**Water System**

**Basic System Description:** The water system consists of one water treatment facility for potable water; over 107 miles of water lines for more than 300 raw and potable water service connections; and two pump houses, one each at 181B and 181D, drawing water from the Columbia River and pumped to the respective 25-million-gallon reservoir in 182B or 182D area. (Note: The 182D reservoir is restricted to 5.25-million-gallon storage capacity due to deteriorated condition.)

The water is then pumped from the reservoirs to the 200 Area and other end users in the 100B/C and 100K areas by the 182B and 182D export water pumps. Water supply to the 100D, 100F and 100H areas was removed in FY2017. The 200 Areas have over 67 miles of in-ground distribution lines. Each 200 Area has a 3-million-gallon raw water reservoir and a 1.1-million-gallon potable water storage tank required for fire protection capacity.

The 200E Area and 200W Area raw and potable water fire protection systems were modified to supply all 200 Area fire protection water from the 1.1-million-gallon potable water storage tanks and converting the raw water reservoirs to strictly process water storage and supply. Upon further evaluations from HNF-60418 “Cross Connection Study for 200 East and 200 West Areas for Water System”, the fire protection systems, storage tanks, and distribution systems for potable and raw water will be modified in order to remove any ties between the raw and potable water grids, and to establish the appropriate means of fire suppression storage and distribution for each system independent of the other.

The 283-W water treatment facility produces potable water for distribution throughout both 200 Areas. The City of Richland supplies water to the 300 Area, 700 Area, HAMMER, and other DOE facilities adjacent to Horn Rapids Road (e.g., PTA, ORP test facilities). The 400 Area is supplied by a well located in the 400 Area. The 300 Area water system recently transitioned to MSA control for operations during FY2014, and is expected to transition to PNNL by the end of FY17. The 400 Area water system and 100K water system are operated and maintained by an OHC.

Attributes for water systems are provided in Table 3-14.

<table>
<thead>
<tr>
<th>Table 3-14. Water System Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operate, Safe &amp; Regulatory Compliant System</strong></td>
</tr>
<tr>
<td>• Meets or exceeds Washington Administrative Code Standards.</td>
</tr>
<tr>
<td>• Domestic and fire protection needs of the Central Plateau.</td>
</tr>
<tr>
<td>• Capable of fighting a 4-hour fire in any Central Plateau facility.</td>
</tr>
<tr>
<td>• Treatment of water for potable water requirements.</td>
</tr>
<tr>
<td><strong>Availability, Right-Size &amp; Reduce Active Site Footprint</strong></td>
</tr>
<tr>
<td>• Requirements for export, raw, potable, and fire protection systems.</td>
</tr>
<tr>
<td>• Capabilities of export, raw, potable, and fire protection systems.</td>
</tr>
<tr>
<td>• Storage capacities for export, raw, potable, fire protection systems.</td>
</tr>
<tr>
<td>• Planned water systems projects.</td>
</tr>
<tr>
<td>• System Availability - 100%.</td>
</tr>
<tr>
<td>• Component Availability - 99.5%.</td>
</tr>
<tr>
<td>• Cut and cap lines to reduced impact footprint.</td>
</tr>
<tr>
<td>• Conditions Assessments.</td>
</tr>
<tr>
<td><strong>Sustainability &amp; Minimize Impact to Environment</strong></td>
</tr>
<tr>
<td>• Reductions in resource consumption.</td>
</tr>
<tr>
<td>• Reductions in lifecycle costs.</td>
</tr>
<tr>
<td>• Improved efficiency.</td>
</tr>
<tr>
<td>• Reduced risks of impacts.</td>
</tr>
<tr>
<td>• Reduction of water leaks.</td>
</tr>
<tr>
<td>• Projects supporting reduced environmental impacts.</td>
</tr>
<tr>
<td><strong>Reliability</strong></td>
</tr>
<tr>
<td>• Criticality analysis.</td>
</tr>
<tr>
<td>• Redundancies to the Plateau.</td>
</tr>
<tr>
<td>• Risks and mitigations.</td>
</tr>
<tr>
<td>• Implement planned improvements.</td>
</tr>
<tr>
<td><strong>Maintainability</strong></td>
</tr>
</tbody>
</table>
| • Execute MSA Maintenance program 5 Year Plan Strategies and Section 6.0 of the Water System Master Plan.
Current Condition FY2017:

- **Condition:**
  - Export water system: Fair.
  - Raw water distribution system: Good.
  - Potable water distribution system: Fair.
  - Fire suppression infrastructure: Fair.
  - 300 Area potable water system: Good.

- **Capacity:**
  - Export water system: Excellent.
  - Raw water distribution system: Excellent.
  - Potable water distribution system: Good.
  - Fire suppression infrastructure: Excellent.
  - 300 Area potable water system: Excellent.

- **Reliability:**
  - Export water system: Fair.
  - Raw water distribution system: Good.
  - Potable water distribution system: Fair.
  - Fire suppression infrastructure: Fair.
  - 300 Area potable water system: Good.

- **Population Served:** 6,766. Includes 100, 200 (including WTP), 300, and 600 (not including ENW) areas.
- **Areas Served:** 100 Areas, Central Plateau, and 300 Area.

- **Gaps and Planned Projects:** Refer to Appendix D for gaps, Appendix B for planned projects and Appendix E for decisions needed. The significant projects include a new water treatment facility, potable water storage tanks, raw water fire suppression, cross-connection control configurations, and river pump station upgrade project in the 100 Areas (convert to variable speed motors, disconnect two reservoirs). The Maintenance Management Program, based on diagnostics and a priority analysis, remains active in FY2017 to continue to define the path forward for the aging water system.

Some of the Hanford Site in-ground pipelines used for water delivery have deteriorated to the point that replacing the pipe is required to protect the environment and continue performing the Hanford Site cleanup mission. Numerous water line breaks from FY2012 through FY2016 have required unbudgeted, unplanned emergency repairs. Replacing pipelines is a continual process that occurs as funding is available. Additionally, laterals that are no longer needed are being capped and isolated from the system as project work is completed.

The overall age and condition of major components in the existing water supply system serving the Central Plateau has generated major concern about the overall system’s reliability and its ability to meet mission support needs of the WTP complex including DF LAW during commissioning, plus 40 years of continuous plant operation. As reported in the FY2014 ISAP annual update, the remaining 5 year window of opportunity for RL to fund, design and complete major water system upgrades prior to DF LAW plant start-up is rapidly closing.

Since the FY2016 update of HNF-5828, Hanford Master Plan - Water System, there were $135 million in defined, validated water system reliability projects now awaiting RL funding priority, including projects funded in FY2017 listed on Figure 3-19. Constructing a new water treatment facility will change the scope or cancel up to 10 defined water system projects. In addition, several new water system projects were identified during the FY2016 update of the Hanford Master Plan - Water System, including two major projects to reconfigure the potable and raw water distribution systems to maintain compliance with cross connection control regulations (L-
894 and L-895). After the DF LAW plant components of the overall WTP complex become operational by FY2023, a major water system shut-down (more than 8 hours) to make water system upgrades can cause high probability event with very high consequential costs. In addition, MSA has defined two future year system configurations to guide near term decision making:

**Water System Configuration #1 - FY2021 to FY2060**

Using FY2021 for completing major water mission support projects, the DF LAW plant component of WTP complex can become operational by end of FY2023 as planned, based on the existing water system reconfiguration for the period FY2021 to FY2060 needs for 40 years of uninterrupted system service at a high level of water system reliability. Several projects are needed to enable continuation of using Columbia River water withdrawn from two locations (181B and 181D). Both existing structures require smaller efficient pumps plus new controls. Existing 42” export water pipelines will be replaced to right-size the delivery to the Central Plateau. Also, the existing water treatment facility at 283W needs to be replaced in order to serve 75 square miles in 200E and 200W Central Plateau area. An engineering feasibility study was conducted to identify water treatment technologies available and suitable to sustain potable water production at Hanford. A business case analysis was developed to select the most appropriate path forward to satisfy the potable water needs of the Hanford Site FY2060 and beyond. Upon completion of the business case analysis and alternatives analysis, a new water treatment facility installed with membrane filtration has been chosen as the best technology for long term potable water production. L-897 will design and construct a new water treatment facility, anticipated by FY19.

**Water System Configuration #2 - FY2060 to FY2090**

By FY2060, in order to meet long term stewardship and serve the remaining workforce through the end of the projected program life in FY2090, it is anticipated that only one of the two existing river water pump stations will satisfy the limited number of DOE program facilities within the 10 square miles of the Central Plateau area. The smaller water system reconfiguration should be completed by FY2060 following WTP decommissioning and demolition. The small water supply and distribution system will be active during the final 30 years of service life through the end of the DOE program projected in FY2090.

Water demand for current levels of public access (day use via bus tours) has been included for the current Manhattan Project proposal including existing 20 buildings in FY2017 with minimal water demand although no other long-term public access water demand has been included.

Recently, the large mechanical and automated equipment that makes up the water system, including pumps, valves, computers, and instrumentation, has been closely monitored. Some components are 70+ years old, requiring extensive maintenance in recent years. The components are being refurbished or replaced to increase system reliability on a priority and failure basis. In addition, increased emphasis has been placed on shrinking the Hanford Site water system’s footprint by upgrading only those portions that have a long-term mission plus running other components to the end of useful life. Because of the deteriorated condition of the 182D reservoir and marginal system performance, the 2011 Export Water System Options study recommends bypassing the 182D reservoir, pumping straight into the plateau reservoirs and reconfiguring the Central Plateau 3-million-gallon raw water reservoirs. The net impact of the proposed actions will be to improve overall system reliability, support decommissioning of the 182D facility, and allow future waste stream treatment needs to be met. Direct pump installation for the 100D Area is scheduled for FY2020.
Incorporating a cooling tower (closed-loop condenser) water system on the 242-A Evaporator facility was a high, near term priority after four years of tracking, planning and consideration. The 242-A Cooling Tower project L-846 was expected to result in a dramatic cost avoidance for water pipe sizing and pump sizing during water system reconfiguration needed to prepare for the period FY2021 through FY2060, as well as ongoing energy cost avoidance and water consumption reduction. The 242-A facility is one of the Hanford Site’s largest raw water consumers when in operation. After 4 years of no campaigns, the 242-A plant was reactivated and has a heavy schedule of active campaigns for the next 5 years as well as planned plant upgrades. The 242-A Cooling Tower proposal could have helped meet the Hanford Site’s sustainability goal of a 20% decrease in raw water consumption by FY2021 compared to base year, and reduce the peak water demand levels enabling smaller pumps at 181B and 1818D as well as smaller diameter replacement water pipes from the 100 Area to the 200 Area, however the proposed project was cancelled in FY2016. As a result, several infrastructure projects, including the 181B and 181D pumps and the 42” lines originating from the 100B and 100D areas, will have new engineering studies performed to satisfy the site water demands without the installation of the cooling tower. Sustainability goals for reduced water consumption are at risk as well, considering the increased water demands planned for DFLAW and WTP.

Potable water demand will increase from approximately 348,000 gal/day in FY2017 to nearly 900,000 gal/day in FY2021 and beyond. The projected increase is caused primarily by operation of the DFLAW facility at 950 gal/min. Peak anticipated potable water demand for the Central Plateau is expected to be nearly 2,400 gal/min by FY24, including the following:

- Balance of Facilities.
- Domestic water makeup.
- Cooling water makeup.
- Process operations.

Planning and design moved forward during FY2017 that continued from FY2016 brought forward three documents for a new potable water treatment plant, plus one report supporting the needs for cross-connection compliance, and a water tank contact time calculation:

- Feasibility report to define three treatment alternative processing options to replace the current chlorination process.
- Analysis of Hierarchy Process (AHP) report to down select from three options to one preferred option.
- Business case report including the 2 above reports as appendix supporting information recommendation for a membrane filtration system.
- Predesign report to define the total site potable (sanitary) water demand and a preferred alternative using the AHP approach for a single air gap and required modifications for fire protection, including segmenting the existing reservoir, pump modifications and sizing of a proposed 4-mile Raw Water line for intertie of the existing 200 E and 200 W Raw Water system.
- Memo to calculate and verify minimum required contact time can be met for a 1.1 million gallon water tank for at least 30 minutes of contact time including baffles.

The water treatment plant planning to date, plus engineering design work on projects L-894 and L-895 is leading to rescoping L-849 and L-850 for dual use of replacement water tanks in 200 E and 200 W for storage and treatment functions, similar to a comparable existing water tank project located in City of Pasco near Court Street.

In addition, a reevaluation of all affected water system projects was performed following the cancellation of L-846 Evaporative Cooling Tower proposal and the addition of project L-897 Water Treatment Plant.
End State FY2022:

Raw and export water system capacity will be excellent. The raw and export water system condition will be good. The export water demand forecasts are for 8,000 gal/min onsite, primarily pumped to and treated on the Central Plateau. The raw water capacity is 16,500 gal/min. The potable water system capacity will be at risk without a new water treatment facility by FY2021. The potable water demand forecasts peak flows exceeding 2,400 gpm, with daily averages up to 1,000 gpm. The existing Water Treatment Facility is limited to 1,500 gpm production capacity. The planned FY2018 water system master plan update will describe the water system that will exist in FY2022, with reliability and capacity for 40 years of service life plus implementation of Maintenance Management Program measures.

- **Condition:**
  - Export water system: Good.
  - Raw water distribution system: Good.
  - Potable water distribution system: Good.
  - Fire suppression infrastructure: Good.
  - 300 Area potable water system: Expected to be transitioned outside of MSC scope.

- **Capacity:**
  - Export water system: Excellent.
  - Raw water distribution system: Excellent.
  - Potable water distribution system: At risk (unless new water treatment facility is constructed).
  - Fire suppression infrastructure: Excellent.
  - 300 Area potable water system: Expected to be transitioned outside of MSC scope.

- **Reliability:**
  - Export water system: Good.
  - Raw water distribution system: Good.
  - Potable water distribution system: Good.
  - Fire suppression infrastructure: Good.
  - 300 Area potable water system: Expected to be transitioned outside of MSC scope.

- **Population Served:** 7,112. Includes 100, 200 (including WTP), 300, and 600 (not including ENW) areas.

- **Areas Served:** 100 Areas, Central Plateau. The 300 Area water system is expected to be transitioned to PNNL by FY18.

**Existing Gaps:**

- By 2023, DFLAW is expected to be fully operational. Potable water demands will exceed existing supply at 283W. In addition, 283W has been operational for over 70 years, requiring extensive maintenance and infrastructure upgrades to maintain operational capabilities. A new Water Treatment Facility will need to be constructed as part of L-897 in order to meet future potable water needs of the Hanford Site.

- The potable water loop surrounding the CSB and 2704-HV Facilities is fed from a single 10” feed, creating a single point of failure which would cease the supply of potable water in the event of a line break. Additionally, the WESF/B-Plant potable water supply is fed from a single 10” line, creating a single point of failure as well. A potable water line between 2704-HV and WESF should be installed to create a looped system and eliminate both single points of failure.
The raw water loop surrounding the CSB and 2704-HV Facilities is fed from a single 12” feed, creating a single point of failure which would cease the supply of raw water in the event of a line break. Additionally, the WESF/B-Plant raw water supply is fed from a single 12” line, creating a single point of failure as well. A raw water line between 2704-HV and WESF should be installed to create a looped system and eliminate both single points of failure.

The Metron Fire Pump Control Cabinets in 200 East and 200 West have become obsolete and are no longer supported by the vendor for spare parts or service. Failure to these control cabinets will put the fire suppression capabilities on the Central Plateau at risk. Both units should be replaced.

During recent line isolation activities, it was identified that several valves on the CSB potable water loop were not able to fully operate, not allowing for a proper isolation of the line during maintenance activities or repair. The valves on the potable water loop should be replaced.

During recent line isolation activities, it was identified that several valves on the CSB raw water loop were not able to fully operate, not allowing for a proper isolation of the line during maintenance activities or repair. The valves on the raw water loop should be replaced.

Cost Avoidance Proposals: As summarized in Appendix F, the cost avoidance, innovations, and quality improvements for the water system are described as follows:

- **Water Treatment Plant Treatment Method Change (L-897).** The one area of potential cost avoidance, in addition to reducing the diameter and the total length of pipe being maintained, and reducing energy costs for pumping water, is eliminating gas chlorination and the current chlorine gas alarm and safety requirements. An alternative disinfection method was identified. The business case study was prepared for a proposed new water treatment plant under project L-897 using an ultrafiltration membrane filtration type process, along with on-site generation of sodium hypochlorite, which would supplant chlorine gas.

- **Remote Area Water Strategy – Consolidate Demand.** Isolated water connections at the end of a long run of pipe are good candidates for facility demolition prioritization. The primary cost avoidance would result from reducing costs to maintain water pipes for small loads to entire areas that can be fully closed for water demand at distances far from the main system serving the core of the Central Plateau Area. This strategy is ongoing and applies Sitewide through FY2022 and beyond. Elimination of a dead end line in 300 Area is one example.

- **Remote Small Building Water Strategy - Eliminate Sources of Demand.** In conjunction with the findings of the forthcoming FY2017 update to the FY2012 Facility Master Plan (FMP) for general-purpose buildings, there is a strategy to continue to remove small buildings and disconnect and abandon water piping distribution systems where feasible. For example, during FY2014, there were 42 buildings (including DOE owned and contractor leased, some outside of site limits and/or not served by the RL water system, etc.) eliminated. This strategy is ongoing and applies Sitewide through FY2022 and beyond.

- **New Buildings Strategy – Reduce Reliance on Existing Water Utilities.** The document titled *Guiding Principles for Sustainable Federal Buildings Updates crosswalk: New Construction and Modernization (May, 2016)* currently provides applicable guidance for New Construction proposals for high performance buildings are required to consider alternative water sources for each new building rather than assume the existing water system will provide 100% of the new water demand. Examples of high-performance water-saving measures at federal facilities in arid locations designed to the new DOE guidance based on Executive Order 13693 include storm water capture, storage tanks, rainwater storage, gray-water processing, treatment by filtration, and reduced-flow water fixtures to avoid 100% reliance on piped-water systems. This strategy applies to any large new large facilities in 200 East Area plus 300 Area redevelopment.

Major Actions/Decisions Needed: Refer to Appendix E.

Roadmap: Refer to Figure 3-19.

Revised September 11, 2017
Figure 3-19. Water Roadmap

**Water Roadmap: Export, Raw, and Potable**

### 2017 CURRENT CONDITION

- Population served: 6,766
- Outlined Trough Study to increase 280M water filter plant capacity to 1,240 gpm/min
- Completed raw connection compliance study report
- Completed plateaus improvements to 200E and 200W raw water operations
- Sliding water tank and new water treatment plant

### Water System Service Conditions

- Good
- Poor
- Fire
- Unknown

- PVC/HDPE
- Reinforced PVC
- Steel
- Concrete
- Aluminum
- Unlined DVC

### Project Descriptions

| Project Description | 2017 | 2018 | 2019 | 2020 | 2022 | 2024
|---------------------|------|------|------|------|------|------
| L-094, River Drive Connection励志 to 330 Area | 888 | 888 | 888 | 888 | 888 | 888
| L-095, River Drive Connection励志 to 330 Area | 888 | 888 | 888 | 888 | 888 | 888
| L-096, River Drive Connection励志 to 330 Area | 888 | 888 | 888 | 888 | 888 | 888
| L-097, River Drive Connection励志 to 330 Area | 888 | 888 | 888 | 888 | 888 | 888
| L-098, River Drive Connection励志 to 330 Area | 888 | 888 | 888 | 888 | 888 | 888

### Project Descriptions (Continued)

| Project Description | 2017 | 2018 | 2019 | 2020 | 2022 | 2024
|---------------------|------|------|------|------|------|------
| L-100, River Drive Connection励志 to 330 Area | 888 | 888 | 888 | 888 | 888 | 888
| L-101, River Drive Connection励志 to 330 Area | 888 | 888 | 888 | 888 | 888 | 888
| L-102, River Drive Connection励志 to 330 Area | 888 | 888 | 888 | 888 | 888 | 888
| L-103, River Drive Connection励志 to 330 Area | 888 | 888 | 888 | 888 | 888 | 888
| L-104, River Drive Connection励志 to 330 Area | 888 | 888 | 888 | 888 | 888 | 888

### Major Actions/Decisions

- Tracer Study to increase 280M water plant output to 1950 gallon
- Water System Master Plan Update

### END STATES 2022

- Population served: 7,112
- Eliminate 150D reservoir
- Variable speed drives for export water pumps for energy savings
- Support WTP operations tank waste reduction
- Operate 280M on alternative disinfection process
- Potential 200 Area system transfer to Plant B (ETW) according to REV/PHSA agreement
- Raw water intakes between 200E and 200W is completed for fire protection
- Global air gap completed for cross connection compliance with Safe Drinking Water Act and State of Washington requirements
- Completed potable water air gap at 222-S

Project years are based on Reliability Project Investment Portfolio List version 3rd Qtr. 2017

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