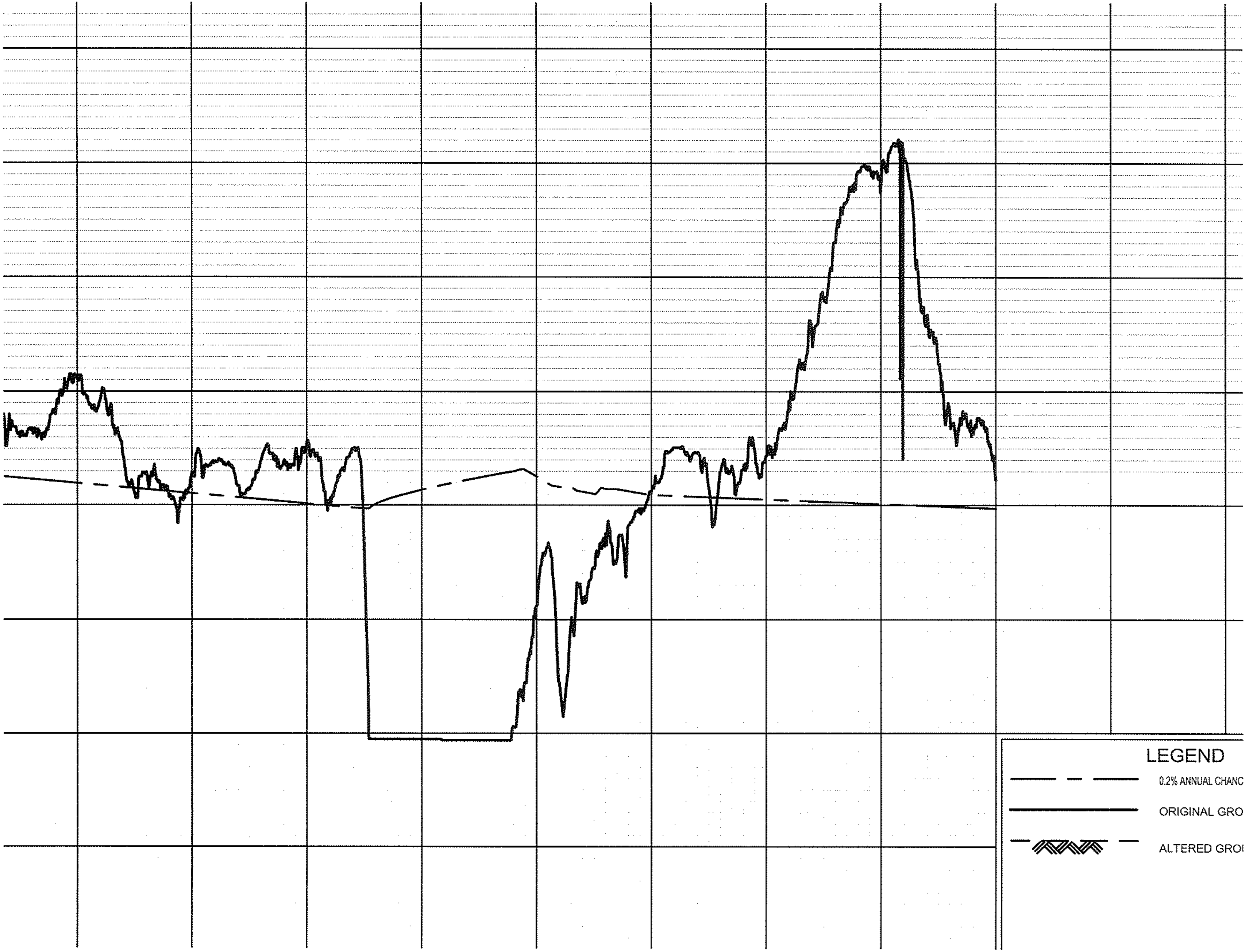
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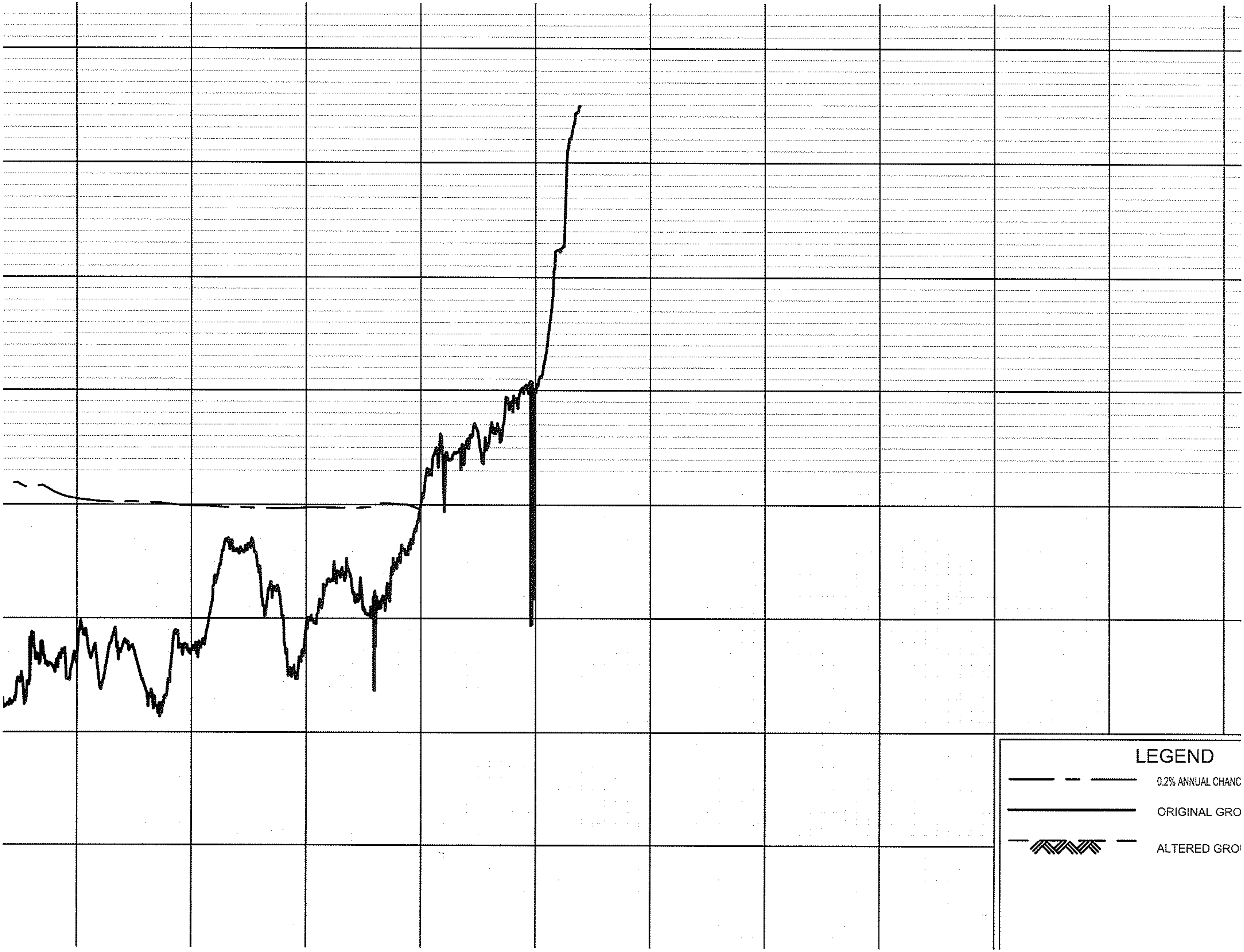

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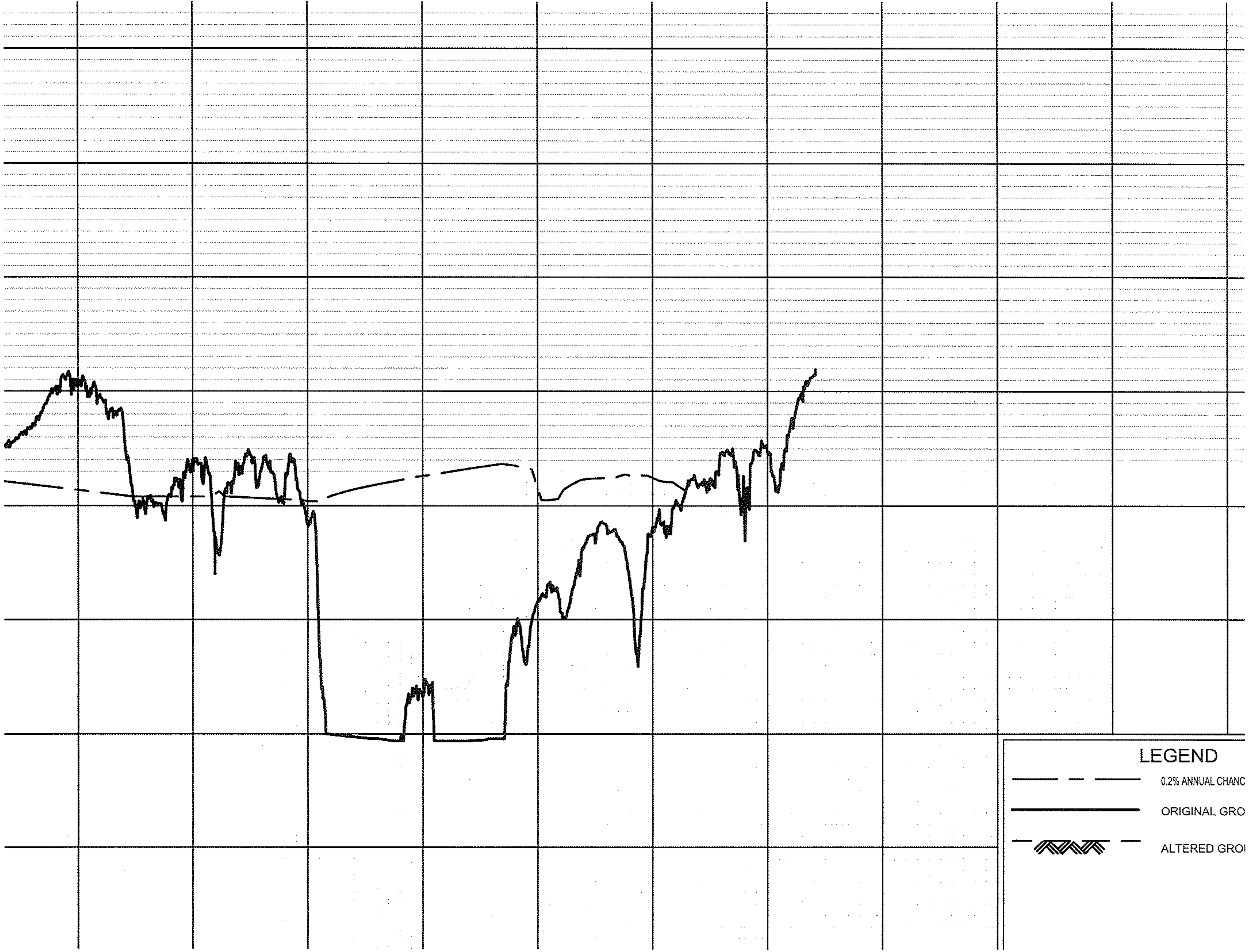
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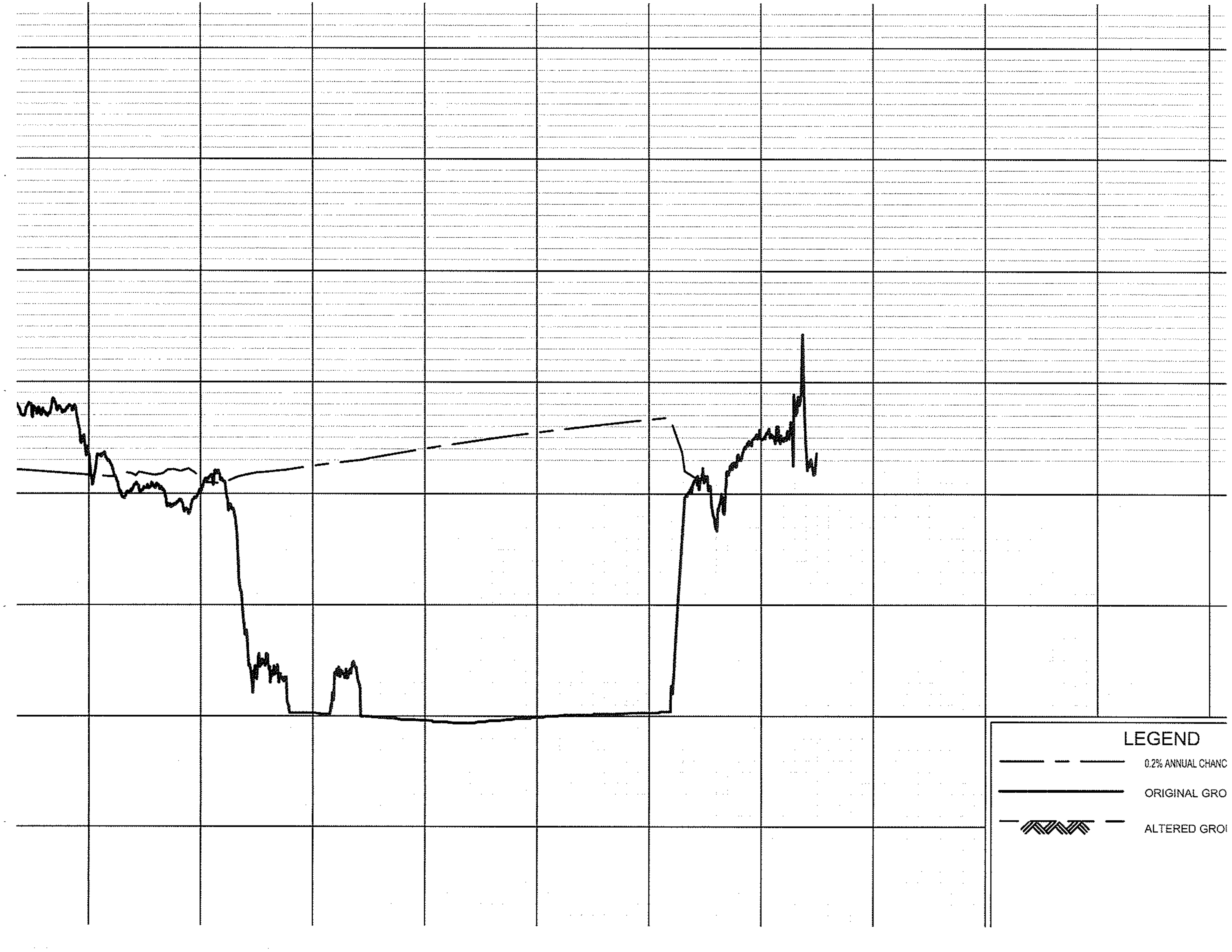
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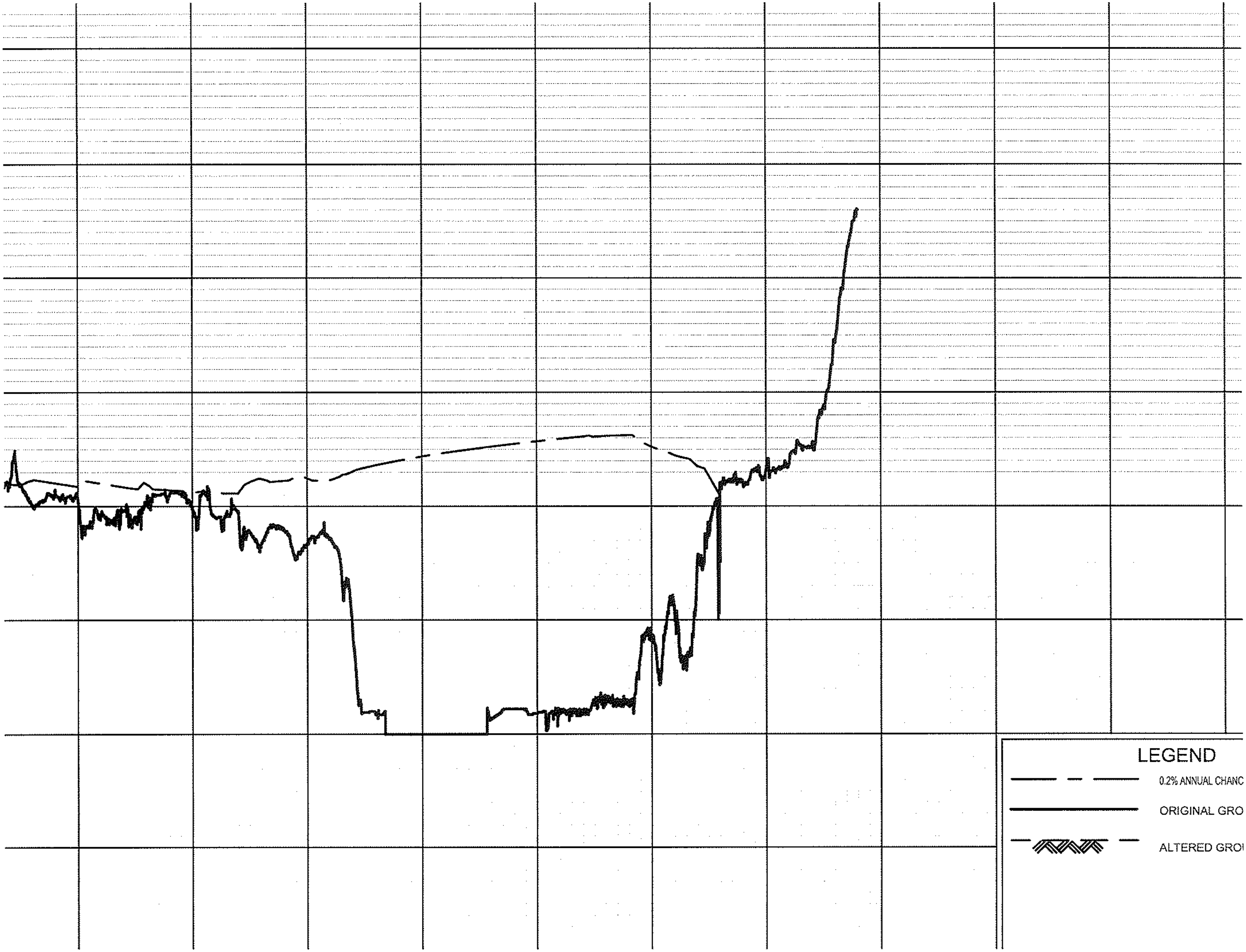

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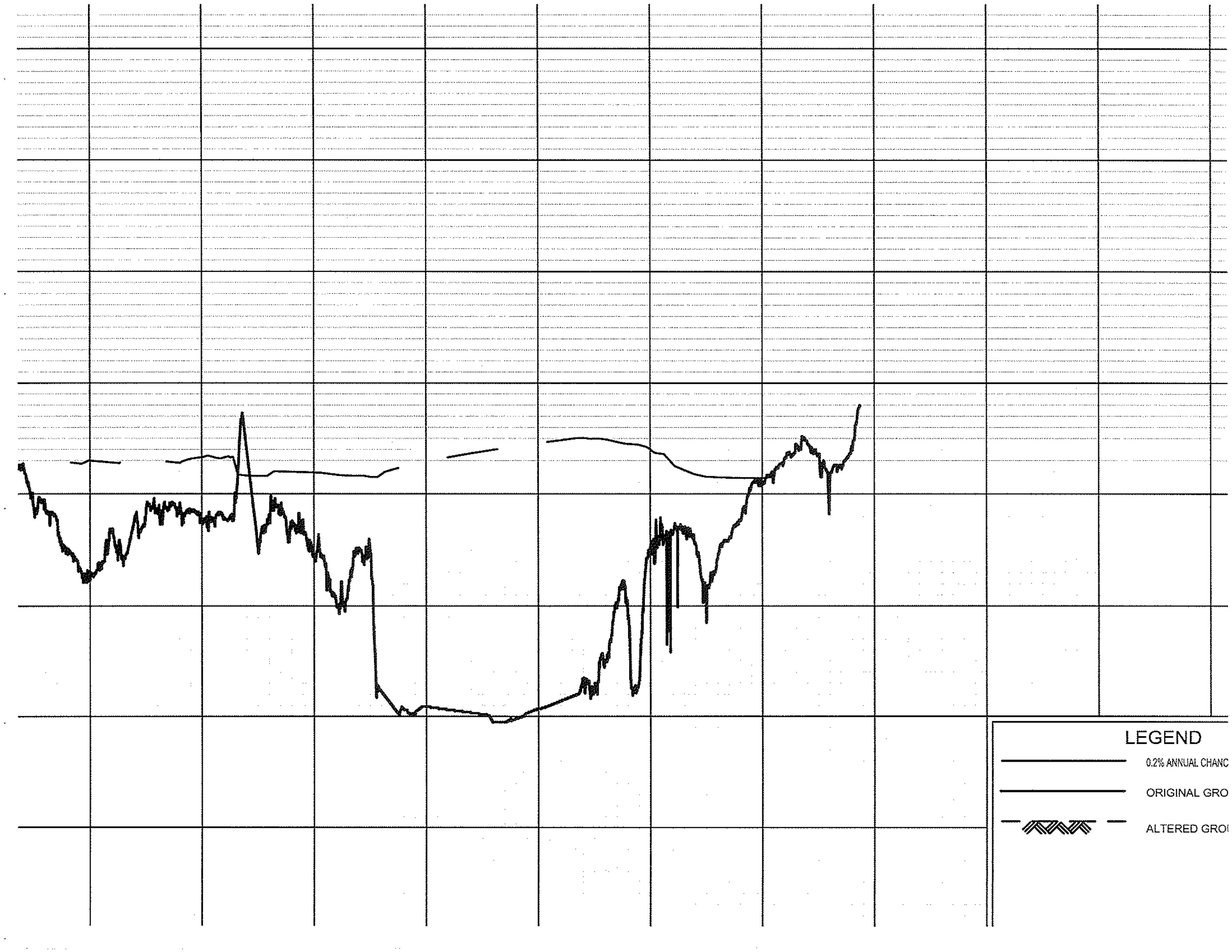
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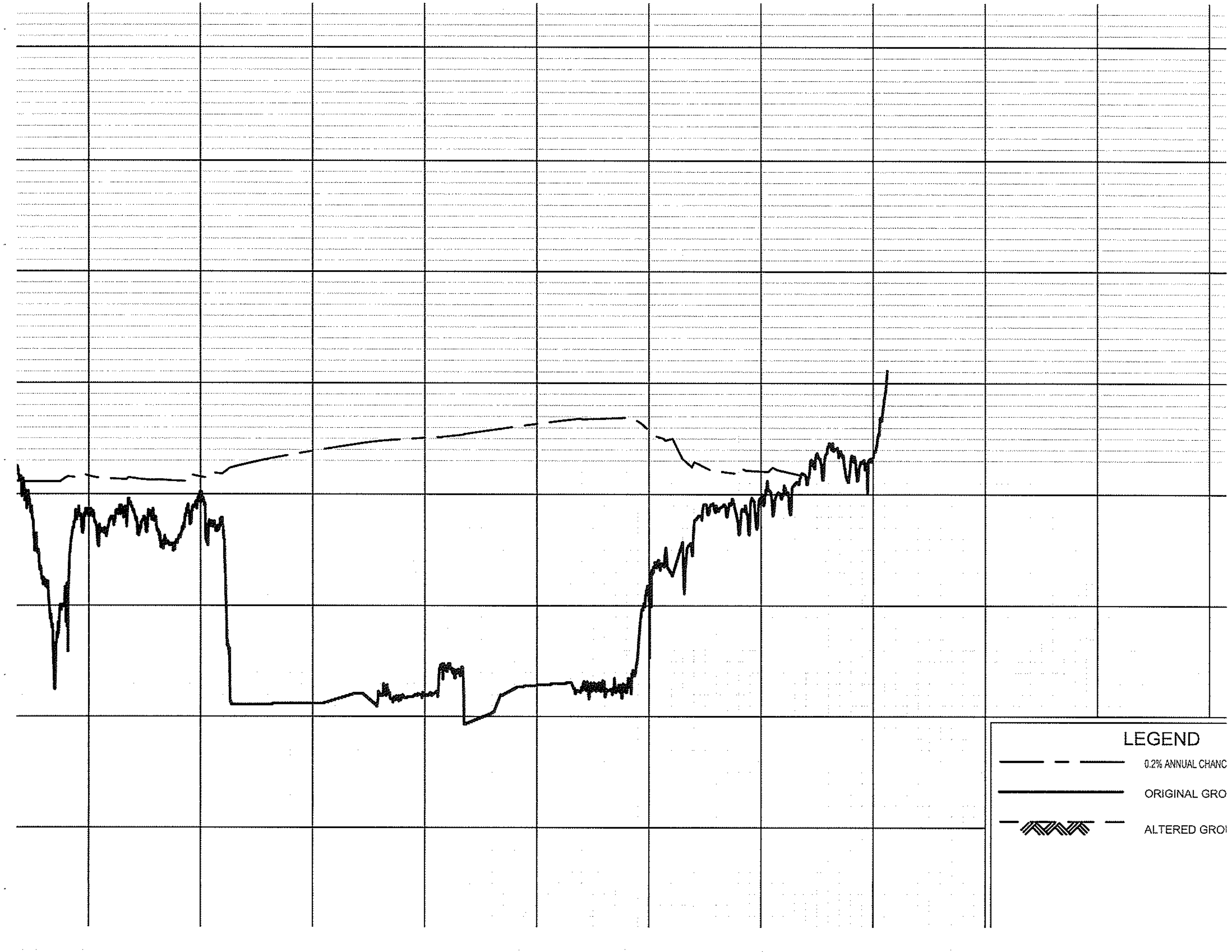
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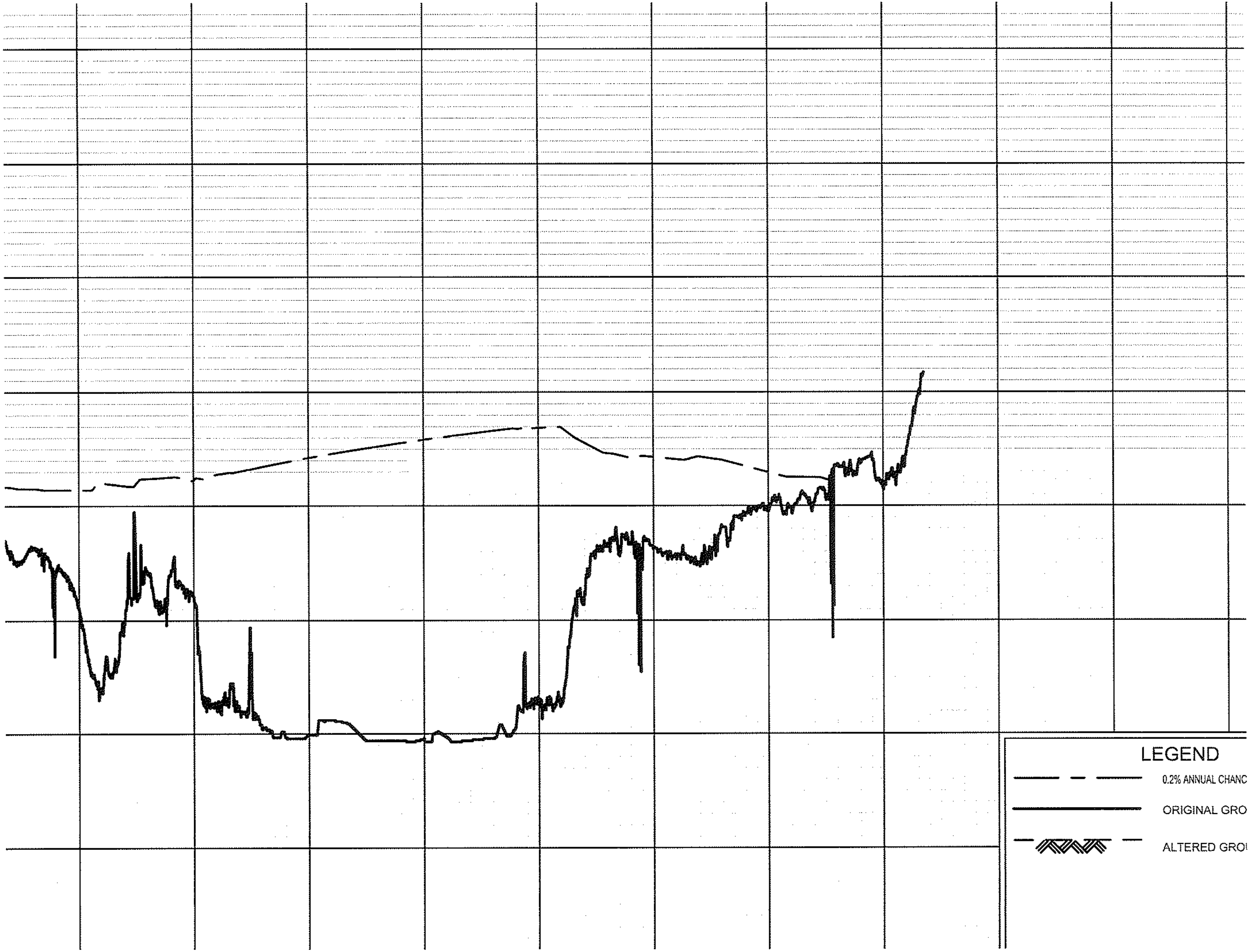
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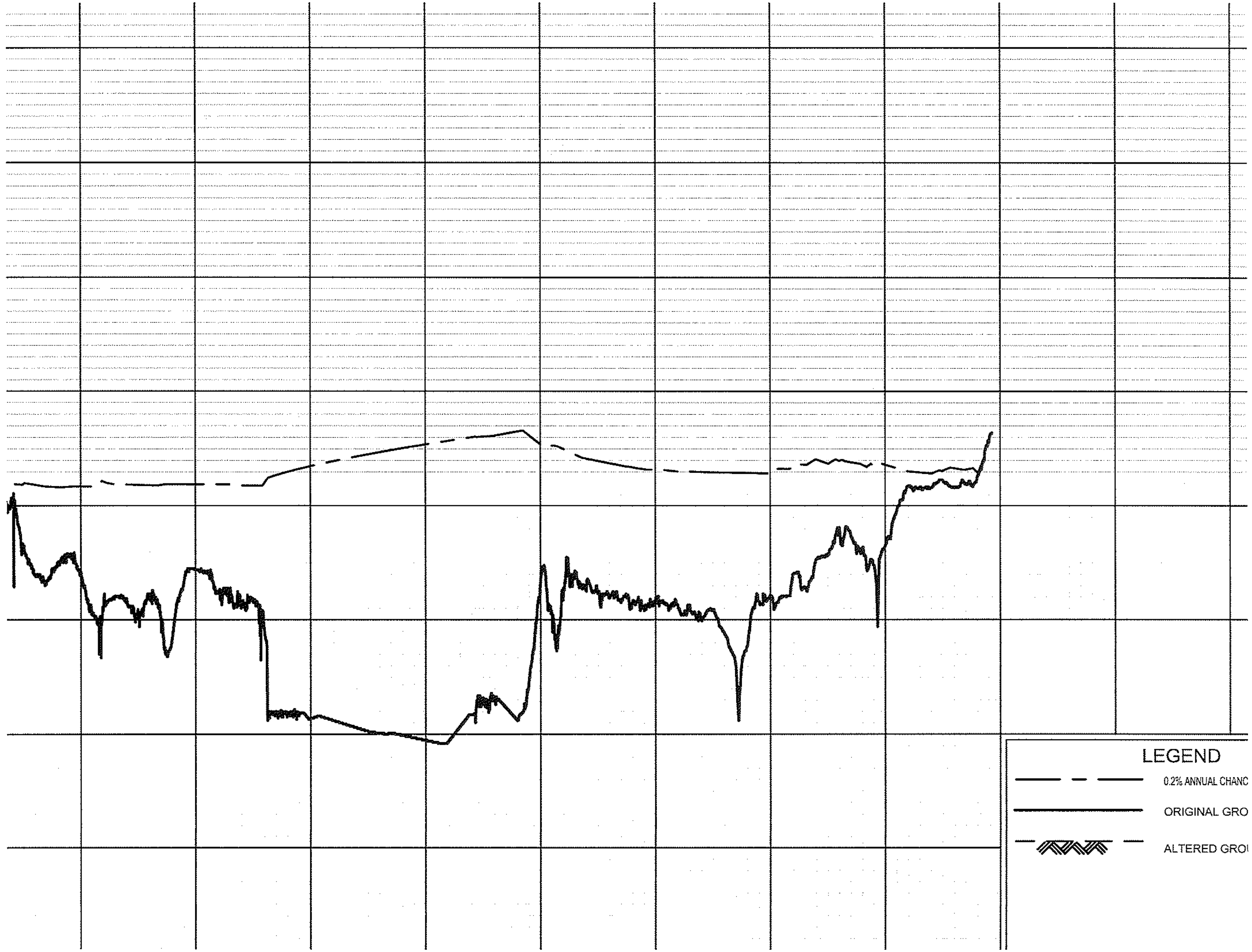
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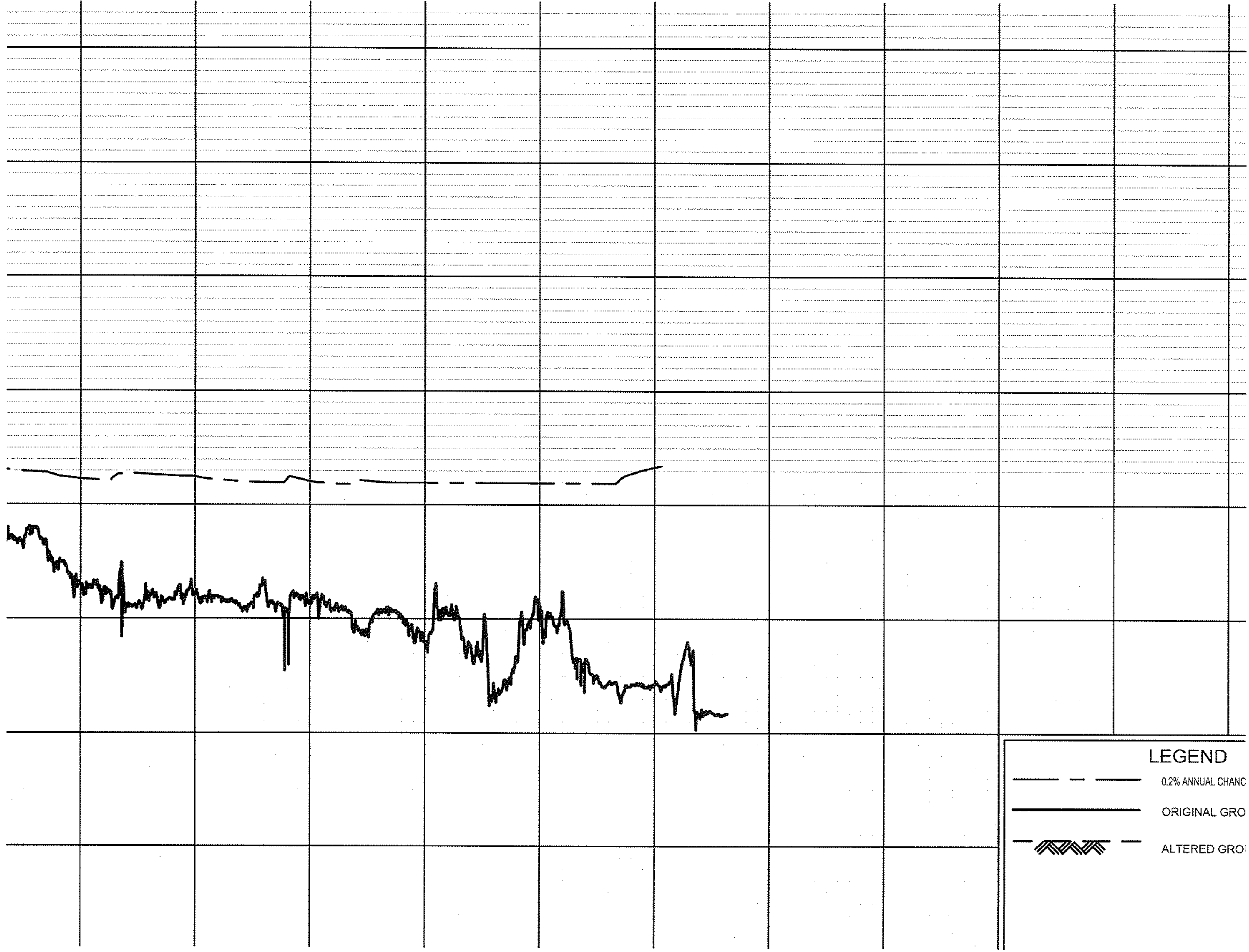

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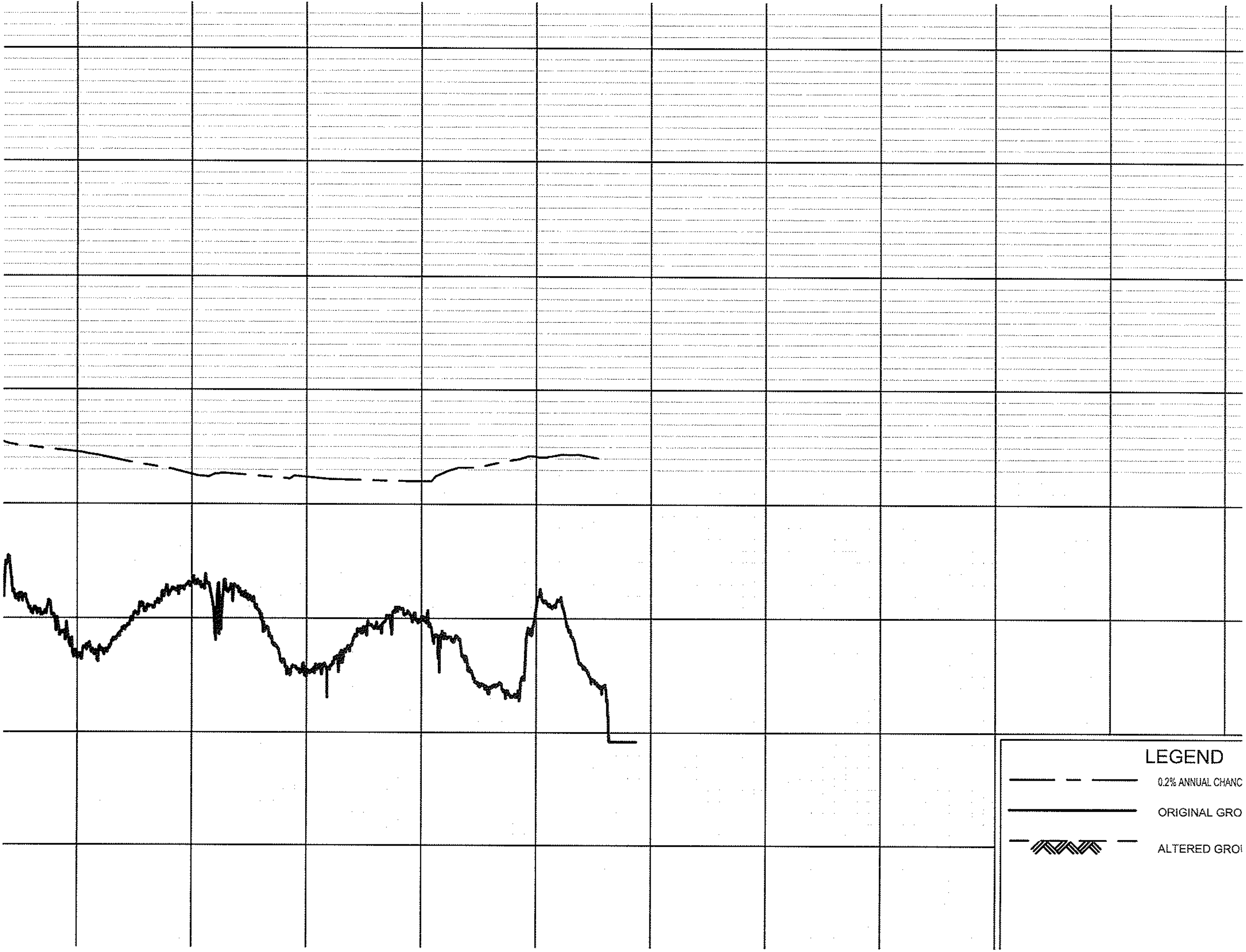

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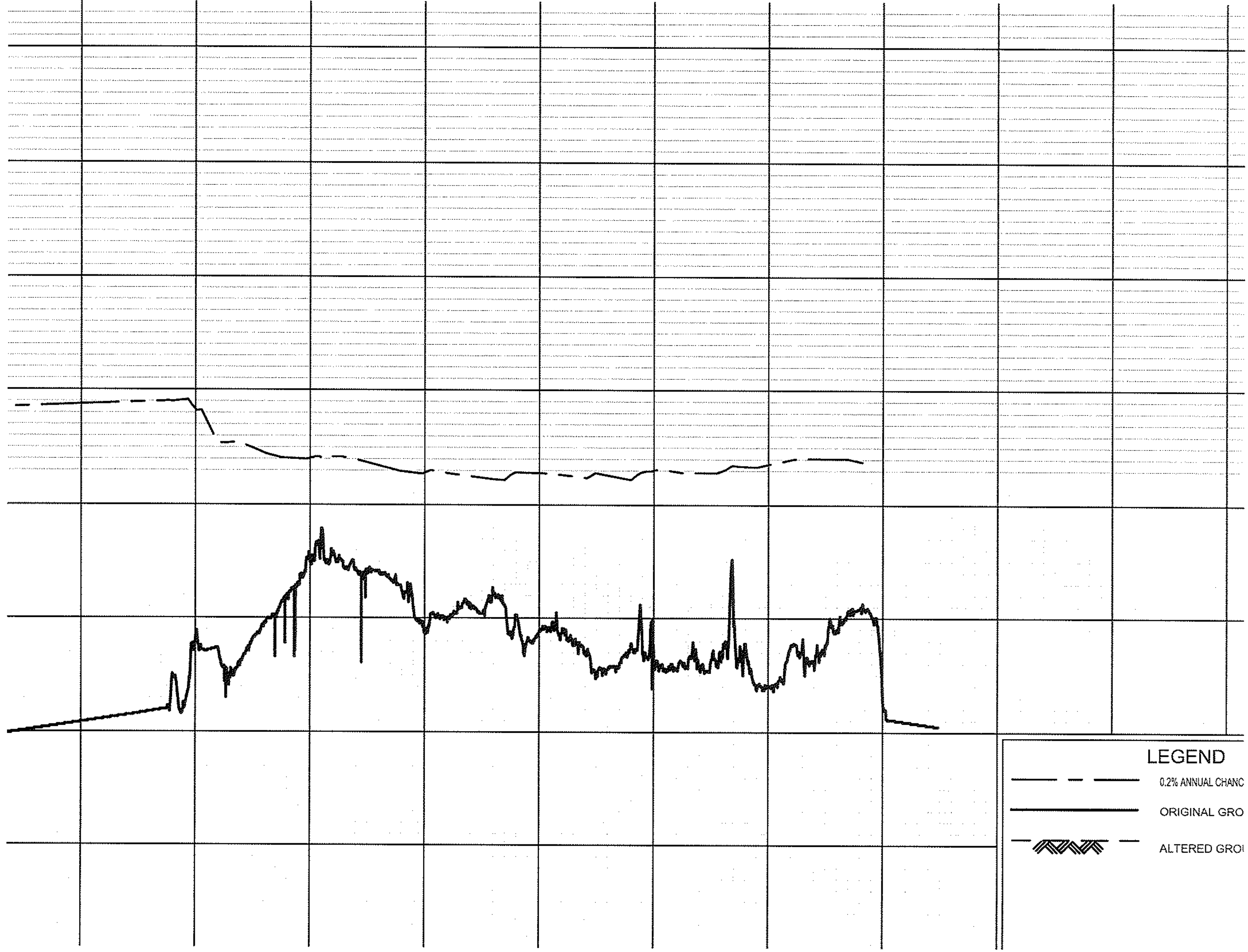
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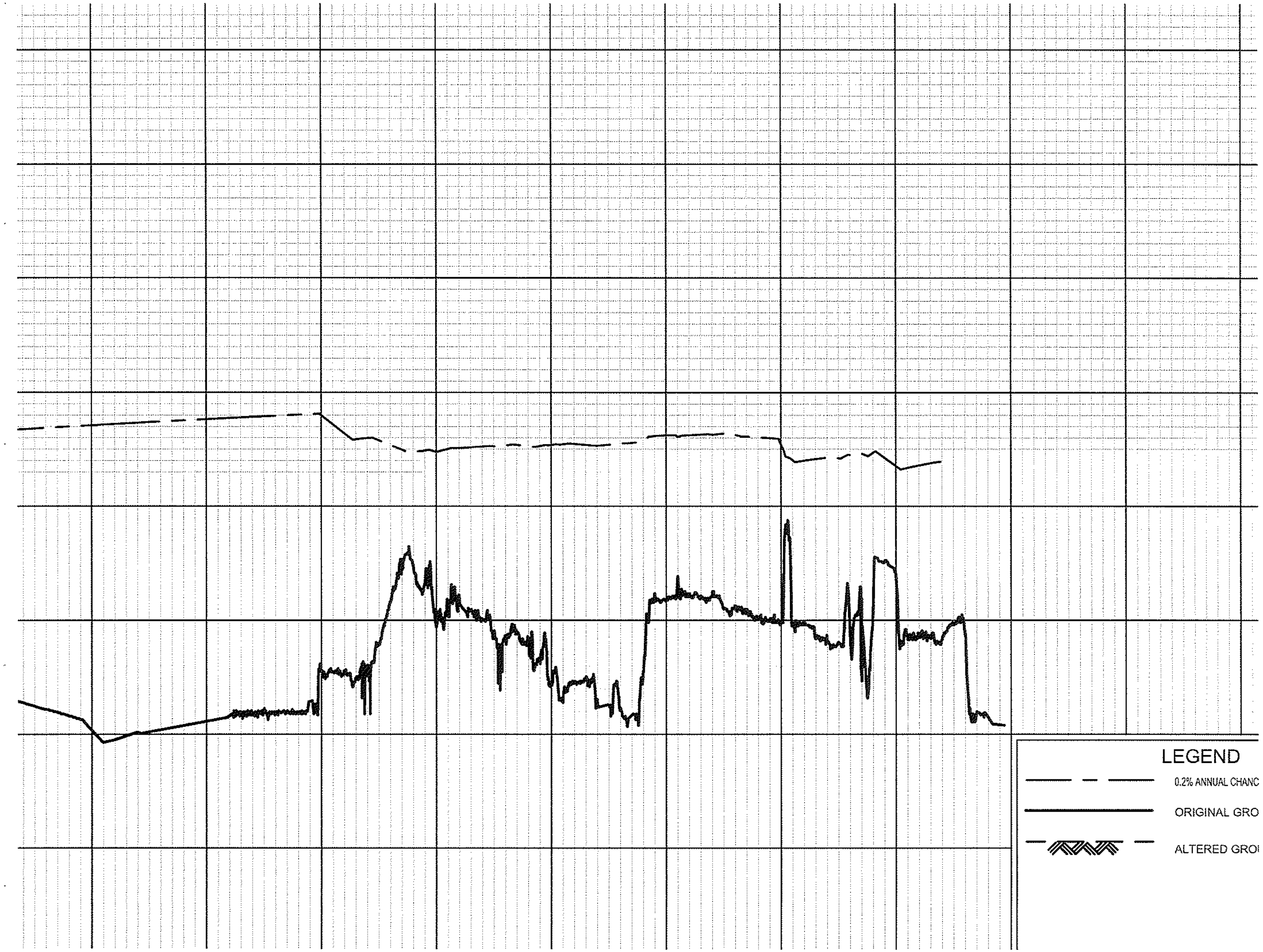
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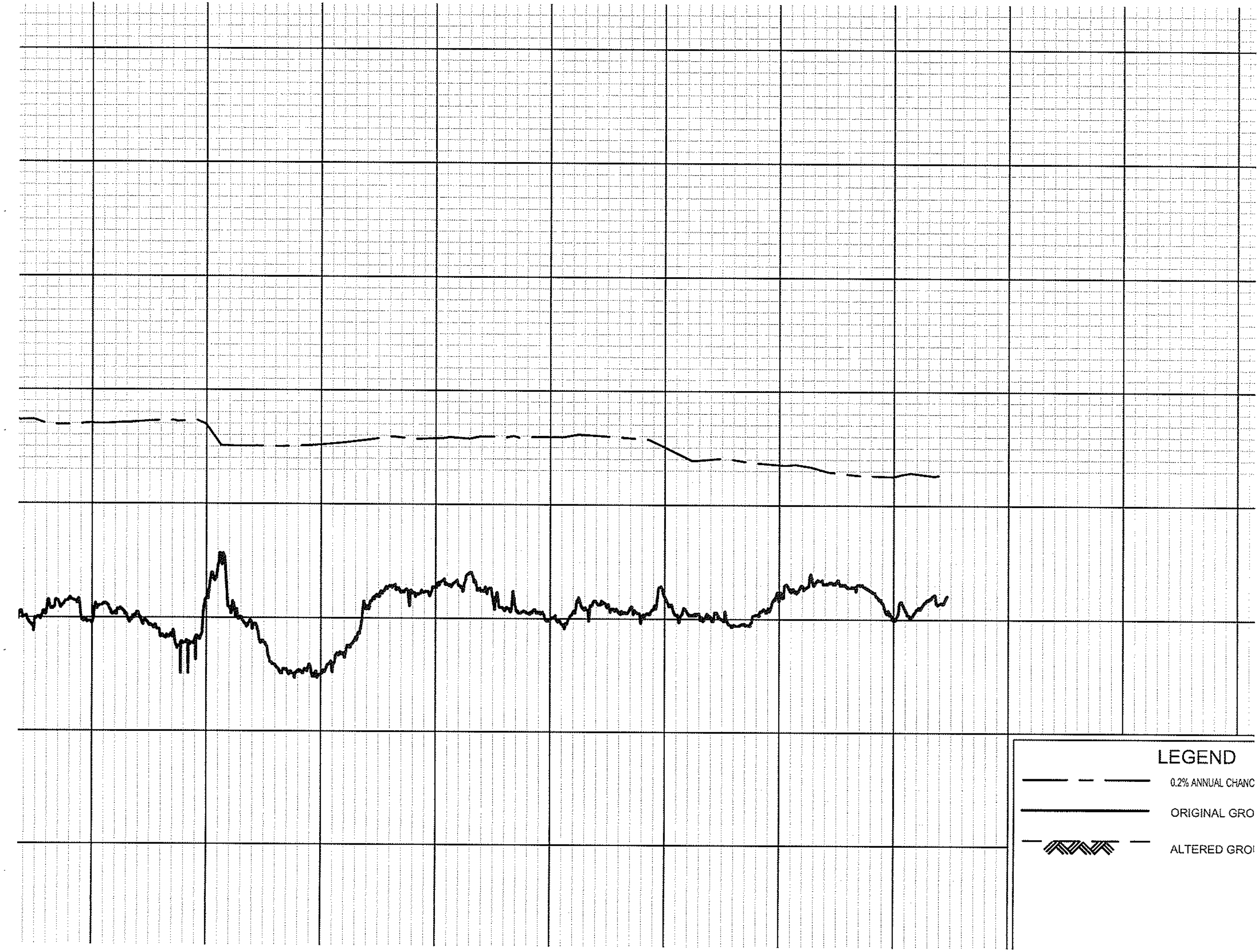
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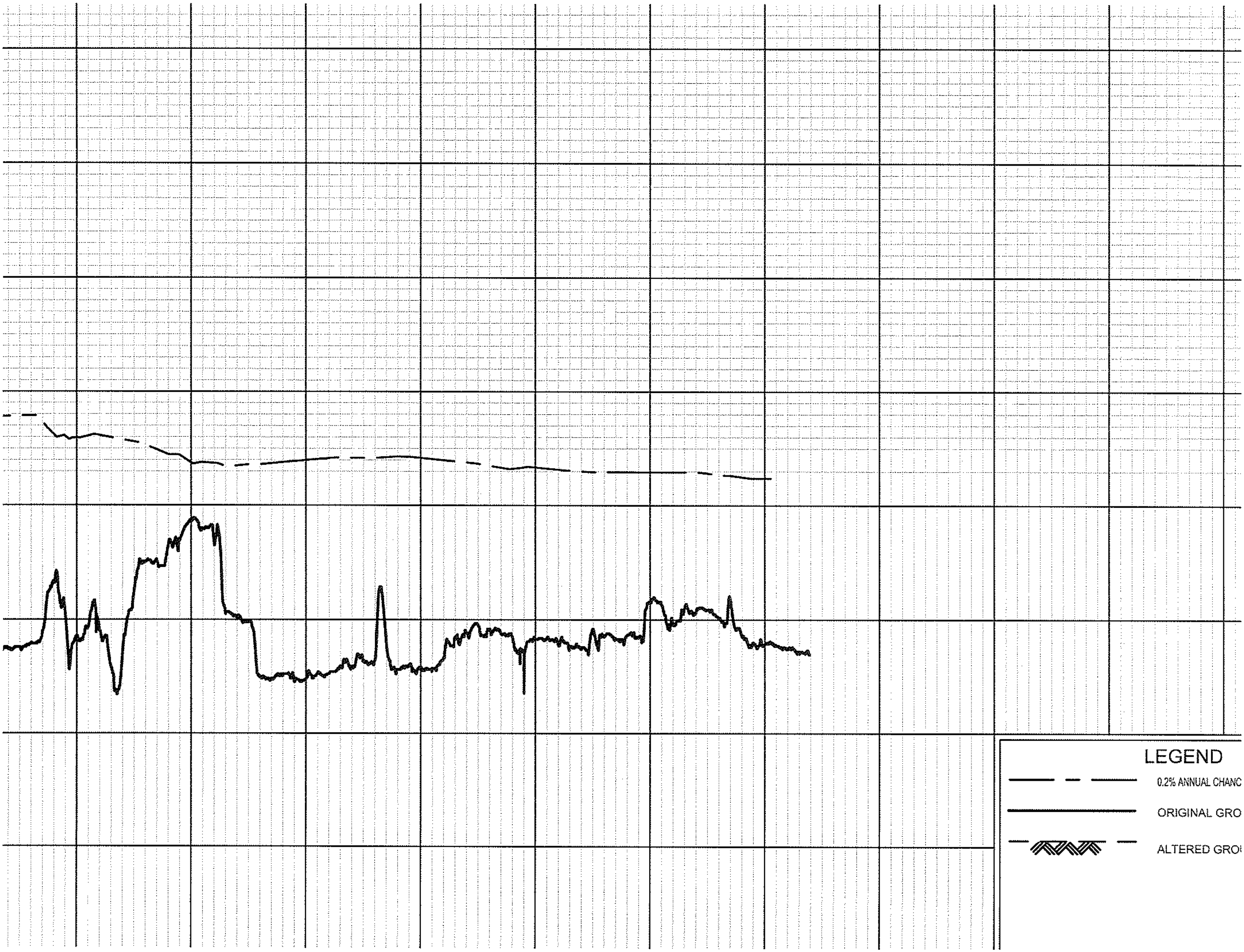
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APPENDIX 4
ANNOTATED FIS DATA

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Tchoutacabouffa River								
A	4,100[1]	1,226	10,326	3.0	*	3.7[3]	4.7	1.0
B	14,900[1]	1,000	8,960	3.5	*	5.7[3]	6.6	0.9
C	21,764[1]	1147	11741	2.7	*	7.0[3]	7.9	0.9
D	25,464[1]	580	11788	2.7	*	7.6[3]	8.5	0.9
E	38,014[1]	384	9312	3.4	*	8.3[3]	9.2	0.9
F	52,464[1]	300	6546	4.8	13.9	11.1[3]	11.7	0.6
G	55,914[1]	292	4161	7.5	13.9	11.9[3]	12.6	0.7
H	71,514[1]	108	1408	11.2	15.2	14.6[3]	15.6	1.0
I	107,264[1]	204	3057	4.3	37.1	37.1	38.1	1.0
Turkey Creek								
A	2,680[2]	~~297~~ 186	~~2,053~~ 1481	~~2.8~~ 5.0	*	~~9.5~~[3] 7.8[3]	~~10.3~~ 7.8	~~0.8~~ 0.0
B	7,730[2]	~~435~~ 448	~~3,452~~ 2920	~~1.7~~ 2.0	14.2	~~11.4~~[3] 11.0[3]	~~12.4~~ 11.9	~~1.0~~ 0.9
C	10,430[2]	495	4,186	1.4	14.2	12.2[3]	13.2	1.0
D	12,830[2]	200	1,398	3.9	14.6	13.2[3]	14.2	1.0
E	13,530[2]	263	2,671	2.1	14.8	13.9[3]	14.8	0.9
F	14,570[2]	735	5,821	0.9	15.4	14.4[3]	15.4	1.0
G	21,430[2]	129	898	5.4	16.6	16.3[3]	17.2	0.9
H	25,230[2]	500	3,111	1.6	20.4	20.3[3]	21.3	1.0
I	28,330[2]	1,006	4,362	1.1	21.7	21.7	22.6	0.9
J	31,685[2]	798	1,770	2.6	24.9	24.9	25.8	0.9

[1] Feet above confluence with Biloxi River
[2] Feet above confluence with Bernard Bayou
[3] Elevation computed without consideration of storm surge effects from Back Bay of Biloxi
* BFE determined by coastal storm surge flooding

Annotated FDT based on the proposed project

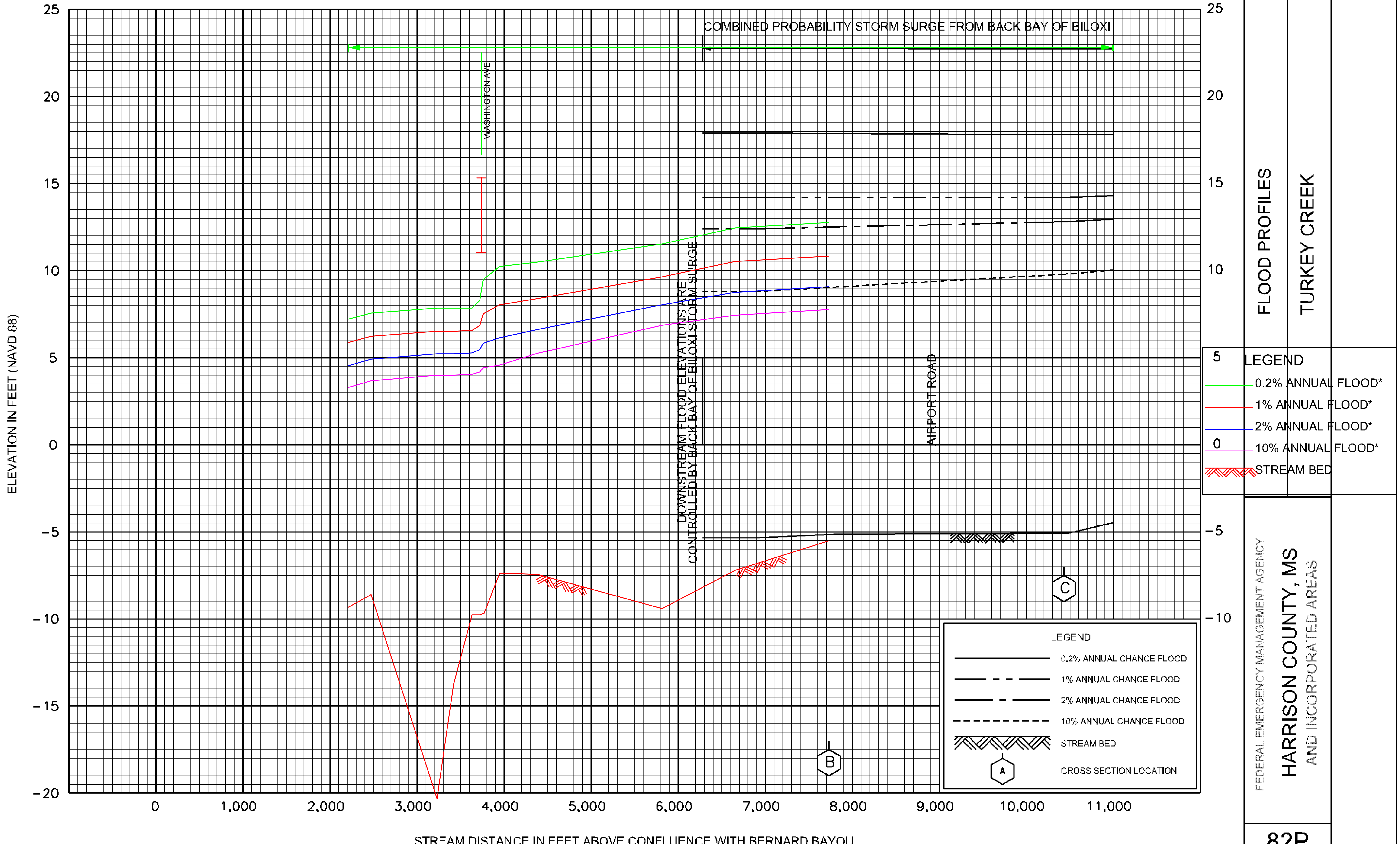
TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
HARRISON COUNTY, MS
AND INCORPORATED AREAS

FLOODWAY DATA

TCHOUTACABOUFFA RIVER - TURKEY CREEK

* Flood profile due to riverine flooding



FLOOD PROFILES

TURKEY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HARRISON COUNTY, MS

AND INCORPORATED AREAS

82P

APPENDIX 5
CORRECTED EFFECTIVE VERSUS PORPOSED BYPASS
(PROFILES AND CROSS SECTIONS)

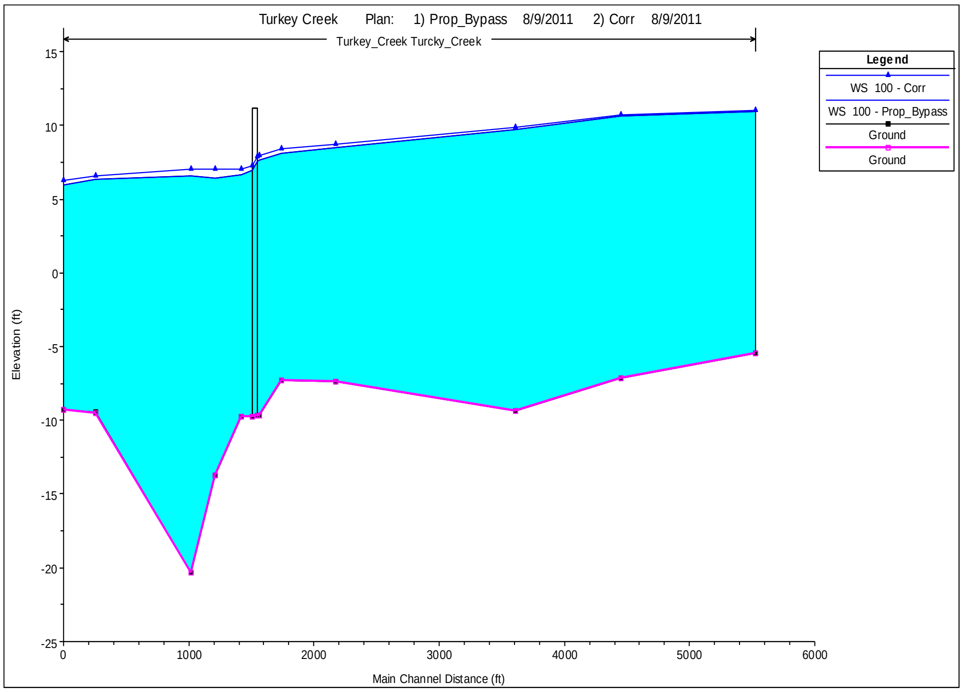


Figure 2: Corrected Effective versus Proposed Bypass (100-yr profile)

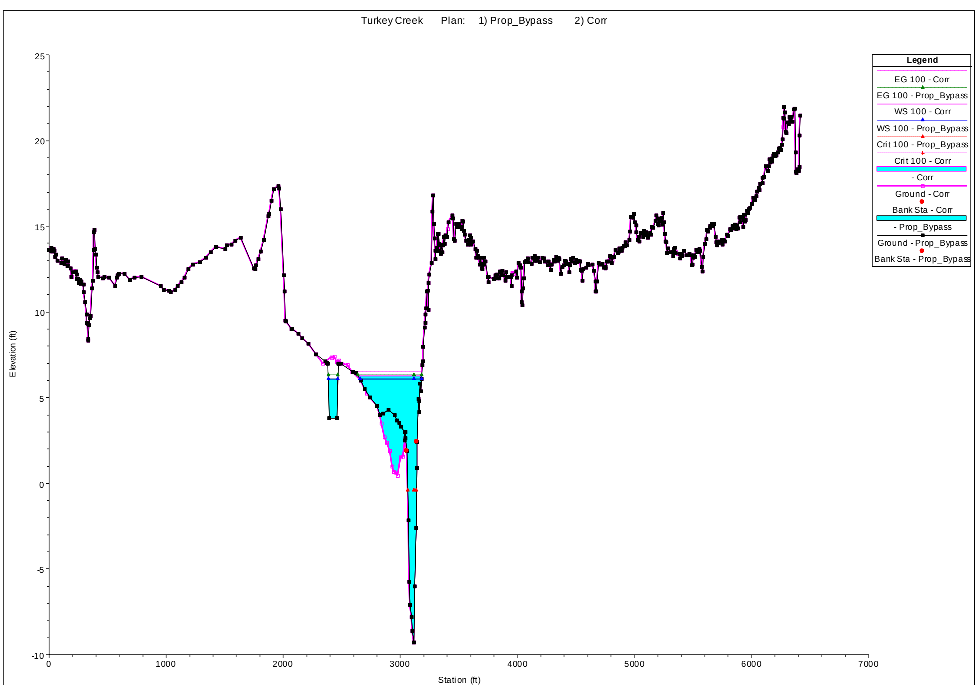


Figure 3: XS 557- Corrected Effective versus Proposed Bypass

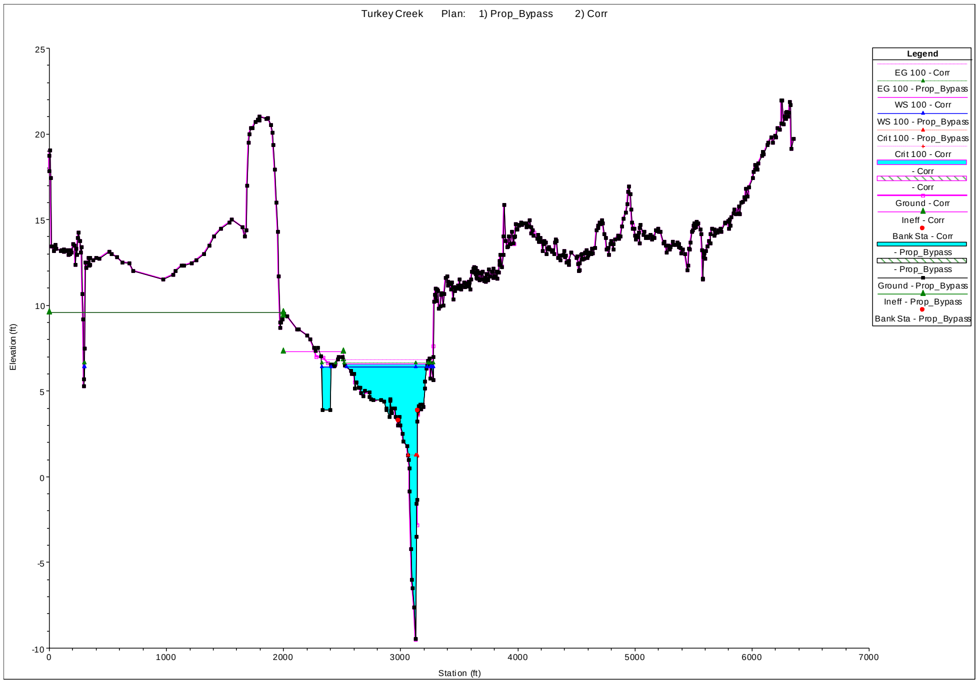


Figure 4: XS 815- Corrected Effective versus Proposed Bypass

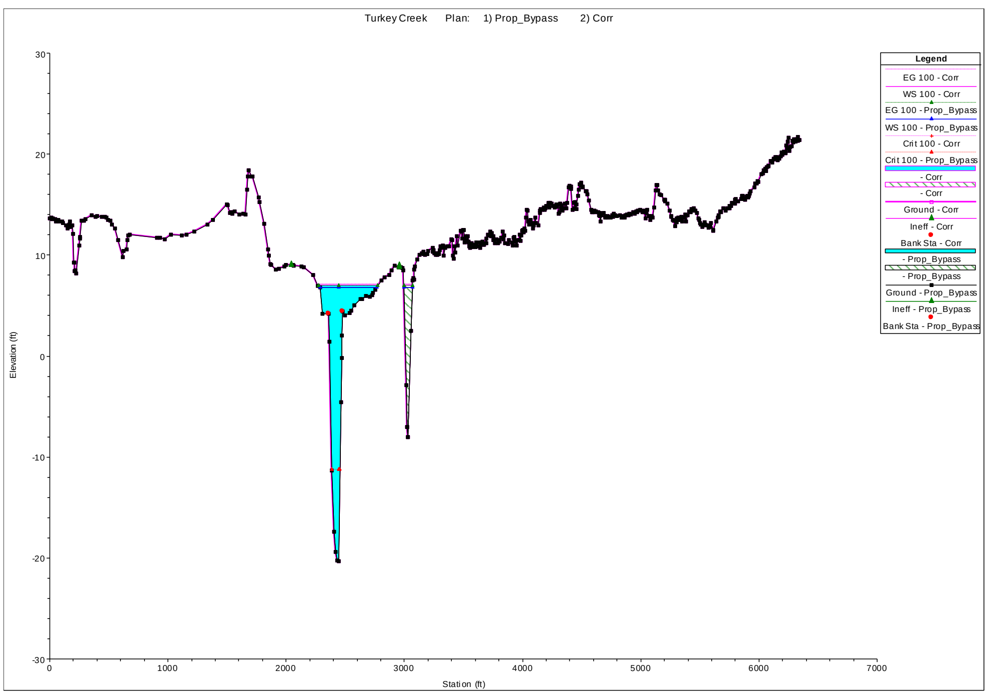


Figure 5: XS 1575- Corrected Effective versus Proposed Bypass

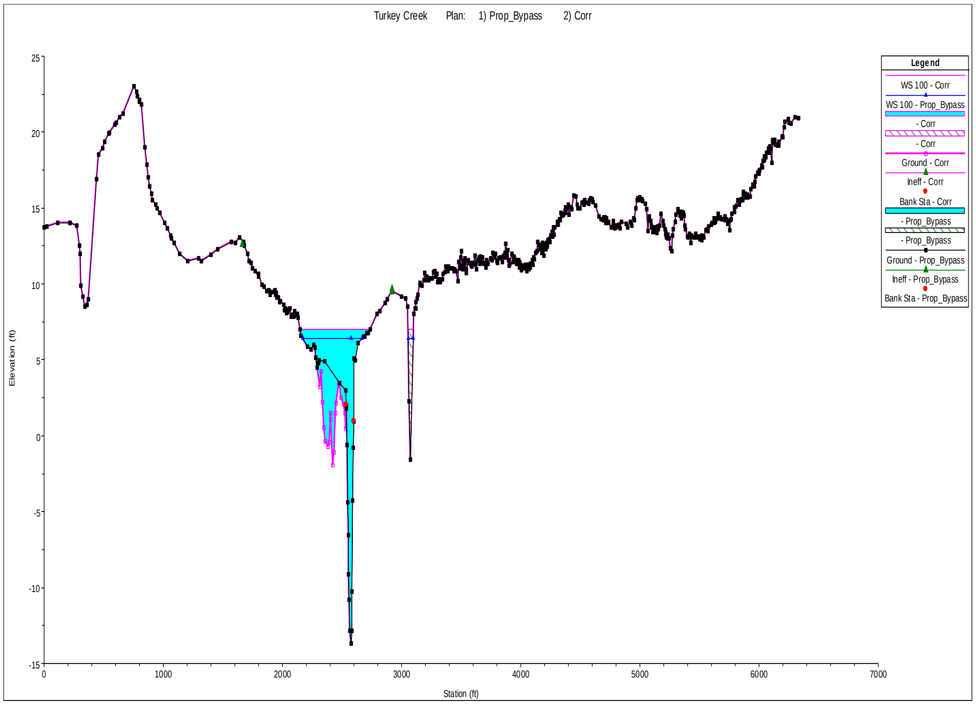


Figure 6: XS 1766- Corrected Effective versus Proposed Bypass

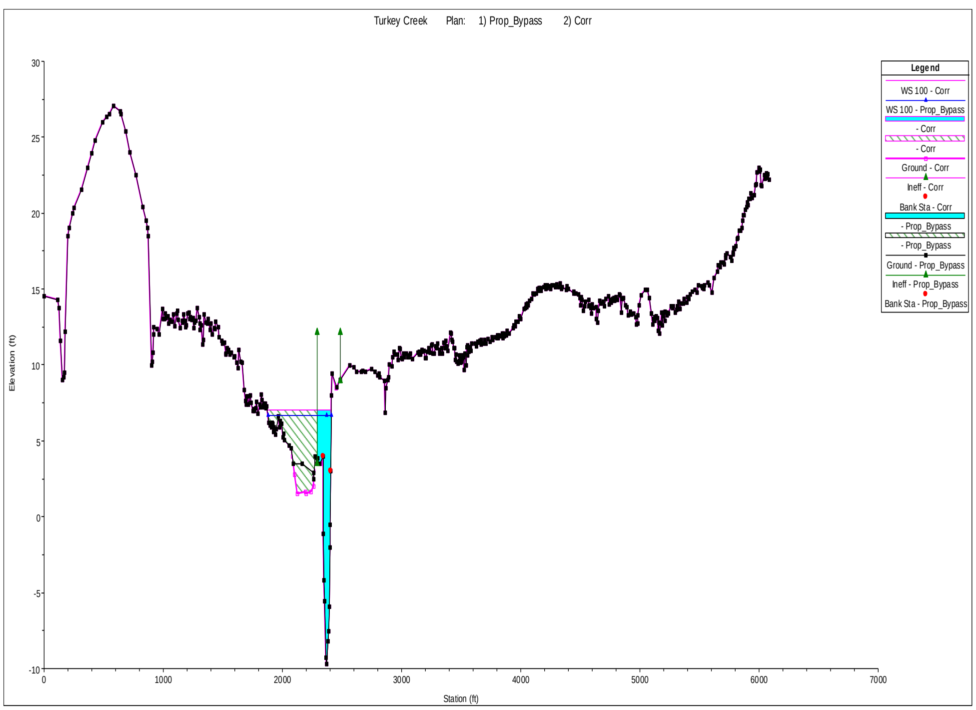


Figure 7: XS 1978- Corrected Effective versus Proposed Bypass

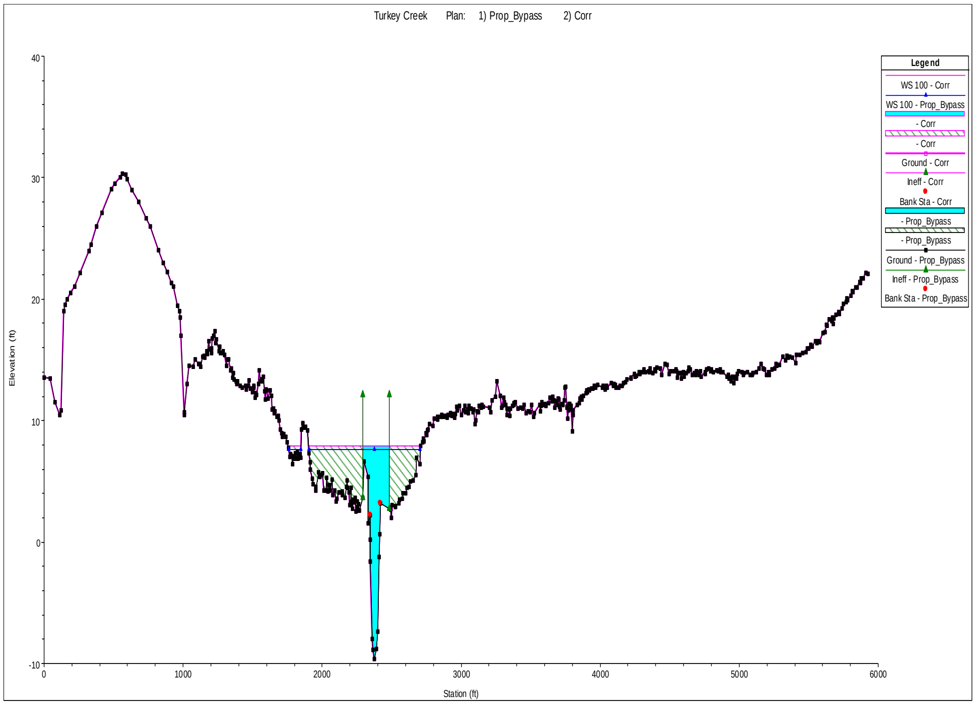


Figure 8: XS 2117- Corrected Effective versus Proposed Bypass

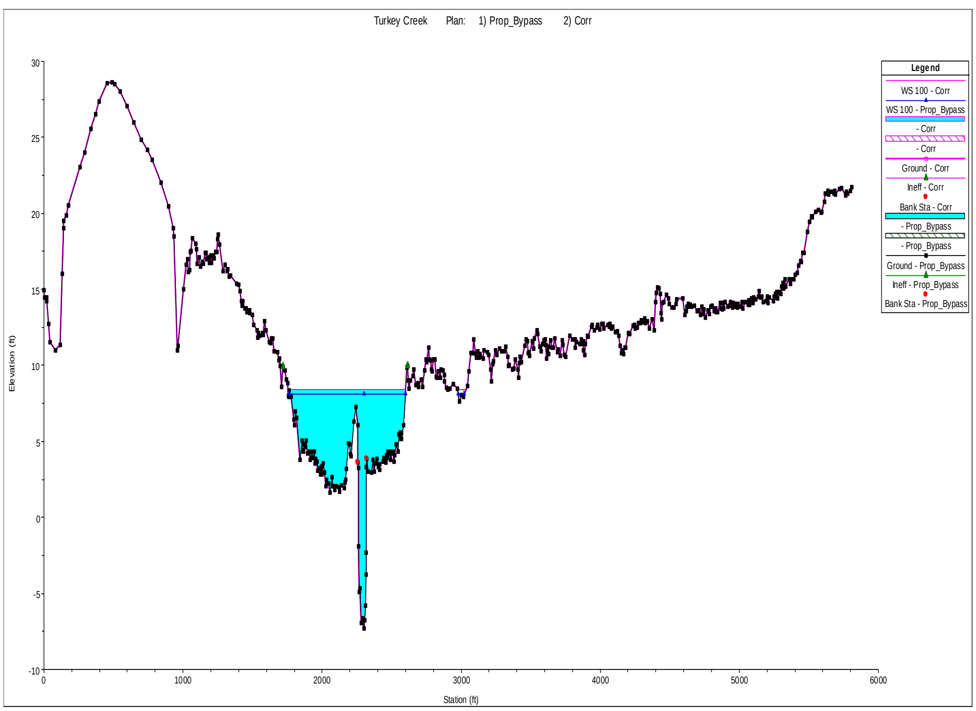


Figure 9: XS 2298- Corrected Effective versus Proposed Bypass

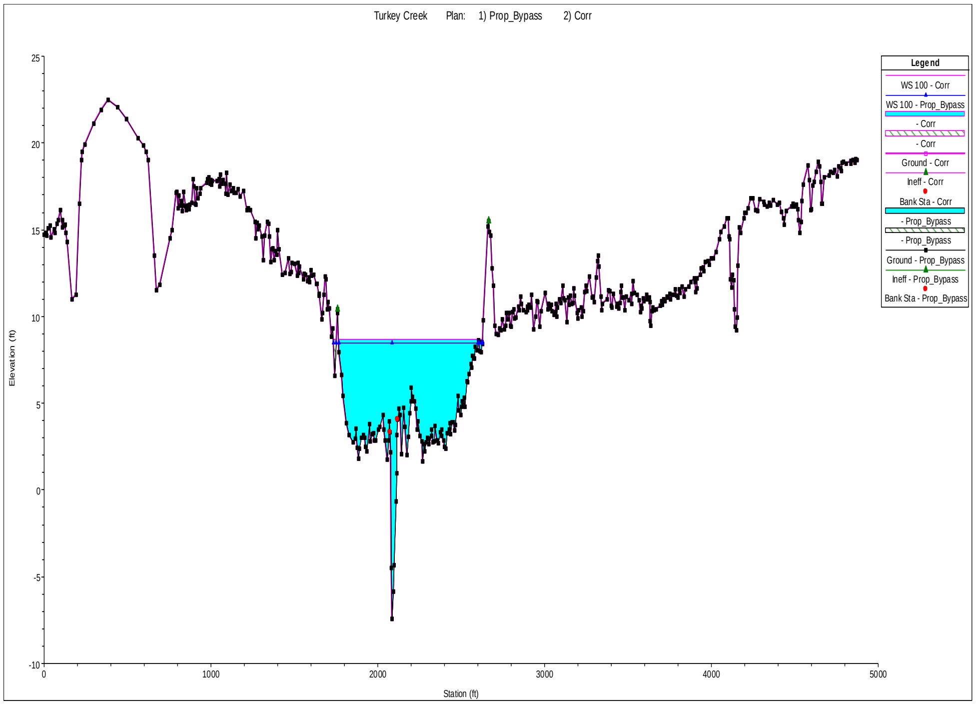


Figure 10: XS 2734- Corrected Effective versus Proposed Bypass

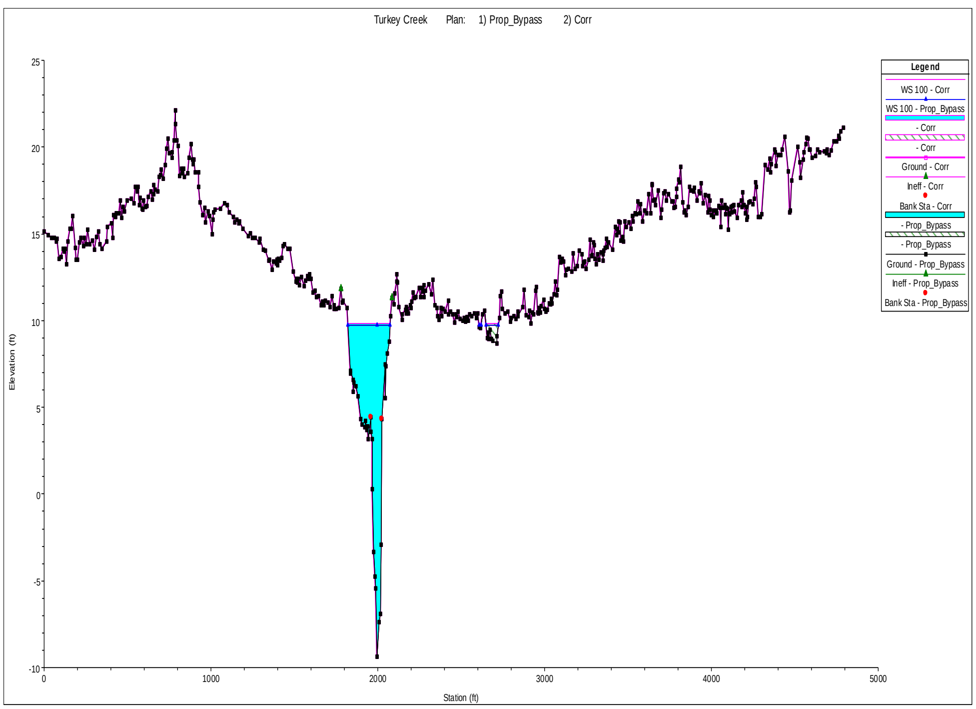


Figure 11: XS 4167- Corrected Effective versus Proposed Bypass

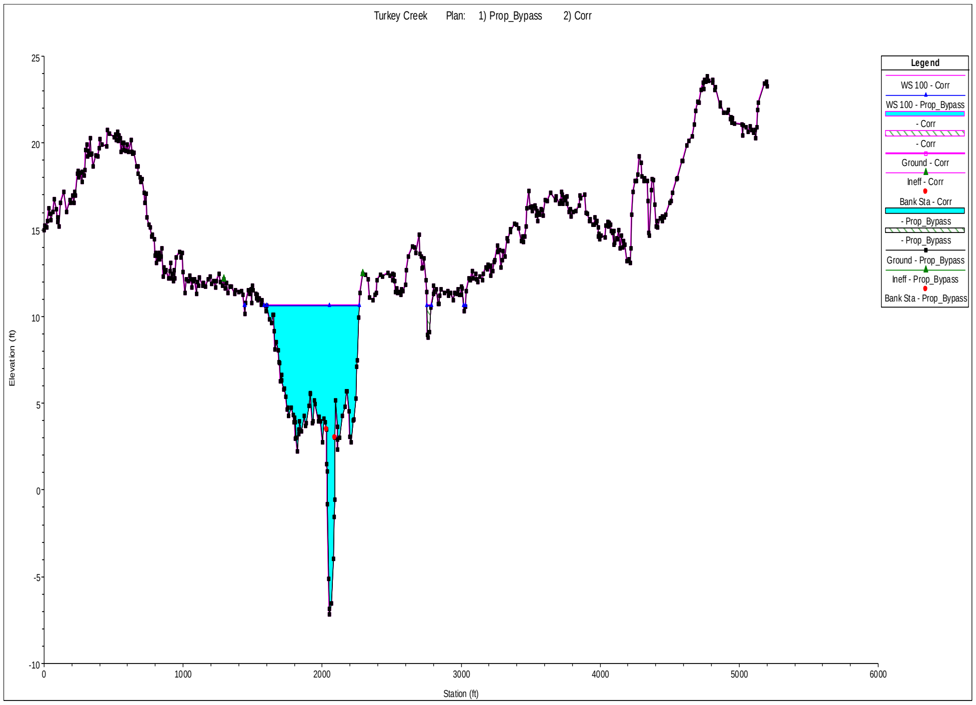


Figure 12: XS 5008- Corrected Effective versus Proposed Bypass

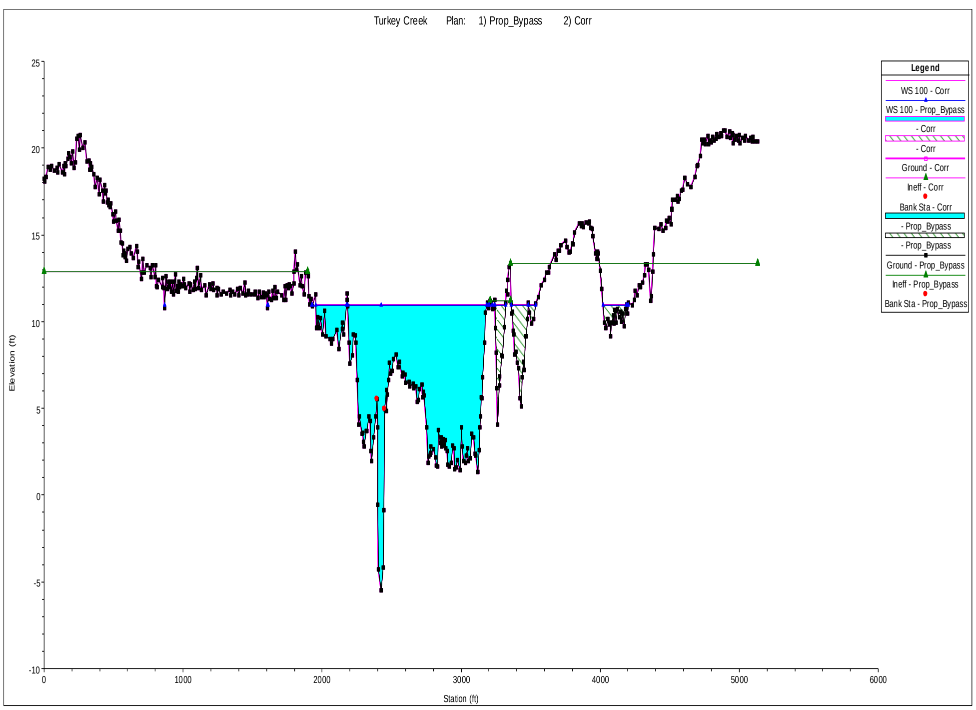


Figure 13: XS 6087- Corrected Effective versus Proposed Bypass

APPENDIX 6
DATA FILES ONLY – HYDRAULIC MODELS

APPENDIX 7
ENGINEERING CERTIFICATION

BASE FLOOD ELEVATION "NO-RISE" CERTIFICATION

This document is to certify that I am a duly qualified engineer licensed to practice in the State of Mississippi. It is to further certify that the attached technical data supports the fact that the Cavenham Forest Industries, LLC project will not impact the base flood elevations on Turkey Creek at published cross sections in the Flood Insurance Study for, City of Gulfport, dated September 12, 2011 and will not impact the base flood elevations at the unpublished cross-sections in the area of the proposed development.

SEAL, SIGNATURE AND DATE

Michael A. Hanson, P.E., LEED AP BD+C
Name

Senior Associate
Title

Dewberry & Davis, Inc. of Mississippi

8401 Arlington Blvd.
Fairfax, VA, 22031
Address

FOR COMMUNITY USE ONLY:

Community Approval

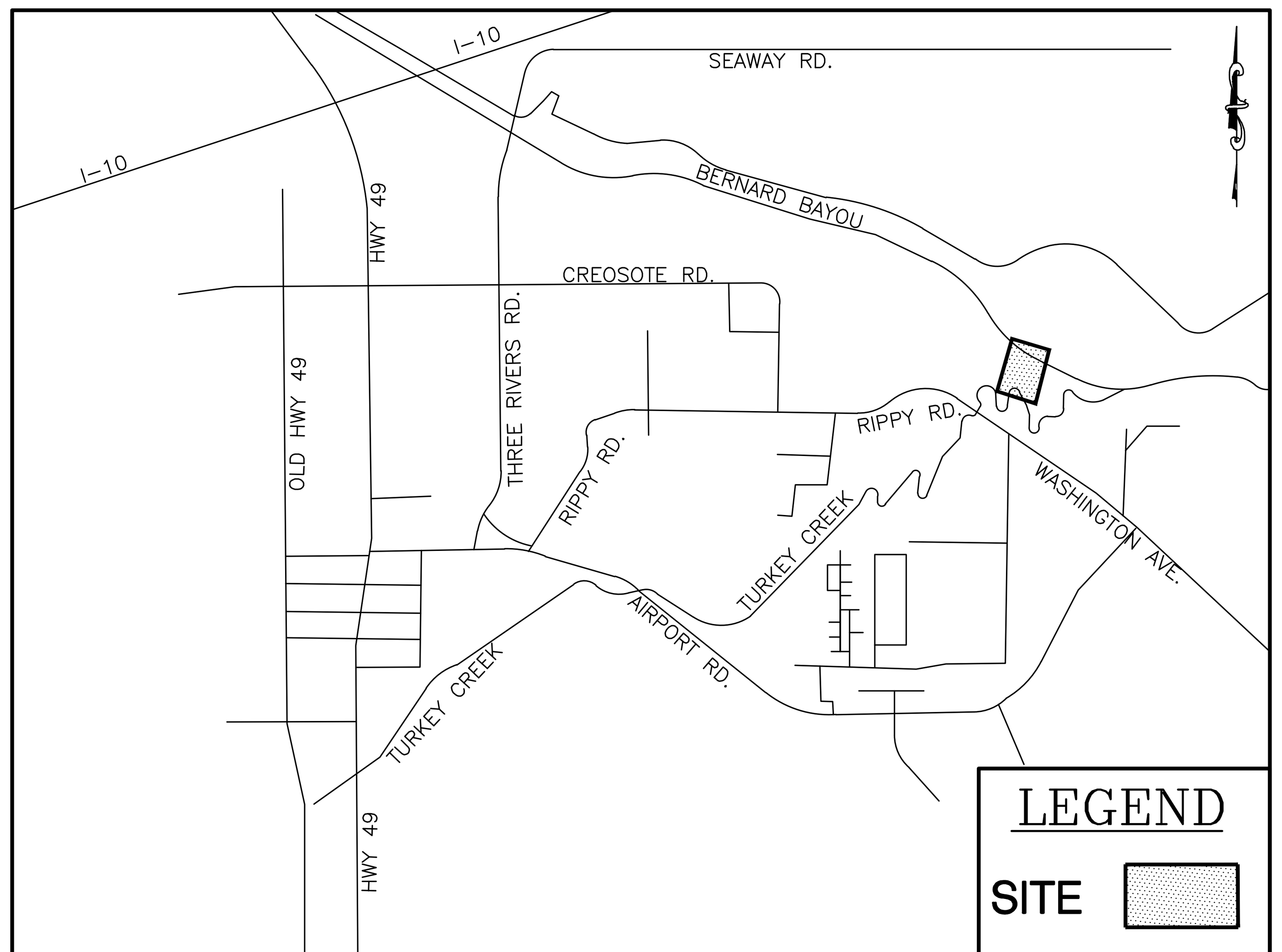
☐ Approved ☐ Disapproved

Community Official's Name	Community Official's Signature	Title

APPENDIX I
Floodwater Spillway Design
Dewberry & Davis, Inc. of Mississippi

CAVENHAM FOREST INDUSTRIES, LLC
TURKEY CREEK
FLOODWATER SPILLWAY

SEPTEMBER 2011



VICINITY MAP N.T.S.

SHEET INDEX

SHEET NO.	TITLE
1	TITLE SHEET
2	LEGEND AND GENERAL NOTES
3	EXISTING CONDITIONS
4	DEMOLITION PLAN
5	SITE PLAN & PROFILE
6	GRADING AND EROSION CONTROL PLAN
7	ALIGNMENT GEOMETRY PLAN
8	GENERAL DETAILS
9	GENERAL DETAILS
10	GENERAL DETAILS
11	GENERAL DETAILS
12	STRUCTURAL DETAILS

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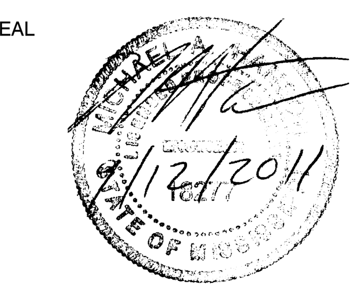
TURKEY CREEK
FLOODWATER SPILLWAY
GULFPORT, MISSISSIPPI

C/O ENVIRONMENTAL MANAGEMENT SERVICES, INC.
P.O. BOX 15369
HATTIESBURG, MS 39404-5369

SEAL



KEY PLAN

SCALE

No.	DATE	BY	Description

REVISIONS

DRAWN BY ACH
DESIGNED BY CML
CHECKED BY MAH
DATE SEPT. 2011

TITLE

TITLE SHEET

PROJECT NO. 50023352

1

GENERAL NOTES

1. SHEET PILING TO BE DESIGNED BY OWNER. PLANS ONLY INDICATE LOCATION IN RELATION TO FLOODWATER SPILLWAY.
2. ALL CONSTRUCTION ACTIVITIES MUST BE PERFORMED IN THE DRY.
3. CONTRACTOR SHALL ESTABLISH BASELINE AS SHOWN ON PLANS, THEN USE TYPICAL CROSS SECTION SHOWN IN DETAILS TO CONSTRUCT FLOODWATER SPILLWAY AND TIE TO GRADE. SIDE SLOPES AND BOTTOM WIDTH OF CHANNEL WILL REMAIN CONSTANT.
4. GULFPORT PLANT COORDINATE SYSTEM USED ON THIS PLAN SET AND PROVIDED BY ENVIRONMENTAL MANAGEMENT SERVICES, INC.
5. HORIZONTAL CONTROL (GULFPORT PLANT COORDINATE SYSTEM) AND VERTICAL CONTROL (NAVD88), SHOWN ON EXISTING CONDITIONS SHEET 3, PROVIDED BY ENVIRONMENTAL MANAGEMENT SERVICES, INC YIELDING VALUES OF:

   #29 N= 187.11
E= −581.29
ELEV=25.77

   #464 N= −11.43
E= 1830.40
ELEV= 6.35
6. PROJECT LOCATED NEAR CONFLUENCE OF BERNARD BAYOU AND TURKEY CREEK IN GULFPORT, MISSISSIPPI.
7. ALL EXISTING SITE FEATURES AND CONTOURS PROVIDED BY ENVIRONMENTAL MANAGEMENT SERVICES, INC.
8. GRADING SHEET SHOWS PROPOSED GRADING FOR FLOODWATER SPILLWAY IN RELATION TO PROPOSED CONTOURS PROVIDED BY ENVIRONMENTAL MANAGEMENT SERVICES, INC.
9. MEAN LOW TIDE= 0.03' (TIDAL DATA PROVIDED BY ENVIRONMENTAL MANAGEMENT SERVICES, INC.)
MEAN HIGH TIDE= 1.34'.
10. SHEET PILING, CAP AND CONNECTION TO FLOODWATER SPILLWAY WILL BE PERFORMED BY OTHERS.

STANDARD LEGEND

DESCRIPTION	SYMBOL
MONITORING WELL	RW-1 MW-1 PW-1 I-1
PROPERTY LINE	ℙ
SLURRY WALL	
SHEET PILING	
SOIL BENTONITE WALL	
WORKPAD	
BENCHMARK	#29
SILT FENCE	SF
CONSTRUCTION FENCE	CF
EXISTING CONCRETE SLAB	
PROPOSED CONTOURS	1
EXISTING CONTOURS	1
ARTICULATED CONCRETE ARMORING	

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SUITE 200
RALEIGH, NC 27607
PHONE: 919.881.9939
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KEY PLAN

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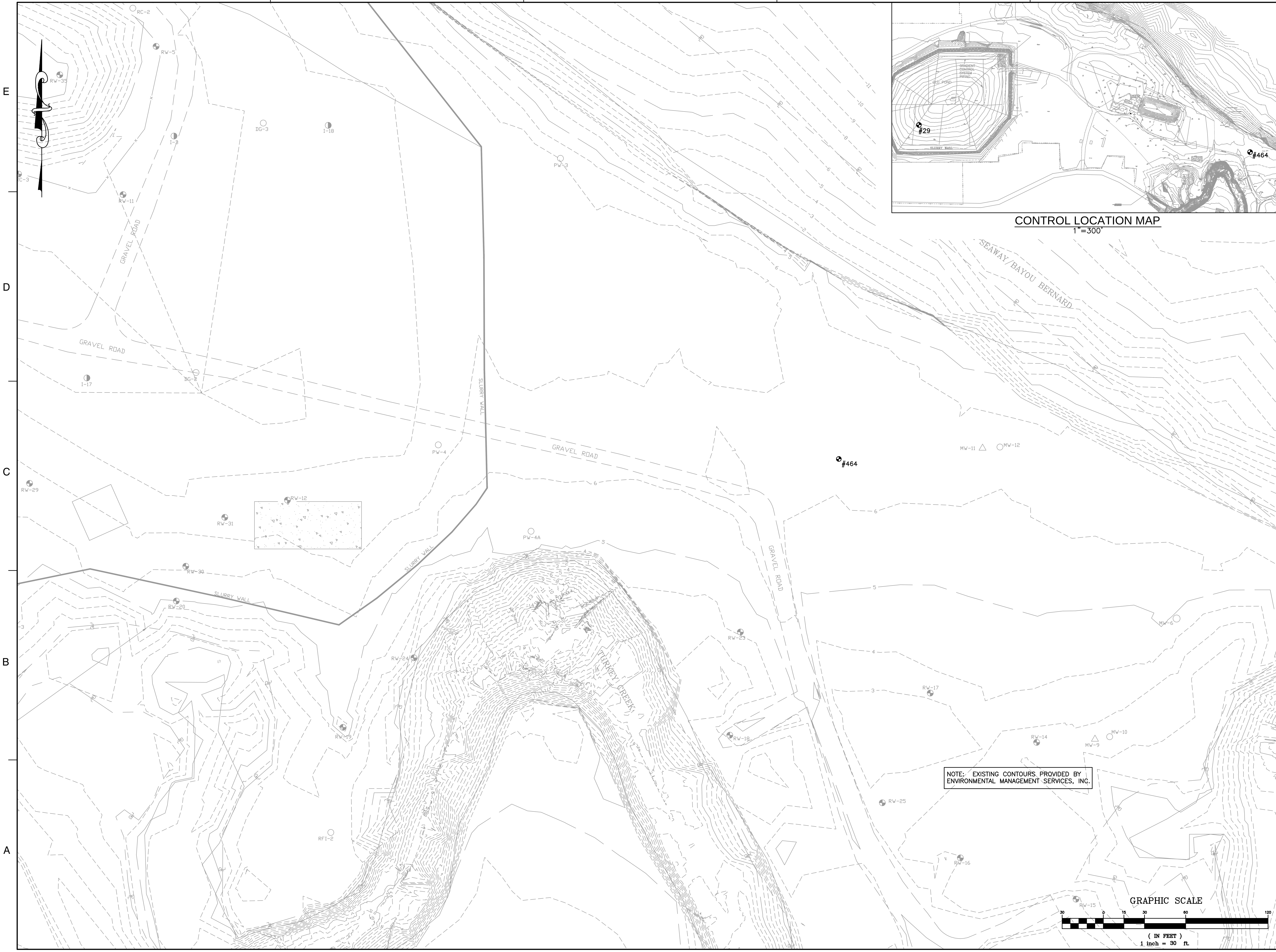
TITLE

LEGEND AND GENERAL NOTES

PROJECT NO. 50023352

2

SHEET NO. 2 OF 12



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SUITE 200
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KEY PLAN

SCALE

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DATE	SEPT. 2011

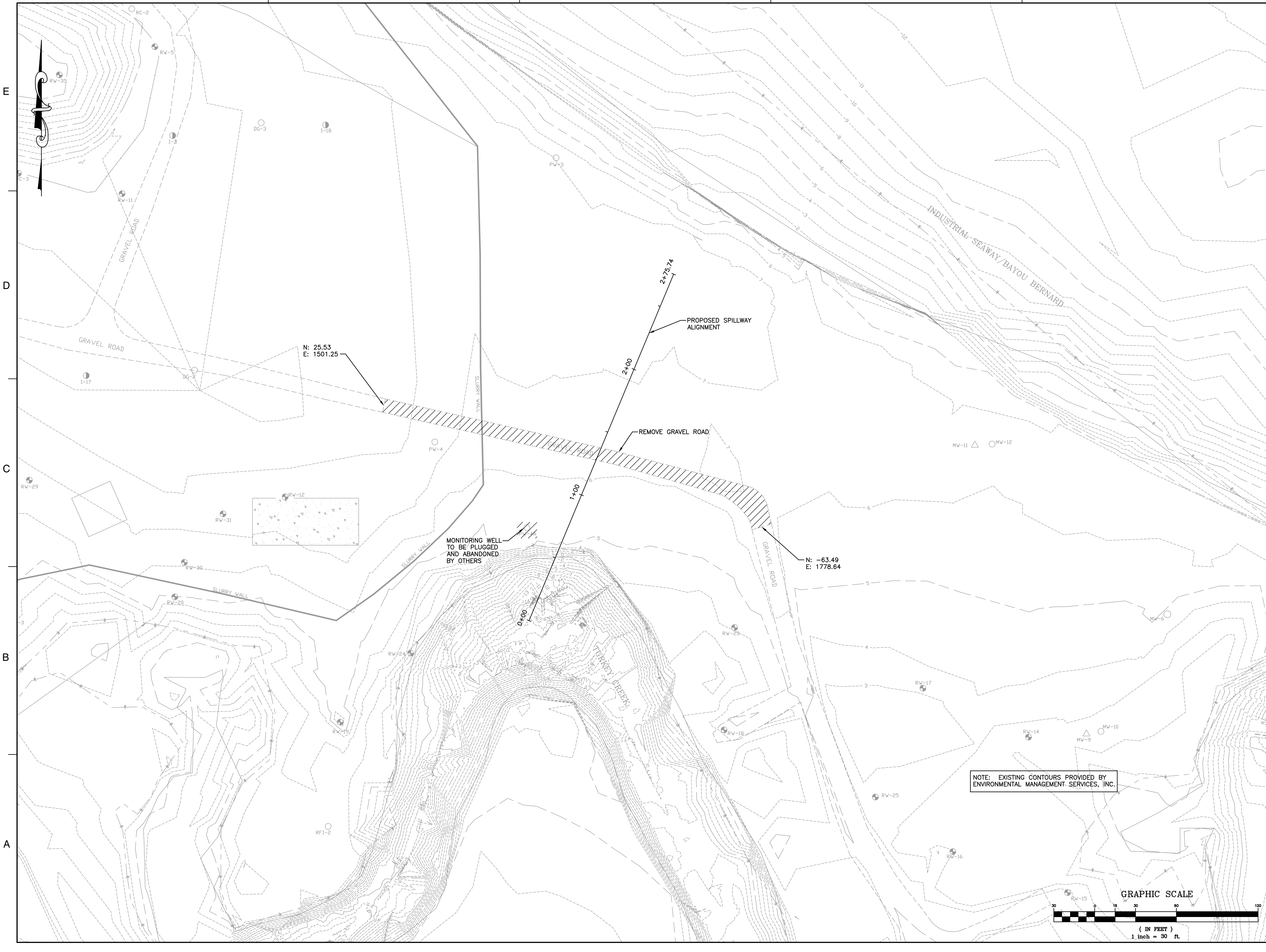
TITLE

EXISTING CONDITIONS

PROJECT NO. 50023352

3

SHEET NO. 3 OF 12



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KEY PLAN

SCALE

No.	DATE	BY	Description

REVISIONS

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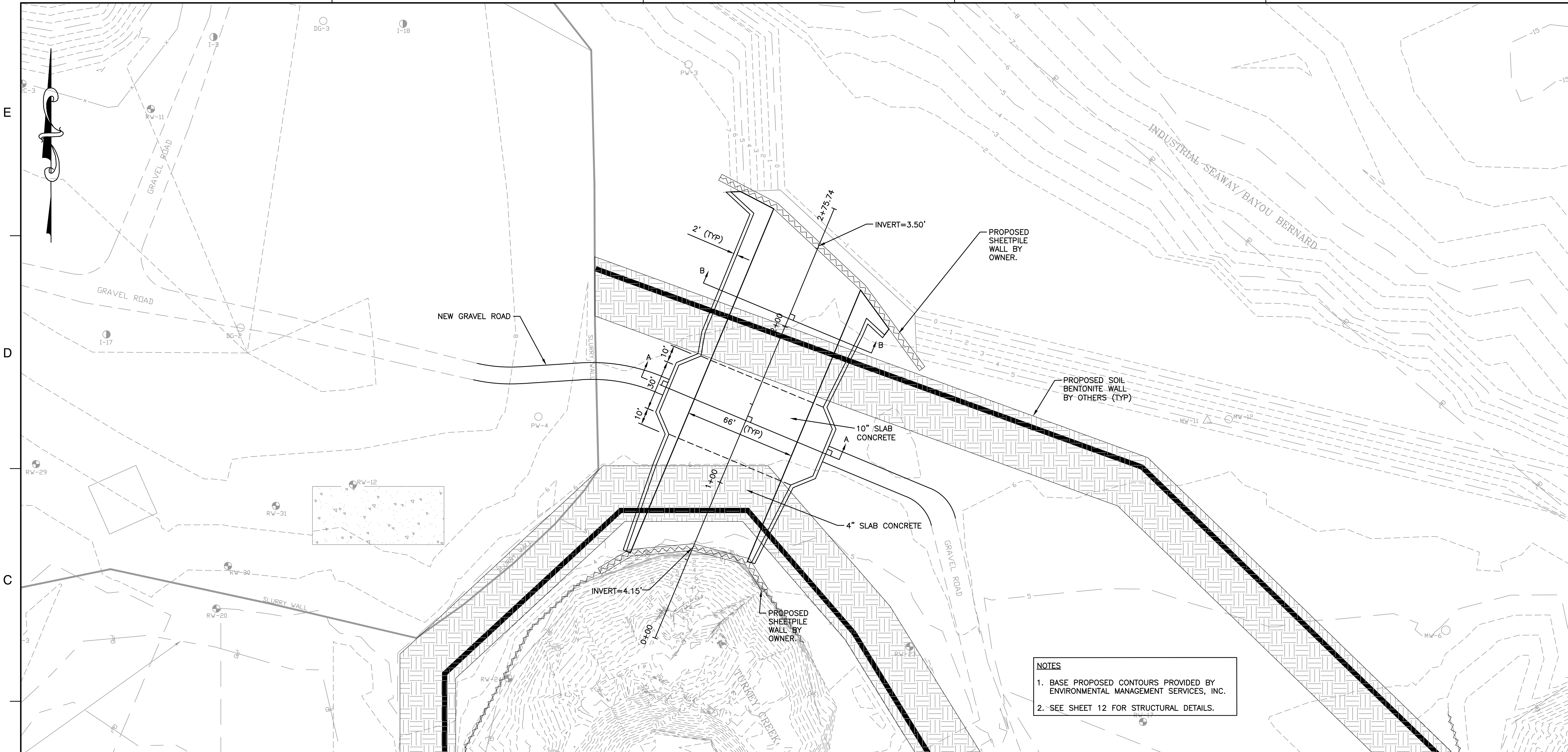
CHECKED BY MAH
DATE SEPT. 2011

TITLE
DEMOLITION PLAN

PROJECT NO. 50023352

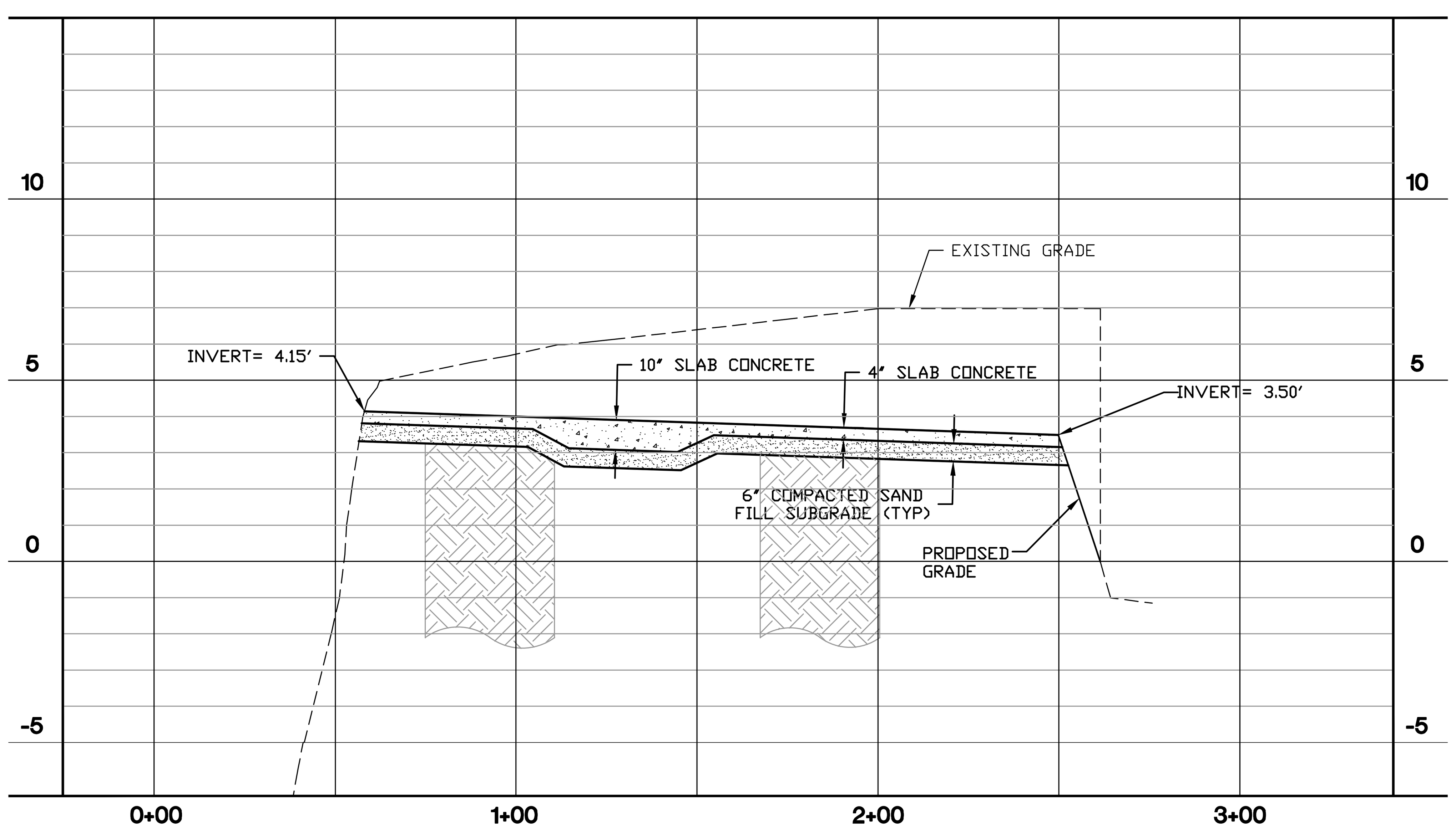
4

SHEET NO. 4 OF 12

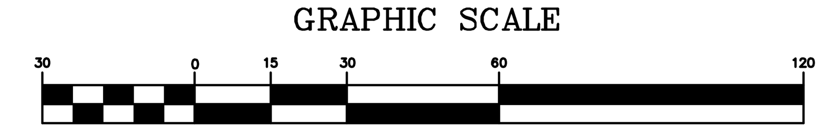


NOTES

1. BASE PROPOSED CONTOURS PROVIDED BY ENVIRONMENTAL MANAGEMENT SERVICES, INC.
2. SEE SHEET 12 FOR STRUCTURAL DETAILS.

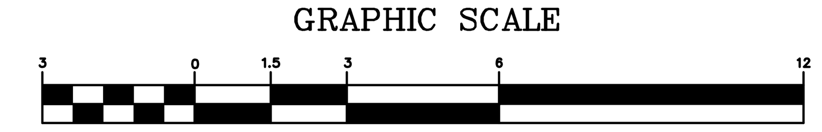


HORIZONTAL GRAPHIC SCALE



(IN FEET)
1 inch = 30 ft.

VERTICAL GRAPHIC SCALE



(IN FEET)
1 inch = 3 ft.

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KEY PLAN

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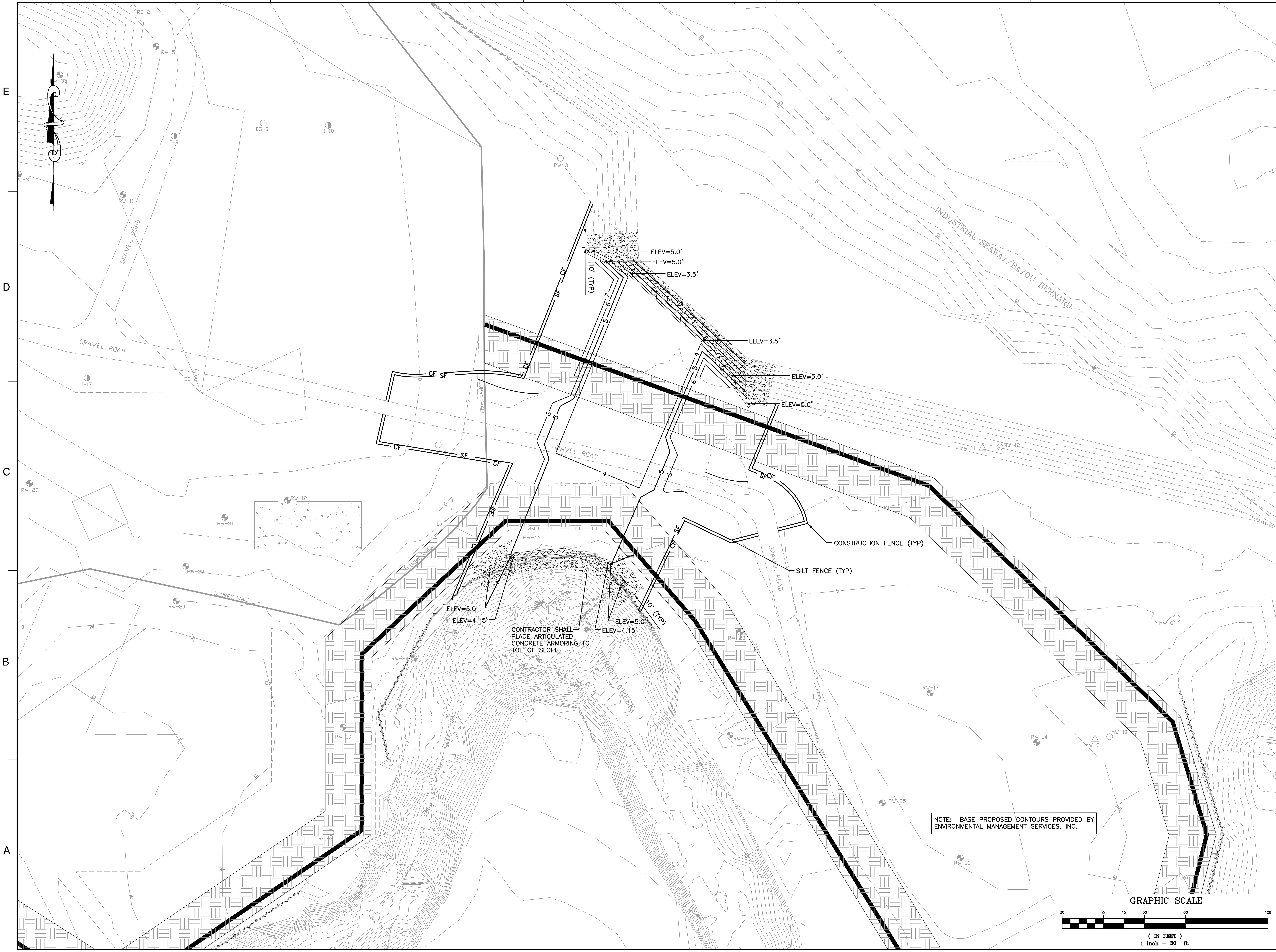
DATE SEPT. 2011

TITLE
SITE PLAN & PROFILE

PROJECT NO. 50023352

5

SHEET NO. 5 OF 12



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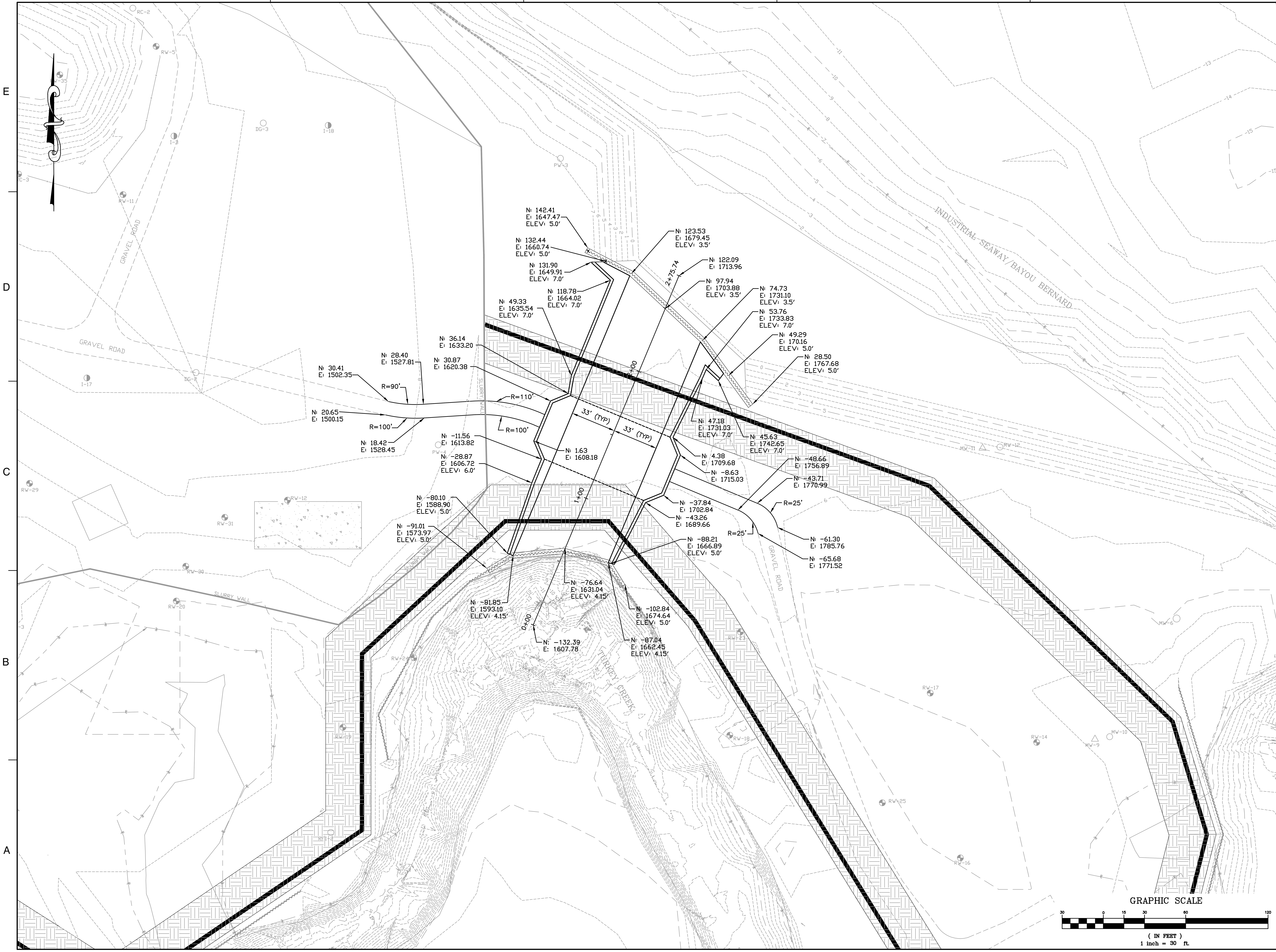
GRADING AND EROSION CONTROL PLAN

PROJECT NO. 50023352

SHEET NO. 6

6 OF 12



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SUITE 200
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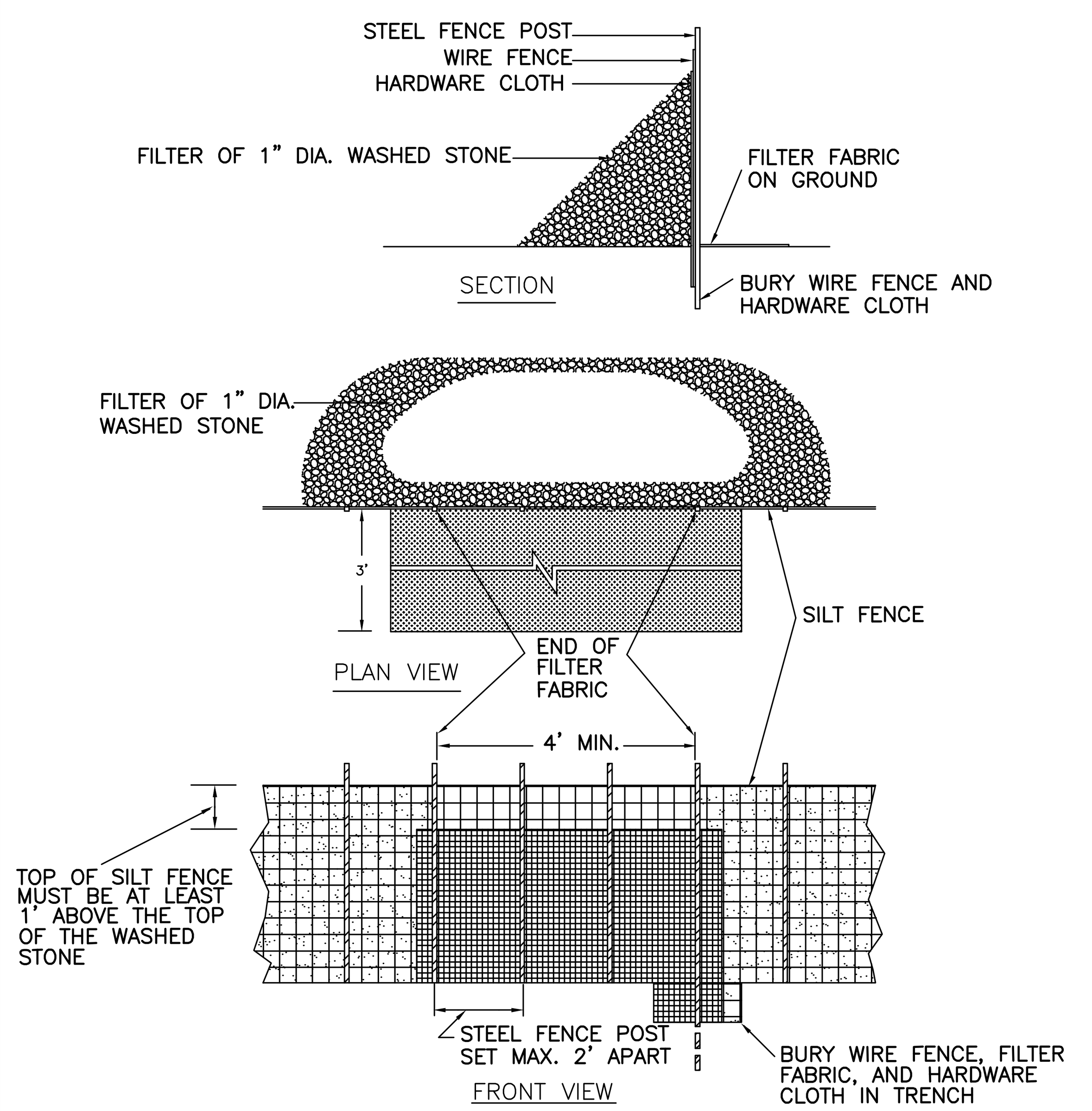
TITLE

ALIGNMENT GEOMETRY PLAN

PROJECT NO. 50023352

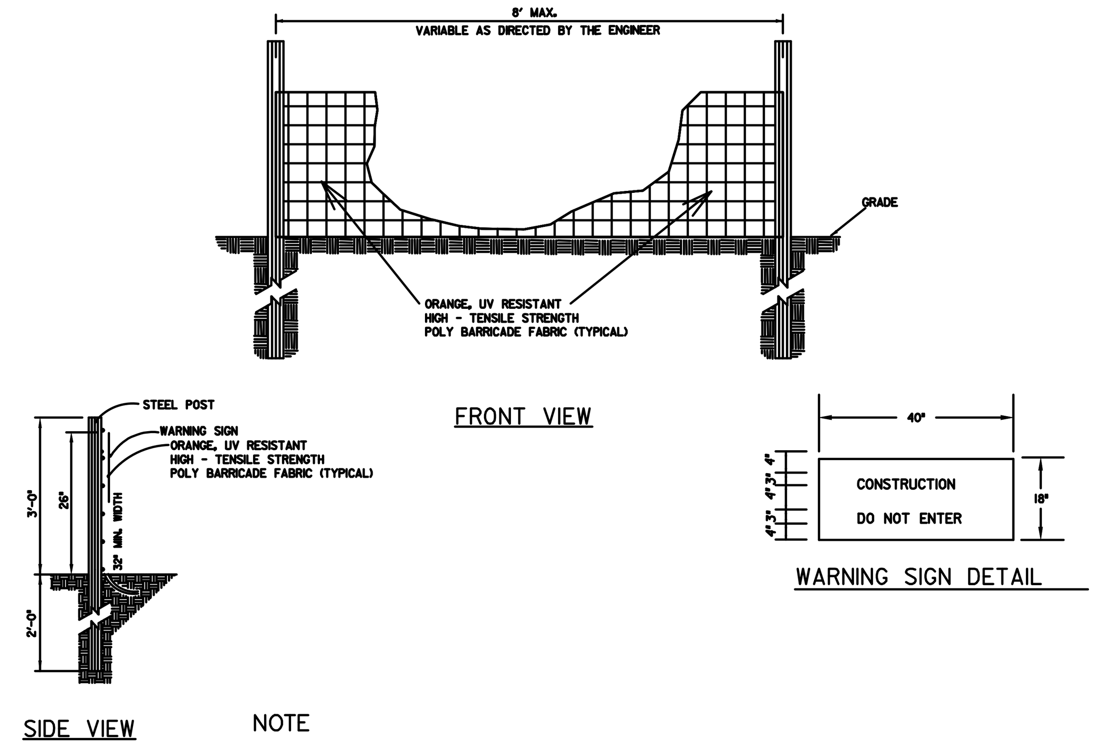
SHEET NO. 7

7 OF 12



SILT FENCE GRAVEL OUTLET

N.T.S.



NOTE

INSTALL CONSTRUCTION FENCE BETWEEN TEMPORARY SILT FENCE AND LIMITS OF DISTURBANCE AROUND ENTIRE PROJECT

CONSTRUCTION FENCE DETAIL

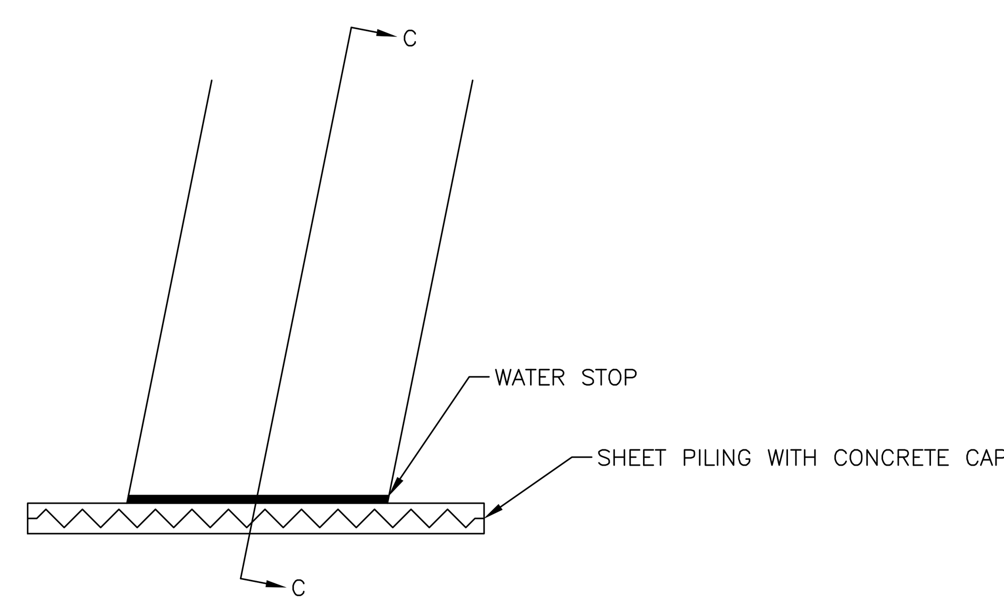
N.T.S.

ARTICULATED CONCRETE ARMORING INLET/OUTLET PROTECTION:

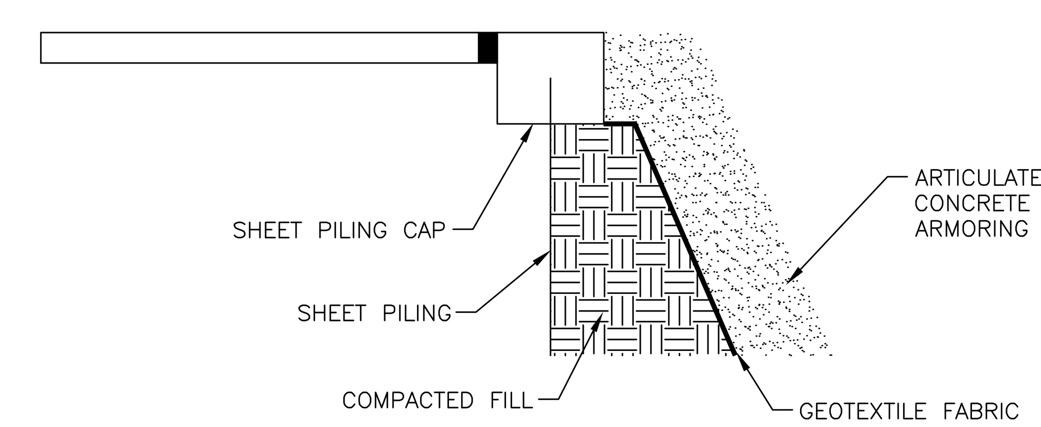
1. ENSURE THAT THE SUBGRADE FOR THE LINER AND ARTICULATED CONCRETE ARMORING FOLLOWS THE REQUIRED LINES AND GRADES SHOWN IN THE PLAN. COMPACT ANY FILL REQUIRED IN THE SUBGRADE TO THE DENSITY OF THE SURROUNDING UNDISTURBED MATERIAL.
2. THE ARTICULATED CONCRETE ARMORING SHALL CONFORM TO THE SPECIFIED GRADING LIMITS SHOWN ON THE PLANS.
3. GEOTEXTILE LINER, WHEN USED, MUST MEET DESIGN REQUIREMENTS AND BE PROPERLY PROTECTED FROM PUNCHING OR TEARING DURING INSTALLATION. REPAIR ANY DAMAGE BY REMOVING THE ARTICULATED CONCRETE ARMORING AND PLACING ANOTHER PIECE OF GEOTEXTILE LINER OVER THE DAMAGED AREA. ALL CONNECTING JOINTS SHOULD OVERLAP A MINIMUM OF 1 FOOT. IF THE DAMAGE IS EXTENSIVE, REPLACE THE ENTIRE GEOTEXTILE LINER.
4. ARTICULATED CONCRETE ARMORING MAY BE PLACED BY EQUIPMENT, BUT TAKE CARE TO AVOID DAMAGING THE GEOTEXTILE LINER.
5. THE MINIMUM THICKNESS OF THE ARTICULATED CONCRETE ARMORING SHOULD BE AS SPECIFIED IN THE DETAIL.
6. MAKE THE TOP OF THE ARTICULATED CONCRETE ARMORING AT THE DOWNSTREAM END LEVEL WITH THE RECEIVING AREA OR SLIGHTLY BELOW IT.
7. IMMEDIATELY AFTER CONSTRUCTION, STABILIZE ALL DISTURBED AREAS WITH VEGETATION.

MAINTENANCE:

INSPECT ARTICULATED CONCRETE ARMORING OUTLET STRUCTURES AFTER HEAVY RAINS TO SEE IF ANY EROSION AROUND OR BELOW THE ARTICULATED CONCRETE ARMORING HAS TAKEN PLACE OR IF STONES HAVE BEEN DISLODGED. IMMEDIATELY MAKE ALL NEEDED REPAIRS TO PREVENT FURTHER DAMAGE.



PLAN VIEW

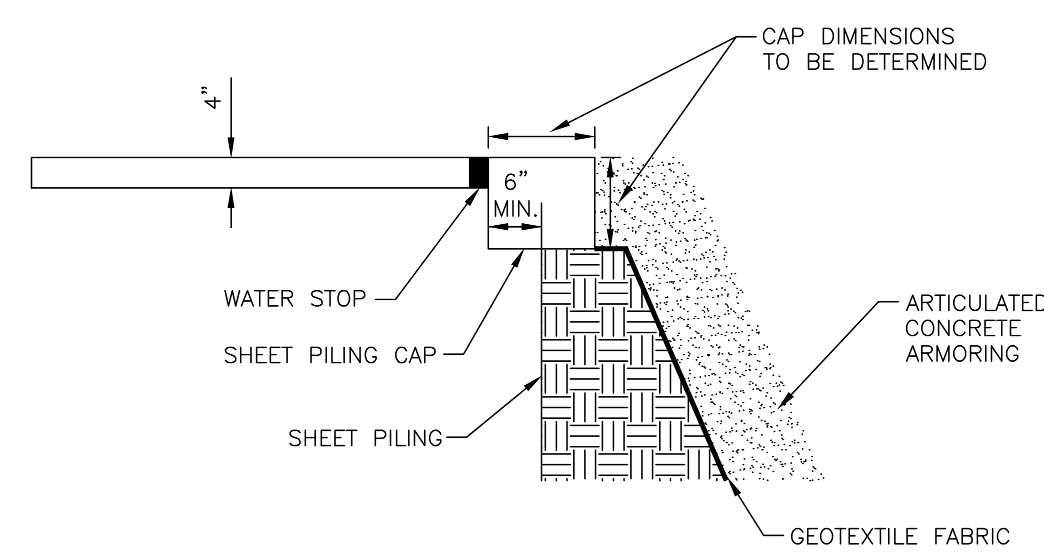


ARTICULATED CONCRETE ARMORING

N.T.S.

NOTES

1. MAXIMUM SIDE SLOPES OF 2:1 OR GENTLER FOR INSTALLATION.
2. IF FILL IS REQUIRED FOR INSTALLATION TO ACHIEVE DESIRED SLOPE, THEN COMPACT FILL TO THE CONSISTENCY OF EXISTING BANK.



CROSS SECTION C-C

NOTE: SHEET PILING, CAP AND CONNECTION TO BYPASS CHANNEL WILL BE PERFORMED BY OTHERS.

SHEET PILING CONCRETE CAP DETAIL (TYPICAL BOTH SIDES)

N.T.S.

SEEDING SCHEDULE IN COASTAL AREAS

LIME, SEED AND FERTILIZER SHALL BE APPLIED WITH NECESSARY EQUIPMENT TO GIVE UNIFORM DISTRIBUTION OF THESE MATERIALS. THE KINDS OF MATERIALS TO BE APPLIED PER ACRE:

TEMPORARY SEEDING

DATE	TYPE	PLANTING RATE	FERTILIZER 10-10-10 BLEND	LIMESTONE	STRAW MULCH
DEC. 1 – APR. 15	RYE (GRAIN) KOBE LESPEDEZA *	120 LBS./ACRE 50 LBS./ACRE	750 LBS./ACRE	2000 LBS./ACRE	4000 LBS./ACRE
APR. 15 – AUG. 15	GERMAN MILLET	40 LBS./ACRE	750 LBS./ACRE	2000 LBS./ACRE	4000 LBS./ACRE
AUG. 15 – DEC. 30	RYE (GRAIN)	120 LBS./ACRE	1000 LBS./ACRE	2000 LBS./ACRE	4000 LBS./ACRE

PERMANENT SEEDING

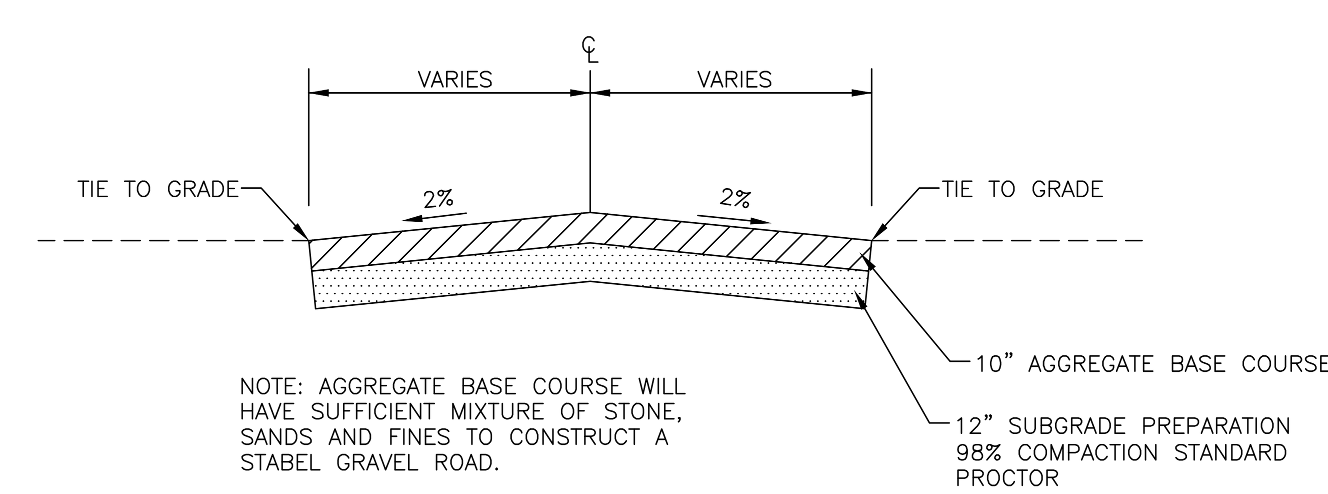
DATE	TYPE	PLANTING RATE	FERTILIZER ** 10-10-10 BLEND	LIMESTONE ***	STRAW MULCH
APR. 1 – JULY 15 FEB. 1 – MAR. 31	PENSACOLA BAHIAGRASS CENTIPEDE GRASS GERMAN MILLET	50 LBS./ACRE 5 LBS./ACRE 10 LBS./ACRE	500 LBS./ACRE	3000 LBS./ACRE	4000 LBS./ACRE

* OMIT KOBE LESPEDEZA WHEN DURATION OF TEMPORARY COVER IS NOT TO EXTEND BEYOND JUNE.

** QUANTITY OF FERTILIZER AND LIME SHALL BE CONFIRMED BY SOILS TEST.

2. SEEDED AREA SHALL BE CULTIPACKED TO FIRM SEEDBED AND COVER SEED.
3. GRAIN STRAW SHALL BE APPLIED OVER SEEDED AREAS AS A MULCH WITHIN 24 HOURS OF THE INITIAL SEEDING OPERATION. NO BARE GROUND SHALL BE VISIBLE WHEN RIDING BY A MULCHED AREA IF PROPER APPLICATION IS ACHIEVED. THICK CLUMPS OF STRAW ARE NOT PERMISSIBLE AS A UNIFORM COVERAGE IS EXPECTED.
4. MULCHED AREA SHALL BE TACKED WITH HYDROMULCH AT A RATE OF 0.10 GALLON PER SQUARE YARD (10 GAL/1000 SQ. FT.). HYDRAULIC TACKING MATERIAL SHALL BE USED IN HIGH QUALITY WATER ZONES AND CRITICAL HABITAT AREAS.
5. DITCH TREATMENT SHALL BE USED IN AREAS WHERE STEEP GRADES COULD CAUSE DITCH EROSION. USE OF EXCELSIOR MATTING OR FIBERGLASS/SYNTHETIC ROVING IS ACCEPTABLE. DITCH TREATMENT SHALL BE INSTALLED BEFORE MULCHING OPERATION.
6. PROVIDE TEMPORARY SEEDING AFTER CLEARING AND GRUBBING OPERATION IF THE AREA IS TO REMAIN UNDISTURBED FOR MORE THAN 15 WORKING DAYS OR 60 CALENDAR DAYS, WHICHEVER IS LESS. PROVIDE PERMANENT SEEDING WITHIN 15 WORKING DAYS OR 60 CALENDAR DAYS, WHICHEVER IS LESS, OF ESTABLISHING FINAL GRADES. SLOPES SHALL BE SEEDED WITHIN 21 CALENDAR DAYS.
7. CONTRACTOR SHALL PLAN ON WATERING 0.5 INCHES EVERY THREE DAYS WITH A MINIMUM OF 1.0 INCH PER WEEK FOR A DURATION OF MINIMUM OF TWO WEEKS UNTIL THE GRASS IS ESTABLISHED AND ACCEPTED BY THE CONTRACTING OFFICER.

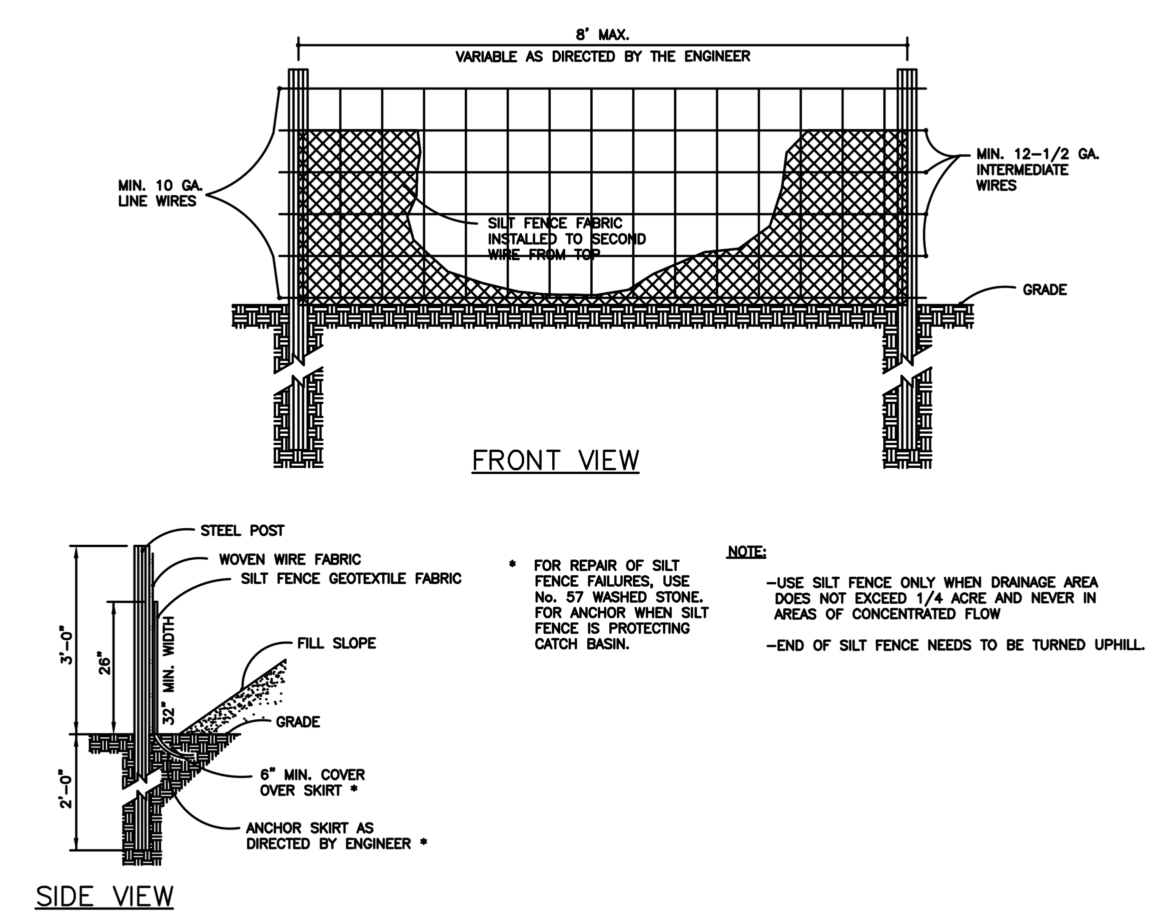
NOTE: ABOVE SEEDING SCHEDULE APPLIES TO ALL DISTURBED AREAS.



NOTE: AGGREGATE BASE COURSE WILL HAVE SUFFICIENT MIXTURE OF STONE, SANDS AND FINES TO CONSTRUCT A STABEL GRAVEL ROAD.

GRAVEL ROAD DETAIL

N.T.S.



* FOR REPAIR OF SILT FENCE FAILURES, USE No. 57 WASHED STONE. FOR ANCHOR WHEN SILT FENCE IS PROTECTING CATCH BASIN.

NOTE:

-USE SILT FENCE ONLY WHEN DRAINAGE AREA DOES NOT EXCEED 1/4 ACRE AND NEVER IN AREAS OF CONCENTRATED FLOW

-END OF SILT FENCE NEEDS TO BE TURNED UPHILL.

TEMPORARY SILT FENCE

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GULFPORT, MISSISSIPPI

C/O ENVIRONMENTAL MANAGEMENT SERVICES, INC.
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KEY PLAN

SCALE

No.	DATE	BY	Description

REVISIONS

DRAWN BY	ACH
DESIGNED BY	CML
CHECKED BY	MAH
DATE	SEPT. 2011

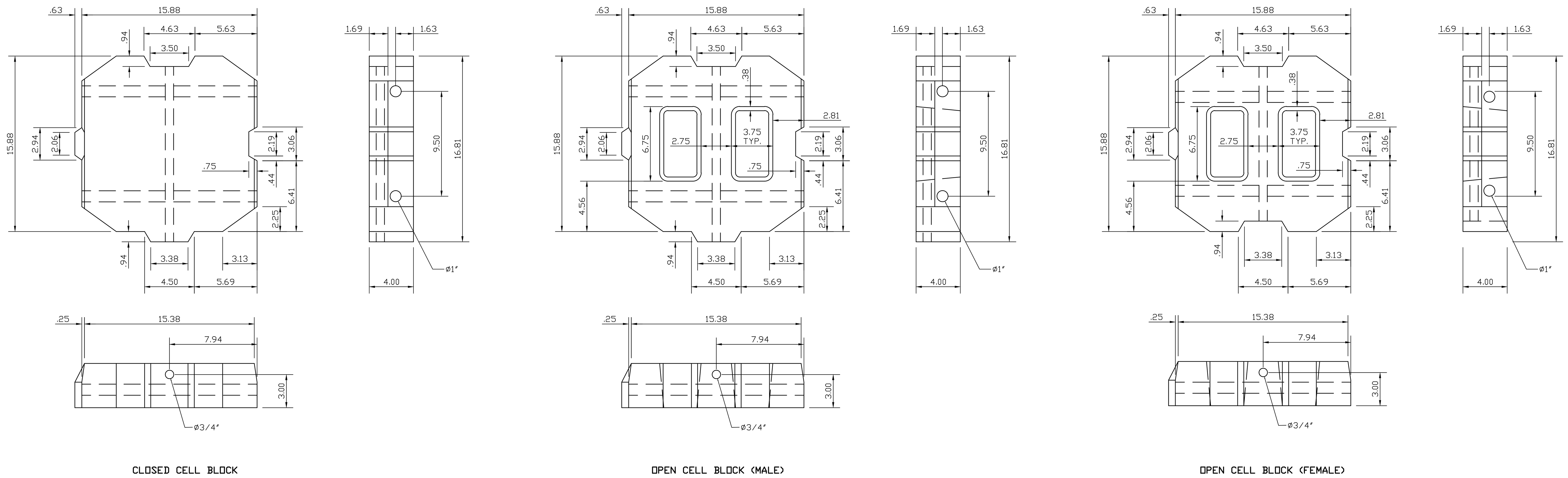
TITLE

GENERAL DETAILS

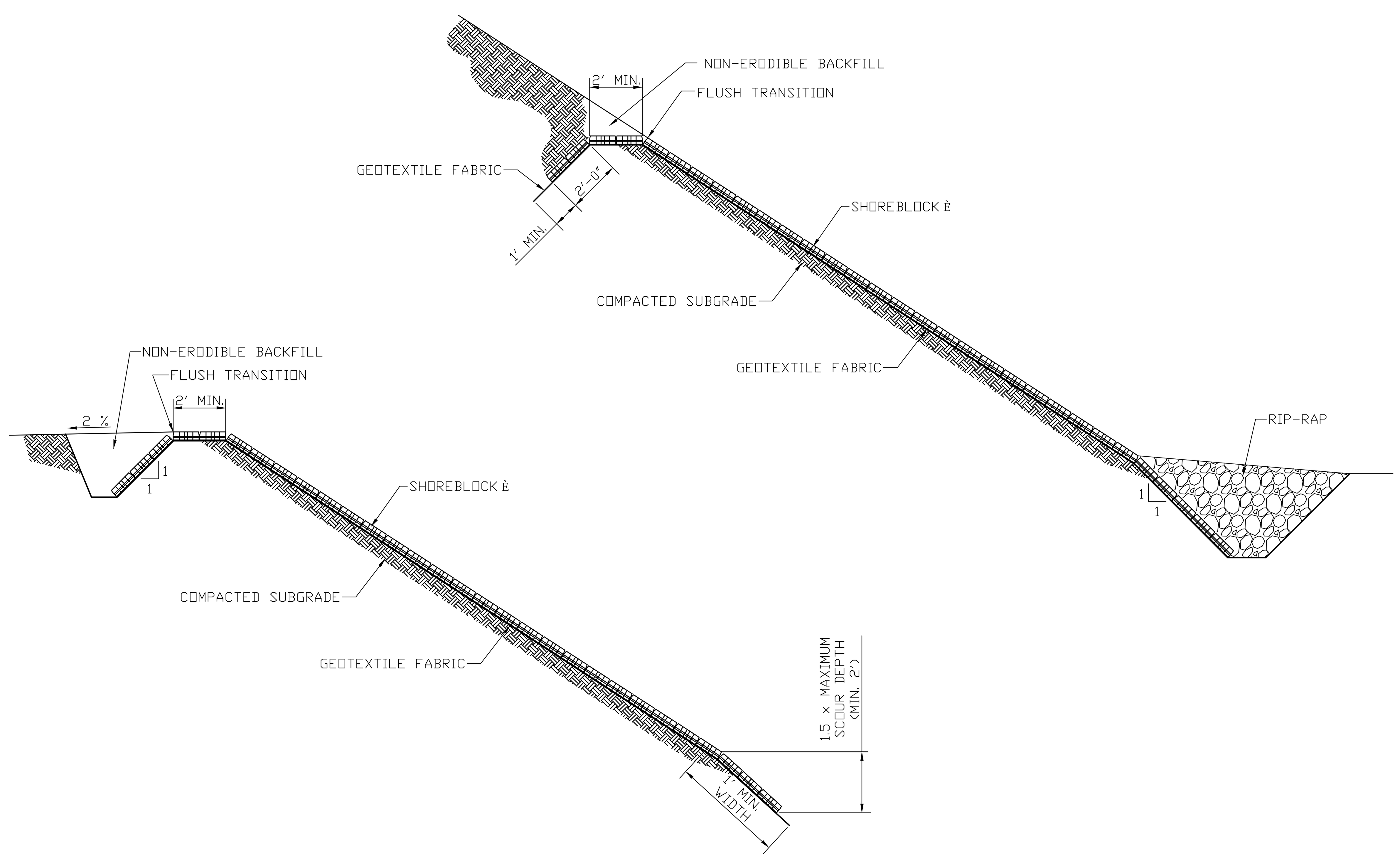
PROJECT NO. 50023352

8

SHEET NO. 8 OF 12



SHOREBLOCK® BD SERIES BLOCK DETAILS
N.T.S.



SHOREBLOCK® BD TYPICAL CROSS SECTION
N.T.S.

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KEY PLAN

SCALE

No.	DATE	BY	Description

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CHECKED BY	MAH
DATE	SEPT. 2011

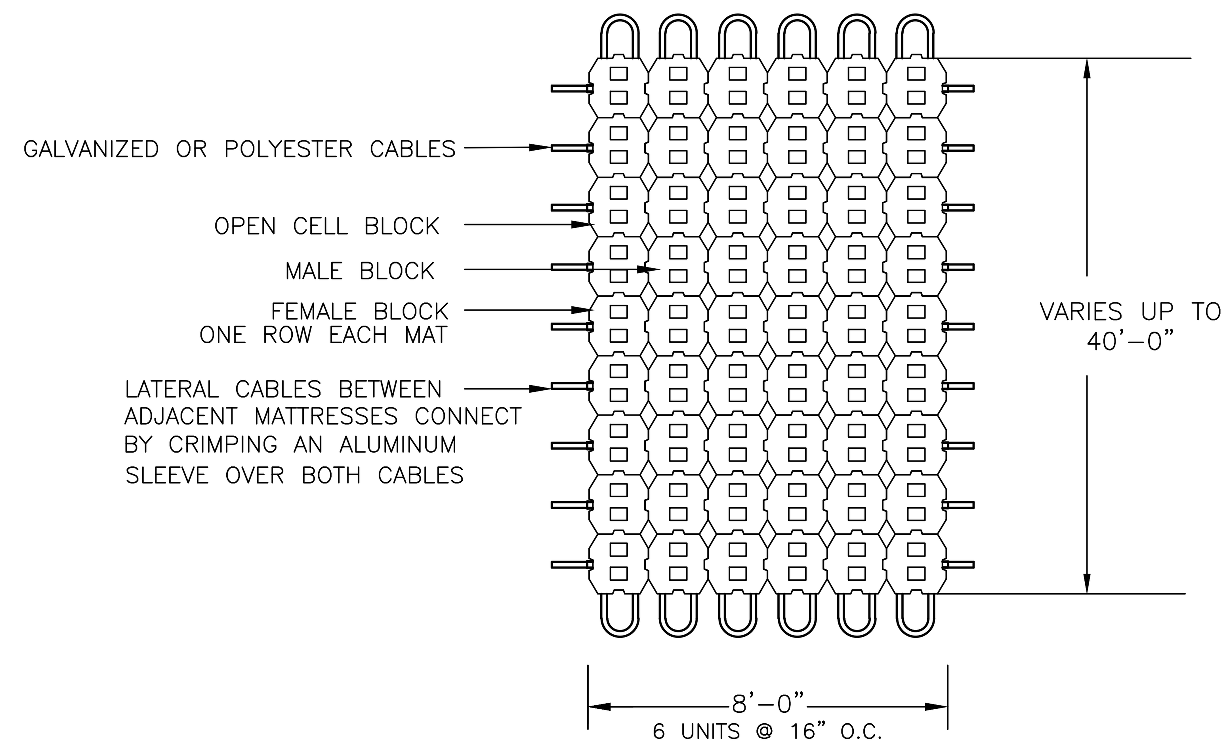
TITLE

GENERAL DETAILS

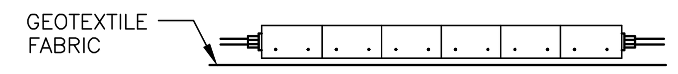
PROJECT NO. 50023352

9

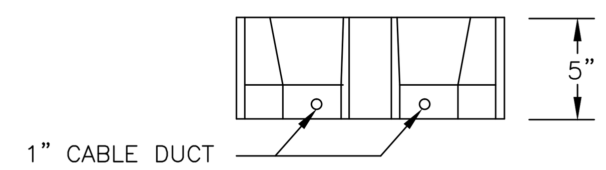
SHEET NO. 9 OF 12



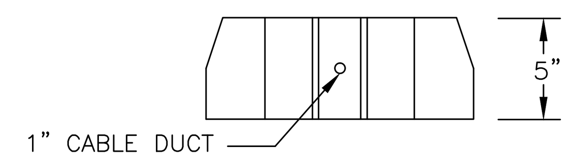
SHOREBLOCK® MAT ASSEMBLY DETAIL
N.T.S.



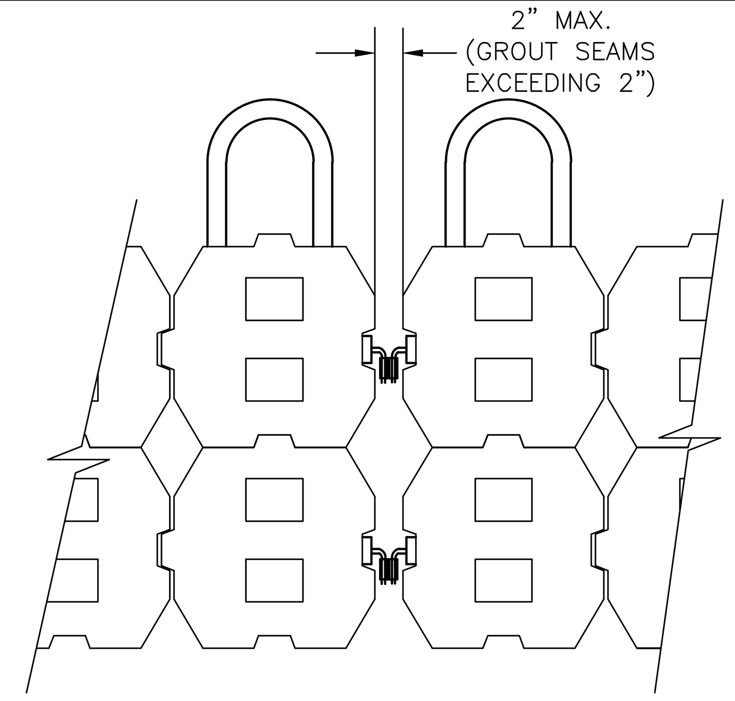
TYPICAL SECTION OF SHOREBLOCK®



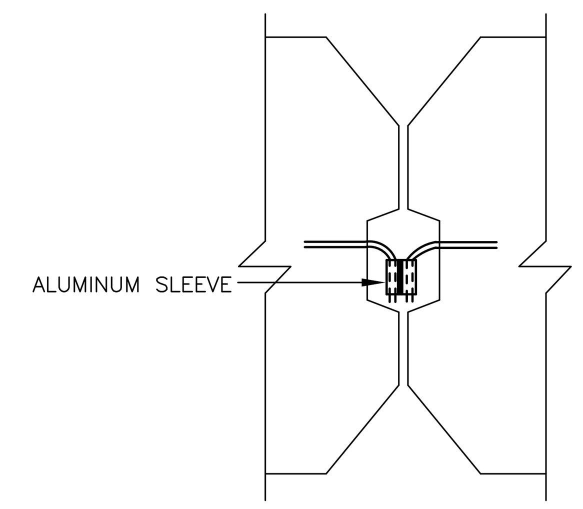
TYPICAL SECTION B



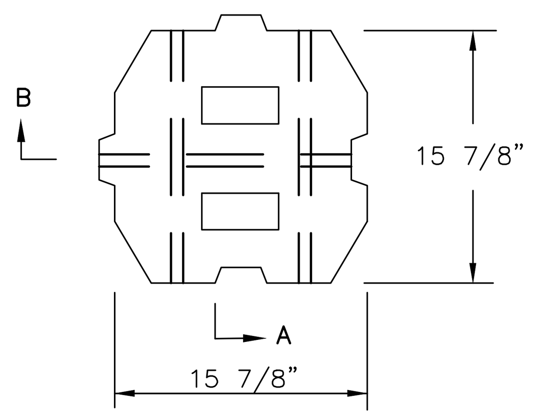
TYPICAL SECTION A



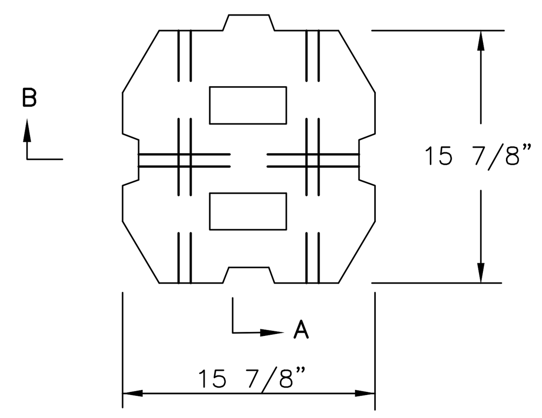
TYPICAL CONNECTION OF TWO MATS



TYPICAL SECTION OF CONNECTOR
N.T.S.



BD-500 OC UNIT
(MALE)



BD-500 OC UNIT
(FEMALE)

TECHINCAL SPECIFICATIONS

1) SHOREBLOCK® UNITS ARE MANUFACTURED IN ACCORDANCE WITH ASTM C90 AND C140 AND THE FOLLOWING CRITERIA:
   A) CONCRETE UNIT WEIGHT 130 -150 LBS/CF
   B) MINIMUM COMPRESSIVE STRENGTH - 4,000 PSI.
   C) MAXIMUM ABSORPTION - 5 %
   D) DIMENSIONAL TOLERANCE ± 1/8"
2) GALVANIZED OR POLYESTER CABLING

NOTE:
FEMALE BLOCK ARE USED ON THE OUTSIDE OF THE MATS TO ALLOW CRIMPING.

UNIT	WEIGHT LBS.	COVERAGE (lbs/sq.ft)	OPEN AREA
BD-500 OC	71 - 76	40 - 44	20%

ASSEMBLY SPECIFICATIONS

1) SHOREBLOCK® UNITS ARE SHOP ASSEMBLED IN A CABLED MATTERESS AS SHOWN ABOVE.
2) SHOREBLOCK® MATS ARE PLACED BY THE CONTRACTOR IN THE FIELD ON PREPARED SLOPES PER THE CONTRACT DRAWINGS.

SHOREBLOCK® BD SERIES BD-500 OPEN CELL
N.T.S.

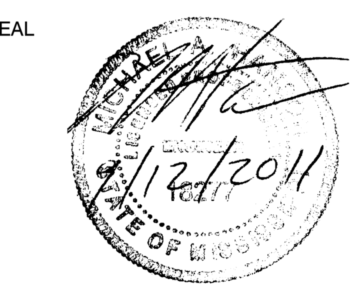
Dewberry®

Dewberry & Davis, Inc.
2301 REXWOODS DRIVE
SUITE 200
RALEIGH, NC 27607
PHONE: 919.881.9939
FAX: 919.881.9923

CAVENHAM FOREST INDUSTRIES, LLC
TURKEY CREEK FLOODWATER SPILLWAY
GULFPORT, MISSISSIPPI

C/O ENVIRONMENTAL MANAGEMENT SERVICES, INC.
P.O. BOX 15369
HATTIESBURG, MS 39404-5369

SEAL



KEY PLAN

SCALE

No.	DATE	BY	Description

REVISIONS

DRAWN BY	ACH
DESIGNED BY	CML
CHECKED BY	MAH
DATE	SEPT. 2011

TITLE

GENERAL DETAILS

PROJECT NO. 50023352

10

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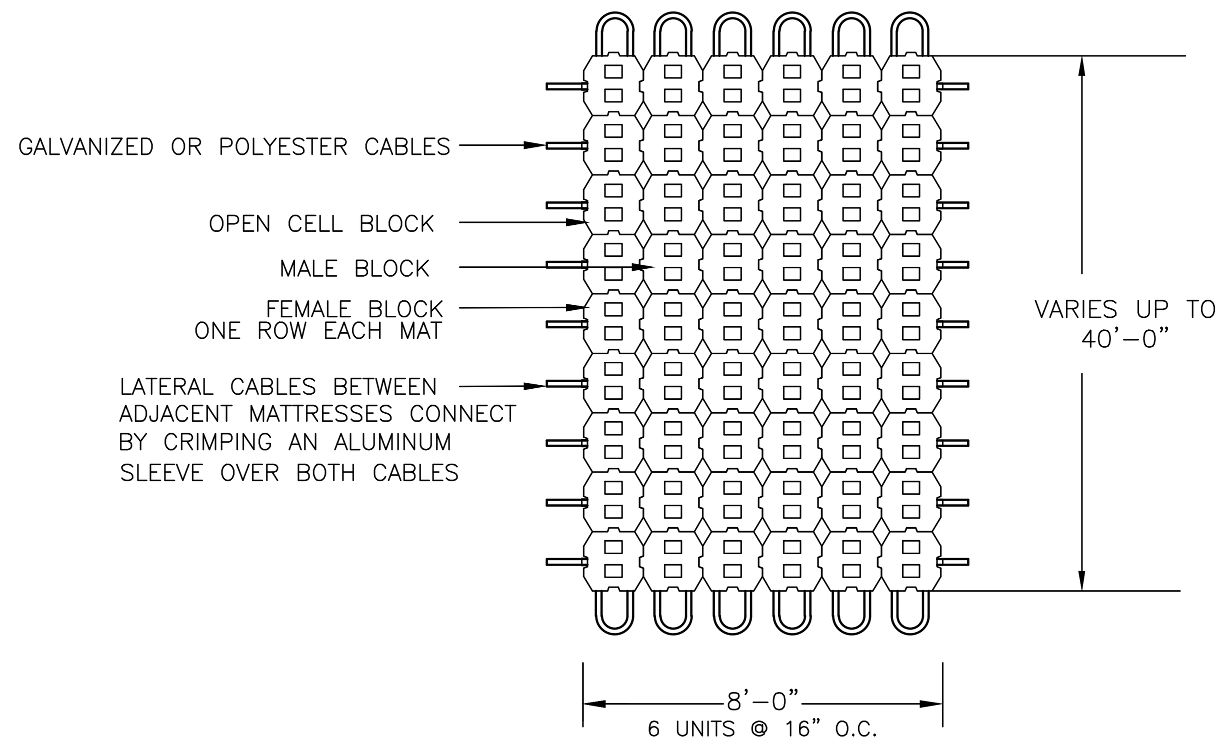
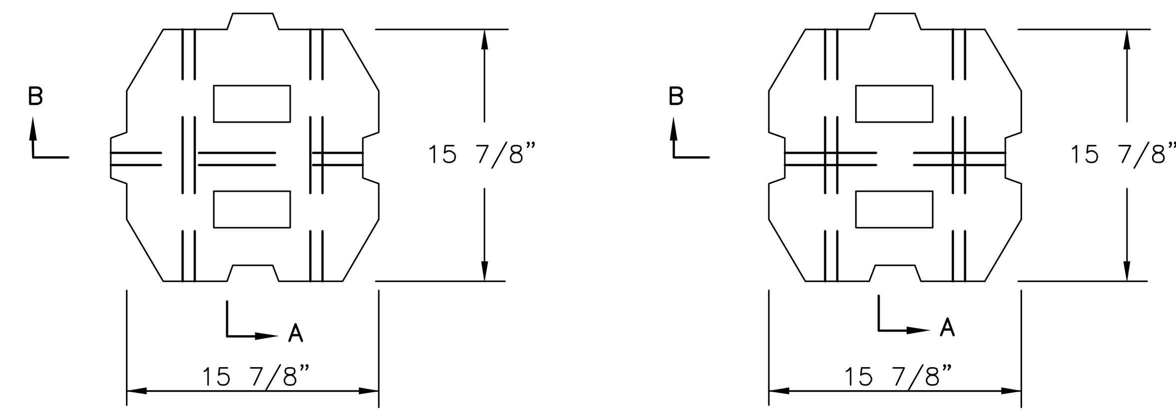
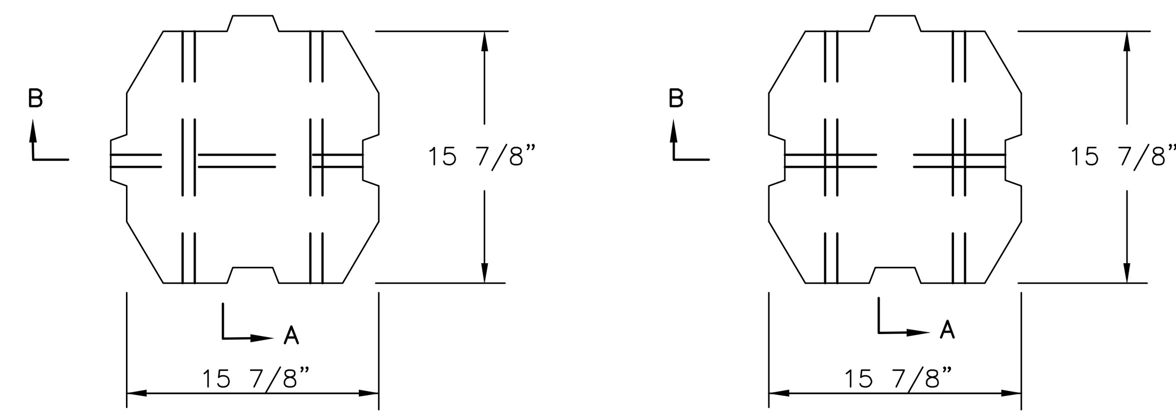


SHOREBLOCK® MAT ASSEMBLY DETAIL
N.T.S.



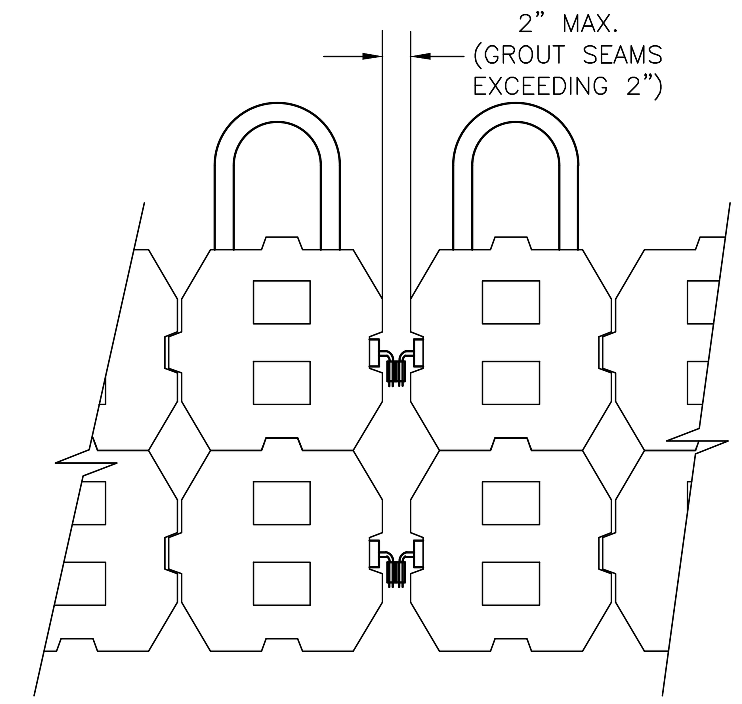
BD-500 OC UNIT
(MALE)

BD-500 OC UNIT
(FEMALE)

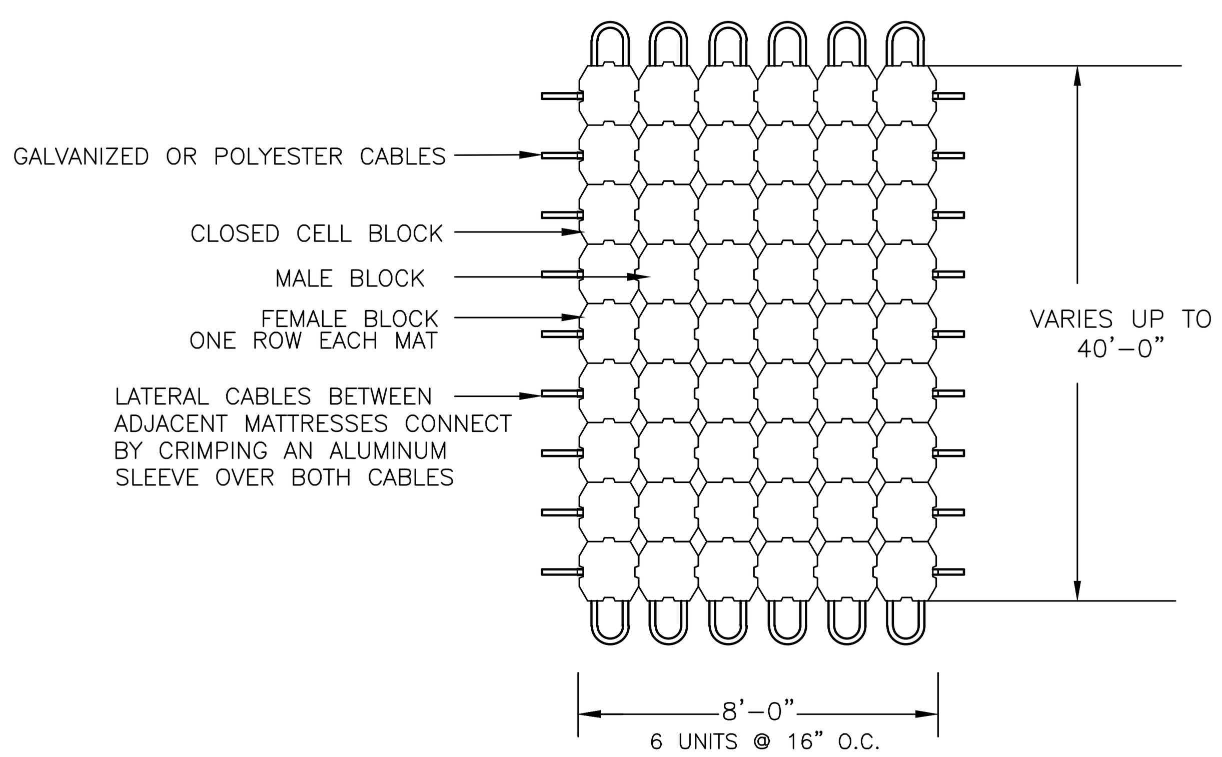


BD-500 CC UNIT
(MALE)

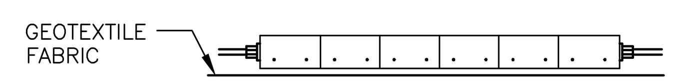
BD-500 CC UNIT
(FEMALE)



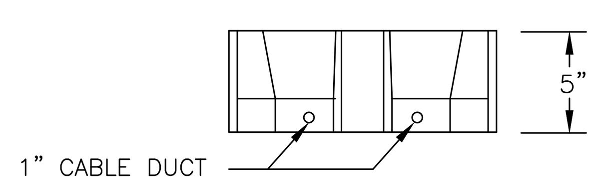
TYPICAL CONNECTION OF TWO MATS



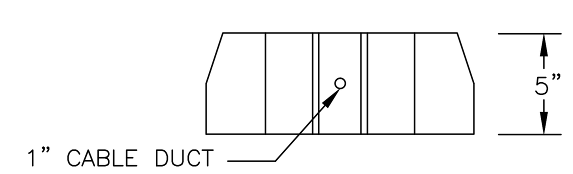
SHOREBLOCK® MAT ASSEMBLY DETAIL
N.T.S.



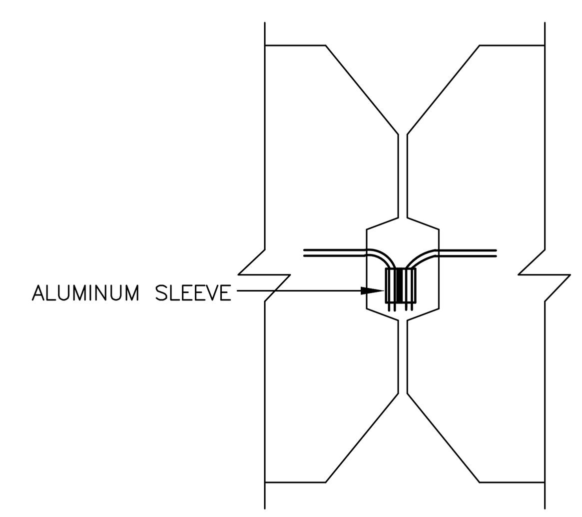
TYPICAL SECTION OF SHOREBLOCK®



TYPICAL SECTION B



TYPICAL SECTION A



TYPICAL SECTION OF CONNECTOR
N.T.S.

TECHINCAL SPECIFICATIONS

1) SHOREBLOCK® UNITS ARE MANUFACTURED IN ACCORDANCE WITH ASTM C90 AND C140 AND THE FOLLOWING CRITERIA:
   A) CONCRETE UNIT WEIGHT 130 –150 LBS/CF
   B) MINIMUM COMPRESSIVE STRENGTH – 4,000 PSI.
   C) MAXIMUM ABSORPTION – 5 %
   D) DIMENSIONAL TOLERANCE ± 1/8"
2) GALVANIZED OR POLYESTER CABLING

NOTE:
FEMALE BLOCK ARE USED ON THE OUTSIDE OF THE MATS TO ALLOW CRIMPING.

UNIT	WEIGHT LBS.	COVERAGE (lbs/sq.ft)	OPEN AREA
BD-500 OC	71 – 76	50 – 54	20%
BD-500 CC	82 – 88	40 – 44	7%

ASSEMBLY SPECIFICATIONS
1) SHOREBLOCK® UNITS ARE SHOP ASSEMBLED IN A CABLED MATTERESS AS SHOWN ABOVE.
2) SHOREBLOCK® MATS ARE PLACED BY THE CONTRACTOR IN THE FIELD ON PREPARED SLOPES PER THE CONTRACT DRAWINGS.

SHOREBLOCK® BD SERIES BD-500 OPEN AND CLOSED CELL
N.T.S.

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SEAL

9/12/2011

KEY PLAN

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PROJECT NO. 50023352

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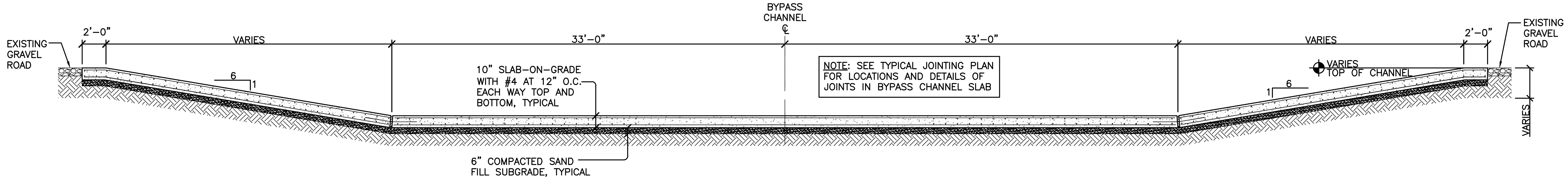
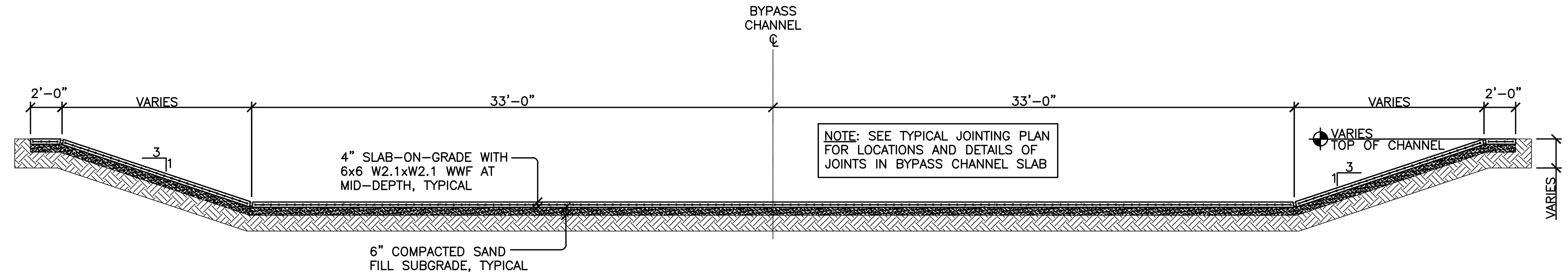
SHEET NO. 11 OF 12



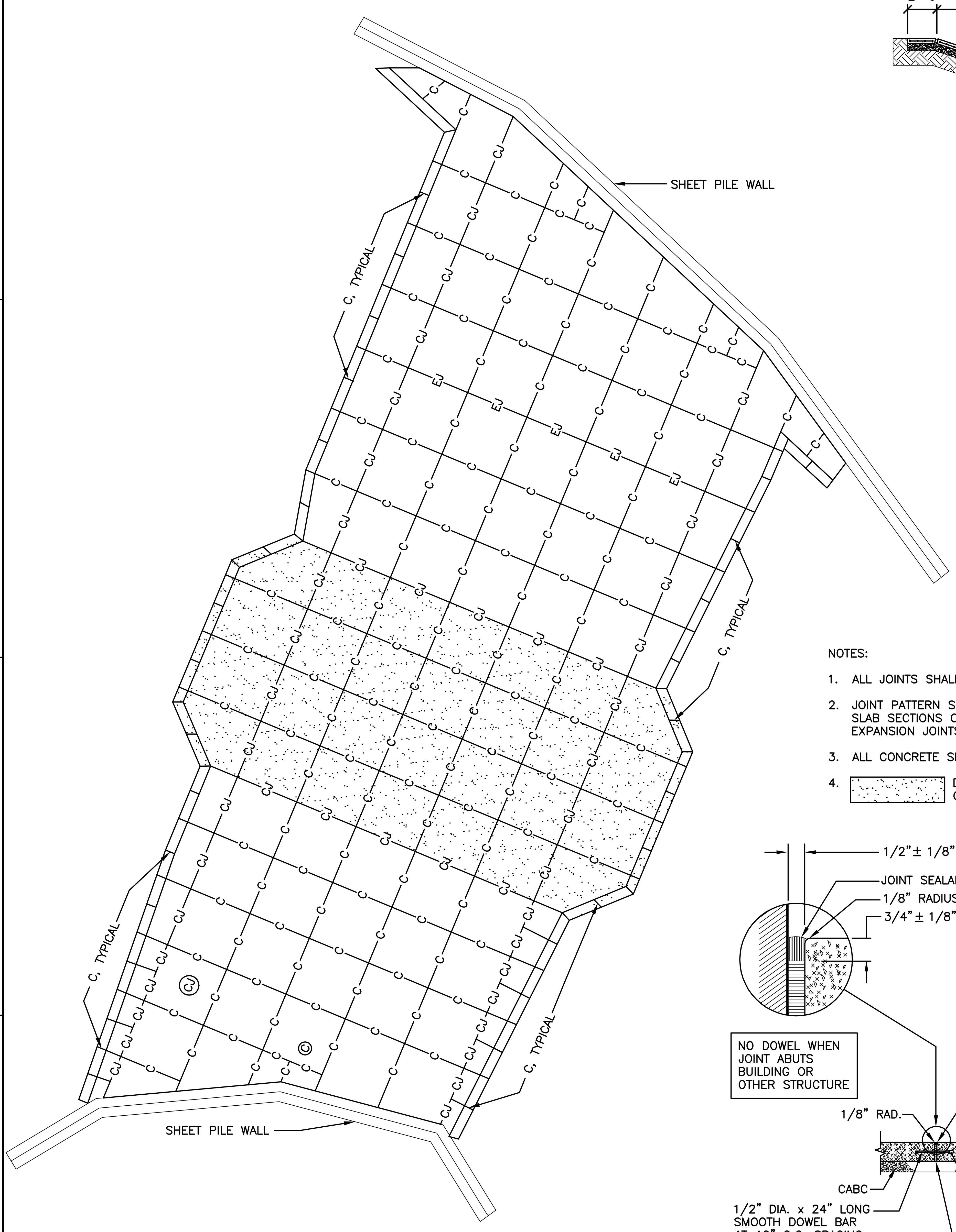
BYPASS CHANNEL SECTION (A-A) AT ACCESS CROSSING

SCALE: 3/16" = 1'-0"



TYPICAL BYPASS CHANNEL SECTION (B-B)

SCALE: 3/16" = 1'-0"

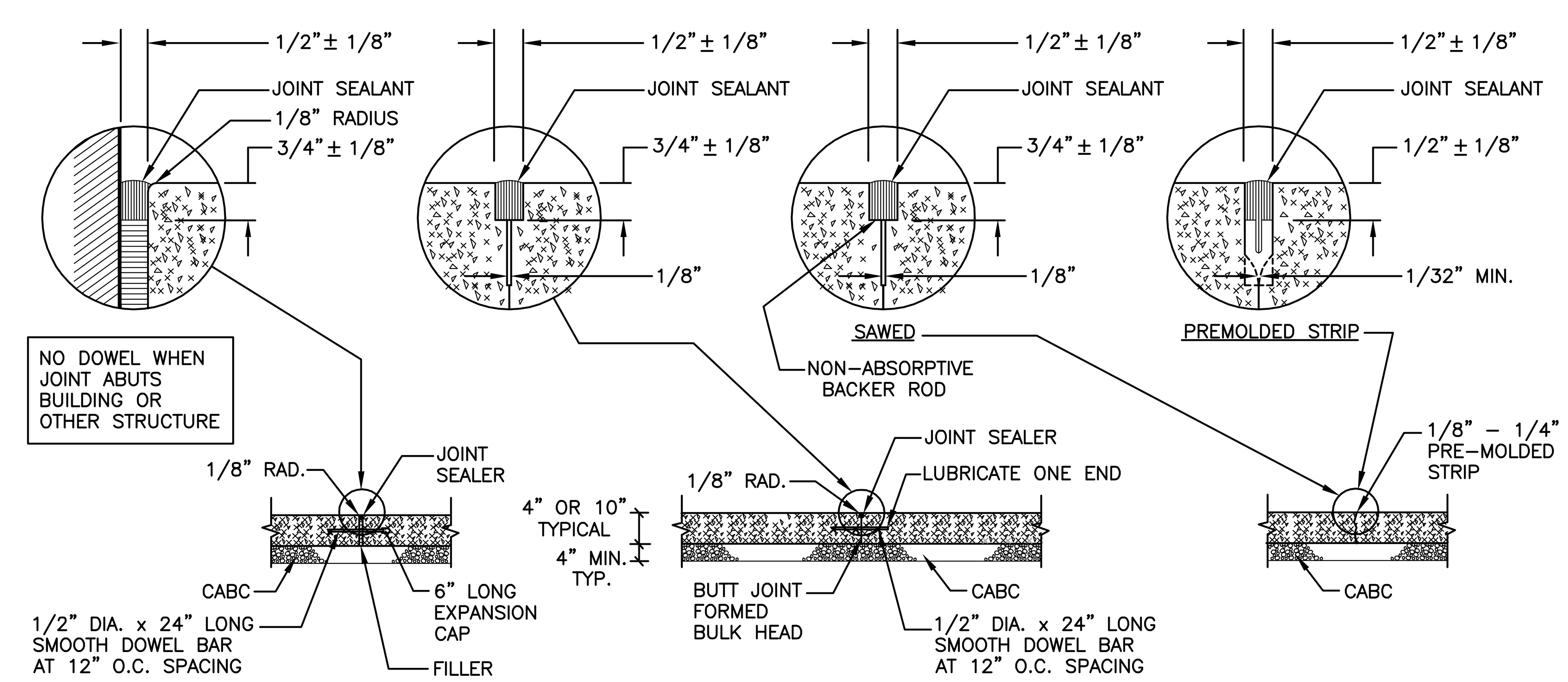


BYPASS CHANNEL JOINTING PLAN NOTES:

1. "CJ" DENOTES AN EXPANSION JOINT.
2. "C" DENOTES CONTRACTION JOINT.
3. "CJ" DENOTES CONSTRUCTION JOINT.

NOTES:

1. ALL JOINTS SHALL BE 2" DEEP.
2. JOINT PATTERN SHOWN IS SCHEMATIC. JOINT SPACING SHALL NOT EXCEED 15'–0" O.C AND ASPECT RATIO OF SLAB SECTIONS CREATED BY JOINTS SHALL NOT EXCEED 1.5:1 WHERE PRACTICAL. CONSTRUCTION JOINTS AND EXPANSION JOINTS SHALL BE PLACED AS SHOWN UNLESS NOTED OTHERWISE.
3. ALL CONCRETE SHALL BE NORMAL WEIGHT WITH A MINIMUM 28–DAY COMPRESSIVE STRENGTH OF 4,000 PSI.
4. DENOTES LOCATION OF ACCESS CROSSING



EXPANSION JOINT

TIED BUTT LONGITUDINAL CONSTRUCTION JOINT

CONSTRUCTION JOINT

CONTRACTION JOINT

SAWED OR PREMOLDED STRIP (LONGITUDINAL OR TRAVERSE)

TYPICAL JOINTING PLAN & DETAILS

SCALE: 1/16" = 1'-0"

GENERAL STRUCTURAL NOTES

TRAFFIC LOADS

1. HEAVY TRUCK TRAFFIC SHALL BE LIMITED TO THE AREA DENOTED AS "ACCESS CROSSING" AND IS ASSUMED TO BE LESS THAN OR EQUAL TO (10) TRACTOR–TRAILER CROSSINGS PER DAY.

FOUNDATIONS:

1. FOUNDATION DESIGN IS BASED ON A REPORT OF SUBSURFACE INVESTIGATION BY EUSTIS ENGINEERING COMPANY INC. OF MISSISSIPPI DATED SEPTEMBER 14, 2010 (EUSTIS ENGINEERING PROJECT NO. G0101)
2. ALL CONCRETE SHALL BE UNDERLAIN BY AT LEAST 6" OF COMPACTED SAND FILL. THE SAND BASE SHALL BE COMPACTED TO AT LEAST 95% OF ITS MAXIMUM DRY DENSITY WITHIN ±2% OF OPTIMUM WATER CONTENT USING ASTM D 1557. SAND FILL SHALL CONFORM TO THE REQUIREMENTS FOR AN A–3 MATERIAL ACCORDING TO THE AASHTO SOIL CLASSIFICATION SYSTEM OR FOR CLASS B3 BORROW EXCAVATION GIVEN IN SECTION 703.21 OF THE MISSISSIPPI STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, 2004 EDITION (MSSRBC). PRIOR TO TRANSPORTATION OF STRUCTURAL FILL TO THE SITE, A SAMPLE OF THE BORROW MATERIAL SHALL BE TESTED TO VERIFY CONFORMANCE WITH THE ABOVE SPECIFICATIONS.

REINFORCED CONCRETE:

1. UNLESS NOTED OTHERWISE, ALL CONCRETE WORK, DETAILING, FABRICATION, AND PLACING OF REINFORCING AND CONCRETE SHALL BE GOVERNED BY THE LATEST REVISIONS OF:
   A. ACI 301, ACI 315, AND ACI 318.
   B. CRSI RECOMMENDED PRACTICE OF PLACING REINFORCING BARS.
   C. ACI 306 AND ACI 305 FOR COLD AND HOT WEATHER CONCRETING RESPECTIVELY.
2. ALL CONCRETE SHALL BE NORMAL WEIGHT WITH A MAXIMUM UNIT WEIGHT OF 150 POUNDS PER CUBIC FOOT AND SHALL HAVE A MIN. 28 DAY COMPRESSIVE STRENGTH OF 4,000 PSI.
3. PROVIDE A 3/4" CHAMFER AT ALL EXPOSED CONCRETE CORNERS.
4. REINFORCING STEEL SHALL CONFORM TO ASTM A 615, AND SHALL BE GRADE 60 U.N.O.

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PROJECT NO. 50023352

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