Summary of Reports and Results

The study area covers about 706 square miles in western Pierce County, Washington, and is underlain by a northwest-thickening sequence of unconsolidated glacial and interglacial deposits which overlie sedimentary and volcanic bedrock units that crop out in the foothills along the southern and southeastern margin of the study area. Geologic units were grouped into 11 hydrogeologic units consisting of aquifers, confining units, and an underlying bedrock unit. A surficial hydrogeologic unit map was developed and used with well information from 450 drillers' logs to construct 6 hydrogeologic sections, and unit extent and thickness maps. Groundwater in unconsolidated glacial and interglacial aquifers generally flows to the northwest towards Puget Sound, and to the north and northeast towards the Puyallup River. These generalized flow patterns likely are complicated by the presence of low permeability confining units that separate discontinuous bodies of aquifer material and act as local groundwater-flow barriers. Water levels in wells completed in the unconsolidated hydrogeologic units show seasonal variations ranging from less than 1 to about 50 feet. The largest groundwater-level fluctuation (78 feet) observed during the monitoring period (March 2007–September 2008) was in a well completed in the bedrock unit. Synoptic streamflow measurements made in September 2007 and July 2008 indicated a total groundwater discharge to streams in the study area of 87,310 and 92,160 acre-feet per year, respectively. The synoptic streamflow measurements show a complex pattern of gains and losses to streamflows that varies throughout the study area, and appears to be influenced in places by local topography. Groundwater discharge occurs at numerous springs in the area and the total previously reported discharge of springs in the area is approximately 80,000 acre-feet per year. There are, in addition, many unmeasured springs and the total spring discharge in the area is unknown. The water-budget area (432 mi2 located within the larger study area) received an annual average (September 1, 2006, to August 31, 2008) of about 1,025,000 acre-ft or about 45 inches of precipitation a year. About 44 percent of precipitation enters the groundwater system as recharge. Almost one-half of this recharge (49 percent) discharges to the Puyallup and Nisqually Rivers and leaves the groundwater system as submarine groundwater discharge to Puget Sound. The remaining groundwater recharge discharges to streams (20 percent) and springs (18 percent) or is withdrawn from wells (13 percent).

The model covers an area of about 491 square miles in western Pierce County, Washington, and is underlain by a northwest-thickening sequence of unconsolidated glacial (till and outwash) and interglacial (fluvial and lacustrine) deposits. Ten unconsolidated hydrogeologic units in the model area form the basis of the groundwater-flow model. Groundwater flow in the Chambers-Clover Creek Watershed and vicinity was simulated using the groundwater-flow model, MODFLOW-2000. The finite-difference model grid comprises 146 rows, 132 columns, and 11 layers. Each model cell has a horizontal dimension of 1,000 by 1,000 feet, and the model contains a total of 123,602 active cells. The thickness of model layers varies throughout the model area and ranges from 1.5 feet in the A3 aquifer unit to 1,567 feet in the G undifferentiated unit. Groundwater flow was simulated for both steady-state and transient conditions. Steady-state conditions were simulated using average recharge, discharge, and water levels for the 24-month period September 2006–August 2008. Transient conditions were simulated for the period September 2006–August 2008 using 24 monthly stress periods. Resource managers and local stakeholders intend to use the model to evaluate a range of water resource issues under both steady-

state and transient conditions. Initial conditions for the transient calibration were developed from a 3-year “lead-in” period that used recorded precipitation and river levels, and temporal extrapolations of other boundary conditions. During model calibration, variables were adjusted within probable ranges to minimize differences between measured and simulated groundwater levels and stream baseflows. The model as calibrated to steady-state conditions has a standard deviation for heads and flows of 28.42 feet and 2.12 cubic feet per second, respectively; the model as calibrated to transient conditions has a standard deviation for heads and flows of 23.01 feet and 2.67 cubic feet per second, respectively. Simulated steady-state inflow to the model area from precipitation and secondary recharge was 477,266 acre-feet per year (acre-ft/yr) (79 percent of total simulated inflow), and simulated inflow from stream and lake leakage was 129,778 acre-ft/yr (21 percent of total simulated inflow). Simulated outflow from the model primarily was through discharge to streams, lakes, springs, seeps, and Puget Sound (559,192 acre-ft/yr; 92 percent of total simulated outflow), and withdrawals from wells (47,863 acre-ft/yr; 8 percent of total simulated outflow).

Six scenarios were formulated and simulated using the calibrated model to provide representative examples of how the model can be used to evaluate the effects on groundwater levels and stream baseflows of potential changes in groundwater withdrawals, in consumptive use, and in recharge.