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Integrated Waste Feed Delivery Plan

Volume 2 – Campaign Plan

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Abstract: The Integrated Waste Feed Delivery Plan (IWFDP) describes how waste feed will be delivered to the Waste Treatment and Immobilization Plant (WTP) to safely and efficiently accomplish the River Protection Project (RPP) mission. The IWFDP is integrated with the Baseline Case operating scenario documented in ORP-11242 (Rev. 6), *River Protection Project System Plan*. **Volume 1 – Process Strategy** (RPP-40149-VOL1) provides an overview of waste feed delivery (WFD) and describes how the WFD system will be used to prepare and deliver feed to the WTP based on the equipment configuration and functional capabilities of the WFD system. **Volume 2 – Campaign Plan** (RPP-40149-VOL2) describes the plans for the first eight campaigns for delivery to the WTP, evaluates projected feed for systematic issues, projects 242-A Evaporator campaigns, and evaluates double-shell tank (DST) space and availability of contingency feed. **Volume 3 – Project Plan** (RPP-40149-VOL3) identifies the scope and timing of the DST and infrastructure upgrade projects necessary to feed the WTP, and coordinates over 30 projectized projects and operational activities that comprise the needed WFD upgrades. Issues or project-specific risks, potential mitigating actions, and future refinements are also identified in each volume of the IWFDP.

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By Kelly L Wheeler at 7:54 am, Mar 26, 2012

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RPP-40149-VOL2, Rev. 2

Integrated Waste Feed Delivery Plan

Volume 2 – Campaign Plan

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Tank Operations Contractor RECORD OF REVISION		(1) Document Number: RPP-40149-VOL2, Rev. 2	
(2) Title Integrated Waste Feed Delivery Plan, Volume 2 – Campaign Plan			
Change Control Record			
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0	Initial release.	R. A. Sexton July 2009	R. D. Greenwell July 2009
1	Revisions were made to fully align with the System Plan (ORP-11242 Rev. 5). Incorporation of expanded baseline scope and schedule refinement. Updated risk register. Appendices C, K, L, M, and 0 have been cancelled for Revision 1 but are reserved for future revisions. The Sludge Staging Plan and Summary of Cost Estimates are brief and have been included in the main body of the document in Sections 5.4.3 and 8.3 respectively. To maintain continuity and to allow for future updates, Appendices F and H have been maintained in the lettered list of Appendices.	P. G. Haigh November 2010	D. C. Larsen November 2010
1A	Editorial changes, Figure 2-1 was reinserted, pagination correction for Appendix N, and page number alignment.	P. G. Haigh December 2010	D. C. Larsen December 2010
2 RS	Complete rewrite. Split RPP-40149 into three volumes, addressing waste feed delivery process strategy (Volume 1), campaign plan (Volume 2), and project plan (Volume 3). Content was aligned with the System Plan (ORP-11242, Rev. 6) Baseline Case operating scenario.	J. S. Ritari [signature] 3/19/12	T. W. Crawford for [signature] 3/19/12

EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE), Office of River Protection (ORP) manages the River Protection Project (RPP). The RPP mission is to retrieve and treat Hanford's tank waste and close the tank farms to protect the Columbia River. As a result, ORP is responsible for the retrieval, treatment, and disposal of approximately 55 Mgal[1] of radioactive waste contained in the Hanford Site waste tanks and closure of all the tanks and associated facilities. The *Hanford Federal Facility Agreement and Consent Order – Tri-Party Agreement* [2] requires DOE to complete the treatment of the Hanford tank waste by September 30, 2047.

Washington River Protection Solutions (WRPS), under the Tank Operations Contract (TOC),[3] is the prime contractor responsible for the construction, operation, and maintenance activities necessary to safely store, retrieve, prepare, and transfer waste to the Waste Treatment and Immobilization Plant (WTP). The TOC provides other supporting functions related to Hanford tank wastes, including supplemental treatment, supplemental pretreatment (if needed), and the management of interim Hanford storage and the Hanford Shipping Facility. Bechtel National, Inc. (BNI), the WTP Construction and Commissioning Contractor, is responsible for the design, construction, and commissioning of the WTP Pretreatment Facility, High-Level Waste (HLW) Vitrification Facility, Low-Activity Waste (LAW) Vitrification Facility, dedicated analytical and radiochemical laboratory, and support facilities to immobilize the radioactive tank wastes into glass for long-term storage or final disposal. WRPS and BNI are jointly responsible for managing the transition to WTP operations. The TOC will then provide for the treatment, storage, and/or disposal of glass product and secondary waste streams supporting WTP operations throughout the RPP mission duration, and the ultimate decommissioning of associated facilities once treatment is complete.

To achieve the RPP mission, wastes must be stored until they are retrieved from 149 aging single-shell tanks (SST) and consolidated into 28 double-shell tanks (DST). Waste feed from the DSTs must be delivered to the WTP in a manner that assures continuous WTP operations over the life-cycle of the treatment mission. The DSTs are used for various roles throughout the RPP mission, and the role each DST performs may change over time. A key challenge in supporting the RPP mission is to efficiently manage the use of the DSTs and the rest of the waste feed delivery (WFD) system. This includes:

- Safely storing the existing tank waste
- Receiving, storing, and transferring wastes from sources outside of the WFD system, such as the 222-S Laboratory and the SSTs

[1] This is the total volume of tank waste as of October 2010 from HNF-EP-0182, *Waste Tank Summary Report for Month Ending September 30, 2010* (Rev. 270). The total volume of tank waste fluctuates over time because water and chemicals may be added to the tanks as part of certain waste retrieval processes to facilitate waste retrieval; water is also removed by the waste evaporator.

[2] Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order – Tri-Party Agreement*, as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

[3] DE-AC27-08RV14800, *Tank Operations Contract*, U.S. Department of Energy, Office of River Protection, Richland, Washington.

- Staging feed for, and receiving concentrated waste from, the 242-A Evaporator
- Incidental and intentional blending or segregation, staging, and delivering solids and supernate tank waste to the WTP
- Accepting emergency returns from the WTP, if necessary.

The planned configuration of the WFD system has been established to effectively perform these functions within the DST system, and associated issues have been identified.

Purpose

The Integrated Waste Feed Delivery Plan (IWFDP) is prepared[4] and will be implemented to "provide optimum and reliable pretreatment (if needed), blending/mixing, retrieval and delivery of feed to DOE-ORP treatment facilities. This Plan shall include the needs of commissioning, near-term, and long-term operations; necessary studies, testing, and infrastructure installation; and projected waste transfer/pretreatment operations" (TOC Section C.2.3.1, "Sub-CLIN 3.1: Treatment Planning, Waste Feed Delivery, and WTP Transition").

The IWFDP defines the systems and infrastructure necessary for conducting WFD operations, identifies the specific upgrades and other workscope to be performed, and describes the approach to prepare and deliver tank waste feed to the WTP.

The IWFDP is divided into three volumes: Volume 1 – Process Strategy,[5] Volume 2 – Campaign Plan, and Volume 3 – Project Plan.[6] The purpose and scope of each volume, and the primary inputs to and outputs from the IWFDP as a whole, are shown in Figure ES-1.

The IWFDP draws from ORP direction, technical and programmatic assumptions, and requirements provided from various documents as they relate to WFD and the interface between the Hanford tank farms and WTP. The IWFDP, in turn, provides the process strategy for WFD, describes the initial campaign plans based on the process strategy and associated operating scenario, identifies the scope and timing of the DST upgrades projects necessary to achieve the RPP mission under the established process strategy, and identifies the project execution plans that are needed for each projectized operational activity. Issues, potential mitigating actions, and future refinements regarding WFD are also identified within each volume of the IWFDP.
Each revision of the IWFDP then evolves and matures through an ongoing iterative process of successive refinements whereby issues are evaluated and potential mitigating actions are established when risks exceed predefined thresholds or are otherwise warranted. Mitigating actions are then performed to the extent permitted by funding and schedule. Refinements to the architecture, tank usage, operating scenario, and delivered feed are identified, as issues are mitigated, resolved, and closed. Each revision of the IWFDP then incorporates the resulting feedback and refinements recommended through the aforementioned process.

[4] This revision of the IWFDP was initiated by the WRPS WTP Support organization; future revisions will be prepared by the newly implemented One System Integrated Project Team.

[5] RPP-40149VOL1, 2012, *Integrated Waste Feed Delivery Plan, Volume 1 – Process Strategy*, Rev. 2, Washington River Protection Solutions, LLC, Richland, Washington.

[6] RPP-40149VOL3, 2012, *Integrated Waste Feed Delivery Plan, Volume 3 – Project Plan*, Rev. 2, Washington River Protection Solutions, LLC, Richland, Washington.

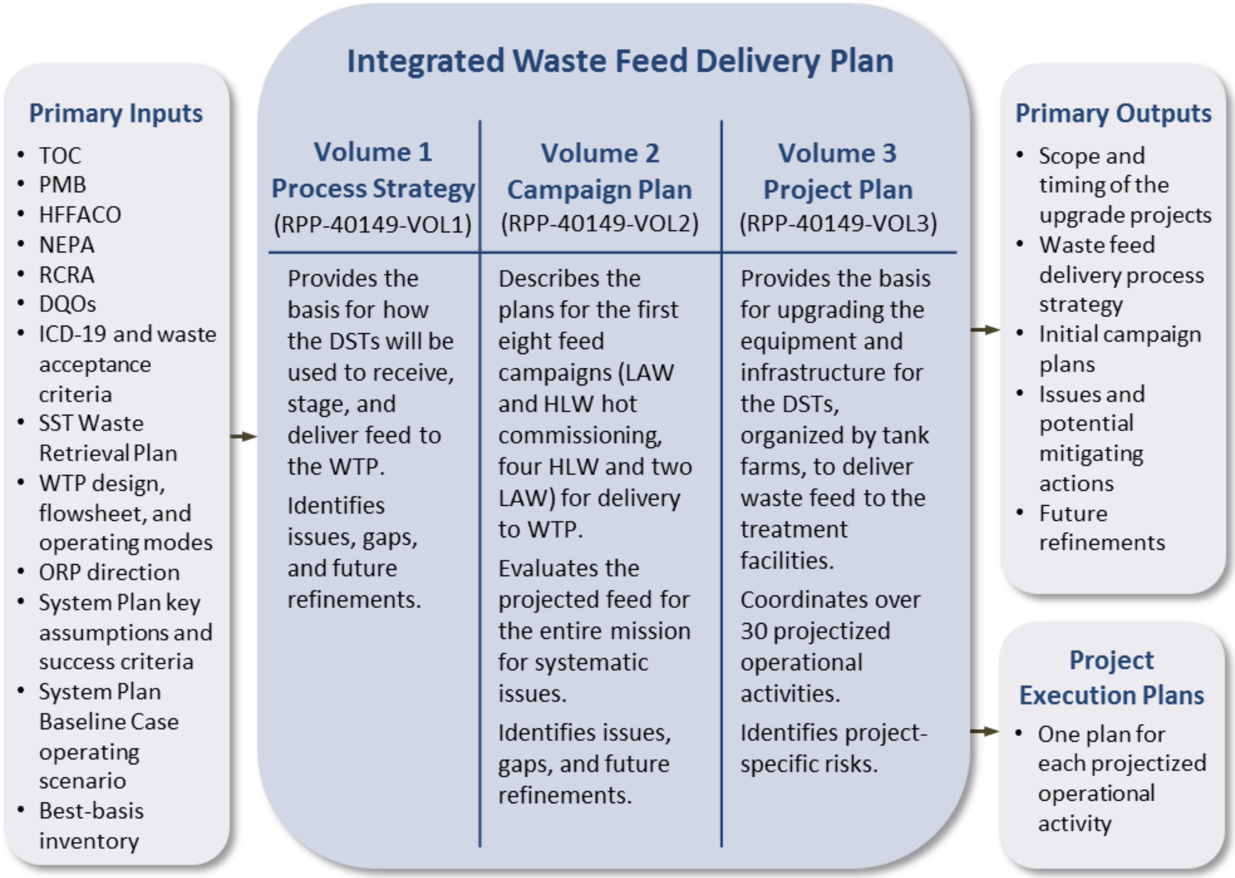

Figure ES-1. Scope and Purpose of the Integrated Waste Feed Delivery Plan

Results

The IWFDP campaign plan describes the plans for the first eight feed campaigns for delivery to the WTP. A campaign consists of a batch(es) of certified LAW or HLW feed delivered to the WTP from a single source tank. This revision of the IWFDP is integrated with the assumptions, requirements, and baseline operating scenario in ORP-11242, *River Protection Project System Plan* (Rev. 6).[7] The campaign plan also evaluates the projected feed for the entire mission, and identifies issues, gaps, and future refinements.

Table ES-1 summarizes the plans for the first eight campaigns for delivery to the WTP. The first batch planned for delivery to WTP is an LAW batch in May 2018. Several HLW batches follow shortly after to complete hot commissioning of the WTP. The remaining six campaigns analyzed in this report are a mix of HLW and LAW campaigns delivering waste to the WTP through early 2023.

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[7] ORP-11242, 2011, *River Protection Project System Plan*, Rev. 6, U.S. Department of Energy, Office of River Protection, Richland, Washington.

Table ES-1. Campaign Plan for First Eight Campaigns

Campaign	Timeframe	No. of batches	Volume/batch
Hot commissioning feed (Tank AY-102)			
Campaign LAW-1	May 2018	1 batch	~120 kgal
Campaign HLW-1	May 2018 – February 2020	5 batches	120 kgal
LAW supernate WFD			
Campaign LAW-2 (Tank AP-104)	February 2020	1 batch	~1 Mgal
Campaign LAW-3 (Tank AP-104)	November 2022	1 batch	~1 Mgal
HLW solids WFD			
Campaign HLW-2 (Tank AW-105)	April 2020 – May 2021	7 batches	120 kgal
Campaign HLW-3 (Tank AZ-102)	June 2021 – December 2021	6 batches	120 kgal
Campaign HLW-4 (Tank AY-102)	December 2021 – June 2022	6 batches	120 kgal
Campaign HLW-5 (Tank AW-105)	August 2022 – January 2023	7 batches	120 kgal

HLW = high-level waste.
LAW = low-activity waste.
WFD = waste feed delivery.

A feed screening was performed on each projected feed batch delivered to the WTP throughout the entire mission. Two batches failed to meet the subset of waste acceptance criteria items screened against in this report. One batch exceeded the LAW bulk density limit as currently modeled, but will be rectified by control strategy refinements. The other batch failed to meet the LAW hydrogen generation rate limit because of ineffective blending strategy.

An analysis was completed to determine the amount of contingency feed available throughout the mission. Early in the mission, until around 2025, sufficient contingency feed is available. Later, very little contingency feed is available since the current strategy does not include consideration of contingency feed.

An evaluation of near-term DST space usage was also completed. Continued SST retrievals minimize DST space. Although 242-A Evaporator campaigns slightly reduce waste volume, available space remains extremely limited prior to and during the startup of WTP. As the DST system nears capacity, it is increasingly difficult to conduct SST retrieval, evaporator, and feed staging operations.

Issues and Uncertainties

Some of the results analyzed in the IWFDP campaign plan present issues and uncertainties that need to be successfully addressed to increase confidence in achieving the desired performance for the RPP mission. The challenges and potential mitigating actions identified in this volume of the IWFDP, and a mapping to the risk items defined in TFC-PLN-39, *Risk and Opportunity Management Plan*, that are associated with each identified issue, are presented in Section 8.0. Selected WFD assumptions and the associated issues and uncertainties are summarized in Table ES-2.

Table ES-2. Selected Waste Feed Delivery Assumptions and Related Uncertainties

Assumption, assertion, or requirement	Issues and uncertainties
Very little schedule contingency exists between feed deliveries and feed preparation activities from one campaign to another.	Modify schedule if possible to provide additional time for contingencies, or provide contingency feed.
The space available in the existing 28 DSTs will be sufficient to execute the RPP mission throughout the mission.	DST space is extremely limited, especially early in the mission before and during WTP startup.
Waste feed delivered to the WTP must meet all established waste acceptance criteria.	Some feed batches do not meet current waste acceptance criteria requirements. Also, evolving WFD acceptance requirements may impose new requirements on WFD.

DST = double-shell tank.
RPP = River Protection Project.
WFD = waste feed delivery.
WTP = Waste Treatment and Immobilization Plant.

Future Refinements

Future revisions of the IWFDP will include updates to WFD planning assumptions, incorporate resolutions to existing issues and uncertainties, and identify emerging issues that arise during ongoing WFD planning activities. A list of specific refinements identified for inclusion in future IWFDP revisions is discussed in Section 9.0. Some of these selected items, which may be paraphrased, include:

- Aligning the timing and quantities of HLW and LAW waste feed delivered during hot commissioning with WTP planning assumptions to meet Consent Decree[8] Milestone A-1, "Achieve initial plant operations for the Waste Treatment Plan" by December 31, 2022[9]
- Updating the operating scenario to avoid delivering HLW feed from the AW Farm to WTP to avoid pressure drop concerns
- Expanding feed screening capabilities to include those waste acceptance criteria, not already screened, that can be projected from Hanford Tank Waste Operations Simulator (HTWOS) model results, such as total organic carbon concentration and unit liter dose
- Updating the operating scenario and process strategy to incorporate an improved control scheme for bulk density
- Developing effective blending strategies for improved control of LAW batch compositions to meet the hydrogen generation rate limit.

[8] Consent Decree, 2010, *State of Washington v. DOE*, Case No. 08-5085-FVS (October 25), Eastern District of Washington.

[9] "Initial plant operations" is defined by the Consent Decree (2010) as "over a rolling period of at least 3 months leading to the milestone date, operating the WTP to produce high-level waste glass at an average rate of at least 4.2 metric tons of glass (MTG)/day, and low-activity waste glass at an average rate of at least 21 MTG/day."

Path Forward

The IWFDP campaign plan will evolve as WFD issues and uncertainties are addressed by the One System Integrated Project Team (IPT), and in response to changes in the overall RPP mission. A list of studies, projects, and actions necessary to improve the WFD strategy is provided in Section 9.0. Some of these selected items include:

- Establishing final waste acceptance criteria for the WTP
  - Use the data quality objective (DQO) process to complete the waste acceptance criteria DQO[10] and the processes established in 24590-WTP-PL-MG-01-001, *Interface Management Plan,* [11] to update 24590-WTP-ICD-MG-01-019, *ICD 19 – Interface Control Document for Waste Feed* (ICD-19)[12]
  - Clarify the relationship between the DQO, ICD-19, and the WTP Contract[13] with respect to the role of Specification 7 and Specification 8.
- Providing WTP feedback, facilitated by the One System IPT, in the form of an assessment of the proposed campaigns so that appropriate adjustments can be made to the process strategy, campaign plan, and project plan
- Completing tank waste mixing and sampling studies to demonstrate adequate DST mixing, sampling, and transfer performance
- Evaluating the early campaigns for projected compliance with the waste acceptance criteria that are not already screened using HTWOS model results
- Performing an evaluation of the 222-S Laboratory demand and capacity to support WFD activities and other tank farms operations.

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[10] 24590-WTP-RPT-MGT-11-014, 2011, *Initial Data Quality Objectives for WTP Feed Acceptance Criteria*, Rev. 0, Bechtel National, Inc., Richland, Washington.

[11] 24590-WTP-PL-MG-01-001, 2011, *Interface Management Plan*, Rev. 5, Bechtel National, Inc., Richland, Washington.

[12] 24590-WTP-ICD-MG-01-019, 2008, *ICD 19 – Interface Control Document for Waste Feed*, Rev. 4, Bechtel National, Inc., Richland, Washington.

[13] DE-AC27-01RV14136, 2010, *Design, Construction, and Commissioning of the Hanford Tank Waste Treatment and Immobilization Plant*, (as amended through A164), U.S. Department of Energy, Office of River Protection, Richland, Washington.

CONTENTS

APPENDICES

FIGURES

TABLES

TERMS

Abbreviations and Acronyms

BBI	best-basis inventory
BCR	baseline change request
BNI	Bechtel National, Inc.
CC	complexed concentrate
CSL	criticality safety limit
DOE	U.S. Department of Energy
DQO	data quality objective
DSA	documented safety analysis
DST	double-shell tank
FRP	feed receipt process
FY	fiscal year
HC	hot commissioning
HGR	hydrogen generation rate
HLP	high-level waste lag storage and feed blending process
HLW	high-level waste
HTWOS	Hanford Tank Waste Operations Simulator
ICD	interface control document
IPT	integrated project team
IWFDP	Integrated Waste Feed Delivery Plan
LAW	low-activity waste
NEPA	National Environmental Policy Act
NVO	non-volatile waste oxides
ORP	U.S. Department of Energy, Office of River Protection
PCP	process control plan
PMA	potential mitigating action
PMB	performance measurement baseline
PT	pretreatment
RCRA	Resource Conservation and Recovery Act
RPP	River Protection Project
SST	single-shell tank
TOC	Tank Operations Contract
TRU	transuranic
WCA	waste compatibility assessment
WFD	waste feed delivery
WFE	wiped-film evaporator
WRF	waste retrieval facility
WRPS	Washington River Protection Solutions, LLC
WTP	Waste Treatment and Immobilization Plant
WVR	waste volume reduction

Units

°F	degrees Fahrenheit
Ci	curie
g	gram
gal	gallon
in.	inch
kg	kilogram
kgal	thousand gallons
L	liters
Mgal	million gallons
M	molar
mol	mole
MTG	metric ton of glass
SpG	specific gravity
vol%	volume percent
wt%	weight percent

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1.0 INTRODUCTION

The U.S. Department of Energy (DOE), Office of River Protection (ORP) manages the River Protection Project (RPP) at the Hanford Site. The RPP mission is to retrieve and treat Hanford's tank waste and close the tank farms to protect the Columbia River. As a result, ORP is responsible for the retrieval,[14] treatment, and disposal of approximately 55 Mgal[15] of radioactive waste contained in the Hanford waste tanks and closure of all the tanks and associated facilities. The tank farms must be able to reliably prepare and transfer waste feed to the Waste Treatment and Immobilization Plant (WTP) and other potential new treatment facilities to execute the RPP mission.

1.1 PURPOSE, SCOPE, AND OBJECTIVES

The purpose of the Integrated Waste Feed Delivery Plan (IWFDP) is to plan for those activities needed to "provide optimum and reliable pretreatment (if needed), blending/mixing, retrieval and delivery of feed to DOE-ORP treatment facilities. This Plan shall include the needs of commissioning, near-term, and long-term operations; necessary studies, testing, and infrastructure installation; and projected waste transfer/pretreatment operations. The Contractor shall ensure that the *Integrated Waste Feed Delivery Plan* is integrated with the *RPP System Plan*" (DE-AC27-08RV14800, *Tank Operations Contract* [TOC], Section C.2.3.1, "Sub-CLIN 3.1: Treatment Planning, Waste Feed Delivery, and WTP Transition").

The IWFDP is divided into three volumes: Volume 1 – Process Strategy (RPP-40149-VOL1), Volume 2 – Campaign Plan, and Volume 3 – Project Plan (RPP-40149-VOL3). The purpose and scope of each volume, and the primary inputs to and outputs from the IWFDP as a whole, are shown in Figure 1-1.

The IWFDP draws from ORP direction, technical and programmatic assumptions, and requirements provided from various documents as they relate to waste feed delivery (WFD) and the interface between the Hanford tank farms and WTP. The IWFDP, in turn, provides the process strategy for WFD, describes the initial campaign plan based on the process strategy and associated operating scenario, identifies the scope and timing of the double-shell tank (DST) upgrades projects necessary to achieve the RPP mission under the established process strategy, and identifies the project execution plans that are needed for each projectized operational activity. Issues, potential mitigating actions, and future refinements regarding WFD are also identified within each volume of the IWFDP. The IWFDP is integrated with ORP-11242, *River Protection Project System Plan* (referred to hereafter as System Plan), since the System Plan Baseline Case uses the assumptions from Volume 3 (Project Plan) and Volume 1 (Process Strategy) of the IWFDP. Volume 2 (Campaign Plan) then documents and evaluates the resulting operating scenario from the System Plan.

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[14] Selected words in the Glossary (Appendix A) appear in this document as blue underlined text, and are hyperlinked to the corresponding definitions in the glossary.

[15] This is the total volume of tank waste as of October 2010 from HNF-EP-0182, *Waste Tank Summary Report for Month Ending September 30, 2010* (Rev. 270). The total volume of tank waste fluctuates over time because water and chemicals may be added to the tanks as part of certain waste retrieval processes to facilitate waste retrieval; water is also removed by the waste evaporator.

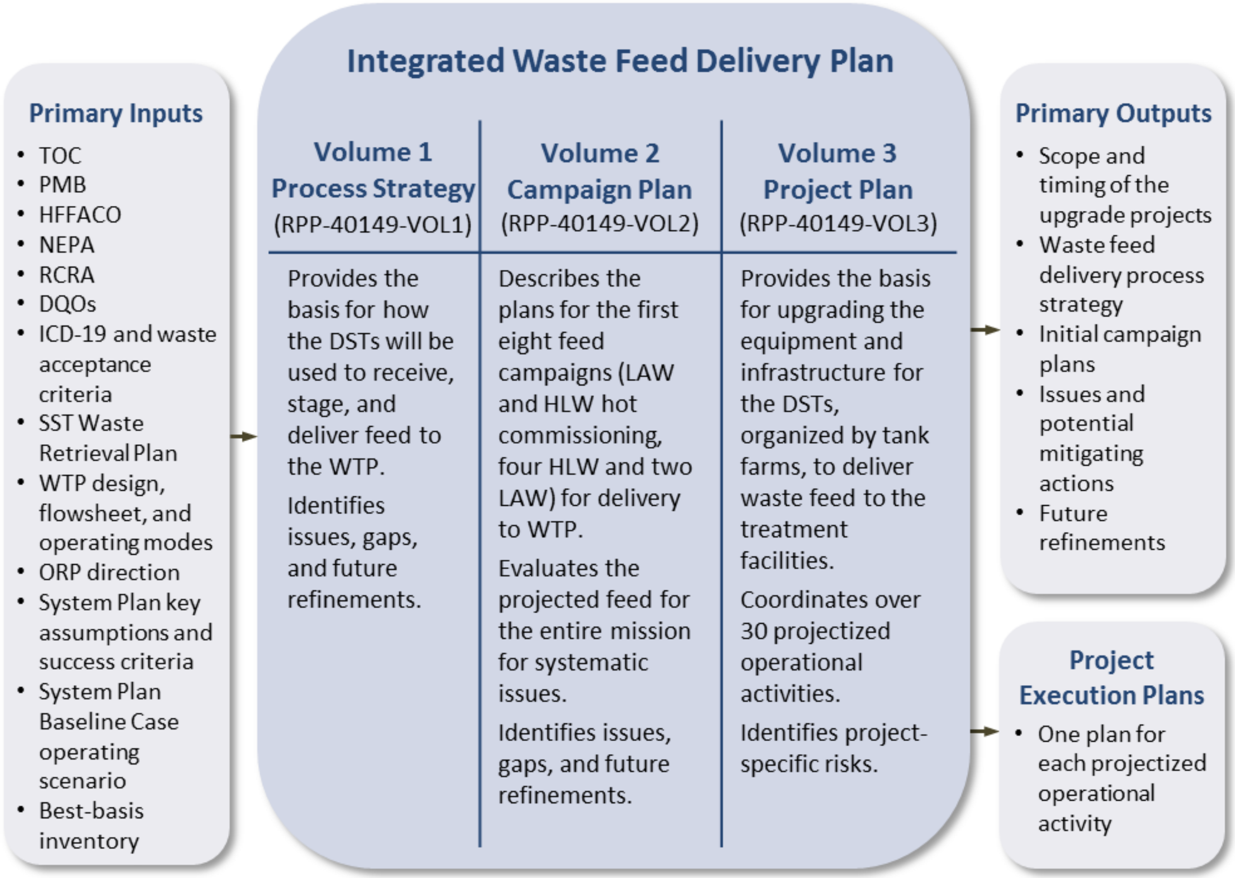

Figure 1-1. Scope and Purpose of the Integrated Waste Feed Delivery Plan

This revision of the IWFDP Volume 2 is based on the operating scenario defined by the System Plan (Rev. 6) Baseline Case, which is consistent with IWFDP Volumes 1 and 3. The objectives of this volume are to describe the plans for the first eight campaigns for delivery to the WTP, evaluate the projected feed for the entire mission for systemic issues, and identify issues, gaps, and future refinements.

1.2 CAMPAIGN PLAN OUTLINE

This volume of the IWFDP is organized as follows.

- Section 1.0 provides a brief site background, and summarizes the scope and objectives of this volume of the IWFDP.
- Section 2.0 presents summary information highlighting the first eight feed campaigns and other mission information.
- Section 3.0 describes the campaign plans for the first eight feed campaigns.
- Section 4.0 presents the WFD feed screening criteria, including WTP Specification 7 and Specification 8, hydrogen generation rate, criticality, waste acceptance criteria action limits, and required samples.
- Section 5.0 evaluates WFD contingency feed availability throughout the RPP mission.

- Section 6.0 evaluates required WFD evaporator campaigns required to support the first eight feed campaigns.
- Section 7.0 presents DST space evaluation to meet the required WFD feed requirements.
- Section 8.0 provides a table of WFD issues and uncertainties identified in this volume of the IWFDP, along with associated assumptions and potential mitigating actions.
- Section 9.0 presents path forward recommendations, including necessary technologies, future projects, key decisions, additional studies, and optimization opportunities. This section also outlines future refinements identified to be incorporated in future revisions of the IWFDP and associated System Plan.
- Section 10.0 lists the references used in the main body of this volume of the IWFDP.

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2.0 SUMMARY

This section provides summary tables and graphics outlining the near- and long-term campaign plans. Each of the low-activity waste (LAW) and high-level waste (HLW) feed campaigns is based on the results of the System Plan (Rev. 6) Baseline Case operating scenario.

Table 2-1 provides a summary of the total number of LAW and HLW campaigns over the entire RPP mission. A LAW campaign consists of one LAW feed batch of approximately 1 Mgal of certified feed delivered to the WTP from a single source tank. A HLW feed campaign consists of six or seven feed delivery batches of approximately 120 kgal each of certified feed delivered to the WTP from a single source tank. In total, approximately twice as much waste is sent in HLW deliveries than in LAW deliveries. The total amount of waste delivered to the WTP is approximately 110 Mgal, which is significantly more than the current waste volume in the tank farms. The additional waste volume mainly originates from water additions required for single-shell tank (SST) retrievals and other tank farms operations.

Table 2-1. Feed Deliveries to the Waste Treatment and Immobilization Plant

Mission totals	LAW feed to FRP	HLW feed to HLP
Number of campaigns	43	92
Number of batches	43	600
Nominal batch volume (gal)	1,000,000	120,000
Total volume (gal)	38,675,000	71,063,000

FRP = feed receipt process.
HLP = high-level waste lag storage and feed blending process.
HLW = high-level waste.
LAW = low-activity waste.

The first eight campaigns, separated into LAW and HLW, are summarized in Table 2-2 and Table 2-3, respectively. Summary information is displayed, including delivery dates, volumes, and the necessary preparation steps. A list of all projected transfers directly associated with the first eight campaigns can be found in Appendix B.

The current status of the first eight campaign plans is provided in Table 2-4. Most of the planning work is listed to be completed in the future. It is premature to develop planning documents to support these campaigns at this time while the system requirements and assumptions are changing. Planning documents and more detailed assessments will be completed as WFD activities approach.

Table 2-2. Summary of Projected Initial Low-Activity Waste Deliveries

Campaign[a]	Feed tank[b]	LAW deliveries		Preparation steps[c]				
		Start date	Volume (kgal)	Transfers From	Transfers To	Start date	Volume (kgal)	Type
LAW-1 (HC)	AY-102	5/11/2018	123	Water	AY-102	9/9/2017	80	Water
				Mix-Sample-Analyze (ready for delivery 4/7/2018[d])				
LAW-2	AP-104	2/3/2020	996	AP-103	AP-104	11/3/2014	1,152	Supernate
				Mix-Sample-Analyze (ready for delivery 7/30/2019[e])				
LAW-3	AP-104	11/22/2022	996	AP-103	AP-104	2/14/2020	729	Supernate
				AP-101	AP-104	4/30/2020	301	Supernate
				Mix-Sample-Analyze (ready for delivery 11/27/2020[e])				

[a] This is the order of delivery of the staged LAW waste.
[b] This is the tank in which the LAW feed is staged.
[c] These are the steps to prepare a specific batch of LAW feed.
[d] The ready-for-delivery date is based on 210 days after a water addition to Tank AY-102.
[e] The ready-for-delivery date is based on 210 days after the last waste addition to Tank AP-104.

HC = hot commissioning.
LAW = low-activity waste.

During the majority of the mission, there are two dedicated LAW feed tanks, AP-102 and AP-104. Two consecutive deliveries originate from Tank AP-104, because early in the mission Tank AP-102 is performing LAW feed staging functions. LAW feed demand is low during this time period, so one LAW feed tank suffices.

Table 2-3. Summary of Projected Initial High-Level Waste Deliveries

Cam-paign[a]	Feed tank[b]	HLW deliveries		Preparation steps[c]				
		Start date	Volume (kgal)	Transfers From	Transfers To	Start date	Volume (kgal)	Type
HLW-1 (HC)	AY-102	5/31/2018	120	Mix-Sample-Analyze (ready for delivery 4/7/2018[d])				
		6/5/2018	120	AY-102	WTP[e]	5/11/2018	123	LAW Feed
		6/10/2018	120					
		7/31/2018	120					
		2/2/2020	120					
HLW-2	AW-105	4/4/2020	120	AW-103	AW-105	1/25/2019	733	Supernate
		6/9/2020	120	AW-105	AW-103	2/2/2019	783	Slurry
		9/5/2020	120	AZ-101	AW-105	2/11/2019	506	Slurry
		11/29/2020	120	AP-103	AW-105	2/18/2019	276	Supernate
		2/3/2021	120	Mix-Sample-Analyze (ready for delivery 9/18/2019[d])				
		4/1/2021	120					
		5/15/2021	120					
HLW-3	AZ-102	6/30/2021	120	Complete retrieval of AX Farm tanks (10/14/2018)				
		8/11/2021	120	AP-107	AZ-102	10/19/2018	89	Supernate
		9/14/2021	120	Mix-Sample-Analyze (ready for delivery 2/27/2021[d])				
		10/13/2021	120					
		11/9/2021	120					
		12/4/2021	120					
HLW-4	AY-102	12/30/2021	120	AZ-101	AY-102	2/14/2020	379	Slurry
		1/26/2022	120	AP-105	AY-102	2/21/2020	348	Supernate
		3/2/2022	120	Mix-Sample-Analyze (ready for delivery 9/19/2020[d])				
		4/8/2022	120					
		5/20/2022	120					
		6/29/2022	120					
HLW-5	AW-105	8/16/2022	120	AN-106	AW-105	5/23/2021	544	Slurry
		9/22/2022	120	AP-105	AW-105	5/31/2021	295	Supernate
		10/11/2022	120	Mix-Sample-Analyze (ready for delivery 12/29/2021[d])				
		11/7/2022	120					
		11/29/2022	120					
		12/19/2022	120					
		1/13/2023	120					

[a] This is the order of delivery of the staged HLW waste.
[b] This is the tank from which the HLW feed is delivered to the WTP.
[c] These are the steps to prepare a specific batch group of HLW feed.
[d] The ready-for-delivery date is based on 210 days after a water addition to a staging tank.
[e] A key step in preparing HLW hot commissioning feed is delivery of the LAW hot commissioning feed to the WTP.

HC = hot commissioning.
HLW = high-level waste.
LAW = low-activity waste.
WTP = Waste Treatment and Immobilization Plant.

Table 2-4. Status of Campaign Plans and Special Flowsheets

Campaign or special flowsheet	System planning				Operational planning					Comments
	Operating scenario	WTP assessment of proposed campaign[a]	Flowsheet	Upgrades ready[b]	DSA coverage	Waste compatibility assessment	Sample plan	Process control plan	Operating procedures ready	
LAW-1/HLW-1 (HC)	System Plan (Rev. 6)[c] Baseline Case	Future	Preliminary[d]	9/2017	Future	Future	Future	Future	Future	
LAW-2	System Plan (Rev. 6)[c] Baseline Case	Future	Future	1/2019	Future	Future	Future	Future	Future	
HLW-2	System Plan (Rev. 6)[c] Baseline Case	Future	Preliminary[e]	1/2019	Future	Future	Future	Future	Future	
HLW-3	System Plan (Rev. 6)[c] Baseline Case	Future	Future	8/2020	Future	Future	Future	Future	Future	
HLW-4	System Plan (Rev. 6)[c] Baseline Case	Future	Future	9/2017	Future	Future	Future	Future	Future	
HLW-5	System Plan (Rev. 6)[c] Baseline Case	Future	Future	1/2019	Future	Future	Future	Future	Future	
LAW-3	System Plan (Rev. 6)[c] Baseline Case	Future	Future	1/2019	Future	Future	Future	Future	Future	
Tank C-104 blending of fissile ^{233}U	N/A	N/A	Not available[f]	N/A	N/A	N/A	N/A	N/A	N/A	
Waste Group A mitigation	N/A	N/A	Not available[g]	N/A	N/A	N/A	N/A	N/A	N/A	
CC strontium/ TRU element precipitation	N/A	N/A	Partial[h]	N/A	N/A	N/A	N/A	N/A	N/A	

[a] The WTP assessment can focus on either long-term campaign plans or an eminent campaign.
[b] Proposed dates that all necessary upgrade activities will be complete.
[c] ORP-11242, 2011, *River Protection Project System Plan*, Rev. 6, U.S. Department of Energy, Office of River Protection, Richland, Washington.
[d] RPP-RPT-46020, 2010, *Tank 241-AY-102 Waste Feed Delivery Flowsheet*, Rev. 0A, Washington River Protection Solutions, LLC, Richland, Washington.
[e] RPP-RPT-50361, 2011, *Tank 241-AW-105 Waste Feed Delivery Preliminary Flowsheet*, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.
[f] RPP-RPT-43828, 2011, *Enhanced Use of AN Farm for C Farm Single-Shell Tank Retrieval*, Rev. 0A, outlines the current strategy for blending the fissile ^{233}U waste in Tank C-104. A full flowsheet has not been developed.
[g] HNF-4347, 2000, *Alternatives Generation and Analysis for Low Activity Waste Retrieval Strategy – DRAFT*, outlines the current strategy for mitigation of Waste Group A tanks. A full flowsheet has not been developed.
[h] RPP-24809, 2005, *Strontium and TRU Separation Process in the DST System*, Rev. 0, is a partial flowsheet that outlines the current strategy for precipitation of CC strontium/TRU elements in Tanks AN-102 and AN-197. A full flowsheet has not been developed.

CC = complexed concentrate.
DSA = documented safety analysis.
HC = hot commissioning.
HLW = high-level waste.
LAW = low-activity waste.
N/A = not applicable.
TRU = transuranic.
WTP = Waste Treatment and Immobilization Plant.

Figure 2-1 illustrates the near-term WFD sequence, including relative timing of deliveries, the feed tank for each campaign, and the predominant feed sources, which traces the waste in each campaign to the original source tanks. The predominant feed sources are those tanks in which the waste for the campaign originates, as included in the best-basis inventory (BBI). Delivery of the feed batches generally accelerates over time, after delivery of the hot commissioning feed in Campaign LAW-1/HLW-1 (HC[16]). The first three batches of Campaign LAW-1/HLW-1 (HC) are in very quick succession, and the fourth batch is not delivered until approximately one year after startup. Beyond Campaign LAW-1/HLW-1 (HC), the batch deliveries become more frequent as the WTP capacity ramps up.

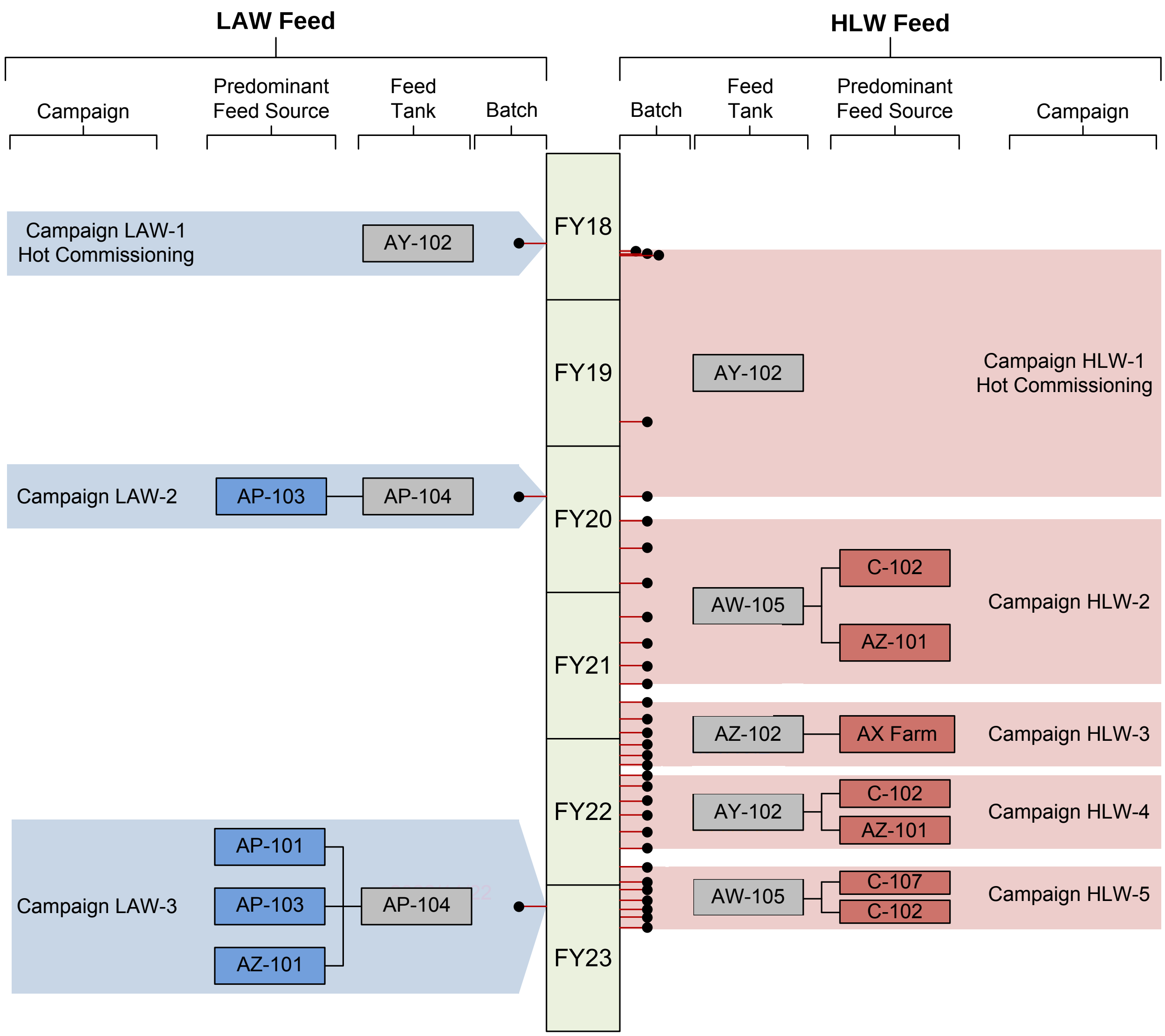

Figure 2-1. Near-Term Waste Feed Delivery Sequence

[16] When used as part of the campaign designation, (HC) stands for hot commissioning.

Figure 2-2 illustrates the proposed usage of all 28 DSTs over the life of the RPP mission. Each DST has a colored row associated with it that indicates each tank's function for the duration of the mission. Functions in purple indicate tank upgrades; yellow represents special waste types; blue indicates liquid-only processes; red/pink indicates solids handling, HLW feed, and staging operations; and green represents cross-site transfer operations.

Figure 2-3 and Figure 2-4 illustrate how the DST system is interconnected (e.g., primary transfer routes), its projected general capabilities (e.g., deep sludge, slurry, mixer pump installations, etc.) and the planned mixer pump installations. Figure 2-3 has the same color coordination as Figure 2-2 and indicates the planned function(s) of each DST during the mission. Figure 2-4 is a more simplified diagram that indicates the type of waste, either supernates or sludges, that each tank can store.

Figure 2-5 illustrates the timing of near-term activities to support the first eight WFD campaigns, including tank upgrades, feed preparation, mixing and sampling activities, and feed batch deliveries. As shown in the figure, there are some instances of overlap between mixing and sampling activities. The 222-S Laboratory will be performing some of these analyses; an evaluation on the laboratory demand or its capacity as a result of WFD has not been completed. This overlap of activities has been identified as an issue and is tracked in Section 8.0. Also included in Figure 2-5 are the full-scale mixing demonstration activities that precede the hot commissioning campaign. These activities include the mixing demonstration and results analysis, reconfiguration period, and the readiness assessment. These activities are discussed in Section 3.1.1.

24590-WTP-RPT-MGT-11-014, *Initial Data Quality Objectives for WTP Feed Acceptance Criteria*, defines the waste acceptance criteria for feed delivery to the WTP. The first eight feed campaigns are projected to meet all waste acceptance criteria action item limits. 24590-WTP-ICD-MG-01-019, *ICD 19 – Interface Control Document for Waste Feed* (ICD-19), and the WTP Contract (DE-AC27-01RV14136, *Design, Construction, and Commissioning of the Hanford Tank Waste Treatment and Immobilization Plant*) currently require that the feed must also meet the limits in Specification 7 and Specification 8. During the full mission, some of the feed is projected to exceed some of the Specification 7 or 8 limits, including several during the first eight feed campaigns. However, the intention is to have the waste acceptance criteria data quality objectives (DQO) define which parameters must be met for delivery of feed. Sections 3.x.6 (3.1.6 to 3.7.6) include a feed screening assessment for each of the first eight feed campaigns, and Section 4.0 presents feed screening analyses for the mission duration.

The DQO process is iterative—it is anticipated that waste acceptance criteria may be deleted, revised, or added as additional data and knowledge are obtained. A final set of waste acceptance criteria (especially the action limits) must be developed, documented, and promulgated. The basis of each waste acceptance criterion should be reevaluated to ensure that it is necessary and sufficient to establish waste acceptance. Additionally, the relationship and content of ICD-19, the waste acceptance DQO, and Specifications 7 and 8 in the WTP Contract should be reviewed for consistency and intent.

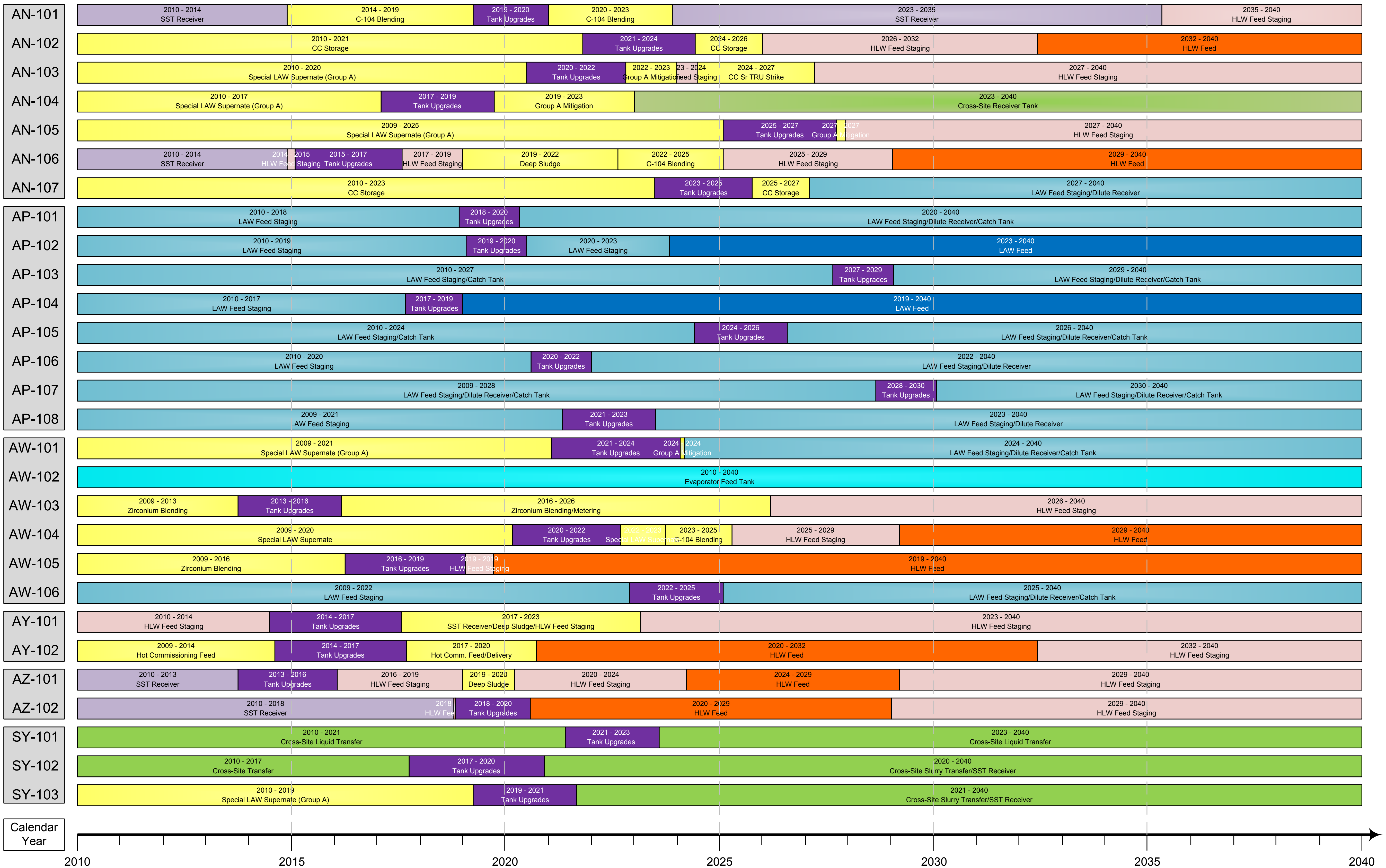

Figure 2-2. Double-Shell Tank Assignments and Usage

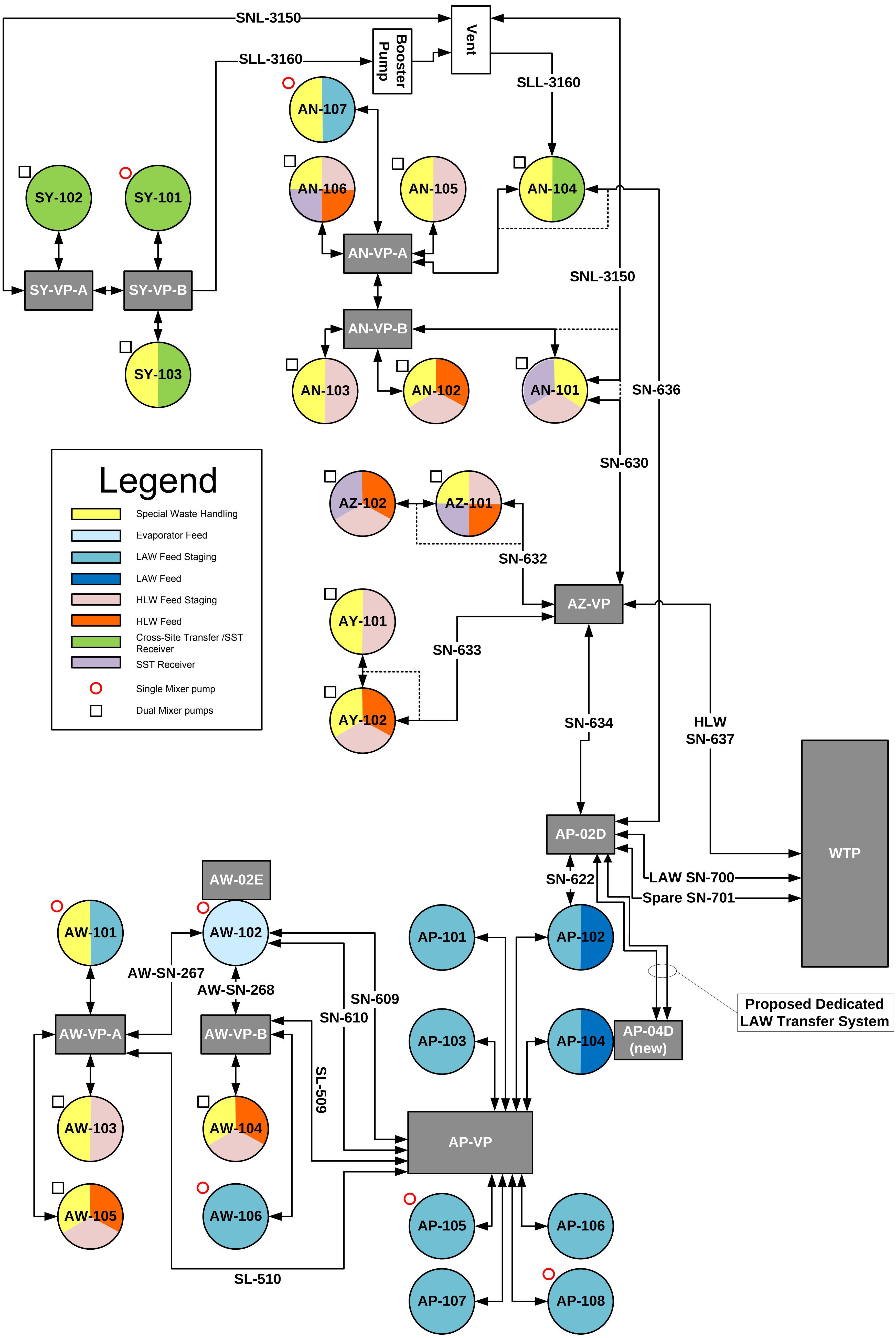

Figure 2-3. Primary Double-Shell Tank Usages

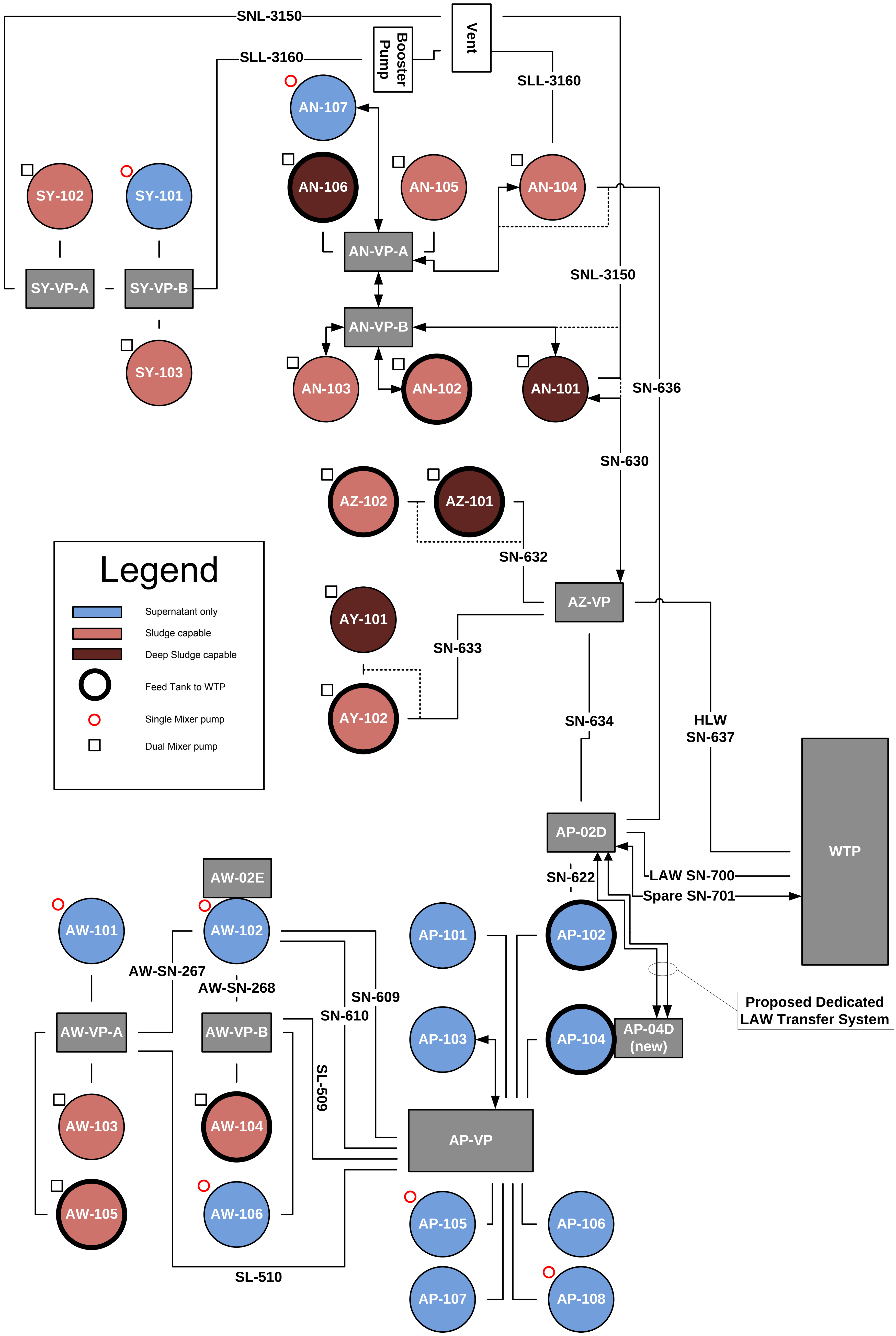

Figure 2-4. Primary Double-Shell Tank Waste Handling Capabilities

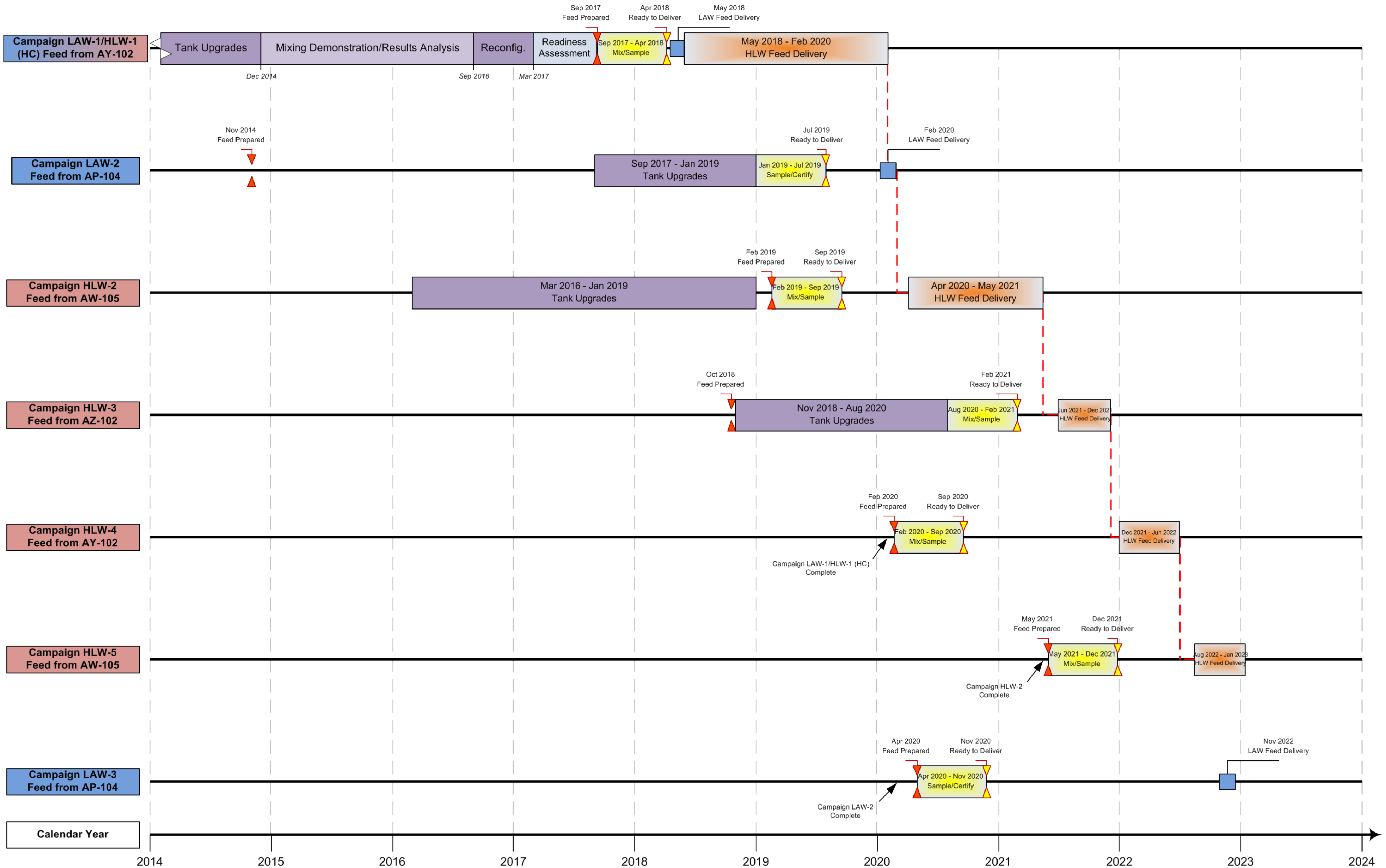

Figure 2-5. Near-Term Waste Feed Delivery Activities

3.0 CAMPAIGN PLANS

This section provides analysis of the first eight feed campaigns to be delivered to the WTP. Eight campaigns were chosen to include at least two full HLW and two full LAW campaigns. Campaign LAW-1/HLW-1 (HC) is scheduled to be delivered in mid-2018, and the last campaign of this report, Campaign LAW-3, is projected to be delivered in late 2023.

The discussion on each campaign is structured along the lines of the graphic illustrating the feed delivery logic for the campaign. Topics to be discussed include:

- Tank upgrades necessary to support the feed delivery campaign
- The status of necessary planning documents that will support the campaign
- The planned feed preparation steps to produce the finalized feed batches, including precursor transfers necessary to free up space for the feed
- A trace-back of the waste in each campaign to the individual source tank(s) from which the waste originates, relative to the starting tank inventory used for developing the baseline operating scenario
- The mixing and sampling activities that are planned to support the campaign
- An analysis of the campaign-specific observations from the screening performed in Section 4.0
- The planned delivery activities
- The identified risks and issues associated with the campaign.

Each of the LAW and HLW feed campaigns is based on the results of the System Plan (Rev. 6) Baseline Case operating scenario.

3.1 CAMPAIGN LAW-1/HLW-1 – HOT COMMISSIONING FROM TANK AY-102

Figure 3-1 illustrates the feed delivery logic for Campaign LAW-1/HLW-1 (HC), including the timing for planning documents, tank upgrades, feed preparation steps, mixing and sampling activities, and both LAW and HLW deliveries. The timing for the planning documents is included to give a relative approximation of when each document will be completed. It is premature to develop a definitive schedule for these documents at this time. Markers indicating potential sampling activities are also included to emphasize the quantity and relative timing of the required samples.

There are several noticeable issues with the current feed delivery logic for this campaign, which are discussed in more detail in Section 8.0.

- Very little schedule contingency exists between the tank upgrades and feed delivery.
- The campaign flowsheet should be refined to align with emerging strategy and plans.
- Development of the full-scale mixing demonstration has not been completed.
- The timing of the first four feed deliveries is very quick. Improvements may be made to avoid feeding four batches to WTP within the first month of operation.

3.1.1 Upgrades

The upgrades described in this section pertain to the equipment associated with Tank AY-102 that is needed to support WFD for this campaign. IWFDP Volume 3 identifies the full set of upgrades necessary for the WFD system. This campaign relies on numerous tank-specific and general infrastructure upgrades, including those required to support other retrievals, staging, and delivery activities.

Tank AY-102 will undergo a five-year equipment upgrade construction and demonstration period from October 2012 to September 2017. Transfers into or out of Tank AY-102 require formal written approval by ORP per the feed control list in HNF-SD-WM-OCD-015, *Tank Farms Waste Transfer Compatibility Program*, to protect the hot commissioning feed. Two mixer pumps will be installed to mobilize the sludge. A slurry transfer pump will be installed to transfer HLW slurries, and a decant transfer pump will be installed to enable LAW supernate transfers.

Additional miscellaneous equipment is also installed during the equipment upgrade construction period. Examples of this include, but are not limited to, thermocouple trees for temperature measurement, cameras to visually monitor tank activities, and tank sampling instrumentation. The upgrade construction period also includes the removal of unnecessary equipment, which is often a challenging activity.

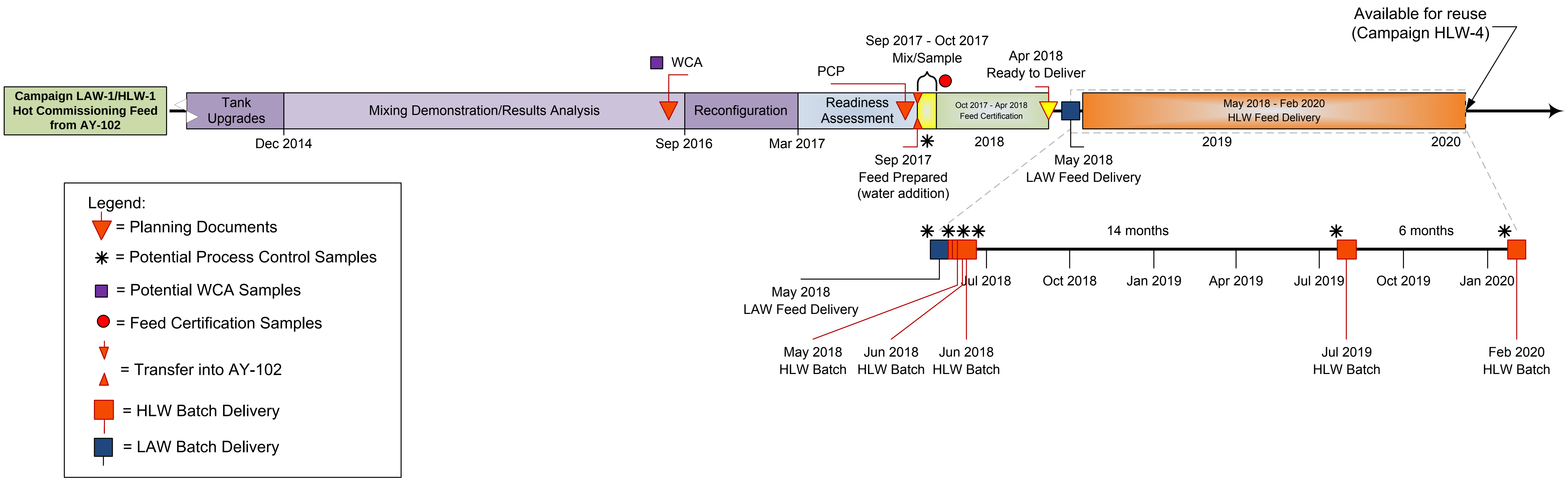

Figure 3-1. Feed Delivery Logic for Campaign LAW-1/HLW-1 (HC) (Tank AY-102)

This campaign is the first time that Hanford tank waste will be prepared, sampled, and delivered to the WTP using the equipment to be installed by the Tank AY-102 upgrade project. The upgrade project schedule provides for performing the full-scale mixing demonstration during this upgrade period. The schedule for the mixing demonstration program was obtained from the summary baseline schedule produced by the Flowsheet Integrated Project Team (IPT) as of April 2011 and includes the timing of the mixing demonstration and results analysis, reconfiguration, and readiness assessment activities.[17] The mixing demonstration program and associated activities are discussed in Section 3.1.5 and in IWFDP Volume 1, Section 2.8.8.

Table 3-1 summarizes a list of the upgrades and activities required for Campaign LAW-1/HLW-1 (HC) and the associated schedule.

Table 3-1. Upgrades and Schedule – Campaign LAW-1/HLW-1 (HC) (Hot Commissioning from Tank AY-102)

Upgrade/Activity description	Purpose	Schedule
Mixer pumps (2)	Sludge mixing	10/2012 – 12/2014
Transfer pump for decant	LAW transfers	10/2012 – 12/2014
Transfer pump for slurry	HLW slurry transfers	10/2012 – 12/2014
Equipment removal	Remove unnecessary equipment	10/2012 – 12/2014
Full-scale mixing demonstration	Confirm mixer performance	12/2014 – 9/2016
Reconfiguration period	Reconfigure equipment	9/2016 – 3/2017
Readiness assessment	Confirm tank readiness	3/2017 – 9/2017

HLW = high-level waste.
LAW = low-activity waste.

3.1.2 Planning

Planning documents must be completed in time to provide support and analysis for each step in preparing the campaign for delivery. RPP-RPT-46020, *Tank 241-AY-102 Waste Feed Delivery Flowsheet,* identifies issues that may exist with the interface between the tank farms and WTP so that the issues may be resolved prior to feed delivery to WTP. The current revision of the flowsheet is based on the System Plan (Rev. 4) Baseline Case, not the current operating scenario.[18] The flowsheet includes a material and heat balance to provide a detailed analysis and identifies major flowsheet risks. The ten risks identified in the flowsheet primarily focus on the following areas:

- Waste properties with respect to the waste acceptance criteria requirements
- The ability to mix and transfer waste to the WTP.

[17]The summary baseline schedule was used for the timing of these activities since the Baseline Case operating scenario in the System Plan (Rev. 6) did not present any of the tank upgrade or mixing demonstration activities prior to the first beneficial use of Tank AY-102 and associated upgrades in September 2017.

[18] The System Plan (Rev. 6) operating scenario does not use any inputs specifically from the current revision of the flowsheet.

Future flowsheet revisions will determine if these risks have been resolved by the current operating scenario. Other planning documents and more detailed assessments, such as process control plans, sample plans, and other documents shown on Table 2-4, will be completed closer to the date of delivery. Future revisions of the IWFDP will include discussion of the planning documents as they are developed.

3.1.3 Feed Preparation

Tank AY-102 currently contains all necessary waste for hot commissioning. The tank contents are protected by the feed control list documented in Appendix A of HNF-SD-WM-OCD-015:

> "The following control is in place to protect the combined LAW and HLW hot commissioning supernate and solid feed in Tank 241-AY-102 [Level 1]:
>
> 1. No waste shall be added to or removed from Tank 241-AY-102 prior to waste feed delivery to WTP."

Prior to delivery to the WTP, water will be added to Tank AY-102 to replace any evaporative losses and to meet the operational constraint on solids concentration for the HLW feed to WTP. A water addition is the only planned transfer into Tank AY-102 prior to delivery to the WTP.

Table 3-2 provides a list of the associated waste transfers for Campaign LAW-1/HLW-1 (HC), including source tank, dates, and volumes (both solids and liquids).

Table 3-2. Associated Waste Transfers – Campaign LAW-1/HLW-1 (HC) (Hot Commissioning from Tank AY-102)

Source	Receipt tank	Transfer date	Liquid volume (gal)	Solid volume (gal)
Water	AY-102	9/9/2017	80,000	0

3.1.4 Source of Waste

Low-level B Plant waste was the first waste transferred into Tank AY-102 during the 1980s. These transfers were small, and solids accumulation was minimal. The majority of the solids in Tank AY-102 came from the retrieval of Tank C-106 in 1999. Tank C-106 was the first SST retrieved into a DST, and contained high-heat waste. The supernate in Tank AY-102 was transferred from Tank AP-101 in January 2007. The WFD strategy consolidates the LAW waste from Tank AP-101 with the HLW from Tank AY-102 to be able to feed the WTP during hot commissioning from one DST feed tank, saving vital DST space. A detailed analysis of the consolidation of Tank AP-101 supernate with Tank AY-102 solids is described in RPP-RPT-25975, *Feed Control List Change Evaluation – Consolidating Tank 241-AP-101 Supernate with Tank 241-AY-102 Solids*.

3.1.5 Mixing and Sampling

A full-scale mixing demonstration will verify mixer pump performance and confirm mixing behavior is consistent with small-scale mixing demonstration results. The full-scale mixing demonstration will be a nearly year-long activity during which mixer pumps will be operated in Tank AY-102 to mobilize solids. Samples will be collected in a certification flow loop to verify that mixing operations are capable of producing HLW slurry that can be certified as HLW feed.

In-tank instrumentation will allow monitoring of mixing performance while mixer pumps are running. After the mixing demonstration, there will be an approximately six-month period to reconfigure the equipment to prepare feed for the WTP. Any necessary changes to mixer pump equipment or other infrastructure will occur during the reconfiguration period. A six-month readiness assessment follows the reconfiguration period to confirm whether the tank is ready for delivery activities. IWFDP Volume 1, Section 2.8.8, provides a more detailed discussion of the mixing and sampling demonstration program.

A detailed sampling procedure and process has not been fully developed. Conceptual assumptions and design, however, indicate some key features of the sampling system. The HLW fraction will be sampled using a recirculation flow loop with a remote sampler. The LAW fraction will be sampled using grab samples. The number of samples required for each campaign will be determined by projected tank compositions. As a projected component or criterion approaches a limit, more samples are necessary to achieve the required confidence that the true value for that criterion is within the limit. Sampling activities will be performed after all tank inventory preparation steps are complete. This will ensure that the final campaign composition will be sampled. Sample analysis will be completed during the 180 days following the sampling process and will verify the projected tank composition for certification of the waste prior to acceptance for treatment in the WTP.

Since both LAW and HLW feed will be delivered to the WTP from Tank AY-102 during hot commissioning, samples taken during the full-scale mixing demonstration and before feed delivery will be used to analyze the LAW and HLW fractions. The quantity and volume of these samples must be sufficient to complete both LAW and HLW prequalification testing during hot commissioning.

3.1.6 Feed Qualification and Certification

After mixing and sampling activities, an evaluation and analysis of the waste constituents in comparison to the waste acceptance criteria is performed. This evaluation is scheduled to take 180 days and will determine if the tank waste is acceptable as feed to the WTP. The screening will test the waste sample for compliance with Specification 7, which is the LAW envelopes definition, and Specification 8, which is the HLW envelope (Envelope D) definition, both of which are contained in Section C of the WTP Contract (DE-AC27-01RV14136). Screening for criticality safety limits (CSL) and hydrogen generation rate (HGR) limits is also performed.

24590-WTP-RPT-MGT-11-014 defines the waste acceptance criteria for feed delivery to the WTP. ICD-19 and the WTP Contract (DE-AC27-01RV14136) currently indicate that the feed must meet the limits in Specification 7 and Specification 8; however, the intention is to have the waste acceptance criteria DQOs define which parameters must be met for delivery of feed. The WTP prequalification process will occur simultaneously with the waste acceptance criteria evaluation. The prequalification process will analyze samples in a hot cell to determine the ability of the WTP to process the waste. Results of the prequalification testing will determine if any adjustments need to be made to the waste feed batches prior to delivering waste to WTP. Specific requirements and prequalification procedures have not been fully developed.

Table 3-3 lists the out-of-specification constituents or criteria for Campaign LAW-1/HLW-1 (HC). Section 4.0 provides a discussion of global implications of out-of-specification constituents per the criteria.

Table 3-3. Out-of-Specification Constituents per Criteria – Campaign LAW-1/HLW-1 (HC) (Hot Commissioning from Tank AY-102)

Batch type	Screening	Waste acceptance criteria item	Parameter	Value	Limit
HLW	Specification 8, Table TS-8.4[a]	N	Al (g/100g NVO)	15.3	14.0
	Specification 8, Table TS-8.4[a]	N	Pb (g/100g NVO)	1.27	1.10

[a] Specification 8 (HLW envelope definition) is included in Section C of the WTP Contract (DE-AC27-01RV14136).

HLW = high-level waste.
NVO = non-volatile oxides.
WTP = Waste Treatment and Immobilization Plant.

The CSL 8.2 liquid phase value for the first LAW feed batch originates from RPP-RPT-46020 instead of the System Plan (Rev. 6) Hanford Tank Waste Operations Simulator (HTWOS) modeling results. The value projected by HTWOS slightly exceeded the CSL 8.2 liquid phase limit for this first batch as a result of a modeling error. The model did not correctly apply residual wash factors before the first LAW batch is delivered to the WTP. The wash factors are different for each component, and in this case when they are correctly applied, they lower the liquid phase ratio of $U_{fissile}$ to U_{total}. Once the residual wash factors were correctly applied by HTWOS to the HLW feed batches, the CSL 8.2 liquid phase value fell within the limit. Analyses of the hot commissioning deliveries to WTP are also available in Table 7-7 of RPP-RPT-46020. The CSL 8.2 liquid phase evaluation in this report is below the limit, at the same value estimated by HTWOS for the HLW batches.

The HLW hot commissioning batches exceed the Specification 8 Envelope D limit for both the aluminum and lead concentrations. The aluminum composition exceeds the Envelope D limit by 9 percent. Aluminum is a component that commonly exceeds the limit, with only 5.7 percent of the waste batches being in range. The lead composition exceeds the Envelope D limit by 15 percent. Both aluminum and lead are listed in Table TS-8.4 of Specification 8. Although the components listed in this table are important for HLW glass production, they will not be used as a basis for determining if the feed meets screening requirements.

The waste certification process to allow delivery to the WTP has not been finalized. If a waste batch is out of specification, an analysis is needed of the uncertainty associated with the estimate and the potential for the waste to be within the actual capability and safety envelope of WTP. If sample analyses determine that the waste composition is unacceptable for delivery to WTP, mitigating actions will be performed to bring a tank into specification. These mitigation activities may include, but are not limited to, dilution of tank contents with water, caustic leaching, transfer of waste out of the feed tank to another DST, and the transfer of waste from another DST into the feed tank. Once the tank contents are deemed acceptable for delivery to the WTP, the waste campaign will be certified for delivery.

3.1.7 Delivery

The first waste batch sent to the WTP during hot commissioning will be a LAW batch from Tank AY-102. This batch will be sent on the hot commissioning start date in May 2018. After the first LAW batch, Tank AY-102 will send five HLW batches to complete hot commissioning. Each HLW feed batch can be a maximum of 120 kgal, so several batches are required to deliver all of the planned HLW feed from the DST. The first three HLW feed batches are sent to the WTP within a month of the first LAW transfer. These four batches (one LAW and three HLW) will be used to fill the WTP with waste to begin processing. The final two HLW batches from Tank AY-102 during hot commissioning are sent to the WTP in July 2019 and February 2020, respectively.

The transfer lines will be flushed with water to the WTP, 2,500 gal pre-transfer and 2,000 gal post-transfer, for a total of 4,500 gal to remove any residual waste from the transfer lines to prevent damage to the lines and reduce the risk of leaks. This transfer line flush is modeled as one transfer for simplicity.

Table 3-4 summarizes the delivery-related activities for Campaign LAW-1/HLW-1 (HC).

Table 3-4. Delivery-Related Activities – Campaign LAW-1/HLW-1 (HC) (Hot Commissioning from Tank AY-102)

Source	Description	Transfer date	Liquid volume (gal)	Solid volume (gal)
AY-102	LAW feed batch	5/11/2018	122,699	0
Water	Transfer line flush	5/11/2018	4,500	0
AY-102	HLW feed batch	5/31/2018	114,799	5,201
Water	Transfer line flush	5/31/2018	4,500	0
AY-102	HLW feed batch	6/5/2018	114,799	5,201
Water	Transfer line flush	6/5/2018	4,500	0
AY-102	HLW feed batch	6/10/2018	114,799	5,201
Water	Transfer line flush	6/11/2018	4,500	0
AY-102	HLW feed batch	7/31/2019	114,799	5,201
Water	Transfer line flush	7/31/2019	4,500	0
AY-102	HLW feed batch	2/2/2020	114,799	5,201
Water	Transfer line flush	2/3/2020	4,500	0

HLW = high-level waste.
LAW = low-activity waste.

After finishing deliveries of the hot commissioning feed, Tank AY-102 is available for reuse and will provide HLW feed to the WTP in Campaign HLW-4.

3.2 CAMPAIGN LAW-2 – LOW-ACTIVITY WASTE FROM TANK AP-104

Figure 3-2 illustrates the feed delivery logic for Campaign LAW-2, including the timing for planning documents, tank upgrades, feed preparation steps, mixing and sampling activities, and LAW delivery. The timing for the planning documents is included to give a relative approximation of when each document will be completed. It is premature to develop a definitive schedule for these documents at this time. Markers indicating potential sampling activities are also included to emphasize the quantity and relative timing of the required samples.

There are noticeable issues with the current feed delivery logic for this campaign, which are discussed in more detail in Section 8.0.

- Detailed sampling methods need to be defined.
- Feed tank and contents are subject to change.

3.2.1 Upgrades

The upgrades described in this section pertain to the equipment associated with Tank AP-104 that is needed to support WFD for this campaign. IWFDP Volume 3 identifies the full set of upgrades necessary for the WFD system. This campaign relies on numerous tank-specific and general infrastructure upgrades, including those required to support other retrievals, staging, and delivery activities.

Tank AP-104 will undergo a 13-month construction period. No waste transfers into or out of Tank AP-104 will occur during the scheduled construction period. The only equipment upgrade will be the installation of a transfer pump to enable the transfer of LAW feed batches to the WTP. Since Tank AP-104 is planned to be used solely for liquid handling, it will not require installation of other pump types.

Additional miscellaneous equipment is also installed during the equipment upgrade construction period. Examples of this include, but are not limited to, thermocouple trees for temperature measurement, cameras to visually monitor tank activities, and tank sampling instrumentation. The upgrade construction period also includes the removal of unnecessary equipment, which is often a challenging activity.

Table 3-5 summarizes a list of the upgrades required for Campaign LAW-2 and the associated schedule.

Table 3-5. Upgrades and Schedule – Campaign LAW-2 (Low-Activity Waste from Tank AP-104)

Upgrade description	Purpose	Schedule
Transfer pump for decant	LAW transfers	9/2017 – 1/2019
Equipment removal	Remove unnecessary equipment	9/2017 – 1/2019

LAW = low-activity waste.

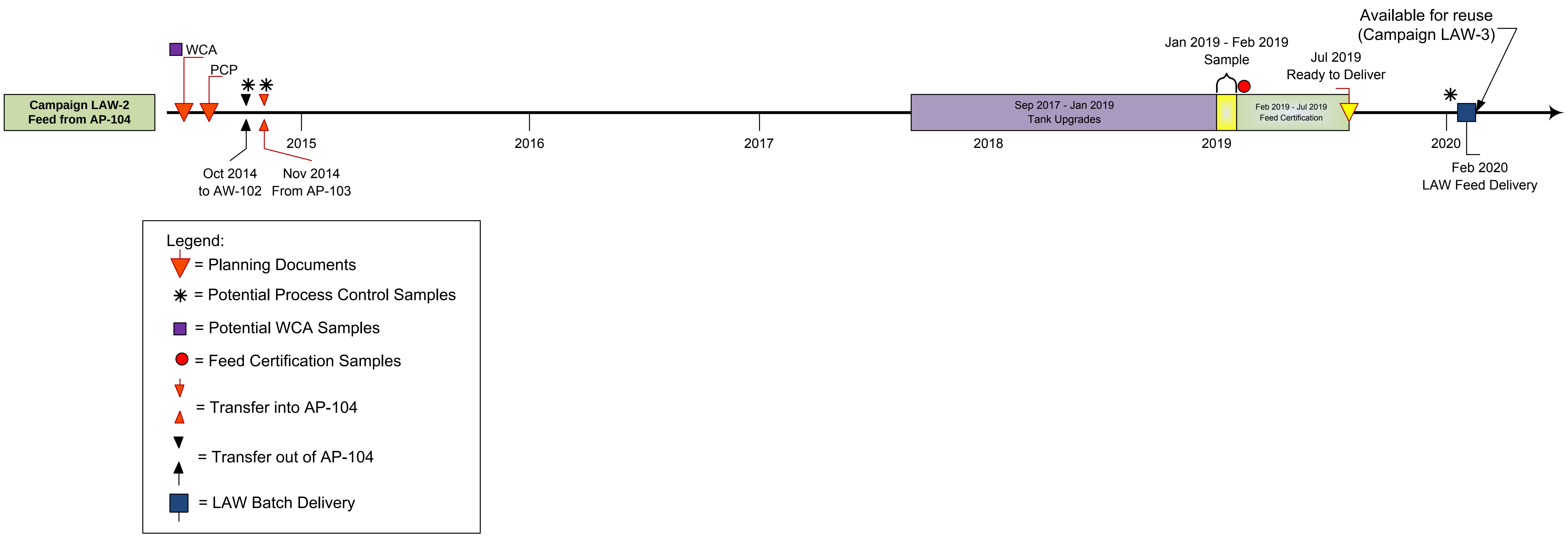

Figure 3-2. Feed Delivery Logic for Campaign LAW-2 (Tank AP-104)

3.2.2 Planning

Planning documents must be completed in time to provide support and analysis for each step in preparing a campaign for delivery. It is premature to develop planning documents to support Campaign LAW-2 at this time while the system is in a state of flux. Planning documents and more detailed assessments, such as process control plans, sample plans, and other documents shown on Table 2-4, will be completed closer to the date of delivery. Future revisions of the IWFDP will include discussion of the planning documents as they are developed.

3.2.3 Feed Preparation

Prior to receiving the waste for this LAW feed campaign, Tank AP-104 is used to transfer liquid waste to and from a variety of DSTs. In preparation for this campaign, Tank AP-104 transfers nearly all of its contents to Tank AW-102 for an evaporator campaign. Waste for this LAW feed campaign originates from Tank AP-103 and is transferred into Tank AP-104 in November 2014. This LAW has a high specific gravity of 1.4 and has no specific concerns, which makes it a good candidate for the first full LAW campaign.

Table 3-6 provides a list of the associated waste transfers for Campaign LAW-2, including source tank, dates, and volumes (both solids and liquids).

Table 3-6. Associated Waste Transfers – Campaign LAW-2 (Low-Activity Waste from Tank AP-104)

Source tank	Receipt tank	Transfer date	Liquid volume (gal)	Solid volume (gal)
AP-104	AW-102	10/5/2014	860,029	0
AP-103	AP-104	11/3/2014	1,152,380	0

3.2.4 Source of Waste

The source of the waste for this LAW campaign is Tank AP-103. There is a residual amount of waste from Tank AN-101 and Tank AN-106, but more than 99 vol% of the waste originates from Tank AP-103. The proximity of Tank AP-103 to Tank AP-104 reduces the risk of transferring waste over long distances; however, this was not a criterion for selection.

Figure 3-3 illustrates the fraction of waste from each source for Campaign LAW-2. This data is developed by tracing the waste back to the individual source tank, as included in the BBI.

3.2.5 Sampling

There are no unique or special sampling requirements that are specific to this feed campaign. Detailed campaign-specific sampling requirements will be developed as the mission matures.

A detailed sampling procedure and process has not been fully developed. Conceptual assumptions and design, however, indicate some key features of the sampling system. The LAW campaigns will be sampled using grab samples. The number of samples required for each campaign will be determined by projected tank compositions. As a projected component or criterion approaches a limit, more samples are necessary to achieve the required confidence that the true value for that criterion is within the limit. Sampling activities will be performed after all tank inventory preparation steps are complete. This will ensure that the final campaign composition will be sampled. Sample analysis will be completed during the 180 days following the sampling process and will verify the projected tank composition for certification of the waste prior to acceptance for treatment in the WTP.

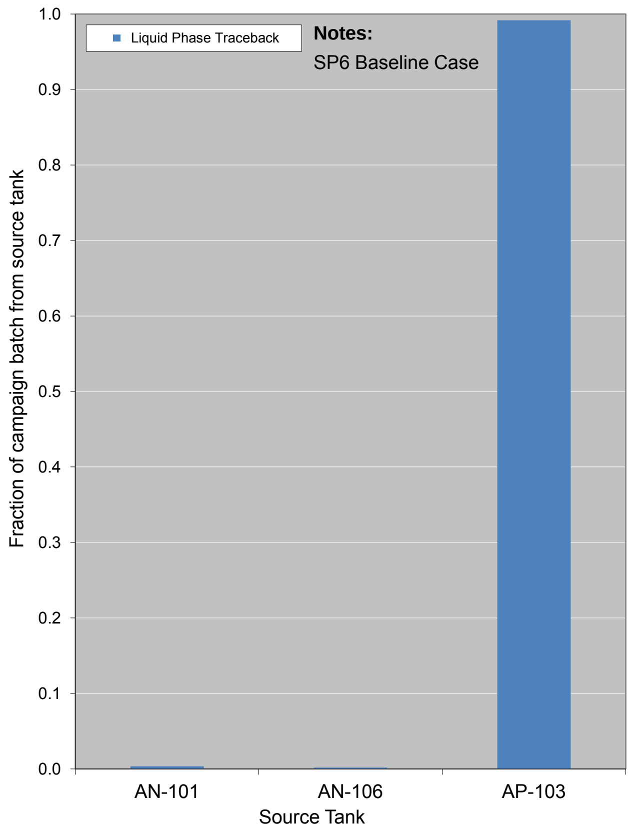

Figure 3-3. Source of Waste – Campaign LAW-2 (Low-Activity Waste from Tank AP-104)

In addition to sampling activities to support certification and delivery of waste to the WTP, there will be other samples taken to support waste compatibility assessments (WCA) and process control plans (PCP). Specifically, samples will be taken as necessary to provide enough information about the waste to complete a WCA. Other samples may also be required by the PCP to ensure that the transfers are compliant. Specific sampling requirements to support the WCA and PCP will be developed closer to the date of each transfer. Sampling events will be scheduled such that there is sufficient time for sampling and analysis for PCP changes, if necessary.

3.2.6 Feed Qualification and Certification

After mixing and sampling activities, an evaluation and analysis of the waste constituents in comparison to the waste acceptance criteria is performed. This evaluation is scheduled to take 180 days and will determine if the tank waste will be certified for feed delivery to the WTP. The screening will test the waste sample for compliance with the Specification 7, Specification 8, CSL, and HGR limits.

The waste acceptance criteria DQO (24590-WTP-RPT-MGT-11-01) defines the waste acceptance criteria for feed delivery to the WTP. ICD-19 and the WTP Contract (DE-AC27-01RV14136) currently indicate that the feed must meet the limits in Specification 7 and Specification 8; however, the intention is to have the waste acceptance criteria DQO define which parameters must be met for delivery of feed.

There are no projected out-of-specification constituents per the criteria for Campaign LAW-2.

The waste certification process to allow delivery to the WTP has not been finalized. If a waste batch is out of specification, an analysis is needed of the uncertainty associated with the estimate and the potential for the waste to be within the actual capability and safety envelope of WTP. If sample analyses determine that the waste composition is unacceptable for delivery to WTP, mitigating actions will be performed to bring a tank into specification. These mitigation activities may include, but are not limited to, dilution of tank contents with water, caustic leaching, transfer of waste out of the feed tank to another DST, and the transfer of waste from another DST into the feed tank. Once the tank contents are deemed acceptable for delivery to the WTP, the waste campaign will be certified for delivery.

3.2.7 Delivery

The delivery of the Campaign LAW-2 batch from Tank AP-104 will occur in February 2020. LAW feed is transferred to the WTP as one large transfer of approximately 1 Mgal, including the water additions for the transfer line flush. The WTP receives the LAW feed batches into four LAW receipt tanks, each with a capacity of 375 kgal.

The transfer lines will be flushed with water to the WTP, 2,500 gal pre-transfer and 2,000 gal post-transfer, for a total of 4,500 gal to remove any residual waste from the transfer lines to prevent damage to the lines and reduce the risk of leaks. This transfer line flush is modeled as one transfer for simplicity.

Table 3-7 summarizes the delivery-related activities for Campaign LAW-2.

Table 3-7. Delivery-Related Activities – Campaign LAW-2 (Low-Activity Waste from Tank AP-104)

Source	Description	Transfer date	Liquid volume (gal)	Solid volume (gal)
AP-104	LAW feed batch	2/3/2020	995,500	0
Water	Transfer line flush	2/8/2020	4,500	0

LAW = low-activity waste.

After finishing the LAW delivery, Tank AP-104 is available for reuse as a dedicated LAW feed tank and will provide LAW feed to the WTP in Campaign LAW-3.

3.3 CAMPAIGN HLW-2 – HIGH-LEVEL WASTE FROM TANK AW-105

Figure 3-4 illustrates the feed delivery logic for Campaign HLW-2, including the timing for planning documents, tank upgrades, feed preparation steps, mixing and sampling activities, and the HLW deliveries. The timing for the planning documents is included to give a relative approximation of when each document will be completed. It is premature to develop a definitive schedule for these documents at this time. Markers indicating potential sampling activities are also included to emphasize the quantity and relative timing of the required samples.

There are noticeable issues with the current feed delivery logic for this campaign, which are discussed in more detail in Section 8.0.

- The long length of transfer from AW Farm to the WTP results in increased reliability risk and potential pressure drop concerns.
- This is the first use of incremental lowering of the mixer pumps, which may lead to operational challenges.
- Very little schedule contingency exists between the tank upgrades and feed delivery.
- The feed tank and contents are subject to change.

3.3.1 Upgrades

The upgrades described in this section pertain to the equipment associated with Tank AW-105 that is needed to support WFD for this campaign. IWFDP Volume 3 identifies the full set of upgrades necessary for the WFD system. This campaign relies on numerous tank-specific and general infrastructure upgrades, including those required to support other retrievals, staging, and delivery activities.

Tank AW-105 will undergo a three-year equipment upgrade construction period from March 2016 to January 2019. During the construction period, no transfer activities into or out of Tank AW-105 will be allowed. Two mixer pumps will be installed to mobilize the sludge. A slurry transfer pump will be installed to transfer HLW slurries, and a decant transfer pump will be installed to enable supernate transfers. The capability of mixer pump incremental lowering will be available to enable mixing of sludge depths that are greater than 70 in.[19] Currently, Tank AW-105 has a sludge depth of approximately 90 in. The mixer pumps will be incrementally lowered while the deep-sludge solids are transferred out of Tank AW-105 in 2019.

Additional miscellaneous equipment is also installed during the equipment upgrade construction period. Examples of this include, but are not limited to, thermocouple trees for temperature measurement, cameras to visually monitor tank activities, and tank sampling instrumentation. The upgrade construction period also includes the removal of unnecessary equipment, which is often a challenging activity.

[19] Section B2.3 of IWFDP Volume 1 provides a discussion of the 70 in. limit.

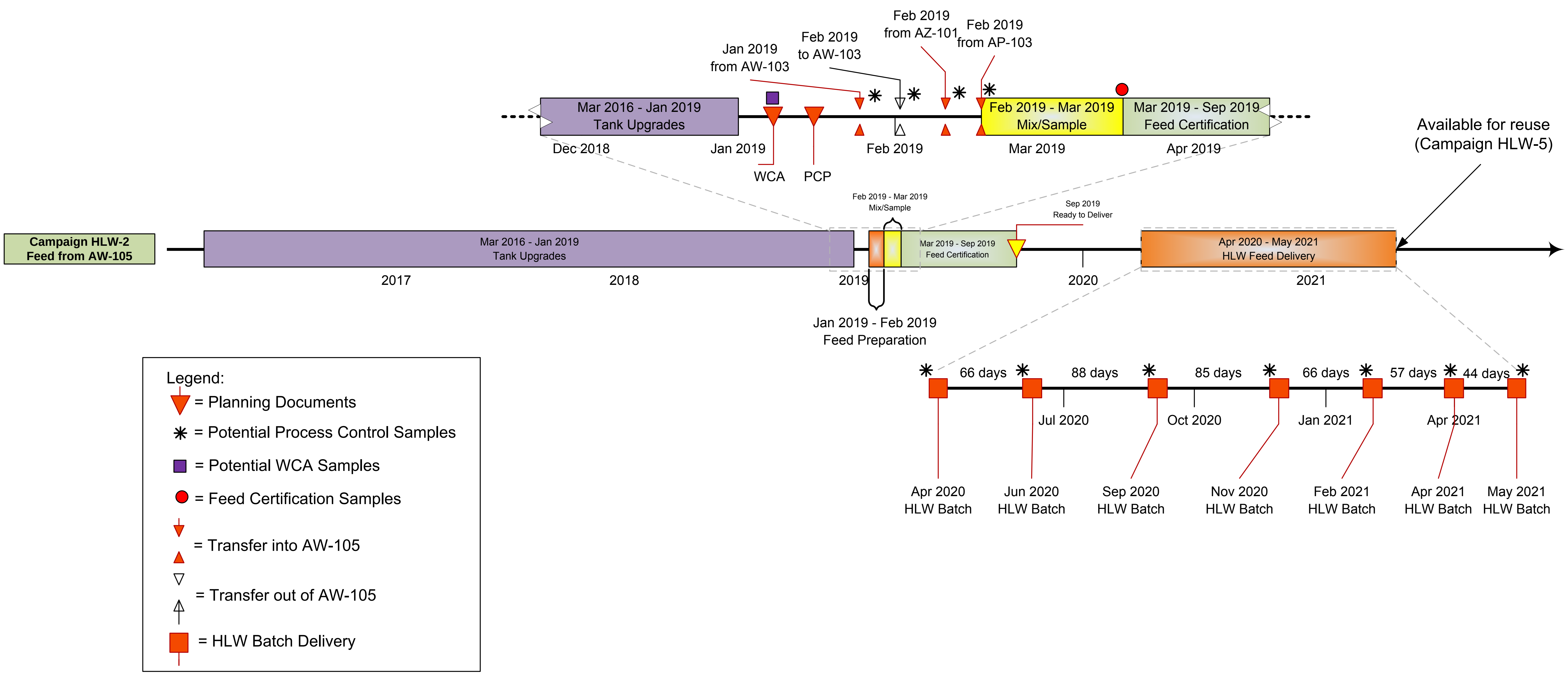

Figure 3-4. Feed Delivery Logic for Campaign HLW-2 (Tank AW-105)

Table 3-8 summarizes a list of the upgrades required for Campaign HLW-2 and the associated schedule.

Table 3-8. Upgrades and Schedule – Campaign HLW-2 (High-Level Waste from Tank AW-105)

Upgrade description	Purpose	Schedule
Mixer pumps (2)	Sludge mixing	3/2016 – 1/2019
Transfer pump for decant	LAW transfers	3/2016 – 1/2019
Transfer pump for slurry	HLW slurry transfers	3/2016 – 1/2019
Equipment removal	Remove unnecessary equipment	3/2016 – 1/2019

HLW = high-level waste.
LAW = low-activity waste.

3.3.2 Planning

Planning documents must be completed in time to provide support and analysis for each step in preparing the campaign for delivery. RPP-RPT-50361, *Tank 241-AW-105 Waste Feed Delivery Preliminary Flowsheet*, is a preliminary flowsheet that identifies issues that may exist with the interface between the tank farms and WTP so that the issues may be resolved prior to delivery of feed to the WTP. The current revision of the flowsheet is based on the current operating scenario, System Plan (Rev. 6) Baseline Case. The flowsheet includes a material and heat balance to provide a detailed analysis and identifies major flowsheet risks. The eleven risks identified in the flowsheet primarily focus on the following areas:

- Waste properties with respect to the waste acceptance criteria requirements
- The ability to transfer waste to the WTP, specifically in regard to complying with transfer line maximum operating pressures.

Future flowsheet revisions developed as the operating scenario changes will determine if these risks have been resolved. Other planning documents and more detailed assessments, such as process control plans, sample plans, and other documents shown on Table 2-4, will be completed closer to the date of delivery.

3.3.3 Feed Preparation

Currently, Tank AW-105 is classified as a deep-sludge tank and has approximately 90 in. of high zirconium solid waste. Under normal use, dedicated HLW feed tanks can have a maximum of 70 in. of solids to prevent the use of incremental lowering of the mixer pumps. Some of the high zirconium waste in Tank AW-105 is transferred into Tank AW-103, which also contains high zirconium solid waste. This transfer reduces the solids level in Tank AW-105 to approximately 30 in. A solids transfer from Tank AZ-101 brings the final solids height before delivery in Tank AW-105 to 70 in. The slurry transfer line is flushed with 500 gal of water for each DST-to-DST solids transfer. A final supernate transfer from Tank AP-103 tops off the liquid in Tank AW-105 and finalizes the tank contents for delivery.

Table 3-9 provides a list of the associated waste transfers for Campaign HLW-2, including source tank, dates, and volumes (both solids and liquids).

Table 3-9. Associated Waste Transfers – Campaign HLW-2 (High-Level Waste from Tank AW-105)

Source tank	Receipt tank	Transfer date	Liquid volume (gal)	Solid volume (gal)
AW-103	AW-105	1/25/2019	732,638	298
AW-105	AW-103	2/2/2019	770,627	12,341
Water	AW-105	2/10/2019	500[a]	0
AZ-101	AW-105	2/11/2019	471,951	34,349
Water	AW-105	2/13/2019	500[a]	0
AP-103	AW-105	2/18/2019	275,585	82

[a] Transfer line flushes are modeled prior to the waste transfer to ensure that space is available for the flush.

3.3.4 Source of Waste

The majority of solid waste for Campaign HLW-2 is from Tank C-102. Tank C-102 is retrieved into Tank AZ-101 and is then transferred into Tank AW-105. The remainder of solid waste in Campaign HLW-2 is original Tank AZ-101 and AW-105 waste. The Tank AW-105 waste is high zirconium waste, but it is diluted with Tank C-102 and AZ-101 waste to ensure that it does not exceed the zirconium concentration constraints. The supernate for this campaign originates from primarily two sources. Liquids associated with the consolidation of the high zirconium waste from Tanks AW-103 and AW-105 account for approximately 25 percent of the supernate. The remainder of the supernate is concentrated evaporator bottoms originating from a variety of DSTs.

Figure 3-5 illustrates the fraction of waste from each source for Campaign HLW-2. This data is developed by tracing the waste back to the individual source tank, as included in the BBI.

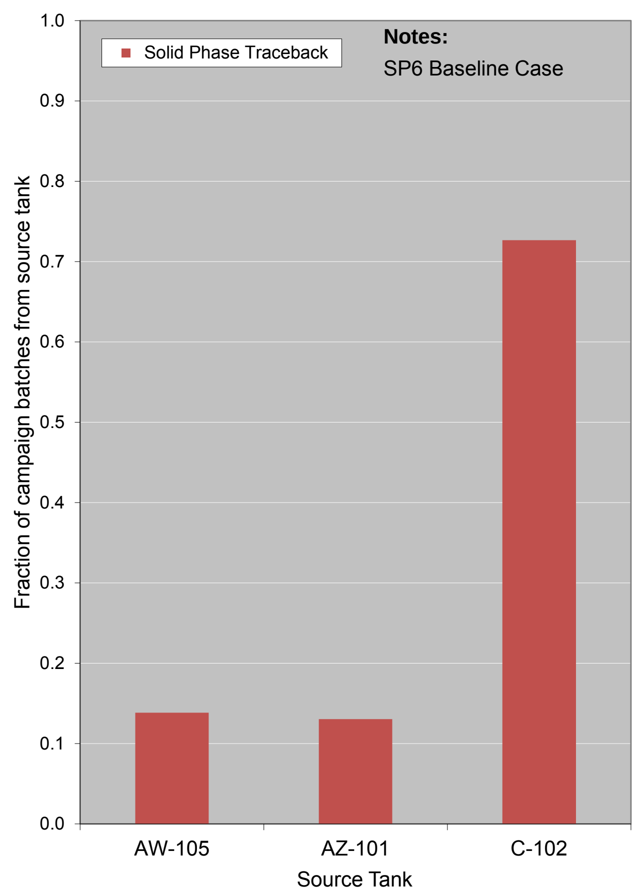

Figure 3-5. Source of Waste – Campaign HLW-2 (High-Level Waste from Tank AW-105)

3.3.5 Mixing and Sampling

There may be unique mixing and sampling requirements that are specific to this feed campaign because of the high zirconium content of the waste (discussed in Sections 3.3.3 and 3.3.4). Detailed campaign-specific mixing and sampling requirements will be developed as the mission matures.

A detailed mixing and sampling procedure and process has not been fully developed. Conceptual assumptions and design, however, indicate some key features of the mixing and sampling system. The HLW campaigns will be sampled using a recirculation flow loop with a remote sampler. Mixing activities will be performed by mixer pumps, which will be operated until the tank contents are as homogeneous as possible. Once the tank is mixed, the recirculation flow loop sampling will be performed. The number of samples required for each campaign will be determined by projected tank compositions. As a projected component or criterion approaches a limit, more samples are necessary to achieve the required confidence that the true value for that criterion is within the limit. Sampling activities will be performed after all tank inventory preparation steps are complete. This will ensure that the final campaign composition will be sampled. Sample analysis will be completed during the 180 days following the sampling process and will verify the projected tank composition for certification of the waste prior to acceptance for treatment in the WTP.

In addition to sampling activities to support certification and delivery of waste to the WTP, there will be other samples taken to support WCAs and PCPs. Specifically, samples will be taken as necessary to provide enough information about the waste to complete a WCA. Other samples will also be required by the PCP to ensure that the transfers are compliant. Specific sampling requirements to support the WCA and PCP will be developed closer to the date of each transfer. Mixer pumps will need to operate prior to sampling and will add to equipment fatigue issues. Sampling events will be scheduled so that sufficient time is available for sampling and analysis for PCP changes, if necessary.

3.3.6 Feed Qualification and Certification

After mixing and sampling activities, an evaluation and analysis of the waste constituents in comparison to the waste acceptance criteria is performed. This evaluation is scheduled to take 180 days and will determine if the tank waste will be certified for feed delivery to the WTP. The screening will test the waste sample for compliance with the Specification 7, Specification 8, CSL, and HGR limits.

The waste acceptance criteria DQO (24590-WTP-RPT-MGT-11-01) defines the waste acceptance criteria for feed delivery to the WTP. ICD-19 and the WTP Contract (DE-AC27-01RV14136) currently indicate that the feed must meet the limits in Specification 7 and Specification 8; however, the intention is to have the waste acceptance criteria DQO define which parameters must be met for delivery of feed.

Table 3-10 lists the out-of-specification constituents or criteria for Campaign HLW-2. Section 4.0 discusses the global implications of out-of-specification constituents per the criteria.

Table 3-10. Out-of-Specification Constituents per Criteria – Campaign HLW-2 (High-Level Waste from Tank AW-105)

Screening	Waste acceptance criteria item	Parameter	Value	Limit
Specification 7, Table TS-7.1[a]	N	SO_4 (mol/mol Na)	0.0187	0.01 (Envelope A)[b]
Specification 7, Table TS-7.2[a]	N	TRU (Ci/mol Na)	31.2	13.0 (Envelope A/B)[b]
Specification 8, Table TS-8.3[a]	N	^{233}U (Ci/100g NVO)	1.12E-05	4.50E-06
Specification 8, Table TS-8.4[a]	N	Al (g/100g NVO)	31.3	14.0

[a] Specification 7 (LAW envelopes definition) and Specification 8 (HLW envelope definition) are included in Section C of the WTP Contract (DE-AC27-01RV14136).
[b] Envelope A/B refers to waste envelope definitions found in the WTP Contract (DE-AC27-01RV14136).

HLW = high-level waste.
LAW = low-activity waste.
NVO = non-volatile oxides.
TRU = transuranic.
WTP = Waste Treatment and Immobilization Plant.

The Specification 7 Envelope A limit on SO_4 is exceeded in Campaign HLW-2 batches. This Envelope A limit is commonly out-of-specification, with 83 percent of the waste batches exceeding the limit. The SO_4 concentration is within the Envelope B limit for these HLW batches.

The Specification 7 Envelope A and B limits on transuranic (TRU) waste are exceeded in Campaign HLW-2 batches. The TRU concentration exceeds the Envelope A and B limits by 140 percent. If the glass projected from these feed batches exceeds the glass limits, blending of this waste would be considered. Currently the glass screening capability is not available, but this potential future enhancement would help confirm the implications of projected feed. If necessary, a blending strategy could be developed to reduce the TRU concentration in the supernate fraction of this campaign.

The Campaign HLW-2 batches exceed the Specification 8 Envelope D limit on the ^{233}U concentration by 149 percent. The basis for this limit is to establish the waste oxide loading in the HLW glass, and has no specific criticality safety implications. Subsequent HLW feed batches have very low ^{233}U concentrations. The main contributor of this high ^{233}U concentration is waste originating from Tank C-102. An evaluation of the importance and necessity of this limit should be completed to determine if the limit can be eliminated or relaxed. If necessary, adjusted SST retrieval planning or development of an intentional blending strategy for this waste could reduce the ^{233}U concentration for this campaign.

The Campaign HLW-2 batches exceed the Specification 8 Envelope D limit on the aluminum concentration. The aluminum composition exceeds the Envelope D limit by 123 percent. Aluminum is a component that commonly exceeds the limit, with only 5.7 percent of the waste batches being in range. Aluminum is listed in Table TS-8.4 of Specification 8. Although the components listed in this table are important for HLW glass production, they will not be used as a basis for determining if the feed meets specification requirements.

A waste certification process to allow feed delivery to the WTP has not been finalized. If a waste batch is out of specification, an analysis is needed of the uncertainty associated with the estimate and the potential for the waste to be within the actual capability and safety envelope of WTP. If sample analyses determine that the waste composition is unacceptable for delivery to WTP, mitigating actions will be performed to bring a tank into specification. These mitigation activities may include, but are not limited to, dilution of tank contents with water, caustic leaching, transfer of waste out of the feed tank to another DST, and the transfer of waste from another DST into the feed tank. Once the tank contents are deemed acceptable for delivery to the WTP, the waste campaign will be certified for delivery.

3.3.7 Delivery

There are concerns about the suitability of using Tank AW-105 as a feed delivery tank because of pressure drop issues involved with transferring waste from AW Farm to the WTP. Further discussion of this issue is provided in Section 8.0.

Feed delivery from Tank AW-105 in Campaign HLW-2 consists of seven HLW feed batches of 120 kgal each. The first feed batch is delivered in April 2020, and each successive batch is sent approximately two to three months later. The last feed batch is delivered in May 2021, for a total Campaign HLW-2 delivery duration of one year.

The transfer lines will be flushed with water to the WTP, 2,500 gal pre-transfer and 2,000 gal post-transfer, for a total of 4,500 gal to remove any residual waste from the transfer lines to prevent damage to the lines and reduce the risk of leaks. This transfer line flush is modeled as one transfer for simplicity.

Table 3-11 summarizes the delivery-related activities for Campaign HLW-2.

Table 3-11. Delivery-Related Activities – Campaign HLW-2 (High-Level Waste from Tank AW-105)

Source	Description	Transfer date	Liquid volume (gal)	Solid volume (gal)
AW-105	HLW feed batch	4/4/2020	115,791	4,209
Water	Transfer line flush	4/4/2020	4,500	0
AW-105	HLW feed batch	6/9/2020	115,791	4,209
Water	Transfer line flush	6/10/2020	4,500	0
AW-105	HLW feed batch	9/5/2020	115,791	4,209
Water	Transfer line flush	9/5/2020	4,500	0
AW-105	HLW feed batch	11/29/2020	115,791	4,209
Water	Transfer line flush	11/30/2020	4,500	0
AW-105	HLW feed batch	2/3/2021	115,791	4,209
Water	Transfer line flush	2/4/2021	4,500	0
AW-105	HLW feed batch	4/1/2021	115,791	4,209
Water	Transfer line flush	4/1/2021	4,500	0
AW-105	HLW feed batch	5/15/2021	115,791	4,209
Water	Transfer line flush	5/16/2021	4,500	0

HLW = high-level waste.

After finishing delivery of Campaign HLW-2, Tank AW-105 is available for reuse as a dedicated feed tank and will provide HLW feed to the WTP in later campaigns.

3.4 CAMPAIGN HLW-3 – HIGH-LEVEL WASTE FROM TANK AZ-102

Figure 3-6 illustrates the feed delivery logic for Campaign HLW-3, including the timing for planning documents, tank upgrades, feed preparation steps, mixing and sampling activities, and HLW deliveries. The timing for the planning documents is included to give a relative approximation of when each document will be completed. It is premature to develop a definitive schedule for these documents at this time. Markers indicating potential sampling activities are also included to emphasize the quantity and relative timing of the required samples.

There are noticeable issues with the current feed delivery logic for this campaign, which are discussed in more detail in Section 8.0.

- Very little schedule contingency exists between AX Farm retrieval operations and planned tank upgrades.
- Feed tanks and contents are subject to change.

3.4.1 Upgrades

The upgrades described in this section pertain to the equipment associated with Tank AZ-102 that is needed to support WFD for this campaign. IWFDP Volume 3 identifies the full set of upgrades necessary for the WFD system. This campaign relies on numerous tank-specific and general infrastructure upgrades, including those required to support other retrievals, staging, and delivery activities.

Tank AZ-102 will undergo a two-year equipment upgrade construction period from November 2018 to August 2020. During the construction period, no transfer activities into or out of Tank AZ-102 will be allowed. Two mixer pumps will be installed to mobilize the sludge. A slurry transfer pump will be installed to transfer HLW slurries, and a decant transfer pump will be installed to enable supernate transfers. Additional miscellaneous equipment is also installed during the equipment upgrade construction period. Examples of this include, but are not limited to, thermocouple trees for temperature measurement, cameras to visually monitor tank activities, and tank sampling instrumentation. The upgrade construction period also includes the removal of unnecessary equipment, which is often a challenging activity.

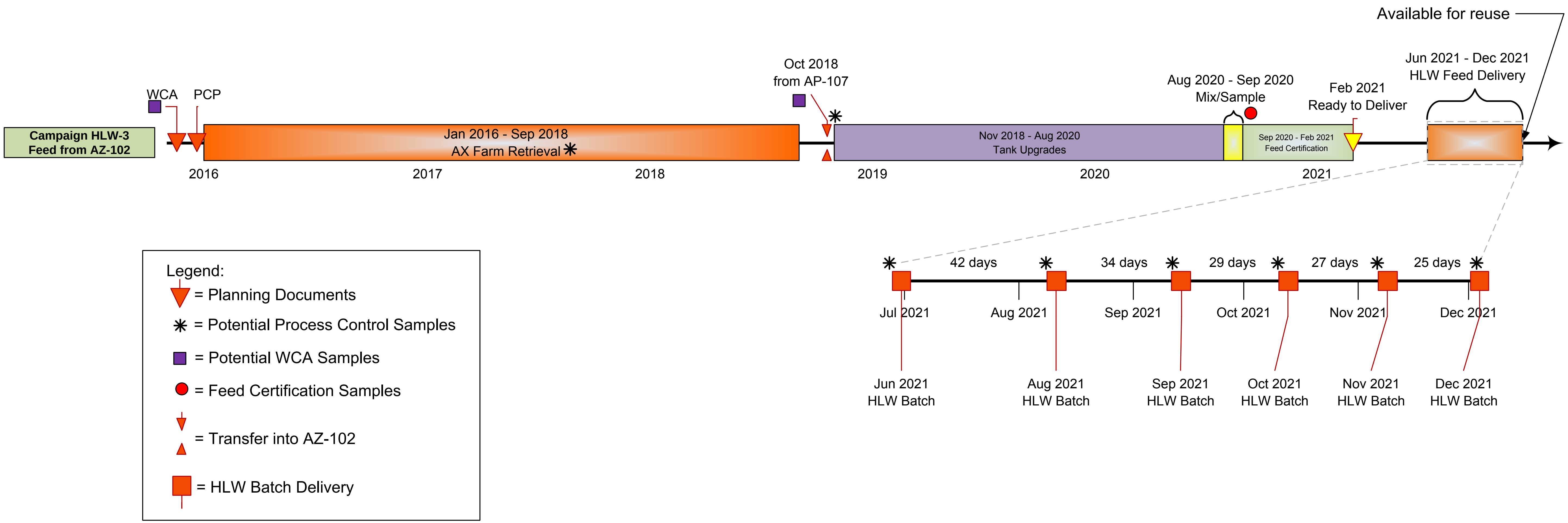

Figure 3-6. Feed Delivery Logic for Campaign HLW-3 (Tank AZ-102)

Table 3-12 summarizes a list of the upgrades required for Campaign HLW-3 and the associated schedule.

Table 3-12. Upgrades and Schedule – Campaign HLW-3 (High-Level Waste from Tank AZ-102)

Upgrade description	Purpose	Schedule
Mixer pumps (2)	Sludge mixing	11/2018 – 8/2020
Transfer pump for decant	LAW transfers	11/2018 – 8/2020
Transfer pump for slurry	HLW slurry transfers	11/2018 – 8/2020
Equipment removal	Remove unnecessary equipment	11/2018 – 8/2020

HLW = high-level waste.
LAW = low-activity waste.

3.4.2 Planning

Planning documents must be completed in time to provide support and analysis for each step of preparing a campaign for delivery. It is premature to develop planning documents to support Campaign HLW-3 at this time while the system is in a state of flux. Planning documents and more detailed assessments, such as process control plans, sample plans, and other documents shown on Table 2-4, will be completed closer to the date of delivery.

3.4.3 Feed Preparation

Currently, Tank AZ-102 has approximately 104 kgal of solid waste and about 815 kgal of liquid waste. In preparation for this HLW feed campaign, there are several waste transfers into and out of Tank AZ-102. The existing dilute supernate is planned to be decanted into Tank AW-102 to supply feed for an evaporator campaign. Supernate is transferred into Tank AZ-102 from Tank AZ-101, and then two years later, the same supernate is transferred out to Tank AP-103. This leaves Tank AZ-102 ready to accept SST retrievals from AX Farm. The feed preparation schedule is complex because all four AX Farm tanks are retrieved into Tank AZ-102, and between each retrieval, the excess supernate is decanted into Tank AW-102. After AX Farm retrievals are complete, Tank AZ-102 is topped off with supernate from Tank AP-107 to complete the feed preparation for Campaign HLW-2.

Table 3-13 provides a list of the associated waste transfers for Campaign HLW-3, including source tank, dates, and volumes (both solids and liquids). Associated flush water transfers are omitted from Table 3-13 for simplicity.

Table 3-13. Associated Waste Transfers – Campaign HLW-3 (High-Level Waste from Tank AZ-102)

Source tank	Receipt tank	Transfer date	Liquid volume (gal)	Solid volume (gal)
AZ-102	AW-102	6/8/2012	371,300	0
AZ-102	AW-102	6/18/2012	371,300	0
AZ-101	AZ-102	10/15/2012	823,647	343
AZ-102	AP-103	11/14/2014	863,994	356
AX-103	AZ-102	1/1/2016	863,155	1,331
AZ-102	AW-102	3/31/2016	855,791	0
AX-103	AZ-102	4/25/2016	312,166	482
AX-104	AZ-102	5/31/2016	291,655	2,065
AX-102	AZ-102	1/5/2017	246,933	171
AZ-102	AW-102	2/8/2017	838,183	0
AX-102	AZ-102	3/4/2017	607,588	421
AX-101	AZ-102	5/21/2017	229,886	288
AZ-102	AW-102	8/25/2017	831,335	0
AX-101	AZ-102	9/18/2017	830,294	1,041
AZ-102	AW-102	3/8/2018	825,424	0
AX-101	AZ-102	4/1/2018	824,391	1,034
AZ-102	AW-102	8/11/2018	693,627	0
AX-101	AZ-102	9/3/2018	603,437	757
AP-107	AZ-102	10/19/2018	89,433	0

3.4.4 Source of Waste

The majority of solid waste for Campaign HLW-3 is original waste in Tank AZ-102. The remainder of the waste originates from the four AX Farm tanks that were retrieved into Tank AZ-102 and a small amount of original high-heat waste from Tank AZ-101. The majority of liquid waste for this campaign originates from Tank AX-101. Tank AX-101 is the last tank to be retrieved into Tank AZ-102. The remainder of the supernate is concentrated evaporator bottoms originating from a variety of DSTs.

Figure 3-7 illustrates the fraction of waste from each source for Campaign HLW-3. This data is developed by tracing the waste back to the individual source tank, as included in the BBI.

3.4.5 Mixing and Sampling

There may be unique sampling requirements that are specific to this feed campaign because the feed will be prepared prior to the tank upgrade activities. It may be beneficial to take a full core sample of the tank contents after feed preparation and before tank upgrade activities to provide a head start to the WCA and other analyses. Detailed campaign-specific mixing and sampling requirements will be developed as the mission matures.

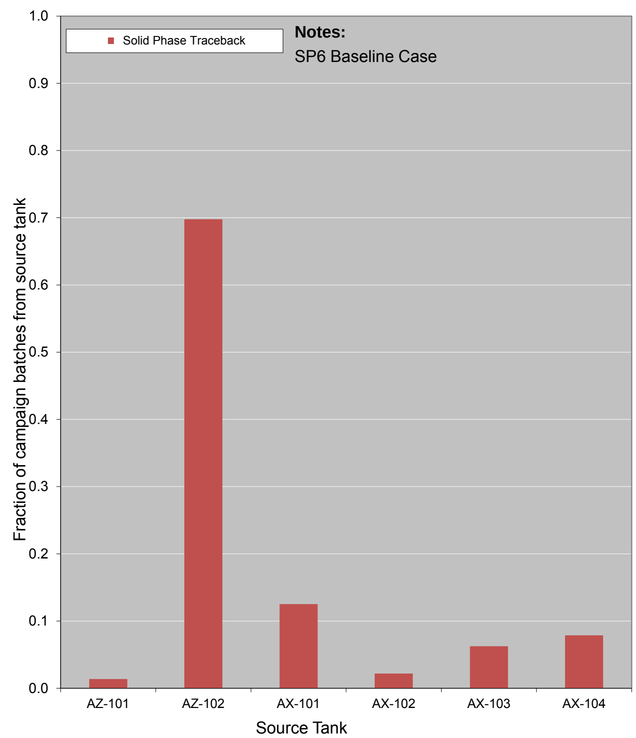

Figure 3-7. Source of Waste – Campaign HLW-3 (High-Level Waste from Tank AZ-102)

A detailed mixing and sampling procedure and process has not been fully developed. Conceptual assumptions and design, however, indicate some key features of the mixing and sampling system. The HLW campaigns will be sampled using a recirculation flow loop with a remote sampler. Mixing activities will be performed by mixer pumps, which will be operated until the tank contents are as homogeneous as possible. Once the tank is mixed, the recirculation flow loop sampling will be performed. The number of samples required for each campaign will be determined by projected tank compositions. As a projected component or criterion approaches a limit, more samples are necessary to achieve the required confidence that the true value for that criterion is within the limit. Sampling activities will be performed after all tank inventory preparation steps are complete. This will ensure that the final campaign composition will be sampled. Sample analysis will be completed during the 180 days following the sampling process and will verify the projected tank composition for certification of the waste prior to acceptance for treatment in the WTP.

In addition to sampling activities to support certification and delivery of waste to the WTP, there will be other samples taken to support WCAs and PCPs. Specifically, samples will be taken as necessary to provide enough information about the waste to complete a WCA. Other samples will also be required by the PCP to ensure that the transfers are compliant. Specific sampling requirements to support the WCA and PCP will be developed closer to the date of each transfer. Mixer pumps will need to operate prior to sampling and will add to equipment fatigue issues. Sampling events will be scheduled so that sufficient time is available for sampling and analysis for PCP changes, if necessary.

3.4.6 Feed Qualification and Certification

After mixing and sampling activities, an evaluation and analysis of the waste constituents in comparison to the waste acceptance criteria is performed. This evaluation is scheduled to take 180 days and will determine if the tank waste will be certified for feed delivery to the WTP.

The screening will test the waste sample for compliance with the Specification 7, Specification 8, CSL, and HGR limits.

The waste acceptance criteria DQO (24590-WTP-RPT-MGT-11-01) defines the waste acceptance criteria for feed delivery to the WTP. ICD-19 and the WTP Contract (DE-AC27-01RV14136) currently indicate that the feed must meet the limits in Specification 7 and Specification 8; however, the intention is to have the waste acceptance criteria DQO define which parameters must be met for delivery of feed.

Table 3-14 lists the out-of-specification constituents and/or criteria for Campaign HLW-3. Section 4.0 discusses the global implications of out-of-specification constituents per the criteria.

Table 3-14. Out-of-Specification Constituents per Criteria – Campaign HLW-3 (High-Level Waste from Tank AZ-102)

Screening	Waste acceptance criteria item	Parameter	Value	Limit
Specification 7, Table TS-7.1[a]	N	SO_4 (mol/mol Na)	0.0271	0.01 (Envelope A)[b]
Specification 8, Table TS-8.4[a]	N	Al (g/100g NVO)	15.5	14.0
Specification 8, Table TS-8.4[a]	N	Cr (g/100g NVO)	2.49	0.68
Specification 8, Table TS-8.4[a]	N	K (g/100g NVO)	2.28	1.30

[a] Specification 7 (LAW envelopes definition) and Specification 8 (HLW envelope definition) are included in Section C of the WTP Contract (DE-AC27-01RV14136).
[b] Envelope A refers to waste envelope definitions found in the WTP Contract (DE-AC27-01RV14136).

HLW = high-level waste.
LAW = low-activity waste.
NVO = non-volatile oxides.
WTP = Waste Treatment and Immobilization Plant.

The Specification 7 Envelope A limit on SO_4 concentration is exceeded in Campaign HLW-3 batches. The Envelope A limit is commonly exceeded, with 83 percent of the waste batches being out-of-specification. The SO_4 concentration is within the Envelope B specification.

The Campaign HLW-3 batches exceed the Specification 8 Envelope D limit on the aluminum, chromium, and potassium concentrations. The aluminum composition exceeds the Envelope D limit by 123 percent. Aluminum is a component that commonly exceeds the limit, with only 5.7 percent of the waste batches being in range. The chromium composition exceeds the Envelope D limit by 266 percent. It is common for the chromium concentration to exceed the limit, with 88 percent of the waste batches being out of specification. The potassium composition exceeds the Envelope D limit by 75 percent. It is uncommon for the potassium concentration to exceed the limit, as only 4.2 percent of the waste batches are out of specification. All three of these components are listed in Table TS-8.4 of Specification 8. Although the components listed in this table are important for HLW glass production, they will not be used as a basis for determining if the feed meets specification requirements.

The waste certification process to allow feed delivery to the WTP has not been finalized. If a waste batch is out of specification, an analysis is needed of the uncertainty associated with the estimate and the potential for the waste to be within the actual capability and safety envelope of WTP.

If sample analyses determine that the waste composition is unacceptable for delivery to WTP, mitigating actions will be performed to bring a tank into specification. These mitigation activities may include, but are not limited to, dilution of tank contents with water, caustic leaching, transfer of waste out of the feed tank to another DST, and the transfer of waste from another DST into the feed tank. Once the tank contents are deemed acceptable for delivery to the WTP, the waste campaign will be certified for delivery.

3.4.7 Delivery

Feed delivery from Tank AZ-102 consists of six HLW feed batches of 120 kgal each. The first feed batch is delivered in June 2021, and each successive batch is sent approximately one to two months later. The last feed batch is delivered in December 2021, for a total Campaign HLW-3 delivery duration of six months.

The solids volume and consequently solids concentration for this campaign is less than ideal, as the modeling wasn't aggressive enough to add additional solids to Tank AY-102 after AX Farm retrievals.

The transfer lines will be flushed with water to the WTP, 2,500 gal pre-transfer and 2,000 gal post-transfer, for a total of 4,500 gal to remove any residual waste from the transfer lines to prevent damage to the lines and reduce the risk of leaks. This transfer line flush is modeled as one transfer for simplicity.

Table 3-15 summarizes the delivery-related activities for Campaign HLW-3.

Table 3-15. Delivery-Related Activities – Campaign HLW-3 (High-Level Waste from Tank AZ-102)

Source	Description	Transfer date	Liquid volume (gal)	Solid volume (gal)
AZ-102	HLW feed batch	6/30/2021	117,036	2,964
Water	Transfer line flush	6/30/2021	4,500	0
AZ-102	HLW feed batch	8/11/2021	117,036	2,964
Water	Transfer line flush	8/11/2021	4,500	0
AZ-102	HLW feed batch	9/14/2021	117,036	2,964
Water	Transfer line flush	9/15/2021	4,500	0
AZ-102	HLW feed batch	10/13/2021	117,036	2,964
Water	Transfer line flush	10/14/2021	4,500	0
AZ-102	HLW feed batch	11/9/2021	117,036	2,964
Water	Transfer line flush	11/10/2021	4,500	0
AZ-102	HLW feed batch	12/4/2021	117,036	2,964
Water	Transfer line flush	12/5/2021	4,500	0

HLW = high-level waste.

After finishing delivery of Campaign HLW-3, Tank AZ-102 is available for reuse as a feed tank and will provide HLW feed to the WTP in later campaigns.

3.5 CAMPAIGN HLW-4 – HIGH-LEVEL WASTE FROM TANK AY-102

Figure 3-8 illustrates the feed delivery logic for Campaign HLW-4, including the timing for planning documents, feed preparation steps, mixing and sampling activities, and the HLW deliveries. The timing for the planning documents is included to give a relative approximation of when each document will be completed. It is premature to develop a definitive schedule for these documents at this time. Markers indicating potential sampling activities are also included to emphasize the quantity and relative timing of the required samples.

There are noticeable issues with the current feed delivery logic for this campaign, which are discussed in more detail in Section 8.0.

- Very little schedule contingency exists between feed deliveries from Campaign LAW-1/HLW-1 (HC) and feed preparation activities in this campaign.
- Feed tank and contents are subject to change.

3.5.1 Upgrades

The upgrades described in this section pertain to the equipment associated with Tank AY-102 that is needed to support WFD for this campaign. IWFDP Volume 3 identifies the full set of upgrades necessary for the WFD system. This campaign relies on numerous tank-specific and general infrastructure upgrades, including those required to support other retrievals, staging, and delivery activities.

No tank upgrades are necessary to support this campaign. Tank AY-102 is used to deliver hot commissioning feed in Campaign LAW-1/HLW-1 (HC), and all necessary tank upgrades needed to support Campaign HLW-4 delivery activities will be completed prior to Campaign LAW-1/HLW-1 (HC).

3.5.2 Planning

Planning documents must be completed in time to provide support and analysis for each step in preparing a campaign for delivery. It is premature to develop planning documents to support Campaign HLW-4 at this time while the system is in a state of flux. Planning documents and more detailed assessments, such as process control plans, sample plans, and other documents shown on Table 2-4, will be completed closer to the date of delivery.

3.5.3 Feed Preparation

Tank AY-102 is used as the hot commissioning feed tank to supply the first feed to the WTP in 2018. After the last hot commissioning feed delivery in February 2020, Tank AY-102 is immediately available for reuse. Ten days later, it receives HLW feed from Tank AZ-101. A week later, Tank AY-102 receives a supernate transfer from Tank AP-105, concluding the feed preparation transfers associated with Campaign HLW-4. The transfer from Tank AZ-101 satisfies the solids requirements for this HLW feed batch, and the supernate transfer from Tank AP-105 provides the necessary liquids to support this HLW feed campaign.

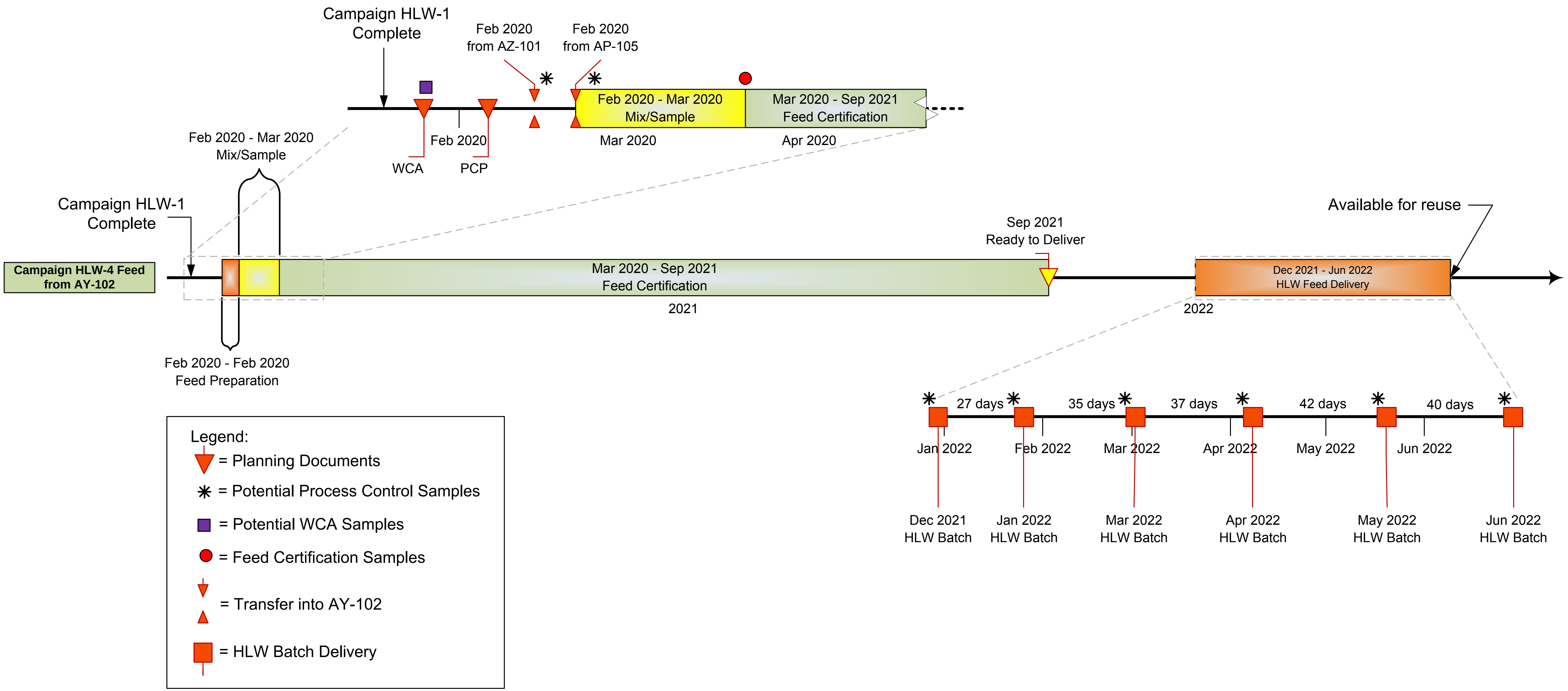

Figure 3-8. Feed Delivery Logic for Campaign HLW-4 (Tank AY-102)

Table 3-16 provides a list of the associated waste transfers for Campaign HLW-4, including source tank, dates, and volumes (both solids and liquids).

Table 3-16. Associated Waste Transfers – Campaign HLW-4 (High-Level Waste from Tank AY-102)

Source tank	Receipt tank	Transfer date	Liquid volume (gal)	Solid volume (gal)
Water	AY-102	2/9/2020	500[a]	0
AZ-101	AY-102	2/14/2020	352,217	26,683
Water	AY-102	2/16/2020	500[a]	0
AP-105	AY-102	2/21/2020	347,521	0

[a] Transfer line flushes are modeled prior to the waste transfer to ensure that space is available for the flush.

3.5.4 Source of Waste

The majority of waste for Campaign HLW-4 originates from Tank C-102, which is retrieved into Tank AZ-101. A small amount of original high-heat Tank AZ-101 waste is also present in this campaign. The remainder of the solid waste originates from Tank AY-102; this is the solid waste that was not delivered in Campaign LAW-1/HLW-1 (HC). The liquid waste from this campaign originates from a variety of DSTs, as the supernate is mixed as a result of DST-to-DST transfers and 242-A Evaporator campaigns.

Figure 3-9 illustrates the fraction of waste from each source for Campaign HLW-4. This data is developed by tracing the waste back to the individual source tank, as included in the BBI.

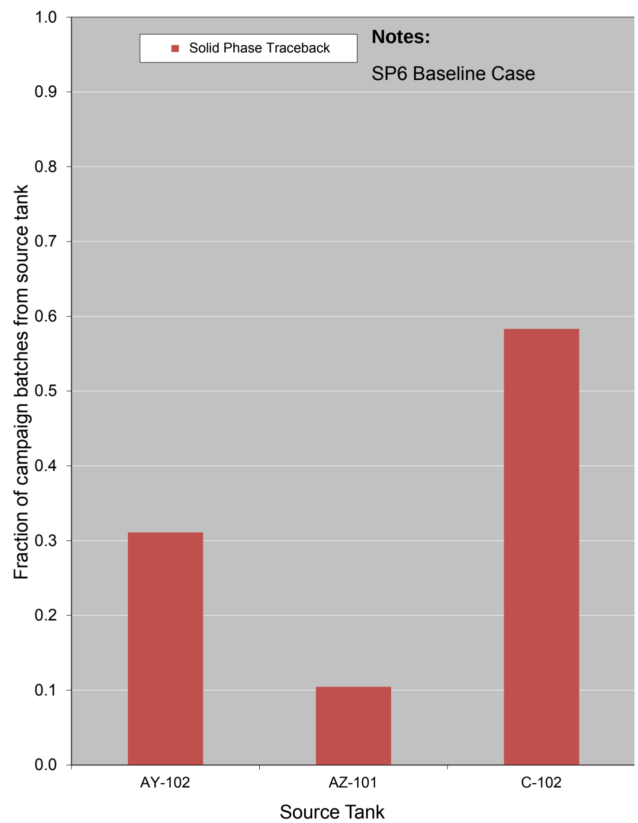

Figure 3-9. Source of Waste – Campaign HLW-4 (High-Level Waste from Tank AY 102)

3.5.5 Mixing and Sampling

There are no unique or special mixing and sampling requirements that are specific to this feed campaign. Detailed campaign-specific mixing and sampling requirements will be developed as the mission matures.

A detailed mixing and sampling procedure and process has not been fully developed. Conceptual assumptions and design, however, indicate some key features of the mixing and sampling system. The HLW campaigns will be sampled using a recirculation flow loop with a remote sampler. Mixing activities will be performed by mixer pumps, which will be operated until the tank contents are as homogeneous as possible. Once the tank is mixed, the recirculation flow loop sampling will be performed. The number of samples required for each campaign will be determined by projected tank compositions. As a projected component or criterion approaches a limit, more samples are necessary to achieve the required confidence that the true value for that criterion is within the limit. Sampling activities will be performed after all tank inventory preparation steps are complete. This will ensure that the final campaign composition will be sampled. Sample analysis will be completed during the 180 days following the sampling process and will verify the projected tank composition for certification of the waste prior to acceptance for treatment in the WTP.

In addition to sampling activities to support certification and delivery of waste to the WTP, there will be other samples taken to support WCAs and PCPs. Specifically, samples will be taken as necessary to provide enough information about the waste to complete a WCA. Other samples will also be required by the PCP to ensure that the transfers are compliant. Specific sampling requirements to support the WCA and PCP will be developed closer to the date of each transfer. Mixer pumps will need to operate prior to sampling and will add to equipment fatigue issues. Sampling events will be scheduled so that sufficient time is available for sampling and analysis for PCP changes, if necessary.

3.5.6 Feed Qualification and Certification

After mixing and sampling activities, an evaluation and analysis of the waste constituents in comparison to the waste acceptance criteria is performed. This evaluation is scheduled to take 180 days and will determine if the tank waste is acceptable for feed delivery to the WTP. The screening will test the waste sample for compliance with the Specification 7, Specification 8, CSL, and HGR limits.

The waste acceptance criteria DQO (24590-WTP-RPT-MGT-11-01) defines the waste acceptance criteria for feed delivery to the WTP. ICD-19 and the WTP Contract (DE-AC27-01RV14136) currently indicate that the feed must meet the limits in Specification 7 and Specification 8; however, the intention is to have the waste acceptance criteria DQO define which parameters must be met for delivery of feed.

Table 3-17 lists the out-of-specification constituents and/or criteria for Campaign HLW-4. Section 4.0 discusses the global implications of out-of-specification constituents per the criteria.

The Specification 7 Envelope A limit on SO_4 is exceeded in Campaign HLW-4 batches. This Envelope A limit is commonly out of specification, with 83 percent of the waste batches exceeding the limit. The SO_4 concentration is within the Envelope B limit for these HLW batches.

Table 3-17. Out-of-Specification Constituents per Criteria – Campaign HLW-4 (High-Level Waste from Tank AY-102)

Screening	Waste acceptance criteria item	Parameter	Value	Limit
Specification 7, Table TS-7.1[a]	N	SO_4 (mol/mol Na)	0.0131	0.01 (Envelope A)[b]
Specification 8, Table TS-8.3[a]	N	^{233}U (Ci/100g NVO)	9.29E-06	4.50E-06
Specification 8, Table TS-8.4[a]	N	Al (g/100g NVO)	30.6	14.0

[a] Specification 7 (LAW envelopes definition) and Specification 8 (HLW envelope definition) are included in Section C of the WTP Contract (DE-AC27-01RV14136).
[b] Envelope A refers to waste envelope definitions provided in the WTP Contract (DE-AC27-01RV14136).

HLW = high-level waste.
LAW = low-activity waste.
NVO = non-volatile oxides.
WTP = Waste Treatment and Immobilization Plant.

The Campaign HLW-4 batches exceed the Specification 8 Envelope D limit on the ^{233}U concentration by 106 percent. The basis for this limit is to establish the waste oxide loading in the HLW glass, and has no specific criticality safety implications. Subsequent HLW feed batches have very low ^{233}U concentrations. The main contributor of this high ^{233}U concentration is waste originating from Tank C-102. An evaluation of the importance and necessity of this limit should be completed to determine if the limit can be eliminated or alleviated. If necessary, adjusted SST retrieval planning or development of an intentional blending strategy for this waste could reduce the ^{233}U concentration for this campaign.

The Campaign HLW-4 batches exceed the Specification 8 Envelope D limit on the aluminum concentration. The aluminum composition exceeds the Envelope D limit by 119 percent. Aluminum is a component that commonly exceeds the limit, with only 5.7 percent of the waste batches being in range. Aluminum is listed in Table TS-8.4 of Specification 8. Although the components listed in this table are important for HLW glass production, they will not be used as a basis for determining if the feed meets specification requirements.

The waste certification process to allow feed delivery to the WTP has not been finalized. If a waste batch is out of specification, an analysis is needed of the uncertainty associated with the estimate and the potential for the waste to be within the actual capability and safety envelope of WTP. If sample analyses determine that the waste composition is unacceptable for delivery to WTP, mitigating actions will be performed to bring a tank into specification. These mitigation activities may include, but are not limited to, dilution of tank contents with water, caustic leaching, transfer of waste out of the feed tank to another DST, and the transfer of waste from another DST into the feed tank. Once the tank contents are deemed acceptable for delivery to the WTP, the waste campaign will be certified for delivery.

3.5.7 Delivery

Feed delivery from Tank AY-102 in Campaign HLW-4 consists of six HLW feed batches of 120 kgal each. The first feed batch is delivered in December 2021, and each successive batch is sent approximately one to two months later. The last feed batch is delivered in June 2022, for a total Campaign HLW-4 delivery duration of six months.

The transfer lines will be flushed with water to the WTP, 2,500 gal pre-transfer and 2,000 gal post-transfer, for a total of 4,500 gal to remove any residual waste from the transfer lines to prevent damage to the lines and reduce the risk of leaks. This transfer line flush is modeled as one transfer for simplicity.

Table 3-18 summarizes the delivery-related activities for Campaign HLW-4.

Table 3-18. Delivery-Related Activities – Campaign HLW-4 (High-Level Waste from Tank AY-102)

Source	Description	Transfer date	Liquid volume (gal)	Solid volume (gal)
AY-102	HLW feed batch	12/30/2021	115,380	4,620
Water	Transfer line flush	12/30/2021	4,500	0
AY-102	HLW feed batch	1/26/2022	115,380	4,620
Water	Transfer line flush	1/27/2022	4,500	0
AY-102	HLW feed batch	3/2/2022	115,380	4,620
Water	Transfer line flush	3/2/2022	4,500	0
AY-102	HLW feed batch	4/8/2022	115,380	4,620
Water	Transfer line flush	4/9/2022	4,500	0
AY-102	HLW feed batch	5/20/2022	115,380	4,620
Water	Transfer line flush	5/20/2022	4,500	0
AY-102	HLW feed batch	6/29/2022	115,380	4,620
Water	Transfer line flush	6/30/2022	4,500	0

HLW = high-level waste.

After finishing delivery of Campaign HLW-4, Tank AY-102 is available for reuse as a dedicated feed tank and will provide HLW feed to the WTP in later campaigns.

3.6 CAMPAIGN HLW-5 – HIGH-LEVEL WASTE FROM TANK AW-105

Figure 3-10 illustrates the feed delivery logic for Campaign HLW-5, including the timing for planning documents, feed preparation steps, mixing and sampling activities, and the HLW deliveries. The timing for the planning documents is included to give a relative approximation of when each document will be completed. It is premature to develop a definitive schedule for these documents at this time. Markers indicating potential sampling activities are also included to emphasize the quantity and relative timing of the required samples.

There are noticeable issues with the current feed delivery logic for this campaign, which are discussed in more detail in Section 8.0.

- Very little schedule contingency exists between feed deliveries from Campaign HLW-2 and feed preparation activities in this campaign.
- The long length of transfer from AW Farm to the WTP results in increased reliability risk and potential pressure drop concerns.
- Feed tank and contents are subject to change.

3.6.1 Upgrades

The upgrades described in this section pertain to the equipment associated with Tank AW-105 that is needed to support WFD for this campaign. IWFDP Volume 3 identifies the full set of upgrades necessary for the WFD system. This campaign relies on numerous tank-specific and general infrastructure upgrades, including those required to support other retrievals, staging, and delivery activities.

No tank upgrades are necessary to support this campaign. Tank AW-105 is used to deliver HLW feed in Campaign HLW-2, and all necessary tank upgrades needed to support Campaign HLW-5 delivery activities will be completed prior to Campaign HLW-2.

3.6.2 Planning

Planning documents must be completed in time to provide support and analysis for each step in preparing a campaign for delivery. It is premature to develop planning documents to support Campaign HLW-5 at this time while the system is in a state of flux. Planning documents and more detailed assessments, such as process control plans, sample plans, and other documents shown on Table 2-4, will be completed closer to the date of delivery.

3.6.3 Feed Preparation

Tank AW-105 is used to deliver HLW feed in Campaign HLW-2 in 2020. After the last Campaign HLW-2 HLW feed delivery in 2021, Tank AW-105 is immediately available for reuse. A week later, it receives HLW feed from Tank AN-106. Shortly after that, Tank AW-105 is topped off with supernate from Tank AP-105. The transfer from Tank AN-106 satisfies the solids requirements for this HLW feed batch, and the supernate transfer from Tank AP-105 provides the necessary liquids to support this HLW feed campaign. A 500-gal water addition ensures that the slurry transfer line is flushed out after each solids transfer.

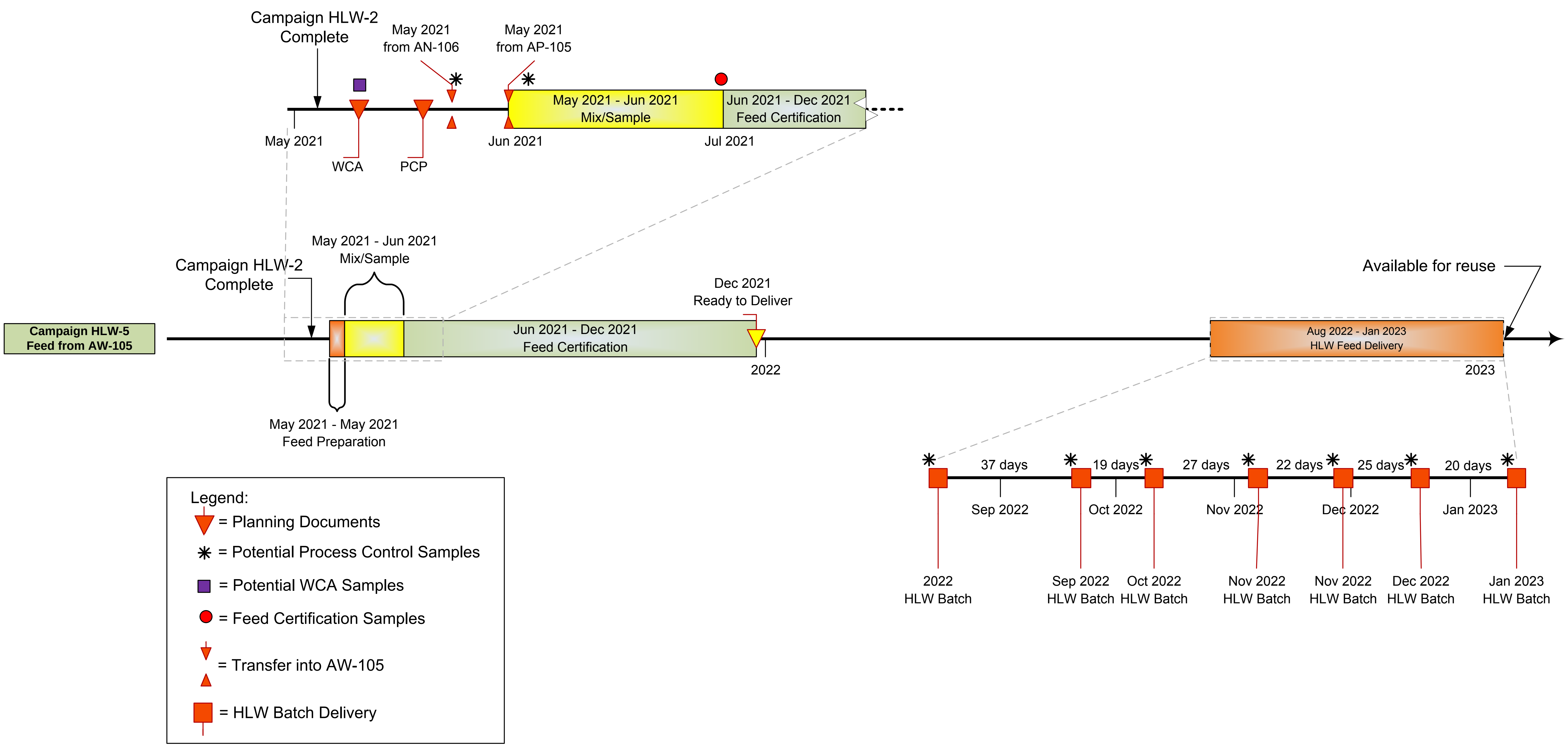

Figure 3-10. Feed Delivery Logic for Campaign HLW-5 (Tank AW-105)

Table 3-19 provides a list of the associated waste transfers for Campaign HLW-5, including source tank, dates, and volumes (both solids and liquids).

Table 3-19. Associated Waste Transfers – Campaign HLW-5 (High-Level Waste from Tank AW-105)

Source tank	Receipt tank	Transfer date	Liquid volume (gal)	Solid volume (gal)
Water	AW-105	5/23/2021	500[a]	0
AN-106	AW-105	5/23/2021	514,723	29,377
Water	AW-105	5/26/2021	500[a]	0
AP-105	AW-105	5/31/2021	294,764	136

[a] Transfer line flushes are modeled prior to the waste transfer to ensure that space is available for the flush.

3.6.4 Source of Waste

The majority of solid waste for Campaign HLW-5 originates from Tank C-107. Tank C-107 is retrieved into Tank AN-106 and is then transferred into Tank AW-105. The remainder of solid waste from Campaign HLW-5 is leftover Tank C-102, AZ-101, and AW-105 waste from Campaign HLW-2. The liquids associated with this campaign originate from a variety of DSTs as a result of various transfers and evaporator campaigns.

Figure 3-11 illustrates the fraction of waste from each source for Campaign HLW-5. This data is developed by tracing the waste back to the individual source tank, as included in the BBI.

3.6.5 Mixing and Sampling

There are no unique or special mixing and sampling requirements that are specific to this feed campaign. Detailed campaign-specific mixing and sampling requirements will be developed as the mission matures.

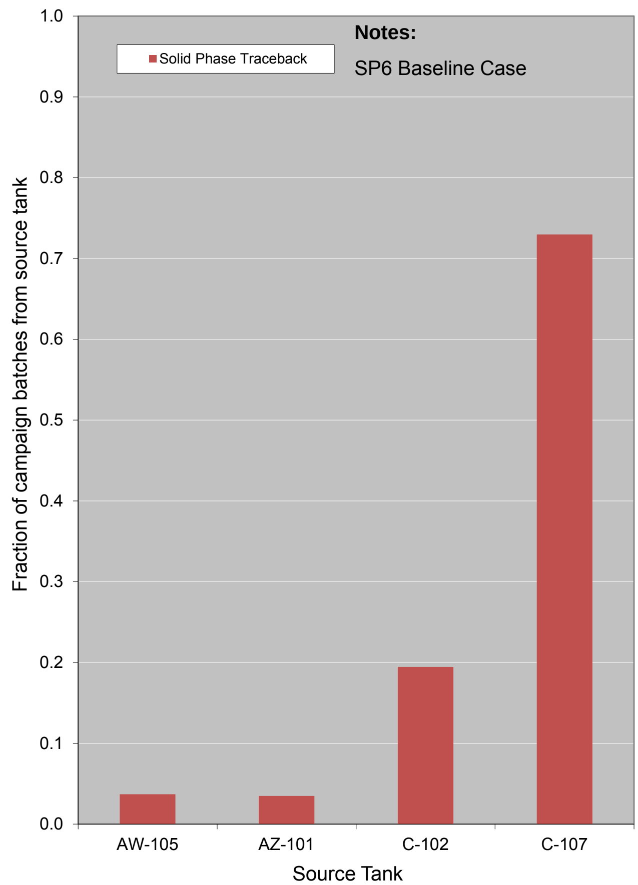

Figure 3-11. Source of Waste – Campaign HLW-5 (High-Level Waste from Tank AW-105)

A detailed mixing and sampling procedure and process has not been fully developed. Conceptual assumptions and design, however, indicate some key features of the mixing and sampling system. The HLW campaigns will be sampled using a recirculation flow loop with a remote sampler. Mixing activities will be performed by mixer pumps, which will be operated until the tank contents are as homogeneous as possible. Once the tank is mixed, the recirculation flow loop sampling will be performed. The number of samples required for each campaign will be determined by projected tank compositions. As a projected component or criterion approaches a limit, more samples are necessary to achieve the required confidence that the true value for that criterion is within the limit. Sampling activities will be performed after all tank inventory preparation steps are complete. This will ensure that the final campaign composition will be sampled. Sample analysis will be completed during the 180 days following the sampling process and will verify the projected tank composition for certification of the waste prior to acceptance for treatment in the WTP.

In addition to sampling activities to support certification and delivery of waste to the WTP, there will be other samples taken to support WCAs and PCPs. Specifically, samples will be taken as necessary to provide enough information about the waste to complete a WCA. Other samples will also be required by the PCP to ensure that the transfers are compliant. Specific sampling requirements to support the WCA and PCP will be developed closer to the date of each transfer. Mixer pumps will need to operate prior to sampling and will add to equipment fatigue issues. Sampling events will be scheduled so that sufficient time is available for sampling and analysis for PCP changes, if necessary.

3.6.6 Feed Qualification and Certification

After mixing and sampling activities, an evaluation and analysis of the waste constituents in comparison to the waste acceptance criteria is performed. This evaluation is scheduled to take 180 days and will determine if the tank waste is acceptable for feed delivery to the WTP. The screening will test the waste sample for compliance with the Specification 7, Specification 8, CSL, and HGR limits.

The waste acceptance criteria DQO (24590-WTP-RPT-MGT-11-01) defines the waste acceptance criteria for feed delivery to the WTP. ICD-19 and the WTP Contract (DE-AC27-01RV14136) currently indicate that the feed must meet the limits in Specification 7 and Specification 8; however, the intention is to have the waste acceptance criteria DQO define which parameters must be met for delivery of feed.

Table 3-20 lists the out-of-specification constituents and/or criteria for Campaign HLW-5. Section 4.0 discusses the global implications of out-of-specification constituents per the criteria.

Table 3-20. Out-of-Specification Constituents per Criteria – Campaign HLW-5 (High-Level Waste from Tank AW-105)

Screening	Waste acceptance criteria item	Parameter	Value	Limit
Specification 7, Table TS-7.1[a]	N	SO_4 (mol/mol Na)	0.0148	0.01 (Envelope A)[b]
Specification 8, Table TS-8.4[a]	N	Al (g/100g NVO)	17.9	14.0
Specification 8, Table TS-8.4[a]	N	Pb (g/100g NVO)	1.67	1.10

[a] Specification 7 (LAW envelopes definition) and Specification 8 (HLW envelope definition) are included in Section C of the WTP Contract (DE-AC27-01RV14136).
[b] Envelope A refers to waste envelope definitions provided in the WTP Contract (DE-AC27-01RV14136).

HLW = high-level waste.
LAW = low-activity waste.
NVO = non-volatile oxides.
WTP = Waste Treatment and Immobilization Plant.

The Specification 7 Envelope A limit on SO_4 is exceeded in Campaign HLW-5 batches. This Envelope A limit is commonly out-of-specification, with 83 percent of the waste batches exceeding the limit. The SO_4 concentration is within the Envelope B limit for the Campaign HLW-5 batches.

The Campaign HLW-5 batches exceed the Specification 8 Envelope D limit on both the aluminum and lead concentrations. The aluminum composition exceeds the Envelope D limit by 28 percent. Aluminum is a component that commonly exceeds the limit, with only 5.7 percent of the waste batches being in range. The lead concentration exceeds the Envelope D limit by 52 percent. Both aluminum and lead are listed in Table TS-8.4 of Specification 8. Although the components listed in this table are important for HLW glass production, they will not be used as a basis for determining if the feed meets specification requirements.

The waste certification process to allow delivery to the WTP has not been finalized. If a waste batch is out of specification, an analysis is needed of the uncertainty associated with the estimate and the potential for the waste to be within the actual capability and safety envelope of WTP. If sample analyses determine that the waste composition is unacceptable for delivery to WTP, mitigating actions will be performed to bring a tank into specification. These mitigation activities may include, but are not limited to, dilution of tank contents with water, caustic leaching, transfer of waste out of the feed tank to another DST, and the transfer of waste from another DST into the feed tank. Once the tank contents are deemed acceptable for delivery to the WTP, the waste campaign will be certified for delivery.

3.6.7 Delivery

There are concerns about the suitability of using Tank AW-105 as a feed delivery tank because of pressure drop issues involved with transferring waste from AW Farm to the WTP. Further discussion of this issue is included in Section 8.0.

Feed delivery from Tank AW-105 in Campaign HLW-5 consists of seven HLW feed batches of 120 kgal each. The first feed batch is delivered in August 2022, and each successive batch is sent approximately one month later. The last feed batch is delivered in January 2023, for a total Campaign HLW-5 delivery duration of five months.

The transfer lines will be flushed with water to the WTP, 2,500 gal pre-transfer and 2,000 gal post-transfer, for a total of 4,500 gal to remove any residual waste from the transfer lines to prevent damage to the lines and reduce the risk of leaks. This transfer line flush is modeled as one transfer for simplicity.

Table 3-21 summarizes the delivery-related activities for Campaign HLW-5.

Table 3-21. Delivery-Related Activities – Campaign HLW-5 (High-Level Waste from Tank AW-105)

Source	Description	Transfer date	Liquid volume (gal)	Solid volume (gal)
AW-105	HLW feed batch	8/16/2022	115,786	4,214
Water	Transfer line flush	8/17/2022	4,500	0
AW-105	HLW feed batch	9/22/2022	115,786	4,214
Water	Transfer line flush	9/23/2022	4,500	0
AW-105	HLW feed batch	10/11/2022	115,786	4,214
Water	Transfer line flush	10/11/2022	4,500	0
AW-105	HLW feed batch	11/7/2022	115,786	4,214
Water	Transfer line flush	11/8/2022	4,500	0
AW-105	HLW feed batch	11/29/2022	115,786	4,214
Water	Transfer line flush	11/29/2022	4,500	0
AW-105	HLW feed batch	12/19/2022	115,786	4,214
Water	Transfer line flush	12/20/2022	4,500	0
AW-105	HLW feed batch	1/13/2023	115,786	4,214
Water	Transfer line flush	1/14/2023	4,500	0

HLW = high-level waste.

After finishing delivery of Campaign HLW-5, Tank AW-105 is available for reuse as a dedicated feed tank and will provide HLW feed to the WTP in later campaigns.

3.7 CAMPAIGN LAW-3 – LOW-ACTIVITY WASTE FROM TANK AP-104

Figure 3-12 illustrates the feed delivery logic for Campaign LAW-3, including the timing for planning documents, feed preparation steps, mixing and sampling activities, and LAW delivery. The timing for the planning documents is included to give a relative approximation of when each document will be completed. It is premature to develop a definitive schedule for these documents at this time. Markers indicating potential sampling activities are also included to emphasize the quantity and relative timing of the required samples.

There are noticeable issues with the current feed delivery logic for this campaign, which are discussed in more detail in Section 8.0.

- Very little schedule contingency exists between feed deliveries from Campaign LAW-2 and feed preparation activities in this campaign.
- Feed tank and contents are subject to change.

3.7.1 Upgrades

The upgrades described in this section pertain to the equipment associated with Tank AP-104 that is needed to support WFD for this campaign. IWFDP Volume 3 identifies the full set of upgrades necessary for the WFD system. This campaign relies on numerous tank-specific and general infrastructure upgrades, including those required to support other retrievals, staging, and delivery activities.

No tank upgrades are necessary to support this campaign. Tank AP-104 is used to deliver LAW in Campaign LAW-2, and all necessary tank upgrades needed to support Campaign LAW-3 delivery activities will be completed prior to Campaign LAW-2.

3.7.2 Planning

Planning documents must be completed in time to provide support and analysis for each step of preparing a campaign for delivery. It is premature to develop planning documents to support Campaign LAW-3 at this time while the system is in a state of flux. Planning documents and more detailed assessments, such as process control plans, sample plans, and other documents shown on Table 2-4, will be completed closer to the date of delivery.

3.7.3 Feed Preparation

Tank AP-104 is used to deliver LAW feed in Campaign LAW-2 in 2020. After the Campaign LAW-2 feed delivery, Tank AP-104 is immediately available for reuse. Two weeks later, it receives LAW feed from Tank AP-103. Shortly after that, Tank AP-104 is topped off with supernate from Tank AP-101. Both of these supernate transfers combine to produce a full LAW feed campaign of approximately 1 Mgal. A 500-gal water addition ensures that the transfer line is flushed out after each transfer.

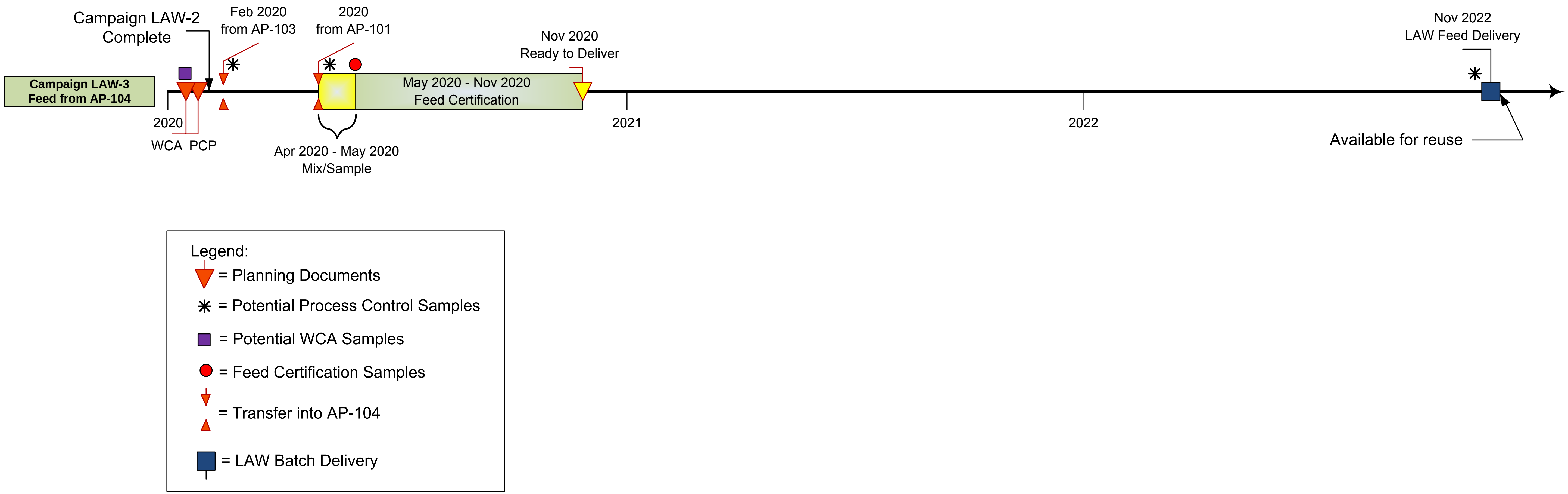

Figure 3-12. Feed Delivery Logic for Campaign LAW-3 (Tank AP-104)

Table 3-22 provides a list of the associated waste transfers for Campaign LAW-3, including source tank, dates, and volumes (both solids and liquids).

Table 3-22. Associated Waste Transfers – Campaign LAW-3 (Low-Activity Waste from Tank AP-104)

Source tank	Receipt tank	Transfer date	Liquid volume (gal)	Solid volume (gal)
Water	AP-104	2/9/2020	500[a]	0
AP-103	AP-104	2/14/2020	728,849	85
Water	AP-104	4/29/2020	500[a]	0
AP-101	AP-104	4/30/2020	300,889	0

[a] Transfer line flushes are modeled prior to the waste transfer to ensure that space is available for the flush.

3.7.4 Source of Waste

The source of the liquid waste from Campaign LAW-3 can be traced back to a variety of DSTs. As a result of the numerous DST-to-DST transfers required to carry out the mission, incidental blending of the supernates and evaporator campaigns causes the source of the waste for this LAW feed campaign to be distributed across several tanks. Approximately 50 percent of the LAW waste can be traced back to AP Farm, specifically Tanks AP-101 and AP-103. Another 25 percent can be traced back to AZ Farm, and the rest of the feed for this batch can be traced back to a variety of source tanks.

Figure 3-13 illustrates the fraction of waste from each source for Campaign LAW-3. Only tanks with at least 5 percent of the LAW feed batch are displayed on the chart for simplicity. This data is developed by tracing the waste back to the individual source tank, as included in the BBI.

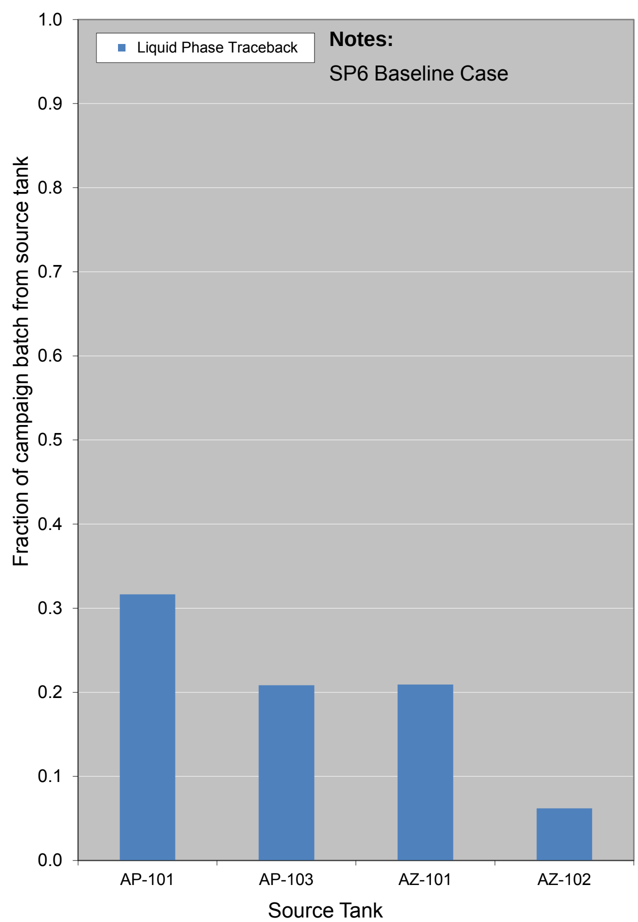

Figure 3-13. Source of Waste – Campaign LAW-3 (Low-Activity Waste from Tank AP-104)

3.7.5 Sampling

There are no unique or special sampling requirements that are specific to this feed campaign. Detailed campaign-specific sampling requirements will be developed as the mission matures.

A detailed sampling procedure and process has not been fully developed. Conceptual assumptions and design, however, indicate some key features of the sampling system. The LAW campaigns will be sampled using grab samples. The number of samples required for each campaign will be determined by projected tank compositions. As a projected component or criterion approaches a limit, more samples are necessary to achieve the required confidence that the true value for that criterion is within the limit. Sampling activities will be performed after all tank inventory preparation steps are complete. This will ensure that the final campaign composition will be sampled. Sample analysis will be completed during the 180 days following the sampling process, and will verify the projected tank composition for certification of the waste prior to acceptance for treatment in the WTP.

In addition to sampling activities to support certification and delivery of waste to the WTP, there will be other samples taken to support WCAs and PCPs. Specifically, samples will be taken as necessary to provide enough information about the waste to complete a WCA. Other samples will also be required by the PCP to ensure that the transfers are compliant. Specific sampling requirements to support the WCA and PCP will be developed closer to the date of each transfer. Sampling events will be scheduled so that sufficient time is available for sampling and analysis for PCP changes, if necessary.

3.7.6 Feed Qualification and Certification

After mixing and sampling activities, an evaluation and analysis of the waste constituents in comparison to the waste acceptance criteria is performed. This evaluation is scheduled to take 180 days and will determine if the tank waste is acceptable for feed delivery to the WTP. The screening will test the waste sample for compliance with the Specification 7, Specification 8, CSL, and HGR limits.

The waste acceptance criteria DQO (24590-WTP-RPT-MGT-11-01) defines the waste acceptance criteria for feed delivery to the WTP. ICD-19 and the WTP Contract (DE-AC27-01RV14136) currently indicate that the feed must meet the limits in Specification 7 and Specification 8; however, the intention is to have the waste acceptance criteria DQO define which parameters must be met for delivery of feed.

Table 3-23 lists the out-of-specification constituents and/or criteria for Campaign LAW-3. Section 4.0 discusses the global implications of out-of-specification constituents per the criteria.

Table 3-23. Out-of-Specification Constituents per Criteria – Campaign LAW-3 (Low-Activity Waste from Tank AP-104)

Screening	Waste acceptance criteria item	Parameter	Value	Limit
Specification 7, Table TS-7.1[a]	N	SO_4 (mol/mol Na)	0.0171	0.01 (Envelope A)[b]
Specification 7, Table TS-7.2[a]	N	TRU (Ci/mol Na)	19.4	13.0 (Envelope A/B)[b]

[a] Specification 7 (LAW envelopes definition) is included in Section C of the WTP Contract (DE-AC27-01RV14136).

[b] Envelope A/B refers to the waste envelope definitions provided in the WTP Contract (DE-AC27-01RV14136).

LAW = low-activity waste.
TRU = transuranic.
WTP = Waste Treatment and Immobilization Plant.

The Specification 7 Envelope A limit on SO_4 is exceeded in the Campaign LAW-3 batch. This Envelope A limit is commonly out-of-specification, with 83 percent of the waste batches exceeding the limit. The SO_4 concentration is within the Envelope B limit for the Campaign LAW-3 batch.

The Specification 7 Envelope A and B limits on TRU are exceeded in the Campaign LAW-3 batch. The TRU concentration exceeds the Envelope A and B limits by 49 percent. If the glass projected from this feed batch exceeds the LAW glass limits, then blending of this waste would be considered. Currently, the glass screening capability is not available, but this potential future enhancement would help confirm the implications of projected feed.

The waste certification process to allow delivery to the WTP has not been finalized. If a waste batch is out of specification, an analysis is needed of the uncertainty associated with the estimate and the potential for the waste to be within the actual capability and safety envelope of WTP. If sample analyses determine that the waste composition is unacceptable for delivery to WTP, mitigating actions will be performed to bring a tank into specification. These mitigation activities may include, but are not limited to, dilution of tank contents with water, caustic leaching, transfer of waste out of the feed tank to another DST, and the transfer of waste from another DST into the feed tank. Once the tank contents are deemed acceptable for delivery to the WTP, the waste campaign will be certified for delivery.

3.7.7 Delivery

The delivery of the Campaign LAW-3 batch from Tank AP-104 will occur in November 2022. LAW feed is transferred to the WTP as one large transfer of approximately 1 Mgal, including the water additions for the transfer line flush. The WTP receives the LAW feed batch into four LAW receipt tanks, each with a capacity of 250 kgal. It should be noted that this LAW feed delivery occurs between the fourth and fifth HLW feed batch from Tank AW-105 in Campaign HLW-5. It is not anticipated that these campaigns will disrupt one another because the waste will be transferred through different transfer lines and into different receipt tanks within the WTP. However, special coordination will still need to occur to ensure that the feed deliveries from the two campaigns can be carried out without interference.

The transfer lines will be flushed with water to the WTP, 2,500 gal pre-transfer and 2,000 gal post-transfer, for a total of 4,500 gal to remove any residual waste from the transfer lines to prevent damage to the lines and reduce the risk of leaks. This transfer line flush is modeled as one transfer for simplicity.

Table 3-24 summarizes the delivery-related activities for Campaign LAW-3.

Table 3-24. Delivery-Related Activities – Campaign LAW-3 (Low-Activity Waste from Tank AP-104)

Source	Description	Transfer date	Liquid volume (gal)	Solid volume (gal)
AP-104	LAW feed batch	11/22/2022	995,500	0
Water	Transfer line flush	11/27/2022	4,500	0

LAW = low-activity waste.

After finishing the LAW delivery, Tank AP-104 is available for reuse as a dedicated LAW feed tank and will provide LAW feed to the WTP in later campaigns.

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4.0 FEED SCREENING

This section provides the results from the System Plan (Rev. 6) Baseline Case for delivering feed to the WTP. About 39 Mgal of waste are delivered to the WTP in 43 LAW feed batches, at an average rate of about two batches per year. About 71 Mgal of wastes are delivered to the WTP in 600 HLW feed batches, at an average rate of about one batch every two weeks.

The projected compositions of all the delivered feed batches were compared to the WTP Contract (DE-AC27-01RV14136) LAW feed specification (Specification 7) and HLW feed specification (Specification 8) to assess the degree of compliance. Specification 7 compliance is discussed in Section 4.1, and Specification 8 compliance is discussed in Section 4.2. The projected HGRs of each batch were screened against limits defined in RPP-39811, *Waste Treatment and Immobilization Plant Hydrogen Generation Rate Screening Criteria for System Modeling*. A discussion of HGR screening is provided in Section 4.3. The screening of all LAW and HLW feed against WTP CSLs is presented in Section 4.4.

The Tank Operations Contractor has the responsibility to deliver feed to the WTP in accordance the WTP waste acceptance criteria, which establish requirements for feed to be delivered to the WTP Pretreatment (PT) Facility for treatment. These requirements are defined in ICD-19 and further refined by the waste acceptance criteria DQO document (24590-WTP-RPT-MGT-11-014). The waste acceptance criteria DQO groups the waste acceptance criteria into two sets called “action limits” and “additional data.” The action limits are those waste acceptance criteria that must be met for safe and compliant transfer of feed to the WTP. The additional data are those waste acceptance criteria required for processability purposes and do not affect the acceptance of the feed.

The DQO process is iterative—it is anticipated that waste acceptance criteria may be deleted, revised, or added as additional data and knowledge are obtained. A final set of waste acceptance criteria (especially the action limits) must be developed, documented, and promulgated. The basis of each waste acceptance criterion should be reevaluated to ensure that it is necessary and sufficient to establish waste acceptance.

In addition to the requirements defined in ICD-19 and refined in the waste acceptance criteria DQO, the WTP Contract requires that feed transferred to the WTP meets the requirements in Specification 7 and Specification 8. However, the waste acceptance criteria DQO identifies some, but not all, of the requirements from Specification 7 and 8, as action limits. The relationship and content of ICD-19, the waste acceptance DQO, and Specifications 7 and 8 in the WTP Contract should be reviewed for consistency and intent.

There are other uncertainties and issues with the current waste requirements. There is a large quantity of waste that will not meet some envelope limits established in Specification 7 and/or 8. There is no straightforward way to adjust this waste to meet the current requirements. Clarification of the meaning, relevancy, and flexibility of the Specification 7 and 8 envelopes is needed to develop strategies for WFD. Also, Envelope C LAW is currently limited to complexed concentrate tank wastes from Tanks AN-102 and AN-107. It is unclear as to what waste Envelope C will apply to as Tank AN-102 and AN-107 wastes are mitigated, transferred, and blended throughout the system. These issues are being tracked in Section 8.0, and must be resolved to establish a clear set of feed requirements.

4.1 SPECIFICATION 7 SCREENING

Most of the LAW and HLW batches delivered to the WTP meet the feed limits specified for liquids in Specification 7. The few exceptions with their details are discussed below.

The sodium concentration limits are met for most batches, with a couple of exceptions. The final batch of LAW fell slightly below the lower limit of 4.0 M sodium, and a group of HLW batches from a single DST of feed toward the end of the mission had a sodium concentration just above the upper limit of 10 M sodium. These out-of-specification batches are delivered during the terminal cleanout[20] operation of the HTWOS model. This lower level of control is likely the cause of the sodium concentrations being out of specification in these late batches.

Control of the wt% solids is exhibited during the main part of the mission, with the HLW batches falling in a span from 5.5 to 9.5 wt% solids, and the LAW batches free of solids per the System Plan (Rev. 6) assumptions. During terminal cleanout, some of the HLW batches deliver with a much lower (but still within specification) wt% solids. At the same time, the LAW batches begin to deliver some solids, with two of the batches having wt% solids just above the 3.8 wt% limit.

The bulk density of the delivered batches was consistently within the feed limits of 1.46 kg/L for LAW feed and 1.5 kg/L for HLW feed, with only a couple of exceptions. One LAW feed batch exceeded the limit slightly due to it being primarily supernate from mitigation of an over-concentrated LAW DST. The indirect control strategy for bulk density was ineffective in preventing this feed batch from exceeding the limit. A group of HLW feed batches was delivered above the limit at 1.62 kg/L during terminal cleanout operations, which is the cause of the variation.

The fluoride in LAW and HLW liquid feeds to WTP met Envelope A and B limits, with the exception of one group of HLW batches delivered during terminal cleanout. These batches did not meet the Envelope A specification and were just within the limit for Envelope B. The major source of waste for these batches was old saltcake heels dissolved from Tanks AP-105, AP-108, and AW-106.

The phosphate in LAW and HLW liquid feeds to WTP consistently meet Envelope A and B limits until about 2034. After that, some of the batches fail to meet Envelope A, but still fall under Envelope B limits. Overall, only about 10 vol% of the liquid fed to the WTP did not meet the Envelope A limits for phosphate.

The general trend shows that the ratio of sulfate-to-sodium tends to increase during the mission due to the order of waste retrieved and then delivered to the WTP. Only about 17 vol% of the liquids fed to WTP meet Envelope A limits for sulfate, and all batches meet Envelope B. The batches with the highest sulfate-to-sodium ratios are associated with the same old saltcake heels that composed the high fluoride batches mentioned above. These heels would be prime candidates for blending to distribute the sulfate and fluoride better.

[20] Terminal cleanout is a facet of the HTWOS model that operates at the end of the mission after all the SSTs are retrieved. The terminal cleanout operation is a less-mature part of the HTWOS model and does not control the feed delivery to WTP as rigorously as the steady-state running period of the mission. An update to the terminal cleanout operation to improve control is underway.

The TRU elements in most of the LAW and HLW liquid feeds to WTP meet Specification 7. For 97 percent of the feed, the feed is within the limits for Envelopes A and B. In the remaining three percent, the concentration of TRU elements was just above the limits for Envelopes A and B. The highest TRU concentrations are associated with HLW feed liquids from the initial batches of waste from Tank AW-105, which has a higher TRU waste content than most other DSTs. Additional detail regarding this HLW campaign can be found in Section 3.3, with the feed qualification and certification of this campaign details provided in Section 3.3.6.

Table 4-1 summarizes the screening of all LAW and HLW projected feed against Specification 7.

Table 4-1. Summary of Screening Projected Feed Against Specification 7

HTWOS Case: SP6 Case 1 - Baseline Case
Run Date: 3/17/2011
Weighted by: Total Vol

Below Lower Range
Above Upper Range
Out-of-Range for all three limits

Group	Parameter	WAC Item	Range A		Range B		Range C		Parameter Type	Units	Display Text	Source	Percentage Out of Range - Lower				Percentage Out of Range - Upper			
			Lower	Upper	Lower	Upper	Lower	Upper					A	B	C	All	A	B	C	All
Feed Batch Summary Information	Mass Na		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	Information	MT			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	Mass Solids		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	Information	MT			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	Total Vol (LAW)		#N/A	1,000,000	#N/A	1,000,000	#N/A	1,000,000	ICD Agreement	Gallons		ICD-19 Rev 4 Table 1 (item 6) and Sec 2.2.3.1	#N/A	#N/A	#N/A	#N/A	0.00%	0.00%	0.00%	0.00%
	Total Vol (HLW)		40,000	120,000	40,000	120,000	40,000	120,000	ICD Agreement	Gallons		24590-WTP-RPT-PET-09-004	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Liquid Vol		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	Information	Gallons			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	Solid vol (LAW)		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	Information	Gallons			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	Solid vol (HLW)		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	Information	Gallons			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	[Na] (LAW)	X	4	10	4	10	4	10	Contract Limit	Na mole / liter		Spec 7 - Sec 7.2.2.1	0.05%	0.05%	0.05%	0.05%	0.00%	0.00%	0.00%	0.00%
	[Na] (HLW)	X	0.1	10	0.1	10	0.1	10	Contract Limit	Na mole / liter		Spec 7 - Sec 7.2.2.1	0.00%	0.00%	0.00%	0.00%	1.60%	1.60%	1.60%	1.60%
	[Solid] (LAW)	X	#N/A	3.8	#N/A	3.8	#N/A	3.8	Contract Limit	wt%		Spec 7 - Sec 7.2.2.1	#N/A	#N/A	#N/A	#N/A	3.22%	3.22%	3.22%	3.22%
	[Solid] (HLW)		#N/A	10	#N/A	10	#N/A	10	Information	wt%		24590-WTP-MRR-PET-	#N/A	#N/A	#N/A	#N/A	0.00%	0.00%	0.00%	0.00%
	[137-Cs Equiv]		#N/A	1.2	#N/A	1.2	#N/A	1.2	Contract Limit	Ci / liter		Spec 7 - Sec 7.2.2.2	#N/A	#N/A	#N/A	#N/A	0.00%	0.00%	0.00%	0.00%
	Liquid Density		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	Information	Kg / liter			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	Bulk Density (LAW)	X	#N/A	1.46	#N/A	1.46	#N/A	1.46	ICD Agreement	Kg / liter		ICD-19 Rev 4 Table 6	#N/A	#N/A	#N/A	#N/A	2.57%	2.57%	2.57%	2.57%
	Bulk Density (HLW)	X	#N/A	1.5	#N/A	1.5	#N/A	1.5	ICD Agreement	Kg / liter		ICD-19 Rev 4 Table 7	#N/A	#N/A	#N/A	#N/A	1.60%	1.60%	1.60%	1.60%
Table TS 7.1 Information moles/mole Na	Al		#N/A	2.50E-01	#N/A	2.50E-01	#N/A	2.50E-01	Contract Limit	moles / Na moles		Spec 7 - Table TS-7.1	#N/A	#N/A	#N/A	#N/A	0.00%	0.00%	0.00%	0.00%
	Ba		#N/A	1.00E-04	#N/A	1.00E-04	#N/A	1.00E-04	Contract Limit	moles / Na moles		Spec 7 - Table TS-7.1	#N/A	#N/A	#N/A	#N/A	0.00%	0.00%	0.00%	0.00%
	Ca		#N/A	4.00E-02	#N/A	4.00E-02	#N/A	4.00E-02	Contract Limit	moles / Na moles		Spec 7 - Table TS-7.1	#N/A	#N/A	#N/A	#N/A	0.00%	0.00%	0.00%	0.00%
	Cd		#N/A	4.00E-03	#N/A	4.00E-03	#N/A	4.00E-03	Contract Limit	moles / Na moles		Spec 7 - Table TS-7.1	#N/A	#N/A	#N/A	#N/A	0.00%	0.00%	0.00%	0.00%
	Cl		#N/A	3.70E-02	#N/A	8.90E-02	#N/A	3.70E-02	Contract Limit	moles / Na moles		Spec 7 - Table TS-7.1	#N/A	#N/A	#N/A	#N/A	0.00%	0.00%	0.00%	0.00%
	Cr		#N/A	6.90E-03	#N/A	2.00E-02	#N/A	6.90E-03	Contract Limit	moles / Na moles		Spec 7 - Table TS-7.1	#N/A	#N/A	#N/A	#N/A	0.00%	0.00%	0.00%	0.00%
	F		#N/A	9.10E-02	#N/A	2.00E-01	#N/A	9.10E-02	Contract Limit	moles / Na moles		Spec 7 - Table TS-7.1	#N/A	#N/A	#N/A	#N/A	1.04%	0.00%	1.04%	0.00%
	Fe		#N/A	1.00E-02	#N/A	1.00E-02	#N/A	1.00E-02	Contract Limit	moles / Na moles		Spec 7 - Table TS-7.1	#N/A	#N/A	#N/A	#N/A	0.00%	0.00%	0.00%	0.00%
	Hg		#N/A	1.40E-05	#N/A	1.40E-05	#N/A	1.40E-05	Contract Limit	moles / Na moles		Spec 7 - Table TS-7.1	#N/A	#N/A	#N/A	#N/A	0.00%	0.00%	0.00%	0.00%
	K		#N/A	1.80E-01	#N/A	1.80E-01	#N/A	1.80E-01	Contract Limit	moles / Na moles		Spec 7 - Table TS-7.1	#N/A	#N/A	#N/A	#N/A	0.00%	0.00%	0.00%	0.00%
	La		#N/A	8.30E-05	#N/A	8.30E-05	#N/A	8.30E-05	Contract Limit	moles / Na moles		Spec 7 - Table TS-7.1	#N/A	#N/A	#N/A	#N/A	0.00%	0.00%	0.00%	0.00%
	Ni		#N/A	3.00E-03	#N/A	3.00E-03	#N/A	3.00E-03	Contract Limit	moles / Na moles		Spec 7 - Table TS-7.1	#N/A	#N/A	#N/A	#N/A	0.00%	0.00%	0.00%	0.00%
	NO2		#N/A	3.80E-01	#N/A	3.80E-01	#N/A	3.80E-01	Contract Limit	moles / Na moles		Spec 7 - Table TS-7.1	#N/A	#N/A	#N/A	#N/A	0.00%	0.00%	0.00%	0.00%
	NO3		#N/A	8.00E-01	#N/A	8.00E-01	#N/A	8.00E-01	Contract Limit	moles / Na moles		Spec 7 - Table TS-7.1	#N/A	#N/A	#N/A	#N/A	0.00%	0.00%	0.00%	0.00%
	Pb		#N/A	6.80E-04	#N/A	6.80E-04	#N/A	6.80E-04	Contract Limit	moles / Na moles		Spec 7 - Table TS-7.1	#N/A	#N/A	#N/A	#N/A	0.00%	0.00%	0.00%	0.00%
	PO4		#N/A	3.80E-02	#N/A	1.30E-01	#N/A	3.80E-02	Contract Limit	moles / Na moles		Spec 7 - Table TS-7.1	#N/A	#N/A	#N/A	#N/A	9.82%	0.00%	9.82%	0.00%
	SO4		#N/A	1.00E-02	#N/A	7.00E-02	#N/A	2.00E-02	Contract Limit	moles / Na moles		Spec 7 - Table TS-7.1	#N/A	#N/A	#N/A	#N/A	82.78%	0.00%	43.22%	0.00%
	TIC		#N/A	3.00E-01	#N/A	3.00E-01	#N/A	3.00E-01	Contract Limit	moles / Na moles		Spec 7 - Table TS-7.1	#N/A	#N/A	#N/A	#N/A	0.00%	0.00%	0.00%	0.00%
	TOC		#N/A	5.00E-01	#N/A	5.00E-01	#N/A	5.00E-01	Contract Limit	moles / Na moles		Spec 7 - Table TS-7.1	#N/A	#N/A	#N/A	#N/A	0.00%	0.00%	0.00%	0.00%
	U		#N/A	1.20E-03	#N/A	1.20E-03	#N/A	1.20E-03	Contract Limit	moles / Na moles		Spec 7 - Table TS-7.1	#N/A	#N/A	#N/A	#N/A	0.00%	0.00%	0.00%	0.00%
Table TS 7.2 Information Curies/mole Na	TRU		#N/A	1.30E+01	#N/A	1.30E+01	#N/A	8.11E+01	Contract Limit	µCi / Na moles		Spec 7 - Table TS-7.2	#N/A	#N/A	#N/A	#N/A	3.07%	3.07%	0.00%	0.00%
	137-Cs		#N/A	1.16E+05	#N/A	5.41E+05	#N/A	1.16E+05	Contract Limit	µCi / Na moles		Spec 7 - Table TS-7.2	#N/A	#N/A	#N/A	#N/A	0.00%	0.00%	0.00%	0.00%
	90-Sr		#N/A	1.19E+03	#N/A	1.19E+03	#N/A	2.16E+04	Contract Limit	µCi / Na moles		Spec 7 - Table TS-7.2	#N/A	#N/A	#N/A	#N/A	0.00%	0.00%	0.00%	0.00%
	99-Tc		#N/A	1.92E+02	#N/A	1.92E+02	#N/A	1.92E+02	Contract Limit	µCi / Na moles		Spec 7 - Table TS-7.2	#N/A	#N/A	#N/A	#N/A	0.00%	0.00%	0.00%	0.00%
	60-Co		#N/A	1.65E+00	#N/A	1.65E+00	#N/A	1.00E+01	Contract Limit	µCi / Na moles		Spec 7 - Table TS-7.2	#N/A	#N/A	#N/A	#N/A	0.00%	0.00%	0.00%	0.00%
	154-Eu		#N/A	1.62E+01	#N/A	1.62E+01	#N/A	1.16E+02	Contract Limit	µCi / Na moles		Spec 7 - Table TS-7.2	#N/A	#N/A	#N/A	#N/A	0.00%	0.00%	0.00%	0.00%

4.2 SPECIFICATION 8 SCREENING

Most of the LAW and HLW batches delivered to the WTP meet the feed limits specified for solids in Specification 8. The few exceptions are discussed below.

The allowable range in Specification 8 for solids concentration is from 10 to 200 g solids/L of feed. Control of solids concentration is exhibited during the mission, with most of the HLW campaigns fitting within a band ranging from 66 to 116 g solids/L of feed. Exceptions to this include the hot commissioning batches at 130 g solids/L of feed (still within waste acceptance criteria), and several HLW campaigns during terminal cleanout operations that trend toward lower concentrations. Future modeling improvements will be made to maximize solids concentrations of HLW feed batches. One of the terminal cleanout HLW campaigns delivered only 8.9 g solids/L of feed and was the only campaign outside the Specification 8 range. The terminal cleanout operation is a less-mature part of the HTWOS model and does not control the feed delivery to WTP as rigorously as the steady-state running period of the mission. An update to the terminal cleanout operation to improve control is underway.

The bulk density of the delivered batches is discussed in Section 4.1. Sodium molarity is also discussed in Section 4.1 (Specification 7 limit, not Specification 8).

The strontium limit for Specification 8 is 0.52 g per 100 g of non-volatile waste oxides (NVO); 14 vol% of the HLW feed delivered to WTP exceeds this limit. Several HLW campaigns excessively high in strontium appear in the 2027 to 2029 timeframe. The high strontium levels in these campaigns are the result of the strontium nitrate strikes used to precipitate ^{90}Sr from the Tank AN-102 and AN-107 supernates. IWFDP Volume 1, Section 4.5.9, discusses the strategy for ^{90}Sr precipitation. A few other later campaigns also reveal strontium levels moderately above the limit. These later campaigns that are out of specification do not have any particular waste type that is clearly driving the strontium concentration higher. Overall, the ^{90}Sr levels are all well within the limit for Specification 8, indicating that the ^{90}Sr levels are not driving the overall strontium levels.

The total organic carbon limit for Specification 8 is 11 g per 100 g NVO. Control of the total organic carbon is exhibited through the main portion of the mission, with the highest total organic carbon levels equaling about 6 g total organic carbon per 100 g NVO. The solids in these elevated total organic carbon batches can be traced back to several of the current Waste Group A tanks in AN Farm. During terminal cleanout operations, some of the HLW campaigns reveal an even higher level of total organic carbon, with one campaign exceeding the limit by about 15 percent. The feed in the campaign that exceeds the total organic carbon limit accounts for 1.6 vol% of all the HLW feed delivered to WTP. The primary source of the waste in these high total organic carbon terminal cleanout batches are residual solids from Tanks AW-101 and SY-101.

The ^{233}U limit for Specification 8 is 4.5E-6 Ci per 100 g NVO; 17 vol% of the HLW feed delivered to WTP exceeds this limit.

A few early HLW campaigns exceed the ^{233}U limit by 100 to 150 percent, interspersed with several other campaigns with varying lesser amounts of ^{233}U. From 2026 through 2030, there are a number of HLW campaigns with ^{233}U levels well above the limit, the highest being greater than seven times the limit. The main contributors to these high ^{233}U concentrations are wastes originating in Tanks C-102 and C-104. An evaluation of the importance and necessity of this limit should be completed to determine if the limit can be eliminated or relaxed. If necessary, adjusted SST retrieval planning or development of an intentional blending strategy for these wastes could reduce the ^{233}U concentration for these campaigns.

Eleven of the feed components listed in Table TS-8.4 of Specification 8 were at concentrations greater than their limits at least one time during the mission. The information on these components is provided to support product and process qualification but is not used as a basis for determining if the feed meets specification requirements. Of the components that exceeded their limits, fluoride, potassium, sodium, nickel, lead, sulfur, and zirconium only exceeded their limits occasionally. None of these components were over the respective limits for greater than 10 vol% of the HLW feed. The remaining four components—aluminum, bismuth, chromium, and phosphorus—were above their respective limits relatively often. Aluminum was over its limit of 14 g per 100 g NVO for 94 vol% of the HLW delivered, and chromium was over its limit of 0.68 g per 100 g NVO for 88 vol% of the HLW feed delivered to WTP. These two components (aluminum and chromium) met the limits the least often, and their quantities prohibit blending as an option to bring the concentrations to below the limits. The other two components that were above their limits often are bismuth and phosphorus. The specific batches that contained excessive quantities of bismuth were fairly common to the same batches that contained excessive quantities of phosphorous, delivered from 2033 to 2038, leading to the presumption that bismuth phosphate processing waste is a significant component of these batches.

Table 4-2 summarizes the screening of projected HLW projected feed against Specification 8.

Table 4-2. Summary of Screening Projected Feed Against Specification 8

HTWOS Case: SP6 Case 1 - Baseline Case
HTWOS Run Date: 3/17/2011
Feed Type: HLW **Normalized by:** Total Vol

Above Upper Range
Below Lower Range
Any Out-of-Range

Group	Parameter	WAC Item	Range Lower	Range Upper	Parameter Type	Units	Source	Percent out of Range Lower	Percent out of Range Upper	Percent In Range
Feed Batch Summary Information	Mass Solids		#N/A	#N/A	Information	MT		#N/A	#N/A	100.0%
	Mass NVO		#N/A	#N/A	Information	MT		#N/A	#N/A	100.0%
	Total Vol		40,000	120,000	ICD Agreement	Gallons	24590-WTP-RPT-PET-09-0	0.0%	0.0%	100.0%
	Liquid Vol		#N/A	#N/A	Information	Gallons		#N/A	#N/A	100.0%
	Solid Vol		#N/A	#N/A	Information	Gallons		#N/A	#N/A	100.0%
	Solid Conc	X	**10**	200	Envelope D Limit	g solids / liter feed	Spec 8 - 8.2.2.1	**1.6%**	0.0%	**98.4%**
	Liquid Density		#N/A	#N/A	Information	Kg / liter		#N/A	#N/A	100.0%
	Bulk Density	X	#N/A	**1.50**	ICD Agreement	Kg / liter	ICD-19 Rev 4 Table 7	#N/A	**1.6%**	**98.4%**
	Na Molar	X	0.1	**10.00**	Contract	moles/liter	Spec 7 - Sec 7.2.2.1	0.0%	**1.6%**	**98.4%**
Table TS-8.1 Non-volatile component composition	As		#N/A	0.160	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
	B		#N/A	1.300	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
	Be		#N/A	0.065	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
	Ce		#N/A	0.810	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
	Co		#N/A	0.450	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
	Cs		#N/A	0.580	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
	Cu		#N/A	0.480	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
	Hg		#N/A	0.100	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
	La		#N/A	2.600	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
	Li		#N/A	0.140	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
	Mn		#N/A	6.500	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
	Mo		#N/A	0.650	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
	Nd		#N/A	1.700	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
	Pr		#N/A	0.350	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
	Pu		#N/A	0.054	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
	Rb		#N/A	0.190	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
	Sb		#N/A	0.840	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
	Se		#N/A	0.520	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
	Sr		#N/A	**0.520**	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	**14.0%**	**86.0%**
	Ta		#N/A	0.030	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
	Tc		#N/A	0.260	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
	Te		#N/A	0.130	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
	Tl		#N/A	0.450	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
	V		#N/A	0.032	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
	W		#N/A	0.240	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
	Y		#N/A	0.160	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
	Zn		#N/A	0.420	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.1	#N/A	0.0%	100.0%
Table TS-8.2 Volatile component composition	Cl		#N/A	0.330	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.2	#N/A	0.0%	100.0%
	CO3		#N/A	30.000	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.2	#N/A	0.0%	100.0%
	NO3 Equiv		#N/A	36.000	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.2	#N/A	0.0%	100.0%
	TOC		#N/A	**11.000**	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.2	#N/A	**1.6%**	**98.4%**
	CN		#N/A	1.600	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.2	#N/A	0.0%	100.0%
	NH3		#N/A	1.600	Envelope D Limit	g / 100 g NVO	Spec 8 - Table TS-8.2	#N/A	0.0%	100.0%
Table TS-8.3 Radionuclide composition	3-H		#N/A	6.50E-05	Envelope D Limit	Ci / 100 g NVO	Spec 8 - Table TS-8.3	#N/A	0.0%	100.0%
	14-C		#N/A	6.50E-06	Envelope D Limit	Ci / 100 g NVO	Spec 8 - Table TS-8.3	#N/A	0.0%	100.0%
	60-Co		#N/A	1.00E-02	Envelope D Limit	Ci / 100 g NVO	Spec 8 - Table TS-8.3	#N/A	0.0%	100.0%
	90-Sr		#N/A	1.00E+01	Envelope D Limit	Ci / 100 g NVO	Spec 8 - Table TS-8.3	#N/A	0.0%	100.0%
	99-Tc		#N/A	1.50E-02	Envelope D Limit	Ci / 100 g NVO	Spec 8 - Table TS-8.3	#N/A	0.0%	100.0%
	125-Sb		#N/A	3.20E-02	Envelope D Limit	Ci / 100 g NVO	Spec 8 - Table TS-8.3	#N/A	0.0%	100.0%
	126-Sn		#N/A	1.50E-04	Envelope D Limit	Ci / 100 g NVO	Spec 8 - Table TS-8.3	#N/A	0.0%	100.0%
	129-I		#N/A	2.90E-07	Envelope D Limit	Ci / 100 g NVO	Spec 8 - Table TS-8.3	#N/A	0.0%	100.0%
	137-Cs		#N/A	1.50E+00	Envelope D Limit	Ci / 100 g NVO	Spec 8 - Table TS-8.3	#N/A	0.0%	100.0%
	152-Eu		#N/A	4.80E-04	Envelope D Limit	Ci / 100 g NVO	Spec 8 - Table TS-8.3	#N/A	0.0%	100.0%
	154-Eu		#N/A	5.20E-02	Envelope D Limit	Ci / 100 g NVO	Spec 8 - Table TS-8.3	#N/A	0.0%	100.0%
	233-U		#N/A	**4.50E-06**	Envelope D Limit	Ci / 100 g NVO	Spec 8 - Table TS-8.3	#N/A	**17.1%**	**82.9%**
	235-U		#N/A	2.50E-07	Envelope D Limit	Ci / 100 g NVO	Spec 8 - Table TS-8.3	#N/A	0.0%	100.0%
	237-Np		#N/A	7.40E-05	Envelope D Limit	Ci / 100 g NVO	Spec 8 - Table TS-8.3	#N/A	0.0%	100.0%
	238-Pu		#N/A	3.50E-04	Envelope D Limit	Ci / 100 g NVO	Spec 8 - Table TS-8.3	#N/A	0.0%	100.0%
	239-Pu		#N/A	3.10E-03	Envelope D Limit	Ci / 100 g NVO	Spec 8 - Table TS-8.3	#N/A	0.0%	100.0%
	241-Pu		#N/A	2.20E-02	Envelope D Limit	Ci / 100 g NVO	Spec 8 - Table TS-8.3	#N/A	0.0%	100.0%
	241-Am		#N/A	9.00E-02	Envelope D Limit	Ci / 100 g NVO	Spec 8 - Table TS-8.3	#N/A	0.0%	100.0%
	243-Cm/244-Cm		#N/A	3.00E-03	Envelope D Limit	Ci / 100 g NVO	Spec 8 - Table TS-8.3	#N/A	0.0%	100.0%
Table TS-8.4 Additional non-volatile component composition	Ag		#N/A	0.550	Guidance	g / 100 g NVO	Spec 8 - Table TS-8.4	#N/A	0.0%	100.0%
	Al		#N/A	**14.000**	Guidance	g / 100 g NVO	Spec 8 - Table TS-8.4	#N/A	**94.3%**	**5.7%**
	Ba		#N/A	4.500	Guidance	g / 100 g NVO	Spec 8 - Table TS-8.4	#N/A	0.0%	100.0%
	Bi		#N/A	**2.800**	Guidance	g / 100 g NVO	Spec 8 - Table TS-8.4	#N/A	**30.1%**	**69.9%**
	Ca		#N/A	7.100	Guidance	g / 100 g NVO	Spec 8 - Table TS-8.4	#N/A	0.0%	100.0%
	Cd		#N/A	4.500	Guidance	g / 100 g NVO	Spec 8 - Table TS-8.4	#N/A	0.0%	100.0%
	Cr		#N/A	**0.680**	Guidance	g / 100 g NVO	Spec 8 - Table TS-8.4	#N/A	**87.8%**	**12.2%**
	F		#N/A	**3.500**	Guidance	g / 100 g NVO	Spec 8 - Table TS-8.4	#N/A	**1.6%**	**98.4%**
	Fe		#N/A	29.000	Guidance	g / 100 g NVO	Spec 8 - Table TS-8.4	#N/A	0.0%	100.0%
	K		#N/A	**1.300**	Guidance	g / 100 g NVO	Spec 8 - Table TS-8.4	#N/A	**4.2%**	**95.8%**
	Mg		#N/A	2.100	Guidance	g / 100 g NVO	Spec 8 - Table TS-8.4	#N/A	0.0%	100.0%
	Na		#N/A	**19.000**	Guidance	g / 100 g NVO	Spec 8 - Table TS-8.4	#N/A	**9.8%**	**90.2%**
	Th		#N/A	5.000	Guidance	g / 100 g NVO	Spec 8 - Table TS-8.4	#N/A	0.0%	100.0%
	Ni		#N/A	**2.400**	Guidance	g / 100 g NVO	Spec 8 - Table TS-8.4	#N/A	**3.2%**	**96.8%**
	P		#N/A	**1.700**	Guidance	g / 100 g NVO	Spec 8 - Table TS-8.4	#N/A	**41.6%**	**58.4%**
	Pb		#N/A	**1.100**	Guidance	g / 100 g NVO	Spec 8 - Table TS-8.4	#N/A	**3.0%**	**97.0%**
	Pd		#N/A	0.130	Guidance	g / 100 g NVO	Spec 8 - Table TS-8.4	#N/A	0.0%	100.0%
	Rh		#N/A	0.130	Guidance	g / 100 g NVO	Spec 8 - Table TS-8.4	#N/A	0.0%	100.0%
	Ru		#N/A	0.350	Guidance	g / 100 g NVO	Spec 8 - Table TS-8.4	#N/A	0.0%	100.0%
	S		#N/A	**0.650**	Guidance	g / 100 g NVO	Spec 8 - Table TS-8.4	#N/A	**1.6%**	**98.4%**
	Si		#N/A	19.000	Guidance	g / 100 g NVO	Spec 8 - Table TS-8.4	#N/A	0.0%	100.0%
	Ti		#N/A	1.300	Guidance	g / 100 g NVO	Spec 8 - Table TS-8.4	#N/A	0.0%	100.0%
	U		#N/A	14.000	Guidance	g / 100 g NVO	Spec 8 - Table TS-8.4	#N/A	0.0%	100.0%
	Zr		#N/A	**15.000**	Guidance	g / 100 g NVO	Spec 8 - Table TS-8.4	#N/A	**2.2%**	**97.8%**

4.3 HYDROGEN GENERATION RATE SCREENING

Table 4-3 presents a summary of the results of screening both HLW and LAW feed against the HGR screening criteria provided by WTP and approved by ORP (RPP-39811). Only one batch of LAW feed exceeded its limit during the mission, while all the HLW batches were well within their limit. The waste in the one LAW batch that exceeded the limit for HGR was primarily supernate from Tanks AN-102 and AN-107. IWFDP Volume 1, Section 2.8.5, discusses the special nature of the waste in these tanks. This supernate contained a very high concentration of total organic carbon that explains the high HGR, which exceeded the HGR limit by just 14 percent. Careful blending of this LAW feed with other feed would reduce the HGR well below the limit. All the other LAW batches had a much lower HGR.

Table 4-3. Summary of Screening Projected Feed Against Hydrogen Generation Rate Criteria

	HGR limit (g moles H_2 / day / kg liquid waste)	Number of batches out of specification	Percent of batches out of specification	Liquid volume out of specification (kgal)	Percent of total liquid volume out of specification
HGR (LAW)	6.6 E-6	1	2.3%	995.5	2.6%
HGR (HLW)	1.9 E-4	0	0%	0	0%

HTWOS model run information: System Plan (Rev. 6) Baseline Case.

HGR = hydrogen generation rate.
HLW = high-level waste.
HTWOS = Hanford Tank Waste Operations Simulator.
LAW = low-activity waste.

The HGR screening summarized in Table 4-3 was performed at 120°F for LAW and 190°F for HLW per RPP-39811. The waste acceptance criteria cited in 24590-WTP-RPT-MGT-11-014 specify that the HLW screening will be done at 150°F instead of 190°F. In addition, the screening limits and the units in the table are different than the waste acceptance criteria DQO. A preliminary evaluation of the results of the System Plan (Rev. 6) Baseline Case using the updated temperatures, units, and screening limits in the waste acceptance criteria DQO showed that the results were similar to those listed in Table 4-3. It is expected that future HGR evaluations will migrate to using the limits in the waste acceptance criteria DQO.

4.4 CRITICALITY SCREENING

Table 4-4 summarizes the screening of all LAW and HLW projected feed against the limits specified in 24590-WTP-CSER-ENS-08-0001, *Preliminary Criticality Safety Evaluation Report for the WTP*. Table 4-4 lists the results of the screening against the solid in the feeds, and Table 4-5 lists the results of the screening against the liquid in the feeds. All of the feeds met the CSL with only one exception. The first LAW feed batch of the mission, the hot commissioning batch, exceeded the CSL 8.2 liquid phase limit by just one percent.

Table 4-4. Summary of Screening Projected Solid Feed Against Criticality Safety Limits

	Criticality safety limit	No. of batches out of specification	Percent of batches out of specification	Solids mass out of specification (kg)	Percent of total solids mass out of specification
CSL 8.1 (solid phase)	<6.2 g/kg (g plutonium to kg metals)	0	0%	0	0
CSL 8.2 (solid phase)	<8.4 g/kg (g $U_{fissile}$ to kg U_{total})	0	0%	0	0

HTWOS model run information: System Plan (Rev. 6) Baseline Case.

CSL = criticality safety limit.
HTWOS = Hanford Tank Waste Operations Simulator.

Table 4-5. Summary of Screening Projected Liquid Feed Against Criticality Safety Limits

	Criticality safety limit	No. of batches out of specification[a]	Percent of batches out of specification[a]	Liquid volume out of specification (kgal)[a]	Percent of total liquid volume out of specification[a]
CSL 8.2 (liquid phase)	<8.4 g/kg (g $U_{fissile}$ to kg U_{total}).	0 [1]	0 [0.16]%	0 [122.7]	0 [0.3]%
CSL 8.3 (liquid phase)	<0.013 g/L (g plutonium per liter)	0	0%	0	0%
CSL 8.4 (liquid phase)	<6.2 g/kg (g plutonium to kg metals	0	0%	0	0%

HTWOS model run information: System Plan (Rev. 6) Baseline Case.

[a] For values listed as a pair, with one inside square brackets [ ], the value outside the brackets excludes out-of-specification results due to modeling artifacts, while the value inside the brackets includes all batches as reported.

CSL = criticality safety limit.
HTWOS = Hanford Tank Waste Operations Simulator.

Analyses of the hot commissioning deliveries to WTP are also available from RPP-RPT-46020. Table 7-1 of RPP-RPT-46020 reports CSL 8.2 liquid evaluation at 12 percent below the limit. Research into the current modeling results has also revealed that the LAW hot commissioning delivery was only partially washed. The residual wash factors in this delivery, had they been applied as they should have, would have reduced the CSL 8.2 liquid evaluation for the delivery to a value close to that reported in RPP-RPT-46020. This issue is being rectified to support future modeling efforts.

4.5 WASTE ACCEPTANCE CRITERIA – ACTION LIMITS

Table 4-6 compares a subset of the screening results from the analyses described in the previous subsections against the action limits (derived from Table 4-1 of 24590-WTP-RPT-MGT-11-014). An action limit is defined as a concentration value or acceptance criteria at which point a predetermined action is taken depending on whether the measured or analytical result is above or below the specified concentration or value. The HTWOS model does not currently project slurry viscosity, separable organics, polychlorinated biphenyls, or temperature change. These are out-of-scope for this revision of the IWFDP and may be addressed by the waste acceptance criteria DQO, flowsheets for specific campaigns, and future revisions of this document. Not all action limits are evaluated in this revision of the IWFDP.

Table 4-6. Summary of Screening Projected Feed Against Waste Acceptance Criteria Action Limits

Parameter	Action limit	No. of batches out of specification[a]	Percent of batches out of specification[a,b]
Bulk density (LAW)	< 1.46 (kg/L)	1	2.3%
Bulk density (HLW)	< 1.5 (kg/L)	0 [10] [c]	0 [1.6]%
Maximum solids (LAW)	≤ 3.8 wt%	0 [2] [d]	0 [4.7]%
Maximum solids (HLW)	≤ 200 g/L	0	0%
CSL 8.4 (Pu/metal) – Liquids	< 6.20 g/kg	0	0%
CSL 8.1 (Pu/metal) – Solids	< 6.20 g/kg	0	0%
CSL 8.2 ($U_{fissile}/U_{total}$) – Liquids	< 8.4 g/kg	0 [1] [e]	0 [0.16]%
CSL 8.2 ($U_{fissile}/U_{total}$) – Solids	< 8.4 g/kg	0	0%
CSL 8.3 (Pu conc.) – Liquids	< 0.013 g/L	0	0%
Sodium molarity	< 10 moles/L	0 [10] [c]	0 [1.6]%
Hydrogen generation rate (LAW) [f]	< 6.6 E-6 gmole H_2/kg/day at 120°F	1	2.3%
Hydrogen generation rate (HLW) [f]	< 1.9 E-4 gmole H_2/kg/day at 190°F	0	0%

HTWOS model run information: System Plan (Rev. 6) Baseline Case.

[a] For values listed as a pair, with one inside square brackets [ ], the value outside the brackets excludes out-of-specification results due to modeling artifacts, while the value inside the brackets includes all batches as reported.

[b] Parameters for LAW are based on 43 LAW batches. Parameters for HLW are based on 600 HLW batches. Parameters without indication of LAW or HLW are based on 643 total batches.

[c] All ten batches represent one HLW campaign (one tank) at the end of the mission and are attributed to a modeling artifact that will be resolved in a future revision.

[d] The two batches represent two LAW campaigns at the end of the mission and are attributed to a modeling artifact that will be resolved in a future revision.

[e] The out-of-specification batch was found to be only partially washed, which resulted in it being over the action limit (see Section 4.4 for details).

[f] The hydrogen generation rates were screened against action limits from RPP-39811, *Waste Treatment and Immobilization Plant Hydrogen Generation Rate Screening Criteria for System Modeling*. Updated action limits have been published in 24590-WTP-RPT-MGT-11-014, *Initial Data Quality Objectives for WTP Feed Acceptance Criteria*, and will be used in the future when the HTWOS model has been updated to screen using the updated limits.

CSL = criticality safety limit.
HLW = high-level waste.
HTWOS = Hanford Tank Waste Operations Simulator.
LAW = low-activity waste.

4.6 REQUIRED SAMPLES

To certify that the waste delivered to the WTP is in compliance with ICD-19 and the waste acceptance criteria DQO (24590-WTP-RPT-MGT-11-014), a number of samples will need to be taken. The quantity of samples required to demonstrate compliance is a function of the projected composition, the required confidence and power, and the sampling and analytical variability. Per 24590-WTP-RPT-MGT-11-014, with the exception of the analyses for CSL requirements (ratio of plutonium to metal absorbers, $U_{fissile}$ to U_{total}, and plutonium concentrations in liquids) all of the action limits in Table 4-6 will be evaluated at a 90 percent confidence level. The CSL action limits will be evaluated at a 95 percent confidence level.

A preliminary evaluation was performed as part of the waste acceptance criteria DQO, and it was concluded that the quantity of samples required is primarily driven by the $U_{fissile}$ to U_{total} ratio and, to a lesser extent, the bulk density of the deliveries. Most of the other parameters should be able to meet the confidence limits with just two samples. Raising the action limit for the uranium ratio is under investigation, as it would have significant benefit in reducing the number of samples required. For the bulk density measurement, the staging of feed near the limits and sampling error will need to be managed to minimize the number of samples. Finally, blending or dilution may be employed to resolve most out-of-tolerance feed conditions and has the potential to reduce the number of samples required. An illustration of the relationship between the number of projected samples and the proximity of waste feed to an action limit is presented in Figure 4-1. This figure shows the number of projected samples needed to demonstrate compliance with CSL 8.2 (solid phase) given the assumed sampling and analytical uncertainty. While sampling and analytical uncertainty are not yet known, this graph demonstrates the impact of waste that is near action limits.

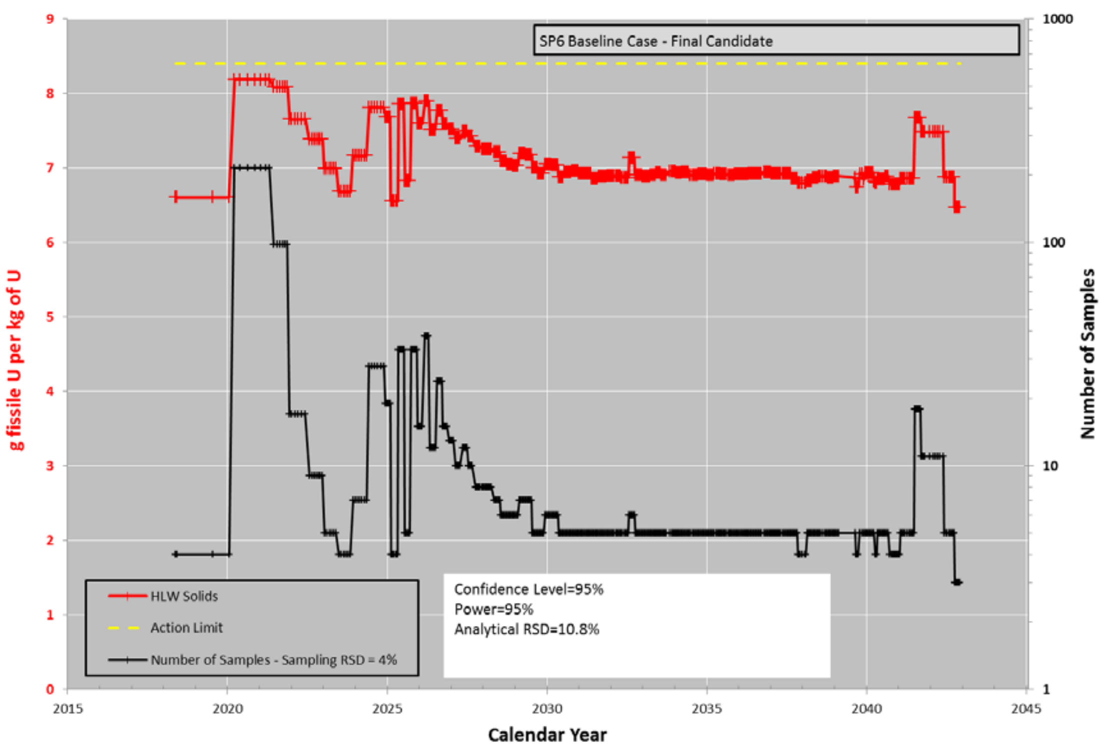

Figure 4-1. Illustrative Number of Projected Samples to Demonstrate Compliance with Criticality Safety Limit 8.2 (Solid Phase)

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5.0 FEED AVAILABILITY

The current strategy to ensure adequate feed availability is to begin preparation of the next campaign as soon as tank space and appropriate waste is available. However, the demands on the DST system due to SST retrievals, emergency space, and special waste handling may sometimes prevent having multiple tanks of feed ready for delivery at certain times during the mission. This section systematically identifies how many feed tanks are available and ready to deliver (both HLW and LAW) over the duration of the mission based on the current operating scenario, which is the System Plan (Rev. 6) Baseline Case.

The number of available ready-to-deliver HLW feed tanks varies throughout the mission. Figure 5-1 shows the time tanks are counted as available to deliver feed to WTP. Tanks are counted as available from the end of feed certification until the start of the last feed delivery batch to the WTP.

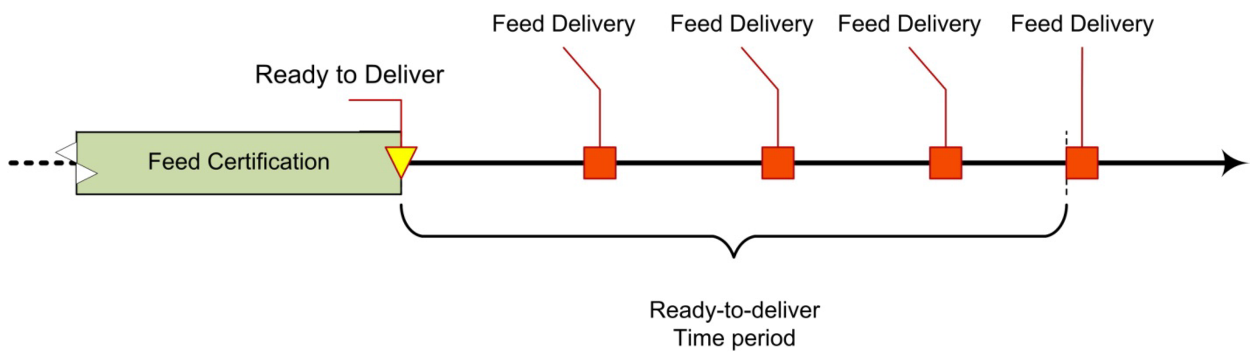

Figure 5-1. Ready-to-Deliver Time Period

Figure 5-2 illustrates feed availability in terms of the number of ready-to-deliver HLW feed DSTs versus time. The top portion of Figure 5-2 shows the duration during which waste from each HLW campaign is ready to deliver. The bottom portion of Figure 5-2 shows the total number of ready-to-deliver HLW feed tanks versus time. The first ready-to-deliver tank typically represents the tank that is currently delivering feed, and any additional tanks represent backup feed. The black line in 2025 represents the date the full combined capacity of WTP and a second LAW facility is reached. No data is displayed beyond 2040 because the model exhibits poor control near the end of the mission. This limitation will be addressed in future modeling efforts.

In the top plot of Figure 5-2, the light green data includes three campaigns in the middle of the mission that have anomalously long ready-to-deliver durations. These campaigns are a result of modeling artifacts, specifically in how the modeling logic operates during the three campaigns in the middle of the mission. These long durations are not desired and will be addressed in future HTWOS modeling efforts. The light green data on the bottom plot in Figure 5-2 includes all data, and the dark green plot omits the suspect data.

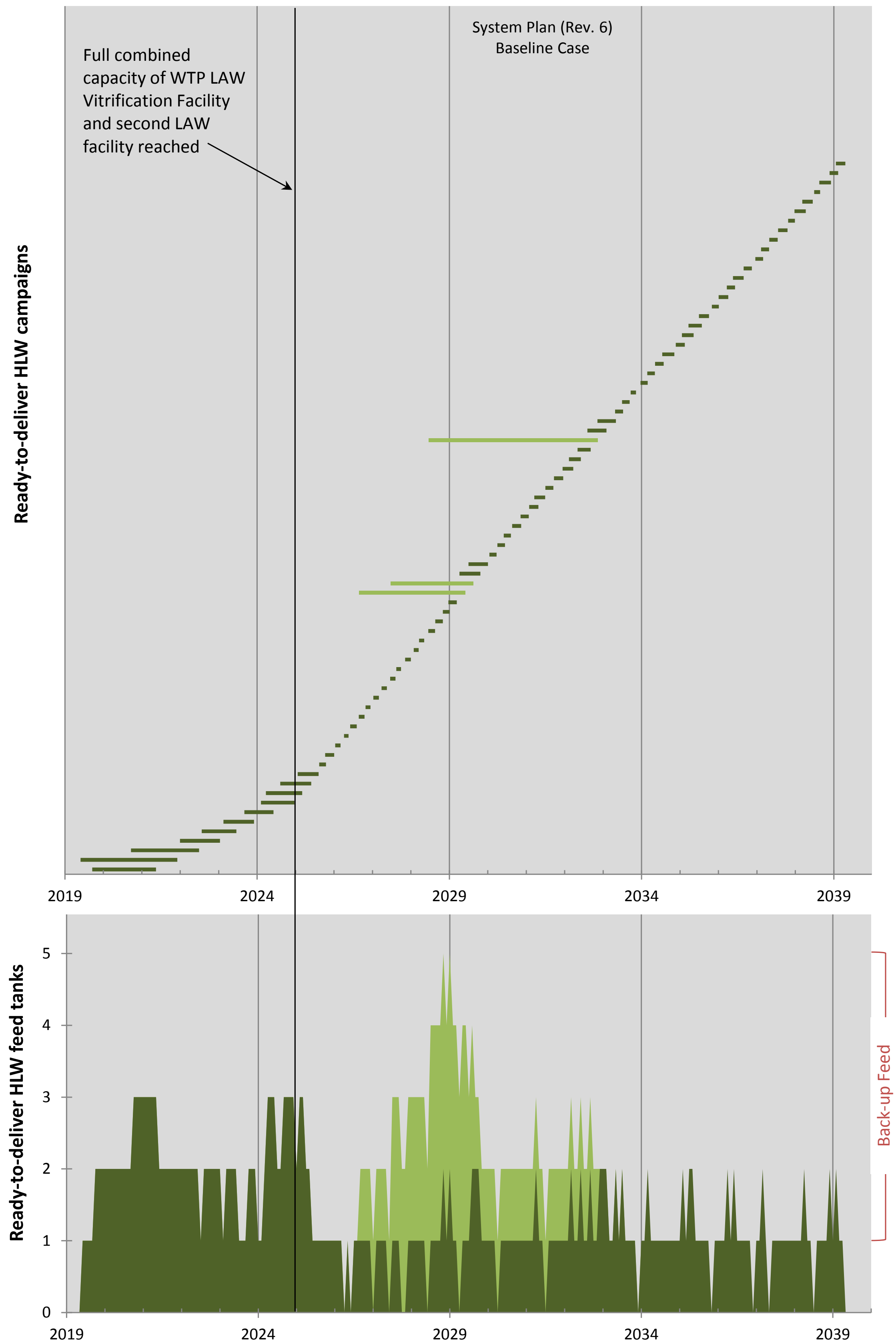

Figure 5-2. Ready-to-Deliver High-Level Waste Feed Tanks

Early in the mission, as shown in Figure 5-2, there is backup feed having at least one additional HLW feed tank ready to deliver to WTP. The top portion shows some overlap of many of the campaigns, which results in more than one ready-to-deliver HLW feed tank. In the time period from 2019 to 2025, there are generally two or three ready-to-deliver HLW feed tanks. Beyond 2025, when the WTP reaches full capacity, the number of ready-to-deliver feed tanks decreases. This means there is less (and often no) backup feed, and these deliveries are made available on a just-in-time basis. Operating under these conditions runs the risk of starving the WTP of feed if issues arise.

From about 2026 to 2029, there are very few additional ready-to-deliver HLW feed tanks. As seen in Figure 5-2, the campaigns rarely overlap. This time period has the highest risk in terms of contingency feed to support delivery of HLW feed.

From about 2029 to 2040, the number of ready-to-deliver HLW feed tanks varies. Figure 5-2 shows that there is little overlap of campaigns during this time. Generally, between 2029 and 2040, there are between one and two ready-to-deliver HLW feed tanks.

An optimal operating scenario balances contingency feed availability with DST space usage to ensure that some backup feed is available, while still reserving the majority of DST space for SST retrievals and feed delivery activities. More contingency feed may become available if alternative waste storage becomes available, or if more DST space is reserved for contingency feed.

LAW feed tanks are counted as ready to deliver from the first date they are classified as ready to deliver, until the start of feed delivery to WTP. Figure 5-3 illustrates feed availability in terms of the number of ready-to-deliver LAW feed DSTs versus time. Similar to Figure 5-2, the top portion shows the ready-to-deliver duration for each LAW feed campaign. The bottom portion of Figure 5-3 shows the total number of ready-to-deliver LAW feed tanks versus time. Additionally, the black line represents the date the full combined capacity of the WTP LAW Vitrification Facility and second LAW facility is reached. No data is displayed beyond 2040 because the model exhibits poor control near the end of the mission. This limitation will be addressed in future modeling efforts.

Similar to HLW feed availability, the number of ready-to-deliver LAW feed tanks varies throughout the mission. It is important to note a few differences between the HLW and LAW feed delivery campaigns. In the current operating scenario, there are 43 LAW feed campaigns and 92 HLW feed campaigns, so LAW requires roughly half the number of campaigns compared to HLW. One batch containing approximately 1 Mgal is transferred per LAW campaign. Six or seven batches, each of approximately 120 kgal, are transferred per HLW campaign. HLW transfers contain much of the sodium that will be treated in the LAW Vitrification Facility. HLW and LAW feed availability is, therefore, not directly comparable.

Generally, throughout the duration of the mission, there is one LAW feed tank available and ready to deliver at any given time. This means there is no contingency LAW feed available for most of the mission. Although this is a risk, the severity of having little to no contingency LAW feed is significantly less than the risk of having no contingency HLW feed. This is because most of the feed for the LAW Vitrification Facility is contained in the HLW feed batches. LAW feed is generally readily interchangeable with other LAW feed.

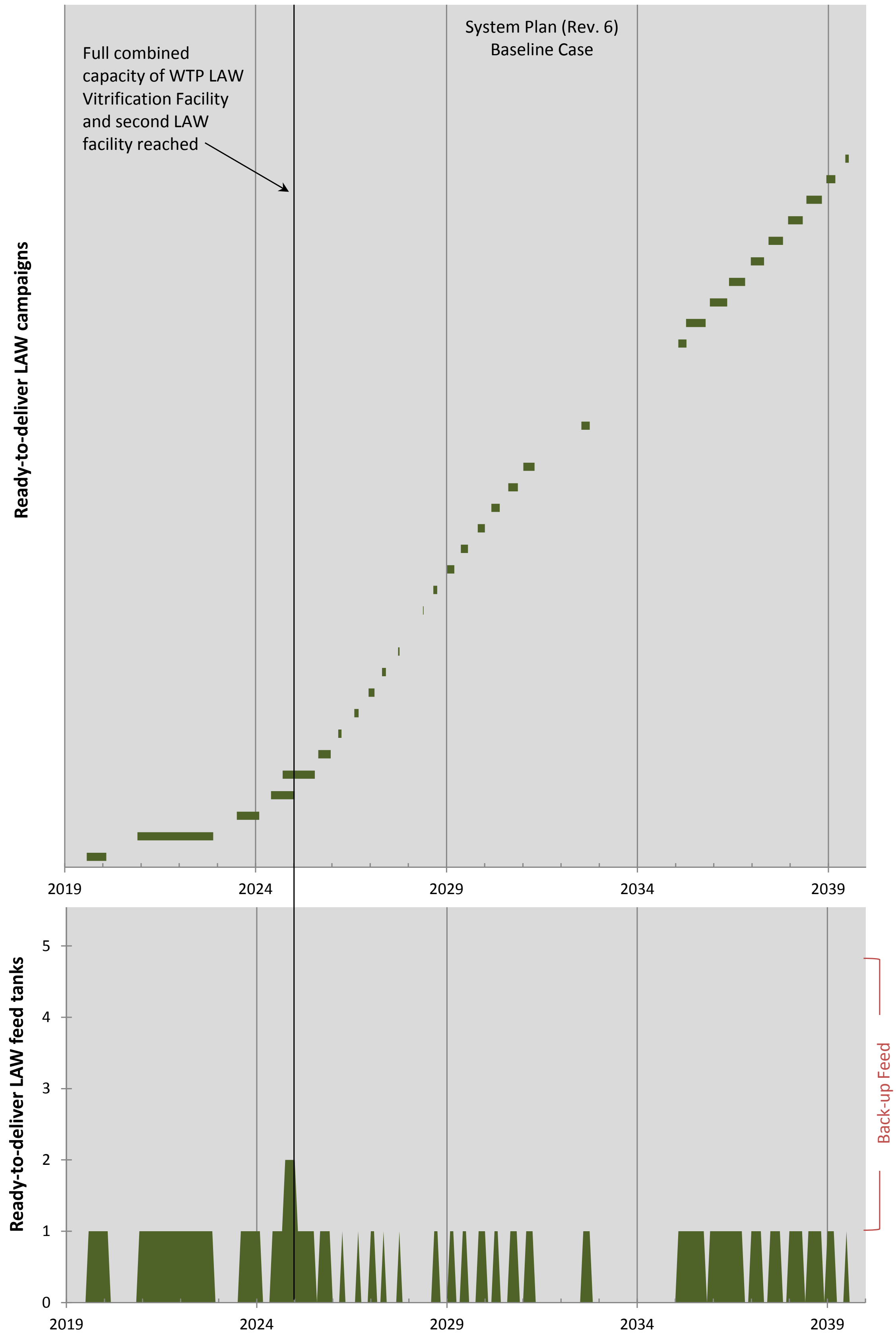

Figure 5-3. Ready-to-Deliver Low-Activity Waste Feed Tanks

6.0 EVAPORATOR CAMPAIGNS

Several 242-A Evaporator campaigns are planned through 2023 to support the DST system, enabling continued WFD activities. 242-A Evaporator operations are planned to continue beyond 2023, but this analysis is focused on near-term projections. Table 6-1 summarizes the projected 242-A Evaporator campaigns through 2023 and includes basic information on projected evaporator operation. The operating scenario for these campaigns is the System Plan (Rev. 6) Baseline Case.

Table 6-1. Projected 242-A Evaporator Campaigns

Campaign	Start date	Feed vol (gal)	Conc. vol (gal)	WVR (%)	Feed SpG	Conc. SpG
1	6/1/2012	932,721	650,852	30.2%	1.203	1.290
2	6/10/2012	839,200	521,510	37.9%	1.249	1.400
3	6/24/2012	836,121	552,044	34.0%	1.255	1.385
4	3/4/2013	774,500	343,293	55.7%	1.163	1.366
5	3/14/2013	498,000	309,207	37.9%	1.267	1.430
6	12/11/2013	932,721	523,275	43.9%	1.241	1.430
7	9/24/2014	600,520	261,731	56.4%	1.188	1.430
8	3/25/2015	860,029	399,019	53.6%	1.151	1.323
9	5/1/2015	580,678	436,609	24.8%	1.323	1.429
10	8/23/2016	855,791	482,718	43.6%	1.100	1.176
11	10/2/2016	919,327	590,983	35.7%	1.276	1.429
12	7/2/2017	838,183	615,362	26.6%	1.062	1.084
13	8/13/2017	932,721	505,554	45.8%	1.233	1.429
14	1/16/2018	650,464	434,289	33.2%	1.073	1.109
15	2/23/2018	932,721	471,925	49.4%	1.218	1.430
16	7/30/2018	586,330	279,925	52.3%	1.144	1.300
17	2/18/2020	932,721	474,231	49.2%	1.139	1.272
18	8/22/2020	932,721	415,754	55.4%	1.168	1.376
19	5/18/2021	534,250	270,650	49.3%	1.218	1.430
20	12/25/2021	932,721	424,259	54.5%	1.184	1.404

WVR = waste volume reduction.

242-A Evaporator campaigns occur frequently, with a total of 20 campaigns planned before 2023. Each evaporator campaign results in a reduction of the total waste volume stored within the DSTs. This volume reduction varies between campaigns and ranges between 24 and 55 percent of the original campaign feed. Evaporator campaigns reduce the volume of waste stored in the DSTs, creating more space for storage and transfer activities and producing concentrated supernates for delivery to WTP. There are no planned 242-A Evaporator outages planned before 2023, and no planned campaigns starting in 2022 or 2023.

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7.0 DOUBLE-SHELL TANK SPACE EVALUATION

Figure 7-1 shows the overall use of the DSTs through 2023. The figure shows the total DST capacity,[21] the total volume of waste, the portion that was retrieved from the SSTs, and the various allocations of headspace for purposes other than waste storage. Table 7-1 summarizes the various DST headspace categories.

Space is extremely limited through this period. Prior to WTP startup, continued SST retrievals minimize available DST space, especially during the 2017 to 2020 timeframe. The 242-A Evaporator campaigns slightly decrease the volume of waste stored in the DST system, but DST space availability remains minimal until the startup of WTP.

Although there is between 1.5 and 4.4 Mgal of unallocated DST space available from 2015 to 2020, that space is not readily usable. The available space is distributed among several tanks and not always directly usable without a complicated series of waste transfers and evaporator staging operations. As the DST system nears capacity, it is increasingly difficult to conduct SST retrieval, evaporator, and feed staging operations.

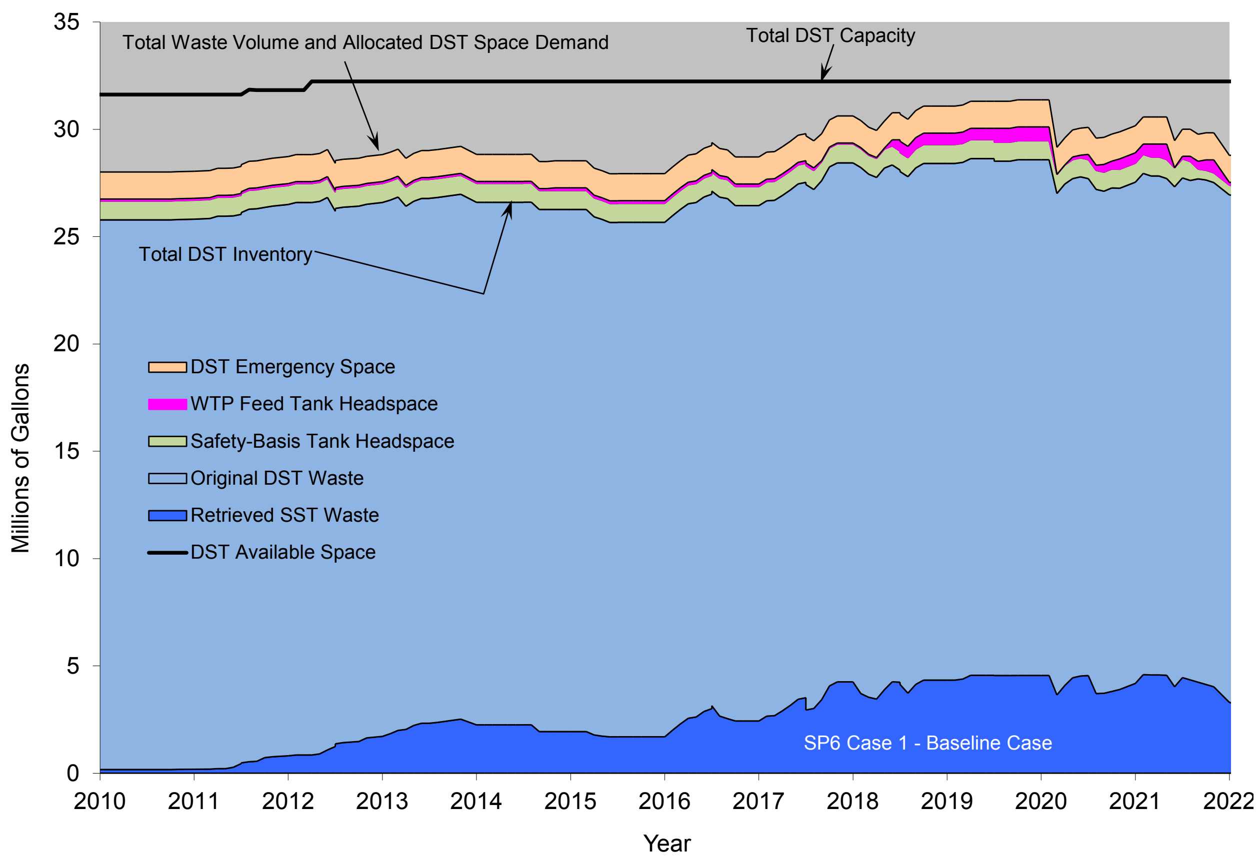

Figure 7-1. Overall Use of the Double-Shell Tanks

[21] The total DST capacity line in Figure 7-1 reflects existing and planned increases in the maximum operating volume of the AP Farm DSTs. The basis for increasing the maximum limit of specific DSTs is documented in Appendix A of OSD-T-151-00007, *Operating Specifications for the Double-Shell Storage Tanks*.

Table 7-1. Double-Shell Tank Headspace Categories

Category	Description
DST emergency space	1.265 Mgal of DST tank space that could be used to receive waste in the event of a leaking DST or emergency returns from the WTP.
WTP feed tank headspace	Space above waste that is specifically identified as an early WTP feed source or in tanks used to deliver feed to the WTP throughout the mission.
Safety-basis tank headspace	Space in tanks that cannot be used because of a safety issue associated with the waste; currently, only Waste Group A tanks are in this category.

DST = double-shell tank.
WTP = Waste Treatment and Immobilization Plant.

Figure 7-2 is a matrix of individual DST plots showing how the liquid level and solids level of each DST varies through 2023. Annotations are included to describe the notable DST transfer operations.

Many tanks remain static and have no (or very few) transfers through this time period. Many of these tanks are full, and there is no planned use for the stored waste. Other tanks are not full, but because of tank specific limitations (e.g., Waste Group A tanks, buoyant displacement gas release event limitations), the free space is not able to be used. The majority of the DST transfer activities during this time period are completed to support SST retrievals, 242-A Evaporator campaigns, waste staging, and feed deliveries to WTP.

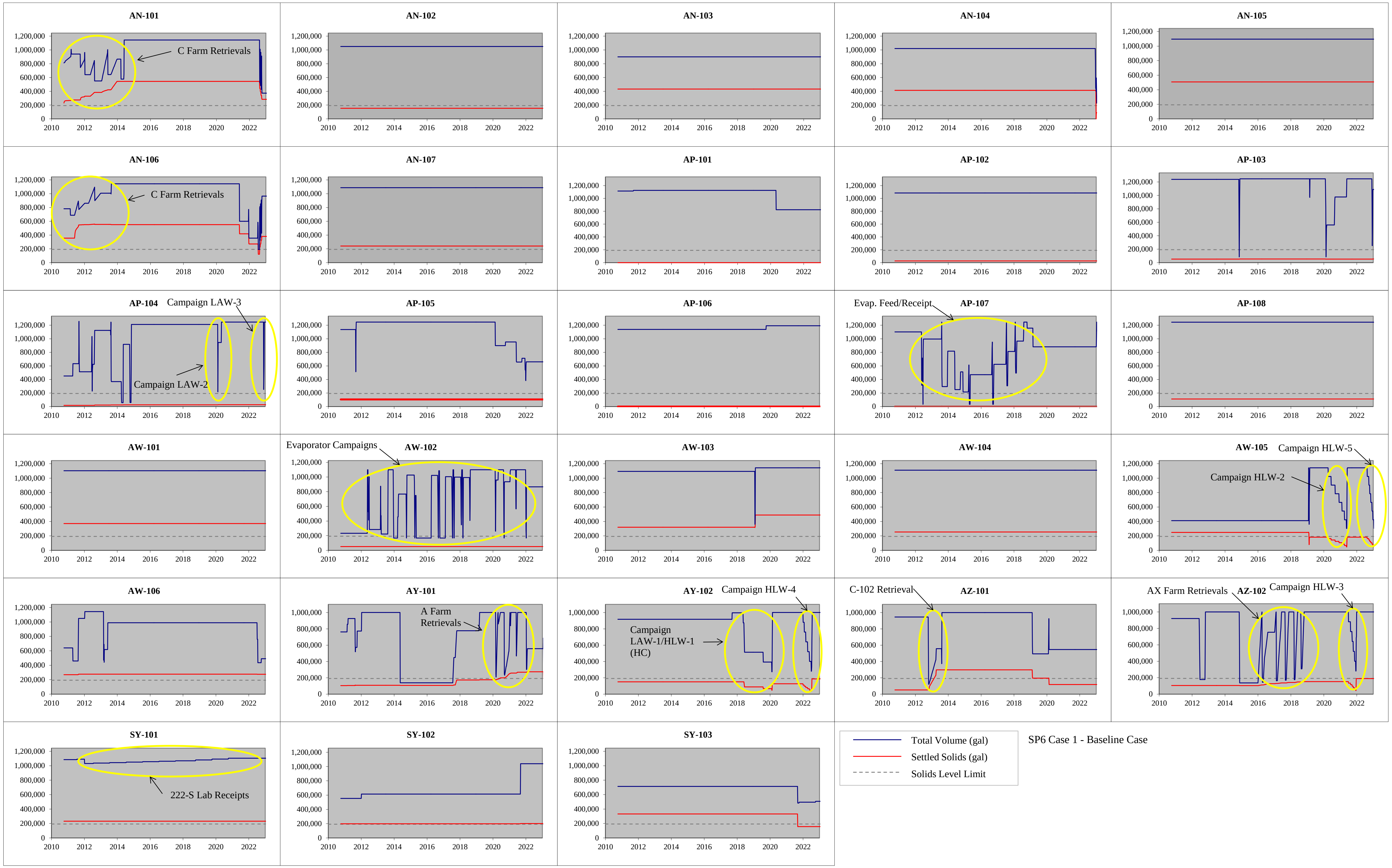

Figure 7-2. Projected Waste Volume over Time for Each Double-Shell Tank

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8.0 ISSUES AND UNCERTAINTIES

This section presents the issues and uncertainties directly associated with and originating from the WFD campaign plan, which will be considered in future revisions of the TOC Risk and Opportunity Management Plan (TFC-PLN-39).

The issues and uncertainties for WFD and the originating assumptions or assertions are presented in Table 8-1 along with a selection of potential mitigating actions. The status of each potential mitigating action is shown in parenthesis following the action statement. This revision of the IWFDP uses three status categories identified as: Planned – Ongoing or Planned – Future, Undetermined, or Refinement.

- **Planned** (ongoing or future) is used to denote that the potential mitigating action is explicitly included within the scope of one or more work breakdown structure elements of the performance measurement baseline (PMB).
- **Undetermined** signifies that the potential mitigating action does not appear to be explicitly addressed within the scope of any work breakdown structure element, and further evaluation is required to determine if the potential mitigating action is indeed part of the PMB scope.
- **Refinements** are improvements to either the operating scenario or to the HTWOS modeling and analysis capabilities that may influence other activities in the PMB; refinements are generally within the routine scope of the system and WFD planning efforts.

Table 8-1 also provides the TOC risk detail numbers, as defined in TFC-PLN-39, associated with each issue identified in this volume of the IWFDP. The listed TOC Risk Detail Numbers are not meant to be all-inclusive or capture every interaction, but provide a cross-walk to some of the primary TOC-level risks that apply to the issues identified in this volume of the IWFDP. Additional details of the key issues and uncertainties, potential mitigating actions and status are presented in TFC-PLN-39. Table 8-1 will be updated as the WFD campaign plan evolves, as existing issues are mitigated, and as new issues or uncertainties emerge.

Table 8-1. Issues/Uncertainties and Mitigating Actions (4 pages)

Item	Assumption/assertion	Issues and uncertainties	Potential mitigating actions (*status category*)	Comments	TOC risk detail number
1	The operating scenario will be defined by the System Plan (Rev. 6)[a] Baseline Case.	The System Plan (Rev.6)[a] Baseline Case may be affected by a number of key issues/uncertainties that may alter the timing, composition, or quantities of delivered feed.	This issue is a rollup of key issues and uncertainties already documented in System Plan (Rev. 6)[a] and the Risk and Opportunity Management Plan;[b] therefore, there are no mitigating actions aside from use of the risk management and DQO process.	Because this is a rollup of issues being tracked elsewhere, the status will not be updated here.	—
2	The LAW and HLW feed deliveries to WTP for Campaign LAW-1/HLW-1 (HC) will be transferred on schedule and in specification.	The equipment upgrades for Tank AY-102 are performed on a just-in-time schedule; there is little contingency for schedule slip.	• Modify schedule if possible to provide additional time for contingencies (*Undetermined*)	Revisit this PMA during preparation of the life-cycle BCR in FY 2012.	TOC-12-079
		Flowsheet needs to be refined to align with emerging strategy and plans, and risks identified within the flowsheet need to be addressed.	• Continue development of the hot commissioning flowsheet to address applicable risks (*Planned – Future*)		TOC-12-019
		A sampling method needs to be fully defined.	• See Item 13 in IWFDP Volume 1,[c] Section 5.0 (*Planned – Future*)		TOC-12-064
		The full-scale mixing demonstration has not been completed.	• Complete of the full-scale mixing demonstration (see Item 13 in IWFDP Volume 1,[c] Section 5.0) (*Planned – Ongoing*)		TOC-12-066
		The delivery schedule transfers three HLW feed batches very quickly during WTP startup.	• Negotiate how to deliver the feed during startup of WTP (see Item 1 in IWFDP Volume 1,[c] Section 5.0) (*Undetermined*)		TOC-12-019 TOC-12-079
		The HLW transfer line to WTP needs to be completed and qualified prior to the first delivery. Project delays could cause deliveries to be postponed.	• Complete necessary construction and perform transfer line qualification testing in time for delivery activities (*Planned – Ongoing*)		TOC-11-057 TOC-12-019 TOC-12-079
3	The LAW waste delivery to WTP for Campaign LAW-2 will be transferred on schedule and in specification.	A sampling method needs to be fully defined.	• See Item 13 in IWFDP Volume 1,[c] Section 5.0 (*Planned – Future*)		TOC-12-064
		Feed tank and contents are subject to change.	• Identify and lock down the specific feed tank (*Undetermined*) • Lock down the tank waste contents via the feed control list,[d] as appropriate (*Undetermined*)	Implementation of these PMAs will be a natural outcome of the evolving operating scenario as other issues are resolved.	TOC-12-079 TOC-12-078
		The dedicated LAW transfer line to WTP needs to be completed and qualified prior to the first delivery. Project delays could cause deliveries to be postponed.	• Complete necessary construction and perform transfer line qualification testing in time for delivery activities (*Planned – Ongoing*)		TOC-11-057 TOC-12-019 TOC-12-079
4	The HLW waste deliveries to WTP for Campaign HLW-2 will be transferred on schedule and in specification.	This HLW campaign transfers waste from Tank AW-105 to the WTP. The long length of transfer results in increased reliability risk and potential pressure drop concerns.	• Explore other DST options to serve as a HLW feed tank that does not raise reliability concerns (*Refinement*) • Evaluate alternative opportunities to reduce pressure drop associated with feed deliveries. Initiate actions to re-rate transfer lines to a higher design pressure (*Undetermined*)	RPP-RPT-50361[e] indicates waste deliveries from AW Farm exceed operating limits on pressure drop when contingency for conservatism is applied.	TOC-12-067 TOC-12-078
		The preliminary flowsheet[e] needs to be more fully developed and refined to align with emerging strategy and plans, and risks identified within the flowsheet need to be addressed.	• Continue development of the preliminary flowsheet to address all applicable risks (*Undetermined*)		TOC-12-019
		Initial use of incremental lowering of mixer pumps may lead to operational challenges.	• See Item 13 in IWFDP Volume 1,[c] Section 5.0 (*Undetermined*)		TOC-12-146
		A sampling method needs to be fully defined.	• See Item 13 in IWFDP Volume 1,[c] Section 5.0 (*Planned – Future*)		TOC-12-064
		The equipment upgrades for Tank AW-105 are performed on a just-in-time schedule; there is no contingency for schedule slip.	• Modify schedule if possible to provide additional time for contingencies (*Undetermined*)	Revisit this PMA during preparation of the life-cycle BCR in FY 2012.	TOC-12-079
		Feed tank and contents are subject to change.	• Identify and lock down the specific feed tank (*Undetermined*) • Lock down the tank waste contents via the feed control list,[d] as appropriate (*Undetermined*)	See comment in Item 3, above.	TOC-12-079 TOC-12-078

Table 8-1. Issues/Uncertainties and Mitigating Actions (4 pages)

Item	Assumption/assertion	Issues and uncertainties	Potential mitigating actions (*status category*)	Comments	TOC risk detail number
5	The HLW waste deliveries to WTP for Campaign HLW-3 will be transferred on schedule and in specification.	The timing of SST retrievals from AX Farm just prior to construction and a just-in-time schedule for the equipment upgrades for Tank AZ-102 do not provide any contingency for schedule slip.	• Modify schedule if possible to provide additional time for contingencies (*Undetermined*)	Revisit this PMA during preparation of the life-cycle BCR in FY 2012.	TOC-02-032 TOC-12-079 TOC-12-064
			• Take core samples of solids just prior to construction activities to aid in waste compatibility assessment and PCP analyses (*Undetermined*)		
		A sampling method needs to be fully defined.	• See Item 13 in IWFDP Volume 1,[c] Section 5.0 (*Planned – Future*)		TOC-12-064
		Feed tank and contents are subject to change.	• Identify and lock down the specific feed tank (*Undetermined*)	See comment in Item 3, above.	TOC-12-079 TOC-12-078
			• Lock down the tank waste contents via the feed control list,[d] as appropriate (*Undetermined*)		
6	The HLW waste deliveries to WTP for Campaign HLW-4 will be transferred on schedule and in specification.	Very little schedule contingency exists between feed deliveries from Campaign LAW-1/HLW-1 (HC) and feed preparation activities in this campaign.	• Modify schedule if possible to provide additional time for contingencies (*Undetermined*)	Revisit this PMA during preparation of the life-cycle BCR in FY 2012.	TOC-12-079
		Feed tank and contents are subject to change.	• Identify and lock down the specific feed tank (*Undetermined*)	See comment in Item 3, above.	TOC-12-079 TOC-12-078
			• Lock down the tank waste contents via the feed control list,[d] as appropriate (*Undetermined*)		
		A sampling method needs to be fully defined.	• See Item 13 in IWFDP Volume 1,[c] Section 5.0 (*Planned – Future*)		TOC-12-064
		Mixing and sampling activities occur more than a year before delivery and overlap with sampling activities associated with Campaigns HLW-3 and LAW-3.	• Evaluate potential to perform mixing and sampling activities closer to delivery (*Undetermined*)		TOC-12-079 TOC-12-078
7	The HLW waste deliveries to WTP for Campaign HLW-5 will be transferred on schedule and in specification.	Very little schedule contingency exists between feed deliveries from Campaign HLW-2 and feed preparation activities in this campaign.	• Modify schedule if possible to provide additional time for contingencies (*Undetermined*)	Revisit this PMA during preparation of the life-cycle BCR in FY 2012.	TOC-12-079
		This HLW campaign transfers waste from Tank AW-105 to WTP. Also, feed preparation involves transfer from AN Farm to AW Farm, which is an arduous path. The long length of transfers result in increased reliability risk and potential pressure drop concerns.	• Explore other DST options to serve as a HLW feed tank that does not raise reliability concerns (*Refinement*)		TOC-12-067 TOC-12-078
			• Evaluate alternative opportunities to reduce the pressure drop associated with feed deliveries; initiate actions to re-rate transfer lines to a higher design pressure (*Undetermined*)	RPP-RPT-50361[e] indicates waste deliveries from AW Farm exceed operating limits on pressure drop when contingency for conservatism is applied.	
			• Explore options of using other DSTs closer to AW Farm as sources of HLW solids if unable to avoid delivering from AW Farm (*Refinement*)		
		A sampling method needs to be fully defined.	• See Item 13 in IWFDP Volume 1,[c] Section 5.0 (*Planned – Future*)		TOC-12-064
		Feed tank and contents are subject to change.	• Identify and lock down the specific feed tank (*Undetermined*)	See comment in Item 3, above.	TOC-12-079 TOC-12-078
			• Lock down the tank waste contents via the feed control list,[d] as appropriate (*Undetermined*)		
8	The LAW waste delivery to WTP for Campaign LAW-3 will be transferred on schedule and in specification.	Very little schedule contingency exists between feed deliveries from Campaign LAW-2 and feed preparation activities in this campaign.	• Modify schedule, if possible, to provide additional time for contingencies (*Undetermined*)	Revisit this PMA during preparation of the life-cycle BCR in FY 2012.	TOC-12-079
		A sampling method needs to be fully defined.	• See Item 13 in IWFDP Volume 1,[c] Section 5.0 (*Planned – Future*)		TOC-12-064
		Sampling activities occur more than a year before delivery and overlap with sampling activities associated with Campaigns HLW-3 and HLW-4.	• Evaluate potential to perform mixing and sampling activities closer to delivery (*Undetermined*)		TOC-12-079
		Feed tank and contents are subject to change.	• Identify and lock down the specific feed tank (*Undetermined*)	See comment in Item 3, above.	TOC-12-079 TOC-12-078
			• Lock down the tank waste contents via the feed control list,[d] as appropriate (*Undetermined*)		

Table 8-1. Issues/Uncertainties and Mitigating Actions (4 pages)

Item	Assumption/assertion	Issues and uncertainties	Potential mitigating actions (*status category*)	Comments	TOC risk detail number
9	Feed that is projected to be delivered will meet all applicable waste acceptance criteria.	The HGR action limit is projected to be exceeded for one LAW batch containing supernate that can be traced back to the complexed concentrate wastes in Tanks AN-102 and AN-107.	• Revisit the flowsheet for strontium/TRU element precipitation (*Planned – Future*)		TOC-12-019
			• Blend the waste to distribute the total organic carbon (*Refinement*)		
			• Evaluate whether organic destruction occurs during strontium/TRU element precipitation (if not, a false peak may be the result) (*Undetermined*)		
		The bulk density limit is projected to be exceeded in one LAW batch.	• Revisit the control strategy for bulk density (*Refinement*)		TOC-12-019
		The waste acceptance process is evolving, specifically in regard to the intended role of Specifications 7 and 8.[f]	• Use the DQO process to complete the waste acceptance criteria DQO.[g] If necessary, use the Flowsheet IPT and processes described in the WTP Interface Management Plan[h] to update ICD-19[i] and the WTP Contract[j] to establish consistency in feed requirements between the documents (*Undetermined*)	DNFSB 2010-2 Implementation Plan[k] commitments include performing gap analyses and preparing the final waste acceptance criteria DQO.[g]	TOC-12-065
		Some waste acceptance criteria items are not assessed in the current operating scenario.	• Add the capability to screen for waste acceptance criteria items in HTWOS, as possible (*Refinement*)		TOC-12-019
			• Evaluate other waste acceptance criteria items that are not modeled via separate analyses (*Undetermined*)		
		There is no straightforward way to adjust a large quantity of waste to meet the current Specification 7 and/or 8 requirements.	• Evaluate the relevancy and meaning of the Specification 7 and 8 envelopes to establish a clear set of feed requirements (*Undetermined*)		TOC-12-065
		It is unclear as to what waste Envelope C will apply to as Tank AN-102 and AN-107 wastes are mitigated, transferred, and blended throughout the system.	• Establish a clear definition and set of requirements for Envelope C waste (*Undetermined*)		TOC-12-065
10	The number of samples required to meet the DQOs for WTP waste acceptance criteria will be reasonable.	The close approach to the action limits for both CSL 8.2 (solids) and bulk density is driving the number of samples to an exorbitant number.	• Evaluate raising the action limit for CSL 8.2 (solids) (*Undetermined*)		TOC-12-064
			• Enhance bulk density control strategy by blending waste to reduce the bulk density values well below the limit (*Refinement*)		
11	The 222-S Laboratory will provide all sample analysis requirements for WFD.	An evaluation on the demand and capacity of the 222-S Laboratory in terms of sample analysis to support WFD has not been completed.	• Perform an evaluation on the 222-S Laboratory sample analysis demand and capacity (*Planned – Ongoing*)	An evaluation is in progress, with anticipated release of the report in FY 2012.	TOC-07-020
12	LAW and HLW feed will be available for delivery to WTP on demand.	Contingency feed is unavailable at times, running the risk of starving the WTP of feed if issues arise, especially with HLW feed.	• Evaluate building a new facility to allow for staging of contingency feed (*Undetermined*)	Although LAW feed contingency is desired, HLW is the driving factor for feed deliveries to WTP, and more important in terms of availability of contingency feed.	TOC-12-079
			• Evaluate allocating additional LAW and HLW feed tanks beyond what is planned to determine impact (*Undetermined*)		
			• Repurpose existing DSTs and make available to stage additional contingency feed (*Undetermined*)		
13	WFD operations will follow tank usage guidelines identified in IWFDP Volume 1.[c]	The System Plan (Rev. 6)[a] Baseline Case operating scenario projects that the use of the aging waste tanks will exceed the slurry fill/empty cycle guidelines identified in Appendix B, Section B2.4 of IWFDP Volume 1.[c]	• Refine future operating scenarios, if possible, to follow the slurry fill/empty cycle guidelines (*Refinement*)	The Tank AY-102 Upgrade Project will soon release structural calculations for in-tank equipment that may provide a basis for updating the fill/empty cycle guidelines. Current guidelines are based on older mixer pump project analyses.	TOC-12-001 TOC-12-078
			• Reevaluate and document fill/empty cycle guidelines for aging waste tanks (*Refinement*)		

Table 8-1. Issues/Uncertainties and Mitigating Actions (4 pages)

Item	Assumption/assertion	Issues and uncertainties	Potential mitigating actions (*status category*)	Comments	TOC risk detail number
14	The 242-A Evaporator will continue to operate as needed to minimize the volume of liquid waste generated during SST retrievals as needed to support the first eight campaigns.	Outages may occur, causing loss of benefit from the evaporator. This will impact waste volume reduction, which is especially vital during the early years of WTP operation.	• Consider coordination of 242-A Evaporator upgrades and maintenance activities to minimize the impact of outages (*Refinement*)		TOC-01-010 TOC-12-008
			• Consider use of WFE technology to provide a transportable system for evaporation of SST waste and DST waste, thus reducing the volume of waste requiring storage and eliminating the current total dependence on the 242-A Evaporator (*Planned – Future*)	Development of a WFE has been projectized to further mature the technology. Full-scale operation is planned in 2016. Work on a bench-scale, thin-film evaporator is also proceeding in parallel.	
15	The space available in the existing 28 DSTs will be sufficient throughout the RPP mission.	DST space is extremely limited, especially early in the mission before and during WTP startup. Sufficient DST space is not available to support efficient feed staging operations during the early years of WTP operation.	• Continue waste management initiatives to increase usable storage space in existing DSTs (per RPP-RPT-45825[l]) (*Planned – Ongoing*)		TOC-01-005
			• Take advantage of the storage space potentially provided by any new feed conditioning, blending, new or expanded WRFs, or other facilities (*Undetermined*)		
			• Use the WFE to create additional space and make it usable by coordinated waste transfers (*Planned – Future*)		
			• Consider focusing available DST space for feed delivery purposes rather than SST retrievals (*Undetermined*)		

[a] ORP-11242, 2011, *River Protection Project System Plan*, Rev. 6, U.S. Department of Energy, Office of River Protection, Richland, Washington.
[b] TFC-PLN-39, 2011, *Risk and Opportunity Management Plan*, Rev. G, Washington River Protection Solutions, LLC, Richland, Washington.
[c] RPP-40149-VOL1, 2011, *Integrated Waste Feed Delivery Plan, Volume 1 – Process Strategy*, Rev. 2, Washington River Protection Solutions, LLC, Richland, Washington.
[d] HNF-SD-WM-OCD-015, 2011, *Tank Farms Waste Transfer Compatibility Program*, Rev. 24, Washington River Protection Solutions, LLC, Richland, Washington. Table A-1 identifies which tanks are affected by each issue and the controls that govern them.
[e] RPP-RPT-50361, 2011, *Tank 241-AW-105 Waste Feed Delivery Preliminary Flowsheet*, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.
[f] Specification 7 and 8 refer to Specification 7 (LAW envelopes definition) and Specification 8 (HLW envelope definition) in Section C of the WTP Contract (DE-AC27-01RV14136).
[g] 24590-WTP-RPT-MGT-11-014, 2011, *Initial Data Quality Objectives for WTP Feed Acceptance Criteria*, Rev. 0, Bechtel National, Inc., Richland, Washington.
[h] 24590-WTP-PL-MG-01-001, 2011, *Interface Management Plan*, Rev. 5, Bechtel National, Inc., Richland, Washington.
[i] 24590-WTP-ICD-MG-01-019, 2008, *ICD 19 – Interface Control Document for Waste Feed*, Rev. 4, Bechtel National, Inc., Richland, Washington.
[j] DE-AC27-01RV14136, 2010, *Design, Construction, and Commissioning of the Hanford Tank Waste Treatment and Immobilization Plant*, (as amended through A164), U.S. Department of Energy, Office of River Protection, Richland, Washington.
[k] Chu, S., 2011, "Department of Energy Plan to Address Waste Treatment and Immobilization Plant Vessel Mixing; Implementation Plan for Defense Nuclear Safety Board Recommendation 2010-2," (Letter to P. S. Winokur, Chairman, Defense Nuclear Facilities Safety Board, November 10), U.S. Department of Energy, Washington, D.C.
[l] RPP-RPT-45825, 2010, *Tank Space Alternatives Analysis Report*, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.

BCR = baseline change request.
CSL = criticality safety limit.
DQO = data quality objective.
DST = double-shell tank.
FY = fiscal year.
HC = hot commissioning.
HGR = hydrogen generation rate.
HLW = high-level waste.
HTWOS = Hanford Tank Waste Operations Simulator.
IPT = integrated project team.
IWFDP = Integrated Waste Feed Delivery Plan.
LAW = low-activity waste.
PCP = process control plan.
PMA = potential mitigating action.
RPP = River Protection Project.
SST = single-shell tank.
TRU = transuranic.
WFD = waste feed delivery.
WFE = wiped-film evaporator.
WRF = waste retrieval facility.
WTP = Waste Treatment and Immobilization Plant.

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9.0 PATH FORWARD

9.1 FUTURE REFINEMENTS

Several potential refinements have been identified throughout this iteration of the WFD planning process. The refinements listed below will be incorporated into future revisions of the IWFDP and System Plan baseline operating scenarios:

1. Align the timing and quantities of HLW and LAW waste feed delivered during hot commissioning with WTP planning assumptions to meet Consent Decree (2010) Milestone A-1, "Achieve initial plant operations for the Waste Treatment Plan " by December 31, 2022[22]
2. Update the operating scenario to avoid delivering HLW feed from the AW Farm to WTP to avoid pressure drop concerns
3. Expand feed screening capabilities to include those waste acceptance criteria, not already screened, that can be projected from HTWOS model results, such as total organic carbon concentration and unit liter dose
4. Update the operating scenario and process strategy to incorporate an improved control scheme for bulk density.

9.2 LONG-TERM PLANNING

Future revisions of this IWFDP will include updates to planning assumptions for WFD, tasks completed to resolve existing issues and uncertainties, and emerging issues that arise during ongoing WFD planning activities. The following items must be completed to resolve the issues and uncertainties associated with the IWFDP:

1. Establish final waste acceptance criteria for the WTP
   a. Use the DQO process to complete the waste acceptance criteria DQO and the processes established in the WTP Interface Management Plan (24590-WTP-PL-MG-01-001) to update ICD-19
   b. Clarify the relationship between the DQO, ICD-19, and the WTP Contract with respect to the role of Specification 7 and Specification 8
2. Periodically update the preliminary flowsheet for preparation and delivery of hot commissioning feed to remain aligned with evolving waste acceptance requirements, WTP hot commissioning plans, WFD plans, and the Baseline Case operating scenario
3. The One System IPT will facilitate providing WTP feedback in the form of an assessment of the proposed campaigns so that appropriate adjustments can be made to the process strategy, campaign plan, and project plan
4. Complete tank waste mixing and sampling studies to demonstrate adequate DST mixing, sampling, and transfer performance

[22] "Initial plant operations" is defined by the Consent Decree (2010) as "over a rolling period of at least 3 months leading to the milestone date, operating the WTP to produce high-level waste glass at an average rate of at least 4.2 metric tons of glass (MTG)/day, and low activity waste glass at an average rate of at least 21 MTG/day."

5. Conduct studies to refine the tank waste blending strategy to address systematic issues, such as feed variability and melter operability, and problematic wastes
6. Place the contents of DSTs containing waste slated for near-term campaigns under configuration control by adding them to the feed control list (HNF-SD-WM-OCD-015, Appendix A), when appropriate (the hot commissioning feed in Tank AY-102 is already on the feed control list)
7. Modify the schedule for the upgrade projects, if possible, to provide additional time for contingencies prior to their first use for WFD operations
8. Update the operating scenario and process strategy, if possible, to provide additional time to prepare feed and to maintain a supply of contingency feed
9. Develop a full flowsheet for the precipitation of ^{90}Sr and TRU elements from the complexed concentrate waste currently in Tanks AN-102 and AN-107:
    a. Address optimization of the process and necessary controls on the resulting supernate and precipitated solids (laboratory-scale testing using waste samples may be required)
    b. Resolve the issue of this waste exceeding the HGR waste acceptance criteria action limit upon delivery (developing effective blending strategies may be required)
10. Expand the evaluation of the early campaigns for projected compliance with the waste acceptance criteria to include those criteria not readily screened using HTWOS model results
11. Perform an evaluation of the 222-S Laboratory demand and capacity to support WFD activities and other tank farms operations

Continue space management initiatives to increase usable storage space in the DST system; these initiatives include development and use of the wiped-film evaporator, construction of additional storage facilities, or focusing available DST space for feed delivery purposes rather than SST retrievals.

10.0 REFERENCES

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RPP-RPT-46020, 2010, *Tank 241-AY-102 Waste Feed Delivery Flowsheet*, Rev. 0A, Washington River Protection Solutions, LLC, Richland, Washington.

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APPENDIX A

GLOSSARY

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Term or Abbreviation	Definition or Expansion
Baseline Case	In System Plan (Rev. 6),[a] the Baseline Case is a mission scenario that forms the technical basis for both the near-term baseline and the out-year planning estimate range.
Buoyant-Displacement Gas Release Event (BDGRE)	Tank waste generates flammable gases through the radiolysis of water and organic compounds, thermolytic decomposition of organic compounds, and corrosion of the carbon steel tank walls. Under certain conditions, this gas may accumulate in a settled solids layer until the waste becomes hydrodynamically unstable (less dense waste near the bottom of the tank). A BDGRE is the rapid release of this gas, partially restoring hydrodynamic equilibrium. The release may result in the temporary creation of a flammable mixture in the headspace of the tank, depending on the size of the release relative to the capacity of the ventilation system.
Campaign	Batch(es) of certified LAW or HLW feed delivered to the WTP from a single source DST.
Complexed Concentrate (CC)	The term used for wastes with organic chelating agents that were used during strontium recovery operations at B Plant in the 1960s and 1970s. Waste was considered to be complexed concentrate if the total organic carbon concentration exceeded 10 g/L after concentration. Complexed concentrate has the potential to maintain strontium and transuranic elements in solution, requiring additional pretreatment steps prior to treatment and disposal. Tanks AN-102 and AN-107 are identified as complexed concentrate waste.
Cross-Site Transfer	The Hanford waste tanks are located in two physically separated areas called 200 East Area and 200 West Area, about seven miles apart. The cross-site transfer system is a pair of transfer pipelines and ancillary equipment that is used to transfer supernate and slurry from the 200 West Area to the 200 East Area.
Disposal	Emplacement of waste in such a manner that ensures protection of the public, workers, and the environment with no intention of retrieval and that requires deliberate action to regain access to the waste (per DOE M 435.1-1[b]).
Group A Tanks	Tanks, that due to their waste composition and quantities, have the potential for a spontaneous BDGRE and are conservatively estimated to contain enough flammable gas within the waste that if all were released into the tank headspace, the concentration of the flammable gas would be a flammable mixture.
High-Level Waste (HLW)	The fraction of the tank waste containing most of the radioactivity that will be immobilized into glass and disposed at an off-site repository. HLW includes the solids remaining after pretreatment plus certain separated radionuclides.
High-Level Waste (HLW) Feed	The slurry stream (sludge plus supernate) that is delivered to the WTP Pretreatment Facility. Any solids remaining after pretreatment are routed to the WTP HLW Vitrification Facility along with separated radionuclides.
Hanford Tank Waste Operations Simulator (HTWOS)	A dynamic event-simulation model that tracks waste as it moves through storage, retrieval, feed staging, and multiple treatment processes from the present day until the end of the River Protection Project (RPP) mission.
Hot Commissioning	The phase in which WTP does production runs using actual tank waste.
Incidental Blending	Blending of HLW feed that naturally occurs during the retrieval, staging, storage, and delivery of feed without any special effort other than single-shell tank (SST) sequencing. It is sometimes called unavoidable blending.
Intentional Blending	Any blending that is specifically orchestrated and, therefore, requires additional effort. Examples include pairwise blending (blending of two tanks at a time), metered blending (where small amounts of a problematic waste are blended into a number of successive feed batches), and the blending of different wastes first segregated according to limiting constituents.

Term or Abbreviation	Definition or Expansion
Low-Activity Waste (LAW)	Waste that remains following the process of separating as much of the radioactivity as practicable from HLW. This stream is transferred from pretreatment to the WTP LAW Vitrification Facility for treatment.
Low-Activity Waste (LAW) Feed	The liquid stream (supernate plus a small amount of entrained solids) that is delivered to the WTP Pretreatment Facility. LAW feed is managed as HLW until it has been pretreated.
Low-Level Waste (LLW)	Radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or byproduct material, as defined in Section 11e.(2) of the *Atomic Energy Act of 1954*.[c] After treatment, low-level waste can be disposed in a near-surface facility.
Operating Scenario	The current RPP mission scenario that forms the technical basis for both the near-term baseline and the out-year planning estimate range. For this version of the IWFDP, the operating scenario is the System Plan (Rev. 6)[a] Baseline Case.
Project Execution Plan (PEP)	The U.S. Department of Energy's core document for management of a project, which establishes the policies and procedures to be followed to manage and control project planning, initiation, definition, execution, and transition/closeout, and uses the outcomes and outputs from all project planning processes, integrating them into a formally approved document. A PEP includes an accurate reflection of how the project is to be accomplished, resource requirements, technical considerations, risk management, configuration management, and roles and responsibilities.
Projectized Operational Activity (based on Category 2 projectized operational activity)	Expense-funded activities (medium complex to complex) consisting of relatively long duration (months to years) work, which require a focused amount of planning and coordination between multiple organizations to develop performance baselines and accomplish project objectives and goals. These activities generally involve relatively minor impacts on the facility safety basis. They can require design and construction, and a system startup. This category may require a management self-assessment/ readiness assessment to begin operations and includes traditional design/build projects that are no longer considered capital assets.
Retrieval	The process of removing, to the maximum extent practical, all of the waste from a given underground storage tank. The retrieval process is selected specific to each tank and accounts for the waste type stored and the access and support systems available. In accordance with OSD-T-151-00031,[d] a tank is officially in "retrieval status" if one of two conditions is met: (1) waste has been physically removed from the tank by retrieval operations, or (2) preparations for retrieval operations are directly responsible for rendering the leak or intrusion monitoring instrument out-of-service.
Saltcake	A mixture of crystalline sodium salts that originally precipitated when alkaline liquid waste from the various processing facilities was evaporated to reduce waste volume. Saltcakes are comprised primarily of the sodium salts of nitrate, nitrite, carbonate, phosphate, and sulfate. Concentrations of transition metals such as iron, manganese, and lanthanum and heavy metals (e.g., uranium and lead) are generally small. Saltcake typically contains a small amount of interstitial liquid. The bulk of the saltcake will dissolve if contacted with sufficient water.
Sludge	A mixture of metal hydroxides and oxyhydroxides that originally precipitated when acid liquid waste from the various reprocessing facilities was made alkaline with sodium hydroxide. Sludge is comprised primary of the hydroxides and oxyhydroxides of aluminum, iron, chromium, silicon, zirconium, and uranium, plus the majority of the insoluble radionuclides such as ^{90}Sr and the plutonium isotopes. Sludge typically contains a significant amount of interstitial liquid (up to nominal 40 wt% water). Sludge is mostly insoluble in water; however, a significant amount of aluminum and chromium will dissolve if leached with sufficient quantities of sodium hydroxide.

Term or Abbreviation	Definition or Expansion
Slurry	The term slurry is used in several different contexts: • Slurry is a mixture of solids (e.g., sludge or undissolved saltcake) suspended in a liquid. For example, a slurry results when the sludge and supernate in a tank is mixed together. Slurries can be used to transfer solids by pumping though a pipeline. • Slurry can refer to the bottoms stream from the 242-A Evaporator or other evaporator streams. • Slurry also refers to a specific waste produced at Hanford that results from evaporating supernate originally removed from tanks containing saltcake so that aluminum salts begin to precipitate in addition to the sodium salts. This material, called “double-shell slurry” or “double-shell slurry feed” is present in the DSTs (specifically Tanks AN-103, AN-104, AN-105, and AW-101). For simplicity, this document will use the term “settled salts” or “saltcake” instead of slurry in this context.
Solids	The product of centrifuging the LAW feed, separating and drying the solids, and removing the dissolved solids contribution.
Specification 7	This WTP contractual specification[e] establishes three LAW feed envelopes: Waste Envelopes A, B, and C. Each waste envelope provides the compositional limits for chemical and radioactive constituents in the waste feed to be provided to the WTP.
Specification 8	This WTP contractual specification[e] establishes the HLW slurry composition and the unwashed solids composition (Envelope D). This waste envelope provides the compositional limits for chemical and radioactive constituents and physical properties in the waste feed to be provided to the WTP.
Supernate	Supernate is technically the liquid floating above a settled solids layer. At Hanford, it is typically used to refer to any non-interstitial liquid in the tanks, even if no solids are present. Supernate is similar to saltcake in composition and contains many of the soluble radionuclides such as ^{137}Cs and ^{99}Tc.
Waste Feed Delivery (WFD)	RPP-47172[f] defines the WFD system as being composed of the DST system and the waste retrieval facilities (WRF); however, for the purposes of the IWFDP, WFD system is used to refer to those portions of the WFD system directly supporting preparation and delivery of waste feed to the WTP.
Waste Feed Delivery (WFD) System	A future facility used to support the retrieval of waste involving slurry transfers from SSTs that are located too far to be readily retrieved directly into a DST. The WRF, located near the SSTs, would accumulate and condition retrieved waste before transfer to a DST.

[a] ORP-11242, 2011, *River Protection Project System Plan*, Rev. 6, U.S. Department of Energy, Office of River Protection, Richland, Washington.

[b] DOE M 435.1-1, 2011, *Radioactive Waste Management Manual*, Change 2, Office of Environmental Management, U.S. Department of Energy, Washington, D.C.

[c] *Atomic Energy Act of 1954*, 42 USC 2011, et seq.

[d] OSD-T-151-00007, 2011, *Operating Specifications for the Double-Shell Storage Tanks*, Rev. 7, Washington River Protection Solutions, LLC, Richland, Washington.

[e] DE-AC27-01RV14136, 2010, *Design, Construction, and Commissioning of the Hanford Tank Waste Treatment and Immobilization Plant*, (as amended through A164), U.S. Department of Energy, Office of River Protection, Richland, Washington.

[f] RPP-47172, 2010, *Waste Feed Delivery System Description*, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.

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APPENDIX B

PROJECTED TRANSFERS

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B1.0 INTRODUCTION

Table B-1 contains a list of the projected transfers directly associated with each campaign, for the first eight campaigns. All transfers for the entire mission are provided in SVF-2111, "Transfers_4MinTimestep(6Melters)-mmr-1-11-031-6.5-8.3r1-2011-03-18-at-01-31-58_M1.xlsm."

Table B-1. Projected Waste Transfers for the First Eight Campaigns (4 pages)

Campaign	Transfer ID	From tank	To tank	Start date	End date	Total volume (gal)	Liquid volume (gal)	Solid volume (gal)	Liquid Spg	[Solids] (g/L)	[Solids] (wt%)	Total activity (Ci)
HLW-3	61	AZ-102	AW-102	6/8/2012	6/10/2012	371,300	371,300	0	1.242	0	0.00%	1,010,931
HLW-3	65	AZ-102	AW-102	6/18/2012	6/20/2012	371,300	371,300	0	1.242	0	0.00%	1,010,931
HLW-3	75	AZ-101	AZ-102	10/15/2012	10/19/2012	823,990	823,647	343	1.251	1.25	0.10%	7,894,070
LAW-2	107	AP-104	AW-102	10/5/2014	10/9/2014	860,029	860,029	0	1.145	0	0%	228,574
LAW-2	108	AP-103	AP-104	11/3/2014	11/9/2014	1,152,380	1,152,380	0	1.406	0	0%	1,586,570
HLW-3	109	AZ-102	AP-103	11/14/2014	11/18/2014	864,350	863,994	356	1.238	1.24	0.10%	7,033,648
HLW-3	119	AX-103	AZ-102	1/1/2016	3/26/2016	864,486	863,155	1,331	1.064	4.62	0.43%	412,394
HLW-3	120	AZ-102	AW-102	3/31/2016	4/5/2016	855,791	855,791	0	1.07	0	0%	363,625
HLW-3	121	AX-103	AZ-102	4/25/2016	5/26/2016	312,648	312,166	482	1.064	4.62	0.43%	149,145
HLW-3	122	AX-104	AZ-102	5/31/2016	8/6/2016	293,720	291,655	2,065	1.015	21.09	2.05%	1,933,382
HLW-3	130	AX-102	AZ-102	1/5/2017	2/3/2017	247,104	246,933	171	1.02	2.08	0.20%	45,673
HLW-3	131	AZ-102	AW-102	2/8/2017	2/12/2017	838,183	838,183	0	1.033	0	0%	137,233
HLW-3	132	AX-102	AZ-102	3/4/2017	5/16/2017	608,009	607,588	421	1.02	2.08	0.20%	112,380
HLW-3	133	AX-101	AZ-102	5/21/2017	6/5/2017	230,174	229,886	288	1.137	3.76	0.33%	76,915
HLW-3	142	AZ-102	AW-102	8/25/2017	8/29/2017	831,335	831,335	0	1.051	0	0%	85,142
LAW-1/HLW-1	143	Water	AY-102	9/9/2017	9/9/2017	80,000	80,000	0	1	0	0%	0
HLW-3	145	AX-101	AZ-102	9/18/2017	11/13/2017	831,335	830,294	1,041	1.137	3.76	0.33%	277,799
HLW-3	151	AZ-102	AW-102	3/8/2018	3/12/2018	825,424	825,424	0	1.133	0	0%	189,664
HLW-3	152	AX-101	AZ-102	4/1/2018	5/27/2018	825,425	824,391	1,034	1.137	3.76	0.33%	269,566
LAW-1	157	AY-102	FRP-VSL-00002ABCD	5/11/2018	5/11/2018	122,699	122,699	0	1.273	0	0%	78,242
LAW-1	158	Inhibited-Water	FRP-VSL-00002ABCD	5/11/2018	5/11/2018	4,500	4,500	0	1.001	0	0%	0
HLW-1	160	AY-102	HLP-VSL-00022	5/31/2018	5/31/2018	120,000	114,799	5,201	1.277	130.02	9.62%	1,039,049
HLW-1	161	Inhibited-Water	HLP-VSL-00022	5/31/2018	5/31/2018	4,500	4,500	0	1.001	0	0%	0
HLW-1	163	AY-102	HLP-VSL-00022	6/5/2018	6/5/2018	120,000	114,799	5,201	1.277	130.02	9.62%	1,039,049
HLW-1	164	Inhibited-Water	HLP-VSL-00022	6/5/2018	6/5/2018	4,500	4,500	0	1.001	0	0%	0
HLW-1	166	AY-102	HLP-VSL-00022	6/10/2018	6/11/2018	120,000	114,799	5,201	1.277	130.02	9.62%	1,039,049
HLW-1	167	Inhibited-Water	HLP-VSL-00022	6/11/2018	6/11/2018	4,500	4,500	0	1.001	0	0%	0
HLW-3	173	AZ-102	AW-102	8/11/2018	8/14/2018	693,627	693,627	0	1.137	0	0%	162,899
HLW-3	174	AX-101	AZ-102	9/3/2018	10/14/2018	604,194	603,437	757	1.137	3.76	0.33%	197,317
HLW-3	177	AP-107	AZ-102	10/19/2018	10/19/2018	89,433	89,433	0	1.339	0	0.00%	105,692
HLW-2	182	AW-103	AW-105	1/25/2019	1/28/2019	732,936	732,638	298	1.225	1.22	0.10%	440,945
HLW-2	183	AW-105	AW-103	2/2/2019	2/6/2019	782,968	770,627	12,341	1.205	47.28	3.83%	402,888
HLW-2	184	Inhibited-Water	AW-105	2/10/2019	2/10/2019	500	500	0	1.001	0	0%	0
HLW-2	185	AZ-101	AW-105	2/11/2019	2/13/2019	506,300	471,951	34,349	1.338	203.53	14.03%	3,640,143

Table B-1. Projected Waste Transfers for the First Eight Campaigns (4 pages)

Campaign	Transfer ID	From tank	To tank	Start date	End date	Total volume (gal)	Liquid volume (gal)	Solid volume (gal)	Liquid Spg	[Solids] (g/L)	[Solids] (wt%)	Total activity (Ci)
HLW-2	186	Inhibited-Water	AW-105	2/13/2019	2/13/2019	500	500	0	1.001	0	0%	0
HLW-2	187	AP-103	AW-105	2/18/2019	2/20/2019	275,667	275,585	82	1.288	0.9	0.07%	1,615,861
HLW-1	194	AY-102	HLP-VSL-00022	7/31/2019	7/31/2019	120,000	114,799	5,201	1.277	130.02	9.62%	1,014,605
HLW-1	195	Inhibited-Water	HLP-VSL-00022	7/31/2019	8/1/2019	4,500	4,500	0	1.001	0	0%	0
HLW-1	200	AY-102	HLP-VSL-00022	2/2/2020	2/3/2020	120,000	114,799	5,201	1.277	130.02	9.62%	990,740
HLW-1	201	Inhibited-Water	HLP-VSL-00022	2/3/2020	2/3/2020	4,500	4,500	0	1.001	0	0%	0
LAW-2	203	AP-104	FRP-VSL-00002ABCD	2/3/2020	2/8/2020	995,500	995,500	0	1.399	0	0%	1,168,639
LAW-2	206	Inhibited-Water	FRP-VSL-00002ABCD	2/8/2020	2/8/2020	4,500	4,500	0	1.001	0	0%	0
HLW-4	208	Inhibited-Water	AY-102	2/9/2020	2/9/2020	500	500	0	1.001	0	0%	0
LAW-3	209	Inhibited-Water	AP-104	2/9/2020	2/9/2020	500	500	0	1.001	0	0%	0
HLW-4	210	AZ-101	AY-102	2/14/2020	2/16/2020	378,900	352,217	26,683	1.319	211.27	14.70%	3,158,568
LAW-3	211	AP-103	AP-104	2/14/2020	2/17/2020	728,934	728,849	85	1.3	0.35	0.03%	3,373,936
HLW-4	212	Inhibited-Water	AY-102	2/16/2020	2/16/2020	500	500	0	1.001	0	0%	0
HLW-4	214	AP-105	AY-102	2/21/2020	2/22/2020	347,521	347,521	0	1.411	0	0%	475,593
HLW-2	219	AW-105	HLP-VSL-00022	4/4/2020	4/4/2020	120,000	115,791	4,209	1.283	105.22	7.83%	557,628
HLW-2	220	Inhibited-Water	HLP-VSL-00022	4/4/2020	4/5/2020	4,500	4,500	0	1.001	0	0%	0
LAW-3	224	Inhibited-Water	AP-104	4/29/2020	4/29/2020	500	500	0	1.001	0	0%	0
LAW-3	226	AP-101	AP-104	4/30/2020	5/1/2020	300,889	300,889	0	1.42	0	0%	277,721
HLW-2	230	AW-105	HLP-VSL-00022	6/9/2020	6/10/2020	120,000	115,791	4,209	1.283	105.22	7.83%	557,628
HLW-2	231	Inhibited-Water	HLP-VSL-00022	6/10/2020	6/10/2020	4,500	4,500	0	1.001	0	0%	0
HLW-2	238	AW-105	HLP-VSL-00022	9/5/2020	9/5/2020	120,000	115,791	4,209	1.283	105.22	7.83%	557,628
HLW-2	239	Inhibited-Water	HLP-VSL-00022	9/5/2020	9/6/2020	4,500	4,500	0	1.001	0	0%	0
HLW-2	251	AW-105	HLP-VSL-00022	11/29/2020	11/30/2020	120,000	115,791	4,209	1.283	105.22	7.83%	557,628
HLW-2	252	Inhibited-Water	HLP-VSL-00022	11/30/2020	11/30/2020	4,500	4,500	0	1.001	0	0%	0
HLW-2	258	AW-105	HLP-VSL-00022	2/3/2021	2/4/2021	120,000	115,791	4,209	1.283	105.22	7.83%	544,748
HLW-2	259	Inhibited-Water	HLP-VSL-00022	2/4/2021	2/4/2021	4,500	4,500	0	1.001	0	0%	0
HLW-2	265	AW-105	HLP-VSL-00022	4/1/2021	4/1/2021	120,000	115,791	4,209	1.283	105.22	7.83%	544,748
HLW-2	266	Inhibited-Water	HLP-VSL-00022	4/1/2021	4/1/2021	4,500	4,500	0	1.001	0	0%	0
HLW-2	268	AW-105	HLP-VSL-00022	5/15/2021	5/16/2021	120,000	115,791	4,209	1.283	105.22	7.83%	544,748
HLW-2	269	Inhibited-Water	HLP-VSL-00022	5/16/2021	5/16/2021	4,500	4,500	0	1.001	0	0%	0
HLW-5	273	Inhibited-Water	AW-105	5/23/2021	5/23/2021	500	500	0	1.001	0	0%	0
HLW-5	274	AN-106	AW-105	5/23/2021	5/26/2021	544,100	514,723	29,377	1.223	161.98	12.28%	2,555,020
HLW-5	275	Inhibited-Water	AW-105	5/26/2021	5/26/2021	500	500	0	1.001	0	0%	0
HLW-5	278	AP-105	AW-105	5/31/2021	6/2/2021	294,900	294,764	136	1.386	1.39	0.10%	370,413

Table B-1. Projected Waste Transfers for the First Eight Campaigns (4 pages)

Campaign	Transfer ID	From tank	To tank	Start date	End date	Total volume (gal)	Liquid volume (gal)	Solid volume (gal)	Liquid Spg	[Solids] (g/L)	[Solids] (wt%)	Total activity (Ci)
HLW-3	280	AZ-102	HLP-VSL-00022	6/30/2021	6/30/2021	120,000	117,036	2,964	1.162	74.11	6.14%	1,060,377
HLW-3	281	Inhibited-Water	HLP-VSL-00022	6/30/2021	6/30/2021	4,500	4,500	0	1.001	0	0%	0
HLW-3	286	AZ-102	HLP-VSL-00022	8/11/2021	8/11/2021	120,000	117,036	2,964	1.162	74.11	6.14%	1,060,377
HLW-3	287	Inhibited-Water	HLP-VSL-00022	8/11/2021	8/11/2021	4,500	4,500	0	1.001	0	0%	0
HLW-3	293	AZ-102	HLP-VSL-00022	9/14/2021	9/15/2021	120,000	117,036	2,964	1.162	74.11	6.14%	1,060,377
HLW-3	294	Inhibited-Water	HLP-VSL-00022	9/15/2021	9/15/2021	4,500	4,500	0	1.001	0	0%	0
HLW-3	299	AZ-102	HLP-VSL-00022	10/13/2021	10/14/2021	120,000	117,036	2,964	1.162	74.11	6.14%	1,060,377
HLW-3	300	Inhibited-Water	HLP-VSL-00022	10/14/2021	10/14/2021	4,500	4,500	0	1.001	0	0%	0
HLW-3	302	AZ-102	HLP-VSL-00022	11/9/2021	11/10/2021	120,000	117,036	2,964	1.162	74.11	6.14%	1,060,377
HLW-3	303	Inhibited-Water	HLP-VSL-00022	11/10/2021	11/10/2021	4,500	4,500	0	1.001	0	0%	0
HLW-3	305	AZ-102	HLP-VSL-00022	12/4/2021	12/5/2021	120,000	117,036	2,964	1.162	74.11	6.14%	1,060,377
HLW-3	306	Inhibited-Water	HLP-VSL-00022	12/5/2021	12/5/2021	4,500	4,500	0	1.001	0	0%	0
HLW-4	315	AY-102	HLP-VSL-00022	12/30/2021	12/30/2021	120,000	115,380	4,620	1.34	115.5	8.23%	689,995
HLW-4	316	Inhibited-Water	HLP-VSL-00022	12/30/2021	12/30/2021	4,500	4,500	0	1.001	0	0%	0
HLW-4	322	AY-102	HLP-VSL-00022	1/26/2022	1/27/2022	120,000	115,380	4,620	1.34	115.5	8.23%	673,939
HLW-4	323	Inhibited-Water	HLP-VSL-00022	1/27/2022	1/27/2022	4,500	4,500	0	1.001	0	0%	0
HLW-4	325	AY-102	HLP-VSL-00022	3/2/2022	3/2/2022	120,000	115,380	4,620	1.34	115.5	8.23%	673,939
HLW-4	326	Inhibited-Water	HLP-VSL-00022	3/2/2022	3/2/2022	4,500	4,500	0	1.001	0	0%	0
HLW-4	328	AY-102	HLP-VSL-00022	4/8/2022	4/9/2022	120,000	115,380	4,620	1.34	115.5	8.23%	673,939
HLW-4	329	Inhibited-Water	HLP-VSL-00022	4/9/2022	4/9/2022	4,500	4,500	0	1.001	0	0%	0
HLW-4	332	AY-102	HLP-VSL-00022	5/20/2022	5/20/2022	120,000	115,380	4,620	1.34	115.5	8.23%	673,939
HLW-4	333	Inhibited-Water	HLP-VSL-00022	5/20/2022	5/20/2022	4,500	4,500	0	1.001	0	0%	0
HLW-4	335	AY-102	HLP-VSL-00022	6/29/2022	6/30/2022	120,000	115,380	4,620	1.34	115.5	8.23%	673,939
HLW-4	336	Inhibited-Water	HLP-VSL-00022	6/30/2022	6/30/2022	4,500	4,500	0	1.001	0	0%	0
HLW-5	346	AW-105	HLP-VSL-00022	8/16/2022	8/17/2022	120,000	115,786	4,214	1.282	105.36	7.85%	441,678
HLW-5	347	Inhibited-Water	HLP-VSL-00022	8/17/2022	8/17/2022	4,500	4,500	0	1.001	0	0%	0
HLW-5	356	AW-105	HLP-VSL-00022	9/22/2022	9/23/2022	120,000	115,786	4,214	1.282	105.36	7.85%	441,678
HLW-5	357	Inhibited-Water	AN-106	9/22/2022	9/22/2022	500	500	0	1.001	0	0%	0
HLW-5	364	AW-105	HLP-VSL-00022	10/11/2022	10/11/2022	120,000	115,786	4,214	1.282	105.36	7.85%	441,678
HLW-5	365	Inhibited-Water	HLP-VSL-00022	10/11/2022	10/11/2022	4,500	4,500	0	1.001	0	0%	0
HLW-5	367	AW-105	HLP-VSL-00022	11/7/2022	11/8/2022	120,000	115,786	4,214	1.282	105.36	7.85%	441,678
HLW-5	368	Inhibited-Water	HLP-VSL-00022	11/8/2022	11/8/2022	4,500	4,500	0	1.001	0	0%	0
LAW-3	370	AP-104	FRP-VSL-00002ABCD	11/22/2022	11/27/2022	995,500	995,500	0	1.345	0	0%	2,998,120
LAW-3	371	Inhibited-Water	FRP-VSL-00002ABCD	11/27/2022	11/27/2022	4,500	4,500	0	1.001	0	0%	0

Table B-1. Projected Waste Transfers for the First Eight Campaigns (4 pages)

Campaign	Transfer ID	From tank	To tank	Start date	End date	Total volume (gal)	Liquid volume (gal)	Solid volume (gal)	Liquid Spg	[Solids] (g/L)	[Solids] (wt%)	Total activity (Ci)
HLW-5	374	AW-105	HLP-VSL-00022	11/29/2022	11/29/2022	120,000	115,786	4,214	1.282	105.36	7.85%	441,678
HLW-5	375	Inhibited-Water	HLP-VSL-00022	11/29/2022	11/29/2022	4,500	4,500	0	1.001	0	0%	0
HLW-5	381	AW-105	HLP-VSL-00022	12/19/2022	12/20/2022	120,000	115,786	4,214	1.282	105.36	7.85%	441,678
HLW-5	382	Inhibited-Water	HLP-VSL-00022	12/20/2022	12/20/2022	4,500	4,500	0	1.001	0	0%	0
HLW-5	389	AW-105	HLP-VSL-00022	1/13/2023	1/14/2023	120,000	115,786	4,214	1.282	105.36	7.85%	431,962
HLW-5	390	Inhibited-Water	HLP-VSL-00022	1/14/2023	1/14/2023	4,500	4,500	0	1.001	0	0%	0

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		ECN No. N/A

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
*****************AEMC:********************					
Bergmann, Linda					
Dunford, Gary					
Petermann, Artha					
Ramsey, Amy					
Sexton, Rich					
Wells, Michele					
*****************CNI:*********************					
Haass, Carolyn					
****************DNFSB:********************					
Quirk,Bob					
Linzau, Bill					
****************MSA:**********************					
Bryan, Catherine					
*******Office of River Protection:*********					
Burandt, Mary					
Callahan, Vic					
Charboneau, Stacy					
Cheadle,Jeffrey					
Diediker, Janet					
Fletcher, Tom					
Gamache, Lori					
Gilbert, Rob					
Harp, Ben					
Harrington, Chris					
Harrington, Paul					
Huffman, Lori					
Knutson, Dale					
Koll, Ronald					
Kruger, Albert					
Logan, Pam					
Mauss, Billie					

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Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
****Office of River Protection (cont.)*****					
Mattlin, Ellen					
Olds, Erik					
Rambo, Jeffrey					
Reddick, Julie					
Samuelson, Scott					
Shuen, Jian-Shun					
Smith, Dabrisha					
Trenchard, Glyn					
Wheeler, Isabelle					
Wicks, Jim					
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Allen, Gail					
Allen-Floyd, Julie					
Arm, Stuart					
Baide, Dan					
Barton, Blaine					

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************WRPS (cont.)*****************					
Basche, Amy D					
Belsher, Jeremy					
Boomer, Kayle					
Bryan, Wes					
Burrows, Christopher					
Carothers, Kelly					
Carter, Robert					
Cato, Diane M					
Certa, Paul					
Chamberlain, Blake					
Cloud, Jack					
Colosi, Kris					
Conner, John M					
Crawford, Tom					
Denning, Jeff					
Donnelly, Jack					
Dunning, Abe					
Eaton, Will					
Eberlein, Susan					
Empey, Peter					
English, Maureen					
Eppler, Larry L					
Exley, Allan					
Feero, Amie					
Frank, Robert					
Gagnon, Paul					
Gallaher, Ben					
Garrett, Richard					
Geary, Jim E					
Goetz, Tom					
Gray, Michael F					

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************WRPS (cont.)*****************					
Greer, Dan					
Gregory, Rob					
Haigh, Paul					
Harrington, Stephanie					
Herting, Dan					
Ho, QD					
Hohl, Ted					
Jasper, Russell					
Jo, Jaiduk					
Kennedy, Doug					
Kelly, James					
Killoy, Steve					
Kirch, Nicholas					
Kirkbride, Randy					
Knight, Mark					
Larson, Doug					
Kelly, James					
Killoy, Steve					
Kirch, Nicholas					
Kirkbride, Randy					
Knight, Mark					
Larson, Doug					
Leonard, Mike					
Little, David					
Luke, Jeff					
Lund, Dennis					
Lyte, Randy					
Meacham, Joe					
Meinert, Fiona					
Mendoza, Ruben					
Mitchell, Carina					

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*************WRPS (cont.)******************					
Nguyen, Duc					
Pace, Timothy					
Pierson, Kayla					
Powell, Bill					
Rasmussen, Juergen					
Ramsey, W Gene					
Reynolds, Jacob					
Rieck, Curtis					
Ritari, Jake					
Robbins, Rebecca					
Roberson, Dale					
Rodgers, Matt					
Russell, Rose					
Rutland, Paul					
Sams, Terry					
Sasaki, Leela					
Saunders, Scott					
Seniow, Kendra					
Shuford, Dave					
Skwarek, Ray					
Smalley, Colleen					
Stamper, Lavonne					
Tedeschi, Rick					
Thompson, Leo					
Thien, Mike					
Turner, David A					
Washenfelder, Dennis					
West, Elizha					
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Arnold, John - jsarnold@bechtel.com					
Duncan, Garth - gduncan@bechtel.com					

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Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
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