8 1100-EM

The 1100-EM interest area is a small region in the southeastern corner of the Hanford Site, south of the 300 Area (Figures 1-1 and 8-1). The adjacent offsite region, which includes part of the former 1100-EM-1 Groundwater OU, is informally known as Richland North. This chapter discusses groundwater monitoring results for 1100-EM and Richland North.

8.1 Overview

The former 1100-EM-1 OU included 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 (Section 1.3 of 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, it was delisted from the NPL and DOE transferred ownership of a portion of the property to the Port of Benton in 1998.

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, p. 3). 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. Table 3-7 in DOE/RL-2015-56 lists the monitoring wells and constituents.

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. Other sources of recharge to the unconfined aquifer are the Yakima River, 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 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, Richland North, and the southern part of 300-FF (Figure 8-4). Section 1.5 provides details about plume mapping, including descriptions of the terms used in the figure legends (e.g., Type 1 control point). Nitrate contamination has likely resulted from industrial and agricultural uses off the Hanford Site and migrated to the northeast. Agricultural uses include fertilizer applications to the irrigated fields west of 1100-EM. The highest nitrate concentrations in 2017 were in wells 699-S28-E12 (in the 300-FF groundwater interest area), 699-S31-E10A, and 699-S31-E10C (Figure 8-5), but the concentrations are declining. The wells are located downgradient of AREVA and the inactive DOE Horn Rapids Landfill.

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1 In early 2018, AREVA became Framatome.
Figure 8-1. 1100-EM Sampling Locations, 2017
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>Groundwater Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contaminant(^a)</td>
</tr>
<tr>
<td>DWS, Units</td>
</tr>
<tr>
<td>Nitrate, 45 mg/L(^b)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Uranium, 30 µg/L</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Remediation

- **Waste sites (final action):** 100% complete.\(^c\)
- **Groundwater (final action):** Monitored natural attenuation has met remedial action goals.
- **Record of Decision for final remedial action:** 1993

\(^a\) Nitrate and uranium in 1100-EM are from offsite sources. Plume areas are not calculated.

\(^b\) 45 mg/L (expressed as the NO\(_3\) ion) is an equivalent concentration to the federal DWS for nitrate of 10 mg/L (expressed as NO\(_3\)-N). To convert nitrate as the NO\(_3\) ion, the NO\(_3\)-N DWS value is multiplied by 4.43.

\(^c\) Sites with status of closed, interim closed, no action, not accepted, or rejected.

DWS = drinking water standard

### 8.3 Tritium

The Hanford Site tritium plume that originated in the 200 Areas extends southeast through the 600 Area and into the 300-FF groundwater interest area at levels below the 20,000 pCi/L DWS. The plume reached its maximum extent in this region in about 1999 (Figure 2.1-3 of PNNL-13116), then the plume began to shrink as concentrations in monitoring wells declined. The maximum tritium concentration in a well in the 300 Area in 2017 was 4,160 pCi/L (399-1-1).

Because groundwater flow in the 1100-EM groundwater interest area is generally west to east, the Hanford Site tritium plume does not migrate southward toward 1100-EM. Wells in 1100-EM are sampled for tritium every 3 to 6 years under the AEA SAP (Table A-25 of DOE/RL-2015-56). In recent years, concentrations remained near or below detection limits (less than 200 pCi/L).

Figure 8-2. 1100-EM Water Table, March 2017
Figure 8-3. 1100-EM Geology

Source: Figure 2-2 of DOE/RL-92-67, Final Remedial Investigation/Feasibility Study-Environmental Assessment Report for the 1100-EM-1 Operable Unit, Hanford.
Figure 8-4. Nitrate Plume in 1100-EM, Richland North, and the 300 Area in 2017
8.4 Uranium

A uranium plume with concentrations above the 30 µg/L DWS originated from the offsite AREVA facility and affects monitoring wells in the southern part of the Hanford Site (Figure 8-6). 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 2017 was 32.7 µg/L. Concentrations in three Hanford Site wells downgradient from AREVA exceeded the 30 µg/L DWS in 2017. The maximum concentration was 34.5 µg/L in well 699-S31-E10C (Figure 8-7).
Figure 8-6. AREVA Uranium Plume, Richland North and 1100-EM, 2017
8.5 CERCLA Remediation and Monitoring

In 1993, the Tri-Parties 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 the Tri-Parties agreed to a reduction in groundwater monitoring (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, 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 scheduled at six 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. Historically, nitrate has been monitored through AEA as an indicator of contaminant migration and continues to be monitored in the current AEA SAP (DOE/RL-2015-56). One well was not sampled for 1100-EM in accordance with SAP requirements in 2017 (Table C-1 in Appendix C). Minor exceptions to planned monitoring occurred due to scheduling constraints.

Radionuclide concentrations detected in groundwater samples from five wells in 1100-EM and six 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 three locations in 1100-EM (Table 8-2). As discussed in Section 8.4, this contamination originated offsite. None of these wells are 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 ICs that restrict access to groundwater.

<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-E10A</td>
<td>32.4</td>
</tr>
<tr>
<td>699-S31-E10C</td>
<td>34.5</td>
</tr>
<tr>
<td>699-S31-E10D</td>
<td>34.2</td>
</tr>
</tbody>
</table>


Note: None of the wells in 1100-EM had total effective dose ≥100 mrem/yr, cumulative beta/photon emitters >4 mrem/yr, or cumulative alpha activity ≥15 pCi/L.