PRELIMINARY DESIGN BASIS DOCUMENT FOR THE 881 HILLSIDE REMEDIAL ACTION

PREPARED FOR

ROCKWELL INTERNATIONAL
NORTH AMERICAN SPACE OPERATIONS
ROCKY FLATS PLANT

JUNE 1988

PREPARED BY

ENGINEERING-SCIENCE, INC.
Denver, Colorado

IN CONJUNCTION WITH

THE RALPH M. PARSONS COMPANY
Pasadena, California

ES ENGINEERING-SCIENCE

PRELIMINARY DESIGN BASIS DOCUMENT
FOR
881 HILLSIDE REMEDIAL ACTION
ROCKY FLATS PLANT
GOLDEN, COLORADO

Prepared for
Rockwell International
North American Space Operations
Rocky Flats Plant

Prepared by
Engineering-Science, Inc.
in conjunction with
The Ralph M. Parsons Company
Pasadena, California

June 16, 1988

FORWARD

This report represents work performed by Engineering-Science, Inc. in conjunction with the Ralph M. Parsons Company under Basic Ordering Agreement BA 55713HJ, Task Order BA98614 HJ for Rockwell International, North American Space Operations, Rocky Flats Plant.

This report represents the Preliminary Design Basis Document for the Building 881 Hillside Remedial Action.

TABLE OF CONTENTS

SECTION 2
BASIS FOR DESIGN

2.1 GENERAL

2.1.1 Design Documents

The documents listed below form the basis for the Facilities Engineering design of the Building 881 Remedial Action Plan:

(a) Design Criteria Manual, Volumes 1 and 2, Rocky Flats Plant.

(b) Design Criteria for Remedial Action 881 Hillside, Rocky Flats Plant, Volume 3.

(c) Feasibility Study Report for High Priority Sites, (881 Hillside Area) Volume I.

2.1.2 Quality Assurance

Design will ensure that applicable regulatory requirements and design basis for structures, modifications, additions, systems and components are correctly translated into specifications, drawings, procedures and instructions. The following are those attributes of design considered to be quality design requirements:

(1) Facilitate inspectability of equipment during fabrication, shipping, construction, testing, operation and maintenance modes;

(b) Include performance and acceptance criteria;

(c) Consider and facilitate control through identification of monitoring instrumentation and control requirements including instruments, controls, and alarms required for operating, testing and maintenance of the facility and process equipment;

(d) Consider and accomodate equipment handling, protection, storage, and shipping;

(e) Optimize maintainability/serviceability of equipment;

(f) Consider and specify material requirements including such items as compatibility, electrical insulation properties, protective coating and corrosion resistance;

(g) Facilitate material traceability through drawing and/or specification callouts, and;

(h) Consider personnel safety, and protection of economic investment.

Prescribed quality control level requirements for each particular system will be compatible with process-specified codes and standards, and will be assigned during the final design phase based on the criteria of Table 1. Ensurance that the quality levels are achieved during design, fabrication, construction, installation, and testing will be accomplished by imposing quality assurance programs on the contractors consistent with the quality level of each item. Table 2 lists the acceptable quality assurance program standards for each quality level.

2.1.3 Design Requirements/Codes and Standards

All facilities will be designed and sized for operation at the site elevation of approximately 6,000 feet above mean sea level. Facilities design has considered the impact of committing the use of existing Building 830 to the Building 881 Remedial Action Plan and its impact on future site utilization.

Unless otherwise directed, facility design will conform to the following codes and design standards where they apply and where not in conflict to those listed in Appendix 6.2 of the Design Criteria for Remedial Action 881 Hillside, Volume 3:

(a) ACI - American Concrete Institute

(b) AISC - American Institute of Steel Construction

(c) ANSI - American National Standards Institute

TABLE 1

QUALITY LEVELS AND CRITERIA

Quality Level	Criteria for Determining Quality Level
I	Applies to all structures, systems, and components primarily concerned with the ultimate containment of radioactive materials or other hazardous environmental conditions. A single failure in this highest level could cause any of the following conditions: 1) An abnormal release of radioactivity or other toxic materials to the outside environment. Abnormal release is defined as anything above the limits set forth in AL5480.1A, Chapter XI. Outside environment is defined as any place beyond the outer containment walls of the facility. 2) A hazardous condition that would jeopardize the life or health of personnel in the facility by direct exposure to fire, explosion, radiation, or other toxic materials. 3) Prevention of safe egress of personnel from a hazardous location. 4) Prevention of a safe shutdown of a critical system that could result in Conditions 1, 2, or 3 above.
IA	Applies to all structures, systems, and components where Quality Level I is not applicable and where a high level of reliability or other special considerations are required. A single failure in this category could cause one of the following conditions: 1) An unacceptable production halt. 2) An unacceptable loss of production, finished product tolerances, surface finish, metallurgical structure, or assembly configuration. 3) An unacceptable or unwanted condition.
II	Applies to all structures, systems, and components where Quality Levels I and IA are not applicable and where an intermediate degree of containment is needed to prevent the following conditions: 1) Failure of the structure, system, or component when a single additional failure of any kind could create a hazard of Quality Level I consequence. 2) A hazardous condition, which could result from a single-event failure, that would expose personnel to the risk of fire, explosion, radiation, or other toxic materials.
IIA	Applies to all structures, systems, and components where Quality Levels I, IA, or II are not applicable and which require a level of reliability, or other special considerations, greater than normal heavy industrial type. A single failure in this category could cause one of the following conditions: 1) Failure of a structure, system, or component when a single additional failure of any kind would create a Quality Level IA consequence. 2) An unacceptable or unwanted condition that would not be a part of normal or expected failure conditions.
III	Applies to all structures, systems, and components where Quality Levels I, IA, II, or IIA are not applicable and where the following conditions are met: 1) The item would not be required for the containment of radioactivity or other hazardous material and is not included in systems that are used for this degree of containment. 2) The item would not need to meet any special reliability or other special conditions other than those expected from normal use, function, or operation.

TABLE 2

QUALITY PROGRAM GUIDANCE FOR QUALITY LEVELS DURING DESIGN, FABRICATION, AND CONSTRUCTION OF ROCKY FLATS SYSTEM, STRUCTURES, AND COMPONENTS

Quality Level	Quality Assurance Program
I	ANSI/ASME NQA-1 with supplements
IA	ANSI/ASME NQA-1 with supplements
II	ANSI/ASME NQA-1 basic
IIA	ANSI/ASME NQA-1 basic
III	Manufacturers Standard Practice

Suppliers working concurrently on items of more than one quality level shall adequately segregate/identify items by quality level or comply with the higher-level QA program. When the design/construction code or standard contains a quality assurance program inconsistent with that of this table, the quality assurance program to be used shall comply, as a minimum, with the above table. In special circumstances and with the approval of RFP Quality Assurance, items designed as quality level I, IA, II, or IIA may be fabricated to quality standards other than NQA-1.

(d) ASTM - American Society for Testing and Materials

(e) AWS - American Welding Society

(f) AWWA - American Water Works Association

(g) IEEE - Institute of Electrical and Electronics Engineers

(h) IPCEA - Insulated Power Cable Engineers Association

(i) ISA - Instrument Society of America

(j) NEC - National Electric Code

(k) NEMA - National Electrical Manufacturers Assoc.

(l) OSHA - Occupational Safety & Health Act of 1970

(m) UBC - Uniform Building Code

(n) UPC - Uniform Plumbing Code

(o) U/L - Underwriters Laboratory

Seismic qualification of structures will be in accordance with Rocky Flats "Guide to Seismic Catagorization of Plant Systems and Components," Standard FE&C-014. The only identified structure for which seismic qualifications may be necessary is the storage tank pad/secondary containment structure.

2.1.4 Special Considerations

1. Contamination Control. All excavated materials shall be handled, in such a manner to minimize contaminant dispersion via aeolian dispersion or leaching. No excavated materials shall be transported or stored downgradient of the proposed french drain and shall be placed as a surface fill in the area of known contamination. Prior to excavation, soils shall be wetted to a moisture content exceeding optimum moisture as defined by Standard Proctor Compaction Testing, ASTM D-698. In general, during handling, the excavated materials shall be thoroughly wetted but shall not contain moisture to the extent which will interfere with the Contractor's

handling equipment. Excavated materials in stockpiles shall be immediately stabilized by covering or other approved means immediately upon conclusion of work at that particular stockpile. During final placement of waste excavated material the surface shall be stabilized by compaction and such covering as may be necessary so that aeolian dispersion is minimized. No earthwork shall be permitted during periods in which the wind velocity exceeds 30 mph. Long-term erosion protection shall be provided by seeding and irrigation as required or other means approved by the Owner. Irrigation shall not begin until after the french drain and treatment unit are functional. Earthwork operations shall be planned and conducted in a manner to promote maximum handling efficiency. Materials shall be immediately placed and compacted after initial excavation where practicable.

The concrete base supporting the influent storage tanks shall be designed to provide secondary containment with a capacity of at least equal to the volume of the largest tank.

Any excavated materials, as determined by the Owner's Health Physics representative (Radiation Monitor) exceeding the criteria for placement as fill shall be immediately segregated from other uncontaminated materials and placed in containers provided by the Owner. The Owner shall arrange for removal and disposal of these containers.

2. Safety Requirements. Design and construction accomplished will conform to Chapter 1 of DOE Order 5480.1, "Environmental Protection, Safety, and Health Protection Standards" and National Fire Protection Association (NFPA) No 241, "Safeguarding Building Construction and

Demolition Operations". All visitors and construction personnel will be required to adhere to all regulations and receive indoctrinations which pertain to them.

3. Safeguards and Security. This project shall be performed in compliance with the established Rocky Flats Plant Security Program. Most of this project is not located in a secured area. Unless the successful bidder can provide "Q" cleared personnel to perform all work within the 881 Security Area, the owner shall provide Guard Escorts during all operations within the 881 Security Area.

   Final specifications shall include requirements for the Contractor to obtain an approved "Land Use Request" from access control prior to entry into the buffer zone in accordance with HSE 20.01. Design investigations in the buffer zone shall also be subject to this requirement.

4. Health, Safety, and Environment. The Contractor will be required to adhere to the procedures established in the Rocky Flats Plant Health, Safety, and Environment (HS&E) Manual, and the Plant Policy Manual where applicable. In particular, the Contractor will be required to adhere to Plant Policy HMS 3-050, which requires that all personnel allowed on the plant site participate in applicable radiation exposure measurement programs. All personnel working on the project will be required to be fully briefed on HS&E rules and regulations that must be followed on the project and will be required to attend all applicable safety training indoctrinations.

   Final specifications for this project shall explicitly reference appropriate worker health and safety standards, including but not limited to, appropriate Rocky Flats Plant HS&E standards, appropriate sections of 29 CFR, and other relevant requirements.

Final specifications and work plans associated with design investigations shall include a site safety plan, in accordance with HSE 24.01.

A full time Radiation Monitor shall be provided by the Owner during all excavation.

5. Operation Interruptions. The Contractor will be required to perform all service and utility disconnects and tie-ins during normal working hours, insofar as it is practicable. The Contractor will be required to schedule disconnects and tie-ins to minimize downtime and interruptions to other facilities, and will be required to schedule all work with Buyer prior to the start of work.

2.2 REMOVALS

The following removals and relocations will be detailed in the Title II Design Package in support of implementation of the Building 881 Hillside Remedial Action Plan:

(a) Former motor generator concrete mounting pad in Building 830 in order to facilitate installation of new UV/hydrogen peroxide treatment system.

(b) Former ventilation unit concrete mounting pad in Building 830 to facilitate installation of small laboratory area.

(c) Abandoned wires and cables in existing conduit runs in order to facilitate installation of new cables and wires into conduits to support electrical requirements within Building 830.

2.3 PROCESS DESIGN

The treatment process has previously been selected as UV/Hydrogen Peroxide. Rockwell has confirmed this process as appropriate for the destruction of volatile organics contained in the contaminated ground water. Two manufacturers will be asked to submit bids under a Government Furnished Equipment (GFE) specification and the equipment

selected will be installed under the general construction contract. Additional process design parameters will be limited to development of the GFE specification to include operational control, interfaces, materials of construction, performance specification and warranty conditions. The GFE specification is the subject of Section 5 of this document.

2.4 CIVIL DESIGN

2.4.1 General

The civil engineering design will encompass the construction of the french drain system, the infiltration gallery, well 9-74, and interconnecting pipelines in addition to minor earthwork to be accomplished at the site. The following sections provide clarification of these items.

Finished grades shall be as close as practicable to the existing.

All buried pipes and utilities shall be protected from future mechanical damage by buried warning tapes.

Final plans and specifications shall require the installation of physical surface monuments at significant points of all buried structures. They shall include: end points, points of curvature, tangent points, and the location of branches.

Final plans and specifications shall include compaction specifications for all fill materials including waste fill, drain rock, pipe bedding, and filters.

All surfaces within the required excavation limits shall be cleared and grubbed. The top 12" of soil shall be stripped and stockpiled uphill of the proposed french drain in an area not proposed for fill placement. This topsoil shall be used for reclamation of surface areas within the zone of expected ground water and soil contamination (upgradient of the french drain).

2.4.2 French Drain

The proposed french drain shall be excavated so that its invert penetrates at least 2' of continuous (uninterrupted by permeable members) claystone bedrock. Permeable bedrock members encountered in the french drain excavation shall not be considered in determination of the design depth. The downstream face of the drain and exposed bedrock surfaces shall be lined with an impermeable synthetic membrane. The impermeable membrane shall be designed to prevent communication between exposed bedrock members and to limit flow beyond the drain during periods of high discharge or if mechanical failure of the pump system is experienced. Slush grouting of the exposed bedrock surfaces shall be considered and included in the design of the french drain if it is determined that it will substantially contriute to the hydraulic isolation of the bedrock members. A minimum 6" diameter perforated drainpipe shall be installed at or near the bottom of the drain. The drainpipe and upstream face of the drain shall be protected with granular or geotextile filters, as appropriate. A water tight collection sump shall be provided at the low point of the drain. The design depth of the sump shall be selected to provide such storage as may be desirable to produce pumping cycles compatible with the mechanical equipment selected. If the collection sump is not cast in place, all backfill beneath the bedrock surface shall be neat cement or concrete with additives to prevent shrinkage.

2.4.3 Well 9-74

Well 9-74 shall be replaced with an approximately 40 foot deep well. The well hole shall be logged during drilling by an experienced engineering geologist or geotechnical engineer to document the lithology. The well shall be at least 12" diameter, cased for its full length with 6" diameter stainless steel well casing, capped at the bottom and provided with surface sanitary seals and completion details as required by the State Engineer. The well shall extend 30'

below top of bedrock and shall have a screened interval extending between the bottom of the surface grouting and the bedrock surface. The well shall be grouted for its entire length below top of bedrock with neat cement grout containing additives to prevent shrinkage.

2.4.4 Infiltration Gallery

The infiltration gallery will be designed to re-inject treated ground water into the shallow aquifer immediately downgradient from the french drain system. The gallery will generally consist of an excavated trench, lined with a porous geotextile and backfilled with drain rock. Within the drain rock a perforated drainpipe will be installed. Since theoretical calculations as shown in Section 3 of this document do not yield a realistic solution, the total length of the infiltration gallery will be based upon the need to re-inject all of the ground water potentially extracted from the french drain system and therefore will be at least as long as the french drain system with an appropriate factor of safety involved to account for system and soil variances. The system will consist of a single linear pipeline or multiple parallel pipes depending upon site topography and soil characteristics.

2.4.5 Collection Sumps

Collection sumps shall be located on the french drain system and the Building 881 foundation footing drain system. The sumps shall consist of pre-cast concrete sumps suitable for installation of dual submersible pumps and shall have a removable cover.

2.4.6 Geotechnical Investigation

The Geotechnical Investigation as described in the "Design Criteria for Remedial Action 881 Hillside, Rocky Flats Plant", Volume 3 is included in Appendix A of this document. The report was prepared by Aguirre Engineers, Inc., Geotechnical and Materials Consultants.

2.5 ARCHITECTURAL DESIGN

The UV/hydrogen peroxide treatment system will be housed in an existing facility, Building 830. This building was previously used to house the Building 881 Isolated Power System. A sheltered storage area was subsequently erected adjacent to this facility to store gas bottles. The facility is now used as a storage shed and all previous mechanical equipment has been removed. The existing building is assumed to meet all existing design codes and standards for roof, floor and seismic loading and appropriate wind loads. Mounting pads for former mechanical equipment will be removed and the floor rebuilt flush to existing flooring to accomodate internal remodeling. The rebuilding of the floor will be adequate to support the expected mechanical equipment dead loads.

Remodeling will consist of building a laboratory facility at one end of the existing building. The laboratory will have an approximate area of 144 square feet and will be insulated and heated. The remainder of the building will house the treatment unit and hydrogen peroxide feed unit. The laboratory area will include a laboratory sink (cold water only), an electric space heater, and emergency eye wash/shower and a work bench and storage shelves. A new door and window will be installed into the treatment area and a new door will be installed to the exterior. The double door entrance to the existing building will be retained as the main entrance to the treatment area. The laboratory space will have insulated walls and ceiling with an R factor of 19. Cold water will be supplied to the laboratory space and electrical outlets will be supplied as appropriate. A sump shall be provided in the treatment plant area which shall be drained to one of the contaminated water influent tanks. Drainage from the laboratory facility will be routed to the nearest sanitary sewer. The safety shower/eye wash station shall be designed in accordance with Rocky Flats Plant Standard SMU 101 and HSE 7.04.

2.5.1 Utility and Equipment Supports

Supports and anchorages for items such as pipes and electrical conduits and equipment will be provided as required. All supports will be designed for the appropriate dead and live loads.

2.5.2 Finishes

Existing exterior building finishes and interior finishes in the treatment plant area will not be altered as a part of this work. Areas damaged by construction activities will be repaired in like and kind materials and finish. The new laboratory walls will consist of steel stud construction finished with 5/8 inch wall board sealed and primed and given two coats of an appropriate interior finish with color to be selected by Building Operations. Interior cabinetry will be sanded smooth and sealed (if wood) and given two coats of an appropriate white enamel paint. Metal, i.e. doors, shall be cleaned, primed and given two coats of paint consistent with environment and use. The floor of the laboratory area will be finished with floor tile.

2.6 STRUCTURAL DESIGN

Structural design elements of the work involve primarily the tank storage pad and secondary containment structure. The tank storage pad will consist of spread footing foundations and pad to distribute overall loading within design guidelines as prescribed by the geotechnical design report attached hereto as Appendix A. The pad will support three 15,000 gallon tanks with a potential combined weight of about 150,000 pounds including tank weight. The pad will have side walls to act as a secondary containment for the contents of one tank. The design will be consistent with current practice and standards.

Concrete reinforcement shall be designed and placed in accordance with Chapter 7 of ACI Standard 318. Reinforcement bars shall conform to American Society for Testing and Materials (ASTM) A-615.

2.7 MECHANICAL DESIGN

2.7.1 General

Mechanical design will include storage tanks, the treatment facility specification, hydrogen peroxide feed system specification (as a part of the GFE), the french drain sump, Building 881 foundation footing sump, well 9-74 and influent transfer pumps to the treatment unit.

2.7.2 Storage Tanks

Three tanks will be provided near the treatment unit. Two tanks shall be influent storage tanks and the other shall provide effluent storage. The use of insulation or supplementary heating for these tanks shall be avoided if determined that operational function is not impaired but the requirement for freeze protection shall be part of the required mechanical investigations. Welded steel vertical tanks have been selected and preliminarily sized at 15,000 gallons each (15 feet in diameter by approximately 15 feet high).

2.7.3 Treatment Plant and Hydrogen Peroxide Feed System

Refer to Section 5 for the Specification of these items.

2.7.4 Well 9-74

Well 9-74 will be provided with a submersible well pump of approximately 1 HP with a approximate 1" diameter riser pipe. The well shall be provided with a "pitless adapter" and the installation shall provide for replacement or servicing of the pump and motor. The pump selected in the final design shall be capable of delivering the total well capacity to the influent storage tanks.

2.7.5 Sump Pumps

The french drain collection sump(s) shall be provided with two submersible sump pumps, each with sufficient capacity to deliver the entire discharge of the french drain to the treatment unit. The pumps shall have level switches set so

that one pump functions as a backup unit. Pumps shall be equipped with fittings so that they may be removed for servicing or replacement without entering the sump.

The Building 881 foundation drain collection sump shall be mechanically equipped similar to the french drain collection sump.

All collection structures shall be equipped with totalizing flow meters with surface readouts mounted above the ground surface.

2.7.6 Influent Transfer Pumps

The influent tanks and piping shall be equipped with two floor mounted centrifugal transfer pumps designed to transfer contaminated influent from the storage tanks to the treatment unit. The pumps shall be controlled from the treatment unit control panel and shall be set so that one pump functions as a standby. Materials of pump construction shall be selected to be compatible with pumped solution.

2.7.7 Building 830 HVAC

Building 830 HVAC system will be designed to provide two zones compatible with the occupancies of both rooms. The treatment unit room shall be designed in accordance with the recommendations of the treatment equipment manufacturer. The office/laboratory space shall be insulated separately from other interior space. The office/laboratory shall require heating to maintain a minimum temperature of 69°F with a ventilating fan for summer use.

The treatment unit bay shall be heated to maintain the minimum temperature required by the treatment equipment manufacturer. Ventilation shall be provided in accordance with Rocky Flats Plant Standard SMU-302. It is believed the existing ventilation louvers located above the existing double door entry will meet this requirement.

2.8 PIPING

2.8.1 General

Piping covered under this section includes influent piping from the sumps to the influent storage tanks, piping to and from the storage tanks, piping from the effluent storage tank to the infiltration gallery and process and utility piping interior to Building 830.

2.8.2 Influent Piping

All below grade piping installed outside the known area of contamination (approximately 500 feet upgradient of the french drain) used to convey contaminated water to the influent storage tanks shall be double wall containment pipe. Each collection sump (not including the Building 830 sump) shall be equipped with a check valve, a manual shutoff valve and a frost proof hydrant installed within five feet of the facility to allow sampling. In addition each sump shall be equipped with a totalizing flow meter with above ground readout/indication on the sump pump control panel.

2.8.3 Transfer Piping

Transfer piping to and from the storage tank area and the treatment facility shall be single wall above grade PVC solvent welded pipe which is heat traced to prevent freezing.

2.8.4 Effluent Piping

Piping from the treated effluent storage tank to the infiltration gallery shall be single wall below grade PVC pipe sized to accomodate expected peak flow.

2.8.5 Utility Piping

Utility piping internal to Building 830 shall be sized to accomodate required flows. Below grade utility water piping shall be copper with a shutoff located inside the laboratory area. All utility water piping located within Building 830 shall be copper with soldered joints. Utility piping from the sump and drains to the influent tank shall be PVC.

2.9 ELECTRICAL

2.9.1 General

An electrical power supply system design will be provided for the new treatment facility and the sump and well pumps. All electrical equipment will be suitable for operation at 6,000 feet elevation. All electric installation shall meet current (latest edition) National Electric Code (NEC). An examination of the existing power being supplied to Building 830 will be made to assess its use and ability to supply power to new facilities. New conduits shall be run in an orderly manner and be grouped in banks wherever possible. Conduit shall be steel with appropriate fittings and connections.

2.9.2 Power Sources

Power for the new treatment unit will be obtained from an existing MCC within Building 881, designation MCC-1K10. Power for the previous IPS system was obtained from this panel and the ability to supply power to the new unit needs to be confirmed during the review of this report. Existing conduit running from this panel to Building 830 can be used providing new cables are installed. An existing conduit and cables currently provide power to the Building 830 lighting panel and appears to be adequate for building utility lighting and power recepticles. This system will remain in service.

13.8 kV overhead transmission lines are located within 200 feet of each of the ground water collection structures. Future plans include replacing these lines with buried lines. The design of electrical services for the collection structures shall be coordinated with the Area Maintenance Engineer and shall consider cost effective alternatives, compatible with future conditions.

A 13.8kV-240W transformer and a fusible cutout with lightning arrester, shall be required for well 9-74 along with approximately 75 feet of buried conduit and a NEMA control box mounted near the well. The pump shall be equipped with level switches causing the pump to cycle at intervals compatible with the selected equipment. The cycle time shall be coordinated with the casing storage provided in the well design.

The electrical service for both the french drain collection sump and the Building 881 foundation drain collection sump shall be similar to that provided above for well 9-74. Both of these structures shall require approximately 200 feet of buried conduit and provisions shall be made to control 2 pumps at each location. The pump level switches shall be set such that one pump functions only during anomalously high discharges or during failure of the primary pump.

2.9.3 Motors

All motors will be rated at 6,000 feet above mean sea level and will be provided with an insulation Class B or F. Motors will have a minimum rated service factor of 1.15 and will be selected based upon intended use and type of service. All bearings on motors larger than 1 HP will have a B-10 rating of 5 years or 20,000 hours whichever comes first. Motors smaller than 1 HP will be furnished with lubricated for life bearings. Motors used with pumps shall be provided as an integral assembly with the pump under a single supplier responsbility. Compatibility of pumps and motors shall be the responsibility of the single supplier.

2.9.4 Lighting and Receptacles

Power for lighting and receptacles will be provided as described in Section 2.9.2. Existing flourescent lighting in Building 830 shall be rearranged and removed as required to support the treatment plant installation and the new laboratory area. Likewise, existing receptacles shall be rear-

ranged or removed to accomodate new facilities. Receptacles, if not already equipped, shall be equipped with ground fault interrupters.

2.9.5 Grounding

A grounding conductor will be pulled through all conduits per Rocky Flats Standard SE-103, "Electrical Wiring". The new treatment system will be grounded to the existing Building 830 grounding system.

2.9.6 Wiring and Identification

Wiring will be in accordance with Rocky Flats Standard SE-103, "Electrical Wiring". Electrical systems will be identified in accordance with Rocky Flats Standard SE-104, "Identification of Electrical Systems". Wire markers will be provided at the ends and intermediate pull boxes and junction boxes of each single conductor; multiconductor cable jacket and each individual conductor; shielded cable jacket; and multicable jacket and each individual cable. Each wire marking will be unique and of a developed system which may be carried throughout the entire building facility.

2.10 ALARMS AND INSTRUMENTATION

2.10.1 General

Instruments shall be industrial grade equipment from established manufacturers; state of the art type instruments will be provided. Selection of instruments will be based on maintainability, provisions for field calibration, flexible operating characteristics, and materials of construction.

In general, high level alarms shall be required on all tanks and malfunction alarms shall be required for all pumps.

2.10.2 Treatment Plant Control Panel UCP-1

The UV/hydrogen peroxide treatment unit shall be provided with a Unit Control Panel which provides for complete operation and control of the treatment plant functions in

accordance with the manufacurers requirements and shall include: high temperature alarms and shutoffs for the reactor vessel and lamp drive unit, temperature gauges for the reactor vessel and lamp drive unit, high pressure shutoff and alarm for the reactor vessel and pressure gauge for the reactor vessel, a lamp drive moisture indicator and shutoff, a low flow indicator and shutoff, high and low water level (from probes in the influent tanks) alarm and shutoff, a high water level alarm and shutoff (from a probe in the effluent tank), integrated transfer pump control and hydrogen peroxide feed unit control, run time indicator, instantaneous and totalizing flow indicator, and amperage and on/off switches for each lamp or banks of lamps. UCP-1 shall also be equipped with a tank selector switch indicating which influent tank is being used (manually selected by the operator) and connecting the appropriate probes to the alarm and shutoff circuits. Refer to Section 5 for unit specifications.

2.10.3 Hydrogen Peroxide Unit Control Panel UCP-2

The hydrogen peroxide feed control unit shall operate and be controlled from the treatment plant unit control panel, UCP-1. Individual on/off/auto switches will be provided for each metering pump. In the auto mode, control will be from UCP-1. Refer to Section 5 for equipment specifications.

2.10.4 Building 830 Control Panel MCC-1

The main control center for Building 830 shall include a main power switch and switches for UCP-1 and UCP-2 in addition to switches for the transfer pumps, laboratory space heater and fan motor and Building 830 sump pumps.

2.10.5 Sump Pump Control Panels

Each sump pump shall be equipped with an above ground control panel with an on/off/auto switch. Also included in the control panel will be the remote flow totalizer. Sump pumps will be configured to selectable between active and standby.

The active pump shall be controlled by tilting float level sensors, with a low water shutoff and a high water on. The control panel will be housed in a NEMA 3R weather tight enclosure.

2.10.6 Well 9-74 Control Panel

The control panel for well 9-74 shall be similar to that described for the sump pumps in Section 2.10.5, except that only one submersible pump will be installed and hence no active/standby switching is necessary. Pump operation shall be controlled by a low water shutoff and a high water on probe installed in the well casing.

2.10.7 Building 830 Sump Pumps

The sump in Building 830 shall be controlled similar to those described in Section 2.10.5 except that the control panel shall be mounted in conjunction with MCC-1 in Building 830 and no flow indication will be provided.

2.10.8 Tank Level Indication and Pump Alarm Panel MCP-1

The two influent storage tanks shall be equipped with both high and low water level probes. The probes shall provide a high and low water signal to MCP-1 and UCP-1 respectively, and, depending upon which tank is selected at UCP-1, shall provide a low water (unit shutoff) signal at UCP-1 or a high water (alarm) signal at MCP-1. The effluent tank shall be equipped with a high water probe to be connected to UCP-1 and MCP-1 and shall provide a high effluent level alarm and signal equipment shutdown. Additionally, a conductive strip level element and level indicator will be provided for each tank with the indicators mounted on MCP-1. Sump and well pump malfunction will be sent via buried cable to MCP-1 with indicators signaling the location of the alarm. All alarm signals will activate an automatic rotary type telephone dialer to alert the appropriate personnel of the alarm condition.

2.11 FIRE PROTECTION

Fire protection for Building 830 and the laboratory area will be provided by installation of two 25 pound dry chemical type extinguishers, wall mounted, in the treatment unit area and in the laboratory area.

All mandoors shall be provided with illuminated exit signs in accordance with Rocky Flats Plant Standard SE-204.

The building shall be non-combustible construction throughout and will normally be unoccupied. Combustible contents, other than minimal necessary files and records, shall not be maintained within the building.

The building shall be non-combustible construction throughout and will normally be unoccupied. Combustible contents, other than minimal necessary files and records, shall not be maintained within the building.

SECTION 3

CALCULATIONS

INDEX

Discipline

New

FILE NAME IS 1025 ROCKY FLATS DRAIN LINES 5/88

PT#	NORTHING	EASTING	DESCRIPTION	ELEVATION
1	748275.194	2084153.433	1+00 ORANGE	5977.00
2	748285.194	2084153.442	1+00 BLUE	5977.00
3	748285.071	2084313.446	2+60 BLUE	5978.20
4	748275.103	2084273.436	2+20 ORANGE	5979.00
5	748274.931	2084493.439	4+40 ORANGE	5974.37
6	748060.383	2084225.537	4+40 ORANGE	5960.70
7	747854.983	2083917.785	8+10 O&Y	5945.10
8	748010.020	2083592.924	1+00 YELLOW	5985.80
9	747829.134	2083971.932	5+20 YELLOW	5939.47
10	747837.928	2084306.819	7+07.19 Y&B	5927.10
11	747737.940	2084305.336	8+07.19 BLUE	5917.30
12	747853.277	2084891.764	14+40 YELLOW	5896.80
13	747970.067	2084824.434	8+90 ORANGE	5919.60
14	747943.980	2085173.461	12+40 O&Y	5892.50
15	747957.467	2085215.396	17+80 YELLOW	5897.80
16	748028.274	2084783.357	WELL W-9-74	5925.10
17	748324.190	2084157.977	COR. 830	.00
18	748312.190	2084157.966	COR. 830	.00
19	748312.194	2084153.466	COR. 830	.00
20	748300.194	2084153.455	COR. 830	.00
21	748300.211	2084134.455	COR. 830	.00
22	748312.211	2084134.466	COR. 830	.00
23	748312.218	2084125.966	COR. 830	.00
24	748324.218	2084125.977	COR. 830	.00
25	748290.194	2084153.446		.00
26	748290.211	2084134.446		.00
27	748270.211	2084134.429		.00
28	748270.194	2084153.429		.00
116	748035.613	2083624.339	MON NO. 305	5986.33
117	748425.241	2084732.492	MON NO. 306	5990.38
118	748329.867	2084256.550	TS 306 A	.00

1) S 56° 12' 19" E 370.00'

2) S 13° 41' 32" E 220.00'

3) S 59° 57' 19" E 220.00'

5) S 47° 21' 12" E 450.00'

13) S 35° 43' 32" E 350.00'

14)

FILE NAME IS 1025 ROCKY FLATS DRAIN LINES 5/88

PT#	DESCRIPTION	ELEVATION
	ORANGE LINE	
29	1+85	5974.3
30	2+20 <POINT	5975.0
31	2+50E	5977.2
32	3+00E	5975.7
33	3+50E	5976.8
34	4+00E	5976.9
35	4+40E <POINT	5974.4
36	4+50E	5972.6
37	5+00E	5968.4
38	5+50E	5963.6
39	6+00E	5954.7
40	6+50E	5946.3
41	7+00E	5939.5
42	7+50E	5932.1
43	8+00E	5926.2
44	8+50E	5921.9
45	8+90E <POINT	5919.6
46	9+50E	5912.3
47	10+00E	5910.4
48	10+50E	5910.0
49	11+00E	5908.2
50	11+50E	5903.9
51	12+00E	5897.6
52	12+40E Y&O INTER	5892.5
	BLUE LINE	
53	2+00	5975.5
54	2+50	5978.5
55	2+60 <POINT	5978.2
56	3+00	5974.8
57	3+50	5971.0
58	4+00	5970.0
59	4+50	5961.0
60	5+00	5962.0
61	5+50	5947.4
62	6+00	5940.1
63	6+50	5932.1
64	7+07.19 Y&B INTER	5927.1
65	7+57.19	5922.1
66	8+07.19 END LINE	5917.3

ORANGE LINE

67	2+50S	5969.2
68	3+00S	5965.6
69	3+50S	5964.4
70	4+00S	5963.4
71	4+40S <POINT	5960.7
72	4+50S	5960.7
73	5+00S	5959.1
74	5+50S	5955.4
75	6+00S	5952.8
76	6+50S	5951.3
77	7+00S	5950.3
78	7+50S	5944.8
79	8+10S Y&O INTER	5945.1

YELLOW LINE

80	1+00	5985.8
81	1+50	5980.7
82	2+00	5974.6
83	2+50	5969.9
84	3+00	5965.5
85	3+50	5960.8
86	4+00	5957.3
87	4+50	5944.8
88	5+00	5939.7
89	5+20 <POINT	5939.5
90	5+50	5937.8
91	6+00	5937.7
92	6+45	5938.7
93	7+00	5934.8
94	7+50	5933.8
95	8+00	5929.8
96	8+50	5927.3
97	9+00	5927.0
98	9+50	5928.7
99	10+00	5930.1
100	10+50	5929.5
101	11+00	5927.1
102	11+50	5924.0
103	12+00	5916.4
104	12+50	5912.3
105	13+00	5907.9
106	13+50	5902.7
107	14+00	5899.5
108	14+40 <POINT	5896.8
109	15+00	5901.2
110	15+50	5902.3
111	16+00	5901.4
112	16+50	5899.6
113	17+00	5895.3
114	17+50	5893.5
115	17+80 END LINE	5897.8

Rocky Flats

Rick S.
Randy G.

1025

5/16/88

001058

			HI = 5.71	
			ROD = -4.78	
			SD	
			1174.92'	ELEV DIFF -4.85'
			HD	
			1174.91'	

			VB =	
			① = 97-48-33	
			② = 262-11-57	
			③ = 97-48-18	

			VK =	
			① = 98-55-20	
			② = 261-04-22	
			③ = 98-55-29	

PT e 306 BS 305

305 VB

① = 90-14-42

② = 269-45-44

m = 90-14-29

STA 17+80

HB = 243-27-36

SD = 678.60'

HD = 672.31'

ROD = 6.00

STA 14+40

HK = 273-48-40

SD = 601.00'

HD = 593.72'

ROD = 6.00

PLANT COORDINATES

306	35439.9190	ELEV =
	21621.3782	5990.38'
	N-20-49-03E 1174.96'	
305	35053.8528	ELEV =
	20511.6815	5986.33

34970.5564 ← STA 17+80
22102.7557

34867.1376 ← STA 111+10
21998.9841

CONT PAGE (1058)

001059

STA 5+20 → 34846.3279 / 20858.8797

HA = 341-17-00 VA =

SD = 967.32' ① = 92-35-48

HD = 966.33' ② = 267-24-28

RoD = 12.80' ③ = 92-35-40

STA 1+00 → 35028.1633 / 20480.1685

HA = 359-21-06 VA =

SD = 1212.87' ① = 90-16-01

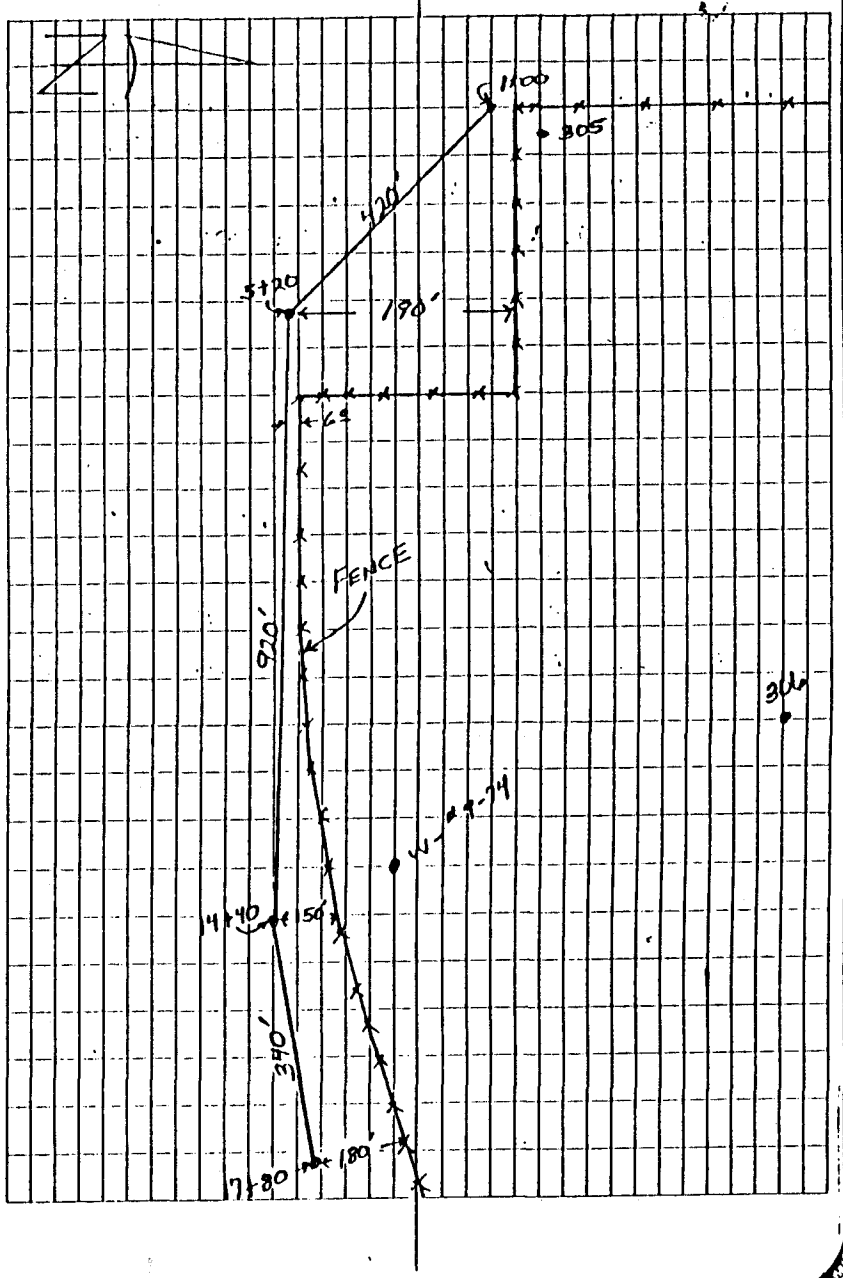
HD = 1212.86' ② = 269-44-18

RoD = 4.28 ③ = 90-15-42

W-9-71 → 35012.7887 / 21670.9521

HA = 282-01-12 VA = 99-24-03

SD = 405.66 HD = 100.21'



CONT PAGE (1059)

001060

PC 306 BS 305 ES 306A

HI ① = 8-02-24 V∡ ① = 90-17-00

② = 16-04-50 ② = 269-43-06

Ⓜ = 8-02-25 ⑪ = 90-16-57

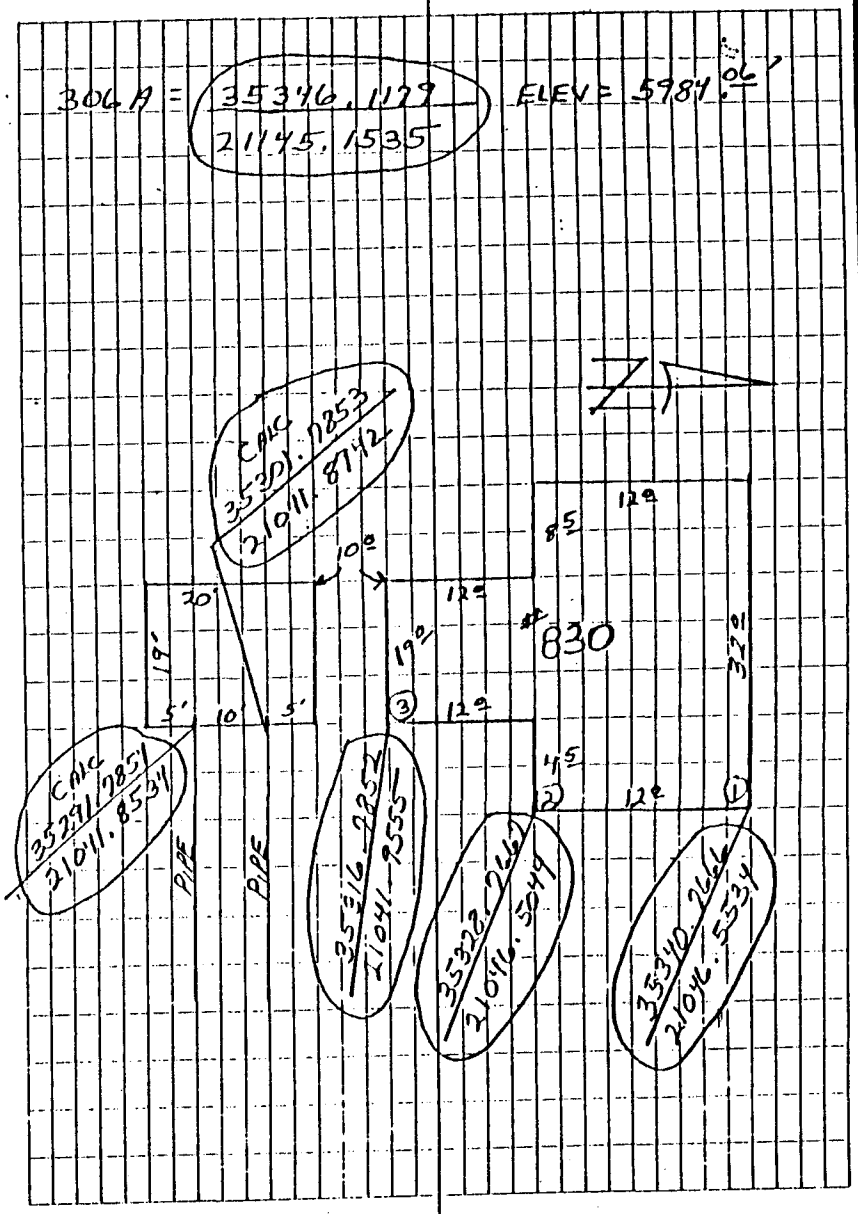
SD = 485.41' HD = 485.40'

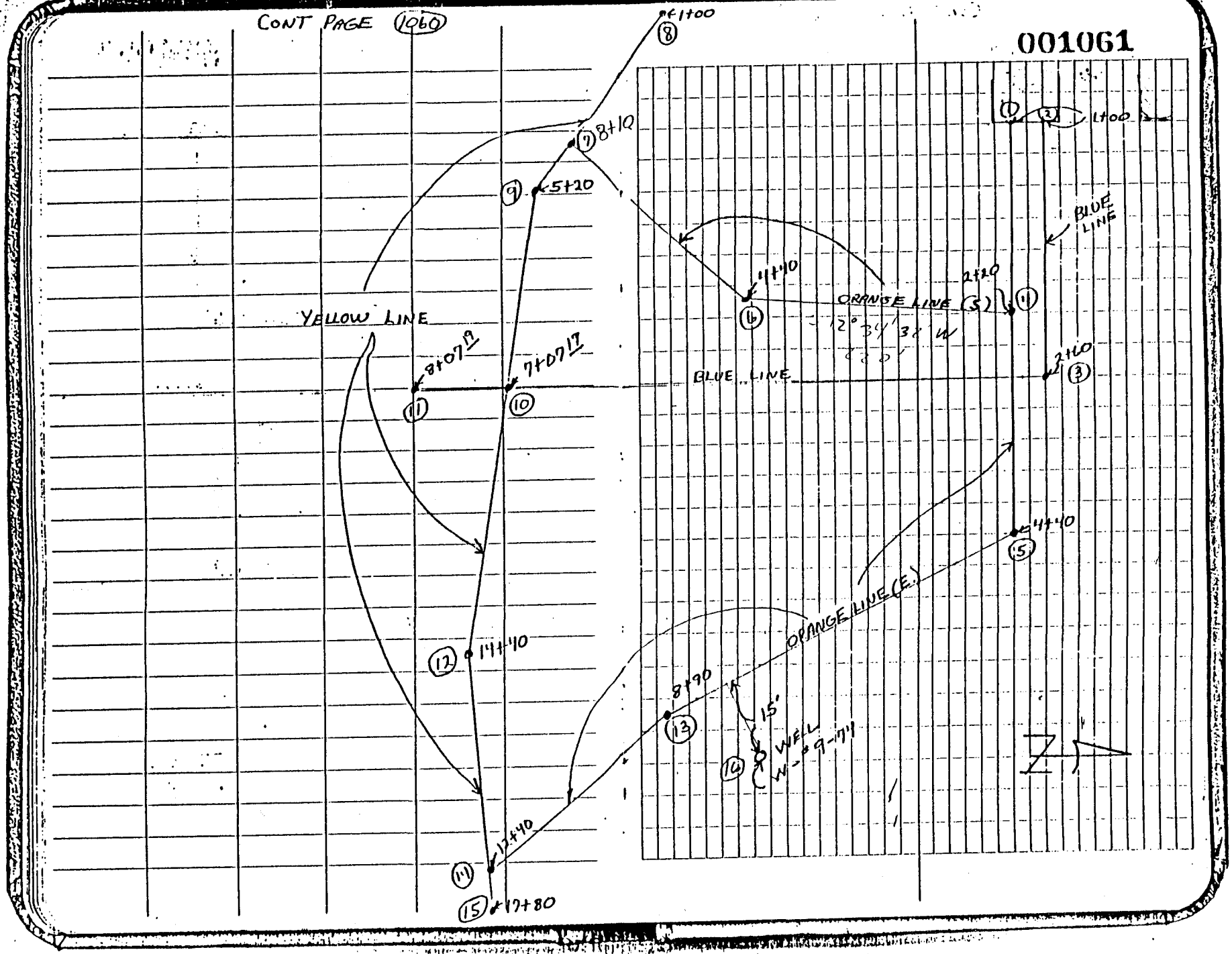
PC 306A BS 306 ∡ RIGHT

HI = 5.27 ROD = 4.28

			SD	HD
①	188-02-08	93-51-06	98.76	98.71
②	181-05-50	93-53-48	100.41	100.18
③	125-07-42	93-49-48	107.50	107.26

306A = 35346.1179 21145.1535 ELEV = 5984.06'




CONT PAGE (1060)
8+00
8
8+10
9
5+20
YELLOW LINE
8+07 19
7+07 17
11
10
11+40
16
ORANGE LINE (S)
12° 34' 32" W
2+20
1
BLUE LINE
BLUE LINE
2+10
3
4+40
5
ORANGE LINE (E)
12
14+10
8+90
13
15'
14
WELL
W-9-71
11
12+40
15
17+80
1
2
1+00

CONT PAGE (1061)

REF TO PAGE (1061)

LIST OF COORD

(1)	35291. 7854	21041. 8534
(2)	35301. 7853	21041. 8942
(3)	35301. 1322	21201. 8929
(4)	35291. 2955	21161. 8524
(5)	35290. 3975	21381. 8506
(6)	35096. 7329	21113. 2436
(7)	34877. 3495	20801. 8161
(8)	35028. 4633	20480. 4685
(9)	34846. 3279	20858. 8997
(10)	34854. 0126	21193. 7916
(11)	34754. 0290	21191. 9799
(12)	34867. 4376	21778. 7841
(13)	34984. 4411	21711. 8392
(14)	34957. 2074	22060. 7778
(15)	34970. 5564	22102. 7557
(16)	35042. 7882	21690. 9571

STA	+	HI	−	ELEV	
306				5990.38	5990.38'
℄	8.80	99.18			
306 A			15.12	5984.06	
℄	14.95	99.01			
306			8.63	5990.38	
306 A				5984.06	
℄	0.76	84.82			
TP#1			20.73	5964.59	
℄	2.73	67.32			
TP# 2 TBM (B)			10.08	5957.24	
℄	13.53	70.77			
TP# 3			2.77	5968.00	
℄	20.63	88.63			
TP#4 TBM (A)			1.11	5982.52	
305			2.21	5986.42	5986.33'

STA	+	HI	−	ELEV
		ORANGE LINE		
306A				5981.06
⊓	0.67	5984.73		
1+85			10.4	5974.3
2+20	+ POINT		9.7	5975.0
2+50 E			7.5	5977.2
3+00 E			9.0	5975.7
3+50 E			7.9	5976.8
4+00 E			7.8	5976.9
4+40 E	+ POINT		10.36 <	5974.37
⊓	1.58	5975.95		
4+50 E			3.4	5972.6
5+00 E			7.6	5968.4
5+50 E			12.4	5963.6
6+00 E			21.3	5954.7
TP#1			19.98 <	5955.97
⊓	2.13	5958.10		
6+50 E			11.8	5946.3
7+00 E			18.6	5939.5
7+50 E			26.0	5932.1
TP#2			23.85 <	5934.25
⊓	1.26	5935.51		
8+00 E			9.3	5926.2
8+50 E			13.6	5921.9
TP#3	< TBM (E)		17.08 <	5918.13

STA	+	HI	−	ELEV
PT	1.17	5919.40		
8+90	℄ POINT		3.74	5917.40
9+50			7.3	5912.3
10+00			9.2	5910.1
10+50			9.6	5910.0
11+00			11.4	5908.2
11+50			15.2	5903.9
12+00			22.0	5897.6
12+40	INTERSECTION YELLOW - ORANGE		27.1	5892.5
17+80	END YELLOW LINE		21.80	5897.80
		BLUE LINE		
306 A				5984.06
	1.33	5985.37		
2+00			9.7	5925.5
2+50			6.9	5978.5
2+60	℄ POINT		7.2	5978.2
3+00			10.6	5974.8
3+50			14.4	5971.0
4+00			15.1	5970.0
4+50			24.4	5961.0
TPW 1			24.80	5960.59
PT	2.64	5963.23		
5+00			1.2	5962.0
5+50			15.8	5947.4

001066

STA	+	HI	−	ELEV
		5963.23		
6+00			23.1	5940.1
TP#2			23.14	5940.09
"	3.42	5943.51		
6+50			11.4	5932.1
TP#3	TBM ©		15.05	5928.46
"	3.24	5931.70		
7+07.19	← INTERSECTION YELLOW-ORANGE LINES		4.6	5927.1
7+57.19			9.6	5922.1
8+07.19			14.4	5917.3
TBM "AA"			11.25 <	5919.95
		ORANGE LINE		
306A				5984.06
"	1.33	5985.39		
2+50 S			16.2	5969.2
3+00 S			19.8	5965.6
3+50 S			21.0	5964.1
4+00 S TP#1			21.98 <	5963.41
"	3.26	5966.67		
4+40 S	X POINT		6.0	5960.7
4+50 S			6.0	5960.7
5+00 S			7.6	5959.1

CONT PAGE (1066)

001067

STA	+	HI	−	ELEV	
5+50 S			11 3	5955 4	
TP#2	TBM (B)		9 43	5957 24	5952.24
TP	3.22	5960 76			
6+00 S			8 2	5952 8	
6+50 S			9 7	5951 3	
7+00 S			10 7	5950. 3	
7+50 S			16 2	5944. 8	
8+10 S	INTERSECTION YELLOW - ORANGE		15 9	5945 1	

001068

STA	+	HI	−	ELEV.
		YELLOW	LINE	
TBM (A)				5782.52
//	1.16	5788.68		
1+00			2.9	5785.8
1+50			8.0	5780.7
2+00			14.1	5774.6
2+50			18.8	5769.9
3+00			23.2	5765.5
TP#1			21.03 <	5767.65
//	2.02	5769.67		
3+50			8.7	5760.8
4+00			12.4	5757.3
4+50			24.7	5744.8
TP#2			20.71 <	5748.93
//	12.01	5760.94		
5+00			21.2	5739.7
5+20 TP#3 X POINT			21.47	5739.42
TBM (B)			3.22	5757.22
TP#3				
//	3.32	5742.79		
5+50			5.0	5737.8
6+00			5.1	5737.7
6+45			4.1	5738.7
7+00			8.0	5734.8
7+50			9.0	5733.8

CONT PAGE (1068)

001069

STA	+	HI	−	ELEV
		YELLOW	LINE	
8+00		5912 29	13 0	5929 8
8+50			15 5	5927 3
TBM "AA"			22 90 <	5919 87
℄	11 75	5931 64		
9+00			4 6	5927 0
9+50			2 9	5928 7
10+00			1 5	5930 1
10+50			2 1	5929 5
11+00			4 5	5927 1
11+50			7 6	5924 0
TP# 4			9 48 <	5922 16
℄	0 95	5923 11		
12+00			6 7	5916 4
12+50			10 8	5912 3
13+00			15 2	5907 7
13+50			20 4	5902 7
14+00			23 6	5899 5
TP# 5			22 51 <	5900.60
℄	19 00	5919 60		
14+40 ◁	POINT		22 8	5896 8
15+00			18 4	5901.2
15+50			17 3	5902. 3
16+00			18 2	5901 4

SE COR CH "D" # 8-87 (WELL)
CONC SLAB

001070

STA	+	HI	−	ELEV	
		5919.60			
16+50			20.0	5899.6	
17+00			24.3	5895.3	
17+50			26.1	5893.5	
17+80	TP#6 END LINE		21.80	5897.80	
TT	12.99	5910.79			
TP#7			23.11	5887.68	
TT	1.57	5889.25			
TP#8			19.81	5869.44	
TT	1.33	5870.78			
"304"			12.86	5857.91	5857.91

BENCH MARKS

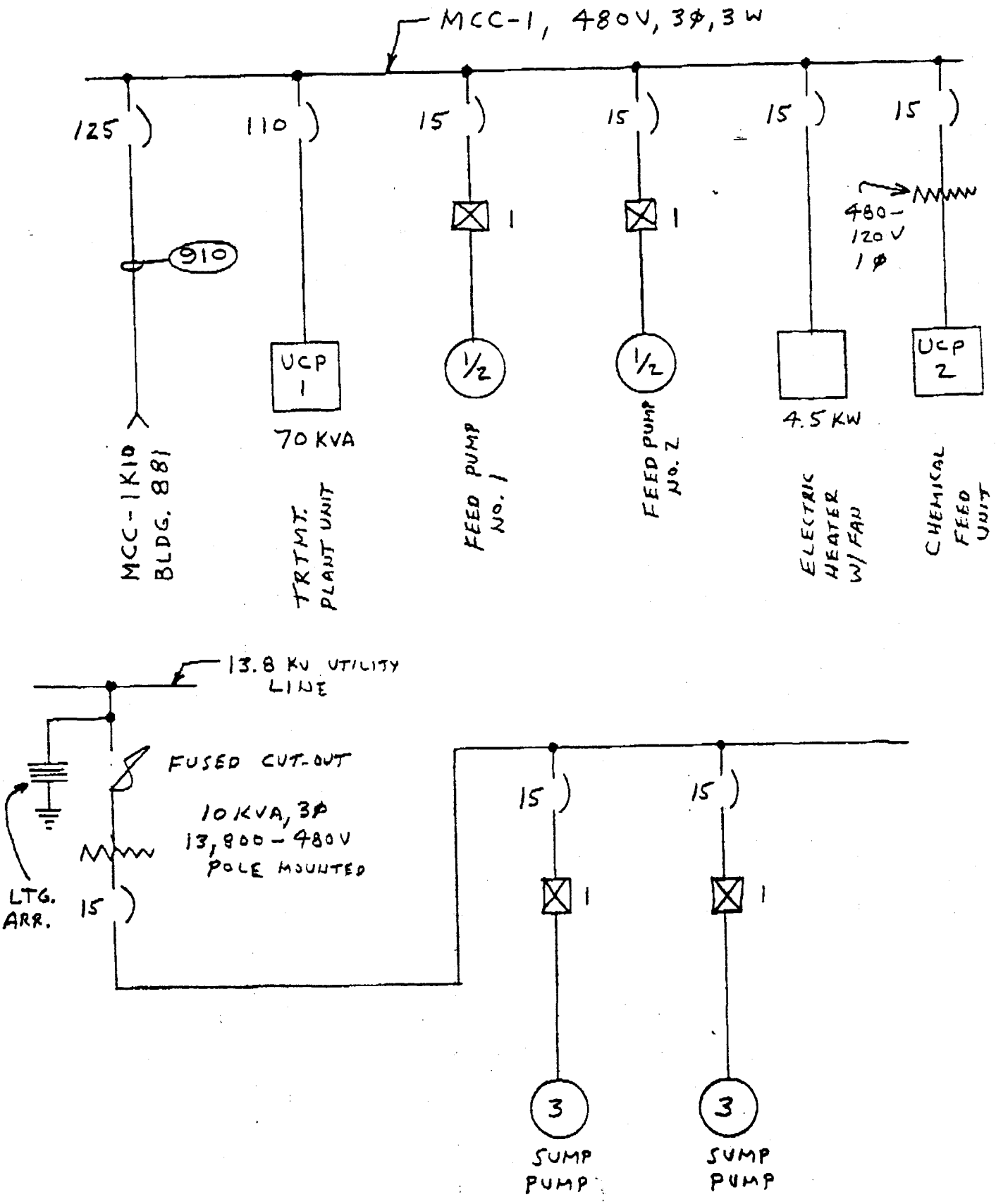
PLANT COORDINATES

	NORTHINGS	EASTINGS	ELEV.	
302	36500.0000	23500.0000	NONE	FND. BRASS CAP IN IRON MONUMENT BOX, 2 3/8" CAP STAMPED "N36500 E23500 ELEV 59" SET IN CONC IN ASPH PARKING AREA
303	36000.0000	23500.0000	NONE	FOUND 2" BRASS CAP STAMPED "N36000.00 E23500.00 ELEV. 59" SET IN A .85' SQ. CONC. MONU RF # S6
304	35094.7943	23285.8798	5857.99	SET #5 REBAR W 1 1/2" ALUM CAP FLUSH AND STAMPED "304" +- 20' N. OF E-W DIRT RD. AND +- 100' E. OF N-S DIRT RD. 700'+- SW OF RIFLE RANGE AND 500' NE OF SMALL POND
305	35053.8528	20511.6815	5986.33	SET #5 REBAR W/ 1 1/2" ALUM CAP FLUSH AND STAMPED "305" 16' N. OF E-W CHAIN LINK FENCE AND 32' E. OF N-S CHAIN LINK FNC, 500'+- SW OF BLDG 881
306	35439.9190	21621.3987	5990.38	SET #5 REBAR WI 1 1/2" ALUM CAP FLUSH STAMPED "306" ON SOUTH SLOPE OF HILL, NEAR CONTRACTOR STORAGE AREA

FOR ASSISTANCE IN 881 SECURITY AREA.
Call X-7752, RICK BAYSTAR

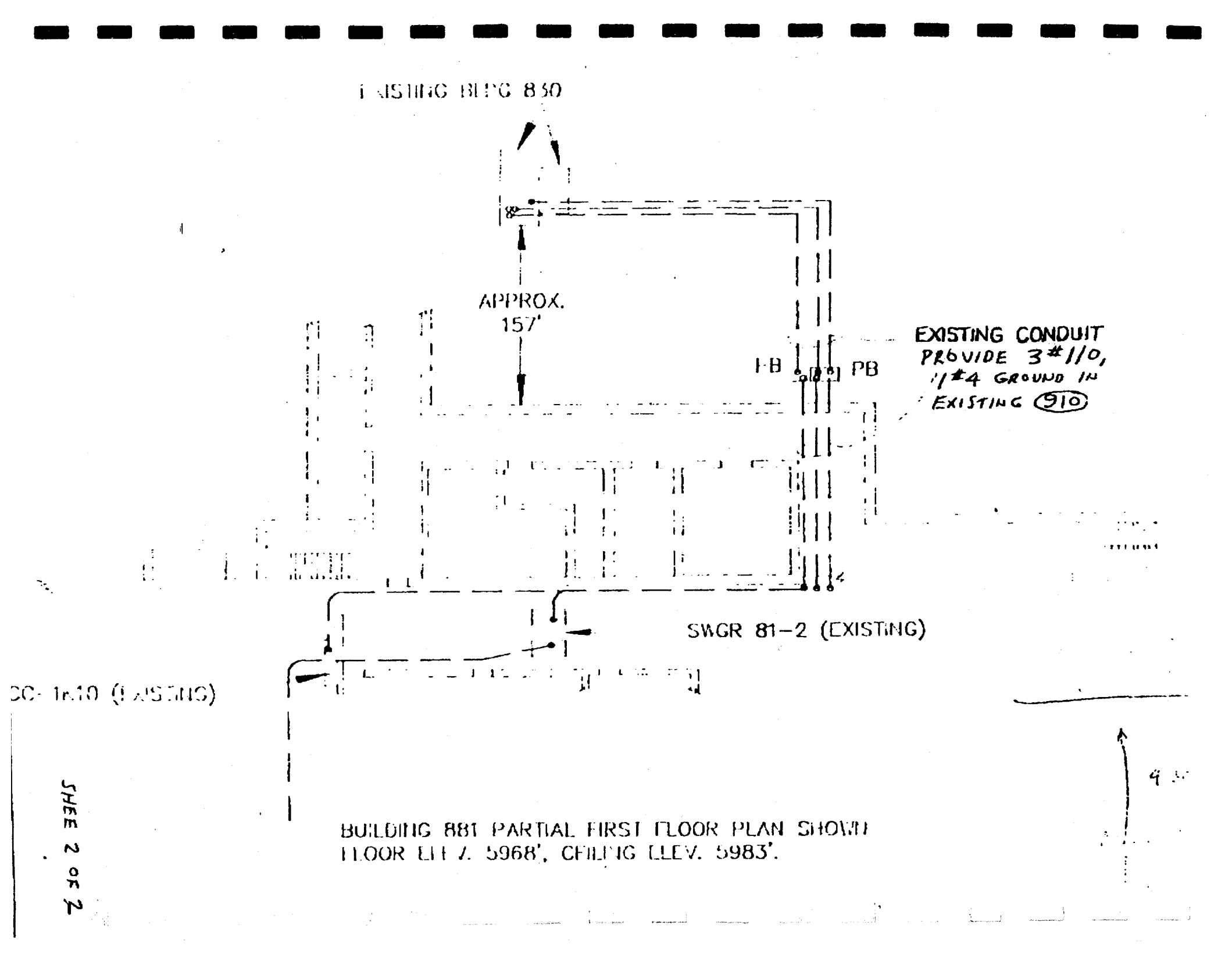
OTHER Problems

Bob Jones @ 5006

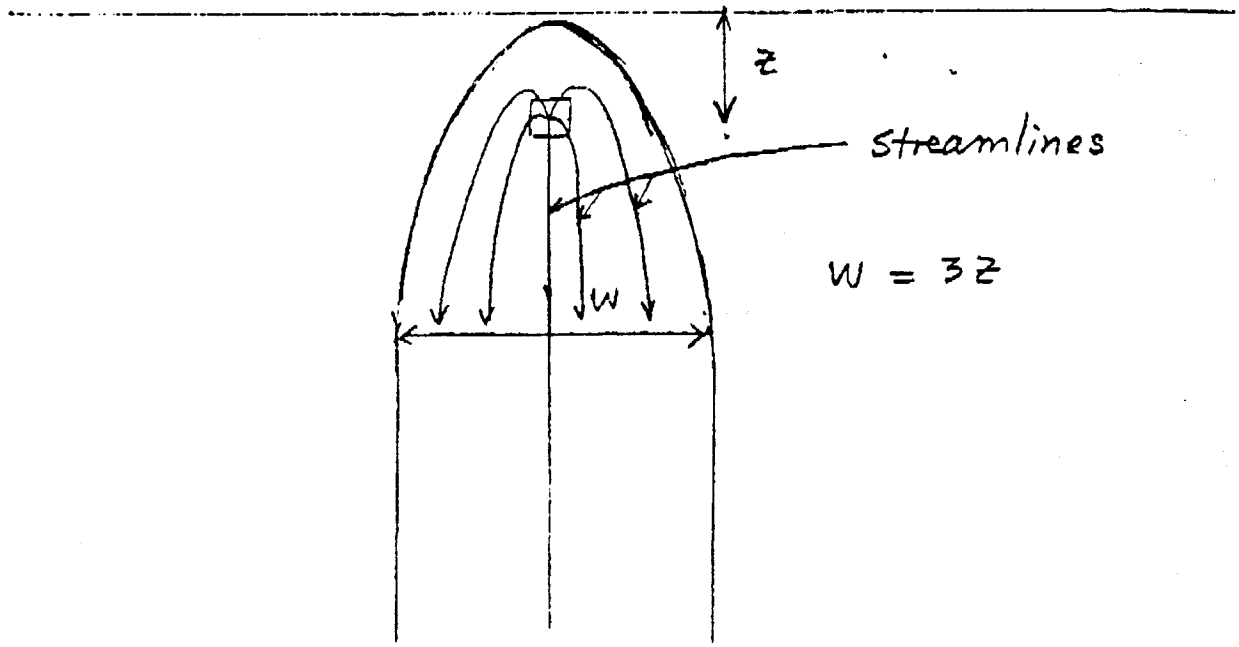


ENGINEERING-SCIENCE P.O. BOX 7107 PASADENA, CALIFORNIA 91109	PROJECT ROCKY FLATS JOB NO. DE 075	DATE 6/13/88	SHEET 1
	DETAIL SINGLE LINE DIAGRAMS	BY JCD	OF 2

ES-ENG 01 (9/86)


EXISTING BLDG 830
APPROX.
157'
EXISTING CONDUIT
PROVIDE 3#1/0,
1/#4 GROUND IN
EXISTING (910)
PB
SWGR 81-2 (EXISTING)
BUILDING 881 PARTIAL FIRST FLOOR PLAN SHOWN
FLOOR ELEV. 5968', CEILING ELEV. 5983'.
SHEE 2 OF 2

INFILTRATION TRENCH



CONSIDERATIONS

1. There is a limit on the head which can be applied in the infiltration trench. There should be no seepage at surface above trench.
2. Because of (1), the maximum flow width in the steady flow regime will be on the order of 3 times the embedment depth z.
3. Maximum flow rate can be computed from W and permeability.

ATTN: Richard Anderton
From: V. Vivatrat Re: Rocky Flats

$$Q = k\,i\,A$$

Q = Flow Rate
i = gradient (head loss / distance)
A = area

$k = 10^{-7}$ cm/sec $= 10^{-9}$ m/sec

for 1 m^2 area at gradient of 1

$Q = 10^{-9}$ $m^3/sec/m^2$

$= 2.64 \times 10^{-7}$ gallon/sec/m^2

$= 2.46 \times 10^{-8}$ gallon/sec/ft^2

$= 1.47 \times 10^{-6}$ gallon/min/ft^2

IF use percolation pond (no evapolation)

$$A = \frac{10}{1.47 \times 10^{-6}} = 6.72 \times 10^{6}\ ft^2$$

If use infiltration trench (see attached figure)
- assume flow width = 15' for 2' width
- length of trench $= 4.5 \times 10^{5}$ ft
  $= 8.56$ miles !

10^{-7} cm/sec $= .002$ g/day/ft^2

$= 1.47 \times 10^{-6}$ gpm/ft^2

Maximum flow - infiltration trench

1. $K = 10^{-7}$ cm/sec
2. $z = 5$ ft
3. $W = 3 \times 5 = 15$ ft
4. gravity flow, $i = 1$

Q (per linear ft of trench)
$= kiA$
$= 10^{-7}$ cm/sec $\times$ 1 $\times$ 15 ft $\times$ 30.5 cm/ft
$= 4.575 \times 10^{-5}$ cm^3/sec/cm

To get 10 gpm need $\frac{630.8}{4.575 \times 10^{-5}} = 1.38 \times 10^7$ cm
$= 4.52 \times 10^5$ ft
$= 85.6$ miles !

Requirements: Two (2) influent storage tanks
One (1) effluent storage tank
Influent tanks sized for 24-hour storage
Effluent tank sized at same volume as influent

Collection System Flows (From "Feasibility Study Report For High Priority Sites (081 Hillside Area), Vol 1.)

French Dram: 100 gpm initially, 2-5 gpm steady flow

Well 9-74: 1 gpm initially, 0.04 gpm steady flow

081 Foundation Footing Dram: 1-5 gpm steady flow

Based on maximum steady flows, assume average collection capacity is 10 gpm

Tank Size

Required volume = $10 \frac{gal}{min} \times 1440 \frac{min}{day}$ = 14,400 gal ⇒ Say 15,000 gal

Volume (ft^3) = $15{,}000 \text{ gal} \times \frac{ft^3}{2485 \text{ gal}}$ = 2004 ft^3

Assuming tanks only taken to 90% full, final volume is

Volume = 2004 ft^3 / 0.9 = 2227 ft^3 ⇒ Say 2250 ft^3

For 15,000 gallons, assume that vertical cylindrical tanks are used.

$$\text{Volume} = \frac{\pi d^2}{4} \times h \Rightarrow h = \frac{2250\ ft^3 \times 4}{\pi d^2} = \frac{2864.8}{d^2}$$

d (ft)	10	11	12	13	14	15	16	17
h (ft)	28.6	23.7	19.9	17.0	14.6	12.7	11.2	9.9

For preliminary sizing purposes, assume a 15 ft. diameter tank with a straight side of 13 ft. Overall height of the tank will be about 15 ft.

Tank Pad Size

Assume that all three tanks are lined up in a row.
Also: Spacing between tanks = 2 ft.
Spacing between tanks & containment = 4 ft.
Containment wall high enough to hold 15,000 gals.

Pad Length = 15 ft × 3 + 2 ft × 2 + 4 ft. × 2 = 57 ft.
Pad Width = 15 ft + 4 ft × 2 = 23 ft.

Wall height must consider volume occupied by tank.

$$SA = \pi d^2/4 = \pi (15)^2/4 = 176.7\ ft^2 \times 3 = 530\ ft^2$$

Wall height = h = Vol / (L×W) − 530 = 2250 / (57×23) − 530

h = 2.9 ft ⇒ Say 4 ft. to allow for freeboard

SECTION 4

CONSTRUCTION SPECIFICATION OUTLINE

A stand-alone construction package will be prepared for administration by Rockwell International as a cost plus fixed fee (CPFF) or lump sum construction contract.

Equipment specifications have been prepared for long lead GFE. These specification are included in Section 5. All other equipment (tanks, pumps) will be furnsihed by the Contractor in accordance with the construction specifications.

Technical sections of the construction specifications will be prepared in CSI format. An outline of the technical sections follows;

TECHNICAL PROVISIONS

INDEX

DIVISION 11 - Equipment

11600 Laboraory Equipment

DIVISION 15 - Mechanical

15050 Basic Materials and Methods

15060 Pipe and Pipe Fittings

15085 Identification of Piping Systems

15095 Field Testing of Piping

15099 Process Valves and Regulators

15140 Pumps

15170 Meters and Gauges

15175 Tanks

15180 Piping Insulation

15832 Ventilators

DIVISION 16 - Electrical

16050 Basic Electrical Materials and Methods

16140 Wiring Devices

16330 Transformer

16450 Grounding

16480 Motor Control Centers

16880 Radiant Heaters

16900 Process Instrumentation and Controls

DIVISION 17 - Systems Operating Test Procedures

17000 UV/Hydrogen Peroxide Treatment Systems Operating Test Procedure

DIVISION 18 - Special Construction

18000 Wells

OUTLINE SPECIFICATIONS

DIVISION 1 - GENERAL REQUIREMENTS

Section 01070 - Abbreviations

This section will list the abbreviations used in the contract documents.

Section 01100 - Special Contract Requirements

This section will identify the location and scope of work covered by the contract documents. Included in this section are special requirements to be followed by the contractor including; noninterruption of current operation, security measures, health sciences measures, regulatory compliance, plan of operations, health and safety, medical radioisotope procedures, monthly employment utilization report, and privately owned radio pagers.

Section 01300 - Submittals

This section will describe what submittals are required, how they are to be prepared, and the procedures for approvals, rejections and time requirements.

Section 01500 - Temporary Facilities, Controls, and Special Project Requirements

This section will describe the temporary field office if required by the contractor, government-furnished property, and availability of utilities and services. Also included in this section will be special considerations for contamination control of excavated materials and work permits.

Section 01650 - Starting of Systems

This section will cover general procedural requirements for starting and placing in service all equipment. Specific requirements for start-up of equipment will be included in the technical specifications for that equipment.

DIVISION 2 - SITE WORK

Section 02050 - Removals/Restorations

This section will specify alterations or removals required to the existing Building 830 to accomodate added wall, doors and window, new equipment, laboratory, and associated utilities.

Section 02200 - Earthwork

This section will provide for clearing and grubbing, excavation, and for classification, placement, and compaction of fill material. Long-term erosion protection will be provided by seeding and irrigation. The contractor will be required to perform excavation and backfilling in an efficient manner to minimize the time that excavated materials are stockpiled.

Section 02554 - French Drain and Infiltration Gallery

This section will cover construction of the french drain including materials to be used and installation procedures. The infiltration gallery will be similar to the french drain except that no impermeable synthetic membrane will be required.

DIVISION 3 - CONCRETE

Section 03300 - Cast-in-Place Concrete

This section will cover mix design, delivery, placing, curing and finishing of concrete. Formwork, reinforcement, embedded items, joints, and grout will be included. The concrete base supporting the storage tanks will include sidewalls for secondary containment.

Section 03400 - Precast Concrete

This section will describe the precast concrete manholes used for collection sumps on the french drain and Building 881 foundation footing drain.

Section 03600 - Grout

This section will describe the grout to be used with the concrete. A non-shrink grout is proposed.

DIVISION 5 - METALS

Section 05400 - Lightgage Metal Framing

This section will describe the material and installation of the metal framing used for erecting the wall in Building 830 to create a laboratory.

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

Section 07200 - Insulation

This section will describe the materials and method of installation of the insulation to be used in Building 830 for the laboratory.

DIVISION 8 - DOORS AND WINDOWS

Section 08100 - Hollow Metal Doors and Frames

The interior metal door to provide access between the laboratory and equipment room and exterior door(s) in Building 830 will be specified in this section.

Section 08700 - Hardware and Specialties

This section will contain the hardware required for the doors being installed in Building 830. Keying requirements will be determined by Rockwell.

Section 08800 - Glass and Glazing

The interior window between the equipment room and laboratory will be specified in this section. The window will be made of wire reinforced glass.

DIVISION 9 - FINISHES

Section 09250 - Gypsum Drywall

The wall being added to Building 830 to create the new laboratory will be constructed of gypsum drywall as specified in this section.

Section 09540 - Ceiling Suspension System

This section will specify the materials and procedure for installation of a suspended ceiling in the laboratory being added to Building 830.

Section 09900 - Painting

This section will cover the interior painting of Building 830. The type of paint and the method of application including safety precautions will be specified.

DIVISION 11 - EQUIPMENT

Section 11600 - Laboratory Equipment

This section will describe any equipment and fixtures, such as a stainless steel sink, to be installed in the laboratory.

DIVISION 15 - MECHANICAL

Section 15050 - Basic Piping Materials and Methods

This section will describe the various piping systems included in this project. The piping system description will cover general materials, fabrication, and installation of the systems. Testing of the system will be covered under Section 15095.

Section 15060 - Pipe and Pipe Fittings

The various pipe systems, including the required fittings, will be described in detail in this section. A piping schedule will list the service, type of material, working and test pressures of each system.

Section 15085 - Identification of Piping Systems

This section shall describe the method of identifying the various piping systems included in the project. Identification of piping will be provided by line number, letter name, and flow direction arrows.

Section 15095 - Field Testing of Piping

The field testing of piping systems including valves, fitting, equipment and appurtenances will be described in this section. This section will be coordinated with the piping schedule in Section 15050.

Section 15099 - Process Valves and Regulators

This section will describe all the valves and regulators to be installed in the piping systems. A valve schedule will list the type of valve, location, service, and tag number.

Section 15140 - Pumps

All of the pumps installed in this project will be specified in this section. This includes the duplex pumps for the french drain and Building 881 foundation footing drain, well 9-74 pump, and feed pumps to transfer contaminated water from the storage tanks to the treatment unit. The specification will include materials of construction, installation, accessories, and testing of the equipment.

Section 15170 - Meters and Gauges

This section will describe the flow meters to be installed in the collection system piping and any miscellaneous meters and gauges. This does not include meters and gauges installed on the treatment unit.

Section 15175 - Tanks

This section will describe the materials, handling, installation, and accessories on the storage tanks. The storage tanks specified for this project include two influent storage and one effluent storage tank.

Section 15280 - Piping Insulation

This section will describe the material and installation of insulation to be used on pipe which is subject to freezing.

Section 15832 - Ventilators

The fan which is required to provide ventilation of the laboratory in the summer will be specified in this section.

DIVISION 16 - ELECTRICAL

Section 16050 - Basic Electrical Materials and Methods

This section will establish the general requirements for materials, equipment and fabrication of wiring systems including wires, cables, boxes, wiring devices, motors, motor starters, panel boards, motor disconnects, overcurrent protective devices, and electrical equipment supporting devices.

Section 16140 - Wiring Devices

This section will cover the requirements for materials, equipment, testing and installation of receptacles and switches.

Section 16330 - Transformer

This section will specify the 13.8kV-240V transformer and a fusible cutout with lightning arrester reqired at well 9-74 and at the two sumps.

Section 16450 - Grounding

This section will cover the materials, equipment, and methods for grounding conduit systems and equipment.

Section 16480 - Motor Control Centers

This section will cover the materials, equipment, and installation of motor control centers.

Section 16880 - Radiant Heater

The radiant heater to be installed in the laboratory will be specified in this section.

Section 16900 - Process Instrumentation and Controls

This section will describe the process instruments including supports and piping. A schedule with tag numbers and the test procedures will also be included. This section will be coordinated with the P&ID sheets in the contract drawings.

DIVISION 17 - SYSTEMS OPERATING TEST PROCEDURES

Section 17000 - UV/Hydrogen Peroxide Treatment System Operating Test Procedure

This section will cover a detailed system operating test procedure for UV/hydrogen peroxide treatment unit. Responsibilities during testing, start-up, and correction of non-conforming items will be outlined.

DIVISION 18 - SPECIAL CONSTRUCTION

This section will describe the development of well 9-74 including procedure for logging during drilling, stainless steel casing, seals, screens, grout and other associated appurtenances. The well will be developed in accordance with requirements of the State Engineer. The well pump will be specified in section 15140.

SECTION 5
GOVERNMENT FURNISHED EQUIPMENT (GFE) SPECIFICATIONS

The only GFE for this project is the UV/hydrogen peroxide unit. Specifications are as follows.

SPECIFICATION

FOR AN

ULTRAVIOLET LIGHT/HYDROGEN PEROXIDE

TREATMENT UNIT

1. SCOPE

1.1 This specification covers the design, fabrication, and performance requirements for an ultraviolet light (UV)/hydrogen peroxide (H_2O_2) treatment unit.

1.2 The Seller shall be responsible for the engineering, design, construction, assembling, testing, and performance of all equipment furnished.

2. GENERAL REQUIREMENTS

2.1 The equipment shall include all components necessary for a complete operating unit even though the components may not be identified in this specification.

2.2 All components shall be new, free of defects or mechanical damage, and in operating condition.

2.3 Equipment performance shall be rated at 6,000 feet above sea level.

2.4 Manuals, instructions, labels, controls, and any other printed material shall be in English.

2.5 Codes and standards shall be those in effect on the date of the order.

3. PRELIMINARY TEST AND FINAL ACCEPTANCE

3.1 A preliminary inspection and performance test shall be performed at the Seller's plant to verify that the requirements set forth in this specification exclusive of Section 7,

have been met. The Seller shall furnish the support equipment, services and utilities necessary to performance test his equipment. The tests shall include an operational check of each component and a demonstration of overall performance.

3.2 A representative of the Buyer shall be present to witness all phases of the preliminary tests and inspect the equipment. The Seller shall notify the Buyer at least seven (7) working days before the equipment will be ready for preliminary testing.

3.3 Final acceptance shall be contingent upon satisfactory testing at the Buyer's plant to ensure that the equipment conforms to these specifications.

4. PACKAGING AND SHIPPING

Package and protect equipment to prevent physical damage and environmental damage during shipping or handling. Protect machined surfaces from rust. Drain fluids and blow lines dry before packaging. Plug fluid and lubrication terminations to exclude moisture, dust, dirt, or other foreign material.

5. DESCRIPTIVE SUBMITTALS

5.1 Submit for Buyer's approval, catalog data; equipment and material lists; elementary diagrams; wiring diagrams; installation isntructions; maintenance manuals and instructions; and operation brochures for equipment and materials listed in Section 5.7 of this specification within the time limits indicated on the purchase order.

5.2 Submit engineering data and shop drawings for approval before fabrication begins and show in sufficient detail for the Buyer to examine Seller's conformance to the design concept, arrangement and general construction set forth in these specifications. Catalogs submitted shall have clearly identified capacities and specified parameters relating to this specification with unrelated pages removed. One set of

shop drawings will be promptly returned by the Buyer with comments or with approval. Buyer's approval shall not relieve the Seller of responsibility for the design accuracy of the drawings, quality of workmanship, and performance to specification of this equipment.

5.3 Provide final drawings in reproducible form. Identify drawings with the equipment builders drawing title and number, and equipment or job order number.

5.4 Define installation requirements so the Buyer can prepare the installation site before receiving equipment. Describe electric power service, utility, piping, floor loading, and foundation requirements, as applicable, by schematic diagrams, connection details, layouts, and instructions.

5.5 Operating and maintenance instructions shall explain operating theory and provide step-by-step instructions for preventive maintenance to ensure safe operation and long life. Instructions shall include lubrication schedules and block and schematic diagrams to describe trouble-shooting diagnoses with corrective action for malfunctions and schedules for frequency of maintenance checks.

5.6 Instructions shall be in English, written in terms easily understood by operating and maintenance techicians, and bound into a properly identified manual.

5.7 The minimum list of submittals required shall be as indicated below.

5.7.1 Preliminary Engineering Data and Shop Drawings

1) Photographs, dimensional outlines, assembly drawings, and general arrangements.

2) Overall dimensions, total weight, weight distribution, capacities.

3) Weight and size of largest component to be shipped.

4) Recommended access and clearance data.

5) Service connections, utility requirements, electrical wiring diagrams.

6) Preliminary equipment list.

7) Motor data.

8) Copy of performance test procedure.

5.7.2 Installation Data and Instructions

1) Recommended method of leveling and anchoring.

2) Anchor bolt layout and sizes.

3) Electrical power requirements (location, size and type).

4) Detailed equipment and material lists.

5) Assembly drawings and details.

6) Installation instructions.

5.7.3 Final Data, Operating and Maintenance Instructions

1) Factory performance data, characteristics, and curves.

2) Complete parts lists, including on hand spare parts recommended, and price list.

3) Final drawings including sectional or exploded views, showing all parts.

4) Final motor data.

5) Final operating and maintenance instructions, manuals, and electrical diagrams.

5.8 All submittals shall be sent under separate cover identified by the Buyer's purchase order number. Buyer will not be responsible for recovery of such material packed with the equipment.

6. PHYSICAL AND ENVIRONMENTAL LIMITATIONS

6.1 The UV/H202 unit will be housed in an existing building, Building 830.

6.2 The attached figure, Figure 1, indicates the available floor area for the Seller's equipment. Both areas 1 and 2 may be used. The Seller shall include a suggested equipment layout and dimensions of major pieces of equipment with his/her bid.

6.3 The maximum roof height in area 1 is 12.5 feet along the building centerline. This height drops to 10 feet at the walls.

6.4 The maximum roof height in area 2 is 9.5 feet at the common wall with area 1. This height drops to 8.5 feet at the opposite wall.

6.5 Access to area 1 is through double doors with an approximate opening of 8 feet wide by 7.5 feet high. Access to area 2 is limited to a door with an approximate opening of 3 feet wide by 6 feet high. Additional access to both areas is possible. The Seller shall indicate the size of such an opening, if necessary, with his/her bid.

6.6 Both areas 1 and 2 are protected from wind, rain and snow. However, current plans for these areas do not include heating. Therefore, provisions are necessary in the Seller's design to allow equipment to be operated in temperatures down to 0°F.

7. PERFORMANCE REQUIREMENTS

7.1 The UV/H202 treatment unit shall be capable of the chemical oxidation and destruction of toxic organic contaminants in water.

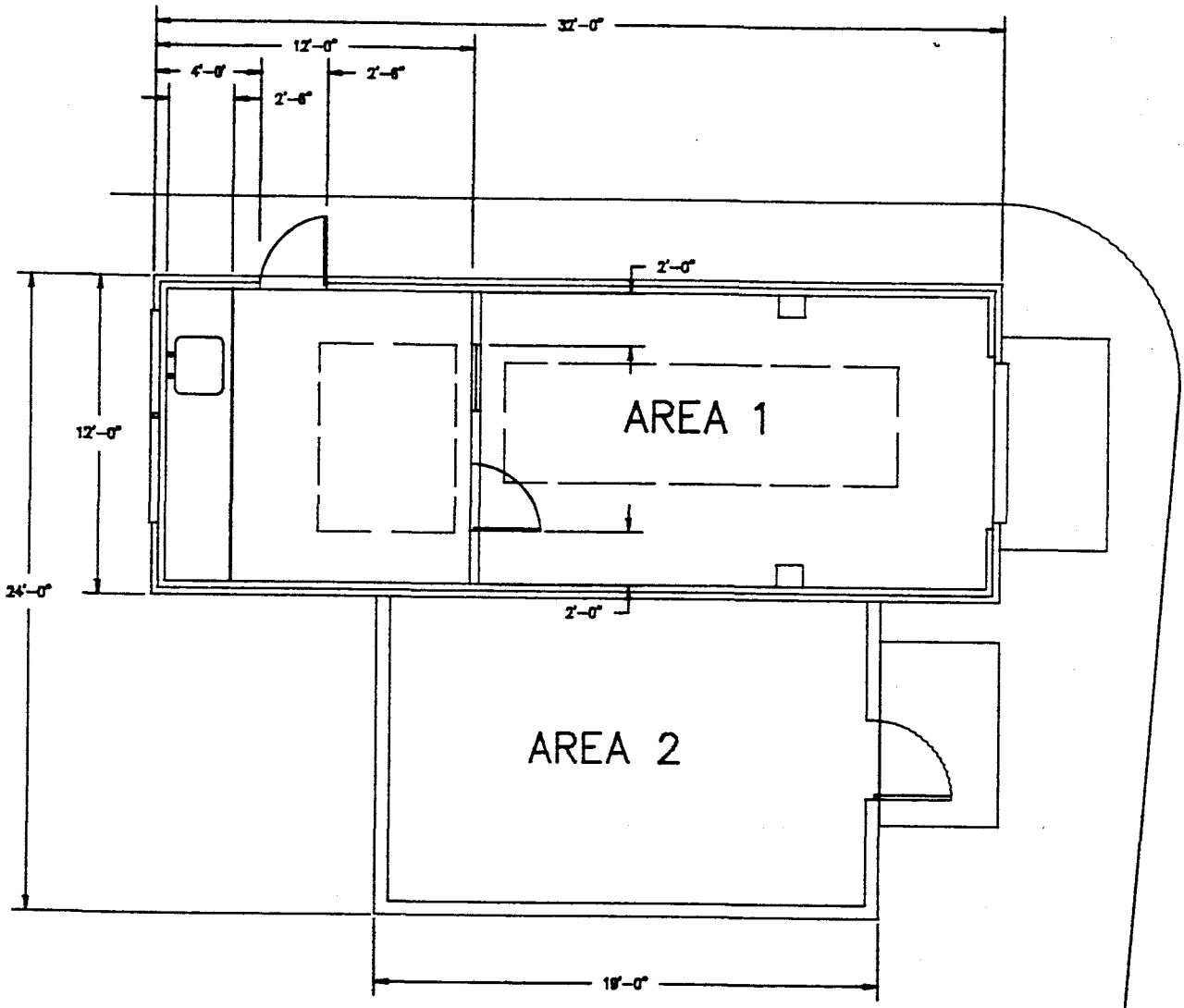


FIGURE 1

7.2 The expected composite concentrations of organic compounds in the feedstream to the UV/H202 treatment unit are as follows.

Compound	Composite Concentration (ug/1)
Trichloroethene	1216
Tetrachloroethene	344
1,1-dichloroethene	930
1,2-trans-dichloroethene	158
1,1-dichloroethane	7
1,2-dichloroethane	6
1,1,1-trichloroethane	943
1,1,2-trichloroethane	7
Chloroform	5
Carbon Tetrachloride	93
Methylene Chloride	15
Toluene	10

7.3 Other anticipated feedstream characteristics are as follows.

1) Maximum expected temperature is 100°F.

2) The expected pressure at the influent to the treatment unit is 9 psig plus the head loss through the Sellers equipment at maximum flow.

7.4 The expected composite concentration of other elements and ions in the feedstream to the UV/H202 treatment unit are as follows.

Element	Composite Concentration (mg/1)	Ion	Composite Concentration (mg/1)
Al	0.06	Ca	125
Ba	0.13	Mg	19
Cu	0.01	K	4
Fe	0.06	Na	120
Mn	0.14	HCO_3	278
Ni	0.09	Cl	141
Se	0.06	NO_3	6
Sr	0.97	SO_3	154
Zn	0.06	TDS	803
		Oil and Grease	6
		TSS	6

7.5 Required treated effluent concentrations from the UV/H202 treatment unit shall be less than the proposed Colorado Drinking Water Standards as follows.

Compound	Limit (ug/l) EPA Method 8010.
Trichloroethene	2.7
1,2-dichloroethane	0.94
1,1,1-trichloroethane	200
1,1,2-trichloroethane	0.06
Chloroform	0.19

7.6 The UV/H202 treatment unit shall meet the criteria defined above at a design maximum sustained flowrate of 30 gallons per minute.

7.7 The UV/H202 treatment unit shall have a turn-down capability of 3:1.

8. APPLICABLE PUBLICATIONS

The following specifications and standards of issues listed in this paragraph (including the amendments, addenda, and errata designated), but referred to hereinafter by basic designation only, form a part of this specification to the extent required by the references thereto. If this specification is in conflict with the referenced documents, this specification takes preference.

8.1 American National Standards Institute (ANSI)

ANSI-TI-1A Practices for Nondestructive Testing Personnel Qualification and Certification

8.2 American Welding Society (AWS)

AWS D1.1 Structural Welding Code

8.3 American Society of Mechanical Engineers (ASME)

ASME Boiler and Pressure Vessel Code, Section VIII	Pressure Vessels, Division 1
Section IX	Welding and Brazing Qualifications
ASME/ANSI B31	Code for Pressure Piping

8.4 National Electrical Manufacturers Association (NEMA)

MG-1-1978 (including Rev. 1 through 7)	Motors and Generators
MG-2	Safety Standards for Construction and Guide for Selection, Installation and Use of Electrical Motors and Generators

9. MATERIAL AND EQUIPMENT

9.1 General

9.1.1 The UV/H202 treatment unit shall consist of two modules. One shall be a UV reactor module and the second a peroxide storage/feed module.

9.1.2 Both modules shall be shipped pre-piped and pre-wired.

9.1.3 Items to be provided by the Owner include the following.

1) Building 830 with concrete foundations.

2) Electric power to the Sellers main control panel.

3) Contaminated water piping to the Sellers influent connection at the conditions detailed in Section 7.

4) Treated water piping to the sellers effluent connection.

9.2 UV Reactor Module

9.2.1 UV Lamps

1) The module shall contain the appropriate number of lamps to meet the requirements of Section 7.

2) All lamps shall be horizontally or vertically mounted within quartz sheaths to prevent contact with water and to allow lamp removal and inspection without having to drain the reactor.

3) Lamp seals shall be of materials compatible with the expected feedstream composition.

9.2.2 Reactor (Oxidation Chamber)

1) The reactor shall be of sufficent size to allow the necessary residence time for the destruction of toxic organics to meet the requirements of Section 7.

2) The interior of the reactor shall be suitably baffled to allow complete mixing of solutions and to prevent short circuiting.

3) The reactor shall be of Type 304 or 316 stainless steel welded construction. If the expected operating pressure within the reactor will be in excess of 15 psig, the ASME Boiler and Pressure Vessel Code shall apply to design and fabrication. All components within the reactor shall be of materials compatible with the expected feedstream composition and shall be resistant to prolonged exposure to UV light.

4) Connections shall be provided for process influent and effluent, influent and effluent sampling, and a low point drain.

5) The reactor shall have provisions for protection from over-pressurization.

9.2.3 Piping

1) All piping shall be of Type 304 or 316 Schedule 40 stainless steel or Schedule 80 PVC construction.

2) All valves shall be of the same material as the piping system which it is a part of. All valve seats and seals shall be of fluoroelastomer materials.

3) Piping fabrication methods shall be consistent with the materials of construction and expected service conditions. Pressure piping rated at greater than 15 psig shall comply with the requirements of the ASME/ANSI Pressure Piping Code.

4) All gaskets shall be of fluoroelastomer materials.

5) All piping and valves shall be designed for ease of operation and maintenance.

6) All final connections, i.e. process influent and effluent connections, vent, sample, and drain lines, shall be threaded (NPT) or flanged.

9.2.4 Instrumentation, Controls, and Alarms

1) Instruments, controls, alarms and indicating alarms (alarms with integral indicating light) shall be industrial grade equipment from established manufacurers; state of the art type instruments shall be provided.

2) All electrical and instrument enclosures shall be in accordance with the NEMA standards appropriate for the intended service.

3) All wiring shall be in accordance with the National Electric Code.

4) Instruments, controls, and alarms shall include the following.

a) Reactor high temperature indicating alarm and shut-off.

b) Lamp drive unit high temperature indicating alarm and shut-off.

c) Reactor and lamp drive unit temperature gauges.

d) Reactor high pressure indicating alarm and shut-off.

e) Reactor pressure gauge.

f) Lamp end enclosure moisture indicating alarm and shut-off.

g) Flow rate indication and total.

h) Low flow indicating alarm and shut-off.

i) Influent tank low level indicating alarm and shut-off. The probes and control signal lines will be provided by others.

k) Effluent tank high level indicating alarm and shut-off. The probes and control signal lines will be provided by others.

l) Shut-off due to opening of lamp access panel.

m) Run time meter to indicate hours of unit operation.

n) Individual lamp amperage readout.

o) Individual or lamp bank on/off controls.

p) Influent tank selector switch and indicator light to activate appropriate low level signal discussed in item (j).

5) All shut-off signals must also be transmitted to the system feed pumps MCC provided by others.

6) The controls for the peroxide storage/feed module shall be interlocked with the reactor module control panel such that the peroxide module operates in conjunction with the reactor module.

9.2.5 Structural Frames

1) Structural framing shall be of welded carbon steel construction.

2) The framing shall be designed to evenly distribute the weight of the modules components.

3) The module framework shall be designed such that the unit may be picked up by either forklift or overhead crane.

9.2.6 Finish

1) Stainless steel finish shall be 2B bright mill finish.

2) Carbon steel surfaces shall be free of rust and dirt prior to painting. One coat of primer and two coats of finish enamel (minimum total thickness of 5 mils) shall then be applied. The enamel color will be of the Sellers choice.

9.2.7 Welding

1) Welding shall be in accordance with AWS procedures or an approved alternate. All procedures shall be submitted to the Buyer for approval prior to the start of welding.

2) If the reactor vessel is fabricated in accordance with ASME Boiler and Pressure Vessel Code, the welding requirements of ASME Section IX shall apply. In this case, welders and welding operators shall be currently qualified in accordance with the code for the materials and process to be used.

9.3 Peroxide Storage/Feed Module

9.3.1 Peroxide Tank

1) The tank shall store 50% hydrogen peroxide.

2) The peroxide tank shall be sized to provide one months storage capacity.

3) The peroxide tank shall be cross linked high density polyethylene with UV inhibitors.

9.3.2 Metering Pumps

1) Two metering pumps for feeding peroxide to the reactor module shall be provided.

2) Metering pumps are to be diaphragm pumps.

3) Pumps must be capable of pumping up to 50% peroxide solutions over the entire range of concentrations that are required to meet the performance requirements in Section 7.

4) All pump materials shall be compatible with the solutions being pumped.

5) Approved pump manufacturers include Milton Roy, BIF, and Wallace-Tiernan.

9.3.3 Piping

1) Items 1 through 5 in Section 9.2.3 apply to this module.

2) Interconnecting piping between the two modules shall be type 304 or 316 stainless steel tubing or Schedule 40 pipe or Schedule 80 PVC pipe.

3) Overpressure protection for piping shall be provided.

9.3.4 Instrumentation, Controls, and Alarms

1) Items 1 through 3 in Section 9.2.4 apply to this module.

2) Instruments, controls, and alarms shall include the following.

a) On/off/auto switches for each pump.

b) In the auto mode, the pumps shall be controlled from the UV reactor module.

9.3.5 Structural Frames

These requirements are the same as Section 9.2.5.

9.3.6 Finish

These requirements are the same as Section 9.2.6.

9.3.7 Welding

These requirements are the same as Section 9.2.7.

10. TEST REQUIREMENTS

10.1 All electrical systems shall be factory tested.

10.2 All controls, indicators, and alarms shall be factory tested.

10.3 Reactor welds shall be inspected in accordance with the appropriate welding codes and hydrostatically tested at 1.5 times the design pressure for 30 minutes with no leaks allowed. Where leaks are found, the joints shall be rewelded, flanged tightened, seals replaced, or other cor-

rective measures taken and retested until no leakage is observed. Mastic or caulking compound shall not be used to stop leaks.

10.4 All pumps and piping shall be hydrostatically tested at 1.5 times the design pressure for 30 minuts with no leaks allowed. Where leaks are found, the joints shall be rewelded, flanged tightened, seals replaced, or other corrective measures taken and retested until no leakage is observed. Mastic or caulking compound shall not be used to stop leaks.

11. INSTALLATION AND START-UP ASSISTANCE

11.1 The Seller shall supply onsite supervision for the placement and installation of the UV/H202 treatment unit. It should be assumed that the site (i.e. Building 830) will be ready when the unit is shipped and that these activities will require 5 working days.

11.2 Once installation is completed, an acceptance test shall be run. Acceptance shall be contingent upon the unit treating up to 15,000 gallons of water to the specifications discussed in Section 7. The Seller shall be notified at least 5 days in advance of the schedule for the test.

11.3 The Owner shall provide analytical services for water samples taken during the acceptance testing.

11.4 Once the unit is accepted, the Seller shall provide two consecutive days of onsite operator training.

SECTION 6

PROJECT SCHEDULE

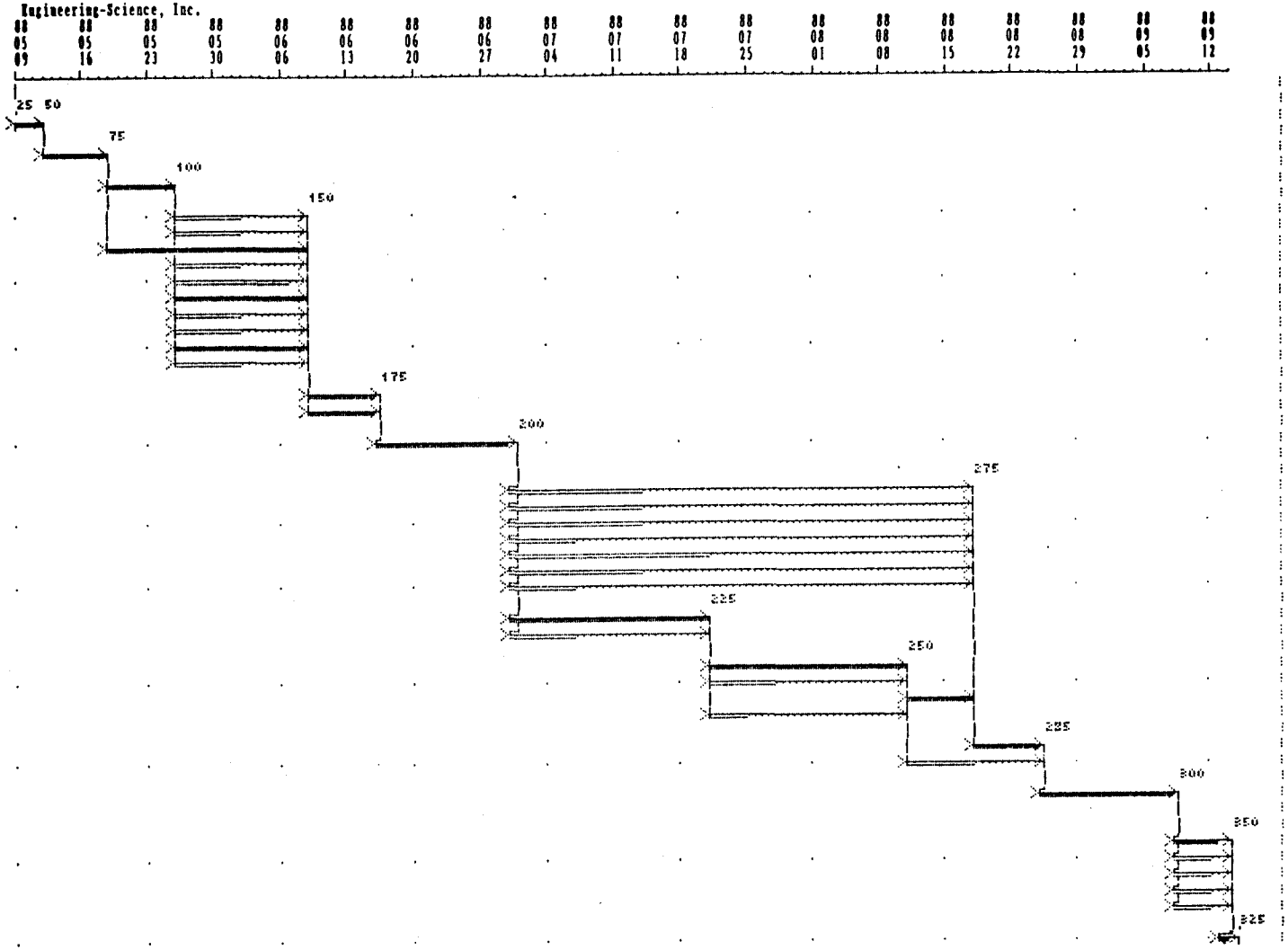
A detailed facilities engineering schedule for tasks associated with the 881 Hillside Remedial Action has been developed. Major milestone completion dates which appear on this schedule are as follows.

Preliminary Design Basis Document Complete	16 June 1988
GFE Specifications Complete	16 June 1988
Definitive Design Package Complete	30 August 1988
Construction Packages Complete	22 September 1988

The facilities engineering schedule follows.

Schedule

Engineering-Science, Inc.



TITLE I DESIGN

- Project Mobilization
- Surveying
- Soils (field work)
- GPE Specifications
- General Drawings
- Civil Drawings
- Structural Drawings
- Architectural Drawings
- Mechanical Drawings
- Electrical Drawings
- Instrumentation Drawings
- Design calculations
- Construction Specification Outline
- Cost Estimate
- Design Summary
- Title I Review

TITLE II DESIGN

- General Drawings
- Civil Drawings
- Structural Drawings
- Architectural Drawings
- Mechanical Drawings
- Electrical Drawings
- Instrumentation Drawings
- Design Calculations
- Purchase Specs
- Construction Specs
- Test Proceedures
- QA Check List
- Vendor Bid Review
- Cost Estimates
- Design Summary
- Title II Review

TITLE II BID PACKAGE

- Drawings
- Calculations
- Specifications
- Cost Estimate
- Project Material List
- Design Summary

SECTION 7
COST ESTIMATE

Per previous agreement, the preliminary design basis cost estimate for the 881 Hillside Remedial Action is being provided under separate cover.

APPENDIX A

Geotechnical and Materials Consultants
13276 East Fremont Place • P.O. Box 3814 • Englewood, Colorado 80155-3814 • U.S.A. • (303) 799-TEST

SUBSURFACE INVESTIGATION AND ENGINEERING ANALYSIS REPORT
INDUSTRIAL WASTE FACILITY
ROCKY FLATS PLANT
JEFFERSON COUNTY, COLORADO

PREPARED FOR:

ENGINEERING SCIENCES, INC.
1100 STOUT STREET, SUITE 1100
DENVER, COLORADO 80204

ATTENTION: MR. RICHARD ANDERTON

PROJECT NO. 18,023

JUNE 15, 1988

AGUIRRE ENGINEERS, INC.

AGUIRRE ENGINEERS, INC.
Geotechnical and Materials Consultants

June 15, 1988

Engineering Sciences, Inc.
1100 Stout Street, Suite 1100
Denver, Colorado 80204

Attention: Mr. Richard Anderton

Subject: Subsurface Investigation and Engineering Analysis Report
Industrial Waste Facility
Rocky Flats Plant
Jefferson County, Colorado
Our Project No. 18,023

Gentlemen:

Aguirre Engineers, Inc. is pleased to present this Subsurface Investigation and Engineering Analysis Report for the subject project.

Briefly, the findings of this study indicate that the proposed storage tank structures may be supported on a mat or pad foundation system bearing on the stiff to very stiff, gravelly CLAY.

Field permeability tests in the area of the proposed exfiltration trench indicate k values on the order of 1.25 to 1.7 x 10^{-7} cm/sec. Laboratory permeability tests are currently being run on select soil samples in this area. (Note: At the printing of this report, the results of these tests are not yet complete.)

Based on the boring hole information and our understanding of the required excavation depths, difficult excavation of the overburden for the proposed pipe lines is generally not anticipated. Excavation of trenches in sandy or gravelly soils may require shoring or excavating trenches with side slopes of about 2 (two) Horizontal (H) and 1 (one) vertical (V).

Additional detailed design and construction recommendations are included in the attached report. We appreciate the opportunity to have

been of service to you on this phase of the project and look forward to serving you on future aspects of this project.

Very truly yours,

AGUIRRE ENGINEERS, INC.

Joseph A. Hess, E.I.T
Staff Engineer

J. Richard Rhudy, P.E.
Project Manager

JAH:pet

Enc: Report

cc: 3 sent

TABLE OF CONTENTS

1.0 CONCLUSIONS

The subsurface conditions encountered at the site are fairly erratic. Our borings generally encountered TOPSOIL, FILL MATERIAL and/or NATURAL SOILS overlying WEATHERED BEDROCK. NATURAL SOILS were encountered underlying the TOPSOIL or FILL MATERIAL and overlying WEATHERED BEDROCK. At the location of the proposed water tank pad area, the WEATHERED BEDROCK was not encountered to its terminal depth of 20 (twenty) feet. Along the proposed infiltration pipeline alignment, the depth to the top of WEATHERED BEDROCK varied from 4 (four) to 36 (thirty-six) feet, and averaged approximately 18 (eighteen) feet below the existing ground surface. WEATHERED BEDROCK was not encountered in the borings along the proposed exfiltration pipeline.

Groundwater was encountered in Borings 1, 8, 9 and 13 at depths of 9 (nine) to 28 (twenty-eight) feet, respectively, below the existing ground surface, at the time of drilling operations (May 19, 24 and 25, 1988). Where possible, groundwater levels were rechecked on May 25, 1988. This corresponds to either 7 (seven) days or 1 (day) after completion of drilling operations. At this time, the groundwater in Borings 3 through 5, 8 and 9 ranged from depths of 3 (three) to 4 (four) feet. Groundwater levels could not be rechecked for Borings 1, 6, and 13 through 16, because of backfill requirements by Rockwell International. No groundwater was encountered in Borings 7 and 10 through 12.

It is our opinion that the proposed tank structures may be supported on a mat or pad foundation system bearing on the stiff to very stiff, gravelly CLAY. No expansive soils were encountered at this proposed tank structure location.

Field permeability tests, in the area of the proposed exfiltration trench, indicate k values on the order of 1.25 to 1.7 x 10^{-7} cm/sec. These values are indicative of material with a very low rate of permeability. As requested, laboratory permeability tests are currently being run on select soil samples retrieved from the same area. At the printing of this report, the results of these tests are not yet complete. Preliminary results indicate that the permeability rates of these laboratory samples will be similar (on the order of magnitude) to the field permeability tests.

Based on the boring information, and our understanding of required excavation depths, difficult excavation of the over-burden soils for the proposed pipeline trenches is generally not anticipated. Construction of the proposed infiltration pipeline trench will encounter WEATHERED CLAYSTONE BEDROCK at depths of from 4 (four) to 36 (thirty-six) feet below the existing ground surface. The excavation condition of this material is anticipated to be mostly in the medium hard range.

Due to the cohesionless nature of some of the NATURAL SOILS and high groundwater conditions along portions of the pipeline alignment, consideration should be given to the trench side slope stability. The trench sidewalls can be either shored or sloped to angles of about 2 (two) Horizontal (H) to 1 (one) Vertical (V).

Additional design and construction recommendations are contained in various sections of this report.

2.0 SCOPE OF STUDY

This report presents the results of our Subsurface Investigation and Engineering Analysis at the site of the proposed Industrial Waste Facility, to be located at the Rocky Flats Plant, Jefferson County, Colorado (see Plate 1). This project will consist of the installation of pipe for infiltration and exfiltration trenches. Additionally, a sump and pipeline system will transport the collected groundwater to the treatment facilities in Building 830. A pad to support three 15,000 (fifteen thousand) gallon storage tanks which will be constructed just south of Building 830.

The scope of this study was to:

A) Explore the subsurface conditions within the project area and collect samples.

B) Test the samples recovered.

C) Analyze and evaluate the data obtained.

D) Recommend the most suitable types and depths of foundation for the proposed water tank structures.

E) Provide recommendations for installation of the proposed pipelines.

F) Determine the permeability of the soils in the area of the proposed exfiltration trench.

G) Evaluate groundwater conditions, soils construction sequences and procedures.

The field work consisted of drilling a series of exploratory borings, in order to obtain disturbed and relatively undis-

turbed samples for laboratory testing. The samples recovered were visually inspected, and various laboratory tests were performed on them to evaluate their physical and mechanical properties.

The soil and rock parameters that we defined, in conjunction with results of observations made on the site, and past experience with similar subsurface conditions, under similar loading conditions were analyzed in order to reach the "Conclusions" presented in this report.

3.0 FIELD INVESTIGATION

The field investigation consisted of drilling 1 (one) exploratory boring at the proposed storage tank structure location and 15 (fifteen) borings along the proposed route of the infiltration/exfiltration trenches (Plate 2) and associated pipelines. The borings were drilled on May 18, 19, 24 and 25, 1988 using a truck-mounted, auger-type drilling rig.

Our drilling rig was equipped with 4 (four) inch diameter, solid stem, continuous flight power augers. The augers were used in cleaning the hole to the depth at which a sample and/or Penetration Test (PT) was desired. The augers were then removed, and a 2 (two) inch inside diameter (I.D.) California Spoon Sampler was subsequently driven with blows of a standard hammer weighing 140 (one hundred forty) pounds and falling a distance of 30 (thirty) inches.

The sampler was first seated 1 (one) inch into the bottom of the hole, and then driven an additional 12 (twelve) inches. The number of blows required to drive the sampler the last foot, or a fraction thereof, constitutes the PT.

This PT is similar to the Standard Penetration Test (SPT) described in ASTM Designation D 1586-67 (Reapproved 1974). The PT, when properly evaluated, is an index of the soil strength

and density of the material tested. The PT results are shown on the Log of Exploratory Borings, Plates 3 through 5.

The Boring locations were physically surveyed in the field by Aguirre Engineers, Inc. by taping or pacing distances from staked locations provided along the proposed pipelines and infiltration trench. (Note: The proposed exfiltration trench stationing is taken off the provided stationing for the infiltration trench. See Plates 3 through 5 for stationing offsets.) Boring elevations were interpolated from the site plan provided to us by Engineering Science, Inc.

These boring elevations and locations are adequate for the purpose of this report, but should be considered as only approximate for any other use.

4.0 SITE CONDITIONS

The proposed Industrial Waste Facility, which includes storage tanks along with associated infiltration and exfiltration pipelines, will be located at the Rocky Flats Plant, located in Jefferson County, Colorado. The specific area in which the Industrial Waste Facility will be located is known as the 881 Hillside, located immediately south of the Rocky Flats Plant.

The proposed storage tanks will be located directly south of Building 830. The proposed storage tanks will be bounded on the east by a small service road and to the west by a rather steep hillside.

The topography of the storage tanks site generally consists of a moderate slope from west to the east and south. The exact location of the storage tank pad was not known at the time of our exploration. The approximate elevations of this area ranged from 5,972 (five thousand nine hundred seventy-two) feet to approximately 5,976 (five thousand nine hundred seventy-six) feet.

The proposed pipelines will run east from the storage tanks and then will branch off in a southerly direction to either the proposed infiltration or exfiltration trenches.

The topography of the proposed pipelines consists of varied slopes ranging from gentle to moderate, generally in a south to southeasterly direction. Elevations ranged from approximately 5,986 (five thousand nine hundred eight-six) feet to approximately 5,894 (five thousand eight hundred ninety-four) feet.

A man-made drainage ditch, runs approximately parallel to, and immediately south of the proposed exfiltration trench. At the time of this investigation, the ditch contained approximately 2 (two) to 3 (three) inches of water flowing in an easterly direction.

An underground gas line ran approximately parallel to, and in the immediate vicinity of the proposed infiltration trench alignment. It is our understanding that this line is abandoned. Another underground gas line was located in the vicinity of Boring 5. Overhead powerlines run along the existing fence line as well as across the proposed infiltration trench in the vicinity of Boring 10. Additional utilities may be on the site and all their locations should be verified prior to construction.

5.0 SUBSURFACE CONDITIONS

The subsurface conditions encountered at the site are fairly erratic. Our borings generally encountered TOPSOIL, FILL MATERIAL and/or NATURAL SOILS underlain by WEATHERED BEDROCK. The generalized subsurface conditions encountered by our test borings are graphically represented on the Log of Borings (see Plates 3 through 5). The Legend and Notes necessary to interpret these Logs are contained on Plates 6A and 6B.

Each of the subsurface materials and groundwater conditions we encountered are described in the following subsections.

5.1 TOPSOIL: was encountered in all of the borings at the ground surface to approximately 0.5 to 1 (one) foot in depth. This material is not suitable for support of structural loads or use as backfill and should be removed.

5.2 FILL MATERIAL: was encountered in Borings 6 through 10 and Boring 14. The FILL MATERIAL was variable consisting of gravelly CLAY to clayey GRAVEL. This FILL MATERIAL contained some sandy lenses, occasional rootlets as well as areas of severely weathered claystone bedrock fragments. This FILL MATERIAL was found to be moist to very moist, medium stiff to very stiff, and gray to brown to orange in color. According to the Unified Soil Classification System (USGS), this FILL MATERIAL classified as CL or GC material. The

thickness of the FILL MATERIAL ranged from 5 (five) to 21.5 feet with an average thickness of approximately 14 (fourteen) feet.

5.3 NATURAL SOILS: which consisted of some gravel to gravelly CLAY; some sand to sandy CLAY; SAND and GRAVEL; and CLAY (severely weathered claystone bedrock).

The NATURAL SOILS were found underlying the TOPSOIL or FILL MATERIAL, and overlying the WEATHERED BEDROCK. The thickness of the NATURAL SOIL in the area of the storage tank structures was not fully penetrated to the boring's maximum depth of 20 (twenty) feet. The thickness of the NATURAL SOILS (where penetrated) along the proposed pipelines and infiltration and exfiltration trenches, ranged from 1 (one) to 21.5 feet with an average thickness of approximately 7 (seven) feet.

The gravelly CLAY, which was encountered in Borings 1, 4 through 8 and 10 through 12, contained a trace to some sand, occasional rootlets, and was moist to wet. This CLAY material was found to be stiff to very stiff and black to dark brown to gray in color. In accordance with the USCS this gravelly CLAY classified as CL material.

The sandy CLAY, which was encountered in Borings 2, 12, 13, 15, and 16, contained occasional gravels, occasional sand lenses, and was moist to very moist. This CLAY material was found to be stiff to very stiff and brown in color. In accordance with the USCS, this material classified as CL-CH material.

The SAND and GRAVEL, which was encountered in Borings 1, 3 and 5, varied from containing some clay to being clayey and was moist to wet. This SAND and GRAVEL material was found to be medium dense to dense and light brown to dark brown in color. In accordance with the USCS, this material classified as SC-SP and GC-GP material.

The CLAY (severely weathered claystone bedrock), which was encountered in Borings 8, 9, 12, 13, and 16, contained a trace to little sand, trace gravel and was slightly calcareous. This CLAY material was found to be very moist, stiff to very stiff and brown to gray with orange in color. In accordance with the USCS, this material classified as CL material.

5.4 WEATHERED BEDROCK: consisted of WEATHERED CLAYSTONE BEDROCK. Within the proposed storage tank pad area, WEATHERED BEDROCK was not encountered to the boring's terminal depth of 20 (twenty) feet. Along the proposed pipelines and in-

filtration/exfiltration trenches, where WEATHERED BEDROCK was encountered, the depth to the top of WEATHERED BEDROCK varied from 4 (four) to 36 (thirty-six) feet, and averaged approximately 14.5 feet below the existing ground surface.

The WEATHERED CLAYSTONE BEDROCK, which was encountered in all borings, except Borings 1 and 13 through 16, contained a trace to little sand, was slightly calcareous with iron-stains noted in the fractures, and was very moist. This material was found to be hard to very hard and was gray to brown with orange in color.

5.5 GROUNDWATER: was encountered in Borings 1, 8, 9 and 13, at depths of 12, 28, 13.5 and 9 feet, respectively, below the existing ground surface, during drilling operations (May 19, 24 and 25, 1988). No groundwater was encountered in the remaining borings at the time of drilling (May 18, 19, 24 and 25, 1988).

Groundwater levels in Borings 3 through 5, and 7 through 12, were rechecked on May 25, 1988, which corresponds to either 1 (one) day or 7 (seven) days after completion of drilling operations. At that time, the groundwater levels had stabilized in Borings 8 and 9 at depths of 4 (four) and 3 (three) feet, respectively, below the existing ground surface. Also at that time, groundwater was encountered in

Borings 3 through 5, at depths ranging from 3 (three) to 4 (four) feet below the existing ground surface. The remaining borings had remained dry.

Groundwater levels could not be rechecked for Borings 1, 6, and 13 through 16, because of backfill requirements by Rockwell International.

During wet season periods, the groundwater levels at the site are expected to rise somewhat due to surface water infiltration and subsurface groundwater seepage. More erratic variations may result from short term changes in the drainage located near proposed exfiltration trench. It is our opinion that these seasonal changes in groundwater levels should be considered during design and construction phases of the project.

6.0 LABORATORY AND FIELD TESTING

All soil and weathered bedrock samples recovered were physically inspected and visually classified in the laboratory by the Project Geotechnical Engineer. Representative samples were then selected for laboratory tests to help define the geotechnical properties of the subsurface materials. The testing program consisted of performing the following tests: Swell/Consolidation, Gradation Analysis, Natural Dry Density, Natural Moisture Content, Atterberg Limits, Laboratory Permeability and Field Permeability.

A Swell/Consolidation Test (see Plate 7) was performed in order to estimate the swell or consolidation potential of specific subsurface materials.

Gradation Analysis Tests (see Plates 8 through 20) were performed to estimate the grain size distribution of the soils which could be used to aid in classifying the soil, estimating the load carrying capacity of the materials tested, as well as estimate the permeability of this material. This test is also useful in evaluating the swell potential of the material tested.

Natural Dry Density and Natural Moisture Content Tests (see Table 1), were performed to determine the density and moisture

content of the soils encountered, to evaluate some of their compaction characteristics, and to correlate their swell potential with other tests.

Atterberg Limits Tests (see Table 1) were performed to determine the water contents which define the various stages of soil consistency. These are the Liquid Limit (LL), where the soil behaves as a viscous liquid, and the Plastic Limit (PL), where the soil begins to break apart and crumble and is no longer plastic. The difference between the LL and PL, defined as the Plasticity Index (PI), represents the range in water contents through which the soil is in the plastic state. These properties are also useful in classifying the soil according to the various soil classification systems.

Laboratory Permeability Tests are currently in progress on selected samples along the infiltration and exfiltration trenches. The samples have been set under a constant water pressure in order to: first, saturate the soil; and secondly, determine a permeability or "k" value for each sample. At the writing of this report, the laboratory tests are not yet complete. (Note: Samples have been subject to a constant water pressure head since June 2, 1988 and are not yet saturated.)

Falling Head Field Permeability Tests were run in Borings 14 and

15, along the proposed exfiltration trench route. A monitor tube and screen was installed using bentonite seals above and below a screen and sand filter to isolate the test zone.

7.0 PROPOSED DEVELOPMENT

Our understanding of the proposed project is based on information provided to us by Mr. Richard Anderton of Engineering Science, Inc.

The proposed storage tank facility will consist of a pad or mat foundation system supporting three 15,000 (fifteen thousand) gallon tanks. The pad or mat will measure approximately 20 (twenty) by 20 (twenty) feet. It is anticipated that this pad or mat will be placed at or close to grade.

The project will also include the installation of approximately 2,800 (two thousand eight hundred) lineal feet of pipe in trenches for infiltration and exfiltration. It is our understanding that the infiltration trench will be keyed into the WEATHERED BEDROCK a minimum of 2 (two) feet and act similar to a french drain. Additionally, a sump and pipeline system (approximately 1,600 lineal feet) will transport the collected groundwater from the infiltration piping to the treatment facilities in Building 830.

8.0 FOUNDATION SLAB RECOMMENDATIONS FOR THE WATER STORAGE FACILITY

Beneath a thin layer of TOPSOIL, the boring at the storage tank facility encountered gravelly CLAY to 9 (nine) feet underlain by approximately 10 (ten) feet of SAND and GRAVEL.

Based on the laboratory test results and our analysis, it is our opinion that the storage tanks can be satisfactorily supported on the proposed pad or mat foundation. We recommend a maximum allowable net bearing pressure of 2,500 (two thousand five hundred) psf be used bearing on the gravelly CLAY material.

Based on the above design pressure and assuming a relatively stable bearing surface is established, total settlements should be minimal.

No expansive soils were encountered in the borings at the storage tank facility. Groundwater was present at approximately 12 (twelve) feet below the existing ground surface. It is not anticipated that the existing groundwater level will interfere with construction or the support function of the tank facility foundation.

The foundation excavation should not be left open for extended periods of time. All soft, wet, very loose, or otherwise disturbed materials should be removed prior to concrete placement.

The base of the excavation should be observed by Aguirre Engineers, Inc. to see that the soil type encountered is as assumed and that adequate bearing conditions exist.

9.0 INFILTRATION/EXFILTRATION TRENCHES AND ASSOCIATED PIPELINES

9.1 General

The borings along the proposed infiltration/exfiltration trenches and associated pipeline alignments were intended to evaluate the subsurface conditions including permeability tests along the exfiltration trench. The detailed site and subsurface conditions are presented in Section 5.0.

9.2 Permeability of Proposed Exfiltration Trench Material

As discussed previously, Falling Head Field Permeability Tests were run in Borings 14 and 15 along the proposed exfiltration trench alignment.

The Field Permeability Test results are as follows:

Boring Location	Permeability (k)
14	1.7×10^{-7} cm/sec
15	1.25×10^{-7} cm/sec

Laboratory Permeability Tests are currently being run on select soil samples in the areas of both the infiltration as well as the exfiltration trenches. At the printing of this report, the results from these tests are not yet complete. Based upon the time at which it is taking to saturate the laboratory samples, laboratory permeability rates will probably be similar (on the order of magnitude) to the field permeability rates.

In summary, based upon these preliminary results, the permeability of the material in the area of the exfiltration trench should be considered poor to practically impermeable. It is not anticipated that laboratory results will vary drastically from the field permeability results.

9.3 Infiltration Trench

As discussed previously, it is our understanding that the infiltration trench will be keyed into the WEATHERED BEDROCK approximately 2 (two) feet. WEATHERED BEDROCK was encountered in all the borings along the proposed infiltration trench at depths ranging from 4 (four) feet to 36 (thirty-six) feet below the existing ground surface. This corresponds to WEATHERED BEDROCK elevations ranging from approximately 5,967 (five thousand nine hundred sixty-seven) feet (Boring 6) to 5,882 (five thousand eight hundred eighty-two) feet (Boring 12). For specific WEATHERED BEDROCK depths, refer to the Log of Borings (Borings 6 through 12), Plates 3 and 4.

9.4 General Trench Excavations

In most areas of the pipeline, the proposed pipelines may be safely supported on the NATURAL SOILS, FILL MATERIAL or WEATHERED BEDROCK. In these areas, normal construction and placement of BEDDING MATERIAL, can be followed.

The recommended gradation for this BEDDING MATERIAL is as follows:

Sieve Designation or Size	Percent Passing
1"	100
3/4"	90 to 100
3/8"	20 to 55
No. 4	0 to 10
No. 8	0 to 5

Along portions of the proposed pipeline, the trench invert level will be excavated into WEATHERED BEDROCK. In areas where the trench is to be excavated into the WEATHERED BEDROCK, the Contractor should be prepared to excavate medium hard WEATHERED CLAYSTONE BEDROCK material.

In the vicinity of borings where groundwater was encountered at the time of drilling, groundwater seepage into the trench excavations should be expected. For trench excavations penetrating groundwater by only a few feet, pumping from sumps should provide adequate drainage. For excavations that penetrate the groundwater by more than a few feet, a more extensive system may be required.

If in certain areas the bottom of the excavation starts "pumping", or appears soft, the problem soils should be excavated and replaced with a thickened, improved bedding

layer. The improved bedding should consist of 1 (one) to 2 (two) feet of 1 (one) to 2 (two) inch size crushed stone.

9.5 Trench Side Slopes

Cuts in the in-situ WEATHERED BEDROCK may stand on nearly vertical slopes for a brief period of time. However, near vertical cuts in sandy or gravelly materials cannot be considered safe, even for short durations. The majority of the NATURAL SOILS along the pipeline alignment consists of gravelly or sandy CLAY material.

The trench sidewalls can either be cut vertically and properly sheeted and braced, or sloped back to a safe angle in conformance with applicable OSHA regulations.

It is the Contractor's responsibility to provide a trench which is safe for his men to work in.

Generally, a dry excavation cut in a granular soil can safely stand at slopes ranging from 2 (two) (H) to 1 (one) (V). However, flatter slopes may be required based on the consistency of the in-situ soils.

10.0 MISCELLANEOUS

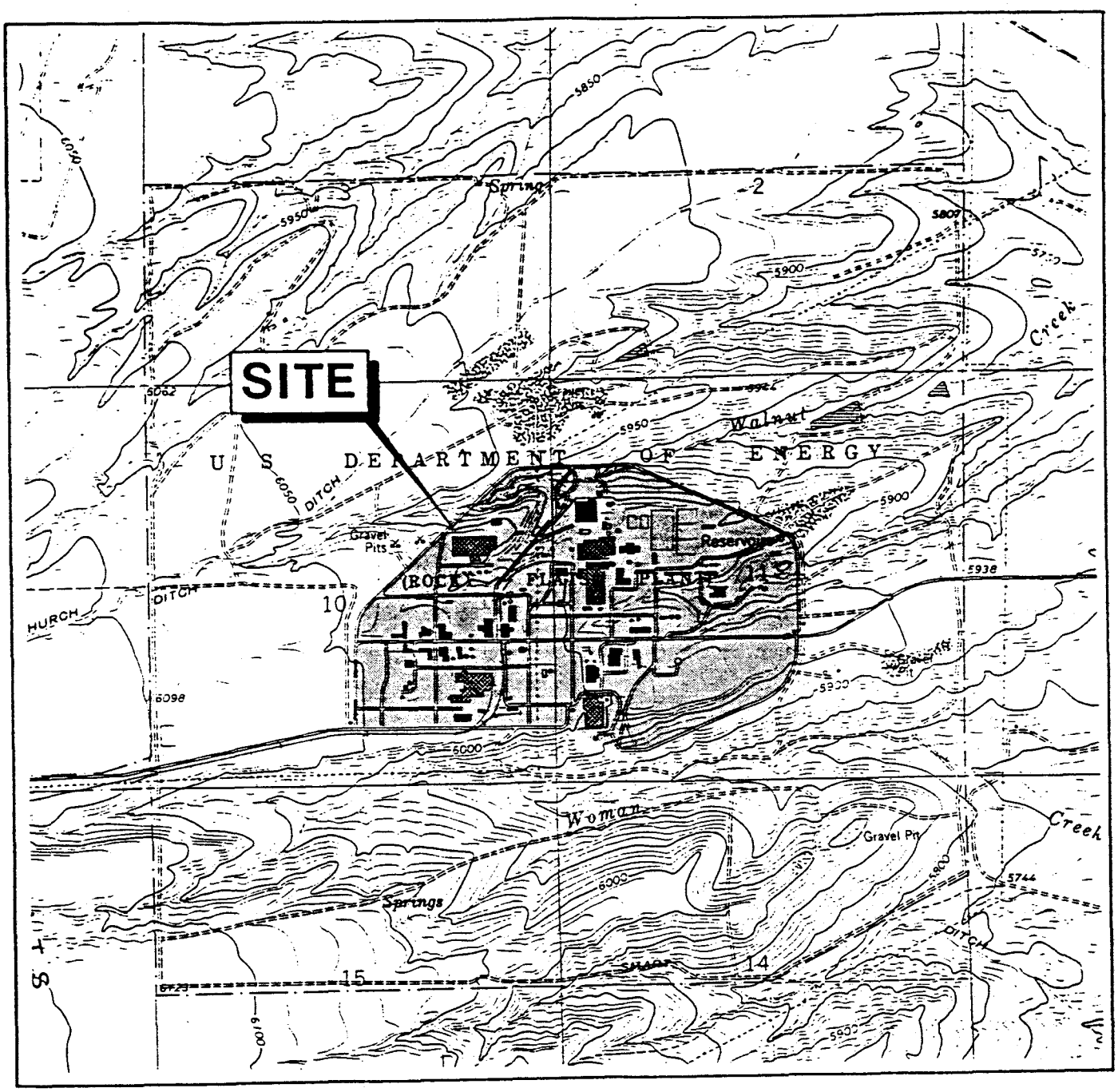
The analysis and recommendations submitted in this report are based upon the data obtained from the 1 (one) soil boring at the proposed storage tank pad and the 15 (fifteen) soil borings along the proposed infiltration and exfiltration pipeline alignments performed at the locations indicated on Plate 2.

In any soils investigation, it is necessary to assume that soil conditions do not change greatly from those indicated by our Exploratory Borings. This report does not reflect any variations which may occur between these borings.

The nature and extent of variations between borings may not become evident until the course of construction. For this reason, we recommend that the Aguirre Engineers, Inc. observe the excavation and backfill operations and provide appropriate recommendations at that time, based on observation and testing.

If variations in subsurface conditions are encountered during construction, then it may be necessary for a re-evaluation of the recommendations contained in this report. If any unforeseen subsurface conditions are encountered, the contractor should notify Aguirre Engineers, Inc. prior to proceeding with the construction.

In the present report, we have presented judgments based partly on our understanding of the proposed development and partly on the data we have obtained. This report meets professional standards expected for reports of this type in this area. Our company is not responsible for the conclusions, opinions or recommendations made by others based on the data we have presented.



Taken from U.S.G.S. Louisville, Colorado Quadrangle, 1965 (photorevised 1979).

SITE LOCATION PLAN

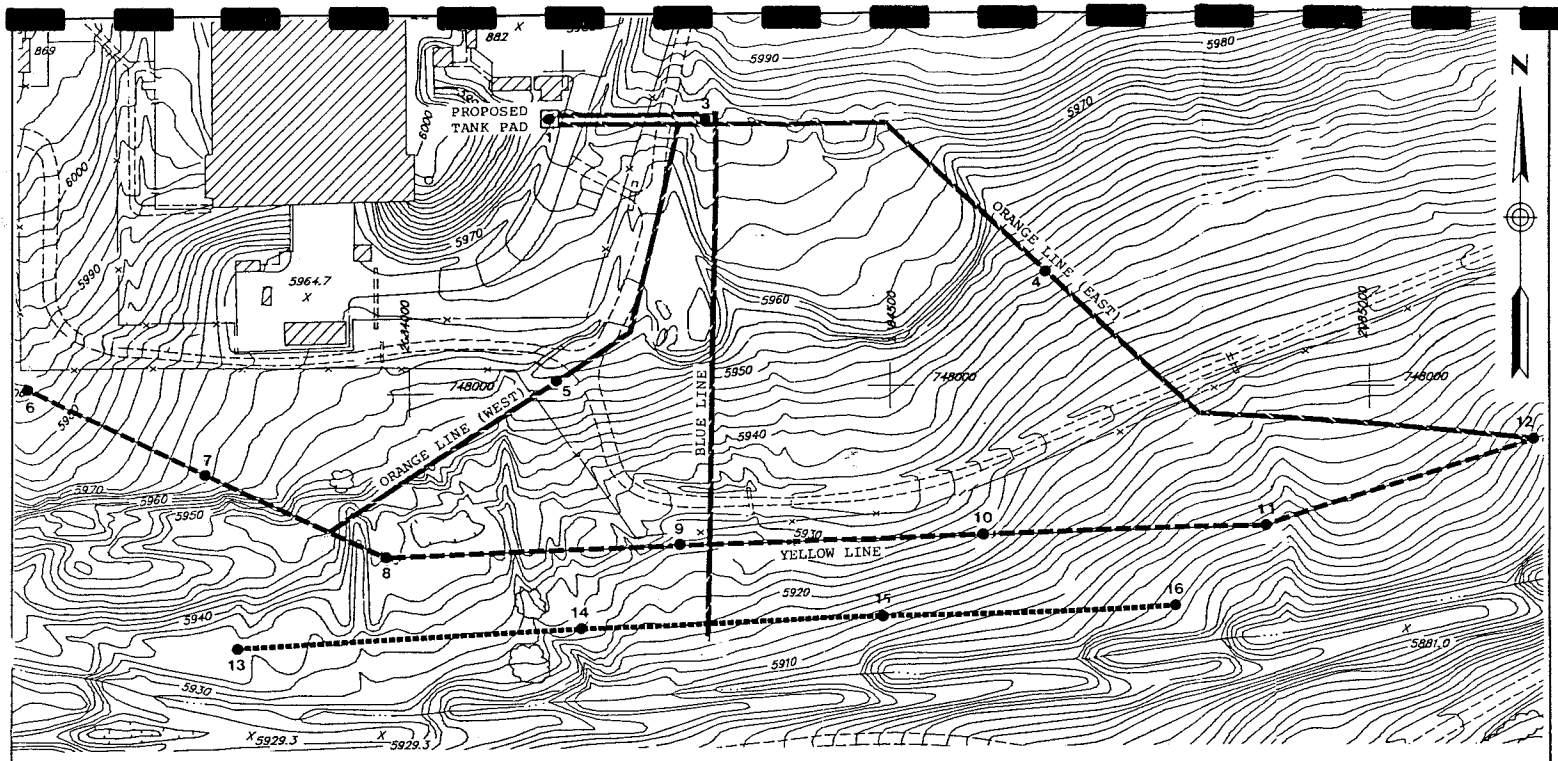
SUBSURFACE INVESTIGATION AND ENGINEERING ANALYSIS REPORT
INDUSTRIAL WASTE FACILITY
ROCKY FLATS PLANT
JEFFERSON COUNTY, COLORADO

AGUIRRE ENGINEERS, INC.
Geotechnical and Materials Consultants
P.O. Box 3814
Englewood, Colorado
80155-3814 U.S.A.

DRAWN BY: NG	SCALE: Vertical N/A	
CHECKED BY: JAH	Horizontal 1" = +2,000'	
DATE: 6/10/88	JOB NO. 18,023	PLATE 1

APPENDIX A

GEOTECHNICAL ENGINEERING REPORT



LEGEND

- BORING LOCATIONS
- PIPELINE
- PROPOSED INFILTRATION TRENCH
- PROPOSED EXFILTRATION TRENCH

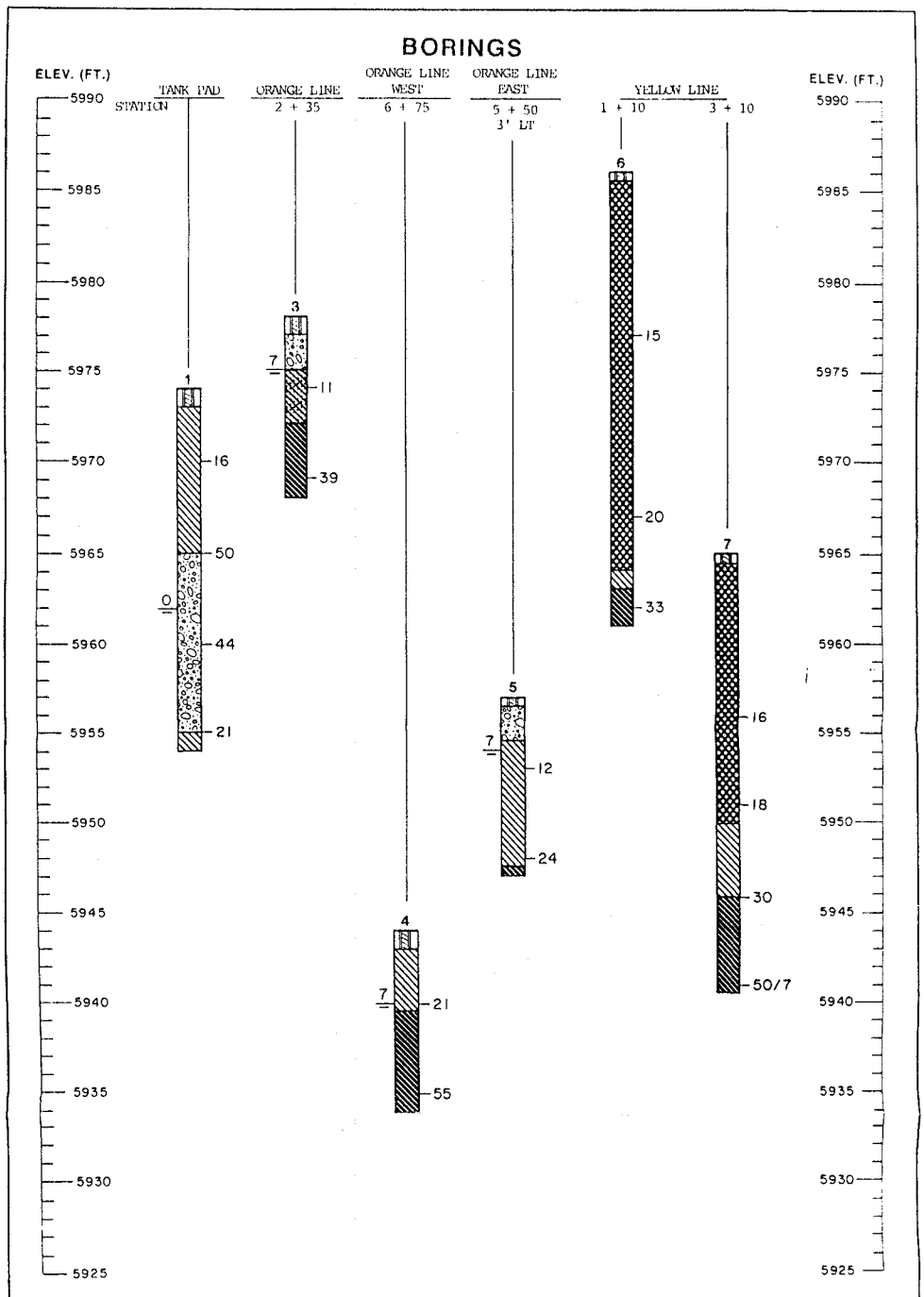
NOTE: Boring 2 was eliminated

PLOT PLAN

SUBSURFACE INVESTIGATION AND ENGINEERING
ANALYSIS REPORT
INDUSTRIAL WASTE FACILITY
ROCKY FLATS PLANT
JEFFERSON COUNTY, COLORADO

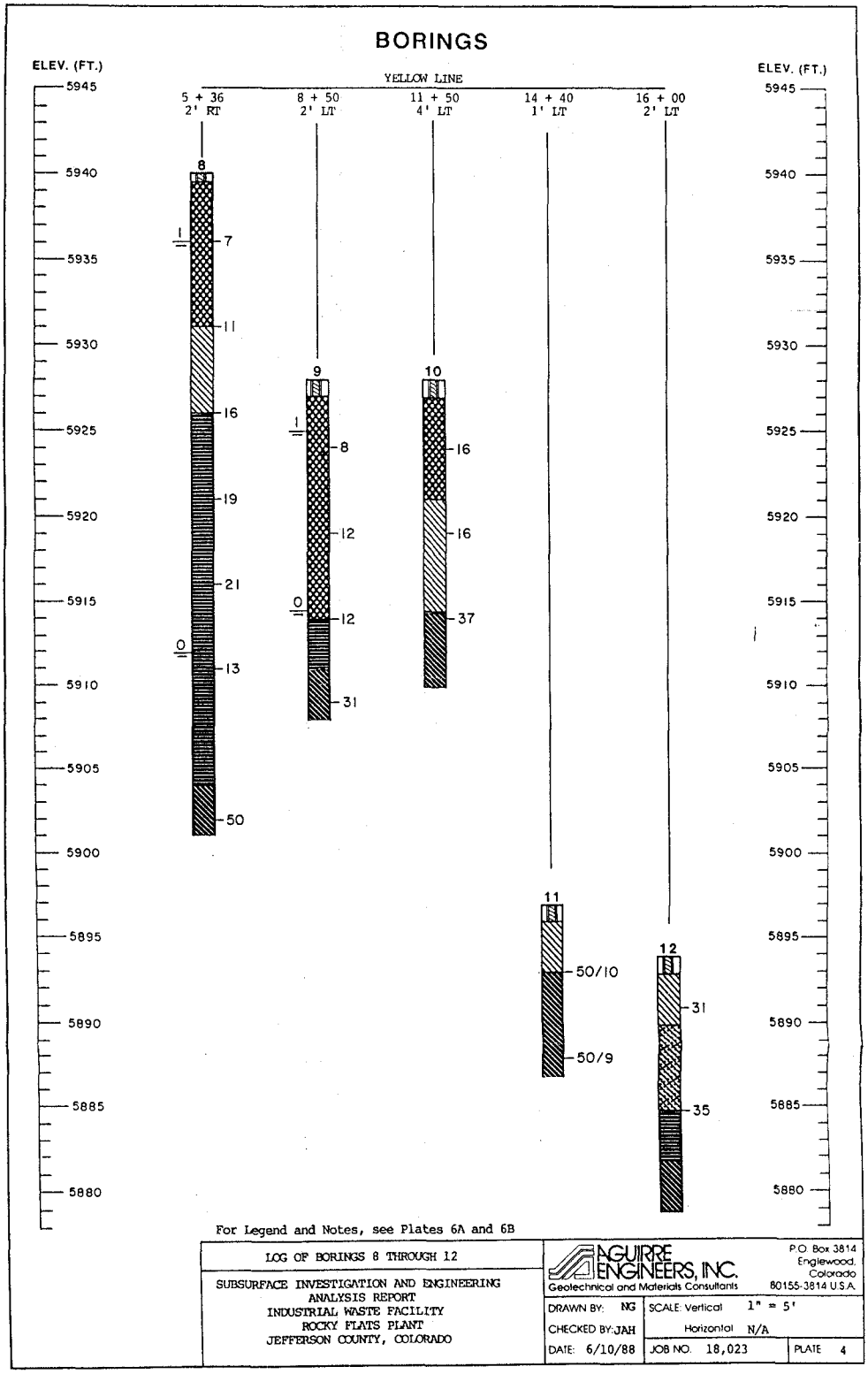
AGUIRRE ENGINEERS, INC.
Geotechnical and Materials Consultants
P.O. Box 3814
Englewood, Colorado
80155-3814 U.S.A.

DRAWN BY: NG	SCALE: Vertical N/A	
CHECKED BY: TAH	Horizontal 1" = 100'	
DATE: 6/10/88	JOB NO. 18,023	PLATE 2



For Legend and Notes, see Plates 6A and 6B

LOG OF BORINGS 1 THROUGH 7	AGUIRRE ENGINEERS, INC. Geotechnical and Materials Consultants
SUBSURFACE INVESTIGATION AND ENGINEERING ANALYSIS REPORT INDUSTRIAL WASTE FACILITY ROCKY FLATS PLANT JEFFERSON COUNTY, COLORADO	P.O. Box 3814 Englewood, Colorado 80155-3814 U.S.A.
DRAWN BY: NG	SCALE: Vertical 1" = 5'
CHECKED BY: JAH	Horizontal N/A
DATE: 6/10/88	JOB NO. 18,023
	PLATE 3



For Legend and Notes, see Plates 6A and 6B

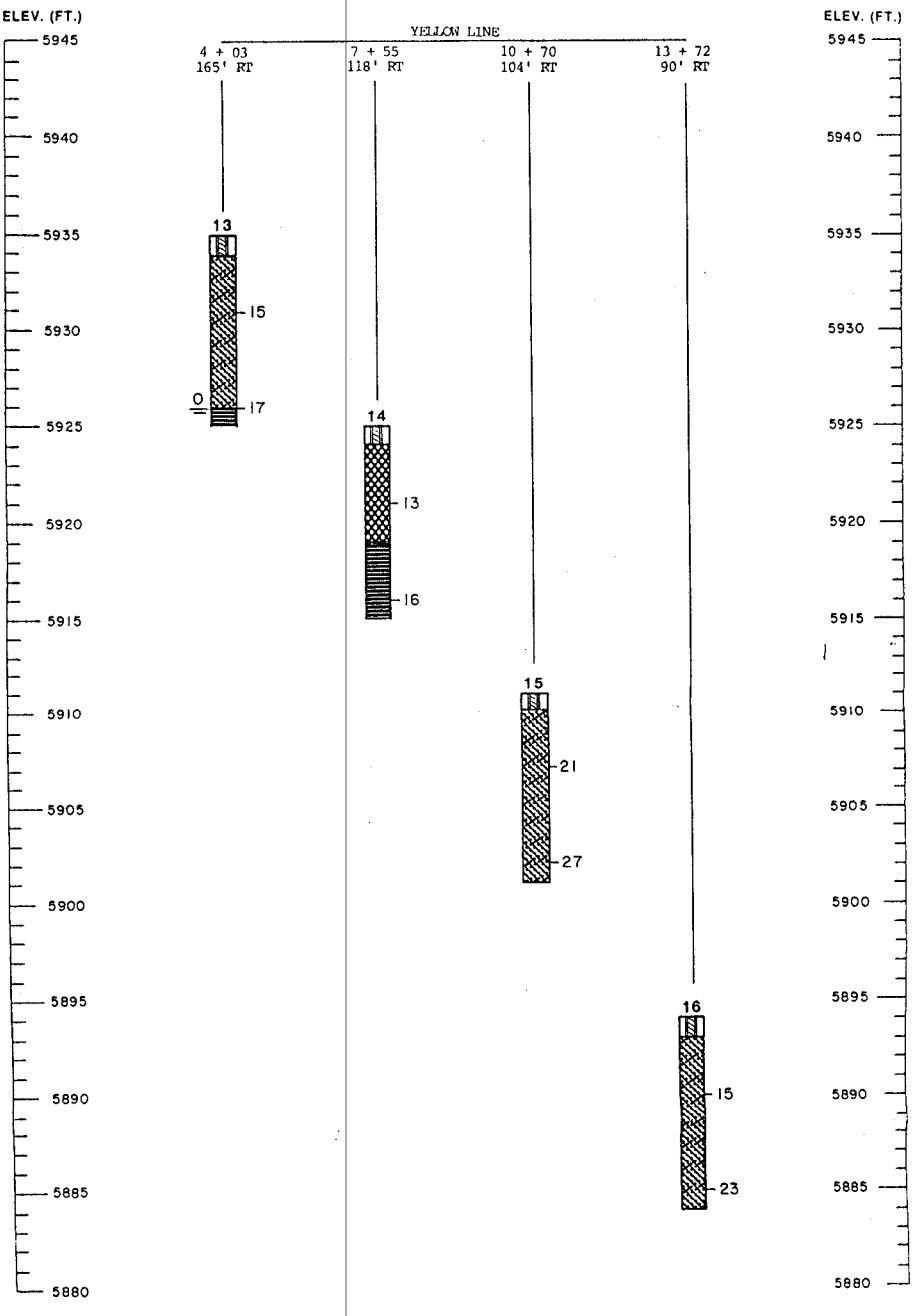
LOG OF BORINGS 8 THROUGH 12

SUBSURFACE INVESTIGATION AND ENGINEERING ANALYSIS REPORT
INDUSTRIAL WASTE FACILITY
ROCKY FLATS PLANT
JEFFERSON COUNTY, COLORADO

AGUIRRE ENGINEERS, INC.
Geotechnical and Materials Consultants
P.O. Box 3814
Englewood, Colorado
80155-3814 U.S.A.

DRAWN BY: NG	SCALE: Vertical 1" = 5'	
CHECKED BY: JAH	Horizontal N/A	
DATE: 6/10/88	JOB NO. 18,023	PLATE 4

BORINGS



For Legend and Notes, see Plates 6A and 6B

LOG OF BORINGS 13 THROUGH 16

SUBSURFACE INVESTIGATION AND ENGINEERING
ANALYSIS REPORT
INDUSTRIAL WASTE FACILITY
ROCKY FLATS PLANT
JEFFERSON COUNTY, COLORADO

AGUIRRE ENGINEERS, INC.
Geotechnical and Materials Consultants
P.O. Box 3814
Englewood, Colorado
80155-3814 U.S.A.

DRAWN BY: NG	SCALE: Vertical 1" = 5'	
CHECKED BY: JAH	Horizontal N/A	
DATE: 6/10/88	JOB NO. 18,023	PLATE 5

LEGEND

TOPSOIL

FILL MATERIAL: consisting of CLAY, gravelly to GRAVEL, clayey, some sandy lenses, some severely weathered claystone bedrock fragments, occasional rootlets, moist to very moist, medium stiff to very stiff, gray to brown to orange (CL, GC).

CLAY: some gravel to gravelly, trace to some sand, occasional rootlets, moist to wet, stiff to very stiff, black to dark brown to gray (CL).

CLAY: some sand to sandy, occasional gravels, occasional sand lenses, moist to very moist, stiff to very stiff, brown (CL-CH).

SAND and GRAVEL: some clay to clayey, moist to wet, medium dense to dense, light brown to dark brown (SP-SC to GP-GC).

CLAY (severely weathered claystone bedrock): trace to little sand, trace gravel, slightly calcareous, very moist, stiff to very stiff, brown to gray with orange (CL).

CLAYSTONE BEDROCK: weathered, trace to little sand, slightly calcareous, iron stains noted in fractures, very moist, hard to very hard, gray to brown with orange.

Water Table Elevation: At number of days, indicated, after drilling.

NOTES

1) The borings were drilled on May 18, 19, 24 and 25, 1988, with a 4 (four) inch diameter, continuous flight, power auger (Note: because of access difficulties, Boring 2 location was eliminated).

(Continued on Plate 4B)

LEGEND AND NOTES

SUBSURFACE INVESTIGATION AND ENGINEERING ANALYSIS REPORT
INDUSTRIAL WASTE FACILITY
ROCKY FLATS PLANT
JEFFERSON COUNTY, COLORADO

AGUIRRE ENGINEERS, INC.
Geotechnical and Materials Consultants
P.O. Box 3814
Englewood, Colorado
80155-3814 U.S.A.

DRAWN BY: NG	SCALE: Vertical N/A	
CHECKED BY: JAH	Horizontal N/A	
DATE: 6/10/88	JOB NO. 18,023	PLATE 6A

NOTES: (Continued from Plate 4A)

2) 16 (sixteen) indicates that 16 (sixteen) blows of a 140 (one hundred forty) pound hammer falling 30 (thirty) inches were required to drive the sampler 12 (twelve) inches (or number of inches indicated).

3) 3' LT indicates the boring was offset from the stationing 3 (three) feet to the left.

4) The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

5) The boring logs show subsurface conditions at the dates and locations indicated, and it is not warranted that they are representative of subsurface conditions at other locations and times.

6) The Boring locations were physically surveyed in the field by Aguirre Engineers, Inc. by taping or pacing distances from staked locations provided along the proposed pipelines and infiltration trench. Boring elevations were interpolated from the site plan provided to us by Engineering Science, Inc. These boring locations and elevations are adequate for the purpose of this report, but should be considered as only approximate for any other use.

7) Groundwater was encountered in Borings 1, 8, 9, and 13, during drilling operations (May 19, 24, and 25, 1988), at depths of from 9 (nine) to 28 (twenty-eight) feet below the existing ground surface.

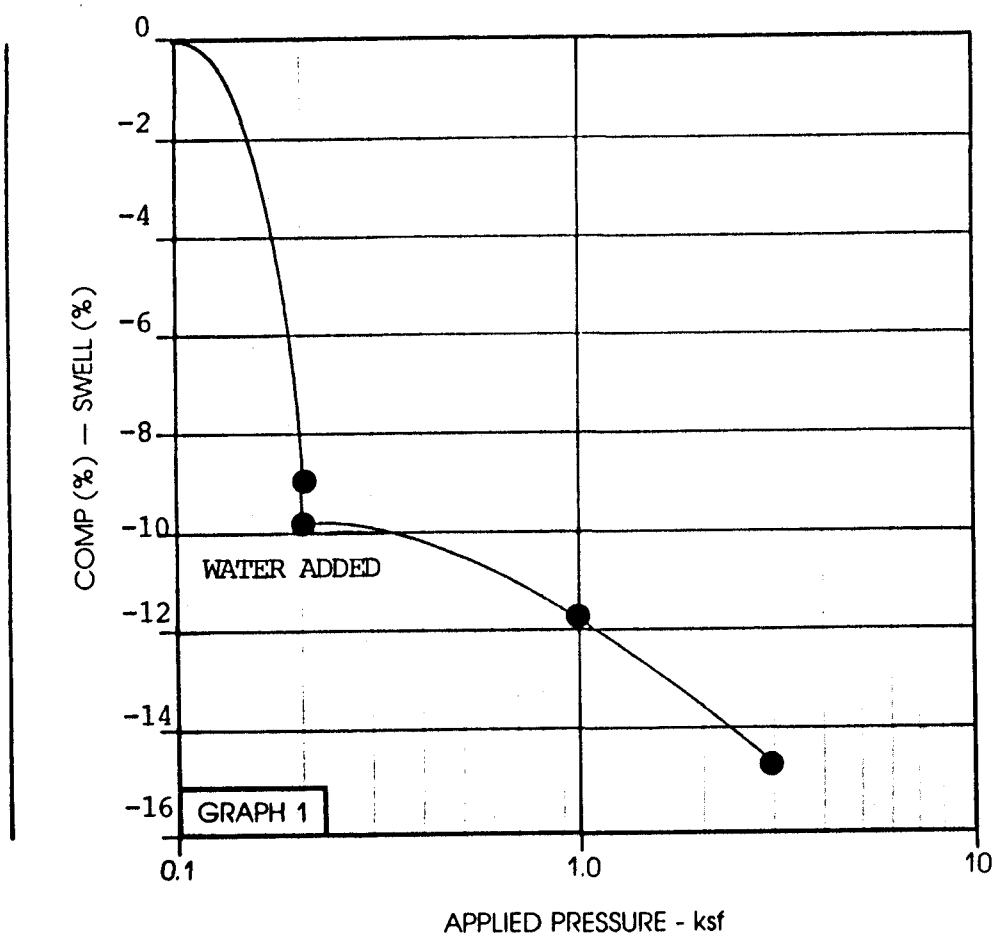
Where possible, groundwater levels were rechecked on May 25, 1988. This corresponds to either 7 (seven) days or 1 (one) day after completion of drilling operations. Groundwater levels could not be rechecked for Borings 1, 6, and 13 through 16, because of backfill requirements by Rockwell International.

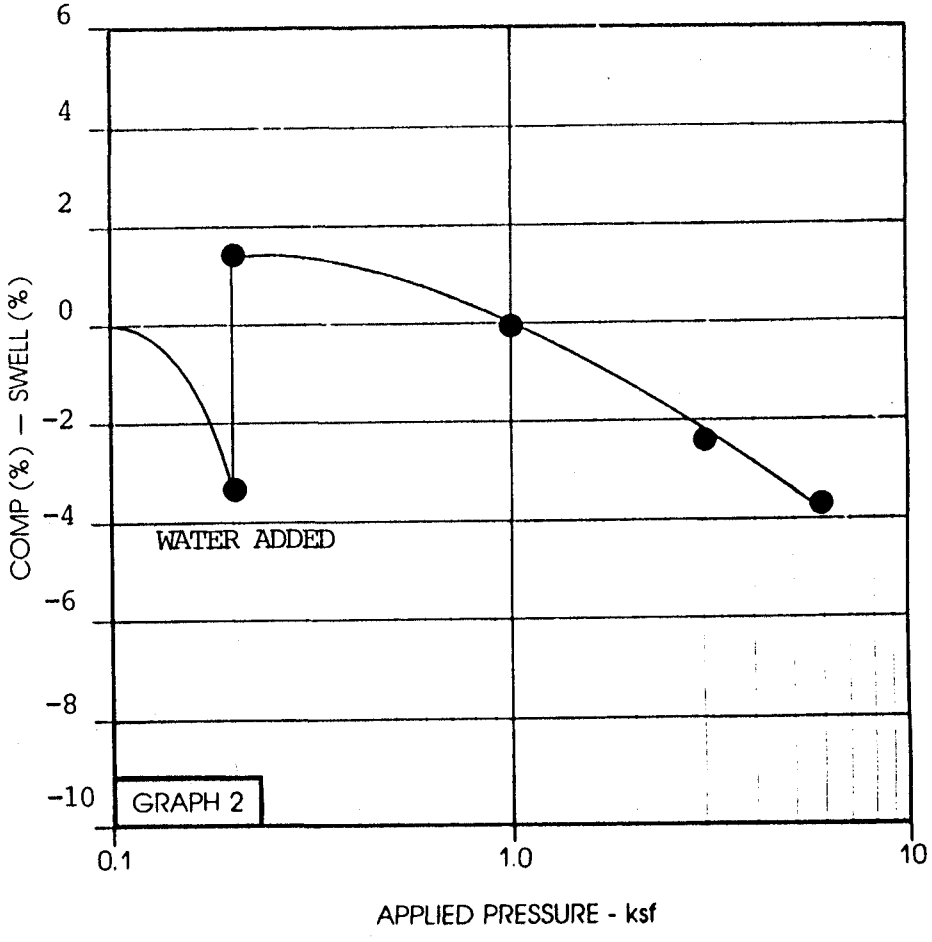
LEGEND AND NOTES

SUBSURFACE INVESTIGATION AND ENGINEERING ANALYSIS REPORT
INDUSTRIAL WASTE FACILITY
ROCKY FLATS PLANT
JEFFERSON COUNTY, COLORADO

AGUIRRE ENGINEERS, INC.
Geotechnical and Materials Consultants
P.O. Box 3814
Englewood, Colorado
80155-3814 U.S.A.

DRAWN BY: NG	SCALE: Vertical N/A		
CHECKED BY: JAH	Horizontal N/A		
DATE: 6/10/88	JOB NO. 18,023	PLATE 6B	





GRAPH NO.	BORING NO.	SAMPLE NO.	DEPTH (FEET)	NATURAL DRY DENSITY (PCF)	NATURAL MOISTURE (%)	SOIL DESCRIPTION
1	1		4	114.7	15.1	CLAY, some gravel, little sand, dark brown (CL)
2	6		24	114.4	16.2	CLAYSTONE BEDROCK, weathered, gray

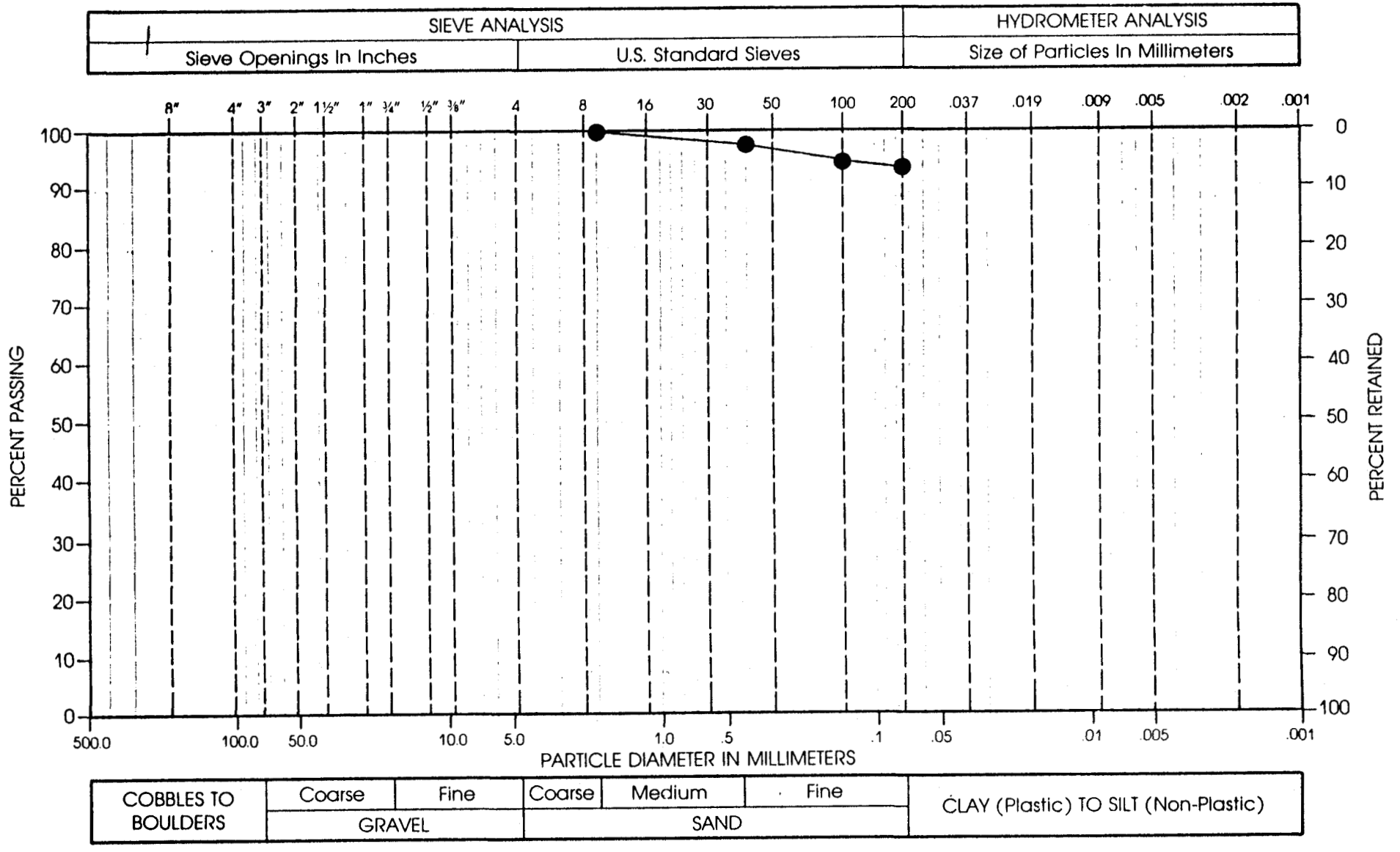
AGUIRRE ENGINEERS, INC.

SWELL-CONSOLIDATION TEST

DRAWN BY: PDF
CHECKED BY: JAH
DATE: 6/13/88

JOB NO. 18,023

PLATE 7



GRAPH NO.	BORING NO.	SAMPLE NO.	DEPTH (FEET)	NATURAL DRY DENSITY (PCF)	NATURAL MOISTURE (%)	PL	PI	LL	SOIL DESCRIPTION
	4		4						CLAY, trace sand, gray to dark brown (CL)

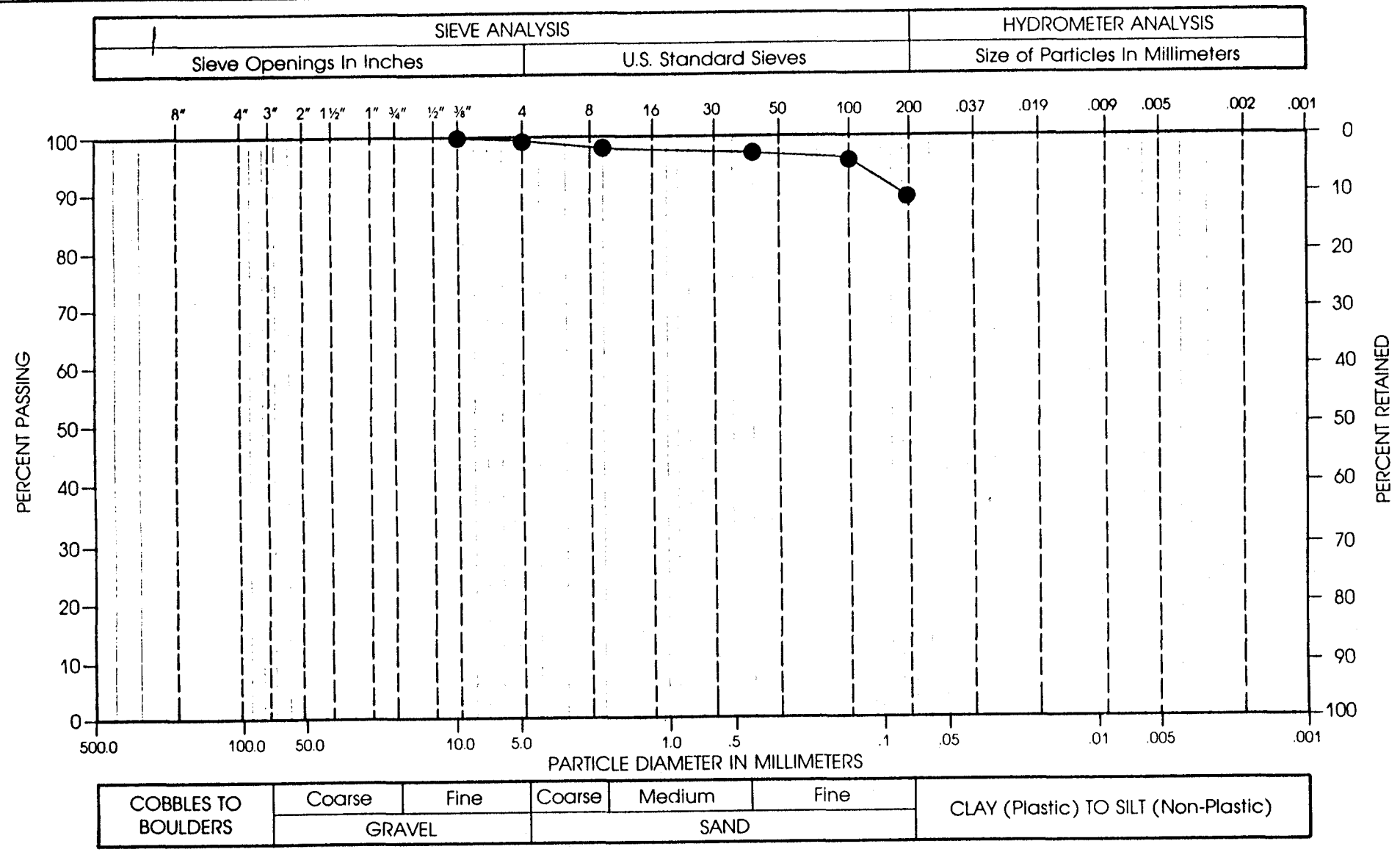
AGUIRRE ENGINEERS, INC.

GRADATION ANALYSIS

DRAWN BY: PDF
CHECKED BY: JAH
DATE: 6/10/88

JOB NO. 18,023

PLATE 8



GRAPH NO.	BORING NO.	SAMPLE NO.	DEPTH (FEET)	NATURAL DRY DENSITY (PCF)	NATURAL MOISTURE (%)	PL	PI	LL	SOIL DESCRIPTION
	5		4	106.9	21.8				CLAY, little sand, trace gravel (CL)

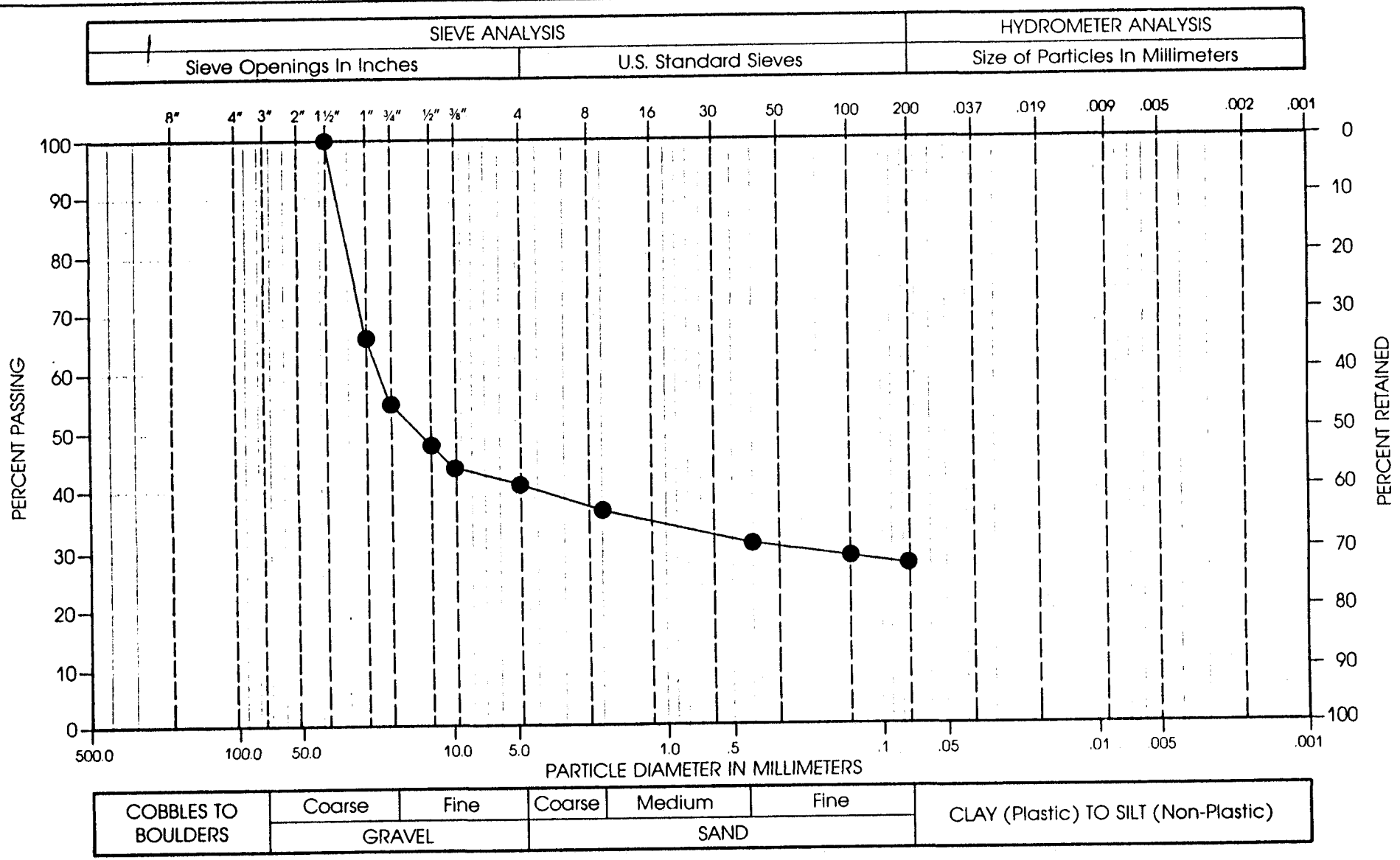
AGUIRRE ENGINEERS, INC.

GRADATION ANALYSIS

DRAWN BY: PDF
CHECKED BY: JAH
DATE: 6/10/88

JOB NO. 18,023

PLATE 9



GRAPH NO.	BORING NO.	SAMPLE NO.	DEPTH (FEET)	NATURAL DRY DENSITY (PCF)	NATURAL MOISTURE (%)	PL	PI	LL	SOIL DESCRIPTION
	6		19						FILL MATERIAL, consisting of gravel, clayey, little sand, gray to brown (GC)

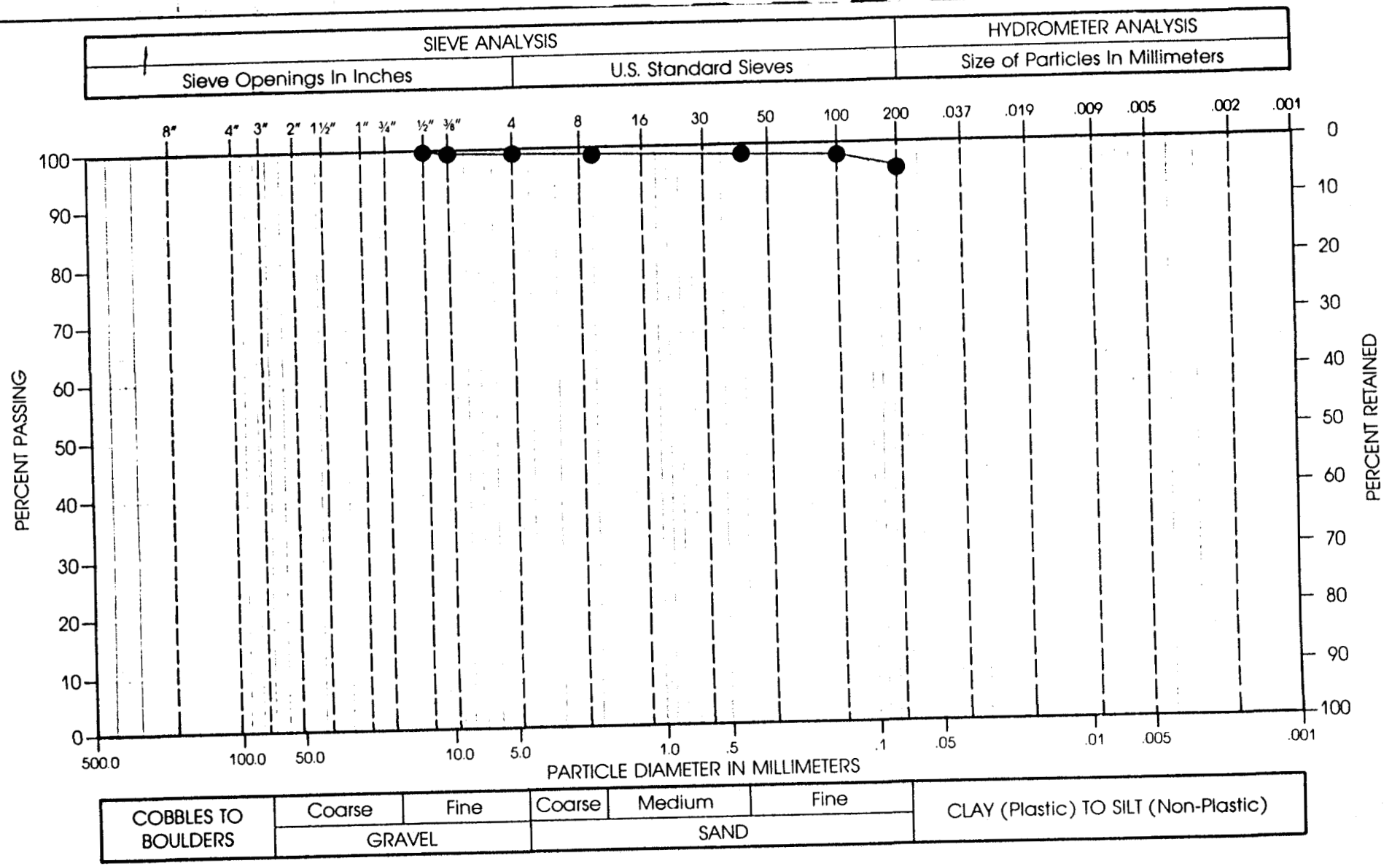
AGUIRRE ENGINEERS, INC.

GRADATION ANALYSIS

DRAWN BY: PDF
CHECKED BY: JAH
DATE: 6/20/88

JOB NO. 18,023

PLATE 10



GRAPH NO.	BORING NO.	SAMPLE NO.	DEPTH (FEET)	NATURAL DRY DENSITY (PCF)	NATURAL MOISTURE (%)	PL	PI	LL	SOIL DESCRIPTION
	7		14						FILL MATERIAL; consisting of clay and severely weathered claystone bedrock fragments, trace sand, orange to brown

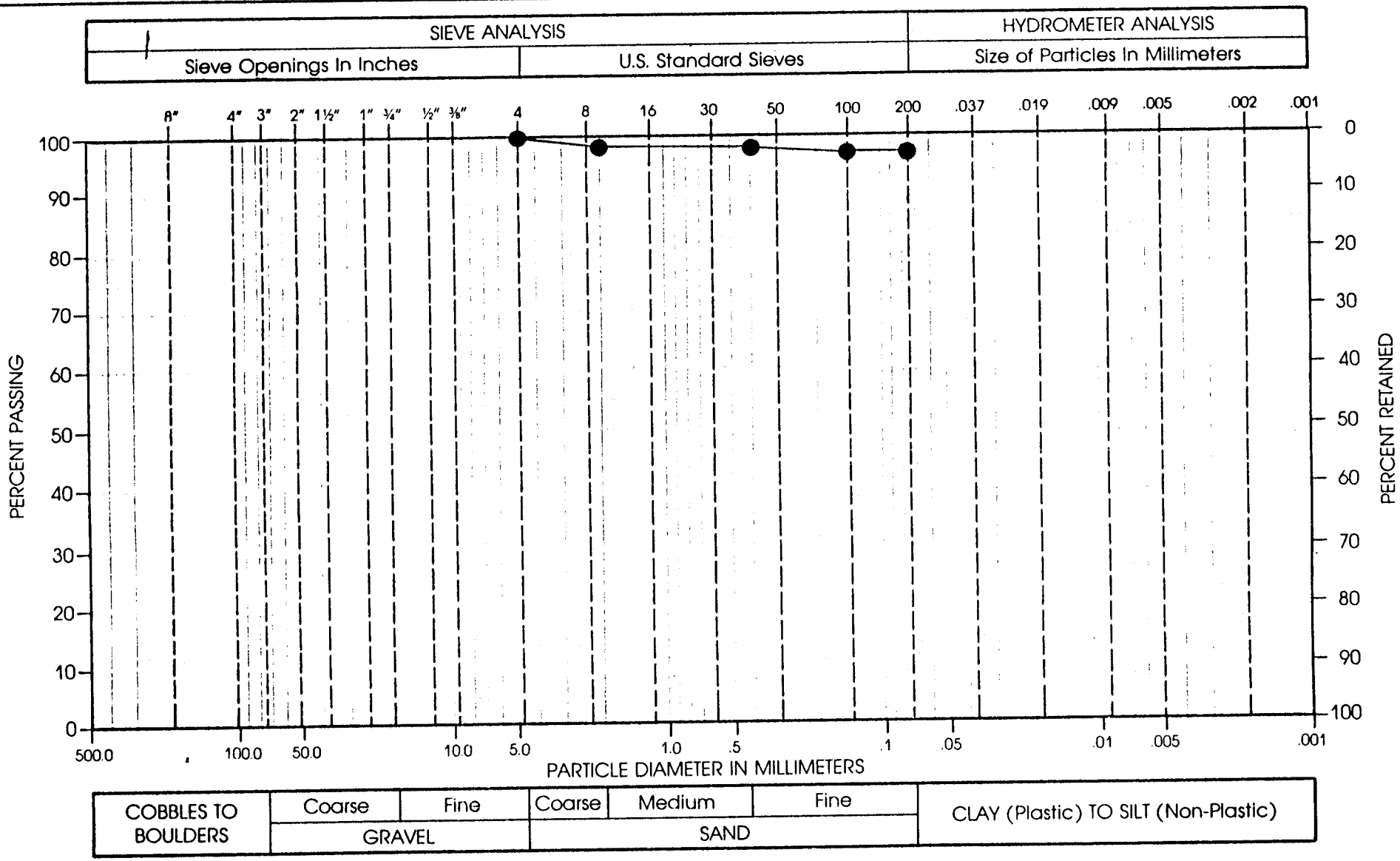
AGUIRRE ENGINEERS, INC.

GRADATION ANALYSIS

DRAWN BY: PDF
CHECKED BY: JAH
DATE: 6/10/88

JOB NO. 18,023

PLATE 11



GRAPH NO.	BORING NO.	SAMPLE NO.	DEPTH (FEET)	NATURAL DRY DENSITY (PCF)	NATURAL MOISTURE (%)	PL	PI	LL	SOIL DESCRIPTION
	7		19	111.7	16.9				CLAYSTONE BEDROCK, weathered, trace sand, gray to brown with orange

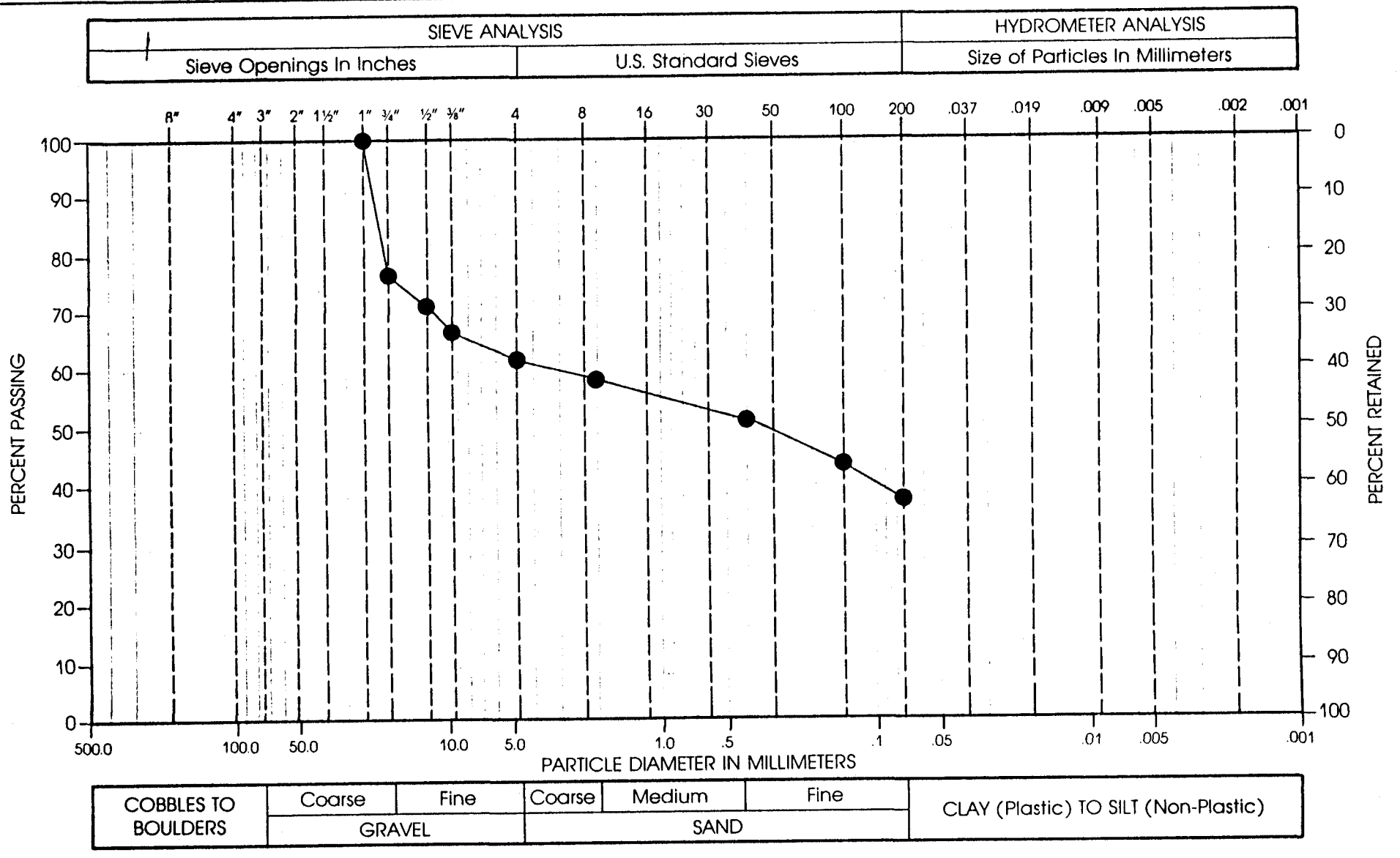
AGUIRRE ENGINEERS, INC.

GRADATION ANALYSIS

DRAWN BY: PDF
CHECKED BY: JAH
DATE: 6/10/88

JOB NO. 18,023

PLATE 12



GRAPH NO.	BORING NO.	SAMPLE NO.	DEPTH (FEET)	NATURAL DRY DENSITY (PCF)	NATURAL MOISTURE (%)	PL	PI	LL	SOIL DESCRIPTION
	8		9						FILL MATERIAL, consisting of gravel, clayey, some sand, brown (GC)

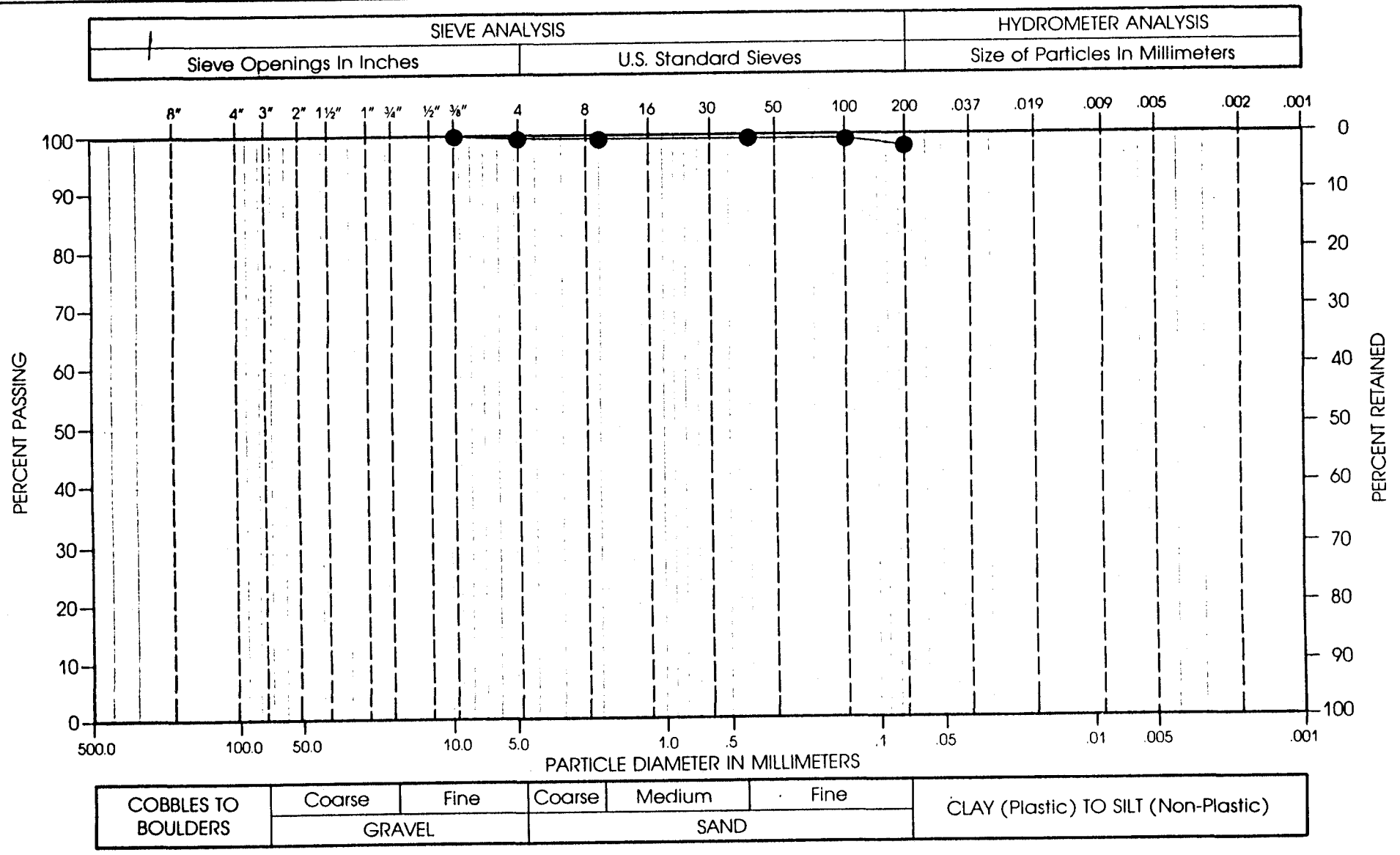
AGUIRRE ENGINEERS, INC.

GRADATION ANALYSIS

DRAWN BY: PDF
CHECKED BY: JAH
DATE: 6/10/88

JOB NO. 18,023

PLATE 13



GRAPH NO.	BORING NO.	SAMPLE NO.	DEPTH (FEET)	NATURAL DRY DENSITY (PCF)	NATURAL MOISTURE (%)	PL	PI	LL	SOIL DESCRIPTION
	8		19						CLAY (severely weathered claystone bedrock), trace sand, brown to gray with orange (CL)

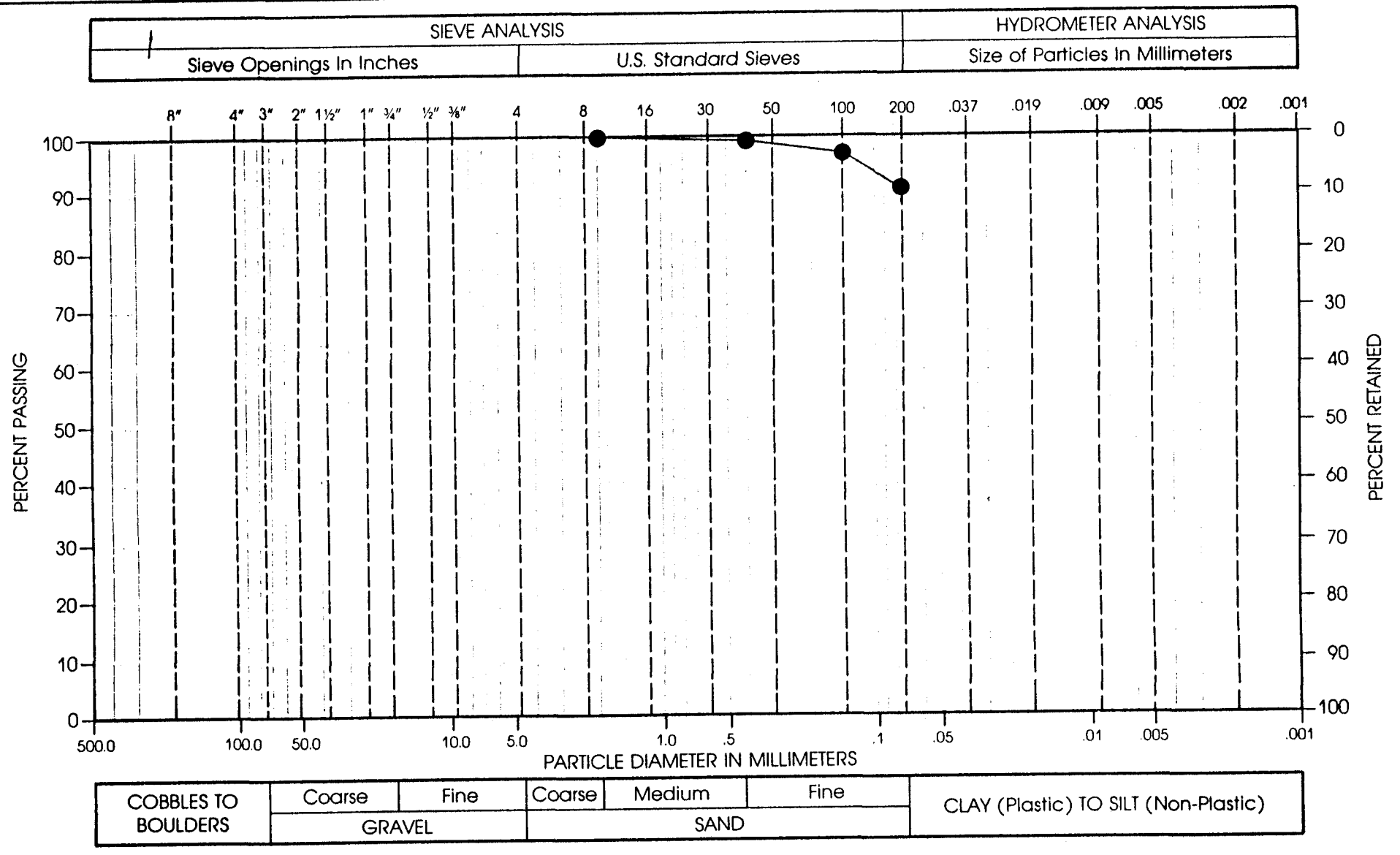
AGUIRRE ENGINEERS, INC.

GRADATION ANALYSIS

DRAWN BY: PDF
CHECKED BY: JAH
DATE: 6/10/88

JOB NO. 18,023

PLATE 14



GRAPH NO.	BORING NO.	SAMPLE NO.	DEPTH (FEET)	NATURAL DRY DENSITY (PCF)	NATURAL MOISTURE (%)	PL	PI	LL	SOIL DESCRIPTION
	8		24						CLAY (severely weathered claystone bedrock), trace sand, brown with orange (CL)

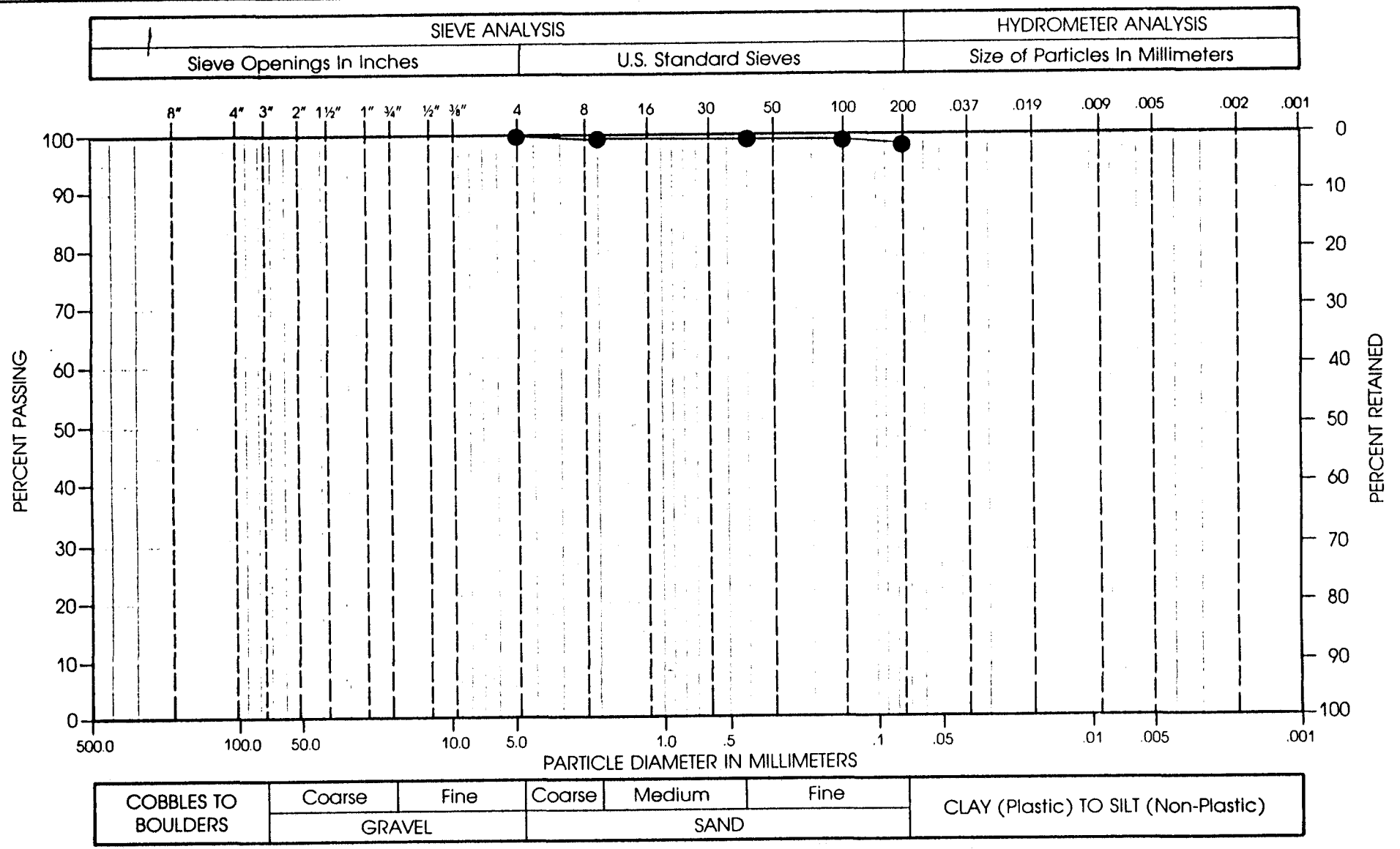
AGUIRRE ENGINEERS, INC.

GRADATION ANALYSIS

DRAWN BY: PDF
CHECKED BY: JAH
DATE: 6/10/88

JOB NO. 18,023

PLATE 15



GRAPH NO.	BORING NO.	SAMPLE NO.	DEPTH (FEET)	NATURAL DRY DENSITY (PCF)	NATURAL MOISTURE (%)	PL	PI	LL	SOIL DESCRIPTION
	9		14						CLAY (severely weathered claystone bedrock), trace sand, brown to gray with orange (CL)

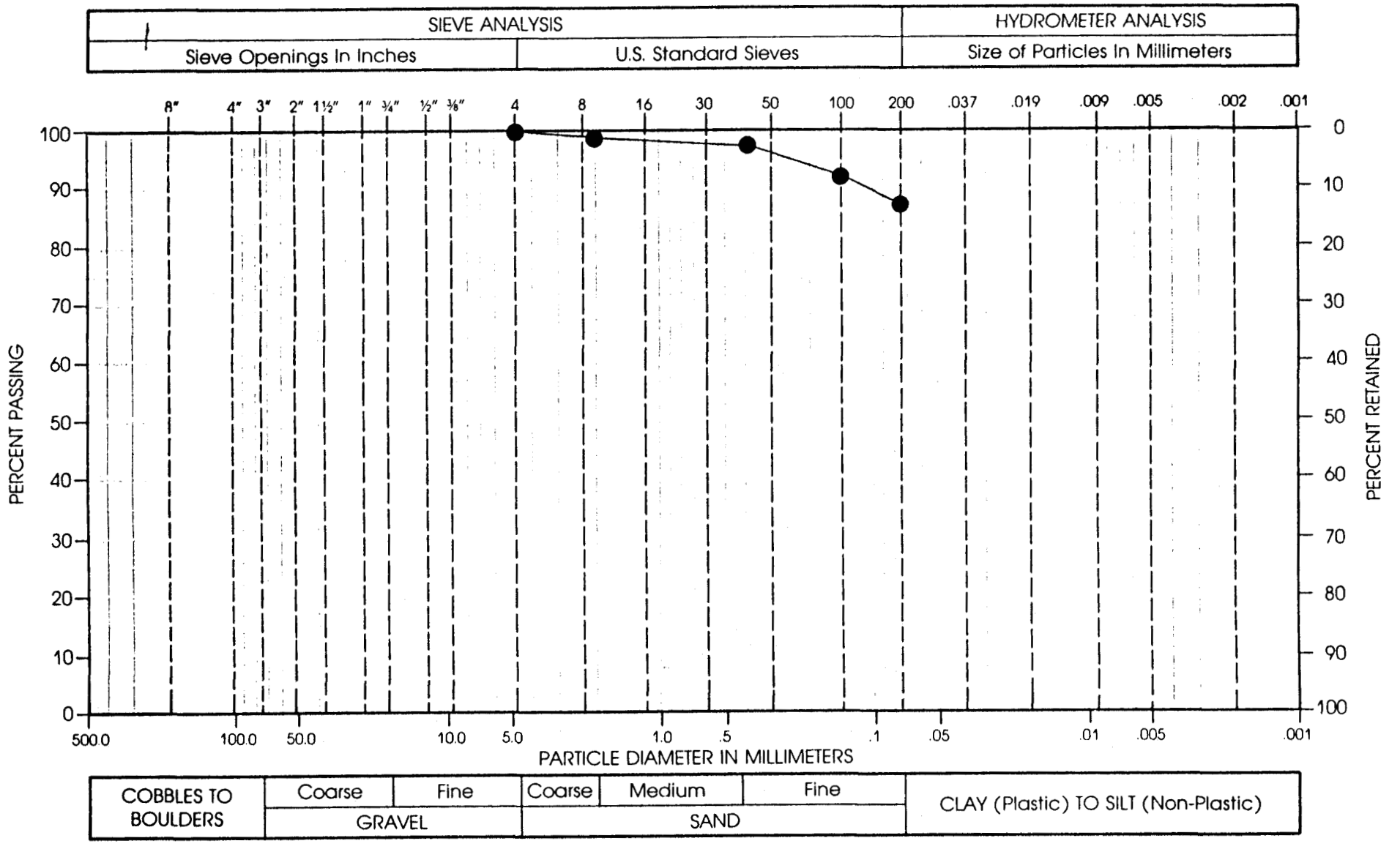
AGUIRRE ENGINEERS, INC.

GRADATION ANALYSIS

DRAWN BY: PDF
CHECKED BY: JAH
DATE: 6/10/88

JOB NO. 18,023

PLATE 16



GRAPH NO.	BORING NO.	SAMPLE NO.	DEPTH (FEET)	NATURAL DRY DENSITY (PCF)	NATURAL MOISTURE (%)	PL	PI	LL	SOIL DESCRIPTION
	11		4						CLAYSTONE BEDROCK, weathered, little sand, gray to brown

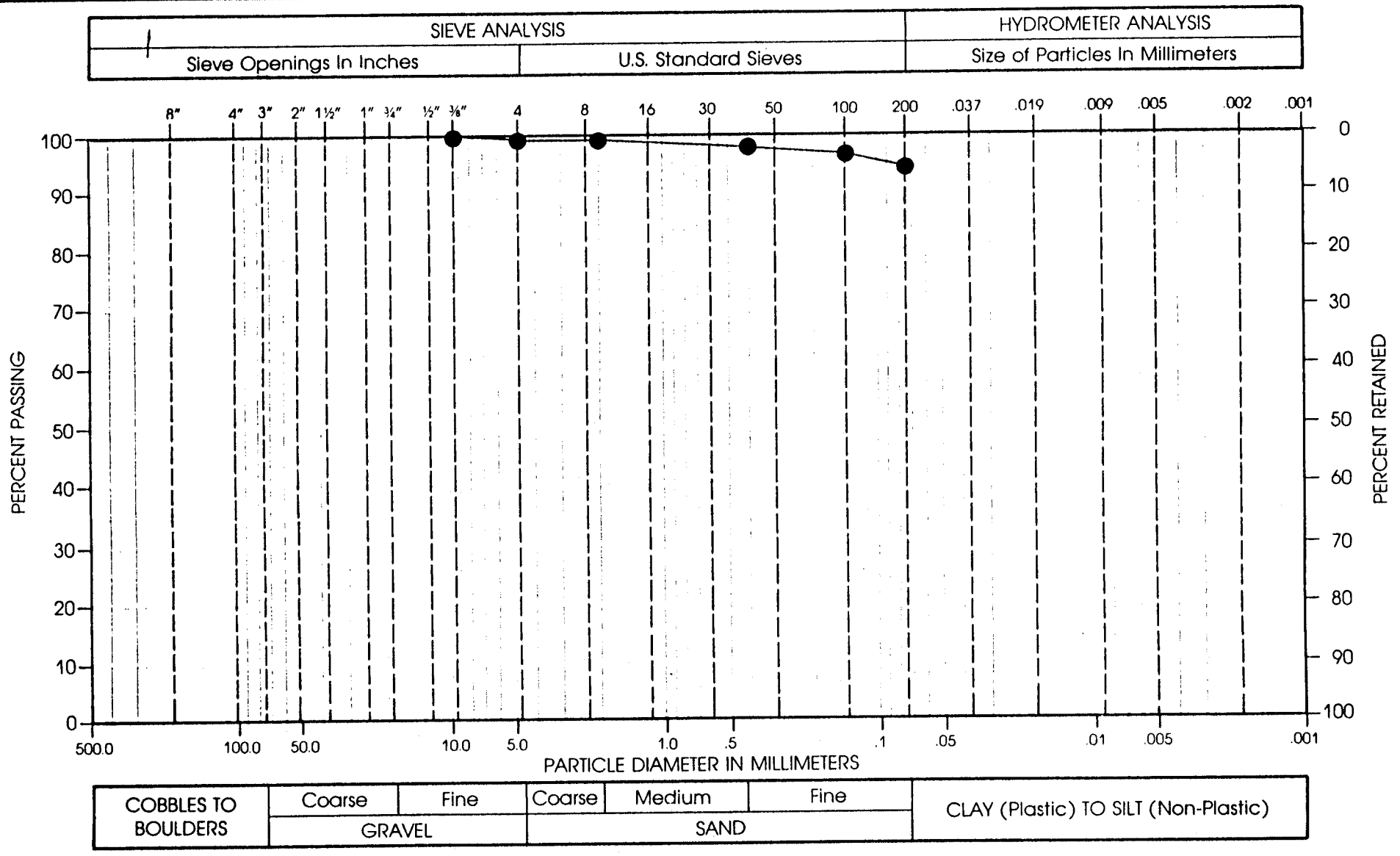
AGUIRRE ENGINEERS, INC.

GRADATION ANALYSIS

DRAWN BY: PDF
CHECKED BY: JAH
DATE: 6/10/88

JOB NO. 18,023

PLATE 17



GRAPH NO.	BORING NO.	SAMPLE NO.	DEPTH (FEET)	NATURAL DRY DENSITY (PCF)	NATURAL MOISTURE (%)	PL	PI	LL	SOIL DESCRIPTION
	13		9						CLAY (severely weathered claystone bedrock), trace sand, brown (CL)

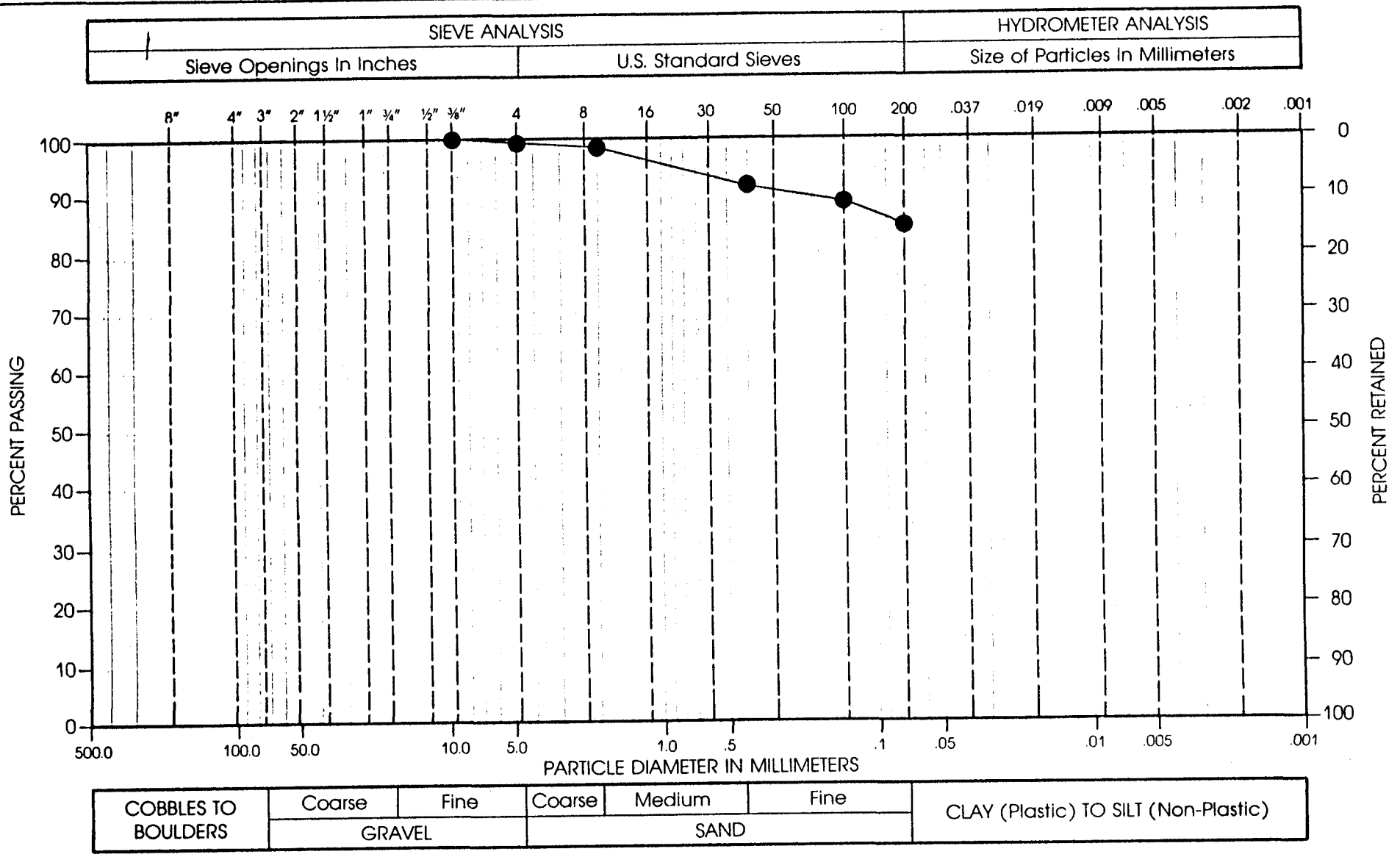
AGUIRRE ENGINEERS, INC.

GRADATION ANALYSIS

DRAWN BY: PDF
CHECKED BY: JAH
DATE: 6/10/88

JOB NO. 18,023

PLATE 18



GRAPH NO.	BORING NO.	SAMPLE NO.	DEPTH (FEET)	NATURAL DRY DENSITY (PCF)	NATURAL MOISTURE (%)	PL	PI	LL	SOIL DESCRIPTION
	14		9						CLAY (severely weathered claystone bedrock), little sand, trace gravel, brown to gray with orange (CL)

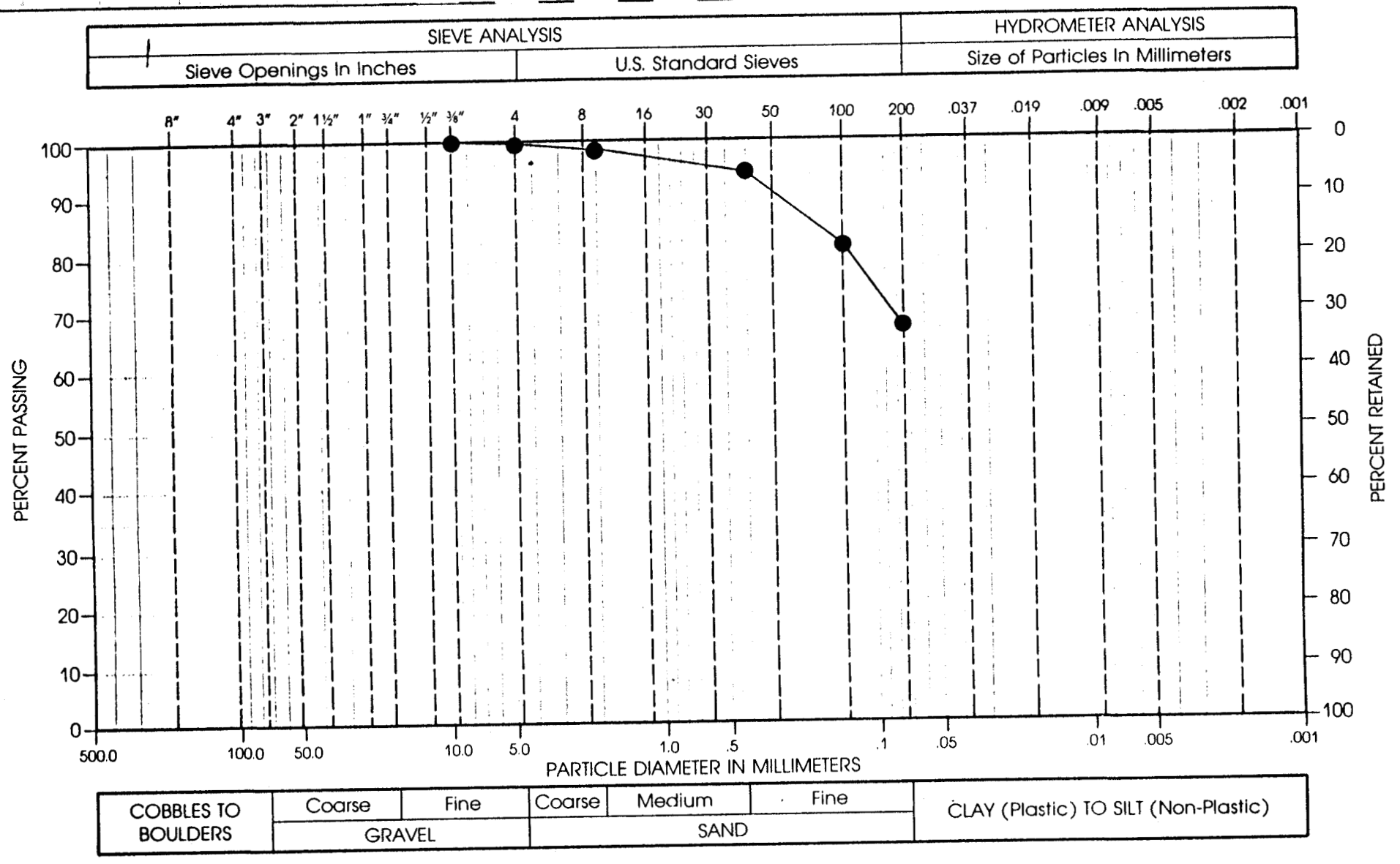
AGUIRRE ENGINEERS, INC.

GRADATION ANALYSIS

DRAWN BY: PDF
CHECKED BY: JAH
DATE: 6/10/88

JOB NO. 18,023

PLATE 19



GRAPH NO.	BORING NO.	SAMPLE NO.	DEPTH (FEET)	NATURAL DRY DENSITY (PCF)	NATURAL MOISTURE (%)	PL	PI	LL	SOIL DESCRIPTION
	15		4						CLAY, sandy, trace gravel, brown (CL)

AGUIRRE ENGINEERS, INC.

GRADATION ANALYSIS

DRAWN BY: PDF
CHECKED BY: JAH
DATE: 6/10/88

JOB NO. 18,023

PLATE 20

BORING NO.	SAMPLE NO.	DEPTH (FEET)	SAMPLE TYPE (SEE NOTE 1)	NATURAL DRY DENSITY (pcf)	NATURAL MOISTURE (%)	FINES (%)	ATTERBERG LIMITS			UNCONFINED COMPRESSIVE STRENGTH (psf)	SWELL INDEX (%)	WATER SOLUBLE SULFATES (%)	ADDITIONAL TEST RESULTS ATTACHED (SEE NOTE 2)	SOIL DESCRIPTION	UNIFIED SOIL CLASSIFICATION
							PL	PI	LL						
1		4	CA	114.7	15.1						-0.9		SW	CLAY, some gravel, little sand, dark brown	CL
3		4	CA				21	30	51					CLAY, trace gravel, sand lenses, brown	CL-CH
3		9	CA	119.6	13.6									CLAYSTONE BEDROCK, weathered, gray with orange	
4		4	CA			93.9							GA	CLAY, trace sand, gray to dark brown	CL
5		4	CA	106.9	21.8	89.7							GA	CLAY, little sand, trace gravel	CL
6		9	CA				20	23	43					FILL MATERIAL; consisting of clay, gravelly, some claystone bedrock fragments, brown	CL
6		19	CA			27.8							GA	FILL MATERIAL; consisting of gravel, clayey, little sand, gray to brown	GC

NOTE 1 - SAMPLE TYPE
AD - Air Dried
AS - Auger Sample
BS - Bag Sample
CA - California Sample
HD - Hand Drive
SS - Standard Spoon
ST - Shelby Tube Sample
RM - Remolded Sample

NOTE 2 -ADDITIONAL TEST RESULTS ATTACHED
C_1 - Unconfined Compression
C_2 - Miniature Vane Shear
C_3 - Pocket Penetrometer
C_4 - Pocket Vane
CT - Consolidation Test
GA - Gradation Analysis
PT - Proctor
SW - Swell-Consolidation Test
TT - Triaxial Test

PERM - Lab Permeability Tests (test results not available at this writing)

AGUIRRE ENGINEERS, INC.
Geotechnical and Materials Consultants

SUMMARY OF LABORATORY TEST RESULTS

PROJECT NO. 18,023

TABLE 1

BORING NO.	SAMPLE NO.	DEPTH (FEET)	SAMPLE TYPE (SEE NOTE 1)	NATURAL DRY DENSITY (pcf)	NATURAL MOISTURE (%)	FINES (%)	ATTERBERG LIMITS			UNCONFINED COMPRESSIVE STRENGTH (psf)	SWELL INDEX (%)	WATER SOLUBLE SULFATES (%)	ADDITIONAL TEST RESULTS ATTACHED (SEE NOTE 2)	SOIL DESCRIPTION	UNIFIED SOIL CLASSIFICATION
							PL	PI	LL						
6		24	CA	114.4	16.2						+4.8		SW	CLAYSTONE BEDROCK, weathered, gray	
7		9	CA				15	19	34					FILL MATERIAL; consisting of clay, gravelly, some sand lenses, brown	CL
7		14	CA			95.7							GA	FILL MATERIAL; consisting of clay and severely weathered claystone bedrock fragments, trace sand, orange to brown	CL
7		19	CA	111.7	16.9	96.3							GA	CLAYSTONE BEDROCK, weathered, trace sand, gray to brown with orange	
8		4	CA	102.6	18.3		21	29	50					FILL MATERIAL; consisting of clay and severely weathered claystone bedrock fragments, trace sand, orange to brown	CL
8		9	CA			37.4							GA	FILL MATERIAL; consisting of gravel, clayey, some sand, brown	GC

NOTE 1 - SAMPLE TYPE
AD - Air Dried
AS - Auger Sample
BS - Bag Sample
CA - California Sample
HD - Hand Drive
SS - Standard Spoon
ST - Shelby Tube Sample
RM - Remolded Sample

NOTE 2 -ADDITIONAL TEST RESULTS ATTACHED
C_1 - Unconfined Compression
C_2 - Miniature Vane Shear
C_3 - Pocket Penetrometer
C_4 - Pocket Vane
CT - Consolidation Test
GA - Gradation Analysis
PT - Proctor
SW - Swell-Consolidation Test
TT - Triaxial Test

PERM - Lab Permeability Tests (test results not available at this writing)

AGUIRRE ENGINEERS, INC.
Geotechnical and Materials Consultants

SUMMARY OF LABORATORY TEST RESULTS

PROJECT NO. 18,023

TABLE 1

BORING NO.	SAMPLE NO.	DEPTH (FEET)	SAMPLE TYPE (SEE NOTE 1)	NATURAL DRY DENSITY (pcf)	NATURAL MOISTURE (%)	FINES (%)	ATTERBERG LIMITS			UNCONFINED COMPRESSIVE STRENGTH (psf)	SWELL INDEX (%)	WATER SOLUBLE SULFATES (%)	ADDITIONAL TEST RESULTS ATTACHED (SEE NOTE 2)	SOIL DESCRIPTION	UNIFIED SOIL CLASSIFICATION
							PL	PI	LL						
8		14	CA	106.8	18.2									CLAY (severely weathered claystone bedrock), trace sand	CL
8		19	CA			98.7							GA	CLAY (severely weathered claystone bedrock), trace sand, brown to gray with orange	CL
8		24	CA			90.2							GA	CLAY (severely weathered claystone bedrock), trace sand, brown with orange	CL
8		29	CA	118.7	14.2		18	25	43					CLAY (severely weathered claystone bedrock), little sand, brown to gray with orange	CL
9		4	CA	102.8	22.6		20	19	39					FILL MATERIAL; consisting of clay, gravelly, some sand lenses, brown	CL
9		9	CA										PERM	FILL MATERIAL; consisting of clay, gravelly, some sand lenses, brown	CL

NOTE 1 - SAMPLE TYPE
AD - Air Dried
AS - Auger Sample
BS - Bag Sample
CA - California Sample
HD - Hand Drive
SS - Standard Spoon
ST - Shelby Tube Sample
RM - Remolded Sample

NOTE 2 -ADDITIONAL TEST RESULTS ATTACHED
C_1 - Unconfined Compression
C_2 - Miniature Vane Shear
C_3 - Pocket Penetrometer
C_4 - Pocket Vane
CT - Consolidation Test
GA - Gradation Analysis
PT - Proctor
SW - Swell-Consolidation Test
TT - Triaxial Test

PERM - Lab Permeability Tests (test results not available at this writing)

AGUIRRE ENGINEERS, INC.
Geotechnical and Materials Consultants

SUMMARY OF LABORATORY TEST RESULTS

PROJECT NO. 18,023

TABLE 1

BORING NO.	SAMPLE NO.	DEPTH (FEET)	SAMPLE TYPE (SEE NOTE 1)	NATURAL DRY DENSITY (pcf)	NATURAL MOISTURE (%)	FINES (%)	ATTERBERG LIMITS			UNCONFINED COMPRESSIVE STRENGTH (psf)	SWELL INDEX (%)	WATER SOLUBLE SULFATES (%)	ADDITIONAL TEST RESULTS ATTACHED (SEE NOTE 2)	SOIL DESCRIPTION	UNIFIED SOIL CLASSIFICATION
							PL	PI	LL						
9		14	CA			99.0							GA	CLAY (severely weathered claystone bedrock), trace sand, brown to gray with orange	CL
10		4	CA	99.0	26.8		22	26	48				PERM	FILL MATERIAL; consisting of clay, gravelly with severely weathered claystone bedrock fragments, gray to brown	CL
10		9	CA				20	26	46					CLAY, some gravel, some sand, dark brown to gray	CL
10		14	CA	116.6	12.5									CLAYSTONE BEDROCK, weathered, slightly calcareous, gray to brown	
11		4	CA			86.7							GA	CLAYSTONE BEDROCK, weathered, little sand, gray to brown	
11		9	CA	117.9	12.6									CLAYSTONE BEDROCK, weathered, trace sand, gray to brown	

NOTE 1 - SAMPLE TYPE
AD - Air Dried
AS - Auger Sample
BS - Bag Sample
CA - California Sample
HD - Hand Drive
SS - Standard Spoon
ST - Shelby Tube Sample
RM - Remolded Sample

NOTE 2 -ADDITIONAL TEST RESULTS ATTACHED
C_1 - Unconfined Compression
C_2 - Miniature Vane Shear
C_3 - Pocket Penetrometer
C_4 - Pocket Vane
CT - Consolidation Test
GA - Gradation Analysis
PT - Proctor
SW - Swell-Consolidation Test
TT - Triaxial Test

PERM - Lab Permeability Tests (test results not available at this writing)

AGUIRRE ENGINEERS, INC.
Geotechnical and Materials Consultants

SUMMARY OF LABORATORY TEST RESULTS

PROJECT NO. 18,023

TABLE 1

BORING NO.	SAMPLE NO.	DEPTH (FEET)	SAMPLE TYPE (SEE NOTE 1)	NATURAL DRY DENSITY (pcf)	NATURAL MOISTURE (%)	FINES (%)	ATTERBERG LIMITS			UNCONFINED COMPRESSIVE STRENGTH (psf)	SWELL INDEX (%)	WATER SOLUBLE SULFATES (%)	ADDITIONAL TEST RESULTS ATTACHED (SEE NOTE 2)	SOIL DESCRIPTION	UNIFIED SOIL CLASSIFICATION
							PL	PI	LL						
13		4	CA	111.4	16.1									CLAY, some sand, brown	CL
13		9	CA			94.8							GA	CLAY (severely weathered claystone bedrock), trace sand, brown	CL
14		4	CA	107.1	19.4		20	28	48					FILL MATERIAL; consisting of clay, gravelly, some severely weathered claystone bedrock fragments, gray to brown	CL
14		9	CA			84.4							GA	CLAY (severely weathered claystone bedrock), little sand, trace gravel, brown to gray with orange	CL
15		4	CA			67.7							GA PERM	CLAY, sandy, trace gravel, brown	CL
15		9	CA			70.1								CLAY, sandy, brown	CL
16		4	CA			58.3							GA PERM	CLAY, some sand, brown	CL-CH

NOTE 1 - SAMPLE TYPE
AD - Air Dried
AS - Auger Sample
BS - Bag Sample
CA - California Sample
HD - Hand Drive
SS - Standard Spoon
ST - Shelby Tube Sample
RM - Remolded Sample

NOTE 2 -ADDITIONAL TEST RESULTS ATTACHED
C_1 - Unconfined Compression
C_2 - Miniature Vane Shear
C_3 - Pocket Penetrometer
C_4 - Pocket Vane
CT - Consolidation Test
GA - Gradation Analysis
PT - Proctor
SW - Swell-Consolidation Test
TT - Triaxial Test

PERM - Lab Permeability Tests (test results not available at this writing)

AGUIRRE ENGINEERS, INC.
Geotechnical and Materials Consultants

SUMMARY OF LABORATORY TEST RESULTS

PROJECT NO. 18,023

TABLE 1

APPENDIX B

PRELIMINARY DRAWINGS

ROCKWELL INTERNATIONAL

ROCKY FLATS PLANT

881 Hillside Remedial Action
Ground Water Collection,
Treatment and Reinjection System

FACILITIES ENGINEERING
Golden, Colorado 80402-0464

INDEX OF DRAWINGS

FOR TITLE I REVIEW NOT FOR CONSTRUCTION

A	ORIGINAL ISSUE			986147
ISSUE	DESCRIPTION	BY	DATE	

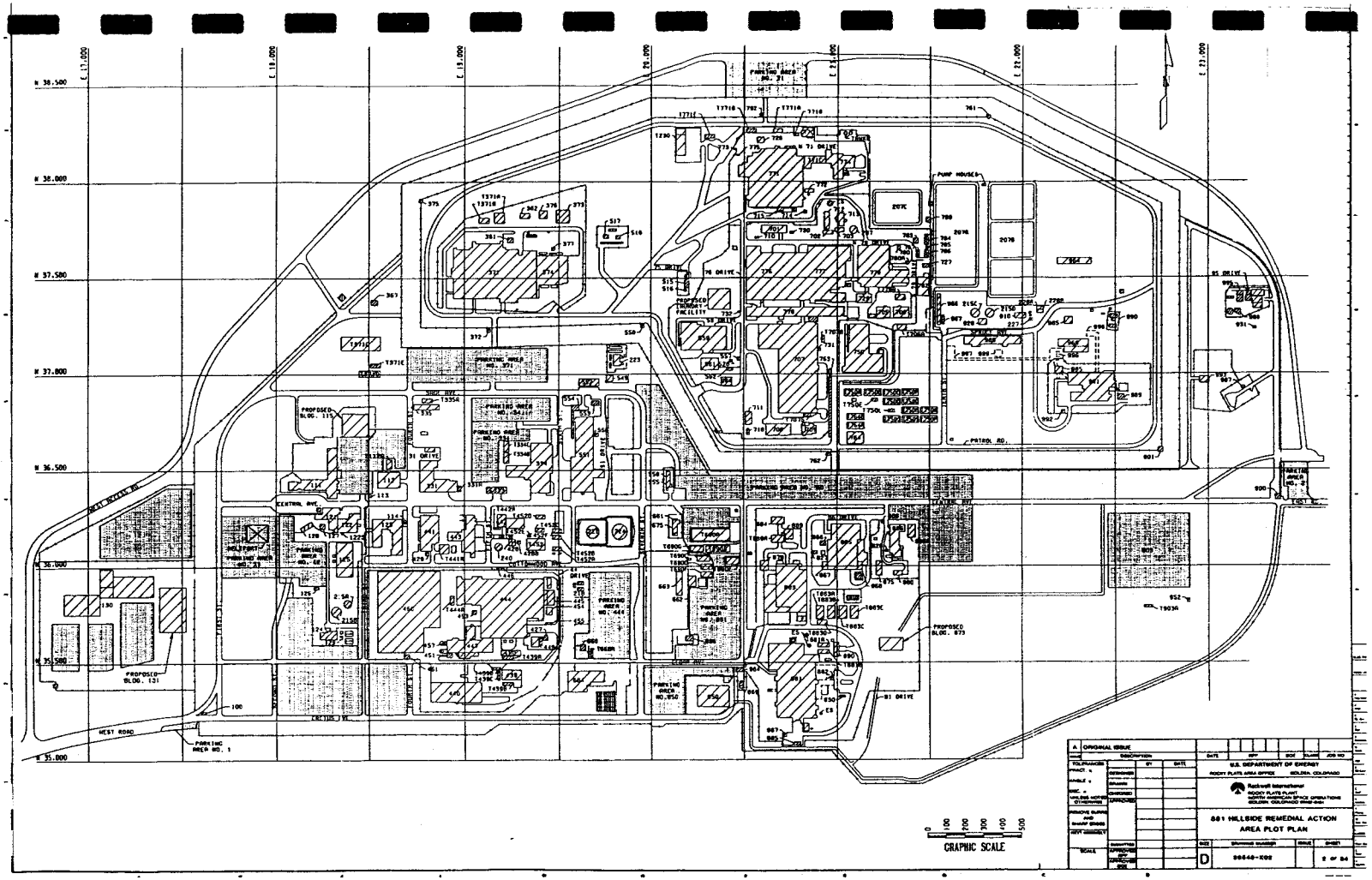
U.S. DEPARTMENT OF ENERGY
ROCKY FLATS AREA OFFICE GOLDEN, COLORADO

Rockwell International
ROCKY FLATS PLANT
ENERGY SYSTEMS GROUP
GOLDEN, COLORADO 80402

881 Hillside Remedial Action
Index and Title Sheet

SIZE D | 38548-X01 | 1 of 34

ENGINEERING-SCIENCE
Denver, Colorado

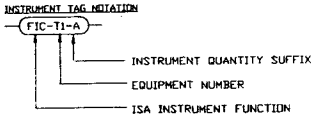

E 17,000
E 18,000
E 19,000
E 20,000
E 21,000
E 22,000
E 23,000
N 38,500
N 38,000
N 37,500
N 37,000
N 36,500
N 36,000
N 35,500
N 35,000
WEST ROAD
PROPOSED BLDG. 131
PARKING AREA NO. 1
PROPOSED BLDG. 115
PROPOSED BLDG. 873
PUMP HOUSE
PATROL RD.
CENTRAL AVE.
81 DRIVE
GRAPHIC SCALE
0 100 200 300 400 500
A ORIGINAL ISSUE
DESCRIPTION
BY
DATE
U.S. DEPARTMENT OF ENERGY
ROCKY FLATS AREA OFFICE GOLDEN, COLORADO
Rockwell International
ROCKY FLATS PLANT
NORTH AMERICAN SPACE OPERATIONS
GOLDEN, COLORADO
881 HILLSIDE REMEDIAL ACTION
AREA PLOT PLAN
SIZE
D
99648-X02
SHEET
2 OF 84

[redacted]

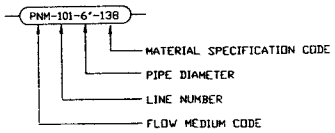
LINE CODES

- ELECTRICAL
- PROCESS OR MECH.
- PNEUMATIC
- CAPILLARY
- SONIC OR R.F.
- HYDRAULIC
- TELEPHONE
- SOFTWARE OR DATA
- NO CONNECTION
- CONNECTIONS
- SIGNAL CONTINUATION TO SHEET
- SIGNAL CONTINUATION FROM SHEET
- SHEET — PROCESS LINE CONTINUATION ON SHEET INDICATED
- CONTINUED ON SAME SHEET

INSTRUMENT TAG NOTATION



PIPE NUMBER NOTATION



VALVES, PUMPS & METERS

- GATE
- BUTTERFLY
- BALL OR ROTARY
- GLOBE
- PLUG OR COCK
- CHECK (FLOW -->)
- PINCH
- CONTROL VALVE POSITIONER
- PRESSURE REGULATING VALVE
- PISTON OPERATED
- S=SOLENOID OPERATED
- H=MOTOR OPERATED
- T=HAND OPERATED
- NEEDLE
- Y=WEIR GATE
- T=SLIDE GATE
- I=STOP LOG
- PRESSURE RELIEF OR SAFETY
- 3-WAY
- 4-WAY
- TELESCOPING
- REDUCER
- HOSE CONNECTION
- WAFER/CHECK VALVE
- ORIFICE
- MAGNETIC METER
- SONIC METER
- VENTURI OR FLOW TUBE
- PROPELLOR OR TURBINE METER
- ROTAMETER
- PROGRESSING CAVITY PUMP
- CENTRIFUGAL PUMP
- POSITIVE DISPLACEMENT PUMP
- DIAPHRAGM OR METERING PUMP
- STROKE ADJUSTMENT MECHANIZED OR
- H = MANUAL ONLY
- EDUCTOR
- STRAINER
- DIAPHRAGM ISOLATOR
- HORN
- GRADUATED
- MEASURING
- CYLINDER
- RUPTURE DISK
- FILTER
- CENTRIFUGAL BLOWER
- POSITIVE DISPLACMENT BLOWER

MISCE[redacted]MBOLS

- PURGE CONNECTION
- SAMPLE POINT
- INTERLOCK
- X MULTIPLY
- ÷ DIVIDE
- HIGH SELECT
- LOW SELECT
- SQUARE ROOT
- Σ SUM (ALGEBRAIC)
- SPECIAL FUNCTION
- R+B RATIO PLUS BIAS
- * INCLUDED WITH VENDOR SUPPLIED PACKAGE

[redacted]VE OPE[redacted]TION

- EFC = ELECTRIC FAIL CLOSE
- AFC = AIR FAIL CLOSE
- EFO = ELECTRIC FAIL OPEN
- AFO = AIR FAIL OPEN
- AFS = AIR FAIL STATIC
- EFS = ELECTRIC FAIL STATIC

CONTROLLER NOTATION

- PV = PROCESS VARIABLE INPUT
- SP = SET POINT INPUT
- C = CONTROL OUTPUT

EQUIPMENT NOTATION

- T = TANK OR SUMP
- P = PUMP
- B = BLOWER
- C = COMPRESSOR
- A = AGITATOR
- AR = AERATOR
- M = MOTOR

HAND SWITCH NOTATION

- HOA = HAND-OFF-AUTO
- S/S = START/STOP
- SEL = SELECTOR
- O/C = OPEN/CLOSE
- O/O = ON/OFF

VALVE DESIGNATIONS

HV	HAND VALVE
FCV	FLOW CONTROL VALVE
PCV	PRESSURE CONTROL VALVE
LCV	LEVEL CONTROL VALVE
GV	GAGING VALVE

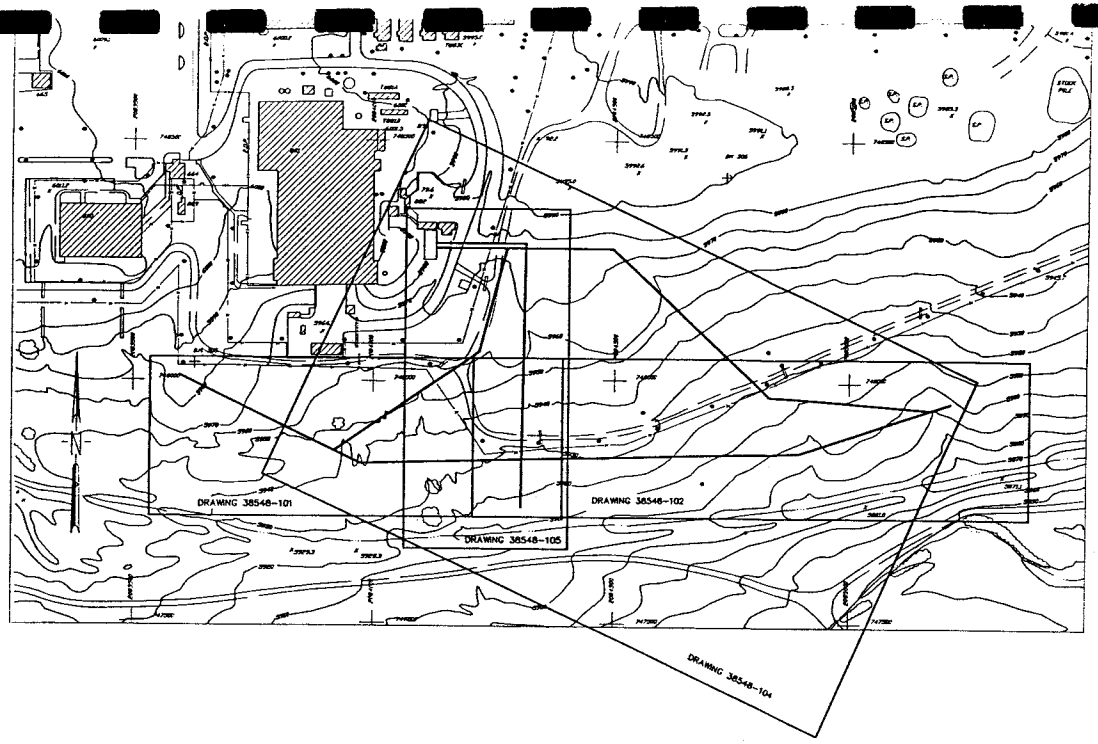
INCOMPLETE

FOR TITLE I REVIEW NOT FOR CONSTRUCTION

A	ORIGINAL ISSUE			986147
REVISIONS	DESCRIPTION	BY	DATE	

ENGINEERING-SCIENCE
Denver, Colorado

U.S. DEPARTMENT OF ENERGY ROCKY FLATS AREA OFFICE GOLDEN, COLORADO	
Rockwell International ROCKY FLATS PLANT ENERGY SYSTEMS GROUP GOLDEN, COLORADO 80402	
881 Hillside Remedial Action	
P & ID LEGEND AND SYMBOLS	
SIZE D	DRAWING NUMBER 38548-001
SCALE NONE	SHEET 4 OF 34



FOR TITLE I REVIEW NOT FOR CONSTRUCTION

A	ORIGINAL ISSUE		986147

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS AREA OFFICE GOLDEN, COLORADO

ROCKWELL INTERNATIONAL
ROCKY FLATS PLANT
ENERGY SYSTEMS GROUP
GOLDEN, COLORADO 80402

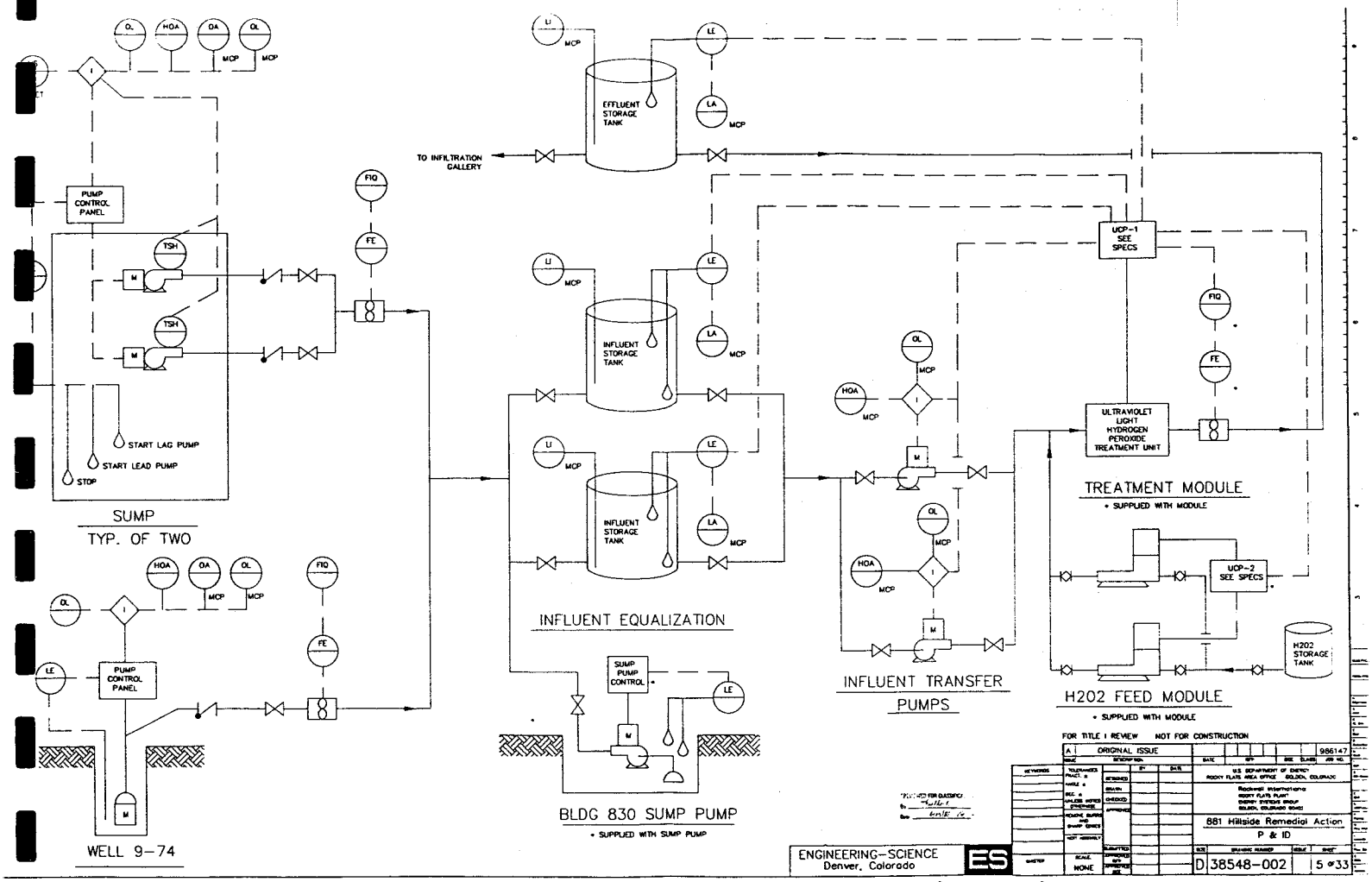
881 Hillside Remedial Action
General Site Plan

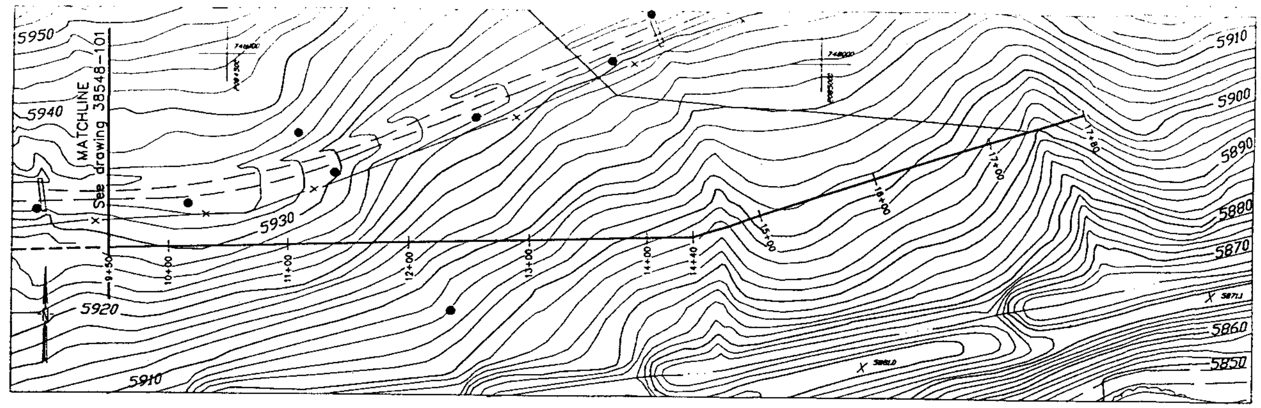
DRAWING NUMBER: D38548-100 SHEET: 6 of 34

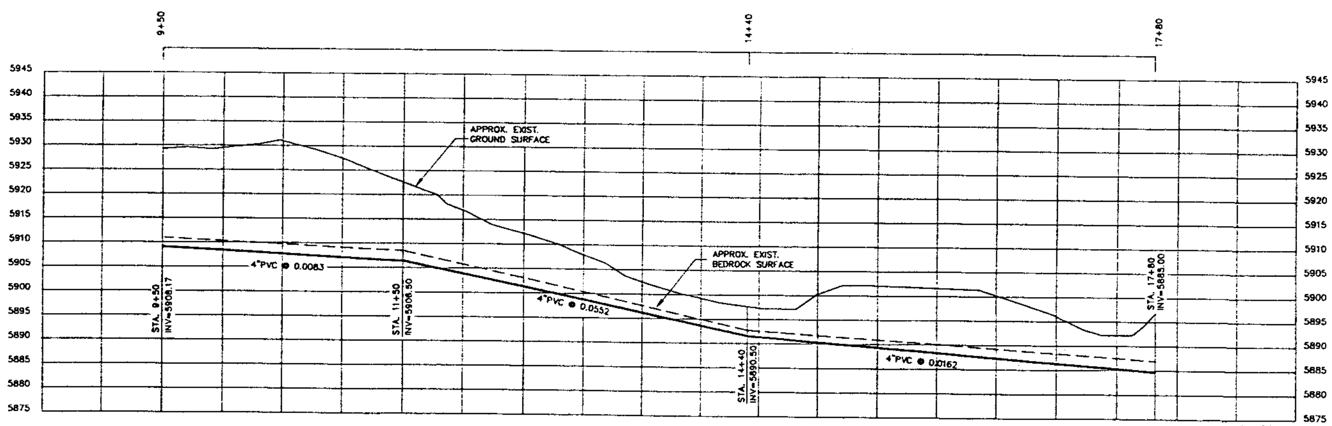
ENGINEERING-SCIENCE
Denver, Colorado

SCALE: 1"=100'

COMPUTER GENERATED DRAWING NO MANUAL CHANGES ALLOWED


PUMP CONTROL PANEL
TSH
M
START LAG PUMP
START LEAD PUMP
STOP
SUMP
TYP. OF TWO
WELL 9-74
BLDG 830 SUMP PUMP
* SUPPLIED WITH SUMP PUMP
INFLUENT EQUALIZATION
INFLUENT STORAGE TANK
EFFLUENT STORAGE TANK
TO INFILTRATION GALLERY
INFLUENT TRANSFER PUMPS
UCP-1 SEE SPECS
ULTRAVIOLET LIGHT HYDROGEN PEROXIDE TREATMENT UNIT
TREATMENT MODULE
* SUPPLIED WITH MODULE
UCP-2 SEE SPECS
H202 STORAGE TANK
H202 FEED MODULE
* SUPPLIED WITH MODULE
FOR TITLE I REVIEW NOT FOR CONSTRUCTION
A ORIGINAL ISSUE
986147
US DEPARTMENT OF ENERGY ROCKY FLATS AREA OFFICE GOLDEN, COLORADO
Rockwell International ROCKY FLATS PLANT ENERGY SYSTEMS GROUP GOLDEN, COLORADO 80402
881 Hillside Remedial Action
P & ID
D 38548-002
5 of 33
ENGINEERING-SCIENCE Denver, Colorado
ES
SCALE NONE
COMPUTER GENERATED DRAWING NO MANUAL CHANGES ALLOWED





FOR TITLE I REVIEW NOT FOR CONSTRUCTION

REVIEWED FOR CLASSIFICATION
By Thrift
Date 6/1/92

ENGINEERING-SCIENCE
Denver, Colorado

A	ORIGINAL ISSUE	986147

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS AREA OFFICE GOLDEN, COLORADO

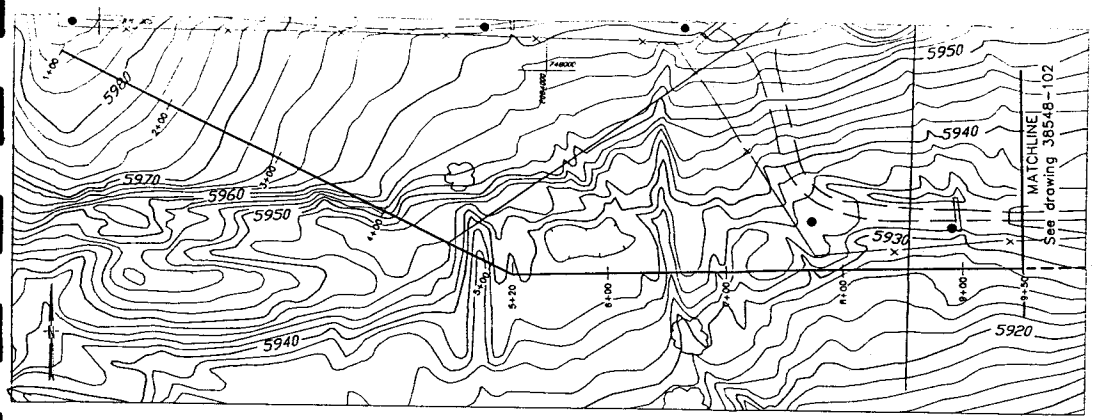
Rockwell International
ROCKY FLATS PLANT
ENERGY SYSTEMS GROUP
GOLDEN, COLORADO 80402

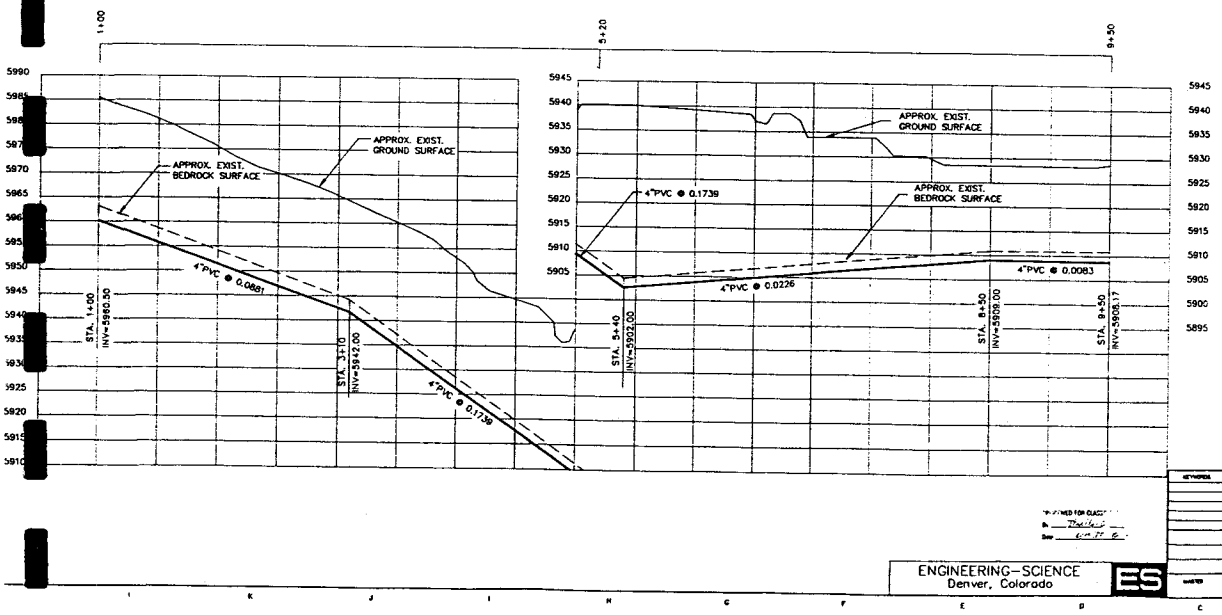
881 Hillside Remedial Action
French Drain Plan/Profile
Sta. 9+50 to 17+80

SCALE 1"=40'

D 38548-102 | 8 of 34

COMPUTER GENERATED DRAWING NO MANUAL CHANGES ALLOWED





FOR TITLE I REVIEW NOT FOR CONSTRUCTION

A	ORIGINAL ISSUE				986147

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS AREA OFFICE GOLDEN, COLORADO

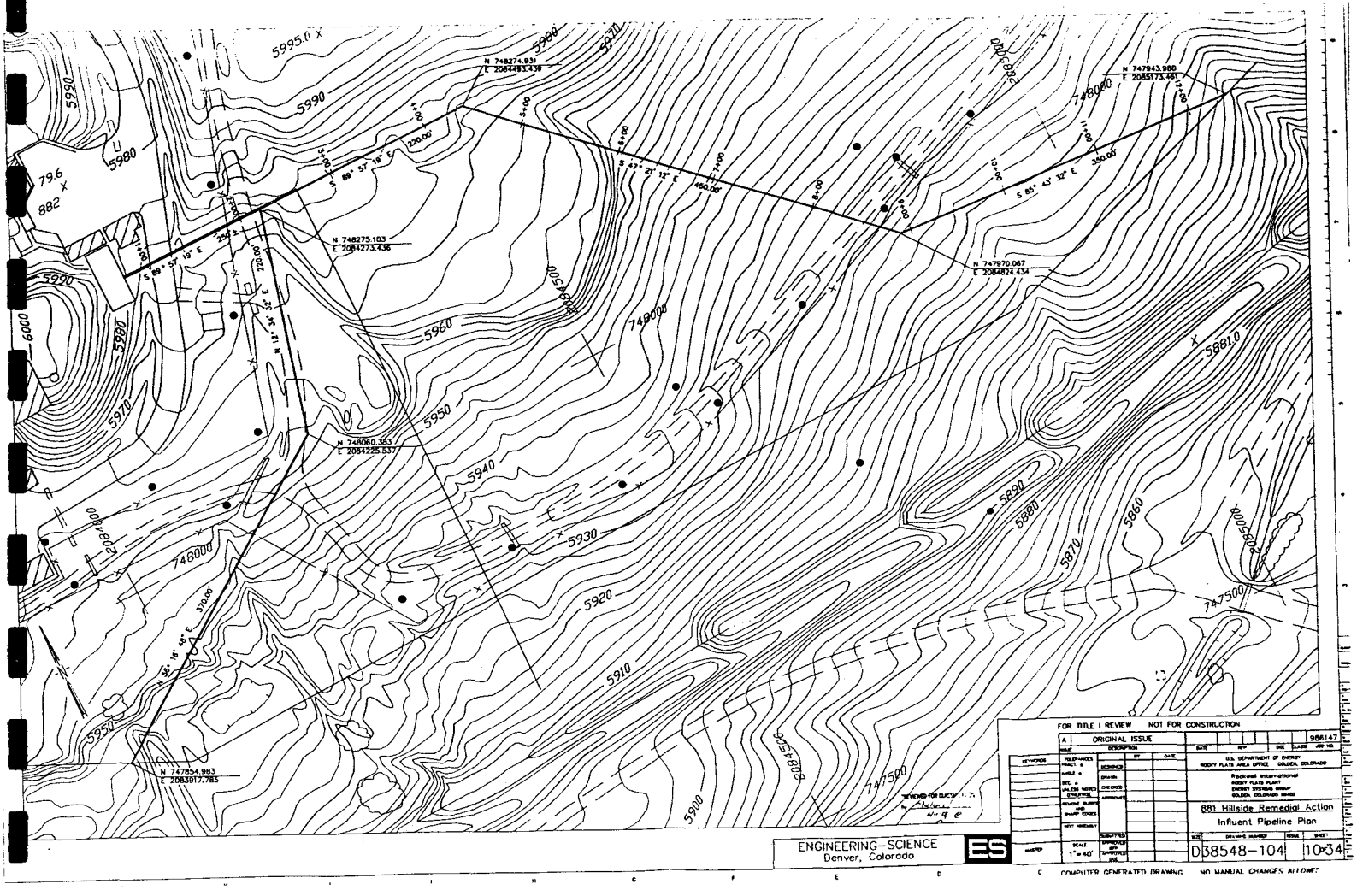
Rockwell International
ROCKY FLATS PLANT
ENERGY SYSTEMS GROUP
GOLDEN, COLORADO 80402

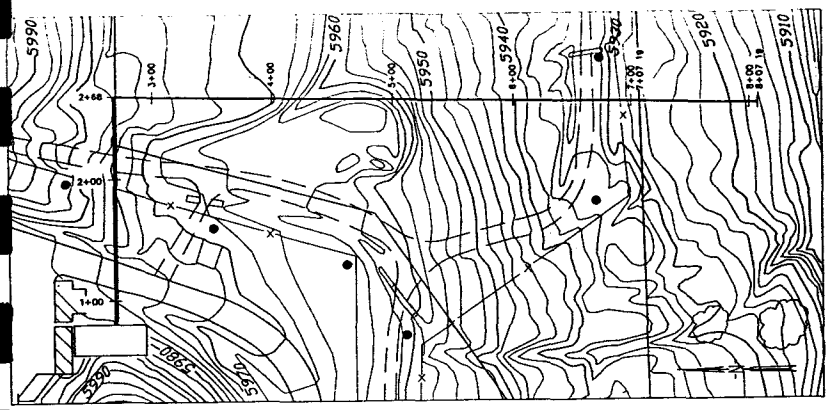
881 Hillside Remedial Action
French Drain Plan/Profile
Sta. 1+00 to 9+50

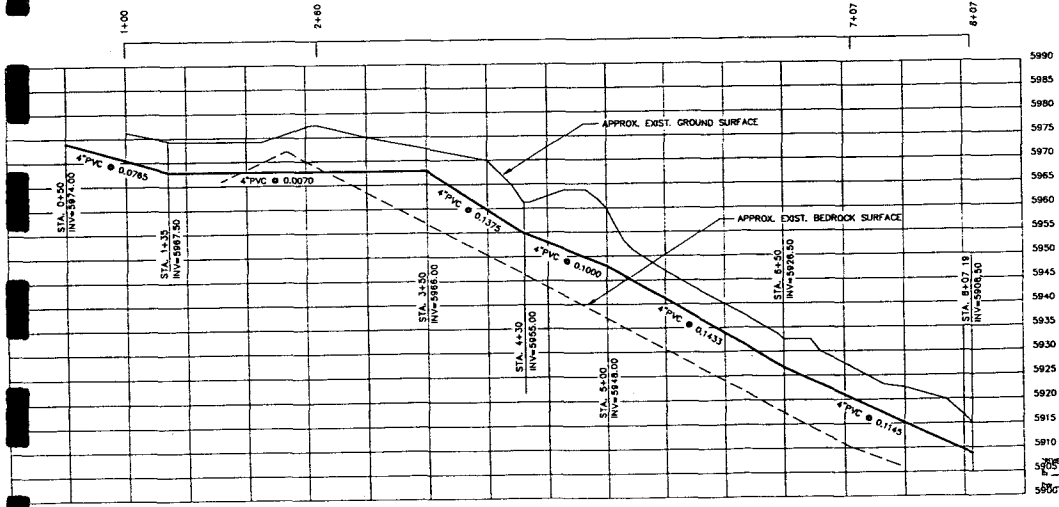
SCALE	DRAWING NUMBER	REV	SHEET
1"=40'	D 38548-101		7 of 34

ENGINEERING-SCIENCE
Denver, Colorado

COMPUTER GENERATED DRAWING NO MANUAL CHANGES ALLOWED


N 748274.931
E 2084493.439
N 747943.980
E 2085173.461
N 748275.103
E 2084273.436
N 747970.067
E 2084824.454
N 748060.383
E 2084225.537
N 747854.983
E 2083917.785
S 89° 57' 19" E
220.00'
S 89° 57' 19" E
294.32'
S 43° 21' 12" E
450.00'
S 85° 43' 32" E
350.00'
N 31° 18' 45" E
320.00'
5995.0
79.6
882
5881.0
FOR TITLE I REVIEW NOT FOR CONSTRUCTION
ORIGINAL ISSUE
986147
ENGINEERING-SCIENCE
Denver, Colorado
ES
Rockwell International
ROCKY FLATS PLANT
ENERGY SYSTEMS GROUP
GOLDEN, COLORADO 80402
881 Hillside Remedial Action
Influent Pipeline Plan
D38548-104
10-34
COMPUTER GENERATED DRAWING NO MANUAL CHANGES ALLOWED





REVIEWED FOR CLASSIFICATION
K. Bishop 6/11/97

FOR TITLE I REVIEW NOT FOR CONSTRUCTION

A	ORIGINAL ISSUE					986147
MARK	DESCRIPTION	BY	DATE	DATE	BY	JOB NO.

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS AREA OFFICE GOLDEN, COLORADO

Rockwell International
ROCKY FLATS PLANT
ENERGY SYSTEMS GROUP
GOLDEN, COLORADO 80402

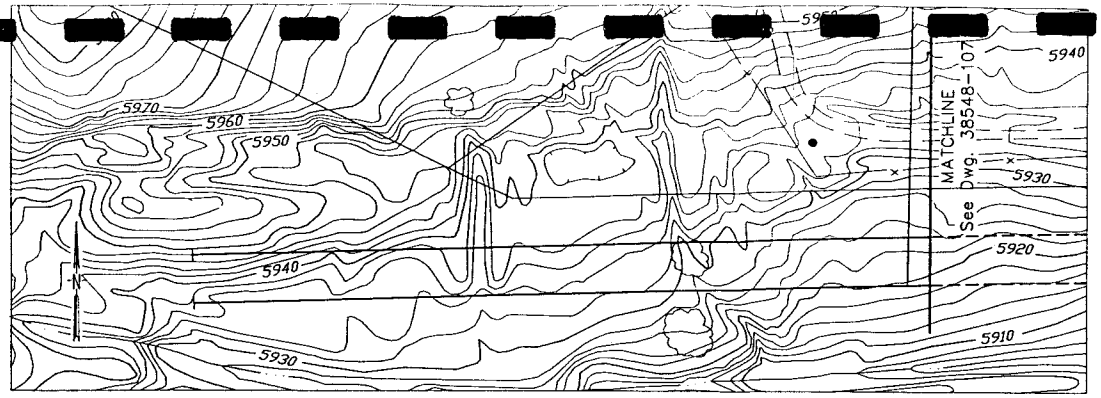
KEYNOTES
REFERENCES
DRAWN
CHECKED
APPROVED
SUBMITTED
APPROVED
APPROVED

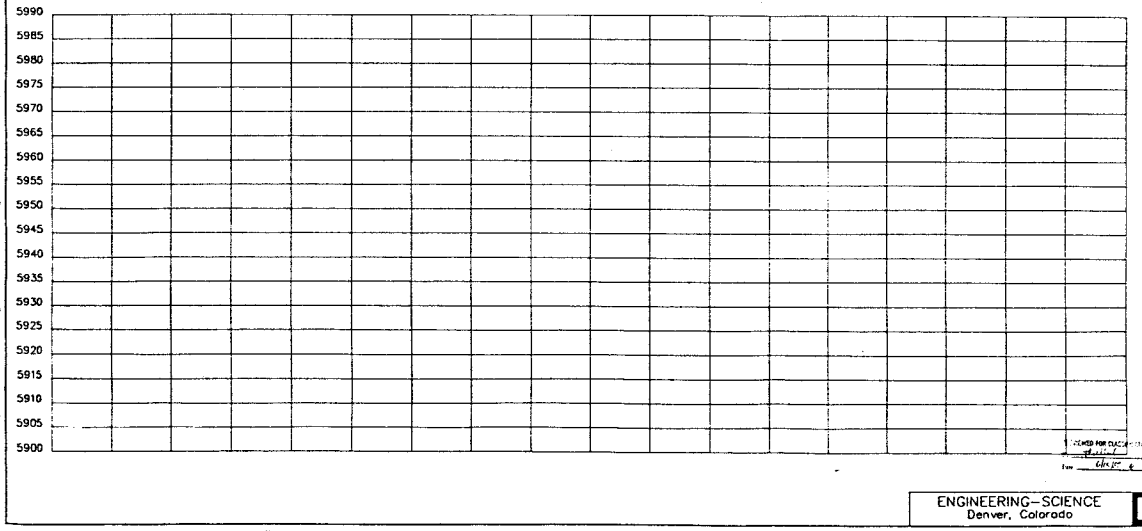
BB1 Hillside Remedial Action
Effluent Pipeline Plan/Profile

SCALE	SIZE	DRAWING NUMBER	SHEET
1"=40'	D	38548-105	11 of 34

ENGINEERING-SCIENCE
Denver, Colorado

COMPUTER GENERATED DRAWING NO MANUAL CHANGES ALLOWED





FOR TITLE I REVIEW NOT FOR CONSTRUCTION

A	ORIGINAL ISSUE				986147
MARK	DESCRIPTION	BY	DATE	DSC CLASS	JOB NO.

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS AREA OFFICE GOLDEN, COLORADO

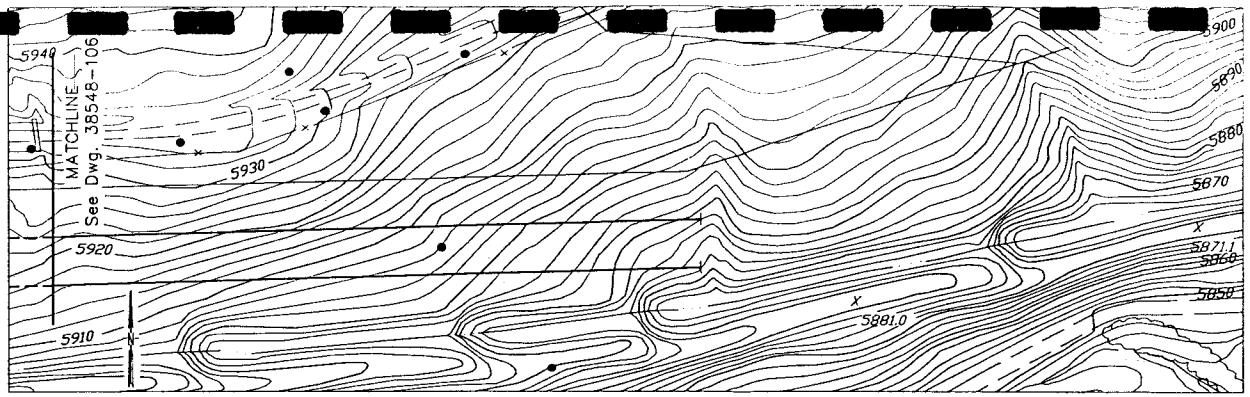
Rockwell International
ROCKY FLATS PLANT
ENERGY SYSTEMS GROUP
GOLDEN, COLORADO 80402

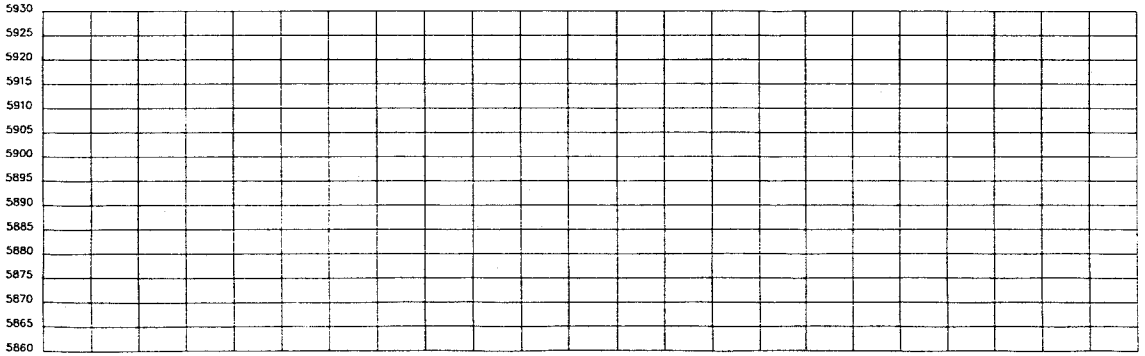
881 Hillside Remedial Action
Infiltration Gallery Plan/Profile

ENGINEERING-SCIENCE
Denver, Colorado

SIZE	DRAWING NUMBER	ISSUE	SHEET
D	38548-106		12 OF 34

COMPUTER GENERATED DRAWING NO MANUAL CHANGES ALLOWED





FOR TITLE I REVIEW NOT FOR CONSTRUCTION

A	ORIGINAL ISSUE				986147
ISSUE	DESCRIPTION	BY	DATE	APP.	DRC CLASS. JOB NO.

REVIEWED FOR CLASSIFICATION
By _____
Date _____

ENGINEERING-SCIENCE
Denver, Colorado

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS AREA OFFICE GOLDEN, COLORADO

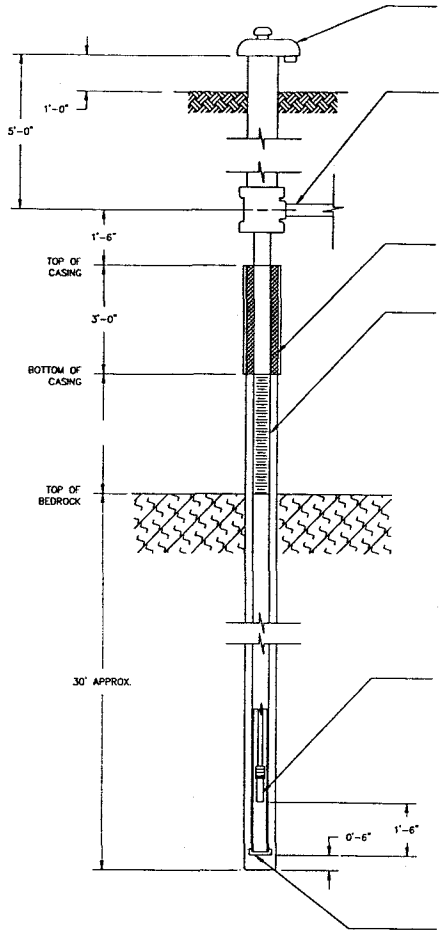
Rockwell International
ROCKY FLATS PLANT
ENERGY SYSTEMS GROUP
GOLDEN, COLORADO 80402

881 Hillside Remedial Action
Infiltration Gallery Plan/Profile

SIZE	DRAWING NUMBER	REV.	SHEET
D	38548-107		13 of 34

L K J I H G F E D C

COMPUTER GENERATED DRAWING NO MANUAL CHANGES ALLOWED



FOR TITLE I REVIEW NOT FOR CONSTRUCTION

A	ORIGINAL ISSUE			986147
DRAFT	DESCRIPTION	DATE	BY	JOB NO. CLASS.

"REVIEWED FOR CLASSIFICATION"
By _____
Date _____

ENGINEERING–SCIENCE
Denver, Colorado

ES

SCALE 3/8"=1'

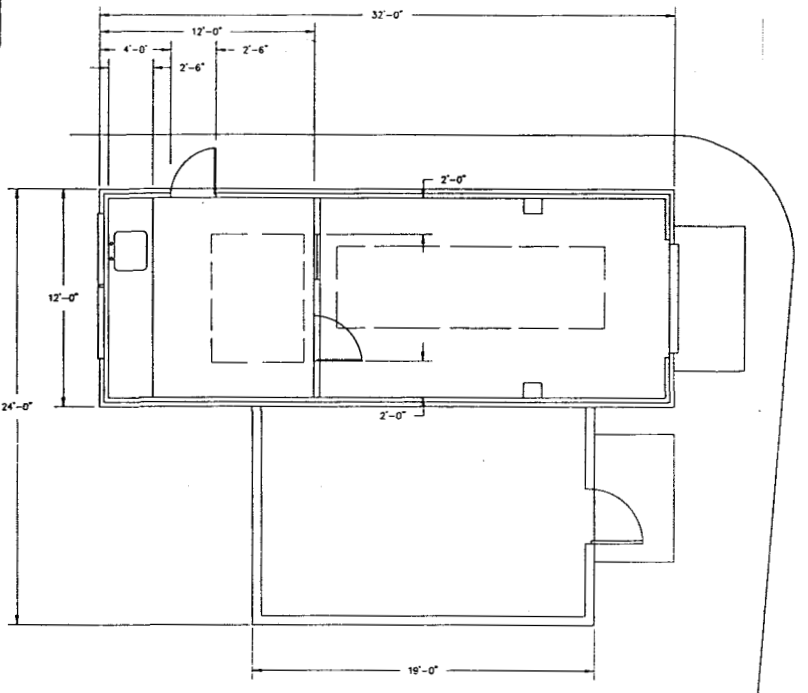
U.S. DEPARTMENT OF ENERGY
ROCKY FLATS AREA OFFICE GOLDEN, COLORADO

Rockwell International
ROCKY FLATS PLANT
ENERGY SYSTEMS GROUP
GOLDEN, COLORADO 80402

881 Hillside Remedial Action
Collection Well 9-34

SIZE D | DRAWING NUMBER 38548-108 | REV. | SHEET 14 of 34

COMPUTER GENERATED DRAWING NO MANUAL CHANGES ALLOWED



FOR TITLE I REVIEW NOT FOR CONSTRUCTION

A	ORIGINAL ISSUE		986147
MARK	DESCRIPTION	DATE	JOB NO

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS AREA OFFICE GOLDEN, COLORADO

Rockwell International
ROCKY FLATS PLANT
ENERGY SYSTEMS GROUP
GOLDEN, COLORADO 80402

681 Hillside Remedial Action
Building 830 Floor Plan

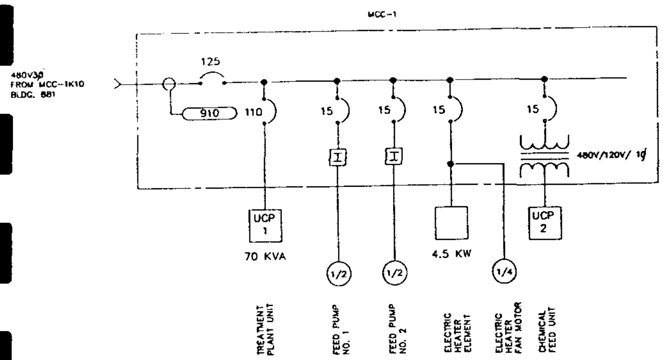
SIZE	DRAWING NUMBER	ISSUE	SHEET
D	38548-200		16 of 34

"REVIEWED FOR CLASSIFICATION"
By Thiele
Date 6/4/91 E

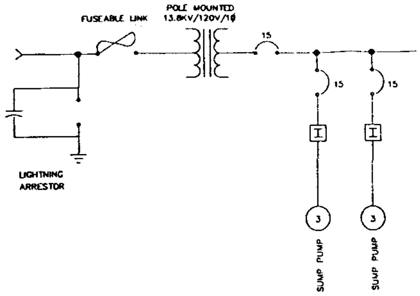
ENGINEERING-SCIENCE
Denver, Colorado

SCALE: 3/8"=1'

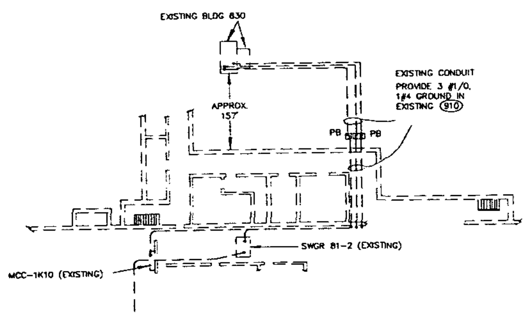
COMPUTER GENERATED DRAWING NO MANUAL CHANGES ALLOWED



MCC-1 SINGLE LINE DIAGRAM



TYPICAL SUMP/WELL LINE DIAGRAM



BUILDING 881 PARTIAL FIRST FLOOR PLAN SHOWN
FLOOR ELEV. 5968', CEILING ELEV. 5983'.

POWER FEEDER PLAN

SCALE: 1/16" = 1'-0"

FOR TITLE I REVIEW NOT FOR CONSTRUCTION

A	ORIGINAL ISSUE	986147

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS AREA OFFICE GOLDEN, COLORADO

Rockwell International
ROCKY FLATS PLANT
ENERGY SYSTEMS GROUP
GOLDEN, COLORADO

881 Hillside Remedial Action
Single Line Drawing
& Power Feeder Plan

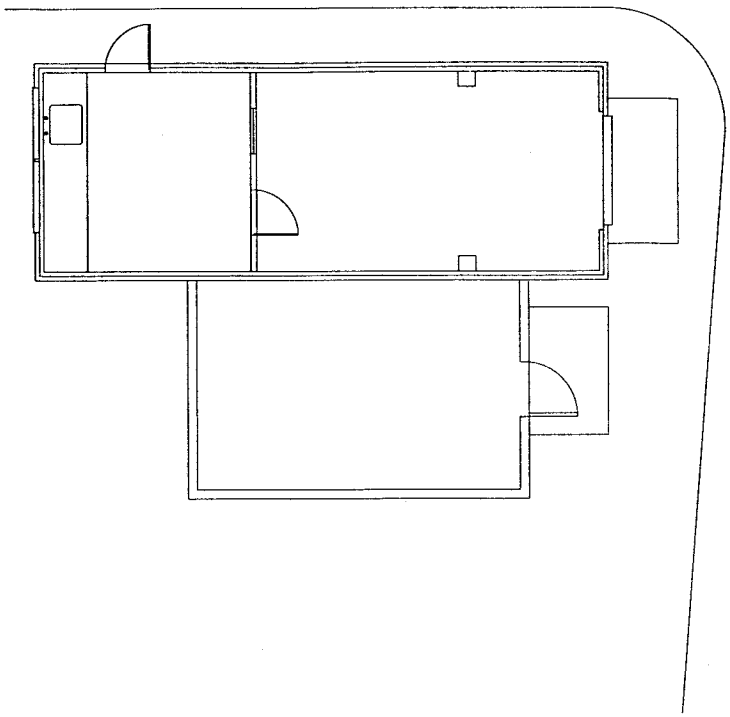
ENGINEERING-SCIENCE
Denver, Colorado

ES

SCALE AS SHOWN

D 38548-700 | 3034

COMPUTER GENERATED DRAWING NO MANUAL CHANGES ALLOWED



FOR TITLE I REVIEW NOT FOR CONSTRUCTION

A	ORIGINAL ISSUE				886147
DWG #	DESCRIPTION	DATE	BY	SOC CLASS	JOB NO

"REVISED FOR CLASSIFICATION"
By _____
Date 6/14/89 CB

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS AREA OFFICE GOLDEN, COLORADO

Rockwell International
ROCKY FLATS PLANT
ENERGY SYSTEMS GROUP
GOLDEN, COLORADO 80402

881 Hillside Remedial Action
Building 830
Equipment Location Plan

ENGINEERING–SCIENCE
Denver, Colorado

SIZE	DRAWING NUMBER	ISSUE	SHEET
D	38548–500		24 OF 34

SCALE 3/8"=1'

COMPUTER GENERATED DRAWING NO MANUAL CHANGES ALLOWED