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Informal Report

Generalized Geology of the 241-SY Tank Farm

April 1976

W. H. Price

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Environmental Engineering Section
Research Department
Research and Engineering Division

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Atlantic Richfield Hanford Company
Richland, Washington 99352

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RICHLAND, WASHINGTON 99352

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GENERALIZED GEOLOGY OF THE 241-SY TANK FARM

INTRODUCTION

A series of maps have been compiled to document the structure and stratigraphy of the sediments underlying the high-level radioactive waste storage tank farms located within the Energy Research and Development Administration Hanford Reservation. The primary purpose of these maps is to provide basic geologic information to be utilized to evaluate the impact of suspected and confirmed tank leaks. For convenience of usage map sets for each tank farm have been published in separate document packets (see Table I). The contents of this packet (see Table II) contain two generalized maps compiled for the new 241-SY Tank Farm.

TABLE I

TANK FARM GEOLOGY DOCUMENTS AVAILABLE
AS OF APRIL, 1976*

Title	Document Number
Geology of the 241-A Tank Farm	ARH-LD-127
Geology of the 241-AX Tank Farm	ARH-LD-128
Geology of the 241-B Tank Farm	ARH-LD-129
Geology of the 241-BX Tank Farm	ARH-LD-130
Geology of the 241-BY Tank Farm	ARH-LD-131
Geology of the 241-C Tank Farm	ARH-LD-132
Geology of the 241-S Tank Farm	ARH-LD-133
Geology of the 241-SX Tank Farm	ARH-LD-134
Geology of the 241-T Tank Farm	ARH-LD-135
Geology of the 241-TX Tank Farm	ARH-LD-136
Geology of the 241-TY Tank Farm	ARH-LD-137
Geology of the 241-U Tank Farm	ARH-LD-138
Generalized Geology of the 241-SY Tank Farm	ARH-LD-139

*Additional documents will be completed as new tank farms are built and well monitoring networks installed.

TABLE II

241-SY TANK FARM GEOLOGY MAPS

Title	Drawing Number
241-SY Tank Farm Geologic Map Legend and Plot Plan	H-2-38986
241-SY Tank Farm Geologic Characterization Generalized Cross Section	H-2-70506
241-SY Tank Farm Geologic Characterization Base of Backfill	H-2-38851

PROCEDURES

During the drilling of 1 dry well and 3 water wells in and around the 241-SY Tank Farm, sediment samples were collected from one to 5-foot depth intervals. Information utilized to prepare the generalized geologic cross section was obtained by the analysis of these samples, numbering approximately 150.

Prior to tank construction, the sediments exposed along the floor and walls of the 241-SY Tank Farm excavation were examined. Approximately 200 sediment samples were collected during this examination. Analysis of these sediments aided in the preparation of the base of the backfill map.

Each sediment sample was quantitatively analyzed according to grain size and $CaCO_3$ content. Size analysis was carried out utilizing a nest of 9 sieves selected for coincidence with the Wentworth (1922) grain size nomenclature (see H-2-38986). The $CaCO_3$ content of each sample was determined utilizing a semiquantitative CO_2 displacement method (Horwitz, 1970). Size and $CaCO_3$ data was input into the Rocksan Computer Program (Parr, 1974) which categorized each sediment sample into 1 of 19 classes (classification scheme modified after Folk, 1968; see H-2-38986). After analysis, each sample was visually examined to aid in further characterization. Each sample was subsequently stored in the Hanford Well Library for future reference.

GENERALIZED GEOLOGY

Included within this section is a brief discussion of the geology underlying the 241-SY Tank Farm. The stratigraphic descriptions included, along with the Glossary (see page 10), are designed only to provide sufficient information to permit a general understanding of the Tank Farm maps presented. For a more detailed discussion of the regional geologic setting of the 241-SY Tank Farm, the reader is referred to articles listed in the Selected References (see page 12).

The 241-SY Tank Farm is underlain by four major stratigraphic units (see Figure 1); (1) basalt of the Columbia River Group which forms the bedrock beneath the area; (2) semiconsolidated sediments of the Ringold Formation which directly overlie the bedrock; (3) unconsolidated eolian silt; and (4) unconsolidated sand, silt, and gravel (collectively termed glaciofluvial sediments) which directly overlie the eolian silt. A more detailed description of the character of these units underlying the Tank Farm follows.

COLUMBIA RIVER BASALT GROUP

About 20 million years ago a series of fissures opened around the periphery of the subsiding Pasco Basin and large volumes of basaltic lava poured out over the land surface. The highly fluid lava was extruded intermittently from these fissures until approximately 8 million years ago. At the cessation of Columbia River Basalt volcanism, the basin had been filled with more than 12,000 feet of basalt.

The surface of the Columbia River Basalt lies beneath 241-SY Tank Farm at an elevation of 90 feet (all elevations based on feet above mean sea level measured at approximate center of Tank Farm). On the 241-SY Tank Farm maps, this surface occurs approximately 270 feet below the bottom border of the prepared cross sections.

ERA	PERIOD	EPOCH	YEARS B. P.	STRATIGRAPHIC NAME AND/OR UNIT		LITHOLOGY DESCRIPTION
CENOZOIC	QUATERNARY	MODERN	30	BACKFILL		VERY POORLY SORTED GRAVEL, SAND & SILT
		PLEISTOCENE		GLACIOFLUVIAL SEDIMENTS		FAIRLY WELL SORTED FLUVIAL SAND & SILT WITH SOME GRAVEL
				EOLIAN SILT		FINE SAND & SILT DERIVED FROM THE UPPER RINGOLD
	TERTIARY	PLIOCENE	1,000,000	RINGOLD FORMATION	UPPER RINGOLD	WELL SORTED FLUVIAL OR LACUSTRINE SILT & SAND WITH SOME CALCAREOUS LAYERS
					MIDDLE RINGOLD	FLUVIAL GRAVEL & SAND VARIABLY CEMENTED WITH CALCIUM CARBONATE & SILICA
		MIOCENE	11,000,000	COLUMBIA RIVER BASALT GROUP	ELEPHANT MOUNTAIN MEMBER	DENSE BLACK EXTRUSIVE IGNEOUS ROCK, MICRO VESICULAR, BRICK BAT ENTABULATURE & NO COLUMNADE
					RATTLESNAKE RIDGE MEMBER	TUFFACEOUS SANDSTONE
					POMONA MEMBER	DENSE BLACK EXTRUSIVE IGNEOUS ROCK, SCATTERED OLIVINE PHENOCRYSTS, UPPER & SOMETIMES BASAL ENTABLATURE WELL DEVELOPED, FAN JOINTING IN COLUMNADE

WHP/KRF 1976

FIGURE 1

GENERALIZED STRATIGRAPHIC COLUMN FOR
THE 200 AREA TANK FARMS

RINGOLD FORMATION

Following the cessation of Columbia River Basalt volcanism the ancestral Columbia River transported sediments from the surrounding highlands into the Pasco Basin where they accumulated to form the Ringold Formation. Beneath the Hanford Reservation, this formation is up to 1200 feet thick and can generally be divided into three units on the basis of lithology: the clays and silts of the lower Ringold unit; the pebbles and cobbles of the middle Ringold unit; and the silts and fine sands of the upper Ringold unit.

Within the region beneath 241-SY Tank Farm, the lower Ringold unit is missing. The combined thickness of the middle and upper Ringold units present is approximately 422 feet.

Middle Ringold

Beneath the 241-SY Tank Farm, the 410-foot thick middle Ringold unit lies unconformably on the Columbia River Basalt and dips to the southeast about 50 feet per mile. The unit consists predominantly of well-rounded pebbles and cobbles with the interstitial spaces filled with medium to fine sand and silt cemented in places with SiO_2 or $CaCO_3$. Table III summarizes the grain size and $CaCO_3$ values of the middle Ringold sediments.

The lower portion of the middle Ringold unit (elevation 90-223 feet) is blue-gray in color suggesting that the sediments have not undergone oxidation and have continuously been below the water table since their deposition. In contrast, sediments of the middle Ringold unit above the 223-foot elevation level have undergone oxidation as evidenced by their gray-brown color and their well developed weathering rinds.

Although the middle Ringold unit consists predominantly of pebbles and cobbles, a few sand units up to 17 feet in thickness occur beneath 200 West Area. Such units represent either lacustrine or fluvial deposits layed down during periods of decreased velocity of the ancestral Columbia River. Two such units are found beneath the 241-SY Tank Farm at elevations of 378 feet and 398 feet.

TABLE III

TYPICAL GRAIN SIZE AND CALCIUM CARBONATE VALUES
FOR MAJOR MIDDLE RINGOLD LITHOLOGIES
BENEATH 241-SY TANK FARM

Lithology	%Pebbles & Cobbles	% Sand					%Silt & Clay	$\%CaCO_3$
		Very Coarse	Coarse	Medium	Fine	Very Fine		
Sandy Gravel	77	2	3	4	9	5	1	0.3
Cemented Calcareous to Siliceous Slightly Silty Sandy Gravel	70	4	6	6	8	5	1	0-12.0
Coarse to Medium Sand	2	11	25	29	15	11	7	1.0
Slightly Cemented Calcareous to Siliceous Slightly Silty Sand Gravel	72	4	5	6	7	5	1	0-12.0
Coarse to Medium Sand	1	9	26	36	15	10	4	1.0
Cemented Calcareous to Siliceous Slightly Silty Sandy Gravel	67	8	7	6	6	5	1	0-12.0

Upper Ringold

The upper Ringold unit, which overlies the middle Ringold unit, occurs between elevations 500 and 512 feet. The unit consists predominately of well sorted fine sands and silts. These sediments, like the sand units of the middle Ringold, are representative of a period of decreased velocity of the ancestral Columbia River or temporary ponding. Table IV summarizes the grain size and $CaCO_3$ values of the upper Ringold unit.

TABLE IV

TYPICAL GRAIN SIZE AND CALCIUM CARBONATE VALUES
FOR UPPER RINGOLD LITHOLOGY
BENEATH 241-SY TANK FARM

Lithology	%Pebbles & Cobbles	% Sand					%Silt & Clay	$\%CaCO_3$
		Very Coarse	Coarse	Medium	Fine	Very Fine		
Slightly Silty Coarse to Medium Sand	1	10	21	22	15	11	20	1.2

EOLIAN SILT DEPOSIT

After deposition of the upper Ringold, the top of the unit was subjected to subaerial erosion. The surface of the unit was altered by wind which winnowed, reworked, and redeposited the fine grained sands and silts. These wind-deposited sediments, termed Early Palouse soil or eolian silt, occur beneath the 241-SY Tank Farm between elevations 512 and 546 feet. Table V summarizes the grain size and $CaCO_3$ content of the eolian silt.

TABLE V

TYPICAL GRAIN SIZE AND CALCIUM CARBONATE VALUES FOR 241-SY TANK FARM EOLIAN SILT

		% Sand						
Lithology	%Pebbles & Cobbles	Very Coarse	Coarse	Medium	Fine	Very Fine	%Silt & Clay	$\%CaCO_3$
Silty Very Fine Sand to Sandy Silt	0	0	1	9	20	34	36	2.0

GLACIOFLUVIAL DEPOSITS

During the close of the Ice Age, approximately 20,000 years ago, a continental ice sheet covered much of northern Washington. As the ice sheet retreated northward, the breakup of ice dams resulted in catastrophic floods in which large volumes of glacial meltwater were released. During one of these floods, over 500 cubic miles of water is estimated to have poured into the Pasco Basin at a rate of more than 9 cubic miles of water per hour. Sediments deposited within the basin by such flooding now comprise the glaciofluvial unit. The characteristic variability of sediment size and degree of sorting within this unit can be attributed to changes in water velocity and water level which occurred during the flooding process.

Glaciofluvial deposits are found beneath the 241-SY Tank Farm between elevations 546 and 614 feet. The 68-foot thick section of these deposits consists predominently of medium to very fine sand with some silt. Table VI summarizes the grain size and $CaCO_3$ values of the glaciofluvial sediments.

TABLE VI

TYPICAL GRAIN SIZE AND CALCIUM CARBONATE VALUES
FOR GLACIOFLUVIAL LITHOLOGY
BENEATH 241-SY TANK FARM

Lithology	%Pebbles & Cobbles	% Sand					%Silt & Clay	$\%CaCO_3$
		Very Coarse	Coarse	Medium	Fine	Very Fine		
Slighty Silty Medium to Very Fine Sand to Medium to Fine Sand	0	3	11	21	25	21	19	1.6

CLASTIC DIKES

Throughout the Pasco Basin, clastic dikes are found cross-cutting the Ringold Formation and glaciofluvial sediments. These dikes, which range from a few inches to several feet in width, are known to exist to depths of more than 100 feet below the ground surface. Generally, the dikes are composed of fine silts to coarse sands. The origin of the clastic dikes is still in refute and will not be discussed here (see Selected References). Identification of clastic dikes by drilling is difficult and although some dikes were detected in the 241-SY Tank Farm base of backfill, they could not be mapped on the geologic cross section.

BACKFILL MATERIAL

In preparation for tank construction, glaciofluvial material was excavated at the 241-SY Tank Farm site. This material, consisting predominantly of pebbles, and coarse to fine sands to silts, is being used as backfill from the base of the completed tanks (614 feet) to the proposed finished grade (672 feet). An inherent characteristic of the backfill is its poor sorting. Grain size and $CaCO_3$ values for the backfill are found in Table VII.

TABLE VII

TYPICAL GRAIN SIZE AND CALCIUM CARBONATE VALUES
FOR THE 241-SY TANK FARM BACKFILL

Lithology	%Pebbles & Cobbles	% Sand					%Silt & Clay	$\%CaCO_3$
		Very Coarse	Coarse	Medium	Fine	Very Fine		
Slightly Pebbly Slightly Silty Coarse to Fine Sand to Slightly Pebbly Coarse to Fine Sand	9	12	18	19	18	11	13	1.2

WATER TABLE

The water table beneath the 241-SY Tank Farm is located within the middle Ringold unit at an elevation of 476 feet, 138 feet below the base of the tanks. For further information concerning contours on the water table beneath 200 West Area the reader is referred to drawings H-2-38397 (200 West Area Water Table Map) and H-2-38877 (200 West Area Depth to Water Map).

GLOSSARY

Basalt. Fine-grained, dark-colored, extrusive igneous rock.

Calcareous. Containing calcium carbonate.

Caliche. Gravel, sand, or silt cemented by calcium carbonate.

Cement. Chemically precipitated material occurring in the interstices between particles of gravel, sand, or silt.

Clastic. A textural term applied to rocks composed of fragmental material derived from pre-existing rocks.

Clastic dike. A tabular body of clastic material transecting the bedding of a sedimentary formation, representing extraneous material that has invaded the containing formation along a crack.

Dip. The angle at which a stratum or any planar feature is inclined from the horizontal.

Eolian. A formation formed by, or deposited from, the wind or currents of air.

Fluvial. Produced by the action of a river or stream.

Formation. The ordinary unit of geologic mapping consisting of a large and persistent stratum of some one kind of rock.

Glaciofluvial. Pertaining to streams flowing from glaciers or to the deposits made by such streams.

Grain. The particles or discrete crystals which comprise a rock or sediment.

Group. A local or provincial subdivision of a series, based on lithologic features and contains two or more formations.

Lacustrine. A formation deposited in a lake environment.

Lava. Fluid rock such as that which issues from a volcano or a fissure in the earth's surface and the same material solidified by cooling.

Lithology. The description of rocks or sediments on the basis of such characteristics as color, minerologic composition and grain size.

Sediment. Descriptive term for gravel, sand, and silt transported from their sources and deposited by air, water, or ice.

Sieve. A utensil having many small perforated openings, used to separate fine particles from coarser ones.

Siliceous. Containing silica.

Silt. Fine grained material between sand and clay in size.

Sorting. The grain size range of the sediments.

Stratigraphy. The part of descriptive geology of an area that pertains to the discrimination, character, thickness, sequence, age and correlation of the sediments and rocks of the area.

Subaerial. Formed, existing, or taking place on the land surface.

Unconformity. A surface of erosion or nondeposition that separates younger strata from older strata.

Water table. The upper surface of a zone of saturation except where that surface is formed by an impermeable body.

Winnowing. Separation of fine particles from coarser ones by wind action.

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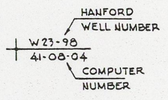
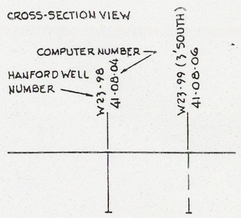
1 - WELL DESIGNATION
WELL NUMBERS PREFIXED BY 299-

PLOT PLAN VIEW



CROSS-SECTION VIEW



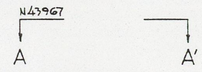
SOLID LINE ON CROSS-SECTION.

DASHED LINE WHEN PROJECTED TO CROSS-SECTION: DISTANCE AND DIRECTION FROM CROSS-SECTION ARE GIVEN.

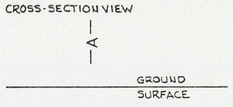
2 - COORDINATES
BASED ON HANFORD COORDINATE SYSTEM.

3 - PLANE OF CROSS-SECTION

PLOT PLAN VIEW



CROSS-SECTION VIEW



4 - TANK DESIGNATION
TANKS PREFIXED BY 241-

5 - CONTACT BETWEEN LITHOLOGIES

SOLID LINE WHERE ACCURATELY KNOWN ———————————

DASHED LINE IF APPROXIMATELY KNOWN — — — — — — — — — —

QUERIED DASHED LINE WHERE INFERRED — — ? — — — ? — — — ? —

BASE OF BACKFILL ———————————

6 - LENSES OR STRINGERS

DISCONTINUOUS SEDIMENTS LESS THAN TWO FEET THICK

DISCONTINUOUS SEDIMENTS GREATER THAN TWO FEET THICK

7 - WATER TABLE

CROSS-SECTION VIEW

DATUM - MEAN SEA LEVEL

WATER TABLE (12/75)
DATE WATER LEVEL MEASUREMENTS TAKEN

8 - HORIZONTAL AND VERTICAL SCALES

VERTICAL EXAGGERATION - 1X
VERTICAL SCALE - FEET ABOVE MEAN SEA LEVEL

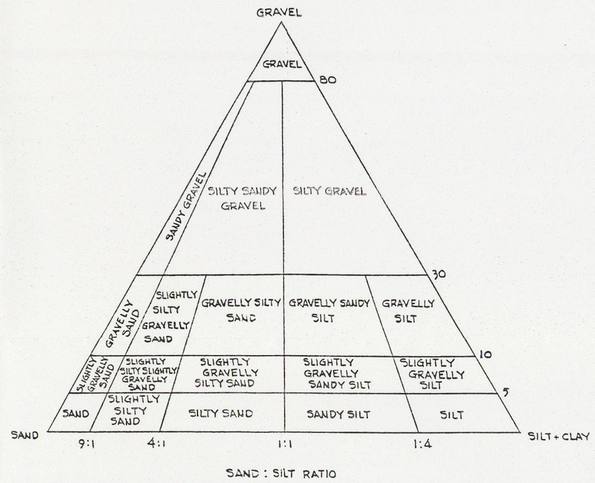
20 10 0 10 20 30 40 50

1:920

9 - SEDIMENT DESCRIPTION

SEDIMENTS BENEATH THE TANK FARMS ARE CLASSIFIED ON THE BASIS OF ONE OF NINETEEN SEDIMENT TYPES (SEDIMENT CLASSIFICATION). FURTHER DETAIL IS GIVEN USING MODIFIERS FROM THE GRAIN SIZE NOMENCLATURE. SEDIMENTS WITH CHEMICALLY PRECIPITATED MATERIALS OCCURRING IN THE INTERSTICES BETWEEN GRAINS ARE PREFIXED BY THE TERM CEMENTED. SEDIMENTS WITH GREATER THAN 10% CALCIUM CARBONATE ARE PREFIXED BY THE MODIFIER CALCAREOUS. SEDIMENTS CONTAINING SILICA IN THE INTERSTICES BETWEEN GRAINS ARE MODIFIED BY THE TERM SILICEOUS.

SEDIMENT CLASSIFICATION (MODIFIED AFTER R.L. FOLK, 1968)

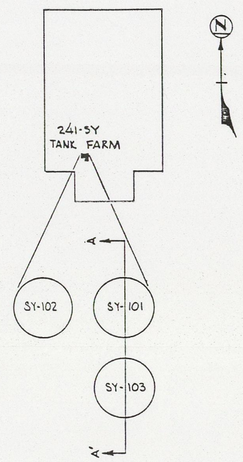


SAND : SILT RATIO

GRAIN SIZE NOMENCLATURE (MODIFIED AFTER C.K. WENTWORTH, 1922)

PARTICLE DESIGNATION			PARTICLE DIAMETER (MM)
GRAVEL	BOULDER		> 256
	COBBLE	LARGE	256 - 128
		SMALL	128 - 64
	PEBBLE	VERY COARSE	64 - 32
		COARSE	32 - 16
		MEDIUM	16 - 8
		FINE	8 - 4
		VERY FINE	4 - 2
SAND		VERY COARSE	2 - 1
		COARSE	1 - 0.5
		MEDIUM	0.5 - 0.25
		FINE	0.25 - 0.125
		VERY FINE	0.125 - 0.0625
SILT + CLAY			< 0.0625

200 WEST AREA



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NEXT USED ON			DRAWING STATUS		

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REV NO.
LAST REV. 0

APPD. FOR CONFORMANCE WITH DESIGN CRITERIA BY A.R. Wright FOR APPD — DATE 4/4/76

APPD — 4/4/76

CHKD D. LIEN — 4/4/76

QA APPD Linda Gamon — 4/4/76

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DRAWN ERICKSON — 3/24/76

SCALE NONE

CLASSIFIED BY NOT REQUIRED — DATE

CLASSIFICATION NONE

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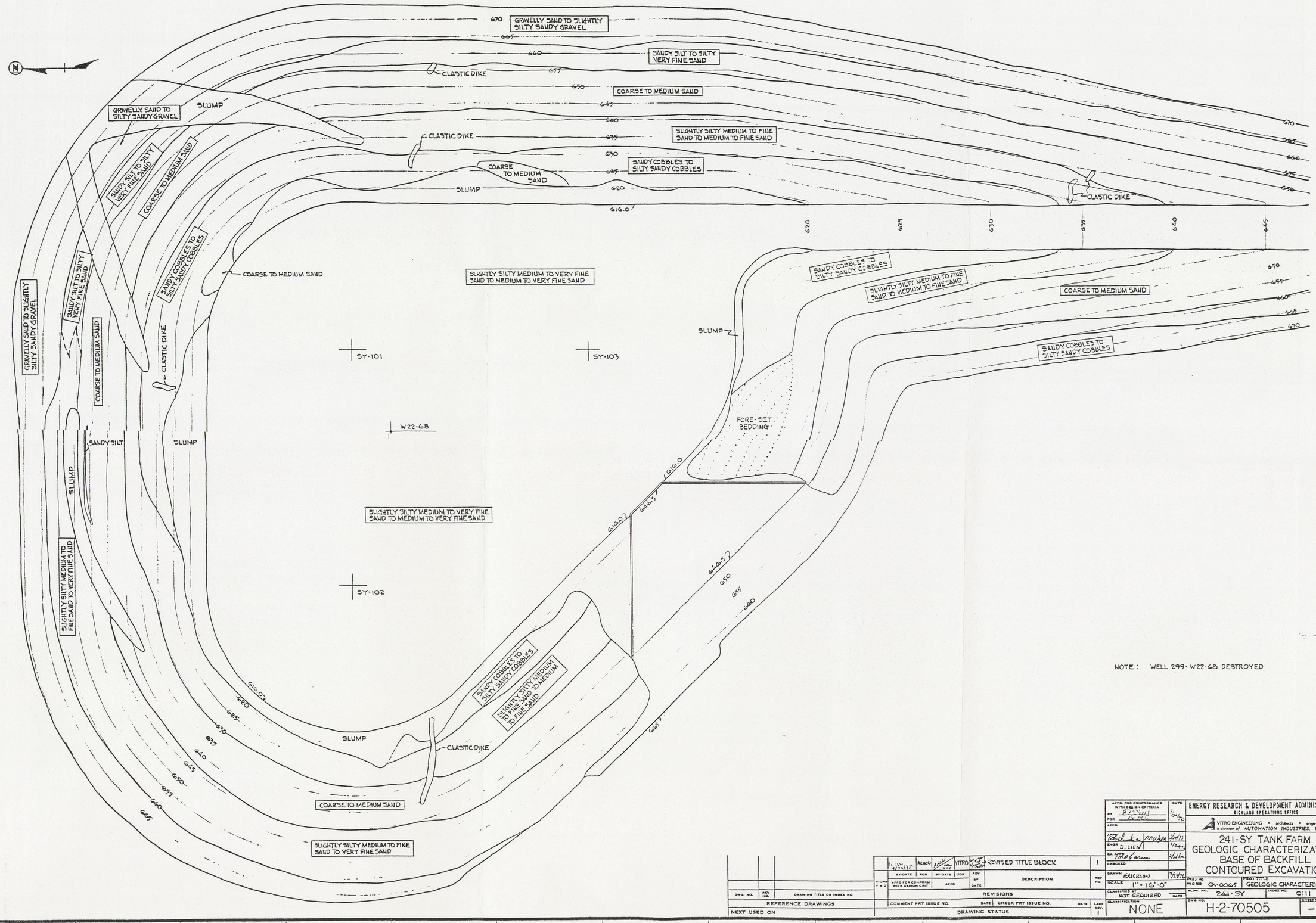
241-SY TANK FARM
GEOLOGIC MAP
LEGEND AND PLOT PLAN

PROJ NO W 0 NO CK-00663 — PROJ TITLE GEOLOGIC CHARACTERIZATION

BLDG. NO. 241-SY — INDEX NO. 0000

DWG NO. H-2-38986 — SHEET NO. — REV NO. —



NOTE : WELL 299-W22-68 DESTROYED

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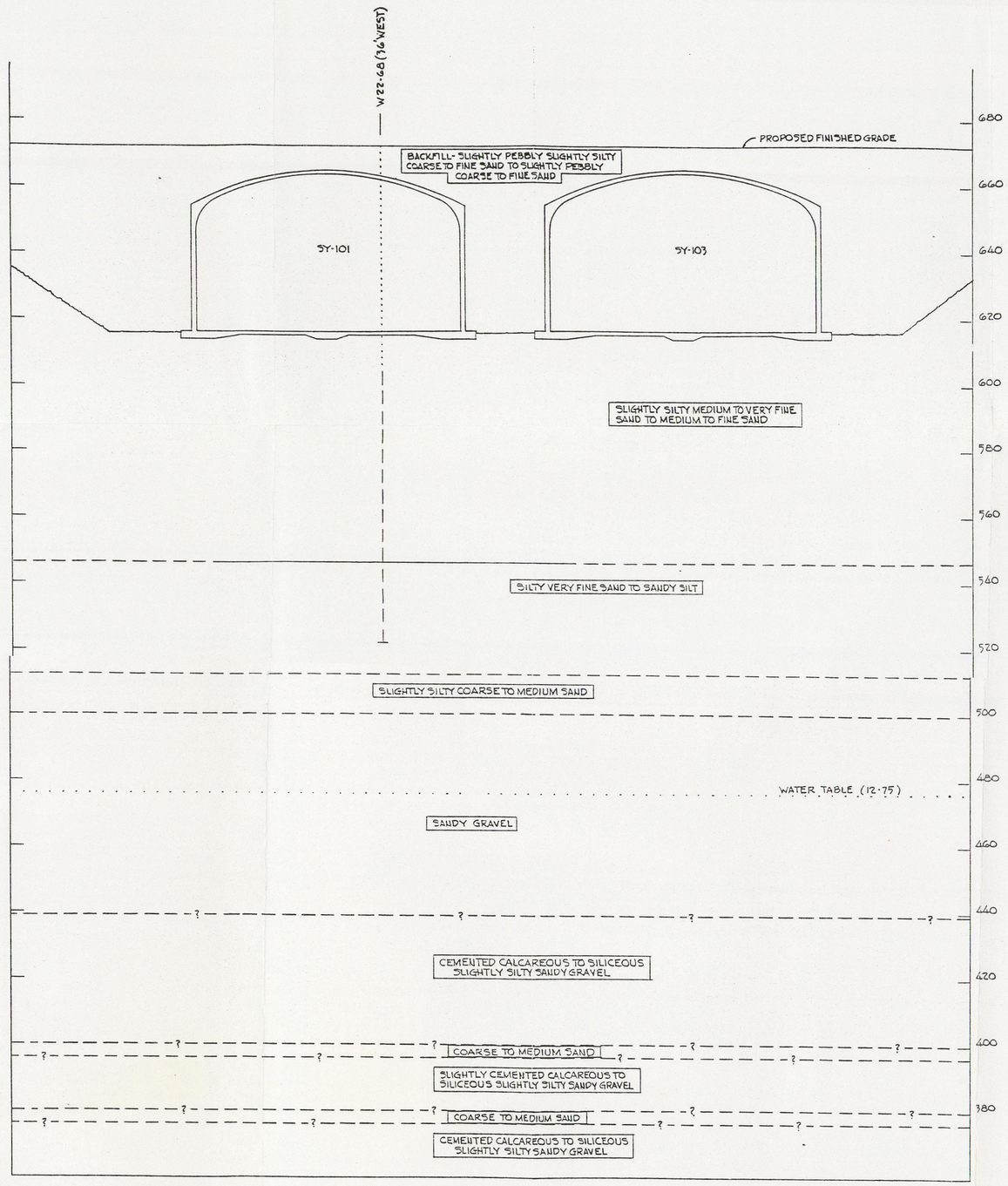
a division of AUTOMATION INDUSTRIES, INC.

241-SY TANK FARM GEOLOGIC CHARACTERIZATION BASE OF BACKFILL CONTOURED EXCAVATION

PROJ NO	
W.O NO	CK-0065
SUBJ TITLE	GEOLOGIC CHARACTERIZATION
BLDG. NO.	241-SY
INDEX NO.	C111
DWG NO.	H-2-70505
SHEET NO.	–
TOT SHTS	–



GENERALIZED CROSS SECTION

NOTE: WELL 299-W22-68 DESTROYED

APPD. FOR COMPLIANCE WITH DESIGN CRITERIA BY Gassaway FOR Hanford	DATE 3/31/76	ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION RICHLAND OPERATIONS OFFICE	
APPD		VITRO ENGINEERING • architects • engineers a division of AUTOMATION INDUSTRIES, INC.	
D. LIEN	3/26/76	241-SY TANK FARM GEOLOGIC CHARACTERIZATION GENERALIZED CROSS SECTION	
QA APPD T.M. Caruso	3/26/76		
CHECKED			
DRAWN ERICKSON	3/24/76		
SCALE 1" = 10'-0"		W.O. NO. CK-0069	PRJ. TITLE GEOLOGIC CHARACTERIZATION
CLASSIFIED BY NOT REQUIRED	DATE	BLDG. NO. 241-SY	INDEX NO. 0111
CLASSIFICATION NONE		DWG NO. H-2-70506	SHT NO. - | -

REFERENCE DRAWINGS			NEXT USED ON
DWG. NO.	REV NO.	DRAWING TITLE OR INDEX NO.	

REVISIONS							DRAWING STATUS		
BY-DATE	FOR	BY-DATE	FOR	REV BY DATE	DESCRIPTION	REV NO.	COMMENT PRT ISSUE NO.	DATE	CHECK PRT ISSUE NO.	DATE	LAST REV. 0
HICAD F'M'D	APPD FOR CONFORM WITH DESIGN CRIT		APPD								