on developing analytical methods and related equipment. Together with district and cooperating laboratories they conduct continuing analytical reference and methods standardization studies to insure maximum practicable reliability and uniformity of results. Similar research is underway on improving data network design, methods of data transmission, and data processing. Both inhouse and extramural research is done on data sensitivity to determine what kinds of data must be collected, how often, and at what points to serve the greatest need at the lowest cost. This program also includes research on improved methods of extrapolation and interpolation from point samples to ungaged points in space and time. A new and highly important research project has been started to develop better methods for collecting water data in urban environments, and a significant start has been made on identification of ecological indicators of stream health.

Remote sensing techniques are being perfected for faster coverage of water resources of larger areas. Airborne radiometers and infrared scanners already are providing useful data on thermal patterns in surface waters, and considerable progress is being made in detecting other pollutants by selective band photography. Lesser equipment offers considerable promise as a quantitative and perhaps a semiquantitative tool for analyzing polluted waters from an aircraft or space platform. Plans already are under way for data satellites with land-based computers capable of reading out synoptic information on a global, time-lapse basis for many factors which bear upon pollution problems. These include effects of changing land use and urbanization on flow and quality of rivers, cyclic quality patterns in lakes and ponds, and evidence of progressive degradation in surface waters.

In addition to the comprehensive programs of basic data collection and data improvement research, the Survey has a sizeable effort in fundamental and applied hydrological research aimed at better understanding of the origin, movement and fates of pollutants. Hydrodynamic research on rivers and estuaries already has produced a two-dimensional mathematical model capable of predicting flow patterns at any point on a water body using data collected from any other point. Similar three-dimensional models are being developed. Hydrodynamic work on lakes started during last fiscal year is expected to produce very useful information on dispersion patterns and to simplify tracing of troublesome pollutants. Survey researchers have played and are continuing to play a lead role in studies of heat dissipation from lakes and ponds, including cooling ponds, and of thermal die-away patterns from point heat sources in rivers. A very significant pilot study is underway on ecological responses of a major estuary to abnormal waste heat loads from a power plant.

Other principal areas of our research closely related to the pollution problem are mechanics of sediment dispersion, transport, and deposition; movement of water and waste materials in the unsaturated soil zone and ground-water systems; practicability and effects of artificial recharge with waste water; processes and problems related to storage of liquid wastes underground, and geochemical controls of water quality in troublesome processes such as mine-acid generation, euthrophication and leaching of solid waste dumps. In recent years there has been increasing emphasis on fates of pollutants in underground systems because of the trend toward more underground waste disposal and the recognized difficulty of purging underground fresh waters once they are accidentally contaminated. Increasing attention also has been paid to the movements and fates of pesticides and other troublesome synthetics. The overall cost of Survey research related either directly or indirectly to pollution problems, is approximately $12 million per year. Each year the work generates 300 to 400 Professional Papers, Water-Supply Papers and journal articles available to many users.

Multidiscipline capability has proved to be of considerable help to the Survey in conducting research of the kinds described above. Knowledge of geology and geochemistry simplify research on behavior of pollutants in surface water and ground water. Expertise in topographic studies helps in predicting flows of surface water which have a marked bearing on the behavior of and impact of water contaminants. Knowledge of geomorphology and geography allows one to understand sediment transport phenomena and related problems. Because of this interaction of disciplines it is fair to say the Survey's entire staff of approximately 9,000 contribute significantly to the subjects discussed above and therewith to the solution of environmental pollution problems