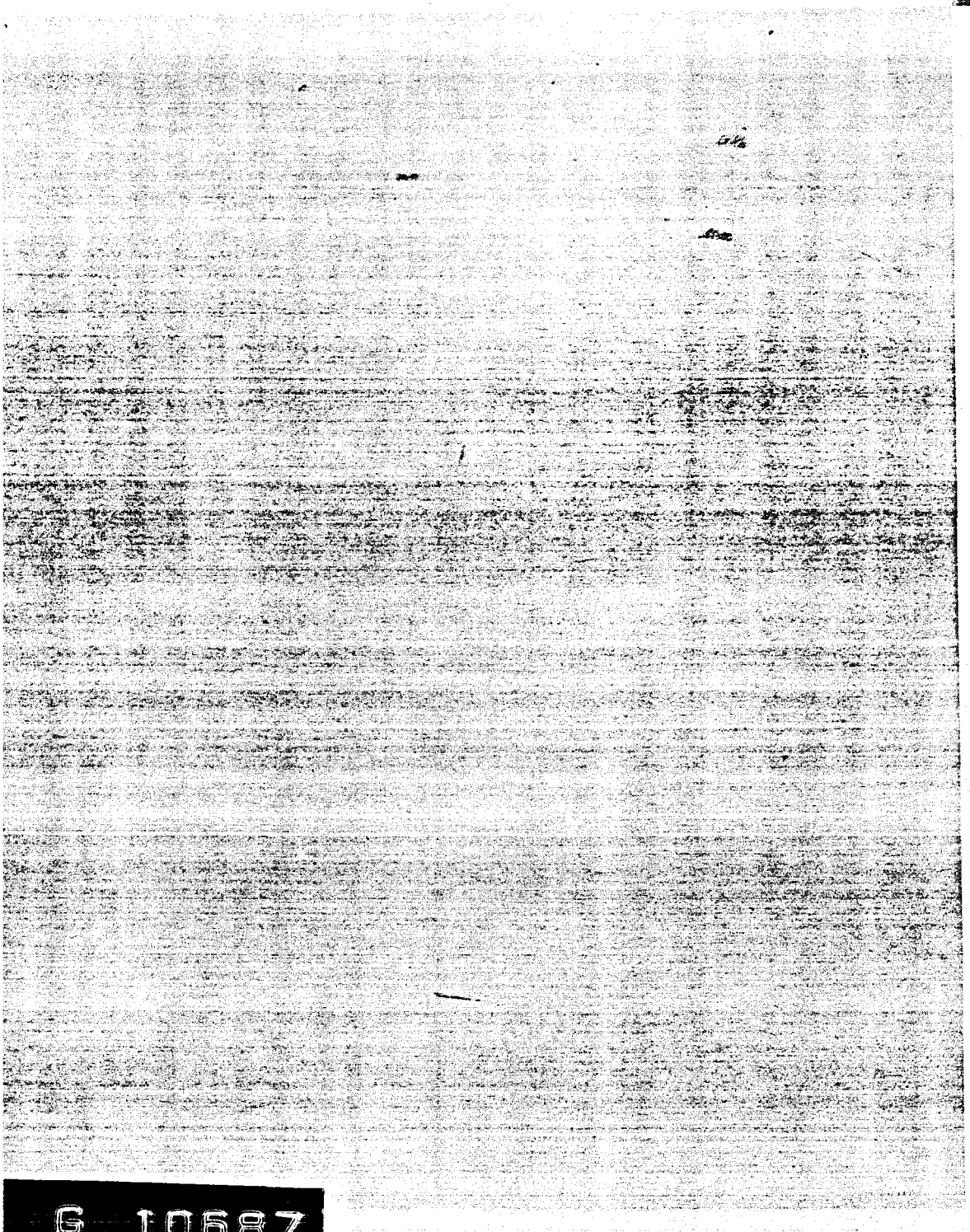
Tritium Migration From a Low-Level Radioactive-Waste Disposal Site Near Chicago, Illinois



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CONTENTS

FIGURES

TABLES

Tritium Migration From a Low-Level Radioactive-Waste Disposal Site Near Chicago, Illinois

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Abstract

This paper describes the results of a study to determine the geologic and hydrologic factors that control migration of tritium from a closed, low-level radioactive-waste disposal site. The disposal site, which operated from 1943 to mid-1949, contains waste generated by research activities at the world's first nuclear reactors. Tritium has migrated horizontally at least 1,300 feet northward in glacial drift and more than 650 feet in the underlying dolomite. Thin, gently sloping sand layers in an otherwise clayey glacial drift are major conduits for ground-water flow and tritium migration in a perched zone beneath the disposal site. Tritium concentrations in the drift beneath the disposal site exceed 100,000 nanocuries per liter. Regional horizontal joints in the dolomite are enlarged by solution and are the major conduits for ground-water flow and tritium migration in the dolomite. A weathered zone at the top of the dolomite also is a pathway for tritium migration. The maximum measured tritium concentration in the dolomite is 29.4 nanocuries per liter. Fluctuations of tritium concentration in the dolomite are the result of dilution by seasonal recharge from the drift.

INTRODUCTION

In 1943, the U.S. Army Corps of Engineers leased 1,025 acres from the Cook County (Ill.) Forest Preserve District to conduct nuclear research. Two nuclear reactors were built on the leased parcel of land, and low-level radioactive waste associated with the research was buried there. After the site was decommissioned and the land returned to the Forest Preserve District in 1956, Argonne National Laboratory (ANL) assumed responsibility for monitoring radionuclide activity at the forest preserve. In 1973, tritium was detected in water from a forest-preserve well located about 1,200 feet (ft) downgradient from the burial site. Since 1976, the U.S. Geological Survey, with the assistance of ANL, has conducted studies to determine the direction and rate of tritium migration in the subsurface and the location and concentration of tritium contamination in the forest preserve.

Purpose and Scope

This paper describes the results of a study to determine the geologic and hydrologic factors that control tritium migration in the study area. Included are an explanation of the migration of tritium from the burial site to a forest-preserve well and the fluctuating tritium levels in that well. The scope of the paper includes discussion of ground-water flow and tritium migration in both glacial drift and dolomite; it also includes discussion of the role of streamflow and the source of tritium concentrations in surface water.

The scope of the work included drilling six wells in dolomite, collecting cores from glacial drift at five locations, and collecting leaves from 12 trees for tritium analysis. Ground-water levels were measured in 28 piezometers in glacial drift and 10 wells in dolomite, and more than 1,100 water samples for tritium analysis were collected from wells completed in glacial drift and dolomite and from a stream near the disposal site.

This investigation continues work reported by Olimpio (1984). Data collected from 1982 to 1985 necessitate refinement or changes of some of Olimpio's interpretations and conclusions.

Physical Setting

The study area consists of the burial site—designated Plot M—and the surrounding land. It is located near the Red Gate Woods picnic area of the Palos Forest Preserve in southwestern Cook County (fig. 1). For this paper, the study area is considered to be subdivided into two distinct areas (fig. 2): (1) the Plot M area, which was the focus of studies of the drift, and (2) the Red Gate Woods picnic area, which was the focus of studies of the dolomite. Plot M is constructed on a morainal upland, which is dissected by two valleys—the Des Plaines River valley to the north and the Sag valley to the south. Total relief in the area is about 200 ft. The upland is characterized by a rolling, knobby topography and poorly developed drainage. Streams are ephemeral and either drain