3. THE HYDROLOGIC CYCLE

The hydrologic cycle provides the conceptual basis for a technical evaluation of a watershed. At a global scale, the hydrologic cycle describes the circulation of water between the oceans, atmosphere and land. At the watershed scale, the hydrologic cycle focuses in on the land-based hydrologic system that is bounded by surface water divides. For WRIA 55, the watershed area is defined as the area of land within Washington State that contributes surface water flow to the Little Spokane River (i.e., the contributing land area between headwaters of the Little Spokane River and the Little Spokane River – Spokane River confluence). For WRIA 57, the watershed area is defined as the area of land within Washington State that contributes surface water flow to the Spokane River above the confluence with hangman Creek (i.e., the contributing land area between the Idaho State Line and the Hangman Creek–Spokane River confluence).

A watershed must be viewed as a combination of both the surface drainage area and the subsurface soils and rocks that underlie the watershed (Figure 3.1). A good understanding of the hydrologic cycle at the watershed scale involves an inventory of the water inputs, outputs and storage within the watershed. Knowledge of the dynamic processes of a watershed hydrologic cycle provides an understanding of what effects various resource management approaches will have on the natural system.

In order to inventory and ultimately model a watershed, it is useful to also represent the hydrologic cycle as a systems diagram. Figure 3.2 illustrates the systems approach to the basin scale hydrologic cycle and differentiates between those terms that involve rates of movement (hexagonal boxes) and those that involve storage (rectangular boxes).

The hydrologic cycle, illustrated in Figures 3.1 and 3.2, is a network of inflows and outflows that may be expressed as a water balance or water budget by equating the primary variables (input, output and change in storage):

$$\text{Input} = \text{Output} + / - \text{Change In Storage}$$

This equation is a conservative statement that assures that all the water within the watershed is accounted for and that water cannot be lost or gained.

The main input to the hydrologic system is precipitation, in the form of rainfall and snowmelt. The amount of precipitation is the primary control on the amount of water that may be available within the watershed. Secondary inflows to the hydrologic system include groundwater recharge and surface water recharge into the watershed. For the Little Spokane WRIA, groundwater recharge from the Middle Spokane WRIA through the Hillyard Trough into the Little Spokane River is an important inflow. For the Middle Spokane WRIA, groundwater inflow and surface water inflow into the watershed at the Idaho State Line are important. The inflow of water across the state line comes from the rest of the watershed that lies outside of the State of Washington, an area much larger than the Middle Spokane WRIA.

Outflow from a watershed occurs naturally as streamflow or runoff, groundwater discharge and as evapotranspiration. Evapotranspiration is the combination of

evaporation from open bodies of water, evaporation from soil surfaces and transpiration from the soil by plants. Outflow from a watershed also occurs as a result of human consumption and redirection of flows

Movement of water within a watershed occurs naturally through a number of processes. Overland flow delivers precipitation to stream channels. Infiltration results in movement of water at the land surface downward into the subsurface. Groundwater flow results in movement of water within the subsurface. Baseflow delivers groundwater to stream channels. Streamflow or surface water flow results in movement of water within stream channels. Infiltration rates and groundwater flow rates are controlled by the nature of the land surface and subsurface. Infiltration rates and groundwater flow rates in turn influence the timing and spatial distribution of surface water flows. Groundwater flows and surface water flows are linked by the relationships between infiltration, groundwater recharge, baseflow and streamflow generation.

Movement and outflow/inflow of water within a watershed is also impacted by a number of human factors including groundwater pumping, extraction of surface water, stormwater generation and discharge, wastewater generation and discharge, and agricultural and land use practices.

The hydrologic cycle at a watershed scale is most commonly analyzed on an annual basis over the water year, defined as the October 1 through September 30 (i.e., the beginning of autumn through to the end of summer). Successive years are compared so that changes in the water budget (and its components) over successive years can be assessed. The primary variables are affected by seasonal, interannual, interdecadal and decadal variability (e.g.: snowpack accumulation and melting; dry versus wet years; El Nino / El Nina; and, Pacific Decadal Oscillations, respectively).

The data compilation completed and documented in this report collects, describes and assesses the existing information that may be used to develop a conceptual and numerical watershed model for WRIA 55 and 57. In broad categories, this information includes: topography and drainage; climate; land cover; geology; groundwater; surface water; hydraulic continuity between groundwater and surface water; and, water use.

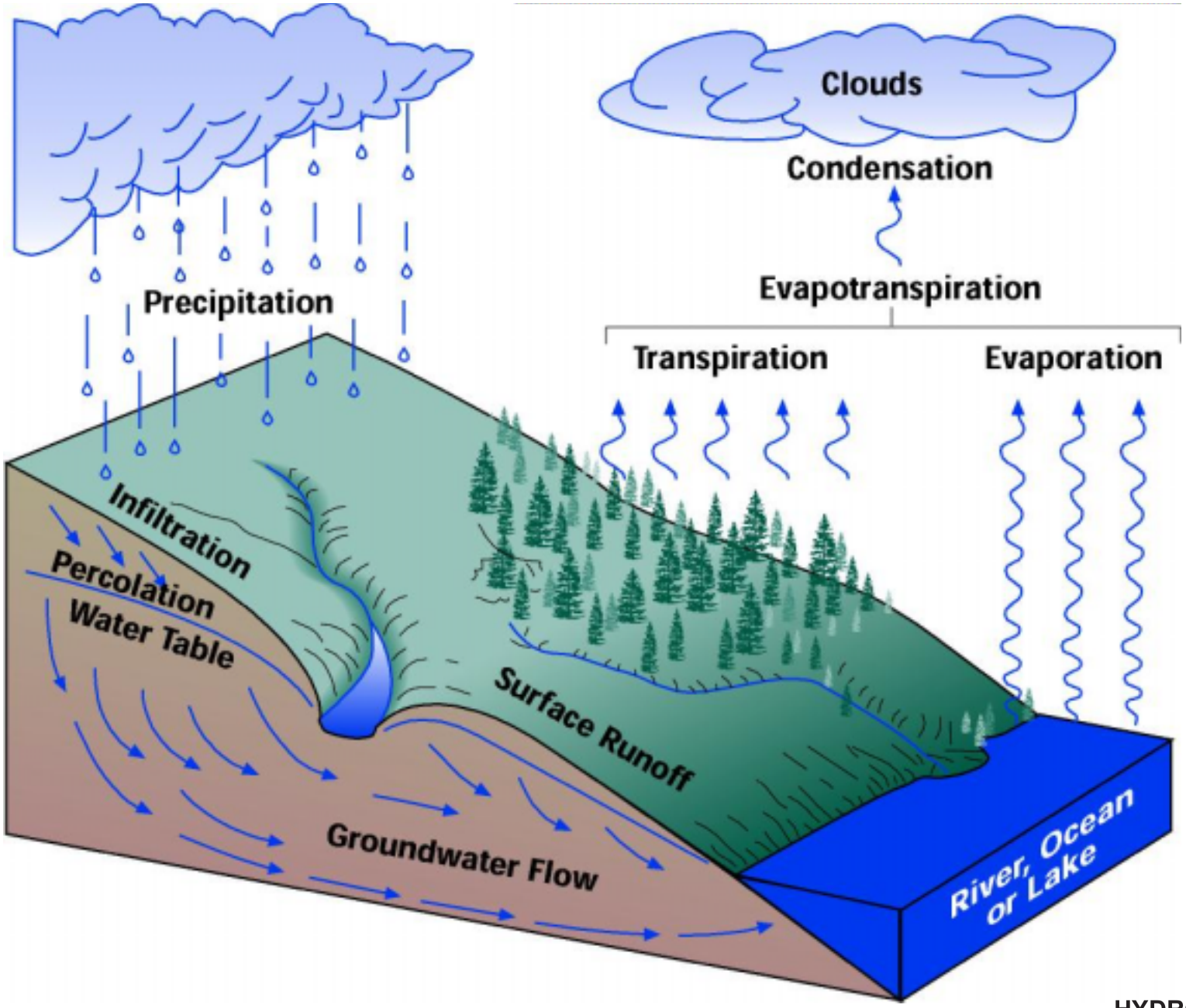

FIGURE **3.1**
HYDROLOGIC CYCLE
SPOKANE COUNTY/LEVEL I ASSESSMENT/WA

PROJECT NO. 013 1372_1700 DRAWING NO. 92886 DATE 10/15/01 DRAWN BY ETF

Golder Associates

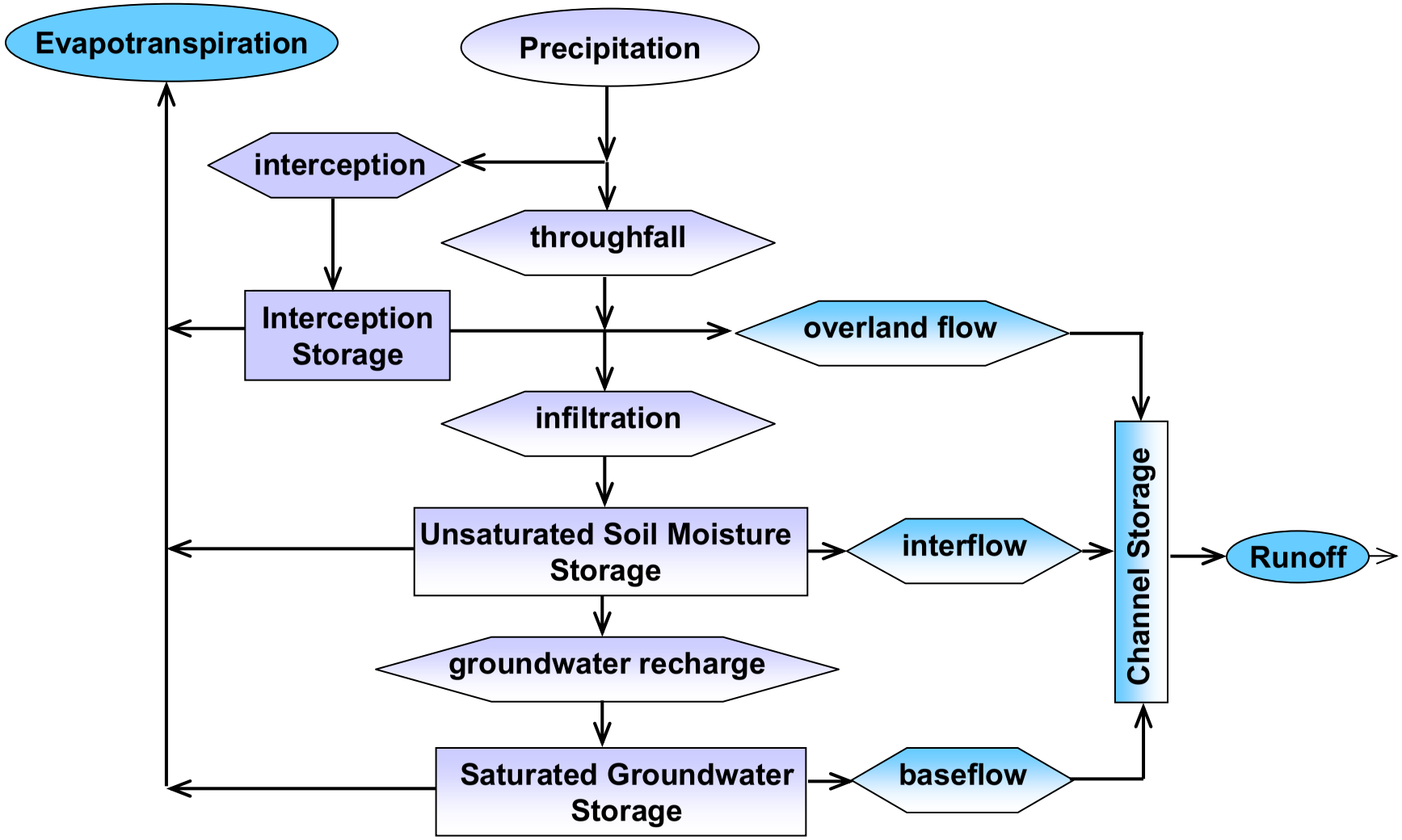

FIGURE **3.2**

SYSTEMS REPRESENTATION OF THE HYDROLOGIC CYCLE

SPOKANE COUNTY / LEVEL 1 ASSESSMENT / WA

Adapted from Freeze and Cherry, 1978.