

RESULTS OF  
21 EXPLORATORY HOLES  
ROGER ROAD RECHARGE EXPANSION AREA

City of Tucson  
Tucson Water Department  
Hydrology Section

Prepared

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## INTRODUCTION:

A 21 drill hole program utilizing a reverse circulation hammer rig was initiated on July 31, 1989 by the Hydrology Section of Tucson Water to collect subsurface geologic data. The project area is located on City of Tucson property adjacent to Pima County's Roger Road Wastewater Treatment Plant (Figure 1). The objectives were to assess the project areas potential as a recharge site for secondary effluent. The drilling program was completed in 10 working days to a cumulative footage drilled of 2,590 feet. All holes were backfilled and capped in accordance with the contract specifications. Grain size analysis was performed on drill cuttings for each five foot interval sampled. Depth to water measurements were performed in each hole to determine the water table elevation.

The original contract award was for \$69,400 whereas actual expenditures were \$67,050.

## METHOD:

### Drilling

The contract was awarded to Layne Environmental of Chandler, Arizona to perform drilling, sampling and backfilling of 21 holes in accordance with Purchase Contract No. 0354-89.

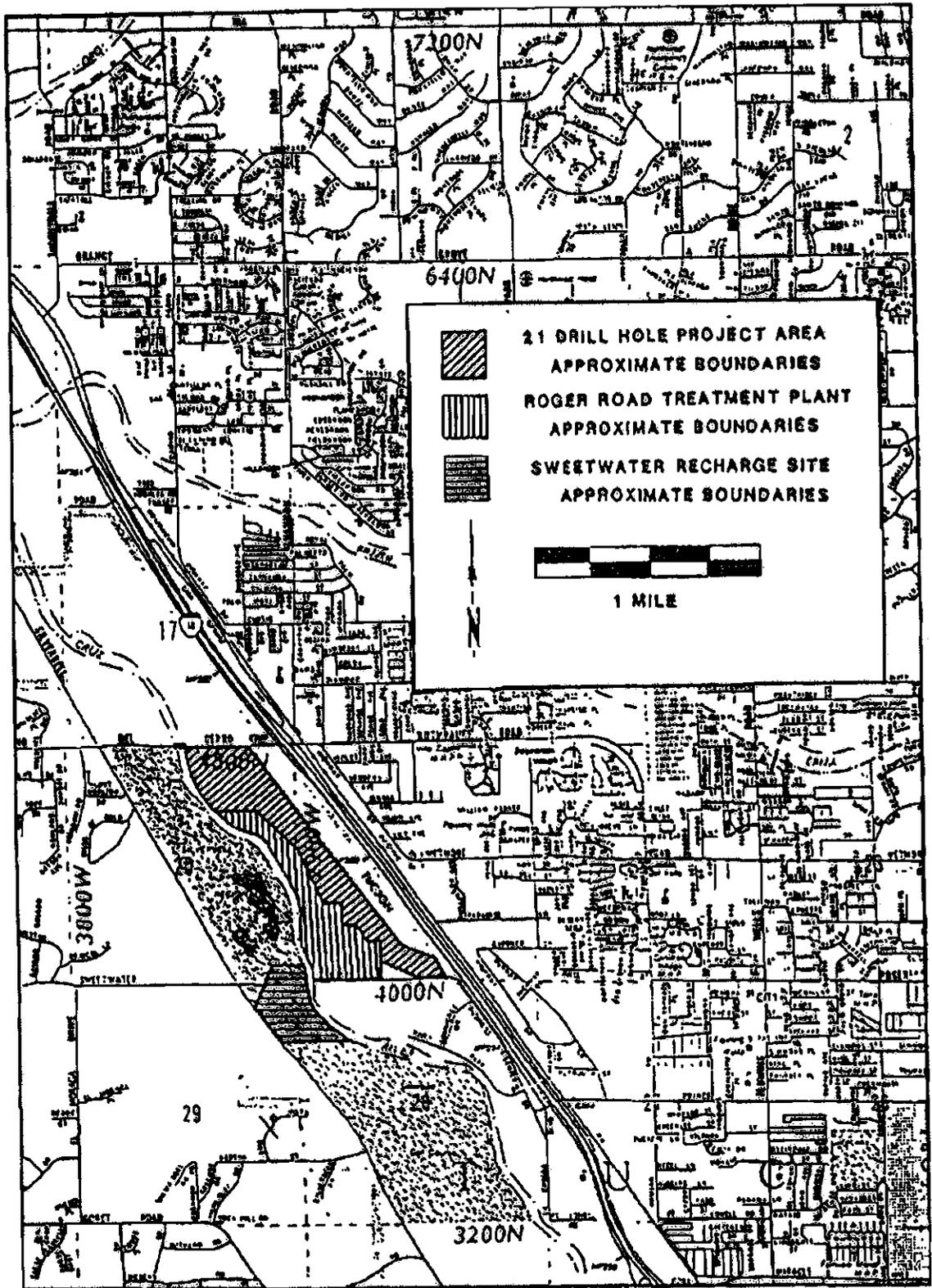


FIGURE 1. PROPERTY LOCATION MAP

The holes were drilled using a truck mounted, top head hammer, reverse circulation rig. Ten foot joints of 10" double walled pipe (6" inner diameter) were utilized throughout the program.

All holes are located on City of Tucson property east and north of the adjoining Pima County Roger Road Wastewater Treatment Plant (Figure 1).

Work was initiated by the contractor on July 31, 1989 and was completed on August 11, 1989. 21 drill holes (EX-045 to EX-065) were drilled for a cumulative footage of 2,590 feet. All holes intersected the significant lithologic contacts in the vadose zone and 19 holes tagged the regional water table at depths from 117 feet to 130 feet.

The overall water table elevation is relatively constant across the property (Plates 2-7). Minor irregularities in the water table may be due to differing recovery rates of water within the boreholes or differences in drill hole collar elevations.

#### Sampling

Subsurface drill cutting samples were collected for each five foot interval. After these airlifted drill cuttings were discharged from a truck mounted cyclone, they were collected in a five gallon sample pan and transferred to and thoroughly mixed on

a flat metal sheet. A representative two to three pound sample was then collected in a zip lock bag for later use in the grain size analysis.

#### Total Depth/Water Level Measurements

Within two to three feet of the regional water table the drill cuttings showed an increasing dampness. At a depth determined by Water Department personnel, drilling paused for five to seven minutes to allow for possible water infilling to occur at the bottom of the hole. When resumption of drilling produced the expected fluid, slurry-like sample, indicating water table intersection, drilling was then stopped and the hole sounded. Water Department personnel measured total depth of borehole first, followed by a standard sounder reading to obtain the depth to water. Layne Environmental personnel verified total depth footages then rounded them up or down to the nearest foot for billing purposes.

#### Backfilling

Backfilling of each completed hole was performed daily to minimize liability. Holes were manually filled with drill cuttings to within 20 feet of the surface. A cement slurry was then mixed at the surface and pumped down to fill the remaining

open hole. A rebar stake was placed in the cement plug with it's end flush with the land surface. This rebar was later used as a location point for City of Tucson surveyors in describing both latitude/longitude coordinates and elevations above mean sea level for each of the drill holes.

### Grain Size Analysis

Drill cutting samples were collected and processed by Tucson Water Hydrology Section personnel. Processing followed a standard procedure for quantifying variations in selected grain size fractions, color and carbonate content.

A portion of each sample is transferred to an aluminum pan and then baked during an initial drying phase. An unwashed representative sample is collected and retained for future analysis. A dry weight measurement is taken and recorded along with the dry color (Munsell soil color chart) and the reaction of the unwashed sample to a 10% HCl acid solution. The sample is then wetted and any color change is recorded. Samples are then washed through sieves to segregate cuttings into three size fractions ( $\geq 4.0\text{mm}$ ,  $\geq 2.0\text{mm}$ ,  $\geq 0.063\text{mm}$ ).

Each size fraction is weighed and the difference between the original dry weight and the sum of the three fractions is recorded as the weight of the unretained fines after washing.

Finally a washed representative sample is collected and stored for future analysis or reference.

## RESULTS:

### Water Level

Water table elevations are illustrated in cross sections A-A' through F-F' (Plates 2-7). As seen in these plates, the projected water surface reflects the gently sloping land surface within the project area.

### Lithology

Three major depositional units and a fourth unit of road fill gravel are found above the water table and can be correlated across the property. These units are briefly described below in descending order along with brief notes regarding their thickness and location (Plates 2-7).

Road Fill - grayish brown, subangular to subrounded sandy gravel with no visible fines. Built up road bed surrounds the oxidation pond and varies in thickness from 2 to 11 feet.

Overbank Deposit - light brown to grayish brown, clayey to silty loam with 2-3% gray brown blocky clay interbeds. This relatively well sorted fine grained unit represents overbank deposits from the Santa Cruz River. It varies in thickness from 2-22 feet around the oxidation pond and 9-18 feet thick southeast of the oxidation pond.

Channel Fill Deposit - medium to reddish brown, rounded to subrounded sandy gravel with numerous 3-5½ inch rounded cobbles. Traces of Mn and Fe Oxides are visible on gravels. Clay content increases with depth and evolves from a brown to a salmon color clay that coats cobbles and gravels near the lower contact. Muscovite-rich gneissic fragments are common in the lower portions of this unit. The channel fill deposits of the Santa Cruz River are present across the property with a thickness of 28 feet to 44.5 feet.

Basin Fill Deposit - Light reddish brown to dark grayish brown, angular to subangular clayey sandy gravel. This interval exhibits a pronounced variability in volcanic gravel lithologies, including andesite, rhyolite and basalt, and appears to have a Tucson Mountain source area. Traces of reddish brown clay occur erratically throughout the unit. All holes were drilled to a total depth within this unit.

SUMMARY AND CONCLUSIONS:

Based on previous projects in the area, the Hydrology Section anticipated encountering the upper, less permeable, overbank deposit. This overbank interval averages 15 feet thick, and if removed would expose the more permeable channel deposits desirable for achieving rapid infiltration of effluent water for aquifer storage.

Regional water level elevations encountered during drilling of this project demonstrate depths to water similar to those encountered immediately west of the Santa Cruz River where recharge operations are underway.

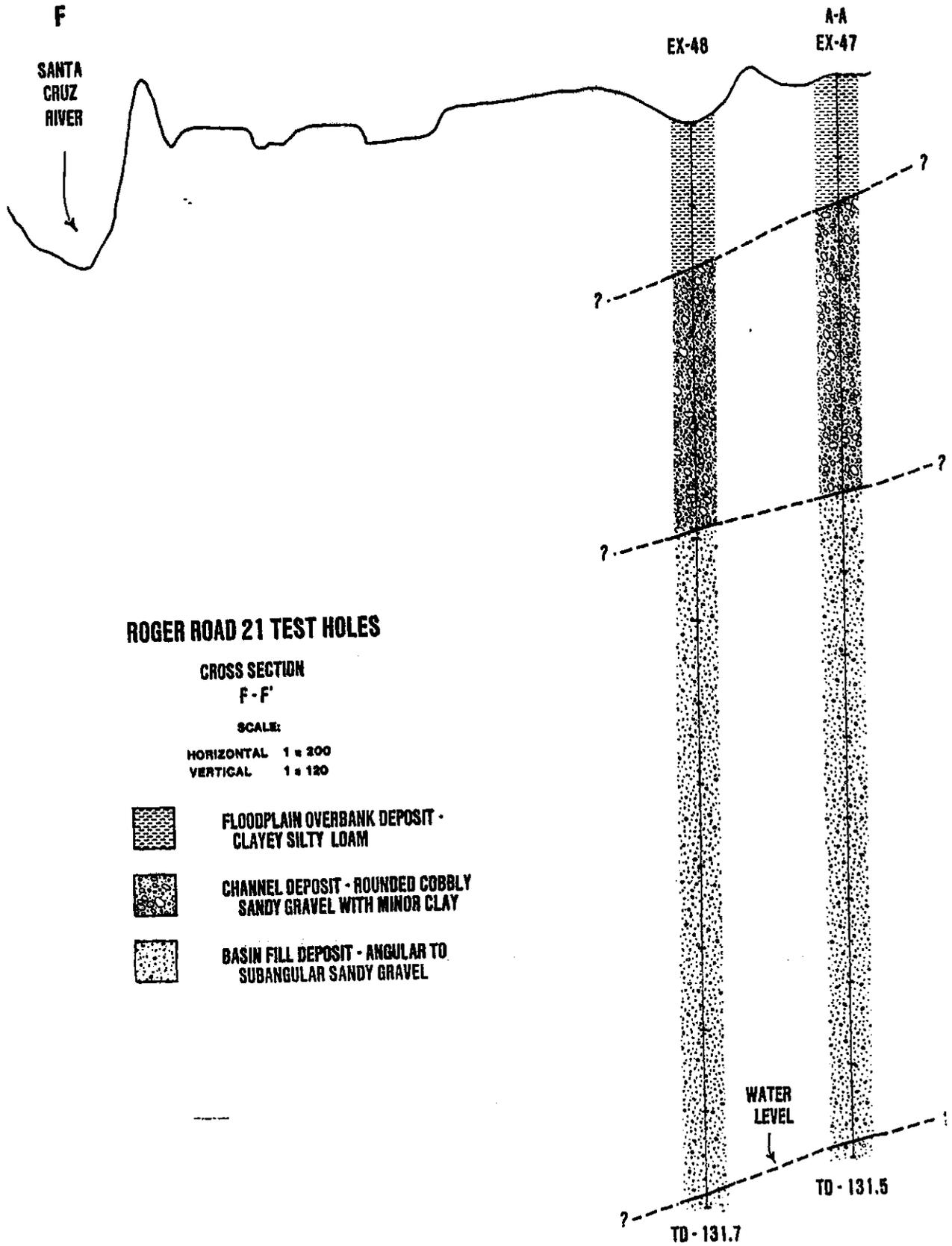
HYD/drilhol



LOOKING NORTH NORTHWEST

ELEVATION  
AMSL

2260 -  
2250 -  
2240 -  
2230 -  
2220 -  
2210 -



**ROGER ROAD 21 TEST HOLES**

CROSS SECTION  
F - F'

SCALE:

HORIZONTAL 1 = 200  
VERTICAL 1 = 120

-  FLOODPLAIN OVERBANK DEPOSIT - CLAYEY SILTY LOAM
-  CHANNEL DEPOSIT - ROUNDED COBBLY SANDY GRAVEL WITH MINOR CLAY
-  BASIN FILL DEPOSIT - ANGULAR TO SUBANGULAR SANDY GRAVEL

WATER LEVEL

TD - 131.7

TD - 131.5





LOOKING NORTH

C'

INTERSECTION  
A-A'  
EX-56

ELEVATION  
AMSL

C

2250 -

SANTA  
CRUZ  
RIVER

EX-59

EX-58

EX-57

2240 -

2230 -

2220 -

2210 -

### ROGER ROAD 21 TEST HOLES

CROSS SECTION  
C - C'

SCALE:

HORIZONTAL 1 = 200  
VERTICAL 1 = 120



FLOODPLAIN OVERBANK DEPOSIT -  
CLAYEY SILTY LOAM

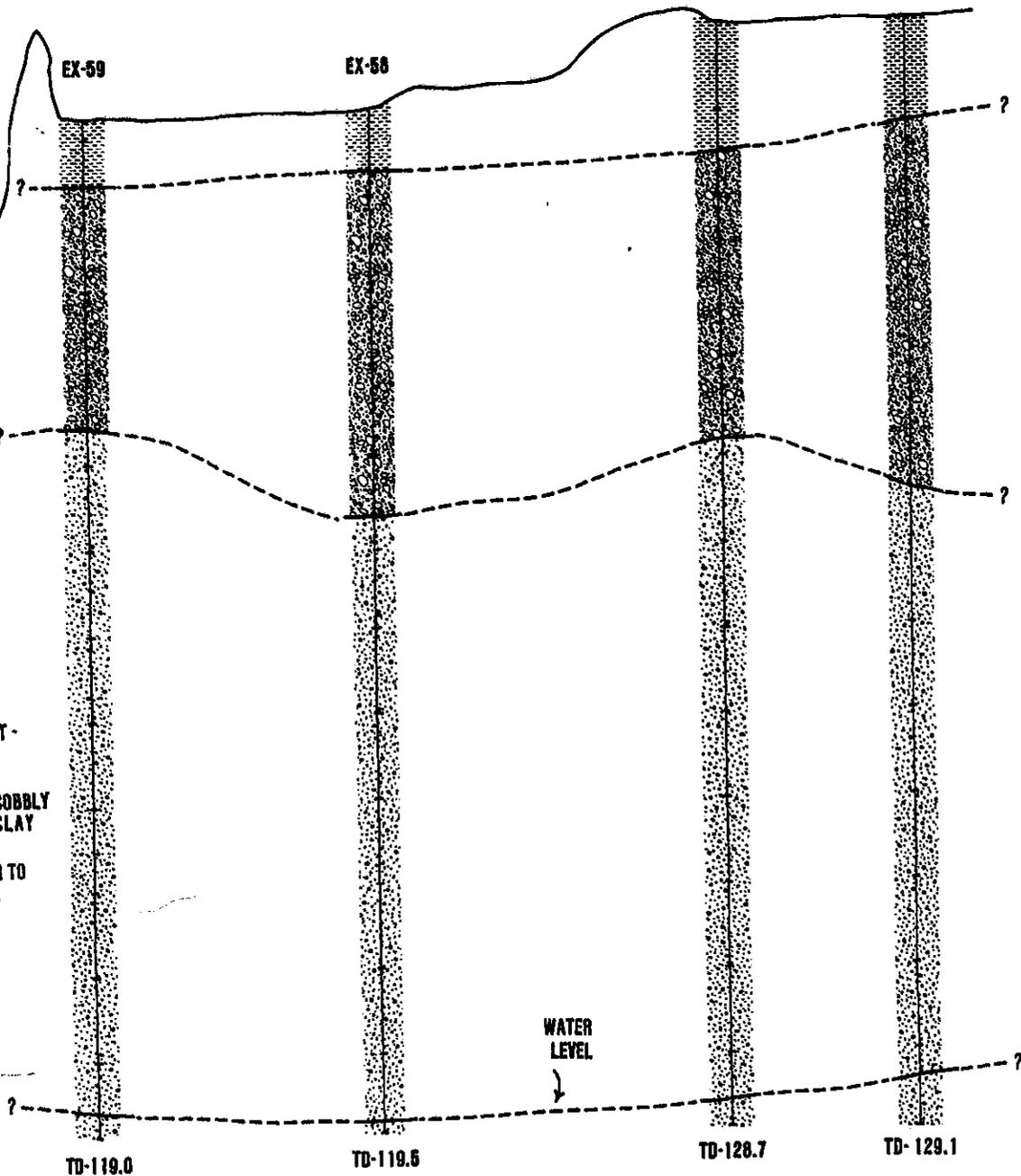


CHANNEL DEPOSIT - ROUNDED COBBLY  
SANDY GRAVEL WITH MINOR CLAY

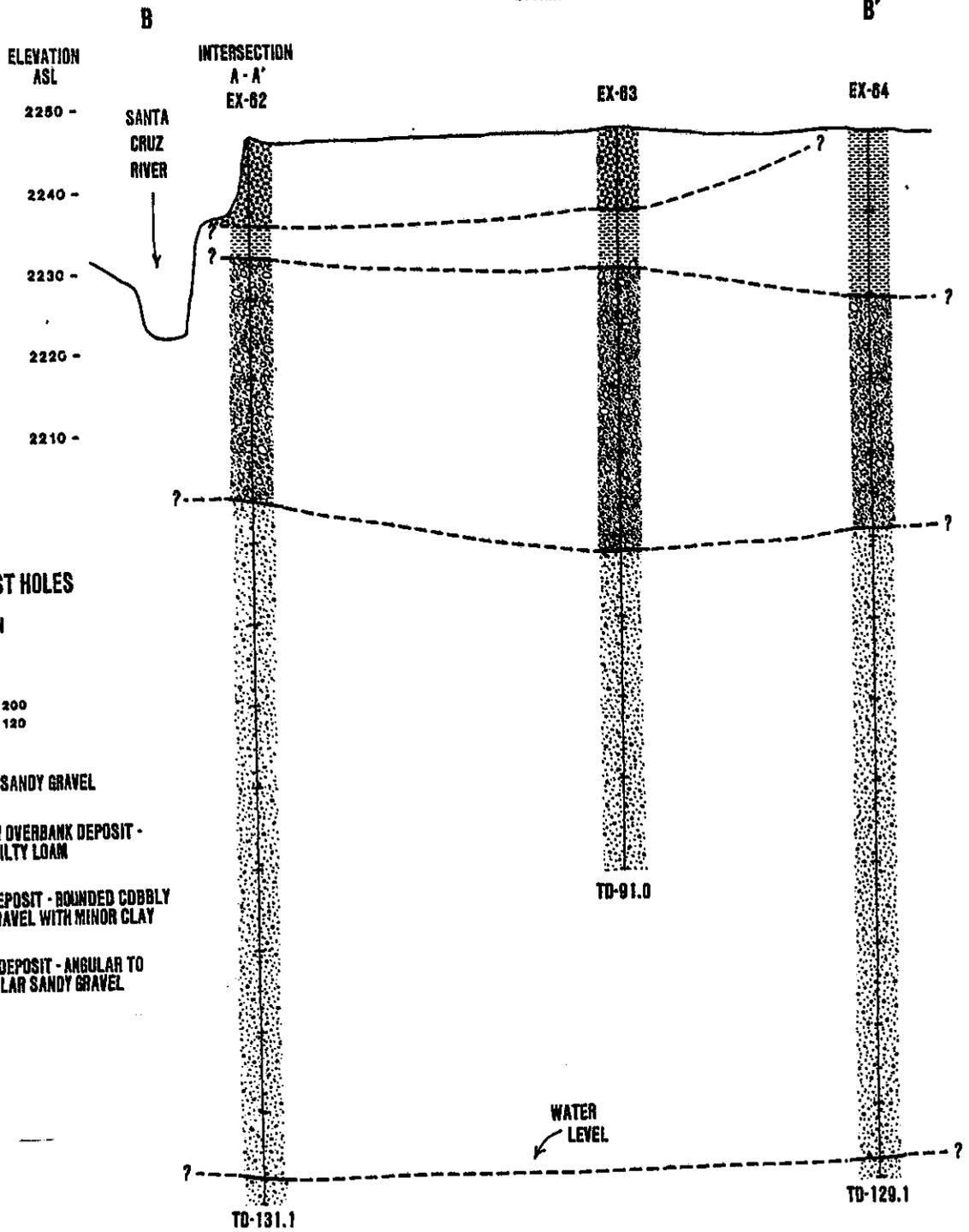


BASIN FILL DEPOSIT - ANGULAR TO  
SUBANGULAR SANDY GRAVEL

WATER  
LEVEL



LOOKING NORTH



**ROGER ROAD 21 TEST HOLES**

CROSS SECTION  
B - B'

SCALE:

HORIZONTAL 1 = 200  
VERTICAL 1 = 120



ROAD FILL - SANDY GRAVEL



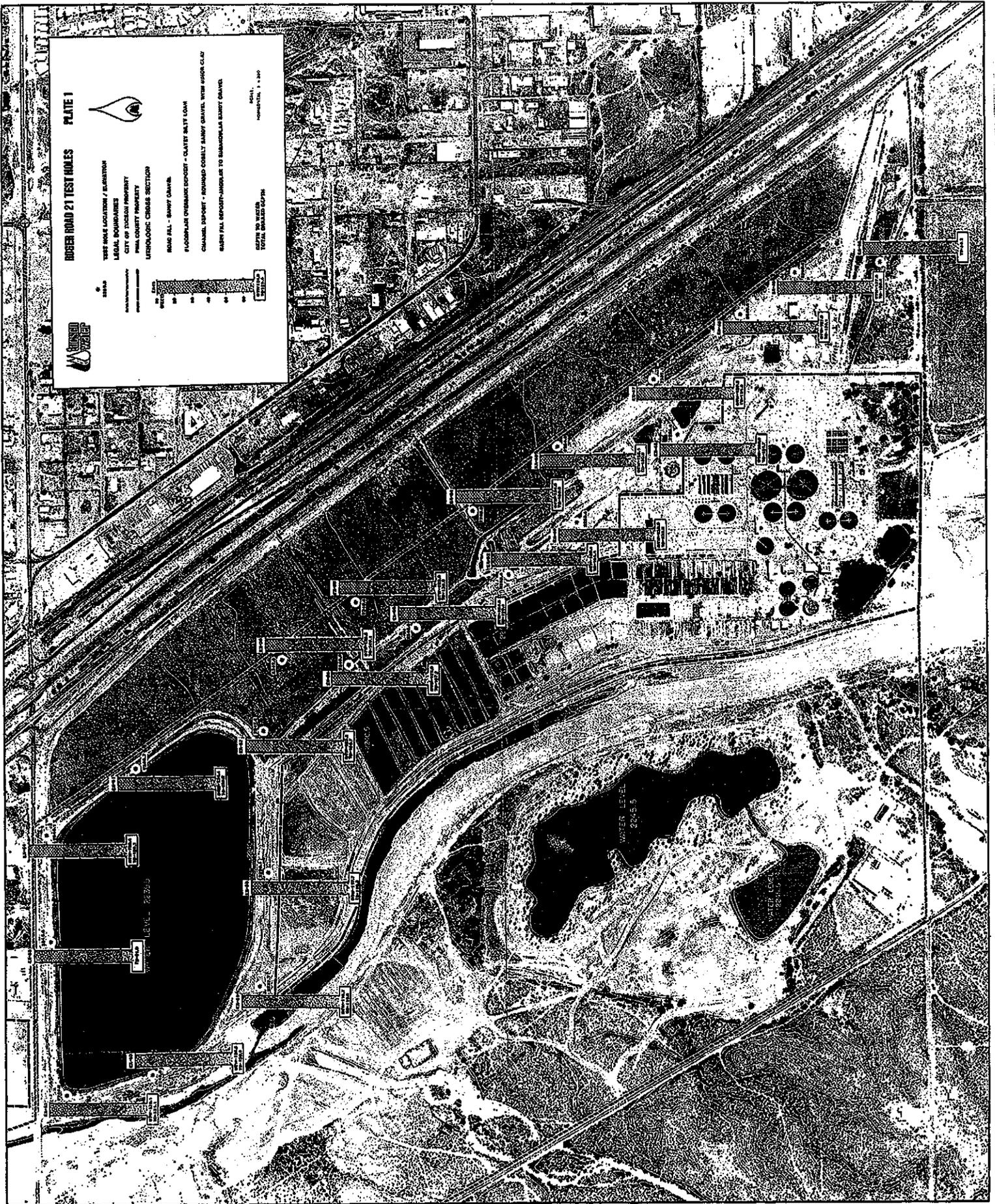
FLOODPLAIN OVERBANK DEPOSIT -  
CLAYEY SILTY LOAM



CHANNEL DEPOSIT - ROUNDED COBBLY  
SANDY GRAVEL WITH MINOR CLAY



BASIN FILL DEPOSIT - ANGULAR TO  
SUBANGULAR SANDY GRAVEL



**REDDER ROAD 21 TEST HOLES PLATE 1**



- TEST HOLE LOCATION / BLANKETTING
- LEGAL BOUNDARIES
- CITY OF SUDBURY PROPERTY
- PAVA COUNTY PROPERTY
- HYDROLOGIC CROSS SECTION



ROAD FILL - SANDY GRAVEL  
 FLOODPLAIN OVERBANK EXPOSURE - CLAYEY SILTY LOAM  
 CHANNEL DEPOSIT - BROWNED COARSE SANDY GRAVEL WITH SANDY CLAY  
 SANDY FILL DEPOSIT - ANALOGOUS TO SANDWICHVILLE SANDY GRAVEL

DATE: 11/1/80  
 PROJECT: SUDBURY WASTEWATER TREATMENT PLANT

