QUALITY MANAGEMENT SYSTEM (QMS)

ST. CLEMENTS - HEIDELBERG

DRINKING WATER SUPPLY AND DISTRIBUTION SYSTEM

OPERATIONAL PLAN

Prepared by:

The Regional Municipality of Waterloo, Water and Wastewater Services - Water Operations and Maintenance

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COMMON QMS ELEMENTS

The St. Clements - Heidelberg operational plan is to be read in conjunction with the "Regional Operational Plan", DOCS #447981.

The "Regional Operational Plan" is the main document containing links that reference all common elements and procedures pertaining to the QMS for all Regional drinking water systems. Site specific Operational Plans consist of information pertaining to the specified system.

Table of Common Elements:

1	Quality Management System	12	Communication
2	QMS Policy	13	Essential Supplies & Services
3	Commitment & Endorsement	14	Review & Provision of Infrastructure
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5	Document & Records Control	17	Monitoring & Recording Equipment Calibration & Maintenance
7	Risk Assessment	18	Emergency Management
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Site specific operational plans consist of information pertaining to a specified system. Only elements with site specific information are included in this operational plan.

Table of Site Specific Elements:

6	Drinking Water System
8	Risk Assessment Outcome
16	Sampling, Testing & Monitoring

6.0 DRINKING WATER SYSTEM

6.1 PURPOSE

Describe RMOW owned and operated drinking water systems, relevant processes/components, raw water source characterization, and critical upstream/downstream processes required for producing safe drinking water.

6.2 BACKGROUND

A healthy public drinking water supply is achieved by the use of the multiple barrier approach. The multiple barrier approach is an integrated system of procedures, processes and tools that collectively prevent or minimize the contamination of drinking water from source to consumer in order to reduce risks to public health.

6.3 GENERAL

The following information is included in the operational plan to ensure that Element 6 requirements are met:

- Drinking water description (including applicable treatment processes and distribution system components)
- Name of the Owner and Operating Authority
- Process flow chart
- Description of source water (including characteristics, common event-driven fluctuations, any operating challenges and/or threats)
- Critical upstream and downstream processes required to ensure safe drinking water
- A summary description of the municipal residential drinking water system is part of
- A summary description of systems connected to one or more drinking water systems owned by different owners indicating:
  - Whether the system obtains water from or supplies water to those systems, and
  - Names of the Owner and Operating Authorities of those systems.

The drinking water system description is updated, as required, and/or when a drinking water system process or component is added or altered.

Note:

Whenever drinking water system infrastructure changes (added, altered, replaced or removed) the corresponding changes must be communicated by relevant O&M personnel to the QMS Representative to ensure that drinking water infrastructure is accurately reflected in the corresponding operational drinking water description.

6.4 TERMS AND DEFINITIONS

See Regional Operational Plan (DOCS# 447981)

6.5 ST. CLEMENTS - HEIDELBERG DRINKING WATER SYSTEM

The Region of Waterloo is the owner and operating authority of the St. Clements - Heidelberg drinking water system and distribution system. For subsystem classification and waterworks information please see DOCS# 209965.

6.5.1 Process Description

Ground water source wells, SC2, SC3, and SC4 supply the drinking water treatment system. Sodium hypochlorite solution is added to the source water to provide primary disinfection and iron/manganese oxidation upstream of the filters. The sodium hypochlorite system is designed to effectively deliver chlorine dosage rates required to achieve primary disinfection within the reservoir, in accordance with the "Procedure for Disinfection of Drinking Water in Ontario."

Table 6-1 Process Component and Description

Process Component		Description
Raw Water Well Supply	• Well SC2 • Well SC3 • Well SC4	Good ground water sources.
Disinfection System	• 2 metering pumps • 1 sodium hypochlorite tank	The metering pumps operate simultaneously. Each metering pump has a sufficient capacity to dose at a sufficient rate to establish a free chlorine residual in the treated water Required to achieve disinfection in accordance with the "Procedure for Disinfection of Drinking Water in Ontario."
Filtration System	• 1 filter feed tank • 2 multi media gravity filters	The filtration system consists of a filter feed tank, for oxidation or iron and manganese, and 2 multi media gravity filters containing sand, manganese greensand, anthracite and gravel.
Backwash System	• backwash pump • settling tank • supernatant tank • supernatant pump • sludge tank	The backwash system consists of a dedicated backwash pump, a 100 cubic meter settling tank, a 30.2 cubic meter supernatant tank, a 50 cubic meter sludge tank and a supernatant pump. Backwash pump rated at 43 L/s @ 17.2 m TDH
Reservoir/Storage	• 4 celled treated water reservoir	The inground four celled treated water reservoir has a usuable volume of 1250 m^3. Sufficient to provide required disinfection contact time and storage.

Process Component		Description
High Lift Booster Pumps	• 4 vertical turbine booster pumps	One jockey pump and 3 booster pumps in a Duty1/2/3 configuration with the fourth pump to provide fire flow. SCB1 rated at 7 L/s @ 50 m TDH SCB2/SCB3 rated at 24 L/s @ 50 m TDH SCB4 rated at 91 L/s @ 38 m TDH
Emergency Power	• 150kW diesel generator	A permanent diesel generator, capable of powering the entire treatment system, is on site.

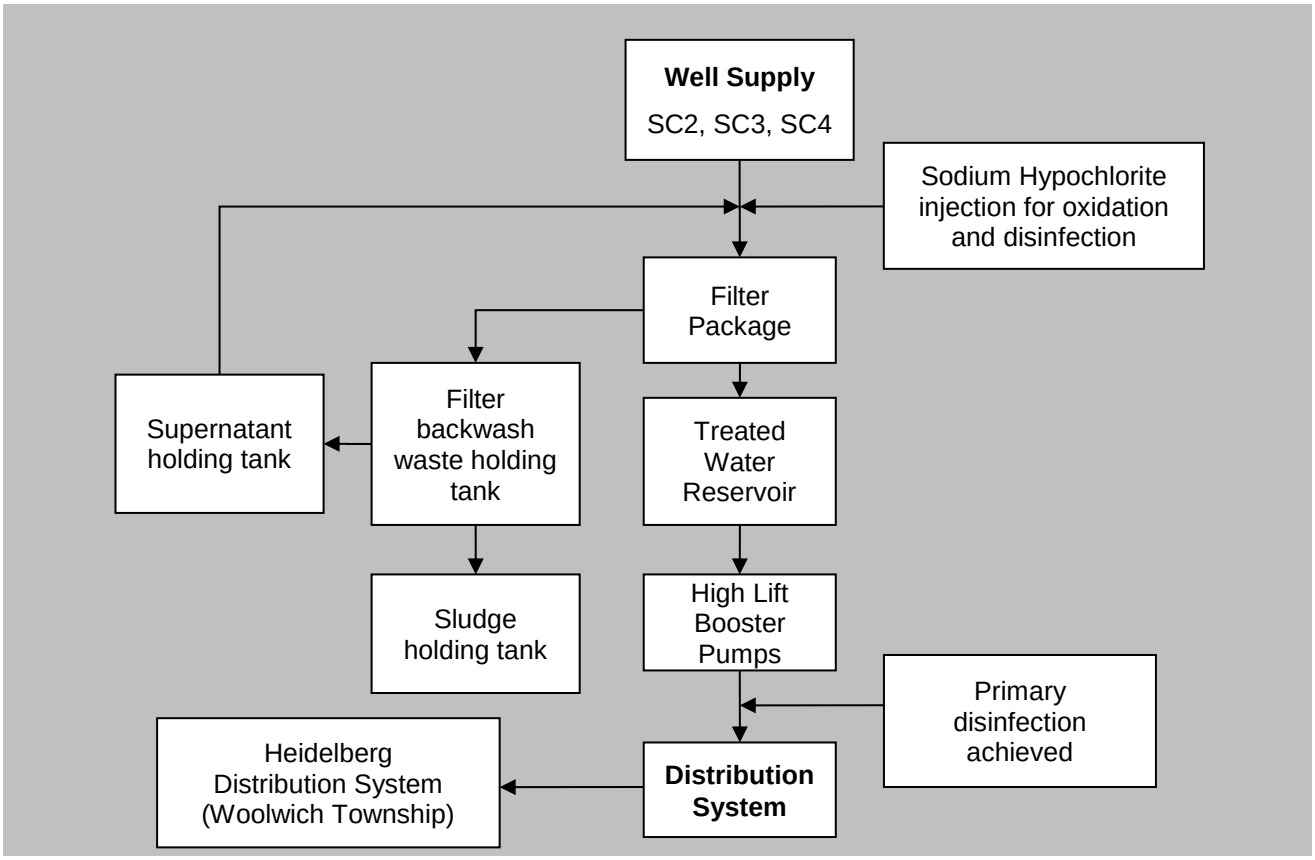

Figure 6-1 St. Clements - Heidelberg drinking water system

6.5.2 Raw Water Supply and Characterization

Overall ground water quality is consistent. Ground water testing demonstrates the presence of iron from the wells above the physical objective as defined in the Ontario Drinking Water

Quality Standard. Raw water characterization is shown in the following table. Drinking water analysis results for raw water microbiological characterization can be found in the Region of Waterloo Annual Water Quality Reports. Refer to "Related Documents" for access to these reports.

Table 6-2 Raw Water Characteristic

St. Clements - Heidelberg Raw Water									
Wells	**SC2**			**SC3**			**SC4**		
(2015-2019)	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Alkalinity	284	303	293	285	294	290	285	298	294
Iron	0.141	5.83	0.611	0.025	0.108	0.063	0.465	0.732	0.578
Manganese	0.020	0.044	0.037	0.012	0.027	0.015	0.026	0.028	0.027
Nitrate-N	<0.10	0.33	0.14	0.71	2.38	1.76	<0.10	<0.10	<0.10
Sodium	8.0	12.5	10.2	18.9	22.3	20.4	5.6	6.0	5.8

Table 6.3 St. Clements – Heidelberg System Well Information

Raw Water Source Information					Pump Information	
Production Well	**Type** **P=** primary **S=** secondary	**Dia.** (mm)	**Depth** (m)	**Casing Depth** (m)	**S=** submersible **VT=** vertical turbine	**Capacity** @ **TDH** (m)
SC2	**P**	203	20.1	16.8	**S**	20.5L/s @ 23m
SC3	**P**	254	20.42	16.76	**S**	17.0L/s @ 17m
SC4	**P**	220	36.6	31.2	**S**	20.0L/s @ 23m

6.5.3 Common Event-driven Fluctuations

The St. Clements - Heidelberg well supply is a consistent and stable ground water source with little to no fluctuations, and doesn't appear to be affected by weather or seasonal patterns.

6.5.4 Operational Challenges

Operational challenges include maintaining distribution system pressure and continual supply of treated water during equipment failure. Low pressure is not normally an issue during power failure. Refer to "Power Failure – Generators" SOP, DOCS #542133, for power failure events.

6.5.5 Monitoring

Continuous analyzers monitor the levels of chlorine and turbidity prior to the water being discharged. Analyzer data is continuously collected and transmitted to the Mannheim Water Treatment Plant SCADA system which is monitored by an operator 24 hours per day.

6.5.6 Distribution System

The St. Clements – Heidelberg distribution system is owned and operated by the Region of Waterloo and is the downstream process after the drinking water supply. In 2024, the existing St. Clements distribution system was expanded via a 1.1 km watermain connection to the town of Heidelberg.

The Heidelberg distribution system (Woolwich Township) is supplied by the St. Clements – Heidelberg distribution system.

Township of Woolwich Side of Distribution System

The distribution system east of Queen St. (County Rd. 16) is owned and operated by Township of Woolwich. Contact the Township of Woolwich for distribution operational plan.

The St. Clements – Heidelberg distribution system has approximately 588 service connections, 112 valves and 67 hydrants. It consists of approximately 11.56 km of a combination of PVC and ductile iron pipes.

Distribution chlorine residual sampling is in accordance with O.Reg 170/03, Schedule 7.

For updated population served by this distribution system please refer to the annual Water and Wastewater Monitoring Report.

See attached map of St. Clements - Heidelberg Distribution System.

8.0 RISK ASSESSMENT OUTCOMES

Requirement for this element is covered by the Regional Operational Plan.

See “QMS Element 8 Procedure – Risk Assessment Outcomes”

- DOCS #500123, in electronic format or
- see “Procedural Element” section in QMS Manual for procedure

Table 8-1 and 8-2 below provide the risk assessment and risk assessment outcomes for St. Clements - Heidelberg drinking water system.

Risk Assessment Table 8-1 St. Clements – Heidelberg Drinking Water System (wells SC2, SC3, SC4)						
Activity/Process & Hazardous Event/Hazard	**Control Measures**	**RV**= LXC **CCP**= R V ≥ 12				**Comment**
		L	**C**	**RV**	**CCP**	
Source Water Quality Changes: • Chemical • Microbiological • Physical • Regulation Changes	• Sampling & testing • Source water protection program • Spill in a Wellhead Protection Area SOP, DOCS #788003 • EELS provides email notification and flags final reports for ½ MAC results. • Standard Practices for Construction within 200m of a Municipal well DOCS# 2071070	3	3	9	No	• May impact on treatment process • Good quality ground water • Only water source • Research and Innovation Committee, working groups discuss potential regulatory impacts
Source water Production Changes: • Well integrity failure • Reduced water production	• Continuous monitoring pressure and flow • Inspection • Well rehabilitation program in place • New well connection and replacement protocol in place	3	1	3	No	

Risk Assessment Table 8-1 St. Clements – Heidelberg Drinking Water System (wells SC2, SC3, SC4)						
Activity/Process & Hazardous Event/Hazard	**Control Measures**	**RV**= LXC **CCP=** R V ≥ 12				**Comment**
		L	**C**	**RV**	**CCP**	
Primary Chlorination system failure: • Loss of primary disinfection-ineffective pathogen removal	• Continuous monitoring & alarms • Scheduled instrumentation maintenance and verification/calibration • Auto well shut off on disinfection system failure or low chlorine residual • Continuous CT calculator to monitor primary disinfection effectiveness • Redundant sodium hypochlorite pumps	4	2	8	Yes	• Mandatory CCP • Low chlorine residual • Disinfection system failure

Risk Assessment Table 8-1 St. Clements – Heidelberg Drinking Water System (wells SC2, SC3, SC4)						
Activity/Process & Hazardous Event/Hazard	**Control Measures**	**RV**= LXC **CCP=** R V ≥ 12				**Comment**
		L	**C**	**RV**	**CCP**	
Secondary Disinfection Residuals (low) Chlorination system failure: • Loss of secondary disinfection (<0.05mg/L free chlorine residual)-potential bacterial re-growth	• Continuous monitoring & alarms • Scheduled instrumentation maintenance and verification/calibration • Watermain Flushing SOP, DOCs #790364 • Routine distribution system chlorine residual monitoring • EELS provides notification for low residuals obtained when collecting microbiological samples	4	2	8	Yes	• Mandatory CCP • Low chlorine residual

Risk Assessment Table 8-1 St. Clements – Heidelberg Drinking Water System (wells SC2, SC3, SC4)						
Activity/Process & Hazardous Event/Hazard	**Control Measures**	**RV**= LXC **CCP=** R V ≥ 12				**Comment**
		L	**C**	**RV**	**CCP**	
Secondary Disinfection Residuals (high) High distribution chlorine residual: • Taste and Odour/Customer concerns	• Continuous monitoring & alarms • Customer service SOP-DOCS#460326 • Scheduled instrumentation maintenance and verification/calibration • Watermain Flushing SOP, DOCS#790364 • EELS provides notification for high residuals obtained when collecting microbiological samples	4	2	8	Yes	• CCL = 3.0 mg/L • System-wide controller upgrade program includes high chlorine residual shutdowns
Mechanical, Instrumentation and Electrical Equipment Failure • Reduced water production • Increased iron manganese (filter failure) • Contractor Activity/Human Error	• Continuous monitoring & alarms • Emergency repair readiness • Redundancy • Customer service SOP-DOCS#460326 • Tender Document • ON1Call • Training/awareness • Preventative maintenance	3	2	6	No	• Well pump/motor failure • Leaks from appurtenances
Water Quality Monitoring	• Continuous monitoring & alarms • Automatic control	4	1	4	No	• Manual sampling and testing

Risk Assessment Table 8-1 St. Clements – Heidelberg Drinking Water System (wells SC2, SC3, SC4)						
Activity/Process & Hazardous Event/Hazard	**Control Measures**	**RV**= LXC **CCP**= R V ≥ 12				**Comment**
		L	**C**	**RV**	**CCP**	
Communication/RPU/SCADA Failure • Loss of remote continuous monitoring and alarming	• Loss of SCADA Communication with a Water Supply Facility SOP, DOCS #449257 • Redundancy (data logger)					• Manual operation option • WREPNET and Bell
Utility Power Power Failure Loss of pressure and/or flow: • Potential compromised water quality	• Emergency power generator • Auto Transfer • Scheduled Monthly Generator checks • Low Pressure Alarm Event SOP, DOCS #449781	4	1	4	No	• Permanent emergency power available • Generator Service agreement in place
Distribution System Watermain Break-Loss of pressure and/or flow: • Potential compromised water quality	• Continuous monitoring & alarms • Emergency repair readiness • Ability to isolate and control • Low Pressure Alarm Event SOP, DOCS #449781 • Watermain Repair SOP, DOCS# 477203	3	2	6	No	• Pool of Contractors for repair

Risk Assessment Table 8-1 St. Clements – Heidelberg Drinking Water System (wells SC2, SC3, SC4)						
Activity/Process & Hazardous Event/Hazard	**Control Measures**	**RV**= LXC **CCP**= R V ≥ 12				**Comment**
		L	**C**	**RV**	**CCP**	
Distribution System • Service Leaks • Frozen Services	• Customer service SOP-DOCS#460326 • Low Pressure Alarm Event SOP, DOCS #449781 • Watermain Repair SOP, DOCS# 477203	4	2	8	No	
Reservoir Compromised structural integrity • Potential compromised water quality • Sewage holding tank overflow	• Redundancy (2 cells) • Regular inspection program • Suspicious Observation SOP, DOCS#519574 • Third party sewage holding system assessment	3	2	6	No	• Possible reservoir infiltration/contamination • Third party sewage holding system assessment to include recommendations
Distribution Equipment Equipment Failure • Reduced water supply	• Hydrant Repair SOP, DOCS #792935 • Hydrant Inspection SOP, DOCS #792184 • Preventative maintenance and regular inspection	2	1	2	No	• Hydrant and Valve Program

Risk Assessment Table 8-1 St. Clements – Heidelberg Drinking Water System (wells SC2, SC3, SC4)						
Activity/Process & Hazardous Event/Hazard	**Control Measures**	**RV**= LXC **CCP=** R V ≥ 12				**Comment**
		L	**C**	**RV**	**CCP**	
Distribution Backflow/Water Quality Potential Cross-Connection	• Watermain Flushing SOP, DOCS#790364 • Preventative maintenance program • Sampling and Monitoring • Flushing Program • Bylaws	2	2	4	No	• Old homes / private wells • Backflow prevention program in progress, reassess likelihood in 2020 Risk Assessment
Distribution Water Quality Lead connections/services Flushing/Swabbing Potential compromised water quality	• Sampling and Monitoring • Monitoring pH/Alkalinity	2	2	4	No	• Lead technical bulletin (PIBs #7423e) • Older system / history of lead detections
Security Vandalism/terrorist threat • Potential compromised water quality	• Security systems (entry alarms, motion detectors, fencing & signage, locked hatches & doors) • Suspicious Observation SOP, DOCS #519574 • Routine patrols made by Security provider as requested	3	2	6	No	

Risk Assessment Table 8-1 St. Clements – Heidelberg Drinking Water System (wells SC2, SC3, SC4)						
Activity/Process & Hazardous Event/Hazard	**Control Measures**	**RV**= LXC **CCP=** R V ≥ 12				**Comment**
		L	**C**	**RV**	**CCP**	
Security Cybersecurity • Network/cyber attacks • Loss of process visibility • Interruption of data logging • Inability to control systems • Loss of automatic control schemes	• Firewalls, anti-virus, passwords, regular updates, and other protections provided by IT • Backups of PLC files (weekly/monthly) • Backup of SCADA (iFix) and other servers (daily/monthly) • Manually retrieve data from PLC dataloggers	3	2	6	No	Future plans: adding backup servers at a different location, Ignition Edge HMI for local control when comms are down, investigate additional control measures and develop operating procedures for Tenable.
Climate Change • Extreme Weather (tornados, ice storms etc.) • Extreme Temperature (freezing/heat wave) • Drought/Flooding	• Source water monitoring • Extreme weather SOP • GRCA flooding alert • GRCA low water response • Conservation By-law	3	1	3	No	

Risk Assessment Outcomes Table 8-2 St. Clements Drinking Water System (wells SC2, SC3, SC4)			
CCP(s)	**Critical Control Limit(s)**	**Monitoring and Response Processes**	**Response Procedure(s)**
Primary Disinfection • Chlorination • CT (chlorine concentration X time)	SCADA Lo Alarm limit (based on current SCADA alarm set points for CT)	• Continuous on-line monitoring • Alarm activated when Lo SCADA alarm values are exceeded • Low chlorine well shutdown • Distribution system chlorine monitoring AWQI response immediately	• Critical Control Response • Protocol DOCS #1127653 • AWQI Response Protocol DOCs #459404 • Primary Disinfection Guideline (CT Spreadsheet) DOC #483459 • Refer to MDWLs DOCS Public Folder # 2138795 for specific disinfection requirements • SCADA Alarm Setpoints DOCS#1567508
Secondary Disinfection residuals (low/high) • Chlorination • Free Chlorine Residual (FCR)	CCL for low secondary disinfection is 0.3 mg/L and the high CCL is 3.0 mg/L.		

16.0 SAMPLING, TESTING AND MONITORING

Requirement for this element is covered by the Regional Operational Plan.

See "QMS Element 16 Procedure – Sampling, Testing and Monitoring"
- DOCS #500161, in electronic format or
- See "Procedural Elements" section of QMS Manual

Sampling, testing and monitoring is done according to a "Master Drinking Water Sampling Schedule" updated each year, in accordance with the Safe Drinking Water Act O. Reg. 170/03.

Contact a Water Quality Specialist for the "Master Drinking Water Sampling Schedule", DOCS #556848.

Any additional or special sampling, testing and monitoring required for this drinking water system can be found in the Master Drinking Water Sampling Schedule.

RELATED DOCUMENTS

Document	Location, Source or URL
Regional Operational Plan	• DOCS #447981
"Drinking Water Quality Management Standard Guidance Document" – Implementing Quality Management, a Guide for Ontario's Drinking Water Systems.	http://www.ontario.ca/drinkingwater/160420.pdf
Safe Drinking Water Act	http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_02s32_e.htm
O.Reg.170/03	http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_030170_e.htm
O.Reg.169/03	http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_030169_e.htm
Procedure for Disinfection of Drinking Water in Ontario	http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/std01_079706.pdf
Water and Wastewater Monitoring Report	https://www.regionofwaterloo.ca/en/regional-government/water-and-wastewater.aspx#Water-and-wastewater-monitoring-reports

Document	Location, Source or URL
DWQMS Procedures	• DOCS Public Subfolder# 878670
Emergency Procedures	• DOCS Public Subfolder# 878588
QMS Related Procedures	• DOCS Public Subfolder# 118350
Information (CT)	• DOCS Public Subfolder# 1331916
Municipal Drinking Water License (MDWL) and Drinking Water Works Permits (DWWP)	• DOCS Public Folder# 987301
QMS Documents Public Folder (all documents and records)	• DOCS Public Folder # 878106
Annual Water Quality Reports	• DOCS Public Folder# 964369

SCHEDULE "C" (SUBJECT SYSTEM DESCRIPTION FORM)

DOCS Public Folder# 3408181

Distribution Maps

Distribution Maps GIS and Distribution Maps Region owned

REVISION HISTORY

Date	Revision #	Reason
May 3, 2021	466926-V10D	• Update equipment description and distribution information
Sept 27, 2022	466926-V10E	• Updated per 2022 Risk Assessment.
January 23, 2023	466926-V11	• Revised hyperlinks • Changed department and division names to EES and W&WW • Complete revision history available in version 10D
October 2, 2023	466926-V11A	• Updated per 2023 Risk Assessment
November 27, 2024	466926-V11B	• Updated per 2024 Risk Assessment

Date	Revision #	Reason
		• Connection to Heidelberg Distribution - several related revisions to system name and distribution components and description