This chapter describes groundwater monitoring in the 1100-EM groundwater interest area and the Richland North Area (Figure 8-1). It includes an overview and summary of 2016 groundwater monitoring results.

### 8.1 Overview

The former 1100-EM-1 OU includes the inactive DOE Horn Rapids Landfill, used from the late 1940s to the 1970s for disposal of office and construction waste, asbestos, sewage sludge, fly ash, and reportedly numerous drums of unidentified organic liquids (DOE/RL-90-18, *Phase 1 Remedial Investigation Report for the Hanford Site 1100-EM-1 Operable Unit*). Following cleanup of 1100-EM-1 and related source OUs, DOE transferred ownership of a portion of the property to the Port of Benton.

The Richland North Area includes the city of Richland north well field and recharge ponds. The city of Richland pumps Columbia River water into the recharge ponds. The water percolates to the groundwater and is then pumped through surrounding wells for municipal use during peak demand periods (WHC-MR-0033, *Recharge to the North Richland Well Field*). The Richland North Area also includes the AREVA NP, Inc. nuclear fuel production facility, which is southwest (upgradient) of the inactive DOE Horn Rapids Landfill. Table 8-1 provides some key facts about 1100-EM. Groundwater monitoring is described in DOE/RL-2015-56.

Groundwater beneath 1100-EM and Richland North flows primarily west to east and discharges to the Columbia River (Figure 8-2). Groundwater flow from the west is diverted to the northeast and southeast around a recharge mound beneath Richland’s recharge ponds. The unconfined aquifer is recharged by the Yakima River, infiltration of agricultural irrigation, and natural precipitation.

The thickness of the unconfined aquifer in this area is 5.6 to 9 m (18 to 30 ft), with all but the upper few meters residing in the Ringold unit E (Figure 8-3). A silt- and clay-dominated facies forms a local, laterally extensive upper aquitard up to 10 m (33 ft) thick.

### 8.2 Nitrate

Nitrate concentrations are above 45 mg/L throughout much of 1100-EM and Richland North (Figure 8-4). Nitrate contamination has likely resulted from industrial and agricultural uses off the Hanford Site and migrated to the northeast into the 300 Area. Agricultural uses include fertilizer applications to the irrigated fields west of 1100-EM. The highest concentrations in 2016 were in wells 699-S28-E12, 699-S31-E10A, and 699-S31-E10C (Figure 8-5) and are declining. The wells are located downgradient of AREVA and the inactive DOE Horn Rapids Landfill.

### 8.3 Tritium

The Hanford Site tritium plume that originated in the 200 Areas extends southeast through the 600 Area and into the 300 Area at levels below the 20,000 pCi/L DWS. Because groundwater flow in the 1100-EM and 300-FF groundwater interest areas is generally west to east, the tritium plume found to the north of 300 Area does not migrate southward toward 1100-EM. In 2016, concentrations remained near or below detection limits in 1100-EM.
Table 8-1. 1100-EM at a Glance

Operations included industrial and automotive activities (1954 to 1985) and a landfill (1950s to 1970).

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>DWS</th>
<th>Maximum Concentration</th>
<th>Plume Area&lt;sup&gt;a&lt;/sup&gt; (km&lt;sup&gt;2&lt;/sup&gt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrate</td>
<td>45 mg/L&lt;sup&gt;b&lt;/sup&gt;</td>
<td>155 mg/L (699-S31-E10C)</td>
<td>Not calculated&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Uranium</td>
<td>30 µg/L</td>
<td>40.9 µg/L (699-S31-E10D)</td>
<td>Not calculated&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

**Remediation**

Waste sites (final action): 100 percent complete.<sup>d</sup>

Groundwater (final action): MNA has met remedial action goals.

Final record of decision: 1993

---

<sup>a</sup> Estimated area at a concentration greater than the DWS.

<sup>b</sup> 45 mg/L (expressed as the NO₃ ion) is an equivalent concentration to the federal DWS for nitrate of 10 mg/L (expressed as NO₃-N). To convert nitrate as the NO₃ ion, the NO₃-N DWS value is multiplied by 4.43.

<sup>c</sup> Nitrate and uranium in 1100-EM are from offsite sources.

<sup>d</sup> Sites with status of closed, interim closed, no action, not accepted, or rejected.

Figure 8-2. 1100-EM Water Table, March 2016
Figure 8-3. 1100-EM Geology
Figure 8-4. Nitrate Plume in 1100-EM, Richland North, and the 300 Area, 2016
Uranium concentrations are elevated in wells downgradient of the AREVA facility. An investigation of the site attributed the groundwater contamination to operation of a surface impoundment system in the 1970s and 1980s when some of the impoundments were single lined and without leak collection capabilities (WAD 99082 8402, Dangerous Waste Management Permit AREVA NP Inc.). The impoundment system was subsequently removed.

The maximum uranium concentration in an AREVA well in 2016 was 44.2 μg/L. Uranium concentrations in three Hanford Site wells downgradient from AREVA are increasing and exceeded the 30 μg/L DWS in recent years. The maximum concentration in 2016 was 40.9 pCi/L in well 699-S31-E10D (Figure 8-6).
8.5 CERCLA Remediation and Monitoring

In 1993, EPA, Ecology, and DOE signed a ROD for the 1100 Area, which included the 1100-EM-1 groundwater OU and the 1100-EM-2 and 1100-EM-3 source OUs (EPA/ROD/R10-93/063, Declaration of the Record of Decision for the USDOE Hanford 1100 Area). The ROD had a groundwater component that relied on MNA for TCE, with a cleanup level of 5 µg/L. In 2006, the second CERCLA 5-year review (DOE/RL-2006-20) concluded that remedies selected for the 1100-EM-1 OU had been completed. The RAOs established in the ROD have been achieved and are protective of human health and the environment so the 1100 Area was removed from the NPL, and DOE, EPA, and Ecology agreed to a reduction in groundwater monitoring, described in (TPA-CN-163, Change Notice for Modifying Approved Documents Work Plans In Accordance with the Tri-Party Agreement Action Plan, Section 9.0, Documentation and Records: PNNL-12220, “Sampling and Analysis Plan Update for Groundwater Monitoring – 1100-EM-1 Operable Unit,”). Monitoring included annual sampling of wells 699-S28-E12, 699-S31-E10A, and 699-S31-E10C for TCE, vinyl chloride, and 1,1-dichloroethene to ensure that remedial action goals were achieved. In 2015, a new change notice (TPA-CN-679, Change Notice for Modifying Approved Documents Work Plans In Accordance with the Tri-Party Agreement Action Plan, Section 9.0, Documentation and Records: PNNL-12220, “Sampling and Analysis Plan Update for Groundwater Monitoring – 1100-EM-1 Operable Unit”) eliminated the need for groundwater monitoring for the 1100-EM-1 OU.
8.6 Atomic Energy Act Monitoring

AEA groundwater monitoring was conducted at four groundwater wells in the 1100-EM groundwater interest area and six wells in the Richland North Area in accordance with the SAP issued in December 2015 (DOE/RL-2015-56). The primary AEA constituents for 1100-EM are nitrate and uranium and for Richland North are nitrate and tritium. Three wells were not sampled for 1100-EM in accordance with SAP requirements in 2016 (Table C-7 in Appendix C). Wells were sampled for Richland North in accordance with SAP requirements in 2016 (Table C-13 in Appendix C). Minor exceptions to planned monitoring occurred because of maintenance issues and scheduling constraints. Appendix C lists the sampling frequencies, types of laboratory analyses, and sample status for 2016 AEA monitoring of the 1100-EM and Richland North groundwater wells.

Concentrations of radionuclides in groundwater samples from five wells in 1100-EM and three wells in Richland North were used to estimate the cumulative TED and to compare the cumulative beta/photon emitters, alpha emitters, and uranium mass to DWSs, as described in Section 1.2.4. The only exceedances were for uranium mass above the 30 µg/L DWS at two locations in 1100-EM (Table 8-2). Neither of these locations is adjacent to the Columbia River, which is the primary potential pathway for offsite exposure to Hanford Site contaminated groundwater. Members of the public are protected from exposure to groundwater through the implementation of institutional controls that restrict access to groundwater and through remedial action measures to control the migration of contaminated groundwater to exposure points.

Table 8-2. Cumulative Total Effective Doses and Groundwater Concentrations that Exceeded Standards at Groundwater Monitoring Locations in 1100-EM in 2016

<table>
<thead>
<tr>
<th>Monitoring Location/Well Name</th>
<th>Cumulative Uranium Mass ≥30 µg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum</td>
</tr>
<tr>
<td>699-S31-E10C</td>
<td>37.4</td>
</tr>
<tr>
<td>699-S31-E10D</td>
<td>40.9</td>
</tr>
</tbody>
</table>

Source: ECF-HANFORD-17-0022, Calculation of Radiological Dose based on Calendar Year 2016 Atomic Energy Act Groundwater Monitoring at Hanford.

Note: No wells in 1100-EM had TED ≥100 mrem/yr, cumulative beta/photon emitters > 4 mrem/yr, or cumulative alpha activity ≥15 pCi/L.
This page intentionally left blank.