Hydrology of the Hawaiian Islands
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PREFACE

Hydrologic concepts and eventually the science of hydrology have played a vital role in the evolution of society in the islands of the Hawaiian Archipelago. Polynesians, the first settlers in Hawai‘i, created a culture that in many ways depended on the proper application of hydrologic principles. The passage of time and the migration of peoples to the Islands from other countries brought an increase in population and the introduction of a variety of new cultures, both of which generated new demands for water and the need to expand utilization of the water resources.

In islands, resources within the confines of each island must meet water demands. This fundamental constraint encouraged the application of relatively sophisticated scientific and engineering principles to water investigations in Hawai‘i long before this approach had become common in most other regions of the world. Besides water demand, other issues concern the protection of groundwater and coastal waters from pollution, the management of flood hazards, and the balance of stream use with protection.

Many hydrologic processes in Hawai‘i are profoundly different from those of continents and other climatic zones. Hawai‘i’s humid tropical climate, the surrounding ocean, its volcanic earth, and high mountains govern hydrologic analysis. Management of water, land, and environments faces great uncertainties and often may be at risk of potential failure. Successful experiences in Hawai‘i may be useful for other communities with similar environments.

A large body of literature concerning water in the Hawaiian Islands has accumulated over the last century, but the reports and documents usually relate to specific problems and their solutions. Several books that include discussions of hydrology have their primary focus on other scientific matters such as geology and volcanology. A text with its focus specifically on the fundamentals of Hawaiian hydrology is appropriate to add to the library of other texts that discuss but do not emphasize hydrologic principles.

This book comprises eight chapters, some of which discuss applications of hydrology that deal with water, land, and environmental issues in Hawai‘i. Chapter 1, on the geological environment, presents the foundation of the water

environment, providing information on rock types and their hydrologic characteristics. Chapter 2, on the hydrologic cycle, discloses a linkage of the hydrologic elements in terms of both quantity (flow cycle) and quality (transport cycle) using equations of water balance based on mass conservation. Precipitation, the starting point of the hydrologic cycle and the virtual freshwater source, is the focus of Chapter 3; and evaporation, the largest single abstractor of water, is the area of interest in Chapter 4. The subject of Chapter 5 is wetting and infiltrating the surfaces. Chapter 6 is about groundwater, the ultimate sink in the disposition of rainwater. Chapter 7 is concerned with surface runoff. Surface runoff and groundwater discharge reach the shoreline and impact the quality of coastal waters. Thus, Chapter 8, the final chapter, focuses on coastal waters.

Chapters 3 through 7 each begins with a short section on the current knowledge of the natural processes and fundamental theories involved with its specific subject. For some, this information provides background and concepts; for others, it provides a quick review. What follows are formal discussions on the distinctive characteristics of each of the hydrologic elements and their interrelations under natural and human-influenced conditions, as well as reference to modeling and database compilation, on which quantitative analysis and management are based.

Much of the book was written with the interested lay reader in mind, but some sections require familiarity with science and quantification of hydrological processes. Nevertheless, the book can serve as an introduction to the hydrology of the Hawaiian Islands as well as a reference for more advanced studies. An extensive bibliography of selected references is appended.