AIR FORCE HANDBOOK 10-222, VOLUME 11

19 May 2011

CONTINGENCY WATER SYSTEM INSTALLATION AND OPERATION

DEPARTMENT OF THE AIR FORCE

BY ORDER OF THE SECRETARY OF THE AIR FORCE

AIR FORCE HANDBOOK 10-222 VOLUME 11

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Operations

CONTINGENCY WATER SYSTEM INSTALLATION AND OPERATION

OPR: AFCESA/CEXX

Certified by: AF/A7CX
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Pages: 154

This handbook provides USAF civil engineers with guidance on the installation and use of Air Force contingency water systems. It addresses site location and layout, assembly, and operation of water system components at bare base or austere locations. When coupled with information contained in applicable technical orders, Air Force Pamphlet (AFPAM) 10-219, Volume 5, *Bare Base Conceptual Planning Guide*, and instruction received at Silver Flag training sites, personnel should be able to effectively set up and operate all components of the water system. This publication applies to all Air Force active duty, Air National Guard (ANG), and Air Force Reserve Command Civil Engineer units. It supports Air Force Instruction (AFI) 10-210, *Prime Base Engineer Emergency Force (BEEF) Program*, and AFI 10-211, *Civil Engineer Contingency Response Planning.* Refer recommended changes and questions about this publication to the Office of Primary Responsibility (OPR) using AF Form 847, *Recommendation for Change of Publication*; route AF Form 847 from the field through the appropriate functional chain of command and Major Command (MAJCOM) publications/ forms managers. Ensure that all records created as a result of processes prescribed in this publication are maintained in

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Chapter 1

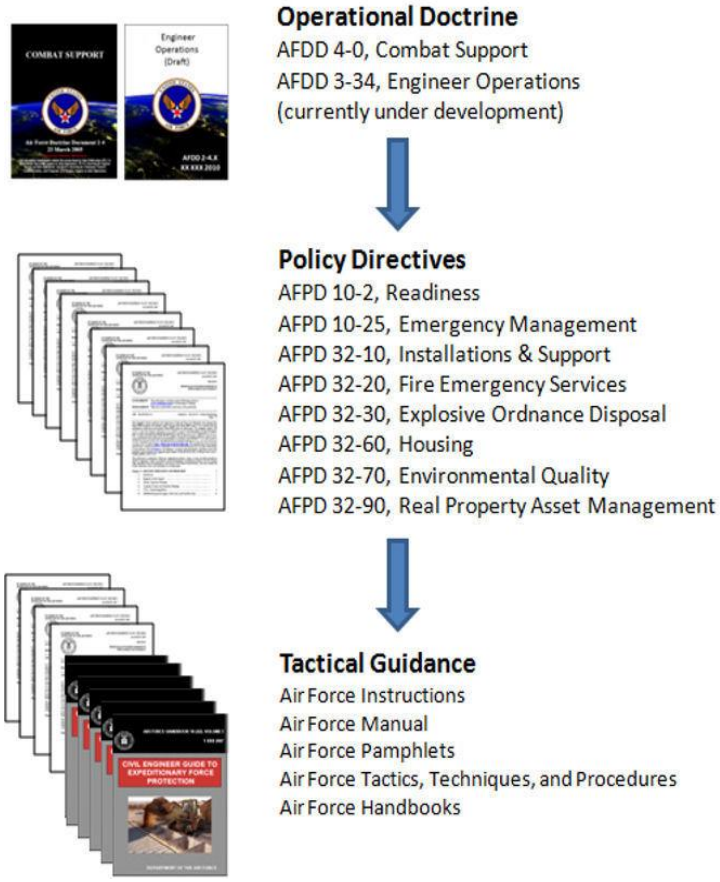
INTRODUCTION

1.1. Scope. This handbook augments, but does not replace information contained in technical orders for contingency water systems and subsystems. Users should refer to applicable technical orders for all warnings and cautions and complete assembly, maintenance, operation, and troubleshooting information. Civil engineer (CE) tactics, techniques, and procedures (TTPs) in this handbook supports precepts outlined in Air Force Doctrine Document (AFDD) 4-0, *Combat Support*, and other published guidance related to Engineer Operations. They also supports implementation of Air Force Policy Directive (AFPD) 10-2, *Readiness*. This relationship is illustrated in **Figure 1.1**, the Air Force CE hierarchy of publications.

1.2. Overview. This handbook addresses general characteristics, setup, and basic operating procedures for the contingency water system and targets civil engineer utilities personnel while performing their beddown and sustainment mission taskings under contingency conditions. Users without a fundamental knowledge of this water system should also review the references in **Attachment 1**.

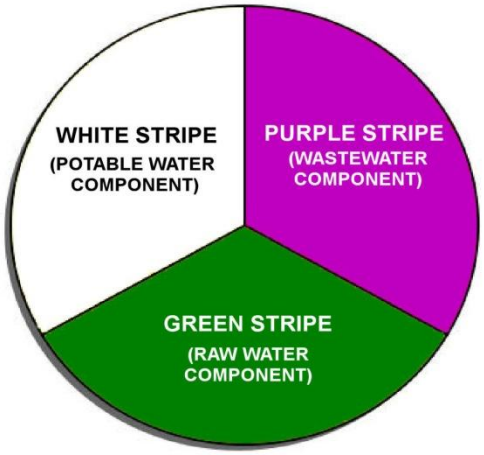
1.3. General Information. The contingency water system fulfills potable water and wastewater recovery needs at austere locations. The water system provides water to support kitchens, latrines, showers, laundries, and other bare base facilities and recovers the wastewater for appropriate disposal. The system is semi-automatic in that the 3,000-gallon facility storage tanks will fill automatically as long as the manually filled 20,000-gallon storage tanks are kept at the appropriate level. Once the system has been filled to capacity, water should be available for 5 days given 30 gallons per person per day usage. The removal of facility wastewater is also automatic under normal circumstances and does not require manual intervention.

Figure 1.1. Air Force Civil Engineer Publications Hierarchy.



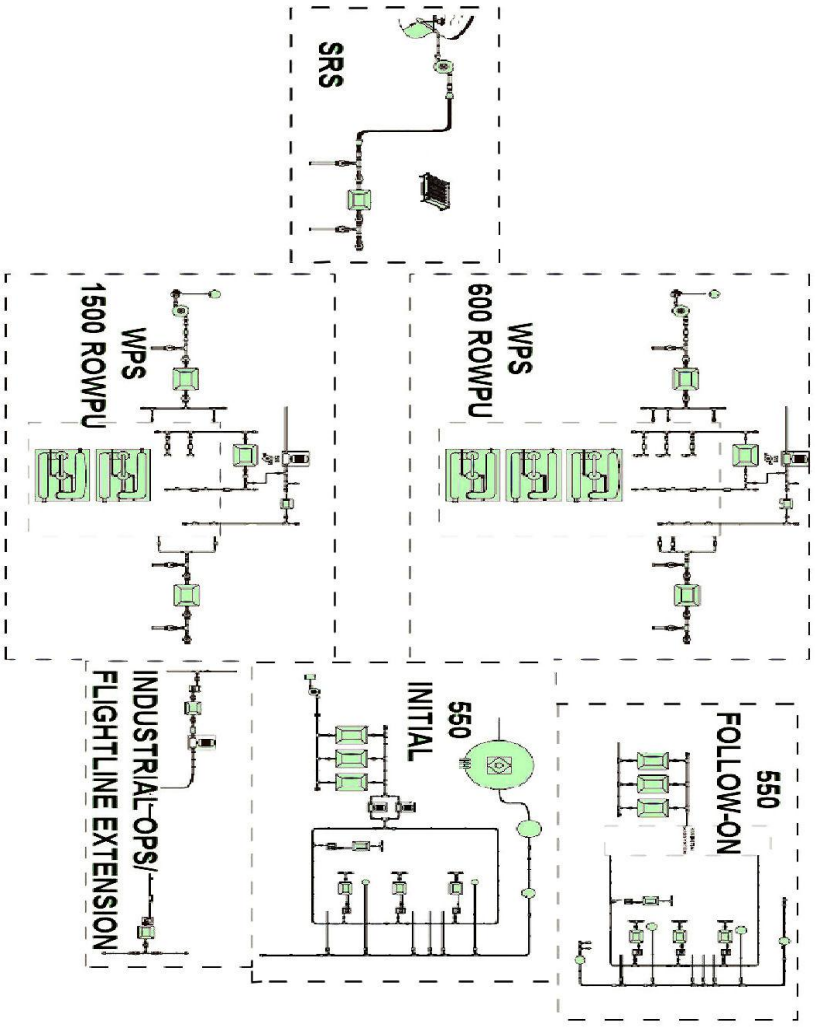
1.4. Water System Design and Capacity. The Air Force's contingency water system is modular in design and scalable to meet a variety of user deployment needs. It can draw water from a natural source and then purify, store, and distribute the water while maintaining sufficient pressure, quantity, and quality for an entire base. The selected modular configuration determines the amount of potable water the system will produce per day. The water system consists of a series of color-coded piping, pumping, fluid control, and water storage components that comprise five distinct subsystems. **Figure 1.2** lists color assignment for subsystem components. The five subsystems are: (1) Source Run Subsystem (SRS), (2) Water Production Subsystem (WPS) with Reverse Osmosis Water Purification Units (ROWPU), (3) 550-Initial Subsystem, (4) 550-Follow-On Subsystem, and (5) the Industrial Operations and Flightline Extension Subsystem (**Figure 1.3**). To streamline installation instructions in this guide, all subsystems are considered interconnected, not stand-alone, and the SRS option is used for raw water collection and the WPS option is used for water production.

Figure 1.2. Color-Coding of Subsystem Components.



Exception: The 3,000-Gallon ROWPU Wastewater Tank and Drain Assembly are color-coded **RED**.

Figure 1.3. Contingency Water Subsystems.



1.5. Safety. All personnel must practice proper safety procedures when setting up and operating water systems. Individuals should guard against electrical, fire, tripping, and falling hazards. In particular, flammable fuels, hazardous chemicals, and lethal voltages used in the operation of some water system components are considerable hazards, and failure to comply with technical order warnings could result in injury or death. Review procedures in AFI 32-1064, *Electrical Safe Practices,* when dealing with lethal voltages. It is also important to protect against other water system hazards such as highly pressurized subsystems and components, harmful solvents and adhesives, and infectious black and gray water products. Be sure to wear appropriate personal protective equipment (PPE) according to applicable technical information and standards.

1.6. Additional Information. Users should refer to Technical Order (T.O.) 40W4-21-1, *Basic Expeditionary Airfield Resources (BEAR) Water System*, for additional information such as unpacking, preparation for use, safety, assembly, operation, and maintenance instructions. In addition, contact the Air Force Civil Engineer Support Agency (AFCESA) Reach-Back Center when looking for information not found in this publication or references in **Attachment 1**. Contact the Reach-Back Center at 888-232-3721 (commercial), DSN 523-6995, or email at afcesareachbackcenter@tyndall.af.mil.

Chapter 2

PLANNING AND PREPARATION

2.1. General Information. The installation and use of contingency water subsystems vary from location to location and depend a great deal on the terrain features and the type and quantity of users. Since potential locations or sites may not need every available contingency water subsystem, the modular design of the water system allows planners to select specific subsystems based on the needs of the installation.

2.2. Site Selection. Before engineer work crews can begin constructing an installation's contingency water system, planners need to determine the site location, equipment prepositioning requirements, size of the camp supported, and whether there is access to an adequate water source to sustain operations. Plans should be detailed enough to enable a work crew to off-load selected subsystems at the designated location and assemble them in a minimum amount of time. Planners should refer to AFPAM 10-219, Vol 5, *Bare Base Conceptual Planning Guide*, for more information on siting contingency water systems and other associated considerations. In addition, engineer planners should take full advantage of Installation Geospatial Information and Services (IGI&S) satellite imagery, global positioning system (GPS) data, and common installation picture (CIP) databases, because these assets can dramatically enhance their planning capabilities. Some of this information can be accessed easily and securely through the Air Force Portal at the Air Combat Command (ACC) IGI&S GeoBase web site. The web site is a good resource for planning water systems in relation to camp layout, terrain, and available water sources.

2.3. Layout. Wherever the camp is located, there should be adequate real estate outside of the camp placement area to allow for the Water Operations Area (WOA). The WOA is an area identified for the Dual Water Pump Station, Water Tank Farm, and Water Production subsystems (**Figure 2.1**). The WOA should be sited on terrain that is relatively flat and free of debris. **Table 2.1** provides WOA dimensions and the quantity of water production

subsystems required based upon camp population. **Figure 2.2** shows a typical location for a WOA in relation to the camp facilities layout area.

Figure 2.1. Illustration of Subsystems within a WOA.

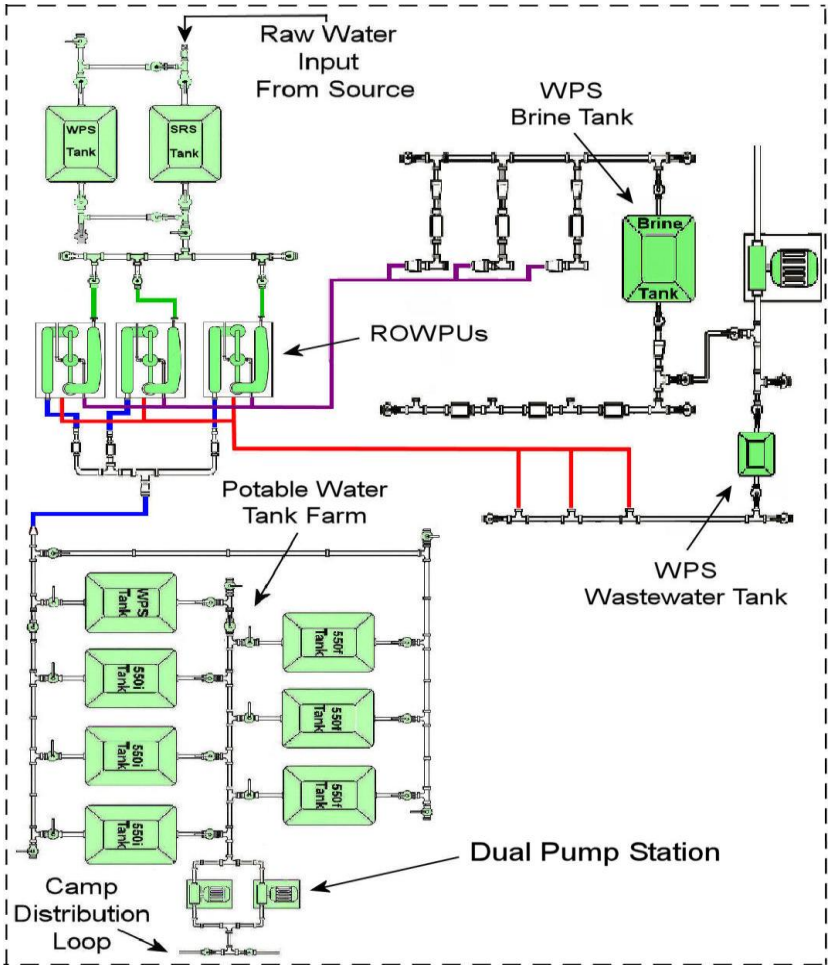
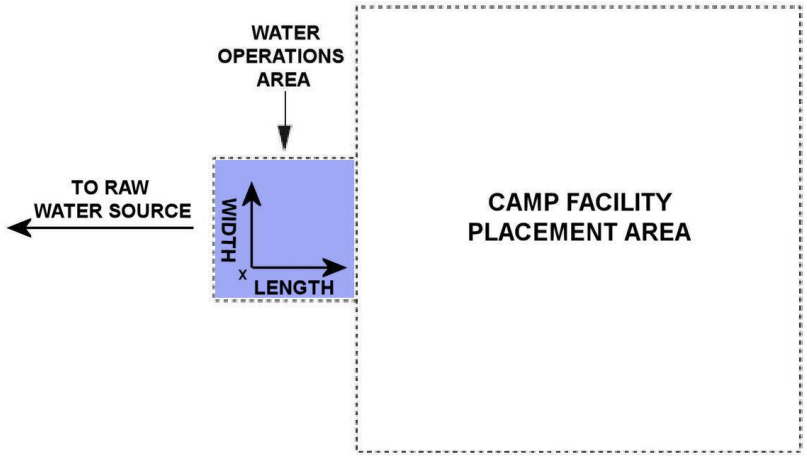


Table 2.1. WOA Layout Dimensions and Water Production Subsystems.

Camp Populace	Gallons Required Per Day (30 GPPPD)	Tank Farm (TF) ONLY Area in Feet (Width x Length)	TF w/600 Water Production Subsystem (WPS)	TF w/1500 Water Production Subsystem (WPS)	600 WPS Quantities 36,000 GPD (3 ROWPUs)	1500 WPS Quantities 60,000 GPD (2 ROWPUs)
550	16,500	50 x 130	160 x 230	140 x 230	1	1
1100	33,000	80 x 130	160 x 230	140 x 230	1	1
1650	49,500	160 x 130	250 x 230	140 x 230	2	1
2200	66,000	160 x 160	250 x 260	210 x 260	2	2
2750	82,500	160 x 190	340 x 290	280 x 290	3	2
3300	99,000	160 x 190	340 x 290	280 x 290	3	2
4400	132,000	200 x 220	430 x 320	350 x 320	4	3

Figure 2.2. Location of WOA (Typical).



2.4. Equipment Preparation. Equipment that is ready for installation should be prepositioned in areas where it will be used. Preplanning should have included drop-off points, the establishment of temporary roads to the sites, and off-loading equipment, such as forklifts and cranes (**Figure 2.3**). When the equipment arrives, work crews should unpack, inspect, and inventory equipment to verify required components are on hand (**Figure 2.4**). **Attachment 2** illustrates common subsystem components. Each subsystem contains all the parts listed in the T.O. inventory, including extra parts that will be left over after subsystem assembly. The extra parts are intentional to provide system flexibility and a source for replacement parts. Though addressed in the technical order, cold weather kits for these subsystems are currently under development and are not included. During inventory, unserviceable or missing equipment should be quickly repaired or replaced. Additionally, make sure to retain and store all serviceable packing material and shipping containers for reuse.

Figure 2.3. Heavy Equipment Needed to Preposition Water Subsystems.

2.5. System Flexibility. Work crews have the flexibility to configure the water system to meet the specific deployment needs of the unit, and the planned or final installation at your base may not look exactly as depicted in this handbook. Regardless, the diagrams and illustrations presented in this guide are still applicable and can provide sufficient guidance to accomplish

installation tasks even if a different configuration of equipment is required. Keep in mind the plumbing illustrations in this guide depict basic subsystem plumbing using a typical layout and a standard water production subsystem. Users should refer to T.O. 40W4-21-1 for other configuration procedures.

Figure 2.4. Inspect and Inventory Subsystem Components.

2.6. Subsystems Interface. The interface to various subsystem components is normally accomplished using suction or discharge hoses with quick disconnect (QD) fittings. Connect these quick disconnect fittings using procedures in **Attachment 3.** In some instances, engineers may need to convert to Polyvinyl Chloride (PVC) pipe connections where unusual areas are encountered and water distribution plumbing must be buried to prevent damage. Refer to T.O. 40W4-21-1 if it becomes necessary to use PVC or to fabricate other threaded or non-threaded connections.

Chapter 3

SOURCE RUN SUBSYSTEM

3.1. General Information. The Source Run Subsystem (SRS) provides raw water input (source water) for the contingency water system. It can pull water from a raw water source (i.e., river, lake, sea, or ocean) up to 100 feet away and 20 feet below the pumping station. The system can pump the source water up to a distance of 6000 feet and to a height of 150 feet to a raw water storage tank.

3.2. Components. The major components that make up the SRS are illustrated in **Figure 3.1** and described in **Table 3.1**. However, for a complete list of all subsystem components, including nomenclature and quantities per subsystem, refer to **Table 3.2** in this handbook and the SRS Illustrated Parts Breakdown (IPB) in T.O. 40W4-21-1.

Figure 3.1. Source Run Subsystem.

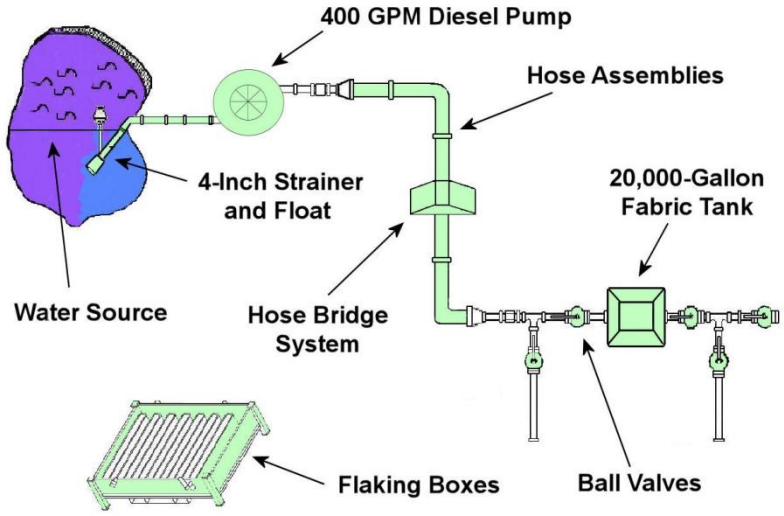


Table 3.1. SRS Major Components.

Item	Function/Use
4-Inch Strainer and Float Assembly	Provides a coarse filter to prevent impurities such as trash, twigs, and debris from entering the SRS. The float buoy, with cable, keeps the strainer end of the suction hose from lying on the bottom of the raw water source where dirt and gravel could enter the SRS. (Green Stripe)
400-Gallon Per Minute (GPM) Diesel Pump	Pumps water at a rate of 400 gallons per minute at 300-foot maximum head from a raw water source to the SRS storage tank. (Green Stripe)
20,000-Gallon Collapsible Fabric Tank	Stores raw water pumped from the source. (Green Stripe)
Hoses	Routes raw water from the source to the storage tank. Hoses are various sizes. (Green Stripe)
Hose Bridge System	Protects water distribution hoses when the hoses are routed across a roadway or similarly traveled area.
Ball Valves	Controls raw water input flow, output flow, and draining of the SRS storage tank. (Green Stripe)
Flaking Boxes	Serve as a storage space for the hoses when they are not in use. Ten each flaking boxes contain four 150-foot lengths of 6-inch hose.

3.3. Installation. Depending on the distance from the water source, it may be necessary to connect multiple SRSs to reach the camp. Before installing the SRS, review the planned dimensions of the water operations area (see **Table 2.1** on page 15). Then, refer to component layout diagrams in this chapter and the list in **Table 3.2** to identify each numbered component when performing the steps below.

CAUTION

To prevent injury to personnel and/or damage to equipment units, ensure adequate personnel and lifting equipment are available to preposition equipment.

3.3.1. **Position 400-GPM Pump and Assemble Strainer and Float Buoy.** Position the 400-GPM diesel pump and assemble the SRS strainer, float buoy, hoses, and associated components according to the following procedures and accompanying illustrations.

3.3.1.1. Position the trailer-mounted 400-GPM pump assembly (**Figure 3.2**) within 100 feet of the raw water source. Then, set the trailer parking brake and chock the wheels to prevent the trailer from moving. Afterward, level the trailer and lower the stabilizer jacks.

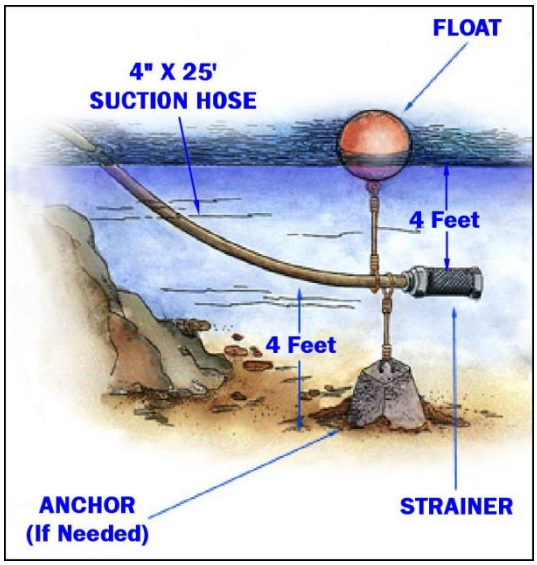
Figure 3.2. 400-GPM Diesel Pump (Typical).

CAUTION

When inflating the float buoy, it will become bulky and possibly hard to handle. Use care to prevent buoy from contacting sharp objects, which may cause damage to the buoy.

3.3.1.2. Inflate the buoy with the hand pump while being careful to avoid sharp objects or similar items that could damage the buoy. Then, connect the wire rope to the strainer and float buoy. Configure the wire so that the strainer is submerged at least four feet, when the strainer and buoy are deployed. If possible, ensure the strainer is also at least four feet from the bottom of the raw water source to avoid sand or silt from entering the system. It may also be necessary to anchor the strainer and float buoy due to constant wave motion (**Figure 3.3**).

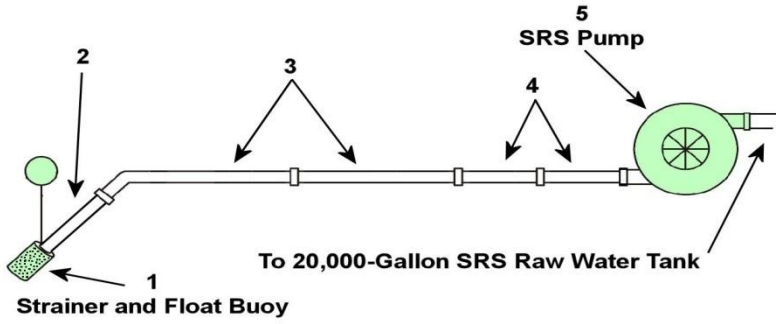
Figure 3.3. Positioning Float Buoy, Strainer, and Anchor.



3.3.1.3. Using **Figure 3.4** as a guide, connect enough SRS 4-inch suction hoses (2, 3, and/or 4) to the strainer and float buoy assembly to reach the 400-GPM pump (5). Afterward, connect the assembled hose to the inlet of the pump. Ensure the hose is long enough so the strainer and float buoy are deployed at least 25 feet from the shoreline. When determining the amount of hose length needed, take into account the differences in shoreline location due to tide changes.

> **Note:** Always ensure neoprene gaskets are in place before connecting suction or discharge hoses.

Figure 3.4. Strainer, Float Buoy, and Pump Inlet Component Layout.



3.3.2. **Position and Assemble Pump Outlet Branch and 20,000-Gallon Tank.** Install hoses and components from the 400-GPM pump to the 20,000-gallon SRS raw water tank as illustrated in **Figure 3.5**.

3.3.2.1. From the outlet side of the 400-GPM pump, connect a 4-inch x 15-foot suction hose to the male QD fitting on the pump. Then attach, in order, a 4-inch swing check valve (6), and 6-inch x 4-inch reducer (7) to the hose.

3.3.2.2. Now, move to the WOA and complete the following actions. Position the 20,000-gallon SRS tank (15) at the edge of the WOA as depicted in **Figure 3.6.** Then install the tank's vent, drain hose and ball valve (16, 17), and 4-inch inlet elbow (female-to-female) and outlet elbow (female-to-male) onto the tank (**Figure 3.7**). Next, attach a 4-inch x 15-foot suction hose (4) to

each QD elbow. Afterward, connect 4-inch ball valve assemblies (14), pipe tee assemblies (13), and 15-foot suction hoses (4) as illustrated below.

Figure 3.5. Pump Outlet and 20,000-Gallon Tank Component Layout.

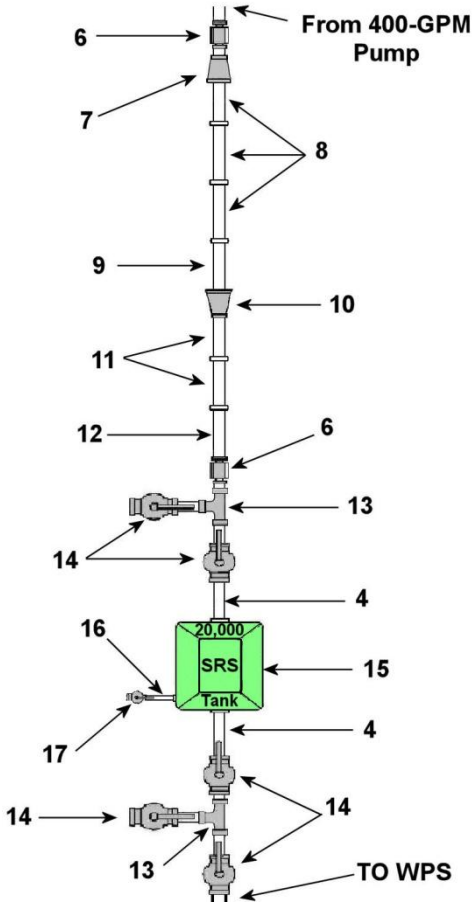
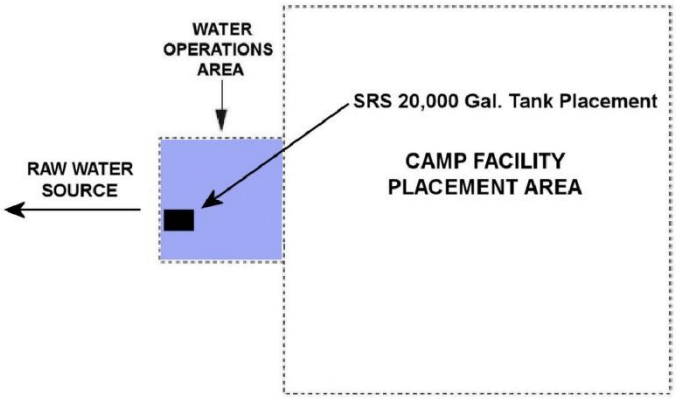
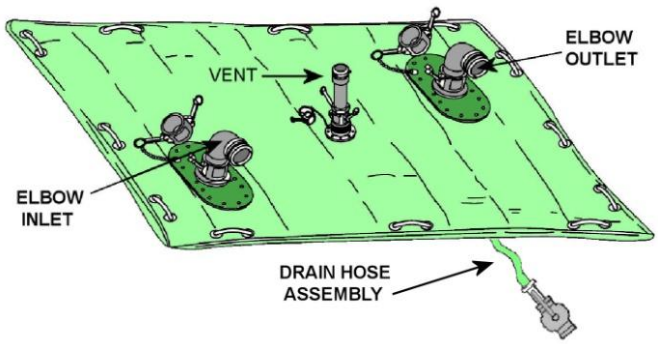


Figure 3.6. SRS Tank Placement In WOA (Typical).



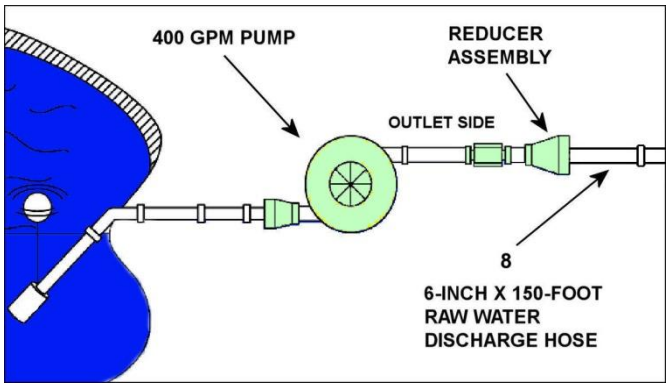
Note: The 20,000-gallon raw water tank in the SRS will be interconnected and parallel to one or more WPS 20,000-gallon raw water tanks spaced 6 feet apart. Make sure the inlet and outlet 4-inch tee branch assemblies are facing toward the 20,000-gallon tank accepting these connections.

Figure 3.7. 20,000-Gallon Raw Water Tank.



3.3.2.3. Complete the SRS installation at the 400-GPM pump as follows. Starting at the reducer assembly on the outlet side of the 400-GPM pump (**Figure 3.8**), connect enough 6-inch x 150-foot raw water discharge hoses (8) until you are within 175 feet of the swing check valve (6) closest to the SRS raw water tank. Then, attach a 6-inch x 50-foot hose assembly (9).

Figure 3.8. 400-GPM Pump Connections.

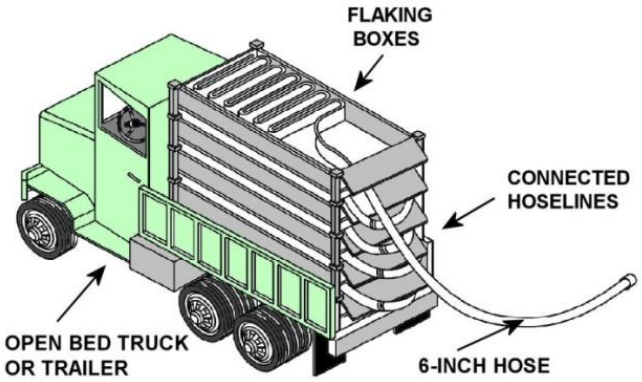


Note: If flaking boxes (**Figure 3.9**) are used to deploy 6-inch raw water hoses, follow the procedures in T.O. 40W4-21-1, Work Package (WP) 004 00. Deployment of hoses from flaking boxes requires at least three people: one to drive the truck and two to remove the hoses from the flaking boxes. One of the two, walking behind the truck, should also act as supervisor of the operation.

3.3.2.4. Next, install a 6-inch x 4-inch reducer (10) to the hose, and then attach two 4-inch x 50-foot hoses (11), followed by a 4-inch x 25-foot hose (12). To finish, connect the hose to the swing check valve.

3.3.2.5. If the subsystem's plumbing is routed across roadways or similar heavy vehicular traffic areas, use the hose bridge system to provide hose roll-over protection. Assemble the hose bridge system according to **Attachment 4**. This completes basic installation of the SRS.

Figure 3.9. Deploying 6-Inch Hose from Flaking Boxes.



3.4. Operation. The following procedures address basic steps to operate the SRS. For detailed operating procedures, including pump engine prestart checks and start-up procedures, consult T.O. 40W4-21-1.

3.4.1. Open the inlet and outlet 4-inch ball valves on the 20,000-gallon SRS raw water tank (and 20,000-gallon WPS tank if interconnected). Close the 2-inch ball valve on the tank drain, and then open the 4-inch ball valves on the pipe tee assemblies. See **Figure 3.5** on page 23 for typical SRS ball valve locations.

3.4.2. Ensure all hose assemblies (and pipes if transition kit was installed), valves, and fittings on the 400-GPM Diesel Pump are properly connected and tight. Check the strainer and float buoy for proper connection.

3.4.3. Start the pump engine according to start-up procedures for existing environmental conditions (i.e. cold/warm weather) and allow the engine to warm up for approximately five minutes. Once the engine has warmed up, adjust the engine speed to recommended normal run speed, and apply load.

3.4.4. Ensure water is properly flowing from the pump to the SRS raw water tank and WPS raw water tank (if interconnected).

3.4.5. Once the pump is started and engaged, shut the pump down when the raw water tanks are full; when service or maintenance is required; or when the pump is likely to experience a dead head condition for more than a brief period.

3.4.6. Be sure to periodically recheck all hoses, connections, pipes, valves, fittings, and 20,000-gallon raw water tank(s) for leaks. Make needed repairs and perform maintenance according to procedures in applicable technical orders and manuals.

> **Note:** Contingency water systems have a tendency to leak a little, so small leaks are usually unavoidable and should not be a major cause of concern. Always ensure neoprene gaskets are installed before connecting suction or discharge hoses.

3.5. Component Descriptions. Table 3.2 provides a detailed description and quantity for each SRS Subsystem component and its corresponding reference number. Refer to T.O. 40W4-21-1 for other subsystem component information.

Table 3.2. SRS Component Description and Item Number.

Ref #	Description	Qty
1	4-Inch Strainer and Float Buoy Assembly, w Hand Air Pump, Green Stripe	1
2	4-Inch x 25-Foot Suction Hose Assembly, Green Stripe	2
3	4-Inch x 50-Foot Suction Hose Assembly, Green Stripe	2
4	4-Inch x 15-Foot Suction Hose Assembly, Green Stripe	8
5	Diesel Pump Assembly, w/4-Inch Female x 4-Inch Male QDs, Green Stripe	1
6	Swing Check Valve Assembly, w/4-Inch Female x 4-Inch Male QDs, Green Stripe	3
7	Reducer, 6-Inch Male x 4-Inch Female QDs, Green Stripe	1

Table 3.2. (Continued)

Ref #	Description	Qty
8	6-Inch x 150-Foot Discharge Hose Assembly, Green Stripe	42
9	6-Inch x 50-Foot Discharge Hose Assembly, Green Stripe	10
10	Reducer, 6-Inch Female x 4-Inch Male QDs, Green Stripe	1
11	4-Inch x 50-Foot Discharge Hose Assembly, Green Stripe	4
12	4-Inch x 25-Foot Discharge Hose Assembly, Green Stripe	4
13	4-Inch x 4-Inch x 4-Inch Pipe Tee Assembly w/Female x Male x Male QDs, Green Stripe	3
14	4-Inch Ball Valve Assembly w/Female x Male QDs, Green Stripe	6
15	20,000-Gallon Collapsible Fabric Tank w/Adapter, 2-Inch Male QD x Male National Pipe Thread (NPT), Green Stripe	1
16	2-Inch x 8-Foot Suction Hose Assembly w/Female QD, Green Stripe	1
17	2-Inch Ball Valve Assembly w/Female QD, Green Stripe	1
18	6 Inch Hose Mender, Hose Shank x Hose Shank	3
19	Hose Clamp, Worm Gear, 1/2 Inch Band Width, (or wider), Slotted Hex Screw, Range 1 3/4 Inch to 8 9/16 Inch	25
20	Hose Clamp, Worm Gear, 1/2 Inch Band Width, Slotted Hex Screw, Range 3 1/2 Inch to 5 Inch	25
21	Ratchet Wrench, 5/16 Drive, 60 Inch Lb. Torque (For Worm Gear Hose Clamps)	2

Table 3.2. (Continued)

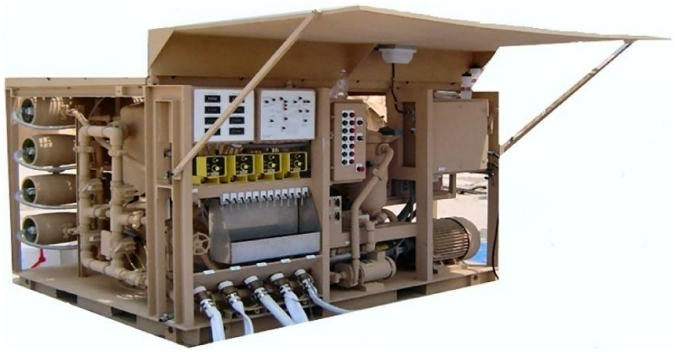
Ref #	Description	Qty
22	Adapter, 4 Inch, Male QD x Male NPT	5
23	Adapter, 6 Inch Male QD x 6 Inch Male NPT	2
24	Coupler, 4 Inch Female QD x Male NPT	3
25	Adapter, 6 Inch Male QD x Female NPT	2
26	Coupler, 6 Inch Female QD x Female NPT	4
27	6.5 Inch Hose Bridge System	8
28	Coupler, 4 Inch Female QD x 4 Inch Female QD	2
29	Coupler, 6 Inch Female QD x 6 Inch Female QD	2
30	Adapter, 4 Inch Male QD x 4 Inch Male QD	2
31	Adapter, 6 Inch Male QD x 6 Inch Male QD	2
32	Tape, Anti-seize, Roll	50
33	Box, Flaking	10
34	J-Clamp 6 Inch Hose Repair Kit	1
35	Kit, Transition	1
36	Kit, Cold Weather, Source Run Subsystem (Optional) (Not Currently Available)	1

Chapter 4

WATER PRODUCTION SUBSYSTEM

4.1. General Information. The Water Production Subsystem (WPS) generates potable water for distribution to user facilities within the contingency water system. Water purification is accomplished using the 1500 ROWPU and/or 600 ROWPU (**Figure 4.1** and **Figure 4.2**) set up in a parallel configuration. Raw water input for the ROWPU is first pumped into 20,000-gallon storage tanks then distributed to the ROWPUs through a series of hoses and fittings. The potable water generated by the ROWPUs is distributed through another series of hoses and fittings to 20,000-gallon potable water storage tanks.

Figure 4.1. 1500 ROWPU.



4.1.1. By-products from the water purification process include both wastewater and reject water (also known as brine or concentrate). Wastewater and reject water (hereafter referred to as brine for clarity) are distributed separately. Wastewater is routed to a 3,000-gallon wastewater tank. Brine is routed to a 20,000-gallon brine storage tank and a ROWPU backwash tank.

4.1.2. The brine tank and hoses are configured so that brine output may be reused for fighting fires, controlling dust, construction purposes, improving electrical grounds, decontamination, and various other purposes. However, it should not be used in fire trucks, or for washing aircraft and vehicles if it has

a high salt content. If brine is not reused, it, along with ROWPU wastewater is distributed by a 35-GPM electric pump (or backup 125-GPM diesel pump) to waste disposal.

Figure 4.2. 600 ROWPU.

4.2. Components. The major components of the WPS are listed in **Table 4.1** and illustrated in **Figure 4.3**. However, for a complete list of all subsystem components, including nomenclature and quantity per subsystem, refer to **Table 4.2** in this handbook and the WPS IPB in T.O. 40W4-21-1.

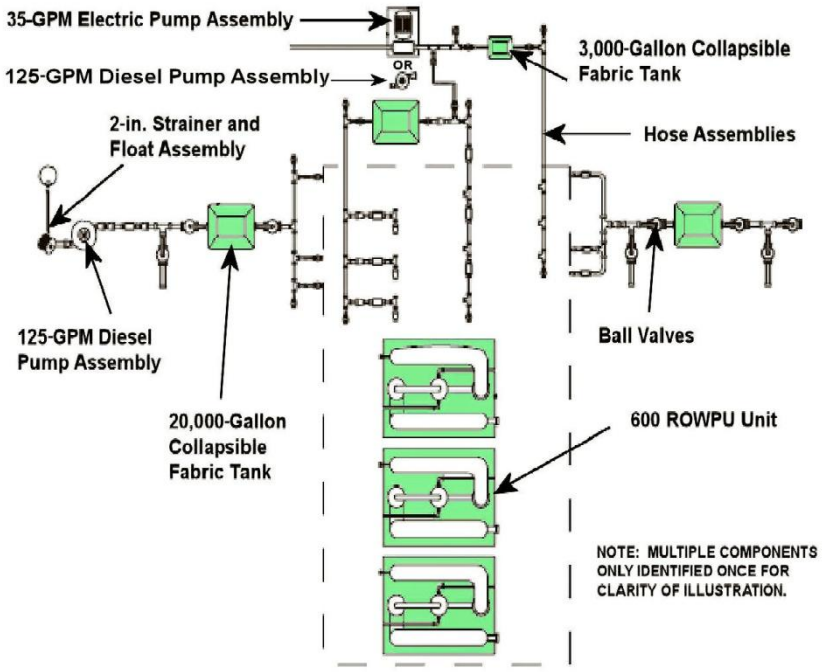
Table 4.1. WPS Major Components.

Item	Function/Use
2-Inch Strainer and Float Assembly	Prevents trash, twigs, and debris from entering the WPS and keeps the strainer from lying on the bottom of the raw water source where dirt and gravel could enter the subsystem. Used for raw water processing when an SRS is not used as part of the water system configuration. (Green Stripe)
125-GPM Diesel Pump (Raw Water)	Pumps raw water to WPS when the SRS is not used as part of the water system configuration. (Green Stripe)

Table 4.1. (Continued)

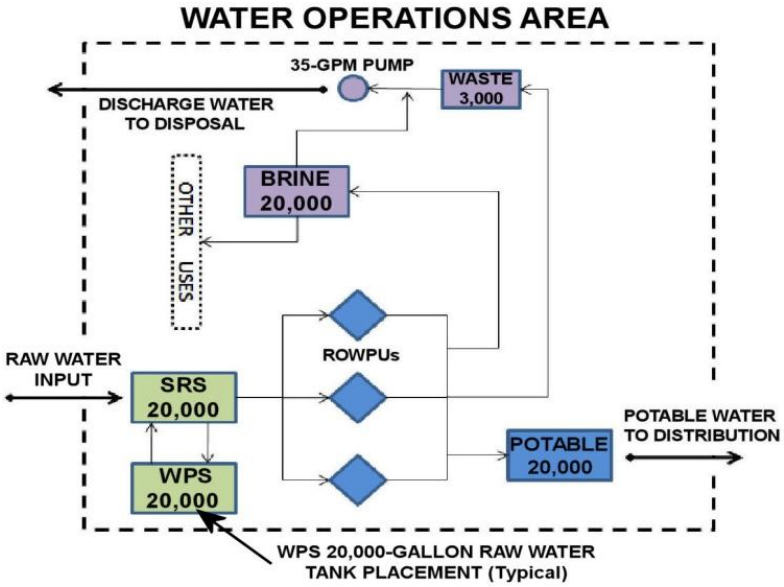
Item	Function/Use
35-GPM Electric Pump Assembly (Wastewater)	Pumps ROWPU wastewater to a waste disposal area when prime power is available and adequate. Pump operation is manually regulated for waste disposal operations. (Purple Stripe)
125-GPM Diesel Pump (Wastewater)	Pumps ROWPU wastewater to a waste disposal area when prime power is not available or adequate. Used as a backup pump for the 35-GPM electric pump. (Purple Stripe)
20,000-Gallon Collapsible Fabric Tanks	Stores raw water, potable water, and brine. The raw water tank is color-coded green. The potable water tank is color-coded white. The brine tank is color-coded purple. None of these tanks are interchangeable.
ROWPU	Produces potable water. The 1500 ROWPU produces potable water at a capacity equal to or greater than 1500 gallons per hour (GPH), and the 600 ROWPU produces potable water at a capacity equal to or greater than 600 GPH.
3,000-Gallon Collapsible Fabric Tank	Stores wastewater from the ROWPU water purification process. (Red Stripe)
Hoses	Routes raw water input for processing, potable water output for storage, and wastewater for disposal. The hoses are color-coded green, white, and purple, respectively, for their particular distribution function.
Ball Valves	Controls flow of raw water input for purification, potable water output for storage, and wastewater for disposal. Also used to isolate water flow to specific ROWPUs for maintenance while maintaining water purification operation.

Figure 4.3. WPS Illustration Using Three ROWPUs.



4.3. Installation. Installation of the WPS is essentially the same regardless of the type of ROWPU used. There are two or three purification units in a WPS basic configuration, but if more ROWPUs are added, the configuration and number of components will obviously change. Since using more ROWPUs, or even interconnecting different types of ROWPUs is optional, our discussion here will only address basic installation of a three-ROWPU WPS. Before installing the WPS, review the planned dimensions of the water operations area (see **Table 2.1** on page 15) and placement of the WPS 20,000-gallon raw water tank (**Figure 4.4**). Then, refer to component layout diagrams in this chapter and the list in **Table 4.2** to identify each numbered component when performing the steps below.

Figure 4.4. Location of WOA Water Tanks and ROWPUs (Typical).



CAUTION

To prevent injury to personnel and/or damage to equipment units, ensure adequate personnel and lifting equipment are available to preposition equipment.

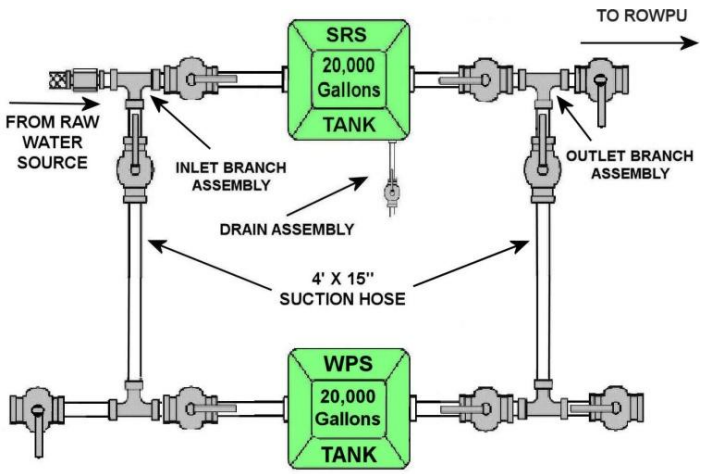
4.3.1. **Position Water Tanks, ROWPUs, and 35-GPM Pump.** Position water tanks, ROWPUs, and 35-GPM pump as follows:

4.3.1.1. Position the WPS 20,000-gallon raw water tank at the edge of the WOA and alongside the SRS tank. Position tanks six feet apart and ensure the vent and drain assembly is installed on the tanks. Link the tanks together by connecting the 4-inch x 15-foot suction hoses from the WPS tank to the inlet and outlet branch assemblies on the SRS tank as illustrated in **Figure 4.5**.

> **Note:** Always ensure neoprene gaskets are in place before connecting suction or discharge hoses.

4.3.1.2. Before positioning ROWPUs verify that a 120-Volt Alternating Current (VAC), 1-phase, 60-Hertz (Hz) and a 208-VAC, 3-phase, 60-Hz power source is available. Then, position ROWPUs approximately 20 feet from the WPS raw water tank and make sure to provide 10 feet of clearance between each water purification unit.

Figure 4.5. WPS and SRS Raw Water Tank Connections (Typical).



4.3.1.3. Position the 20,000-gallon potable water tank approximately 35 feet from ROWPUs, and then install the tank's vent, drain assembly, and 4-inch inlet elbow (female-to-female) and outlet elbow (female-to-male) onto the tank.

4.3.1.4. Position the 20,000-gallon brine tank approximately 50 feet from ROWPUs, and then install the tank's vent, drain assembly, and 4-inch elbows.

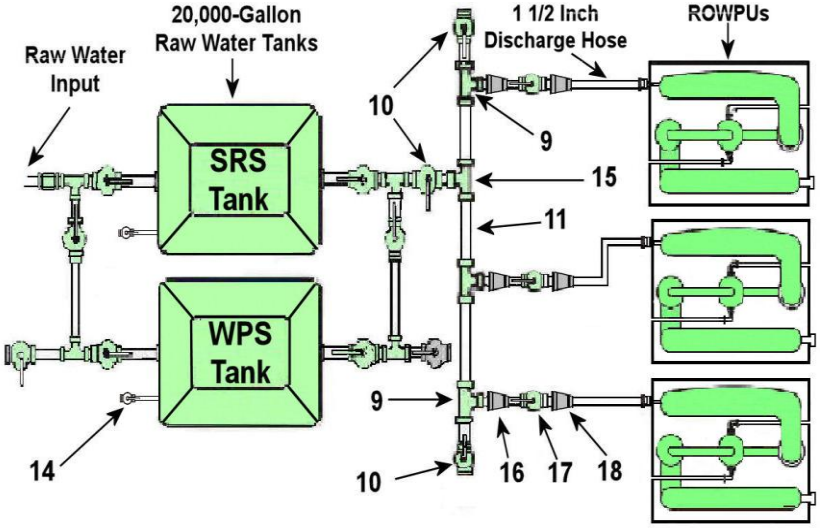
4.3.1.5. Place the 3,000-gallon wastewater tank approximately 25 feet from the brine tank, and then install the tank's vent and drain assembly. Also, connect the 2-inch female QD to the tank inlet and 2-inch male QD to the tank outlet.

4.3.1.6. Before positioning the 35-GPM electric pump, verify that 208-VAC, 1-phase, 60-Hz power is available. Then, place the electric pump approximately 25 feet from the 3,000-gallon wastewater tank. If power is not available, use the backup 125-GPM diesel pump.

4.3.2. **Assemble Raw Water Hoses and Components.** Install hoses and components from the WPS and SRS raw water tanks to ROWPU locations as illustrated in **Figure 4.6**.

4.3.2.1. Starting at the SRS tank outlet branch assembly, attach a 4-inch tee assembly (15) to the previously assembled 4-inch ball valve (10). Then connect three 4-inch x 15-foot suction hoses (11) with three tee assemblies (9) and two 4-inch ball valves as shown below. At each tee, attach in order, a 4-inch x 2-inch reducer (16), a 2-inch ball valve (17), and a 2-inch x 1 1/2-inch reducer (18). Each of these branches connects to a 1 1/2-inch raw water discharge hose leading to water purification units.

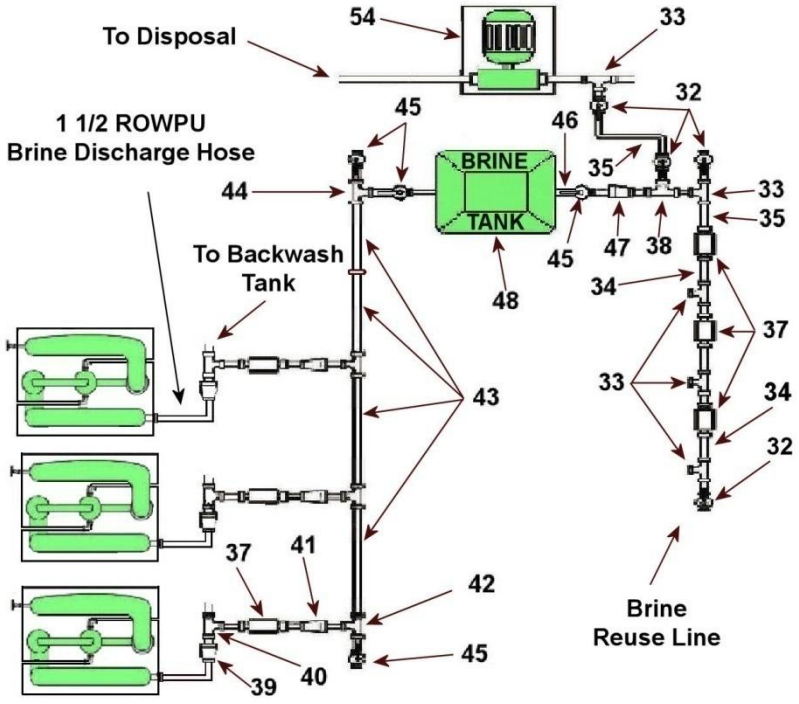
Figure 4.6. Raw Water Hoses and Component Layout.



4.3.2.2. After connecting the 1 1/2-inch reducer to the ROWPU hoses, ensure the ball valves at the inlet and outlet sides of the WPS raw water tank are open and the ball valves on the three branch outlets are closed. Then confirm the ball valves (14) are closed on both WPS and SRS raw water tank drain hoses. After that, ensure the ball valves on the valve inlets to the ROWPUs are also closed. Keep this configuration until the subsystem is ready to begin water production operations.

4.3.3. **Assemble Brine Hoses and Components.** Install brine hoses and components from the ROWPUs to the brine storage tank as illustrated in **Figure 4.7**.

Figure 4.7. Brine Hoses and Component Layout.



4.3.3.1. Starting at the 1 1/2-inch brine discharge hoses from the ROWPUs, attach in order, a 2-inch x 1 1/2-inch reducer (39), a 2-inch tee (40), a check valve (37), a 4-inch x 2-inch reducer (41), and a 4-inch tee (42) on each output hose.

4.3.3.2. Next, connect the 4-inch x 25-foot brine hoses (43) to the tee assemblies and position the hoses so they head towards the brine storage tank (48).

4.3.3.3. Attach a 4-inch tee (44) on the end of the brine hose facing the brine storage tank. Then, connect a ball valve (45) to the open end of each tee assembly.

4.3.3.4. Next, connect one end of a 4-inch x 15-foot brine suction hose (46) to the ball valve facing the brine tank. Attach the other end of the hose to the tank inlet.

4.3.3.5. On the tank outlet, attach another 4-inch x 15-foot brine hose, followed by a 4-inch ball valve (45), 4-inch x 2-inch reducer (47), and 2-inch tee assembly (38).

4.3.3.6. For brine disposal, start at the 2-inch tee (38) and attach a 2-inch ball valve (32) followed by a 2-inch x 50-foot discharge hose (35). Next, attach another 2-inch ball valve and 2-inch tee (33). Afterward, connect the tee to the 35-GPM wastewater pump (54) for disposal.

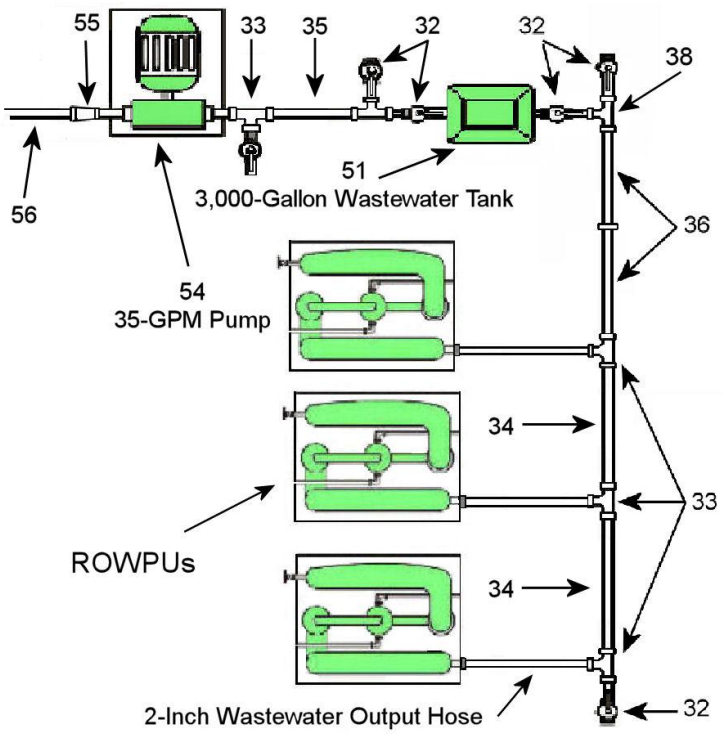
4.3.3.7. For brine reuse, start at the 2-inch tee (38) and attach another 2-inch tee (33) followed by a 2-inch ball valve on one end (32) and a 2-inch x 50-foot discharge hose (35) on the other. Next, attach a 2-inch check valve (37) followed by three 2-inch x 25-foot discharge hoses (34), with 2-inch check valves and tees installed. At the last tee on the end of the discharge hose, attach another 2-inch ball valve. From this valve, brine can be drawn and reused for washing vehicles, decontamination, firefighting, wetting dusty roads, and other various user purposes.

4.3.4. **Assemble Wastewater Hoses and Components.** Install wastewater hoses and components from the ROWPUs to the 3,000-gallon wastewater storage tank and disposal area as illustrated in **Figure 4.8**.

> **Note:** Always ensure neoprene gaskets are in place before connecting suction or discharge hoses.

4.3.4.1. Starting at the ROWPUs' 2-inch wastewater output hoses, attach a 2-inch tee (33) to each hose end. Then, connect two 2-inch x 25-foot wastewater discharge hoses (34) as shown below. Attach a 2-inch ball valve (32) on the open end of the first tee. On the open end of the third tee assembly, connect enough 2-inch x 25-foot suction hoses (36) to reach the wastewater tank.

Figure 4.8. Wastewater Hoses and Component Layout.

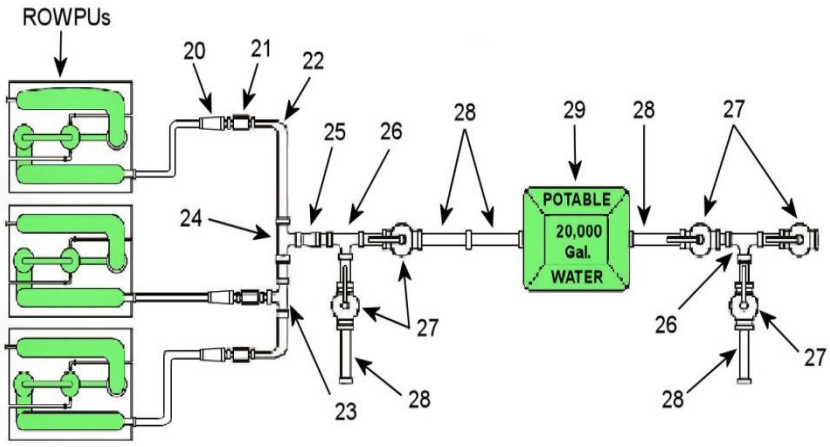


4.3.4.2. At the end of the suction hose, connect another 2-inch tee (38), followed by 2-inch ball valves (32) on the open ends of the tee. Afterward, attach the ball valve nearest the tank to the wastewater tank (51) inlet.

4.3.4.3. On the wastewater tank outlet, attach a 2-inch ball valve followed by a 2-inch tee assembly and a 2-inch x 50-foot wastewater discharge hose (35). Afterward, attach another 2-inch ball valve on the open end of the tee. Then, attach the discharge hose to the tee (33) that is closest to the 35-GPM pump.

4.3.5. **Assemble Potable Water Hoses and Components.** Install potable water hoses and components from the ROWPUs to the potable water storage tank as illustrated in **Figure 4.9**.

Figure 4.9. Potable Water Hoses and Component Layout.



4.3.5.1. Starting at the 1 1/2-inch potable water output hoses from the ROWPUs, attach a 2-inch x 1 1/2-inch reducer (20) and 2-inch check valve (21) to each hose. Afterward, attach a 2-inch x 25-foot suction hose (22) to the first and third (outside) lines and install the 2-inch tees (23, 24) as shown.

4.3.5.2. At the 2-inch tee (24), install a 4-inch x 2-inch reducer (25) followed by a 4-inch tee (26) on the end of the reducer. Afterward, attach a 4-inch ball valve (27) to the free ends of the tee.

4.3.5.3. From the 4-inch ball valves, attach three 4-inch x 15-foot suction hoses (28): attach a line of two hoses to the ball valve that points towards the potable water tank (29), and attach the other hose to the ball valve that points away from the potable water tank. Afterward, connect the suction hose to the potable water tank inlet.

4.3.5.4. On the tank outlet, attach another 4-inch x 15-foot suction hose followed by a 4-inch ball valve and tee assembly. Attach two additional ball valves (27) and a suction hose (28) on the open ends of the tee. Potable water is distributed from this branch tee assembly to the water distribution subsystems addressed in the next few chapters. The lone 20,000-gallon potable water tank in this configuration can be incorporated with the 550-Initial and 550-Follow-On Subsystems 20,000-gallon tanks to form an interconnecting potable water tank farm similar to that being erected in **Figure 4.10**. This completes basic installation of the WPS.

Figure 4.10. Erecting a Potable Water Tank Farm.

4.4. Operation. The following procedures address basic steps to operate the WPS after installation. If necessary, refer back to the basic layout diagrams presented throughout this chapter for part identification when performing these steps.

> **Note:** For ROWPU operating procedures, consult T.O. 40W4-21-1, AFH 10-222, Volume 9, *Guide to Reverse Osmosis Water Purification Unit Installation and Operation*, and the applicable technical orders for the ROWPU (T.O. 40W4-13-41, *Operation Manual—Water Purification, Reverse Osmosis, 600GPH Skid Mounted ROWPU Model WPES-20*, and T.O. 40W4-20-1, *Operation and Maintenance Instruction With IPB – 1500 Reverse Osmosis Water Purification Unit (ROWPU)*.

4.4.1. Open the inlet and outlet 4-inch ball valves on the 20,000-gallon WPS raw water tank (and 20,000-gallon SRS tank if interconnected). Close the 2-inch ball valve on the tank drain(s), and then open the 4-inch ball valves on the branch tees. Ensure proper connection and tightness of all hose assemblies, valves, and fittings for 20,000-gallon raw water tanks.

4.4.2. Repeat this procedure on the 20,000-gallon potable water tank. Also, verify that all potable water fittings, valves, and hoses are color-coded white.

4.4.3. Open the 2-inch ball valve on the 3,000-gallon wastewater tank inlet and close the 2-inch ball valve on the end of the inlet branch tee. Ensure all hose assemblies, valves, and fittings associated with the wastewater tank is properly connected and color-coded purple.

4.4.3.1. Close the 2-inch ball valves on the wastewater tank outlet, the branch tee, and the tee leading to the brine system.

4.4.3.2. Ensure all hoses, valves, and fittings, associated with the wastewater tank discharge system, are properly connected, and color-coded purple.

4.4.4. Check the 35-GPM Electric Pump for adequate power, and verify that all fittings and connections are tight and color-coded purple. If adequate power is not available, use the 125-GPM Diesel Pump.

4.4.5. Open the 4-inch ball valve on the 20,000-gallon brine tank and close the 4-inch ball valves on the branch tees.

4.4.5.1. Close the 2-inch ball valves on the branch tees and 2-inch ball valve on the tank drain.

4.4.5.2. Ensure all hoses, valves, and fittings, associated with the outlet of the 20,000-gallon brine tank, are properly connected, and color-coded purple.

4.4.6. Recheck all hose assemblies, valves, fittings, and the 20,000-gallon raw water tank for leaks and repair as required

4.4.7. Start up ROWPU units according to procedures in the applicable ROWPU technical order (i.e. T.O. 40W4-13-41 for the WPES-20 and T.O. 40W4-20-1 for the 1500), and verify the flow of potable water into the 20,000-gallon potable water tank.

4.4.8. Recheck all hose assemblies, valves, fittings associated with the potable water system, and the 20,000-gallon potable water tank for leaks and repair as required. Repeat these procedures for the brine and wastewater systems and tanks.

> **Note:** Contingency water systems have a tendency to leak a little, so small leaks are usually unavoidable and should not be a major cause of concern. Always ensure neoprene gaskets are installed before connecting suction or discharge hoses.

4.4.9. Recheck all hose assemblies, valves, and fittings connected to the 35-GPM Electric Pump for leaks and repair as required.

> **Note:** Wastewater disposal should be accomplished according to MAJCOM directives or local policies.

4.4.10. When the 3,000-gallon wastewater tank reaches its capacity, turn ON the 35-GPM pump to discharge wastewater from the tank. Turn the pump OFF when the 3,000-gallon tank is empty. Restart as required to dispose of wastewater. If the 125-GPM Diesel Pump was used in lieu of the 35-GPM pump, refer to T.O. 40W4-21-1 for startup and shutdown procedures.

4.4.11. If potable water production exceeds demand and 20,000-gallon potable water storage tanks are full, stop water production by shutting down ROWPU operations according to the applicable ROWPU technical order and terminate operation of the Source Run Subsystem's 400-GPM Diesel Pump according to instructions in the *Commercial Operator's Manual for Power Tech 4.5/6.8 L Tier 2 OEM Diesel Engines*. See **Attachment 1** for specific references.

4.5. WPS Component Descriptions. Table 4.2 lists detailed descriptions and quantities for WPS Subsystem components and their corresponding reference number. Refer to T.O. 40W4-21-1 for other subsystem component information.

Table 4.2. WPS Component Description and Item Number.

Ref #	Description	Qty
1	Strainer And Float Buoy Assembly, 2-Inch, w/Pump, Air, Hand, Green Stripe	1
2	Suction Hose Assembly, 2-Inch x 25-Foot, Green Stripe	4
3	Pump Assembly, 2-Inch Diesel, w/Female x Male QDs, Green Stripe	1
4	Reducer, w/3-Inch Male x 2-Inch Female QDs, Green Stripe	1
5	Discharge Hose Assembly, 3-Inch x 100-Foot, Green Stripe	5
6	Swing Check Valve Assembly, 3-Inch, PVC, w/Female x Male QDs, Green Stripe	1
7	Reducer, w/4-Inch Male x 3-Inch Female, Green Stripe	2
8	Suction Hose Assembly, 4-Inch x 50-Foot, Green Stripe	2
9	Tee Assembly, 4-Inch x 4-Inch x 4-Inch, w/Female x Male x Male QDs, Green Stripe	7

Table 4.2. (Continued)

Ref #	Description	Qty
10	Ball Valve Assembly, 4-Inch, w/Female x Male QDs, Green Stripe	8
11	Suction Hose Assembly, 4-Inch x 15-Foot, Green Stripe	8
12	20,000-Gallon Collapsible Fabric Tank w/Adapter, 2-Inch Male QD x Male NPT, Green Stripe	1
13	Suction Hose Assembly, 2-Inch x 8-Foot, Green Stripe	1
14	Ball Valve Assembly, 2-Inch, w/Female QD x Female NPT, Green Stripe	1
15	Tee Assembly, 4-Inch x 4-Inch x 4-Inch, w/Male x Male x Female QDs, Green Stripe	2
16	Reducer, w/4-Inch Female x 2-Inch Male QDs, Green Stripe	4
17	Ball Valve Assembly, 2-Inch, w/Female x Female QDs, Green Stripe	4
18*	Reducer, w/2-Inch Male x 1 1/2-Inch Female QDs, Green Stripe	4
19	600 Reverse Osmosis Water Purification Unit (ROWPU) Government Furnished Equipment (GFE)	3
20	Reducer, w/2-Inch Male x 1 1/2-Inch Female QDs, White Stripe	4
21	Swing Check Valve Assembly, 2-Inch, w/Female x Male QDs, White Stripe	4
22	Suction Hose Assembly, 2-Inch x 25-Foot, White Stripe	2
23*	Tee Assembly, 2-Inch x 2-Inch x 2-Inch, w/Female x Male x Female QDs, White Stripe	1

Table 4.2. (Continued)

Ref #	Description	Qty
24	Tee Assembly, 2-Inch x 2-Inch x 2-Inch, w/Female x Female x Male QDs, White Stripe	1
25	Reducer, w/4-Inch Male x 2-Inch Female QDs, White Stripe	1
26	Tee Assembly, 4-Inch x 4-Inch x 4-Inch, w/Female x Male x Male QDs, White Stripe	1
27	Ball Valve Assembly, 4-Inch, w/Female x Male QDs, White Stripe	5
28	Suction Hose Assembly, 4-Inch x 15-Foot, White Stripe	5
29	20,000-Gallon Collapsible Fabric Tank, w/Adapter, 2-Inch Male QD x Male NPT, White Stripe	1
30	Suction Hose Assembly, 2-Inch x 8-Foot, White Stripe	1
31	Ball Valve Assembly, 2-Inch, w/Female QD x Female NPT, White Stripe	1
32	Ball Valve Assembly, 2-Inch, w/Female x Male QDs, Purple Stripe	9
33	Tee Assembly, 2-Inch x 2-Inch x 2-Inch, w/Female x Male x Female QDs, Purple Stripe	8
34	Discharge Hose Assembly, 2-Inch x 25-Foot, Purple Stripe	5
35	Discharge Hose Assembly, 2-Inch x 50-Foot, Purple Stripe	3
36	Suction Hose Assembly, 2-Inch x 25-Foot, Purple Stripe	6
37	Swing Check Valve Assembly, 2-Inch, w/Female x Male QDs, Purple Stripe	6
38	Tee Assembly, 2-Inch x 2-Inch x 2-Inch, w/Female x Male x Male QDs, Purple Stripe	3

Table 4.2. (Continued)

Ref #	Description	Qty
39*	Reducer, 2-Inch Male x 1 1/2-Inch Female QDs, Purple Stripe	3
40	Tee Assembly, 2-Inch x 2-Inch x 2-Inch, w/Female x Female x Male QDs, Purple Stripe	3
41	Reducer, w/4-Inch Male x 2-Inch Female QDs, Purple Stripe	3
42	Tee Assembly, 4-Inch x 4-Inch x 4-Inch, w/Female x Male x Female QDs, Purple Stripe	3
43	Suction Hose Assembly, 4-Inch x 25-Foot, Purple Stripe	4
44	Tee Assembly, 4-Inch x 4-Inch x 4-Inch, w/Female x Male x Male QDs, Purple Stripe	1
45	Ball Valve Assembly, 4-Inch, w/Female x Male QDs, Purple Stripe	4
46	Suction Hose Assembly, 4-Inch x 15-Foot, Purple Stripe	2
47	Reducer, w/4-Inch Female x 2-Inch Male QDs, Purple Stripe	1
48	20,000-Gallon Collapsible Fabric Tank, w/Adapter, 2-Inch Male QD x Male NPT, Purple Stripe	1
49	Suction Hose Assembly, 2-Inch x 8-Foot, Purple Stripe	1
50	Ball Valve Assembly, 2-Inch, w/Female QD x Female NPT, Purple Stripe	1
51	3,000-Gallon Collapsible Fabric Tank Assembly, w/ 2-Inch Female x Male x Male QDs, Red Stripe	1
52	Suction Hose Assembly, 2-Inch x 8-Foot, Red Stripe	1
53	Ball Valve Assembly, 2-Inch, w/Female QD x Female NPT, Red Stripe	1

Table 4.2. (Continued)

Ref #	Description	Qty
54	Electric Pump Assembly, 2-Inch, w/Female x Male QDs, Purple Stripe	1
55	Reducer, w/3-Inch Male x 2-Inch Female QDs, Purple Stripe	1
56	Discharge Hose Assembly, 3-Inch x 100-Foot, Purple Stripe	5
57	Suction Hose Assembly, 2-Inch x 50-Foot, Green Stripe	1
58	Suction Hose Assembly, 4-Inch x 25-Foot, Green Stripe	1
59	Pump Assembly, 2-Inch Diesel, w/2 Inch Female x Male QDs, Purple Stripe	1
60	Discharge Hose Assembly, 3-Inch x 25-Foot, Purple Stripe	1
61	Discharge Hose Assembly, 3-Inch x 50-Foot, Purple Stripe	2
62	Adapter, Swivel, 2 1/2 Inch NST x 2-Inch Female NPT	1
63	Adapter, Swivel, 2 1/2 Inch Female NST x 3-Inch Female NPT	1
64	Adapter, Swivel, 2 1/2 Inch Female NST x 3-Inch Male NPT	1
65	Hose Clamp, Worm Gear, 1/2-Inch Band Width (Or Wider), Slotted Hex Screw, Range 1 3/4 Inch to 8 9/16 Inch	25
66	Hose Clamp, Worm Gear, 1/2-Inch Band Width, Slotted Hex Screw, Range 3 1/2 Inch to 5-Inch	25
67	Coupler, 4-Inch Female x 4-Inch Female QDs	1
68	Adapter, 4-Inch Male x 4-Inch Male QDs	1
69	Coupler, 2-Inch Female x 2-Inch Female QDs	2
70	Adapter, 2-Inch Male x 2-Inch Male QD’s	2
71	Coupler, 1 1/2 Inch Female x 1 1/2 Inch Female QDs	1
72	Adapter, 1 1/2 Inch Male x 1 1/2 Inch Male QDs	1

Table 4.2. (Continued)

Ref #	Description	Qty
74	Tape, Anti-seize, Roll	10
75	Kit, Cold Weather, Water Production 600 ROWPU Subsystem (Optional), (Not Currently Available)	11
*** Not a component of 1500 ROWPU WPS.**		

Chapter 5

550-INITIAL SUBSYSTEM

5.1. General Information. The 550-Initial Subsystem is the primary potable water distribution subsystem of the contingency water system. The subsystem may be deployed as a stand-alone potable water distribution subsystem; however, it is designed for expansion and buildup to meet varying user deployment and operational needs. The 550-Initial Subsystem (**Figure 5.1**) normally receives potable water input from the Water Production Subsystem discussed in **Chapter 4**. However, the adapters supplied with this subsystem do provide a means to draw potable water from other similar potable water sources. Potable water input to the subsystem is typically distributed to three 20,000-gallon fabric tanks for storage. The storage tanks, usually in tank farm configuration, distribute the potable water to a variable speed dual pumping station. The two pumps are parallel configured, enabling dual or single pump operation, and single pump isolation for maintenance or repair purposes. The remaining operational pump maintains water pressure in the distribution line. Output from the pumping station is applied to a distribution line that is looped and connected together to form a pressurized feed line. User facilities, such as latrines, showers, and laundries, are branch fed from the pressurized feed line. Waste output from the user facilities is processed by various lift pumps and wastewater lines that distribute the wastewater to a wastewater collection tank for disposal. Hose rollover protection ramps (hose bridges) are provided in the event potable water distribution and/or wastewater distribution requires crossing roadways or similar heavy vehicular traffic areas.

5.2. Components. The major components that make up the 550-Initial Subsystem are illustrated in **Figure 5.1** and listed in **Table 5.1**. However, for a complete list of all subsystem components, including nomenclature and quantity per subsystem, refer to **Table 5.4** in this handbook and the 550-Initial Subsystem IPB in T.O. 40W4-21-1.

Figure 5.1. 550-Initial Subsystem.

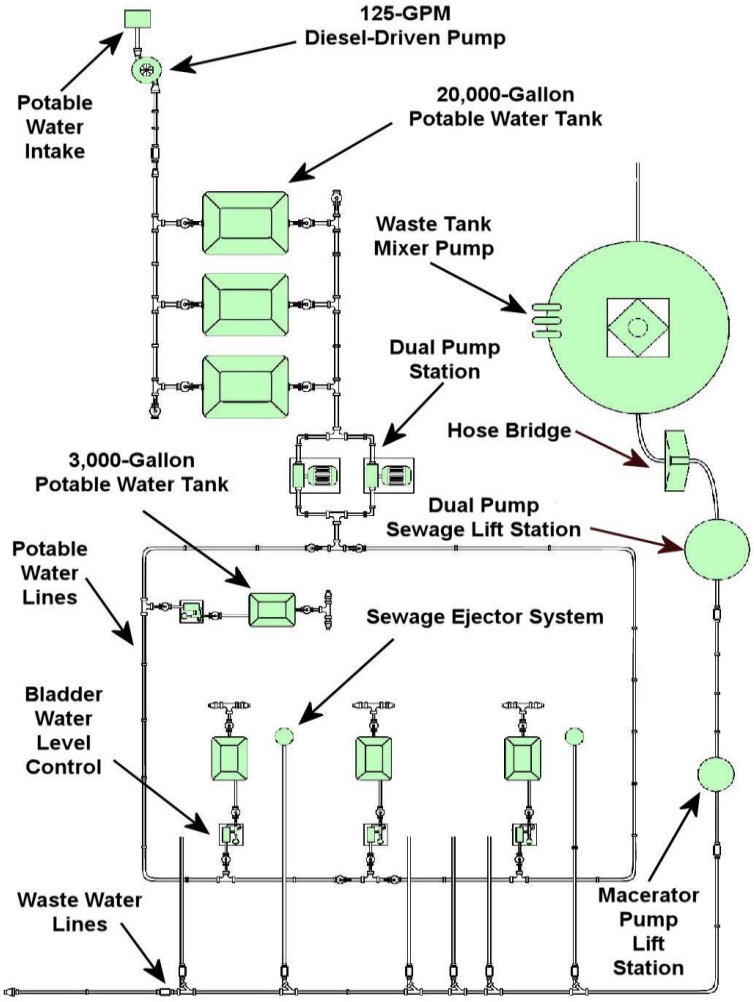


Table 5.1. 550-Initial Subsystem Major Components.

Item	Function/Use
125-GPM Diesel Pump (Potable Water)	Pumps potable water into 20,000-gallon tanks for distribution to user facilities when the WPS is not used as part of the water system configuration. (White Stripe)
20,000-Gallon Collapsible Fabric Tanks	Stores potable water in tank farm configuration. Tanks are color-coded white and are not interchangeable with raw, brine, or wastewater tanks.
Dual Pumping Station	Pressurizes potable water distribution lines and maintain chlorination of the water. Pumps can operate in dual or single configuration. (White Stripe)
3,000-Gallon Collapsible Fabric Tanks	Stores potable water at user facilities. (White Stripe)
Bladder Water Level Controllers	Maintains a preset maximum and minimum volume of potable water in 3,000-gallon water storage tanks.
Sewage Ejector Systems	Pumps raw sewage from latrines for output distribution to a wastewater collection tank. (Purple Stripe)
Macerator Pump Lift Station	Predigests raw sewage and pumps wastewater from user facilities to a waste collection system. (Purple)
Dual Pump Lift Station	Predigests raw sewage and pumps wastewater from user facilities for distribution to a waste collection tank. The two pumps can operate in either dual or single pump configuration. (Purple Stripe)
25,000 Gallon Wastewater Collection Tank w/Mixing System	Provides a 25,000-gallon storage capacity for wastewater and includes an aerator and pump assembly to mix and aerate wastewater to maintain liquid state for disposal. (Purple Stripe)

Table 5.1. (Continued)

Item	Function/Use
Hose Bridge System	Provides rollover protection for potable water and/ or wastewater distribution hoses when routed across roadways or similar heavy vehicular traffic areas.
Hoses	Route potable water to storage or user facilities, and routes wastewater for disposal. The hoses are color-coded white for potable water and purple for waste-water.
Ball Valves	Controls potable water flow. Also used to isolate water flow to specific components and user facilities to help facilitate maintenance and/or repair actions.
Check Valves (Wastewater)	Prevents waste from flowing back into the facilities, minimizes spills from unforeseen ruptures, and prevents sewage pump systems from over tasking.

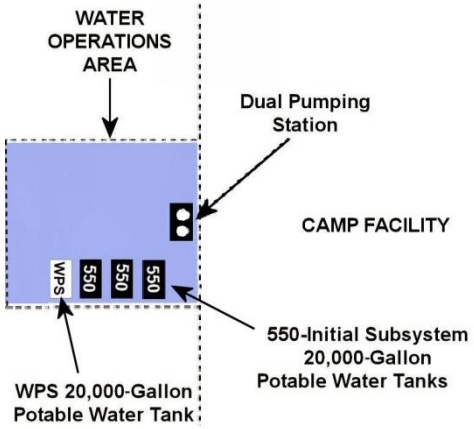
5.3. Installation. Before installing the 550-Initial Subsystem, review the planned dimensions of the water operations area (see **Table 2.1**on page 15) and the orientation of the subsystem in relation to the remaining subsystems. Then, refer to component layout diagrams in this chapter and the list in **Table 5.4** to identify each numbered component when performing the steps below.

CAUTION

To prevent injury to personnel and/or damage to equipment units, ensure adequate personnel and lifting equipment are available to preposition equipment.

5.3.1. **Position/Connect Dual Pump Station and 20,000-Gallon Tanks.** Place the dual pumping station inside and at the center edge of the WOA (**Figure 5.2**) with its 3-inch outlet facing the camp facilities.

Figure 5.2. Siting Dual Pump Station and 20,000-Gallon Tanks (Typical).



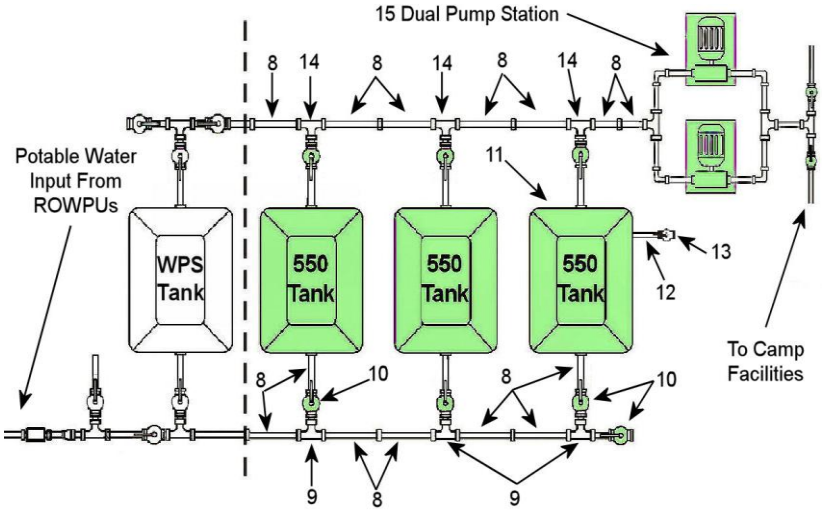
5.3.1.1. Starting on the inlet side of the dual pump station (**Figure 5.3**), attach two 4-inch x 15-foot suction hoses (8) to the 4-inch inlet of the pump station (15). Then, attach a 4-inch tee (14) to the hoses.

5.3.1.2. Position one 20,000-gallon potable water tank (11) approximately 30 feet from the dual pump station inlet, and align the tank outlet with the 4-inch tee assembly branch. Position two more 20,000-gallon tanks spaced 6 feet apart and along the depth of the WOA.

5.3.1.3. Next, install the tank's vent, drain hose and ball valve (12, 13), and 4-inch inlet elbow (female-to-female) and outlet elbow (female-to-male) onto each of the tanks. Then attach a 4-inch x 15-foot suction hose (8) to each tank inlet and outlet QD elbow. Afterward, connect 4-inch ball valves (10), outlet pipe tee assemblies (14), inlet pipe tee assemblies (9), and 15-foot suction hoses (8) to complete the tank inlet and outlet branches.

> **Note:** If setting up a 550 Follow-On subsystem with the Initial subsystem and both are on site, then pre-install the 550-Follow-On tank outlet tees and ball valves according to Paragraph 6.3.1.2. This will prevent having to shut down water supply later for camp expansion.

Figure 5.3. 550-Initial Subsystem Dual Pump Station and 20,000-Gallon Potable Water Tanks Basic Component Layout.



5.3.1.4. Link the 550-Initial potable water tanks and the WPS potable water tank together by connecting the 4-inch x 15-foot suction hoses from the WPS tank to the inlet and outlet branches of the 550-Initial tanks, resulting in a four-tank farm configuration.

5.3.2. **Position Sewage Ejector Systems.** Sewage ejector systems should be located next to the facilities they support. Verify an adequate power source is available to the sewage ejector tank then, position sewage ejector systems as follows:

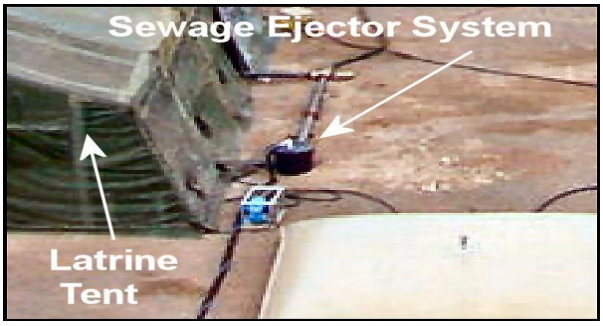
> **Note:** When installing the sewage ejector system, a backhoe or similar digging equipment may be necessary for excavation and backfill operations.

CAUTION

Damage and/or destruction of Sewage Ejector System (Latrine) tank will result if accidental tip-over occurs due to equipment or similar contact occurring as the result of ground-level installation. To prevent tip-over damage, the tank should be installed in-ground to a depth of 24 inches.

5.3.2.1. Position sewage ejector systems alongside latrine facilities (**Figure 5.4**). To determine the exact location, first set up the latrine's drain system to verify its exact ending point. Then, assemble the inlet and outlet components to the sewage ejector tank and excavate a hole for the tank.

Figure 5.4. Sewage Ejector System Placement (Typical).



5.3.2.2. Excavate a hole large enough to accommodate the station tank to a depth of at least 24 inches. Prepare the bottom of the hole with 6 inches of backfill material of gravel or stone that is not less than 3/8 inch in diameter or larger than 3/4 inch in diameter (if available). Ensure the base is level and smooth.

CAUTION

In freezing conditions, backfill material must be dry and free of ice. Do not use other backfill materials unless approved by the manufacturer.

5.3.2.3. Lower the sewage ejector tank into the hole and insert backfill material until it reaches ground level.

5.3.3. **Position 3,000-Gallon Potable Water Tanks.** Position 3,000-gallon potable water tanks (24) next to their respective facilities (**Figure 5.5**) as follows:

5.3.3.1. Position one 3,000-gallon potable water tank about 25 feet away from the kitchen facility's water connection. Position additional 3,000-gallon tanks approximately 25 feet away and centered between each of the two shower/shave and latrine facilities. Each tank will feed one shower/shave and one latrine facility.

5.3.3.2. Position another 3,000-gallon tank directly behind and approximately 25 feet away from the laundry facility. Afterward, connect all vents and drain assemblies to the 3,000-gallon tanks. If a BEAR Laundry facility is used, it comes equipped with its own 3,000-gallon tank that may be used in lieu of the tank from the 550-Initial Subsystem.

Figure 5.5. 3,000-Gallon Potable Water Tank at User Facility.

Note: Always ensure neoprene gaskets are in place before connecting suction or discharge hoses.

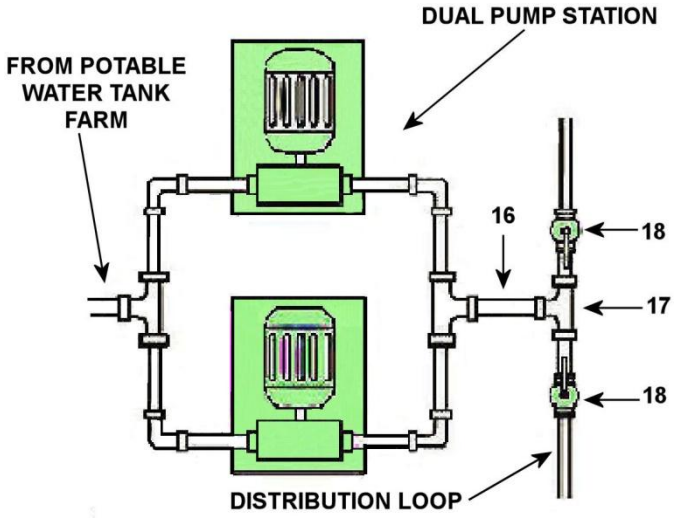
5.3.4. **Assemble Potable Water Distribution Loop and Facility Connections.** Begin assembling the potable water distribution loop and facility connections as depicted in **Figure 5.6**.

> **Note:** If the 550-Follow-On Subsystem or multiple 550-Initial/Follow-On Subsystems will be used, the loop on the 550-Initial Subsystem is NOT closed, but connects to the next subsystem until the last subsystem assembled closes the loop.

5.3.4.1. Connect the 3-inch x 25-foot discharge hoses (16) to the outlet of the dual pump station. Use as many hoses as required to reach the loop starting point, which is along the perimeter of the camp facility placement area.

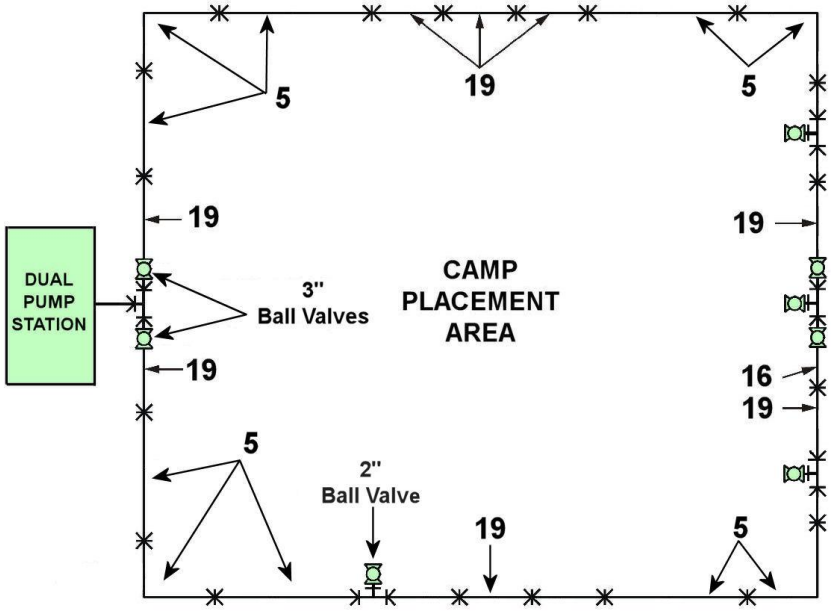
5.3.4.2. Connect one 3-inch tee (17) to the end of the discharge hose. Attach 3-inch ball valves (18) on each end of the 3-inch tee. Next, start laying the loop around the camp facility area toward the water-using facilities using 100, 50, and 25-foot discharge hoses.

Figure 5.6. Potable Water Distribution Loop Starting Point.



5.3.4.3. Connect the first hose to the 3-inch ball valve at the dual pump station outlet branch (**Figure 5.7**) and if possible, route the hose so it will not be subjected to high volumes of traffic. Use the 100-foot hose (5), 50-foot (19), and 25-foot (16) hoses where needed to properly position the hose so it is centered and within 20 to 25 feet of the inlet side of the 3,000-gallon facility tanks.

Figure 5.7. Water Distribution Loop Component Layout.



5.3.4.4. **3,000-Gallon Tank Inlet Connections.** Beginning at the water distribution loop adjacent to each 3,000-gallon facility tank (**Figure 5.8)**, install a 3-inch x 2-inch tee (20), and attach a 2-inch ball valve (21) on the tee assembly's branch outlet. Next, use one 2-inch x 25-foot discharge hose (22) and connect to the bladder water level controller (23). Then, attach another 2-inch ball valve to the inlet of the 3,000-gallon tank, and connect the bladder water level controller directly to the 2-inch valve (**Figure 5.9**).

Figure 5.8. Inlet Connections for 3,000-Gallon Facility Tanks.

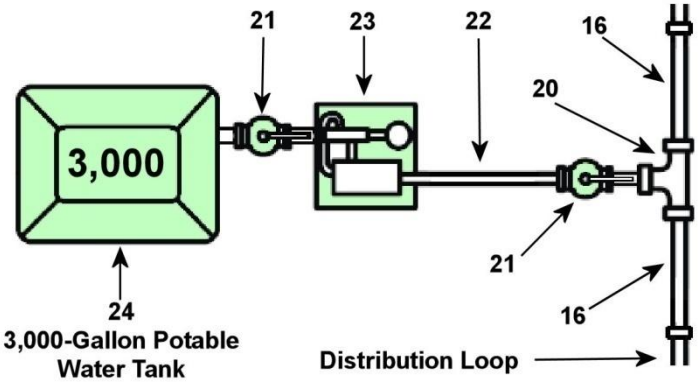


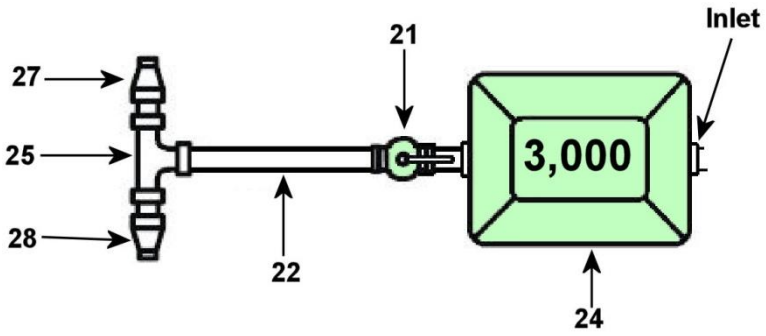
Figure 5.9. Bladder Water Level Controller Connections (Typical).

Note: If necessary to connect facilities "directly" to the water distribution loop, installers must convey the potential consequences of this configuration and should install shut-off valves/pressure regulators and establish a quick response capability to mitigate damages if a failure occurs. The water distribution loop is constantly pressurized at about 45-55 PSI (depending upon camp size), and pressures that high could damage equipment, flood areas, and deplete camp water supplies if the facility's plumbing fail.

5.3.4.5. **3,000-Gallon Tank Outlet Connections.** Assembly of the outlet connections on 3,000-gallon tanks (24) vary according to the type of facility the tanks support. Assemble the outlet manifold of each 3,000-gallon tank as follows:

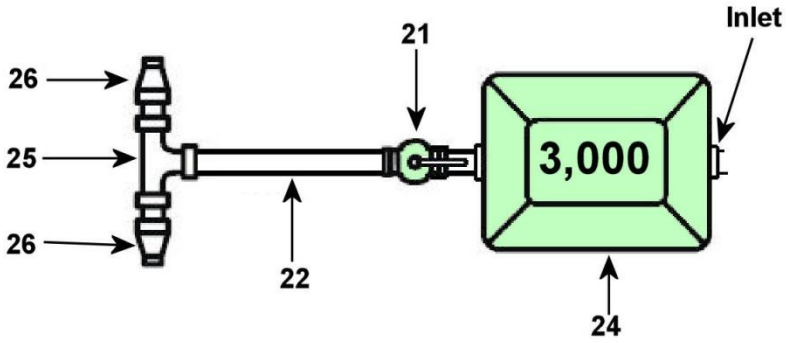
5.3.4.5.1. Shower and Latrine Facilities. As illustrated in **Figure 5.10**, connect a 2-inch ball valve (21) to the outlet of the 3,000-gallon tank. Then connect a 2-inch x 25-foot discharge hose (22) to the ball valve followed by a 2-inch tee. Afterward, connect a 2-inch x 3/4-inch reducer (27) for the latrine and one 2-inch x 1-inch reducer (28) for the shower to the tee assembly.

Figure 5.10. 3,000-Gallon Tank Outlet Connections (Shower/Latrine).



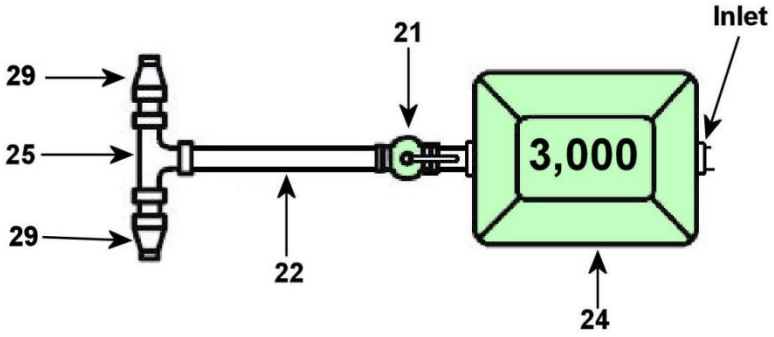
5.3.4.5.2. Laundry Facilities. As illustrated in **Figure 5.11**, connect a 2-inch ball valve (21) to the outlet of the 3,000-gallon tank (24). Then connect a 2-inch x 25-foot discharge hose (22) to the ball valve followed by a 2-inch tee. Afterward, connect two 2-inch x 1 1/2-inch reducers (26) to the tee assembly.

Figure 5.11. 3,000-Gallon Tank Outlet Connections (Laundry).



5.3.4.5.3. Kitchen Facilities. As illustrated in **Figure 5.12**, connect a 2-inch ball valve (21) to the outlet of the 3,000-gallon tank (24). Then connect a 2-inch x 25-foot discharge hose (22) to the ball valve followed by a 2-inch tee. Afterward, connect two 2-inch x 1-inch reducers (29) to the tee assembly.

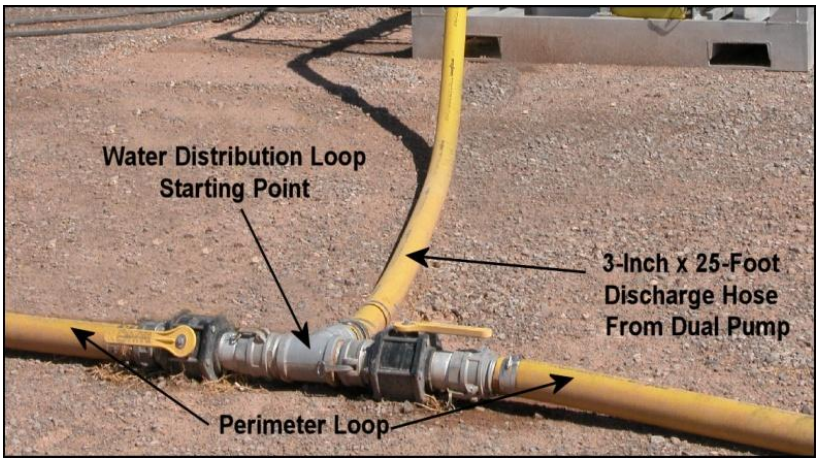
Figure 5.12. 3,000-Gallon Tank Outlet Connections (Kitchen).



> **Note:** All water tanks (bladders or vessels) that are inserted into the water distribution loop or downstream but connected to the Dual Pump Station MUST have a bladder water level controller or be manually filled and isolated with a valve inserted on the inlet side of the bladder/vessel.

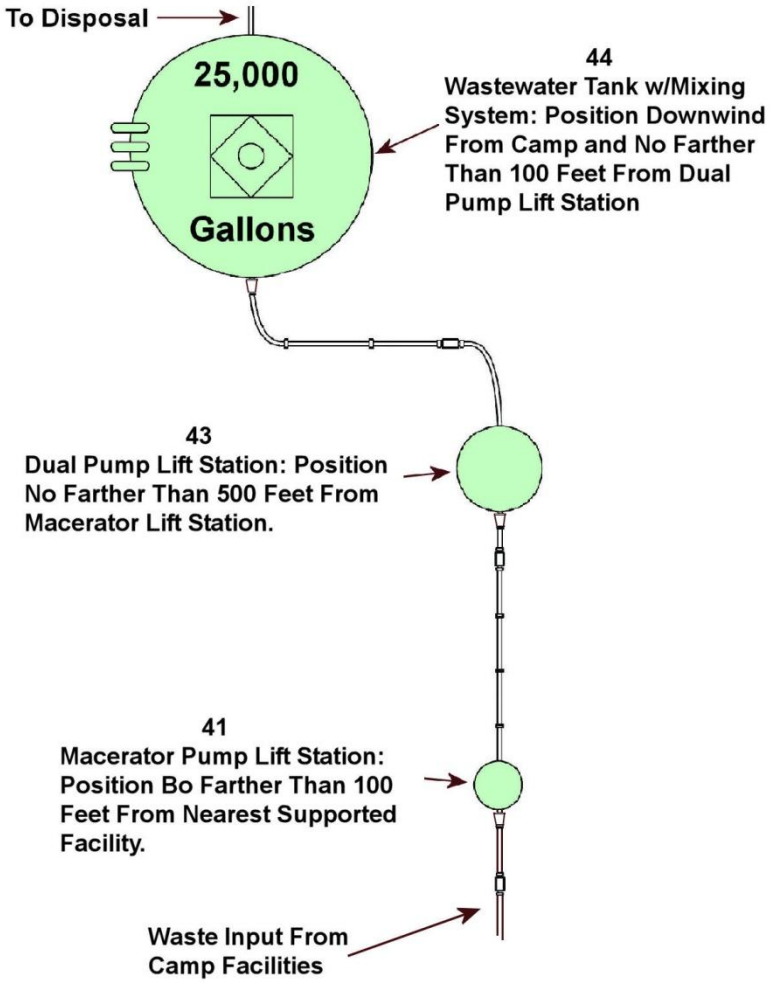
5.3.4.6. After connecting all of the facilities, continue assembling 3-inch x 100-foot (5), 3-inch x 50-foot (19), and 3-inch x 25-foot (16) discharge hoses, forming a loop around the camp, until you come back to the 3-inch tee assembly (17). Then close the loop by connecting the last discharge hose to the ball valve as depicted in **Figure 5.13**.

Figure 5.13. Closed Water Distribution Loop (Typical).



5.3.5**. Position and Assemble Wastewater Lift Stations and Tank Components**. Position and assemble wastewater distribution components of the 550-Initial Subsystem as illustrated in **Figure 5.14**, and proceed as follows:

Figure 5.14. Wastewater Lift Stations and Tank Component Layout.



Note: The maximum distances of lift station placement in this section are based upon the wastewater hose available in the 550-Initial Subsystem and not on pump capability. For maximum distances, refer to the manufacturer's pump specification data for each lift station pump.

CAUTION

Damage and/or destruction of Macerator Pump Lift Station Tank will result if accidental tip-over occurs due to equipment or similar contact occurring as the result of ground-level installation. To prevent tip-over damage, it is recommended that the tank be installed in-ground to a depth of 4 1/2 feet.

5.3.5.1. **Position Macerator Pump Lift Station.** Position the macerator pump lift station (41) on the backside of water-using facilities and away from areas subjected to high volumes of traffic. Locate the macerator pump lift station (**Figure 5.15**) as close as possible and no farther than 100 feet from the nearest facility it serves. Prepare the area for the lift station as follows:

5.3.5.1.1. Excavate a hole large enough to accommodate the lift station tank to a depth of at least 4 1/2 feet. Prepare the bottom of the hole with 6 inches of backfill material of gravel or stone not less than 3/8 inch or larger than 3/4 inch in diameter (if available). Ensure the base is level and smooth.

CAUTION

In freezing conditions, backfill material must be dry and free of ice. Do not use other backfill materials unless approved by the manufacturer.

Figure 5.15. Macerator Pump Lift Station.

5.3.5.1.2. Lower the lift station tank into the hole and backfill the hole to ground level with available backfill material. Make sure an adequate power source is available to the lift station.

CAUTION

Damage or destruction of Dual Pump Lift Station Tank will result if accidental tip-over occurs due to equipment or similar contact occurring as the result of ground-level installation. To prevent tip-over damage, recommend the tank be installed in-ground to a depth of 2 1/2 feet.

5.3.5.2. **Position Dual Pump Lift Station.** Position the dual pump lift station (43) in an area where it is not subjected to high volumes of traffic. Locate the dual pump lift station (**Figure 5.16**) no farther than 500 feet from the macerator pump lift station. Prepare the area for the dual pump lift station as follows:

Note: Backhoe or similar digging equipment may be necessary for excavation and backfill operation.

5.3.5.2.1. Excavate a hole large enough to accommodate the lift station tank to a depth of at least 2 1/2 feet. Prepare the bottom of the hole with 6 inches of backfill material of gravel or stone not less than 3/8 inch or larger than 3/4 inch in diameter (if available). Ensure the base is level and smooth.

CAUTION

In freezing conditions, backfill material must be dry and free of ice. Do not use other backfill materials unless approved by the manufacturer.

5.3.5.2.2. Lower the lift station tank into the hole and backfill the hole to ground level with available backfill material. Make sure an adequate power source is available to the lift station.

Figure 5.16. Dual Pump Lift Station.

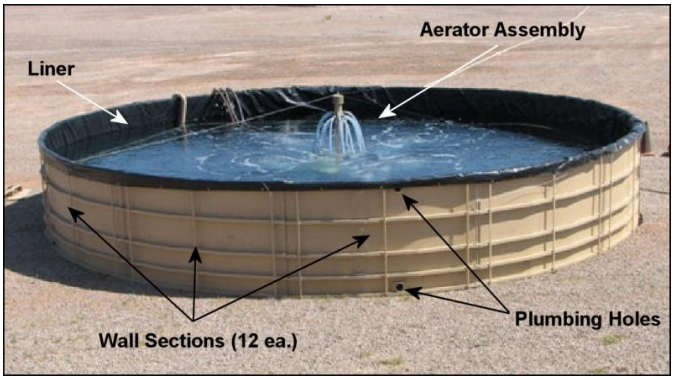
CAUTION

The wastewater mixing assembly (aerator) weighs approximately 290 pounds. To prevent injury and/or damage to equipment, ensure adequate (4 minimum) personnel are available when positioning assembly within 25,000-gallon tank liner.

5.3.5.3. **Position and Assemble 25,000-Gallon Wastewater Collection Tank.** Determine the location for the 25,000-gallon wastewater collection tank (44). Locate the tank (**Figure 5.17**) downwind of the camp and no farther than 100 feet from the dual pump lift station (43). Ensure the area for the tank is flat and level, circular, and at least 40 feet in diameter. Remove any large rocks or sharp objects that could puncture the tank liner. Place the wastewater collection tank components and mixing system components adjacent to the selected location then proceed as follows:

5.3.5.3.1. Spread out the ground cloth, and verify there are no large wrinkles in the cloth material—smooth out the cloth if necessary. Spread the tank liner on the ground cloth, ensuring the liner is free of creases. When the liner is positioned properly, place the aerator assembly in the center of the liner material.

Figure 5.17. 25,000-Gallon Wastewater Collection Tank.

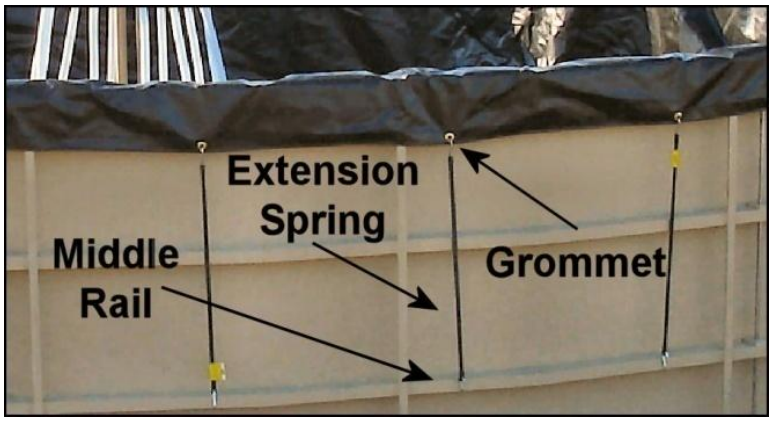


5.3.5.3.2. Position the 12 wall sections around the liner circumference. Note that current configuration tanks have two sections with holes for plumbing connections. Place the sections where inlet and outlet fittings will go (typically 180 degrees from each other) with the inlet facing in the direction of the dual pump lift station outlet. Newer configuration tanks will have four sections with holes for plumbing connections.

5.3.5.3.3. Select a wall section as the starting point and set the wall in place at the edge of the liner. Make sure there is no ground cloth or liner fabric stuck between the wall sections as they are set in place. Connect each wall section with the connecting rods as they are set in place. Ensure the top of the tank wall is level as assembly progresses.

5.3.5.3.4. When the wall sections are assembled, pull the liner wall fabric up and over the wall sections. Attach the extension springs or bungees (**Figure 5.18**) from the grommets in the tank liner to the (middle) reinforcement rail on the exterior of the wall sections. Work from side-to-side when attaching extension springs to get the liner as even as possible.

Figure 5.18. Extension Spring.

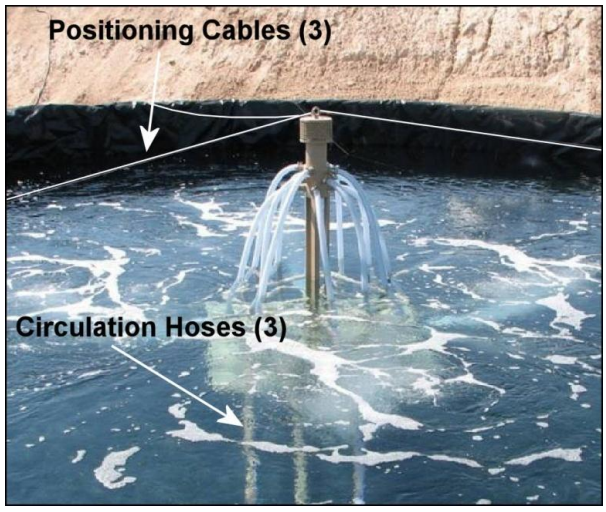


5.3.5.3.5. Refer to instructions supplied with the bulkhead fittings to install the fittings to the wall sections using the plumbing holes.

5.3.5.3.6. After bulkhead fitting installation connect a reducer (3-inch female QD x 4-inch male NPT) to the inlet port. Then, connect one 4-inch male QD x male NPT to the outlet overflow and two 4-inch male QDs to the two lower drain ports. Afterward, connect 4-inch ball valves (with female x male QDs) to the 4-inch male QDs on the tank ports.

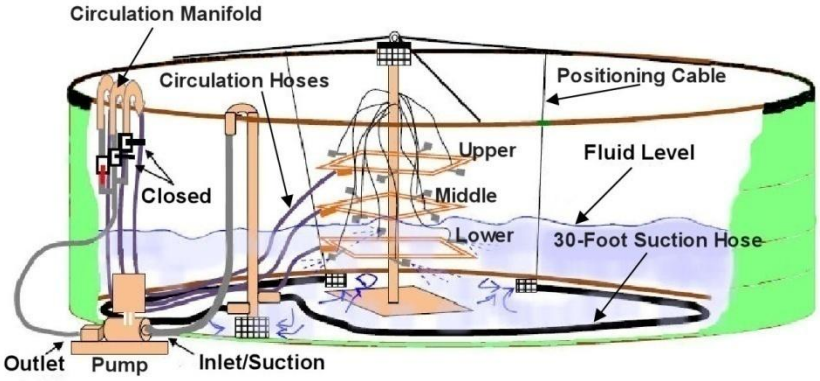
5.3.5.3.7. Connect the three positioning cables to the top of the aerator assembly as depicted in **Figure 5.19**, and run the cables to the outside wall of the tank.

Figure 5.19. Three Positioning Cables Attached to Outside Wall.



5.3.5.3.8. Connect three circulation hoses to the lower, middle, and upper connection of the aerator assembly (**Figure 5.20**). Afterward, connect the circulation manifold to the top of the tank wall and tighten the clamps. Moving left to right, connect the hose assembly from the lower connection on the aerator assembly to the first manifold input. Sequentially connect the middle and upper hoses to the second and third manifold inputs.

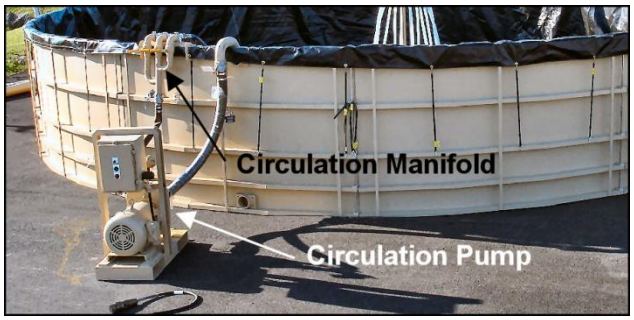
Figure 5.20. Configuration of Wastewater Tank and Mixing System.



5.3.5.3.9. Connect the two 30-foot suction hose assemblies to the discharge assembly. Then, attach the positioning cable to each hose assembly and place over the wall section.

5.3.5.3.10. Position the circulation pump outside the tank wall below the circulation manifold, and connect the hose and pipe connections from the manifold to the pump assembly (**Figure 5.21**). Install the ground rods and connect them to the circulation pump. Afterward, connect the circulation pump to an adequate power source.

Figure 5.21. Circulation Pump Positioned Below Circulation Manifold.



5.3.5.4. **Connect Wastewater Hoses for Shower and Laundry Facilities.** Begin assembling wastewater hoses for shower and laundry facilities as depicted in **Figure 5.22**, and proceed as follows:

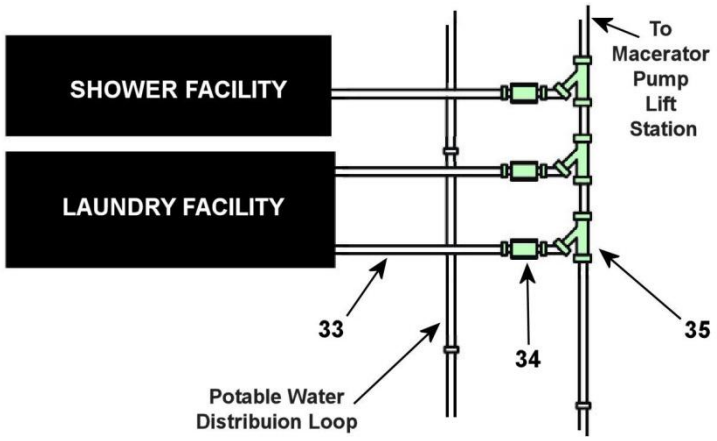
5.3.5.4.1. Lay out one 2-inch x 50-foot discharge hose (33) for each shower facility, making sure to route it over the top of the 3-inch potable water distribution loop.

5.3.5.4.2. Lay out two 2-inch x 50-foot (33) discharge hoses for the laundry facility making sure to route them over the top of the 3-inch potable water distribution loop.

5.3.5.4.3. Connect a 2-inch check valve (34) to each 3-inch x 2-inch wye assembly (35), and then attach the 2-inch x 50-foot discharge hoses (33).

> **Note:** Ensure the 2-inch wye branch on the 3-inch x 2-inch wye assemblies (35) all face away from the direction of wastewater flow to the Macerator Pump Lift Station.

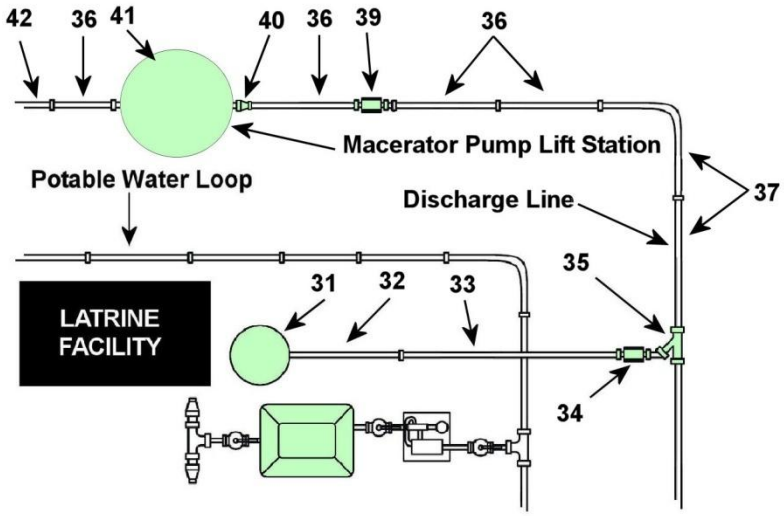
Figure 5.22. Shower and Laundry Wastewater Hose Component Layout.



5.3.5.5. **Connect Wastewater Hoses for Latrine Facilities**. Connect wastewater hoses for latrine facilities by first ensuring the two sewage ejector systems (31) are properly assembled with their pump and float switch and that they are connected to an adequate power supply. If not, refer to T.O. 40W4-21-1 for sewage ejector system maintenance. Begin by connecting the wastewater hoses for latrine facilities as depicted in **Figure 5.23**.

> **Note:** Always ensure neoprene gaskets are in place before connecting suction or discharge hoses.

Figure 5.23. Latrine Wastewater Hose Component Layout.



5.3.5.5.1. Connect one 2-inch x 25-foot discharge hose (32) to the outlet of each sewage ejector system adjacent to the latrines. Then connect one 2-inch x 50-foot discharge hose (33) to the 25-foot discharge hoses. After that, connect a 2-inch check valve (34) to each 3-inch x 2-inch wye assembly (35) and then connect the check valves to the assembled 50-foot hoses.

5.3.5.5.2. Connect all wye assemblies together using necessary lengths of 3-inch discharge hoses (36, 37), and assemble the hoses until you are within 25 feet of the macerator pump lift station (41).

5.3.5.5.3. At the macerator pump lift station (41), install one 4-inch x 3-inch reducer (40) onto the inlet of the lift station and attach a 3-inch x 25-foot discharge hose (36) onto the reducer. Fasten a 3-inch check valve (39) onto the discharge hose and connect the check valve to the discharge hose coming from the facilities.

5.3.5.5.4. Connect one 3-inch x 25-foot discharge hose (36) to the outlet of the macerator pump lift station, and then attach enough 3-inch x 100-foot discharge hose assemblies (42) and other 3-inch discharge hose assemblies (36, 37) until you are approximately 25 feet from the dual pump lift station.

> **Note:** If the 550-Follow-On Subsystem is going to be used, the 3-inch check valve assembly (39) will attach to a 3-inch tee assembly (Waste), supplied with the 550-Follow-On Subsystem.

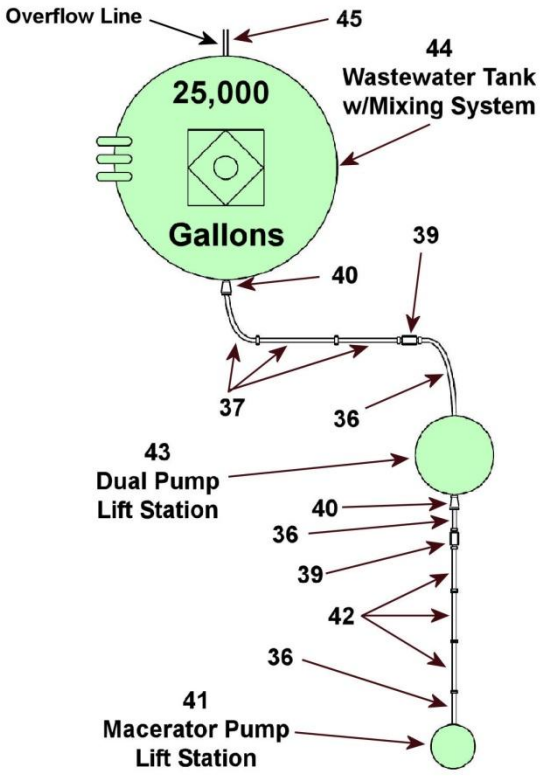
5.3.5.6. **Assemble Dual Pump Lift Station Inlet and Outlet Branches.** Begin assembling the dual pump lift station inlet and outlet branches as depicted in **Figure 5.24**.

5.3.5.6.1. Starting at the dual pump lift station (43), attach one 4-inch x 3-inch reducer (40) onto the inlet of the lift station, followed by a 3-inch x 25-foot discharge hose (36). Fasten a 3-inch check valve (39) onto the discharge hose and connect the check valve to the discharge hose coming from the macerator pump lift station.

5.3.5.6.2. At the dual pump lift station outlet, connect one 3-inch x 25-foot discharge hose (36), followed by a 3-inch check valve (39). Then attach enough 3-inch discharge hoses (37) from the check valve to reach the inlet of the 25,000-gallon wastewater collection tank (44).

5.3.5.6.3. At the upper port ball valve outlet of the 25,000-gallon wastewater collection tank, connect the desired number of 4-inch x 50-foot discharge hose assemblies (45) to serve as the wastewater tank overflow.

Figure 5.24. Dual Pump Lift Station Inlet/Outlet Component Layout.



5.3.5.6.4. If any of the subsystem plumbing is routed across roadways or similar heavy vehicular traffic areas, use the hose bridge system to provide hose rollover protection. Assemble the hose bridge system as illustrated in **Attachment 4**. This completes basic installation of the 550-Initial Subsystem.

5.4. Operation. The following procedures address basic steps to operate the 550-Initial Subsystem after installation. If necessary, refer to basic layout diagrams presented throughout this chapter for component identification.

5.4.1. **Perform 550-Initial Subsystem Preoperational Checks.** Before operating the subsystem, complete the preoperational checks outlined in **Table 5.2**.

WARNING

To prevent injury or death to personnel, make sure Source Power is OFF before connecting power input to the Dual Pump Lift Station, Macerator Pump Lift Station, or Sewage Ejector System.

Table 5.2. 550-Initial Subsystem Preoperational Checks.

PREOPERATIONAL CHECKS			
A	**25,000-Gallon Wastewater Collection Tank:**	**Y**	**N**
	(1) Aeration system is properly installed (centered in tank).		
	(2) All hose assemblies are connected properly and connections are tight.		
	(3) All components are color-coded purple.		
	(4) Circulation pump assembly is connected to adequate power source.		
B	**Wastewater Collection Hoseline:**		
	(1) All components are color-coded purple.		
	(2) Hoseline and fitting connections to Dual Pump Lift Station (43) are connected properly and connections are tight. Pumps and float assemblies are properly installed and station is connected to an adequate power supply.		
	(3) Hoseline and fitting connections to Macerator Pump Lift Station are connected properly and connections are tight. Pumps and float assemblies are properly installed and station is connected to adequate power supply.		

Table 5.2. (Continued)

B	**Wastewater Collection Hoseline: (Continued)**	**Y**	**N**
	(4) Hoseline and fitting connections at facility connection to the wastewater collection hose are connected properly and connections are tight.		
	(5) Hoseline and fitting connections to two Sewage Ejector Systems (Latrines) are connected properly and connections are tight. Pump and float assemblies are properly installed and system is connected to adequate power supply.		
	(6) Hoseline and fitting connections to four 2-inch branch hose lines are connected properly and connections are tight.		
C	**Potable Water Distribution Loop:**		
	(1) All hose assemblies, valves, and couplings through the loop are connected properly and connections are tight.		
	(2) All components are color-coded white.		
	(3) All ball valve assemblies throughout the loop are open.		
D	**3,000-Gallon Potable Water Tanks (All) Connections:**	**Y**	**N**
	(1) All hose assemblies, valves, and fittings on the 3,000-gallon tank are connected properly and connections are tight.		
	(2) 2-inch ball valves, on tank outlet and tank drain, are closed. 2-inch ball valve on tank inlet is open.		
	(3) 2-inch ball valve on the inlet to the Bladder Water Level Control is open.		
	(4) Adequate power supplies to the Bladder Water Level Control.		
	(5) All components are color-coded white.		

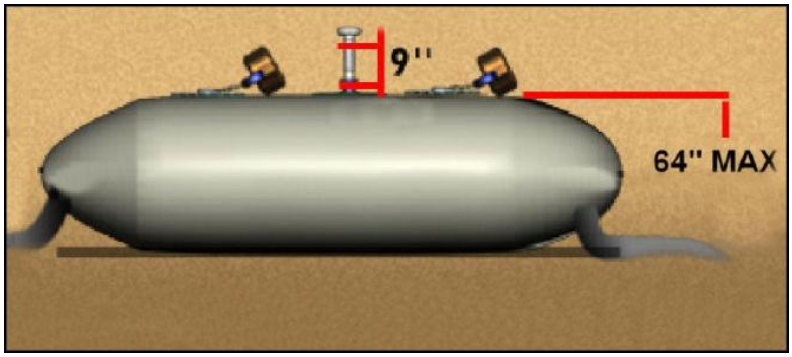
Table 5.2. (Continued)

E	**20,000-Gallon Potable Water Tanks (All) Outlet Manifolds:**	**Y**	**N**
	(1) All hose assemblies, valves, and fittings are properly connected and connections are tight.		
	(2) All components are color-coded white.		
	(3) 4-inch ball valve assemblies on outlet manifold system from in-use 20,000-gallon potable water tanks are open.		
	(4) 4-inch ball valve on outlet branch tee closed, unless other subsystems 20,000-gallon potable water tanks installed		
F	**20,000-Gallon Potable Water Tanks (All) Inlet Manifolds:**		
	(1) All hose assemblies, valves, and fittings are connected properly and connections are tight.		
	(2) All components are color-coded white.		
	(3) 4-inch ball valve assemblies on inlet manifold system from 20,000-gallon potable water tanks are closed; and only opened during filling operations.		

WARNING

Serious injury or death to personnel could occur if tanks are overfilled and explode. When filling tanks, ensure the height of **20,000-gallon tanks do not exceed a maximum height of 64 inches**. Tanks fill at different rates, and it will be necessary to turn on and turn off pumps as required to ensure they do not overfill. (see **Figure 5.25**)

Figure 5.25. Maximum Fill Height (20,000-Gallon Bladder).



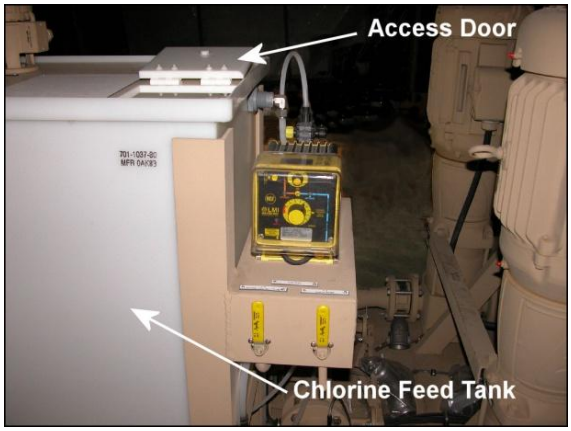
5.4.2. **Verify Potable Water Production.** Ensure potable water from the water production subsystem or alternate potable water collection system is flowing into 20,000-gallon potable water tanks. While the 20,000-gallon tanks are filling, recheck all hose assemblies, valves, fittings, and tanks for leaks. When 20,000-gallon tanks have sufficient water (at least 1/4 full), recheck all hose assemblies, valves, and fittings for leaks, and make needed repairs. Also, make sure that the dual pumping station is connected to an adequate power source. Afterward, ensure the inlet and outlet valves on the dual pumping station are open.

> **Note:** During filling operations, it will be necessary to monitor the level of all 20,000-gallon potable water tanks. When tanks become full, it will be necessary to shut down the water production subsystem or potable water collection system.

5.4.3. **Fill Chlorine Feed Tank.** Fill the chlorine feed tank on the dual pumping station as follows:

5.4.3.1. Open the access door on top of the chlorine feed tank (**Figure 5.26**) and fill the tank with 45 gallons of water using an external water source.

Figure 5.26. Access Door on Chlorine Feed Tank.



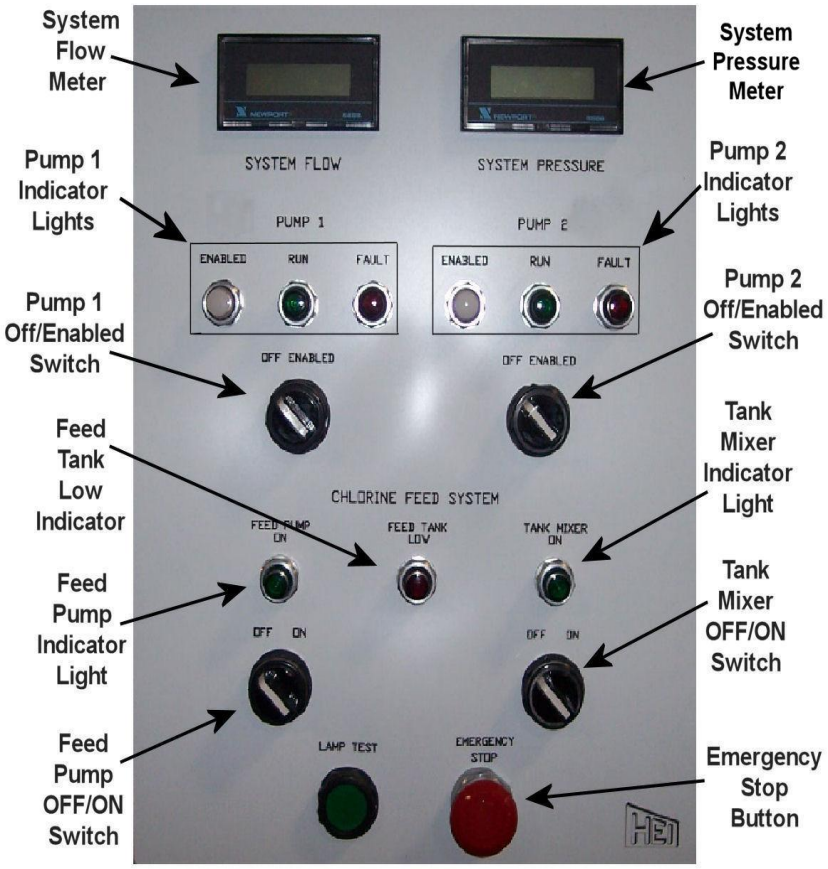
WARNING

CALCIUM HYPOCHLORITE is harmful if contact occurs with skin or eyes, or is inhaled or ingested. Do not take internally. Wear personal protective equipment (PPE). Avoid excessive heat and flame. Avoid contact with skin, eyes, or clothing. Upon contact with eyes or skin, flush with large amounts of water for at least 15 minutes. Call a physician at once. If clothes come in contact with the product, remove immediately and wash before reuse. If ingested, drink large amounts of water. Do not induce vomiting. Call a physician at once. If inhaled, move to fresh air. Give oxygen or artificial respiration as needed. Call a physician.

5.4.3.2. On the dual pumping station control panel (**Figure 5.27**), set the Chlorine Feed System–TANK MIXER–OFF/ON switch to ON. Then verify the TANK MIXER ON indicator is illuminated. Afterward, slowly add 30 pounds of granular Calcium Hypochlorite (HTH) to the chlorine tank.

5.4.3.3. Also on the dual pumping station control panel, set the Chlorine Feed System–Tank Feed Pump-FEED PUMP–OFF/ON switch to ON. Then verify the FEED PUMP ON indicator is illuminated.

Figure 5.27. Dual Pumping Station Control Panel.



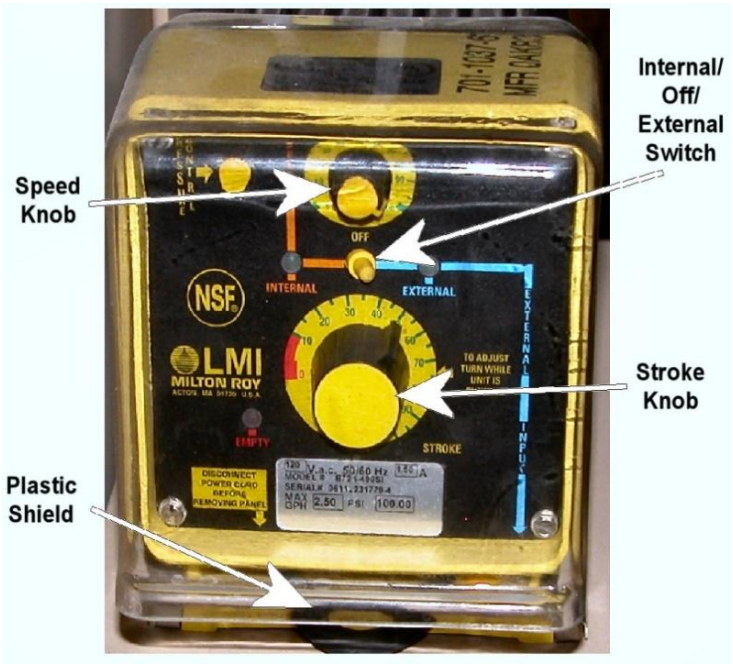
5.4.3.4. On the feed pump control panel (**Figure 5.28**), lift the plastic shield from the panel, and set the INTERNAL/OFF/EXTERNAL switch to INTERNAL position.

CAUTION

Equipment damage will result if STROKE knob is adjusted without the chlorine feed pump running. Ensure chlorine feed pump is running before adjusting STROKE knob.

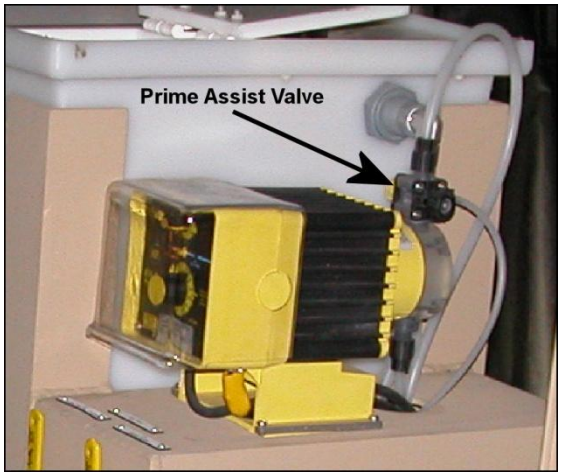
5.4.3.4.1. Position the STROKE and SPEED knobs to their maximum setting.

Figure 5.28. Feed Pump Control Panel.



5.4.3.4.2. Adjust the prime assist valve (**Figure 5.29**) to establish chlorine solution flow. When flow is established, release the priming knob and set the INTERNAL/OFF/EXTERNAL switch to the EXTERNAL position and close the access door on top of the chlorine feed tank.

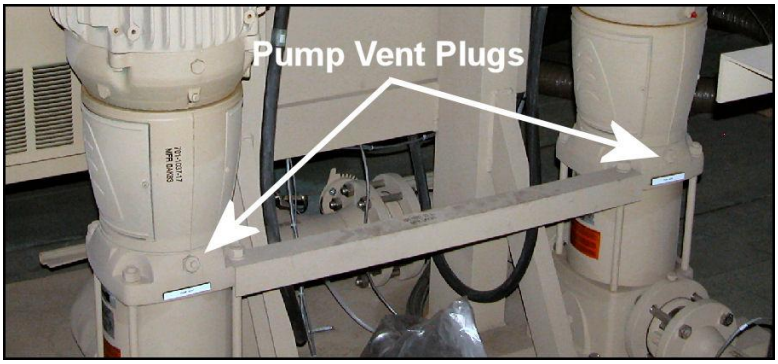
Figure 5.29. Prime Assist Valve (Priming Knob).



5.4.4. **Configure Dual Pumping Station.** Perform the following procedures on the dual pumping station:

5.4.4.1. On both pump assemblies open the vent plug (**Figure 5.30**) until water flows from the vent. Afterward, close the vent.

Figure 5.30. Pump Vent Plugs.



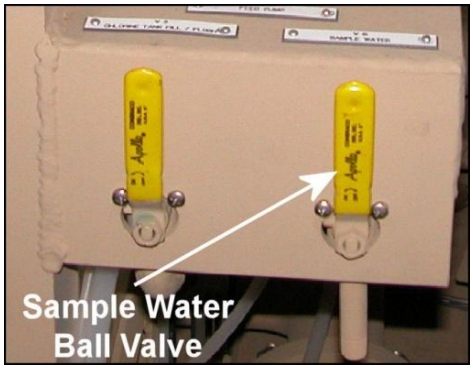
5.4.4.2. Pull the EMERGENCY STOP button out on the control panel and set Pump 1–OFF/ENABLED switch to ENABLED. Verify Pump 1-ENABLED and RUN indicators are illuminated and that Pump 1 rotation is clockwise. Then, set Pump 2–OFF/ENABLED switch to ENABLED. Verify Pump 2-ENABLED and RUN indicators are illuminated and that Pump 2 rotation is clockwise. Then verify SYSTEM PRESSURE is preset to 45 pounds per square inch (PSI).

5.4.4.3. Verify the SYSTEM FLOW and SYSTEM PRESSURE meters stabilize after the entire system is pressurized.

5.4.4.4. Verify the Chlorine Feed System–FEED TANK LOW indicator light is off and that the fault indicators are not illuminated. If a fault indication is illuminated, open the panel and briefly press RESET then START pushbuttons. If indications recur, refer to the installation and operation manual to troubleshoot the problem.

5.4.4.5. On the chlorine feed tank, adjust the STROKE knob for the desired chlorine solution level. Use the SAMPLE WATER ball valve (**Figure 5.31**) to draw water into a container and check required chlorine level. It may be necessary to readjust the STROKE knob and resample the water until the desired chlorine level is achieved. When completed, lower the plastic shield on the feed pump control panel.

Figure 5.31. Sample Water Ball Valve.



5.4.5. **Check Potable Water Distribution Loop**. Ensure potable water is flowing through the water distribution loop. Then, connect bladder water level controllers to an adequate power source at each 3,000-gallon potable water tank. Adjust the bladder water level controls as necessary (see **Figure 5.32** and **Table 5.3** for Controls and Indicators), and verify 3,000-gallon tanks are being filled. Then, recheck all hoses, valves, and fittings throughout the potable water distribution loop and 3,000-gallon tanks for leaks. Make any needed repairs.

> **Note:** Contingency water systems have a tendency to leak a little, so small leaks are usually unavoidable and should not be a major cause of concern. Always ensure neoprene gaskets are installed before connecting suction or discharge hoses.

Figure 5.32. Bladder Water Level Controls.

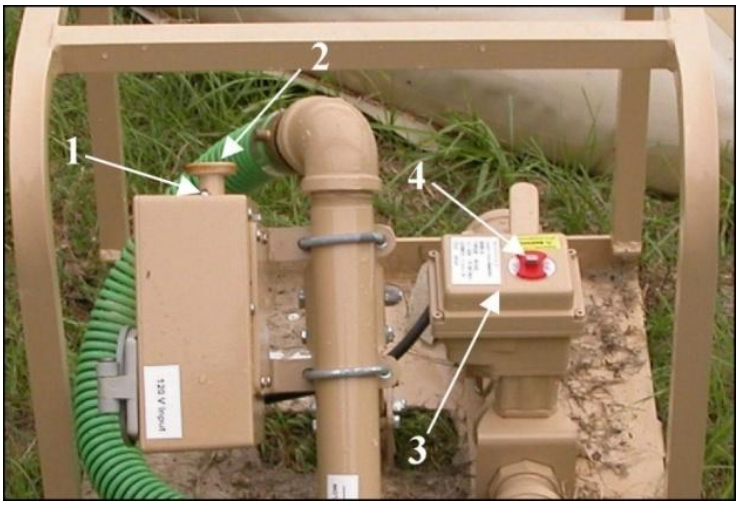


Table 5.3. Bladder Water Level Controller – Controls and Indicators.

Item	Name	Function
1	Power Indicator	Illuminates RED anytime power is applied.
2	Level Control Knob	Used to adjust level (height/capacity) of 3000-gallon tank. Turning knob clockwise raises the height of tank. Turning knob counterclockwise lowers the height of tank.
3	Control Valve Assembly OPEN CLOSED	Controls the main flow valve. Indicates main control valve is open. Indicates main control valve is closed.
4	Valve Shaft	In the event of a power failure, the valve may be opened or closed by manually turning the shaft to the desired position with a wrench.

5.4.6. **Check Facilities Operation.** Once the 3,000-gallon tanks for shower, latrine, laundry, and kitchen facilities have sufficient water, check the operation of these facilities according to their respective technical orders.

5.4.7. **Verify Wastewater Collection.** Check wastewater collection lines by first turning on and allowing water to run in connected facilities. Then complete the following procedures:

WARNING

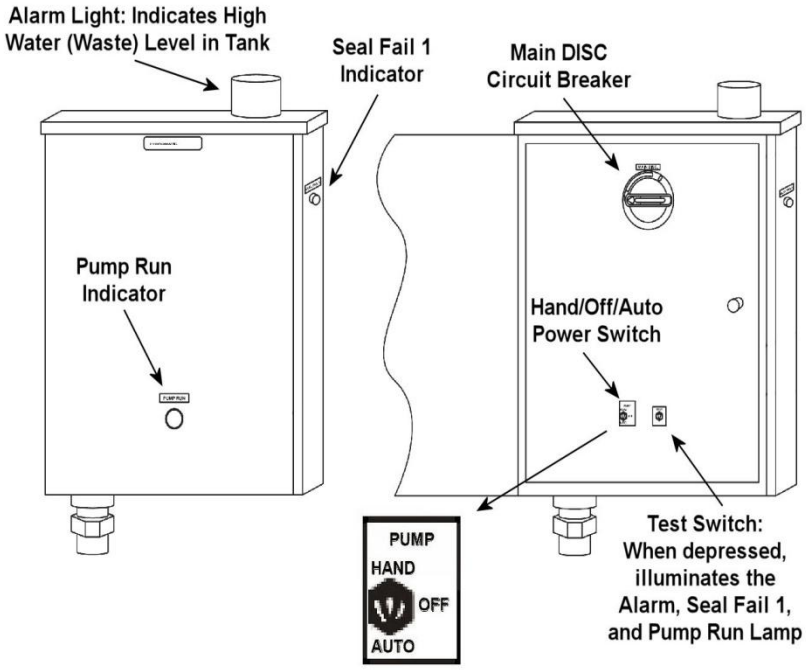
To prevent injury or death to personnel, make sure Source Power is OFF before connecting power input to the Sewage Ejector System.

5.4.7.1. Connect the sewage ejector system to an adequate power source and verify correct pump operation by allowing the latrine holding tank to empty into the sewage ejector system. Repeat this step for each ejector system utilized.

5.4.7.2. Check the hose line, valves, and fittings leading to the macerator pump lift station for leaks and make needed repairs.

5.4.7.3. Set the macerator pump lift station HAND/OFF/AUTO power switch to AUTO (**Figure 5.33**) and verify the PUMP RUN indicator on the front of the control box is illuminated. Then, verify the SEAL FAIL indicator on the side of the control box is off and the macerator pump lift station is operating correctly.

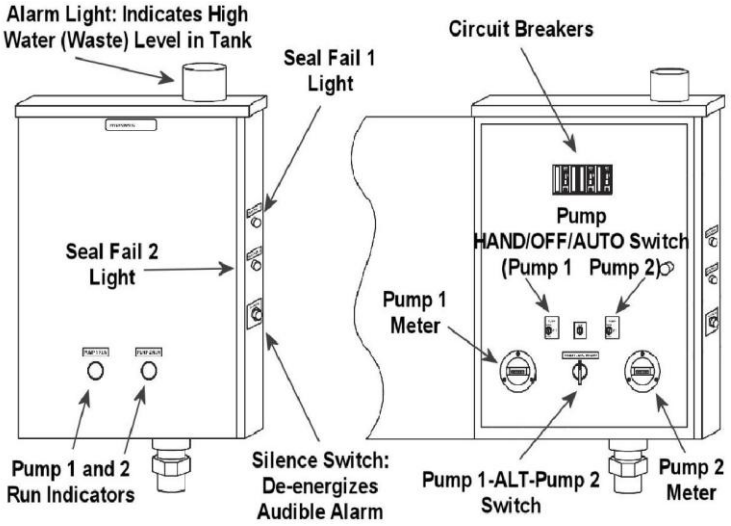
Figure 5.33. Macerator Pump Lift Station Control Box.



5.4.7.4. Check the hose line, valves, and fittings leading to the dual pump lift station for leaks and make any needed repairs.

5.4.7.5. On the dual pump lift station, open the power panel door and set the Pump 1-HAND/OFF/AUTO power switch to AUTO (**Figure 5.34**). Then verify the Pump 1–PUMP RUNNING indicator on the front of the control box is illuminated and the Pump 1-SEAL FAIL indicator is off. Next, set the Pump 2-HAND/OFF/AUTO power switch to AUTO and then verify the Pump 2-SEAL FAIL indicator is off. Afterward, verify the dual pump lift station is operating correctly.

Figure 5.34. Dual Pump Lift Station Control Box.



5.4.7.6. Check the hose line, valves, and fittings leading to the 25,000-gallon wastewater collection tank for leaks and make any needed repairs. When sufficient water has accumulated in the 25,000-gallon waste tank, open the lower (left) stage ball valve on the intake assembly, ensuring the middle and upper stage ball valves on feeding mixer assembly are closed. Then turn on the circulation pump and verify operation of the aerator assembly. As the tank level rises, sequentially turn on the middle (center) and upper stage ball valves for complete system operation. Then, check hose assemblies, valves, and fittings for leaks and make needed repairs.

> **Note:** The wastewater tank needs to be emptied periodically using either a sewage suction trailer/truck, or by contract. Make sure that either the mixing pump is shutdown or the stage ball valves are shut off sequentially as the tank is emptied; top/right, middle, bottom/left. If suction is all the way down to the bottom stage, shut the pump down. Keeping the system running while pumping the tank has advantages because the sludge keeps moving constantly minimizing bottom tank buildup and better tank evacuation.

5.4.8. **Monitor Potable Water Tank Levels.** Keep an eye on the water level of 20,000-gallon and 3,000-gallon potable water tanks throughout the operation of the system. Shut down and start up the SRS, the WPS, and/or the 125-GPM Diesel Pump as necessary to maintain the required amount of water storage. **Attachment 5** lists normal operating steps after the system is initially filled and functioning normally.

5.5. Component Descriptions. Table 5.4 provides a detailed description and quantity for each 550-Initial Subsystem component and its corresponding reference number. Refer to T.O. 40W4-21-1 for other subsystem component information.

Table 5.4. 550-Initial Component Description and Item Number.

Ref #	Description	Qty
1	2-inch Strainer and Float Buoy Assembly w/Hand Air Pump, White Stripe	1
	Adapter Assembly, Hydrant, Swivel, 2 1/2 Inch, Female NST x 2-Inch Female QD	1
	Coupler, 2-Inch Female QD x Male NPT	1
2	Suction Hose Assembly, Potable Water, 2-Inch x 25-Foot, White Stripe	5
3	Pump Assembly, 2-Inch Diesel, Potable Water, w/2-Inch Female x Male QDs, White Stripe	1

Table 5.4. (Continued)

Ref #	Description	Qty
4	Reducer, w/3-Inch Male x 2-Inch Female QDs, White Stripe	1
5	Discharge Hose Assembly, 3-Inch x 100-Foot, White Stripe	15
7	Reducer, w/4-Inch Male x 3-Inch Female QDs, White Stripe	1
8	Suction Hose Assembly, 4-Inch x 15-Foot, White Stripe	20
9	Tee Assembly, 4-Inch x 4-Inch x 4-Inch, White Stripe, w/Female x Male x Male QDs	5
10	Ball Valve Assembly, 4-Inch, w/Female x Male QDs, White Stripe	10
11	20,000-Gallon Collapsible Fabric Tank w/Adapter, 2-Inch Male QD x Male NPT, White Stripe	3
12	Suction Hose Assembly, 2-Inch x 8-Foot, White Stripe	8
13	Ball Valve Assembly, 2-Inch, w/Female QD x Female NPT, White Stripe	8
14	Tee Assembly, 4-Inch x 4-Inch x 4-Inch, w/Male x Female x Female QDs, White Stripe	5
15	Dual Pump Station, Variable Speed, White Stripe	1
16	Discharge Hose Assembly, 3-Inch x 25-Foot, White Stripe	7
17	3-Inch x 3-Inch x 3-Inch Tee Assembly w/Male x Male x Female QDs, White Stripe	2
18	Ball Valve Assembly, 3-Inch w/Female x Male QDs, White Stripe	6
19	Discharge Hose Assembly, 3-Inch x 50-Foot, White Stripe	14

Table 5.4. (Continued)

Ref #	Description	Qty
20	Tee Assembly, 3-Inch x 3-Inch x 2-Inch, w/3-Inch Female x 3-Inch Male x 2-Inch Male QDs, White Stripe	7
21	Ball Valve Assembly, 2-Inch w/Female x Male QDs, White Stripe	15
22	Discharge Hose Assembly, 2-Inch x 25-Foot, White Stripe	10
23	Bladder Water Level Control, Electric w/2-Inch Female x Female QDs and 25-Foot Outdoor Extension Cord, White Stripe	4
24	3,000-Gallon Collapsible Fabric Tank Assembly w/2-Inch Male x Male x Male QDs, White Stripe	5
25	Tee Assembly, 2-Inch x 2-Inch x 2-Inch, w/Male x Male x Female QDs, White Stripe	5
26	Reducer, 2-Inch Female x 1 1/2-Inch Female QDs, White Stripe	3
27	Reducer, 2-Inch Female x 3/4-Inch Male QDs, White Stripe	4
28	Reducer, 2-Inch Female x 1-Inch Female QDs, White Stripe	3
29	Reducer, 2-Inch Female x 1-Inch Male QDs, White Stripe	3
30	Adapter, 4-Inch Male QD x 4-Inch Victaulic/Grooved, Purple Stripe	3
31	Sewage Ejector System (Latrine), w/4-Inch Female QD Inlet x 2-Inch Male QD Outlet, 2-Inch Check Valve, and 2-Inch NPT 90-Degree Elbow (For Field Assembly)	2
32	Discharge Hose Assembly, 2-Inch x 25-Foot, Purple Stripe	3

Table 5.4. (Continued)

Ref #	Description	Qty
33	Discharge Hose Assembly, 2-Inch x 50-Foot, Purple Stripe	10
34	Check Valve Assembly, 2-Inch, w/Female x Male QDs, Purple Stripe	8
35	Wye Assembly, 3-Inch x 3-Inch x 2-Inch, w/3-Inch Female x 3-Inch Male x 2-Inch Female QDs, Purple Stripe	8
36	Discharge Hose Assembly, 3-Inch x 25-Foot, Purple Stripe	10
37	Discharge Hose Assembly, 3-Inch x 50-Foot, Purple Stripe	8
39	Check Valve Assembly, 3-Inch, w/Female x Male QDs, Purple Stripe	5
40	Reducer, w/4-Inch Male x 3-Inch Female QDs, Purple Stripe	4
41	Macerator Pump Lift Station Assembly w/3-Inch Female QD Inlet x 3-Inch Male QD Outlet, Purple Stripe	1
42	Discharge Hose Assembly, 3-Inch x 100-Foot, Purple Stripe	5
43	Dual Pump Lift Station Assembly w/3-Inch Female QD Inlet x 3-Inch Male QD Outlet, Purple Stripe	1
44	25,000-Gallon Rigid Wall Tank Assembly w/Mixing System w/3-Inch Female QD Inlet and two 4-Inch Male QD Outlets w/4-Inch Ball Valve Assemblies w/Female x Male QDs, Purple Stripe (For Field Assembly)	1
45	Discharge Hose Assembly, 4-Inch x 50-Foot, Purple Stripe	8
46	Wastewater Mixing System, Purple Stripe	1

Table 5.4. (Continued)

Ref #	Description	Qty
47	Discharge Hose Assembly, 2-Inch x 100-Foot, White Stripe	1
48	Suction Hose Assembly, 2-Inch x 50-Foot, White Stripe	1
49	Swing Check Valve Assembly, 2-Inch, PVC, w/Female x Male QDs, White Stripe	1
50	Hose Bridge System, 4-Inch	20
51	Tunnel, 4-Inch	10
52	Tunnel Connector, 4-Inch	10
53	Reducer, w/4-Inch Female QD x 2-Inch Male QDs, White Stripe	1
54	Reducer, w/4-Inch Male x 2-Inch Female QDs, White Stripe	1
55	Reducer, w/4-Inch Female QD x 3-Inch Male QDs, White Stripe	1
56	Ratchet Wrench, 5/16 Inch Drive, 60 Inch Lb. Torque (For Worm Gear Hose Clamps)	2
57	Hose Clamp, Worm Gear, 1/2 Inch Band Width (Or Wider), Slotted Hex Screw, Range 1 3/4 Inch to 8 9/16 Inch	25
58	Hose Clamp, Worm Gear, 1/2 Inch Band Width, Slotted Hex Screw, Range 3 1/2 Inch to 5-Inch	25
59	Coupler, 1-Inch Female x 1-Inch Female QDs, White Stripe	2
60	Coupler, 3/4 Inch Female x 3/4-Inch Female QDs, White Stripe	1
61	Male QD x Male NPT, 4-Inch	3
62	Coupler, 2-Inch Female QD x Female QDs	2
63	Adapter, 1 1/2 Inch Male x 1 1/2 Inch Male QDs	1
64	Coupler, 1 1/2 Inch Female x 1 1/2 Inch Female QDs	1

Table 5.4. (Continued)

Ref #	Description	Qty
65	Adapter, 3 Inch Male x 3 Inch Male QDs	2
66	Coupler, 3-Inch Female x 3-Inch Female QDs	2
67	Adapter, 1-Inch Male x 1-Inch Male QDs	2
68	Adapter, 3/4 Inch Male x 3/4-Inch Male QDs	1
69	Coupler, 3/4-Inch Female QD x 3/4-Inch Female NPT	2
70	Faucet, 3/4-Inch Hose Bib x 3/4-Inch Male NPT	2
71	Water Hose Assembly, Garden, 3/4-Inch x 50-Foot, 2 Ply	1
72	Band-It Tool	1
73	Band-It Band, Stainless Steel, 3/4-Inch x 100-Foot (Per Ct)	1
74	Band It Buckles, Stainless Steel, 3/4-Inch Wide, (100 Ea. Per Ct)	1
75	Kit, Cold Weather, 550 Initial Subsystem (Optional) (Not Currently Available)	1

Chapter 6

550-FOLLOW-ON SUBSYSTEM

6.1. General Information. The 550-Follow-On Subsystem expands and builds off the 550-Initial Subsystem; it is not intended to function alone. When used as an expansion to the 550-Initial Subsystem, this system functions identically to the 550-Initial Subsystem. User facilities, such as latrines, showers, laundries, and kitchen (**Figure 6.1**) are branch fed from the pressurized potable water distribution loop or feed line. User facility waste output is processed by various lift pumps and wastewater lines that distribute the wastewater to a wastewater collection tank for disposal. Hose rollover protection ramps (hose bridges) are used if potable and/or wastewater distribution lines need to cross roadways or similar heavy vehicular traffic areas.

Figure 6.1. User Facilities (Typical).

6.2. Components. The major components that make up the 550-Follow-On Subsystem are illustrated in **Figure 6.2** and listed in **Table 6.1**. However, for a complete list of all subsystem components, including nomenclature and quantity per subsystem, refer to **Table 6.3** in this handbook and the 550-Follow-On Subsystem IPB in T.O. 40W4-21-1.

Figure 6.2. 550-Follow-On Subsystem.

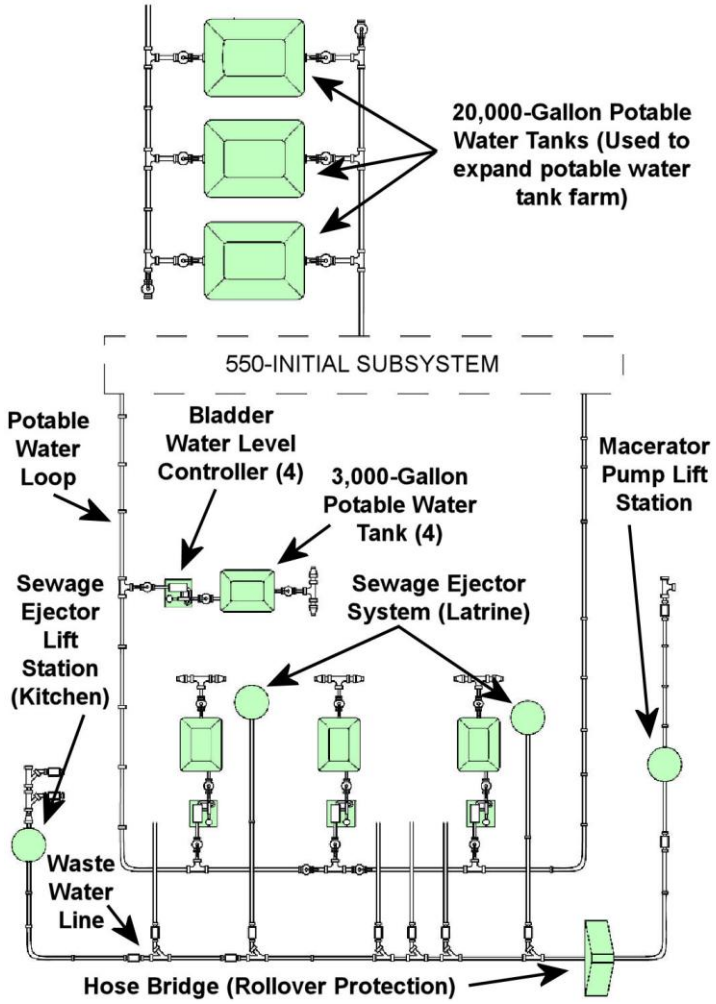


Table 6.1. 550-Follow-On Subsystem Major Components.

Item	Function/Use
20,000-Gallon Collapsible Fabric Tanks	Expands the potable water tank farm and are not exchangeable with raw, brine, or waste tanks. (White Stripe)
3,000-Gallon Collapsible Fabric Tank	Stores potable water at user facilities. (White Stripe)
Bladder Water Level Controllers	Maintains a preset maximum and minimum volume of potable water in 3,000-gallon water storage tanks.
Sewage Ejector Systems	Pumps raw sewage from latrines for output distribution to a wastewater collection tank. (Purple Stripe)
Sewage Ejector Lift Station (Kitchen)	Pumps kitchen waste to the wastewater collection tank. (Purple Stripe)
Macerator Pump Lift Station	Pre-digests raw sewage and pumps wastewater from user facilities to a waste collection system. (Purple Stripe)
Hose Bridge System	Provides rollover protection for potable water and/ or wastewater distribution hoses when routed across roadways or similar heavy vehicular traffic areas.
Hoses	Routes potable water to storage or user facilities and wastewater to disposal facilities or areas. The hoses are color-coded white for potable water and purple for wastewater.
Ball Valves	Controls water flow, including potable water input for storage, storage tank isolation for maintenance and/or repair actions, and isolation of each user facility branch feed from the distribution loop.

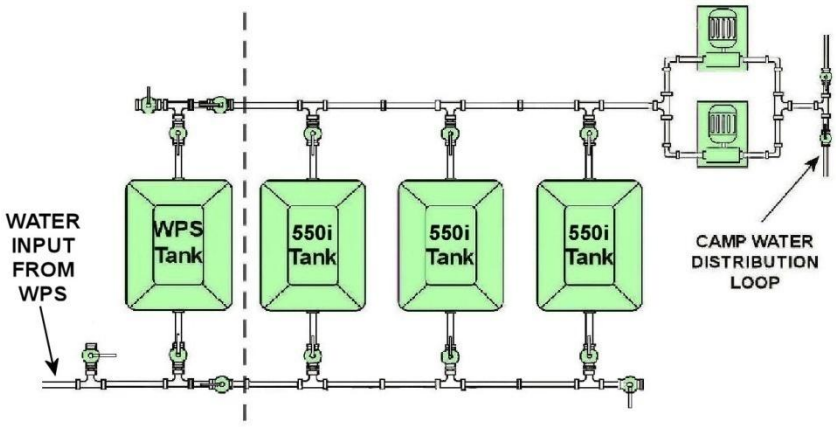
6.3. Installation. Before installing the 550-Follow-On Subsystem, orient the subsystem in relation to the other subsystems. Then, refer to component layout diagrams in this chapter and the list in **Table 6.3** to identify each numbered component when performing the steps below.

CAUTION

To prevent injury to personnel and/or damage to equipment, ensure adequate personnel and lifting equipment are available to preposition equipment.

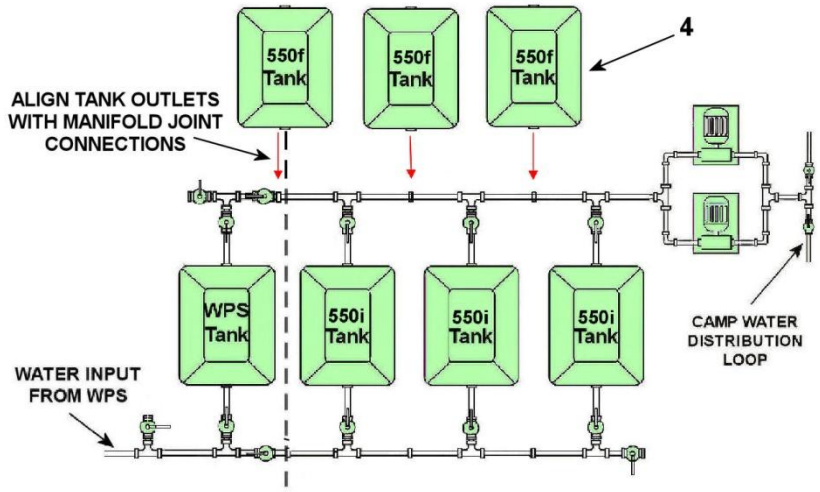
6.3.1. **Expand the Potable Water Tank Farm.** Expand the initial potable water tank farm (**Figure 6.3**) by using the 550-Follow-On Subsystem's 20,000-gallon tanks as follows.

Figure 6.3. Initial Tank Farm Configuration (Typical).



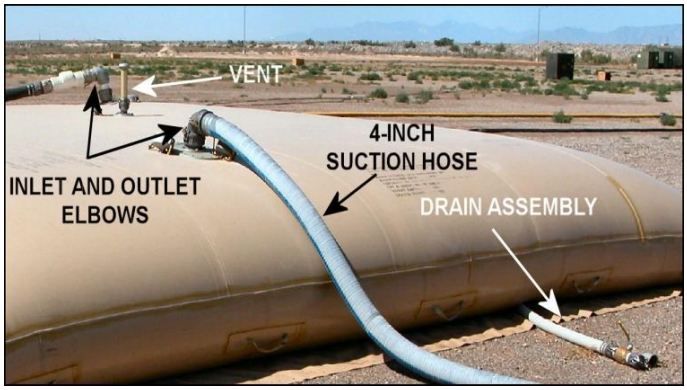
6.3.1.1. Using **Figure 6.4** as a guide, position additional 550-Follow-On Subsystem 20,000-gallon potable water tanks (4) across from the existing tanks by spacing them approximately 6 feet apart. Align the tank outlets with the manifold joint connections.

Figure 6.4. 550-Follow-On Subsystem 20,000-Gallon Tank Alignment.



6.3.1.2. Install the vent and drain assembly, 4-inch inlet elbow QD (female-to-female), and 4-inch outlet elbow QD (female-to-male) onto each of the tanks (**Figure 6.5**).

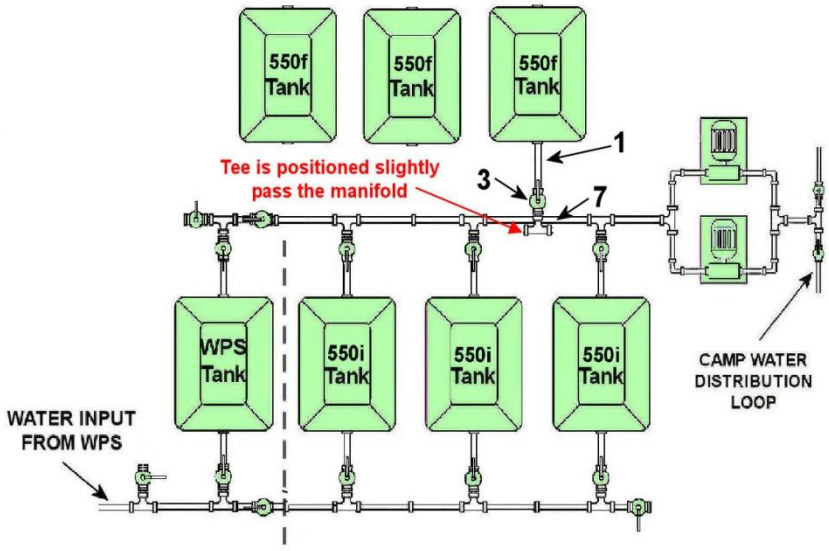
Figure 6.5. Location of 20,000-Gallon Tank Connections.



6.3.1.3. Working backwards from the dual pump station inlet, begin assembling each 550-Follow-On tank outlet branch as shown in **Figure 6.6**. On the first tank outlet, attach a 4-inch x 15-foot suction hose (1) followed by a 4-inch ball valve (3) and 4-inch tee (7). Align the tee with the manifold to gauge the final connection distance, but do not connect the tee to the manifold at this time. Repeat these procedures for the remaining 550F tanks.

> **Note:** When aligning the tee with the manifold, position the tee slightly passed the manifold because the suction hose will move back toward the tank when they are being filled.

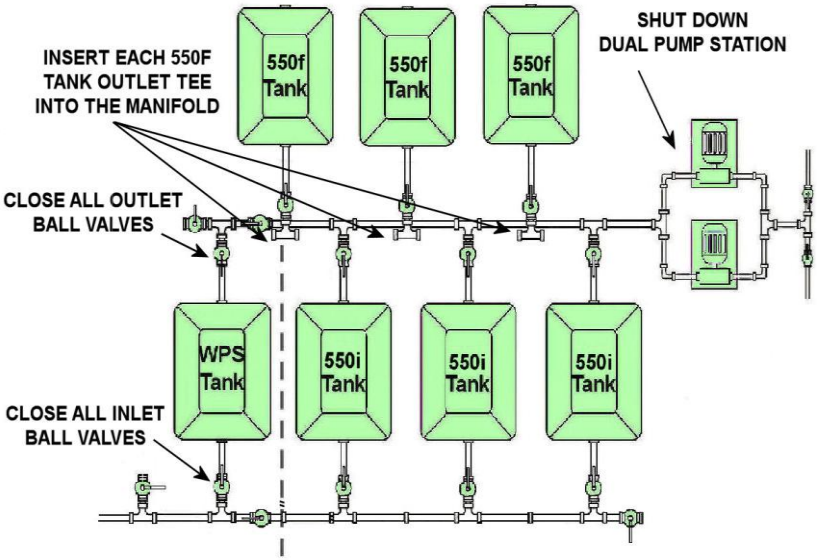
Figure 6.6. Assembly of 20,000-Gallon Tank Outlet Branches.



6.3.1.4. Using **Figure 6.7** as a guide, close the inlet 4-inch ball valves that supply water to the existing tank farm. Then, shut down the dual pump station and close the outlet 4-inch ball valves on all tanks within the tank farm. Next, insert each 550F tank outlet tee into the 4-inch manifold.

> **Note:** Tank inlet ball valves are normally closed except during filling operations. If valves are left open, a single tank leak can drain ALL tanks through back feeding.

Figure 6.7. Tank Farm Isolation and Insertion of 550F Tank Outlet Tees.



6.3.1.5. Assemble 550F 20,000-gallon tank inlet branches according to the following steps.

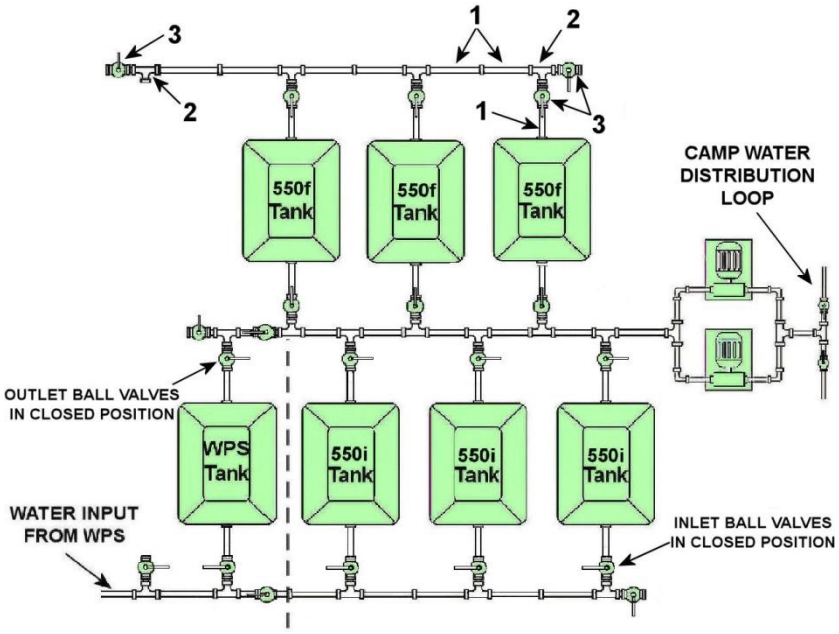
6.3.1.5.1. Connect a 4-inch x 15-foot suction hose (1) to each tank inlet followed by a 4-inch ball valve (3) and 4-inch tee (2) as illustrated in **Figure 6.8**.

6.3.1.5.2. At the tee assembly on the first tank, attach another 4-inch ball valve to the outlet end of the tee. Then, working away from the first tank, connect 4-inch suction hoses, ball valves, and tee assemblies to the remaining two tank inlets.

6.3.1.5.3. Next, insert two 4-inch x 15-foot hoses (1) between each 20,000-gallon tank. Connect the hoses to the 4-inch tee assemblies already in place. Then, connect two more 15-foot hoses to the tee assembly on the last tank. At the end of the 15-foot hose, attach the branch end of another 4-inch tee and install a 4-inch ball valve on the outlet end of the tee.

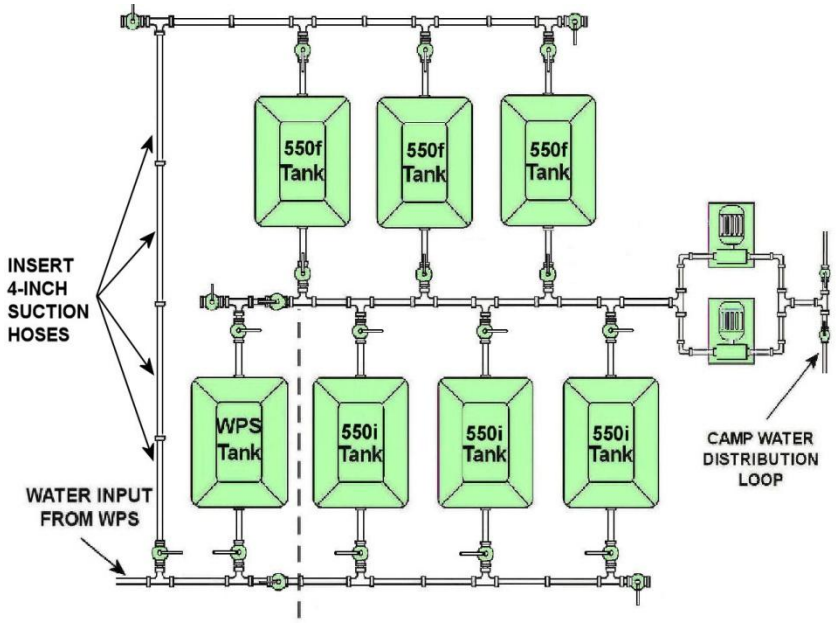
> **Note:** Always ensure neoprene gaskets are in place before connecting suction or discharge hoses.

Figure 6.8. Assembly of 20,000-Gallon Tank Inlet Branches.



6.3.1.6. Complete the tank farm expansion by inserting additional 4-inch suction hoses as depicted in **Figure 6.9** to close the water feed inlet lines to the Follow-On tanks.

Figure 6.9. Assembly of Water Feed Inlet Lines for Follow-On Tanks.

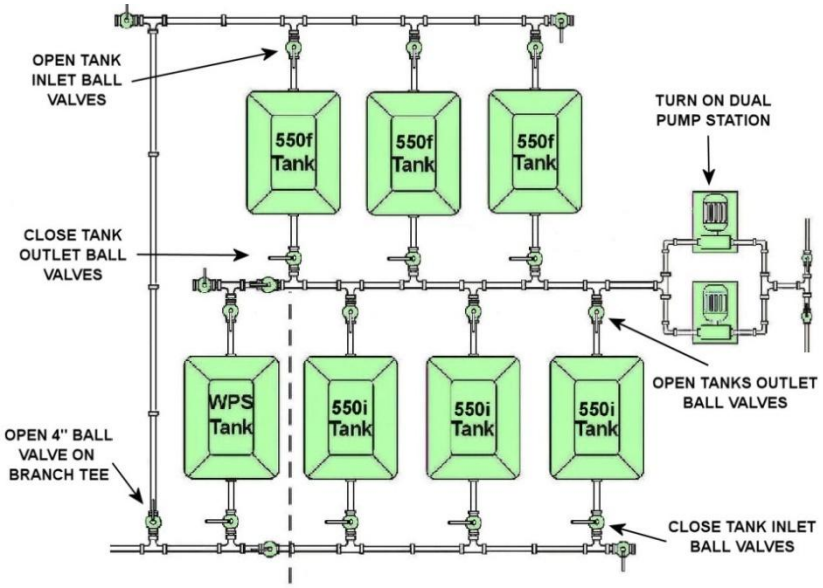


6.3.1.7. To recharge the potable water distribution loop and fill the 550F 20,000-gallon tanks after tank farm expansion, complete the following procedures.

6.3.1.7.1. Ensure the 550F tank outlet ball valves are in the closed position as illustrated in **Figure 6.10**. Then open the WPS and 550I tank outlet ball valves and turn on the Dual Pump Station (allows the WPS and 550I tanks to recharge the distribution loop). Afterward, open the ball valve on the branch tee and begin filling 550F tanks (ensure tank inlet ball valves are in the OPEN position).

6.3.1.7.2. Once the 550F tanks are full, close tank inlets and begin normal use of the expanded tank farm. Make sure to rotate tank use throughout the tank farm to prevent water stagnation and refill tanks as needed.

Figure 6.10. Positioning Ball Valves to Fill 550F Tanks and Recharge Distribution Loop Using WPS and 550I Tanks.

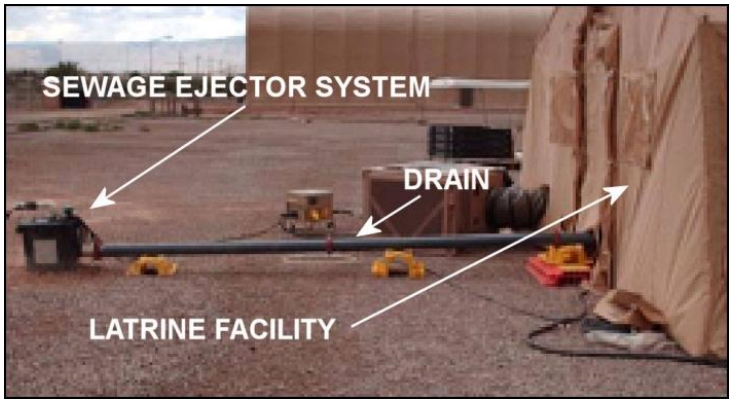


6.3.2. **Install Latrine Sewage Ejector Systems.** Install 550-Follow-On Subsystem sewage ejector systems (latrines) next to their respective facilities as follows.

6.3.2.1. Ensure an adequate power source is available to the sewage ejector tank and then position the sewage ejector system alongside the latrine facility (**Figure 6.11**). To determine the exact location, first set up the latrine's drain system to verify its exact ending point. Then, assemble the inlet and outlet components to the sewage ejector tank.

> **Note:** When installing the sewage ejector system, a backhoe or similar digging equipment may be necessary for excavation and backfill operations.

Figure 6.11. Sewage Ejector System Installed Next to Latrine Facility.



6.3.2.2. Excavate a hole large enough to accommodate the sewage ejector tank to a depth of at least 24 inches. Prepare the bottom of the hole with 6 inches of backfill material of gravel or stone that is not less than 3/8 inch in diameter or larger than 3/4 inch in diameter (if available). Ensure the base is level and smooth.

CAUTION

In freezing conditions, backfill material must be dry and free of ice. Do not use other backfill materials unless approved by the manufacturer.

6.3.2.3. Lower the sewage ejector tank into the hole and insert backfill material until it reaches ground level.

6.3.3. **Install Kitchen Sewage Ejector Lift Station.** Similar to latrines, ensure an adequate power source is available to the lift station and then position the kitchen sewage ejector lift station alongside the kitchen facility. To determine the exact location, first set up the kitchen's drain system to verify its exact ending point. Then assemble the inlet and outlet components to the lift station tank and perform the following procedures:

CAUTION

Damage or destruction of Sewage Ejector Lift Station (Kitchen) tank will result if accidental tip-over occurs due to equipment or similar contact occurring as the result of ground-level installation. To prevent tip-over damage, the tank should be installed in-ground to a depth of 18 inches.

6.3.3.1. Excavate a hole large enough to accommodate the lift station tank to a depth of at least 24 inches. Prepare the bottom of the hole with 6 inches of backfill material of gravel or stone that is not less than 3/8 inch in diameter or larger than 3/4 inch in diameter (if available). Ensure the base is level and smooth.

6.3.3.2. Lower the lift station tank into the hole and insert backfill material until it reaches ground level.

6.3.4. **Position 3,000-Gallon Potable Water Tanks.** Position the four 3,000-gallon potable water tanks from the 550-Follow-On subsystem next to their respective facilities or predesignated facility locations (**Figure 6.12**).

Figure 6.12. Placement of 3,000-Gallon Potable Water Tanks (Typical).

6.3.4.1. Position one 3,000-gallon potable water tank approximately 25 feet away from the kitchen's water connection.

6.3.4.2. Position the next two 3,000-gallon potable water tanks approximately 25 feet away and centered between each of the two shower/shave and latrine facilities to where each tank will feed one shower/shave and one latrine facility.

6.3.4.3. Position the last 3,000-gallon potable water tank directly behind and approximately 25 feet away from the laundry facility.

6.3.4.4. Finally, connect vent and drain assemblies to all 3,000-gallon tanks.

> **Note:** All water tanks (bladders or vessels) that are inserted into the water distribution loop or downstream but connected to the Dual Pump Station MUST have a bladder water level controller or be manually filled and isolated with a valve inserted on the inlet side of the bladder/vessel.

6.3.5. **Expand Potable Water Distribution Loop and Facility Connections.** Using the potable water components in the 550-Follow-On Subsystem, expand the 550-Initial Subsystem potable water distribution loop and facility connections according to requirements at the deployment location. **Figure 6.13** provides a basic example of a distribution loop expansion.

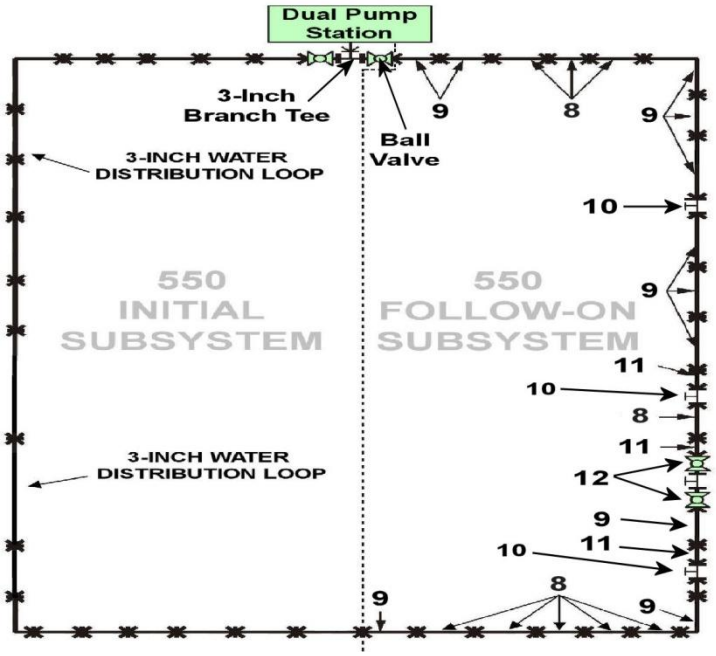
> **Note:** Always ensure neoprene gaskets are in place before connecting suction or discharge hoses.

6.3.5.1. Beginning at the outlet of the dual pump station's 3-inch branch tee, begin expanding the potable water distribution loop by connecting the 3-inch x 100-foot discharge hoses (9) to the 3-inch ball valve on the branch tee.

6.3.5.2. Using 3-inch discharge hoses in lengths of 100 feet (9), 50 feet (8), and 25 feet (11), lay out the potable water distribution loop toward the water-using facilities. If possible, route the hose away from high traffic areas. It may be preferable to use the 3-inch x 100-foot hoses first, and then the 50-foot and 25-foot hoses where needed to properly position the hose so it is centered and within 20 to 25 feet of the inlet side of facility 3,000-gallon tanks.

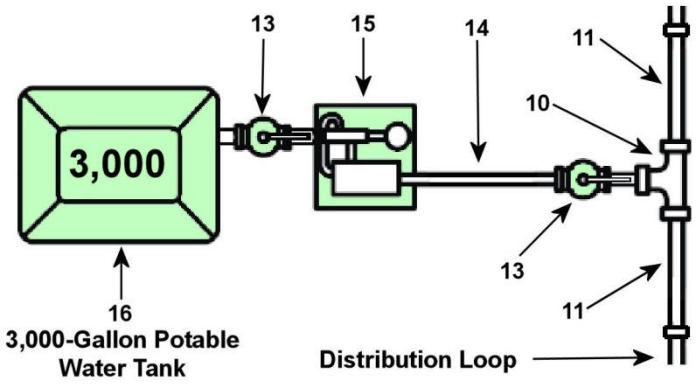
> **Note:** If hose rollover protection becomes necessary, assemble and install hose bridge system as illustrated in **Attachment 4**.

Figure 6.13. Expanded Water Distribution Loop Component Layout.



6.3.5.3. **Assemble 3,000-Gallon Tank Inlet Connections.** At the potable water distribution loop adjacent to each 3,000-gallon facility tank (**Figure 6.14**), install a 3-inch x 2-inch tee (10) and attach a 2-inch ball valve (13) on the tee assembly's branch outlet. Next, insert a 2-inch x 25-foot discharge hose (14) between the ball valve and the bladder water level controller (15). Finally, attach another 2-inch ball valve directly to the bladder water level controller and connect the other end of the valve to the inlet of the 3,000-gallon tank (16).

Figure 6.14. Inlet Connections for 3,000-Gallon Facility Tanks.

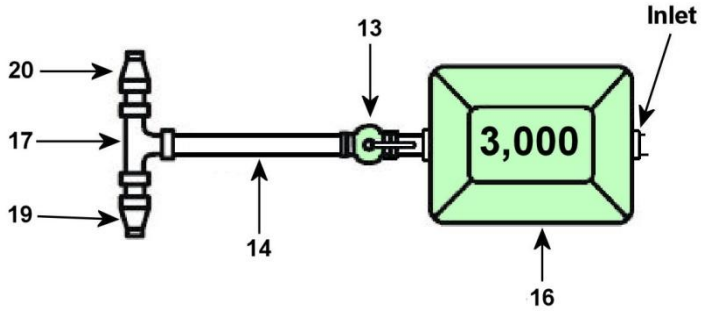


Note: If necessary to connect facilities "directly" to the water distribution loop, installers must convey the potential consequences of this configuration and should install shut-off valves/pressure regulators and establish a quick response capability to mitigate damages if a failure occurs. The water distribution loop is constantly pressurized at about 45-55 PSI (depending upon camp size), and pressures that high could damage equipment, flood areas, and deplete camp water supplies if the facility's plumbing fail.

6.3.5.4. **Assemble 3,000-Gallon Tank Outlet Connections.** Outlet connections on 3,000-gallon tanks vary according to the type of facility supported. Assemble the outlet manifold of each 3,000-gallon tank as follows.

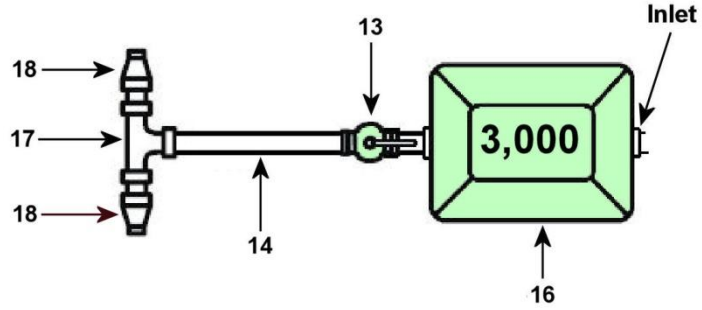
6.3.5.4.1. **Shower and Latrine Facilities.** As depicted in **Figure 6.15**, connect a 2-inch ball valve (13) to the outlet of the 3,000-gallon tank (16). Next, connect a 2-inch x 25-foot discharge hose (14) to the ball valve followed by a 2-inch tee (17). Afterward, connect a 2-inch x 3/4-inch reducer (19) to the tee for the latrine and a 2-inch x 1-inch reducer (20) on the opposite end of the tee for the shower.

Figure 6.15. 3,000-Gallon Tank Outlet Connections (Shower/Latrine).



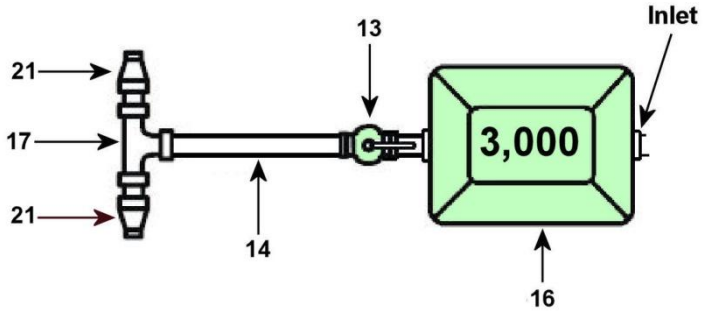
6.3.5.4.2. **Laundry Facility.** As illustrated in **Figure 6.16**, connect a 2-inch ball valve (13) to the outlet of the 3,000-gallon tank (16). Then connect a 2-inch x 25-foot discharge hose (14) to the ball valve followed by a 2-inch tee (17). Lastly, connect a 2-inch x 1 1/2-inch reducer (18) to each open end of the tee.

Figure 6.16. 3,000-Gallon Tank Outlet Connections (Laundry).



6.3.5.4.3. **Kitchen Facility.** Connect a 2-inch ball valve (13) to the outlet of the 3,000-gallon tank (16) as shown in **Figure 6.17**. Then connect a 2-inch x 25-foot discharge hose (14) to the ball valve followed by a 2-inch tee (17). Afterward, connect a 2-inch x 1-inch reducer (21) to each open end of the tee.

Figure 6.17. 3,000-Gallon Tank Outlet Connections (Kitchen).



6.3.5.5. After connecting all facilities, continue assembling 3-inch x 100-foot (9) and 3-inch x 50-foot (8) discharge hoses (see **Figure 6.13** on page 108) until they connect or interface with the 550-Initial Subsystem's potable water distribution hose, forming a loop around the camp.

> **Note:** If using multiple 550 (Initial/Follow-On) subsystems, connect each subsystem to the next until the last subsystem assembled closes the loop.

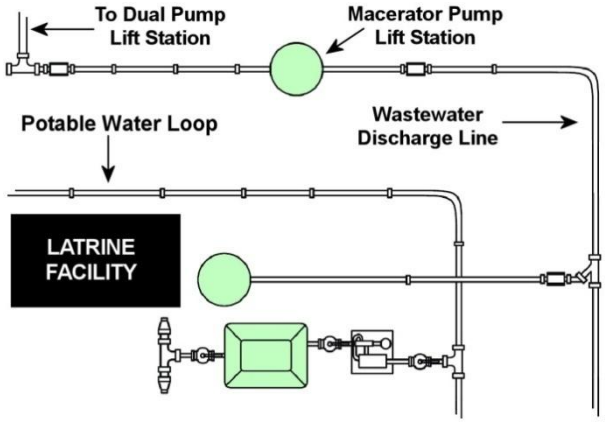
6.3.6. **Assemble Wastewater Distribution Hoses and Components**. Assemble the 550-Follow-On Subsystem wastewater hoses and components according to the following procedures and accompanying illustrations.

> **CAUTION**
>
> Damage or destruction of Macerator Pump Lift Station Tank will result if accidental tip-over occurs due to equipment or similar contact occurring as the result of ground-level installation. To prevent tip-over damage, it is recommended that the tank be installed in-ground to a depth of 4 1/2 feet.

6.3.6.1. **Position Macerator Pump Lift Station**. Ensure an adequate power source is available for the lift station and then position the macerator pump

lift station (34) on the backside of water-using facilities and away from areas with high volumes of traffic. Locate the lift station (**Figure 6.18**) as close as possible to, but no farther than 100 feet from the nearest facility it serves. Prepare the area for the lift station as follows.

Figure 6.18. Placement of Macerator Pump Lift Station (Typical).



Note: The maximum distances of lift station placement in this section, are based upon the wastewater hose available in the 550-Initial Subsystem and not on pump capability. For maximum distances, refer to the manufacturer's pump specification data for each lift station pump.

6.3.6.1.1. Excavate a hole large enough to accommodate the lift station tank to a depth of at least 4 1/2 feet. Prepare the bottom of the hole with 6 inches of backfill material of gravel or stone not less than 3/8 inch or larger than 3/4 inch in diameter (if available). Ensure the base is level and smooth.

CAUTION

In freezing conditions, backfill material must be dry and free of ice. Do not use other backfill materials unless approved by the manufacturer.

6.3.6.1.2. Lower the lift station tank into the hole and backfill the hole to ground level with available backfill material (**Figure 6.19**).

Figure 6.19. Installed Macerator Pump Lift Station.

6.3.6.2. **Connect Wastewater Hoses for Shower and Laundry Facilities.** Assemble wastewater hoses for shower and laundry facilities as illustrated in **Figure 6.20**.

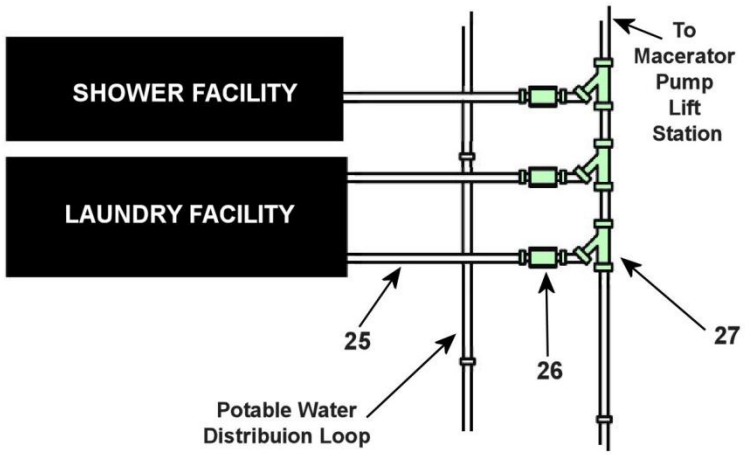
> **Note:** Always ensure neoprene gaskets are installed before connecting suction or discharge hoses.

6.3.6.2.1. Lay out one 2-inch x 50-foot discharge hose (25) for each shower facility, and route it over the top of the 3-inch potable water distribution loop.

6.3.6.2.2. Lay out two 2-inch x 50-foot discharge hoses for the laundry facility, and route them over the top of the 3-inch potable water distribution loop.

6.3.6.2.3. Assemble a 2-inch check valve (26) and 3-inch x 2-inch wye assembly (27) for each shower and laundry facility discharge hose. Then connect the check valves to the discharge hoses. Ensure all three wye assembly branches direct wastewater flow to the Macerator Pump Lift Station.

Figure 6.20. Shower and Laundry Wastewater Hose Component Layout.



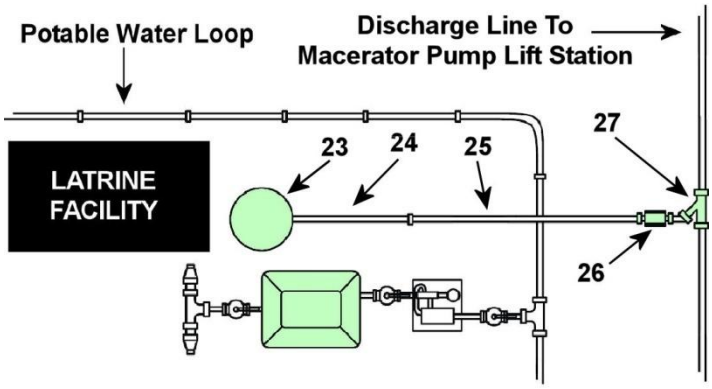
6.3.6.3. **Connect Wastewater Hoses for Latrine Facilities.** Begin by first ensuring proper installation of the sewage ejector systems, to include connection to an adequate power supply. If not, refer to T.O. 40W4-21-1 for sewage ejector system maintenance. Then, connect the wastewater hoses for latrine facilities as depicted in **Figure 6.21**.

> **Note:** Always ensure neoprene gaskets are installed before connecting suction or discharge hoses.

6.3.6.3.1. Connect one 2-inch x 25-foot discharge hose (24) to the outlet of each sewage ejector system (23) adjacent to the latrines. Then, attach a 2-inch x 50-foot discharge hose (25) to the 25-foot hose.

6.3.6.3.2. Connect together a 2-inch check valve (26) and a 3-inch x 2-inch wye assembly (27). Then, attach the check valve to the latrine facility discharge hose (25). Ensure the wye assembly branch directs wastewater flow to the Macerator Pump Lift Station.

Figure 6.21. Latrine Wastewater Hose Component Layout.



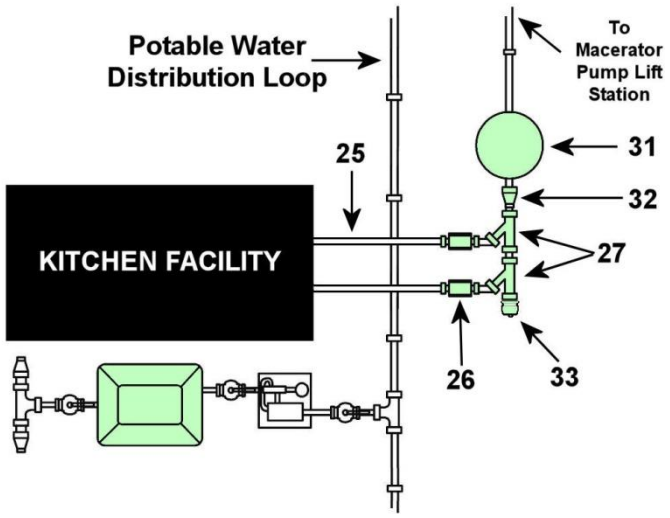
6.3.6.4. **Connect Wastewater Hoses for Kitchen Facilities.** Before connecting wastewater hoses for kitchen facilities ensure the sewage ejector lift station (31) is properly assembled (with the pump and float switch) and connected to an adequate power supply. If the pump and float switch have not been installed, refer to T.O. 40W4-21-1 for detailed installation instructions. Connect wastewater hoses for kitchen facilities as depicted in **Figure 6.22**.

6.3.6.4.1. Connect a 4-inch x 3-inch reducer (32) to the inlet of the sewage ejector lift station (31). Then, connect two 3-inch x 2-inch wye assemblies (27) together and connect them to the reducer. Ensure both wye assembly branches direct wastewater flow to the Macerator Pump Lift Station.

6.3.6.4.2. Next, connect a 2-inch check valve (26) to each wye assembly. Now, lay out two 2-inch x 50-foot discharge hoses (25) for the kitchen facility, and route them over the top of the 3-inch potable water loop. Then, connect one discharge hose to each check valve. Cap the end of the waste line by attaching the 3-inch male QD plug (33) to the open end of the first wye assembly.

6.3.6.4.3. At the sewage ejector lift station outlet, connect four 2-inch x 25-foot discharge hoses (24) and a 3-inch x 2-inch reducer at the end of the discharge hoses.

Figure 6.22. Kitchen Wastewater Hose Component Layout.



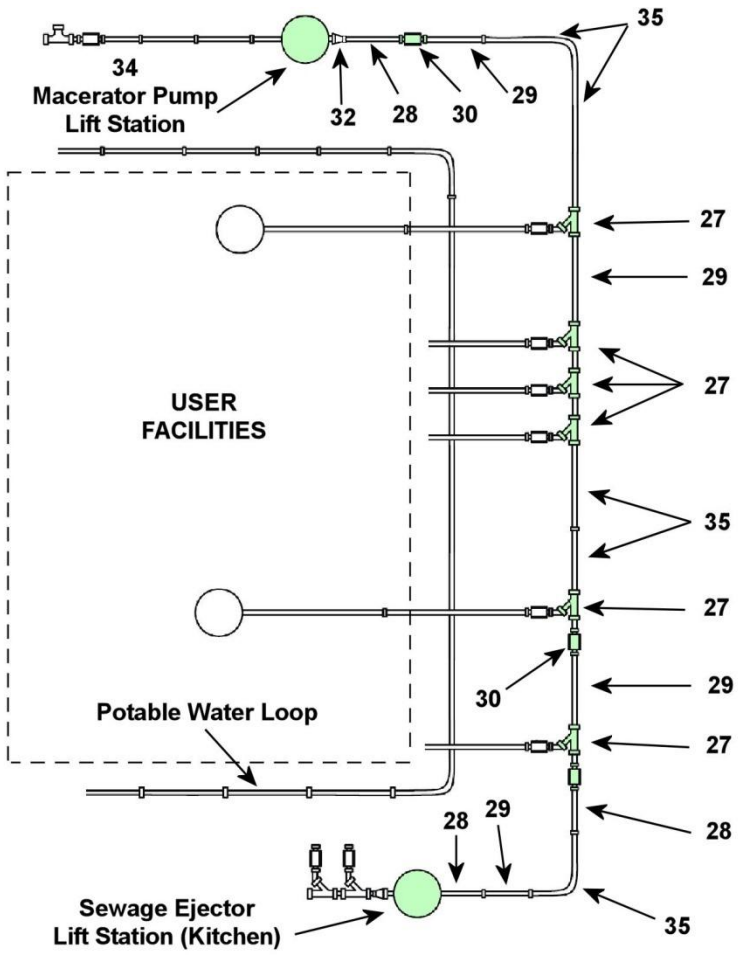
6.3.6.5. **Assemble Wastewater Distribution Hoses and Components.** Assemble wastewater hoses and components as depicted in **Figure 6.23** and **Figure 6.24**.

6.3.6.5.1. Starting at the outlet connections of the sewage ejector lift station, connect all 3-inch x 2-inch wye assemblies (27) together using necessary lengths of 3-inch discharge hoses (28, 29, 35), and assemble the hoses until you are within 25 feet of the macerator pump lift station (34).

6.3.6.5.2. At the inlet of the macerator pump lift station, install one 4-inch x 3-inch reducer (32) followed by a 3-inch x 25-foot discharge hose (28). Next, connect a 3-inch check valve (30) onto the discharge hose and connect the check valve to the 3-inch discharge hose coming from the facilities.

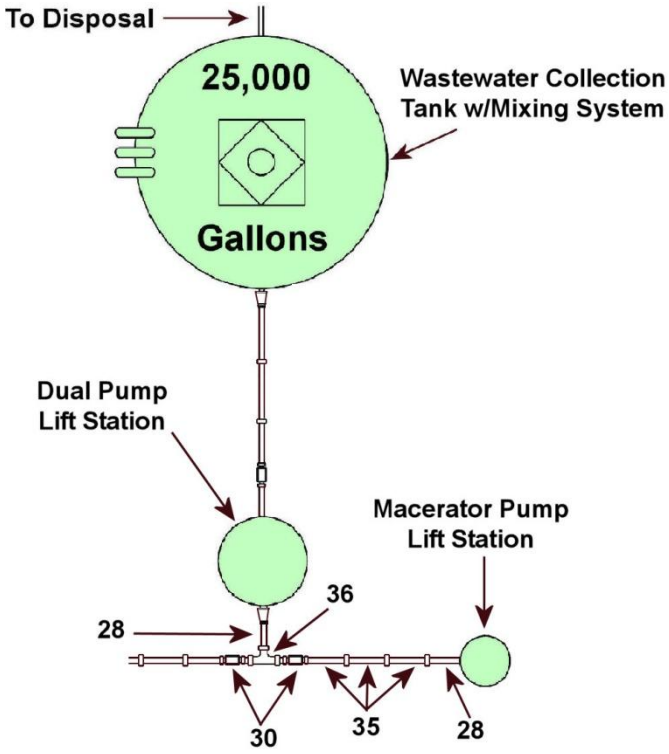
> **Note:** Always ensure neoprene gaskets are installed before connecting suction or discharge hoses.

Figure 6.23. Wastewater Distribution Hose and Component Layout 1.



6.3.6.5.3. At the macerator pump lift station outlet (**Figure 6.24**), connect one 3-inch x 25-foot discharge hose (28), and continue to lay out 3-inch discharge hoses (28, 29, 35) until you are approximately 25 feet from the dual pump lift station.

Figure 6.24. Wastewater Distribution Hose and Component Layout 2.



Note: If the 550-Initial Subsystem is operating, temporarily shut down all facility waste streams and pumps going to the 25,000-gallon waste tank to complete the next steps.

6.3.6.5.4. At the dual pump lift station, insert the branch end of the 3-inch tee (36) into the inlet side of the 3-inch x 25-foot discharge hose (28) that was already assembled to the dual pump lift station during 550-Initial Subsystem installation.

6.3.6.5.5. Connect a 3-inch check valve (30) from the 550-Initial Subsystem onto one end of the 3-inch tee. If not already preassembled during the initial subsystem installation, connect another 3-inch check valve onto the other end of the 3-inch tee. Now, complete the 550-Follow-On Subsystem wastewater piping by connecting the 3-inch x 100-foot discharge hose (35) from the macerator pump lift station to the 3-inch check valve.

6.3.6.5.6. If any of the subsystem plumbing is routed across roadways or similar heavy vehicular traffic areas, use the hose bridge system to provide hose rollover protection. Assemble the hose bridge system as illustrated in **Attachment 4**. This completes basic installation of the 550-Follow-On Subsystem.

6.4. Operation. The following procedures address basic steps to operate the 550-Follow-On Subsystem when integrated with the 550-Initial Subsystem. If necessary, refer to basic layout diagrams presented throughout this chapter for component identification.

6.4.1. **Perform Subsystem Preoperational Checks.** Before operating the subsystem, complete preoperational checks outlined in **Table 6.2**.

WARNING

To prevent injury or death to personnel, make sure Source Power is OFF before connecting power input to the Macerator Pump Lift Station or Sewage Ejector System.

Table 6.2. 550-Follow-On Subsystem Preoperational Checks.

PREOPERATIONAL CHECKS			
A	**Wastewater Collection Hoseline:**	**Y**	**N**
	(1) All components are color-coded purple.		
	(2) Hoseline and fitting connections to Macerator Pump Lift Station (34) connected properly and connections are tight. Pumps, float assemblies installed properly, and station connected to an adequate power supply.		
	(3) Hoseline and fitting connections at facility connection to the wastewater collection hose properly connected and connections are tight.		
	(4) Hoseline and fitting connections to two Sewage Ejector Systems (Latrines) properly connected and connections are tight. Pump, float assemblies properly installed, and system is connected to an adequate power.		
B	Hoseline and fitting connections to four 2-inch branch hose lines properly connected and connections are tight.		
C	**Potable Water Distribution Loop:**		
	(1) All hose assemblies, valves, and couplings through the loop properly connected and connections are tight.		
	(2) All components color-coded white.		
	(3) All ball valve assemblies open throughout the loop.		
	(4) On the branch connections to the 3,000-gallon potable tanks, verify the following:		

Table 6.2. Continued.

C	**Potable Water Distribution Loop: Cont'd.**	Y	N
	(4a) All hose assemblies, valves, and fittings on the 3,000-gallon tank properly connected and connections are tight.		
	(4b) 2-inch ball valves on the tank outlet and tank drain are closed. 2-inch ball valve assembly on the tank inlet is open.		
	(4c) 2-inch ball valve on the inlet to the Bladder Water Level Controller is open.		
	(4d) Adequate power supply connected to the Bladder Water Level Controller.		
	(5) Repeat step 4 above for remaining branch connections to 3,000-gallon tanks.		
D	**20,000-Gallon Potable Water Tank Outlet Manifold:**		
	(1) All hose assemblies, valves, and fittings properly connected and connections are tight.		
	(2) All components are color-coded white.		
	(3) Three 4-inch ball valves on the outlet manifold system from 20,000-gallon potable water tanks are open (as needed).		
	(4) If additional 20,000-gallon potable water tanks installed from other subsystems, open the 4-inch ball valve on the outlet branch tee (as needed), otherwise close this valve.		
E	**20,000-Gallon Potable Water Tank Inlet Manifold:**		
	(1) All hose assemblies, valves, and fittings properly connected and connections are tight.		
	(2) All components are color-coded white.		

6.4.2. **Verify Potable Water Flow.** Verify water is flowing in the 3-inch potable water distribution loop. Ensure an adequate power source connection to bladder water level controllers at each 3,000-gallon potable water tank. Verify 3,000-gallon tanks are being filled. Recheck all hoses, valves, and fittings throughout the 3-inch potable water loop and the 3,000-gallon tanks for leaks. Make repairs as necessary.

6.4.3. **Check Facilities Operation.** Once the 3,000-gallon tanks for shower, latrine, laundry, and kitchen facilities have sufficient water, check the operation of these facilities according to their respective technical orders.

6.4.4. **Check Wastewater Collection.** Check wastewater collection lines by first turning on and allowing water to run in connected facilities. Then complete the following procedures.

WARNING

To prevent injury or death to personnel, make sure Source Power is OFF before connecting power input to the Sewage Ejector System (Latrine).

6.4.4.1. Connect the sewage ejector system (latrine) to an adequate power source and verify correct pump operation by allowing the latrine holding tank to empty into the sewage ejector system. Repeat this step for each sewage ejector system (latrine) utilized.

6.4.4.2. Connect the sewage ejector system (kitchen) to an adequate power source and verify correct pump operation by allowing the kitchen holding tank to empty into the sewage ejector lift station (kitchen).

6.4.4.3. Check the hose line, valves, and fittings leading to the Macerator Pump Lift Station for leaks and make needed repairs.

6.4.4.4. Set the macerator pump lift station HAND/OFF/AUTO power switch (on the control box) to AUTO (see **Figure 5.33** on page 87) and verify the PUMP RUN indicator on the front of the control box is illuminated. Then, verify the SEAL FAIL indicator on the side of the control box is OFF and the macerator pump lift station is operating correctly.

6.4.4.5. Check the hose line, valves, and fittings leading to the dual pump lift station for leaks and make any needed repairs.

> **Note:** Contingency water systems have a tendency to leak a little, so small leaks are usually unavoidable and should not be a major cause of concern. Always ensure neoprene gaskets are installed before connecting suction or discharge hoses.

6.4.5. **Monitor Potable Water Tank Levels.** Keep an eye on the level of the 20,000-gallon potable water tanks and the 3,000-gallon potable water tanks throughout the operation of the system. Shut down and start up the Source Run Subsystem, the Water Production Subsystem, and/or the 125-GPM Diesel Pump as necessary to maintain the required amount of water storage.

6.5. Component Descriptions. Table 6.3 provides a detailed description and quantity for each 550-Follow-On Subsystem component and its corresponding reference number. Refer to T.O. 40W4-21-1 for other subsystem component information.

Table 6.3. 550-Follow-On Component Description and Item Number.

Ref #	Description	Qty
1	Suction Hose Assembly, 4-Inch x 15-Foot, White Stripe	20
2	Tee Assembly, 4-Inch x 4-Inch x 4-Inch, w/Female x Male x Male QDs, White Stripe	5
3	Ball Valve Assembly, 4-Inch w/Female x Male QDs, White Stripe	10
4	20,000-Gallon Collapsible Fabric Tank, w/Adapter, 2-Inch Male QD x Male NPT, White Stripe	3
5	Suction Hose Assembly, 2-Inch x 8-Foot, White Stripe	8

Table 6.3. (Continued)

Ref #	Description	Qty
6	Ball Valve Assembly, 2-Inch w Female QD x Female NPT, White Stripe	8
7	Tee Assembly, 4-Inch x 4-Inch x 4-Inch, w/Male x Female x Female QDs, White Stripe	5
8	Discharge Hose Assembly, 3-Inch x 50-Foot, White Stripe	10
9	Discharge Hose Assembly, 3-Inch x 100-Foot, White Stripe	10
10	Tee Assembly, 3-Inch x 3-Inch x 2-Inch, w/3-Inch Female x 3-Inch Male x 2-Inch Male QDs, White Stripe	7
11	Discharge Hose Assembly, 3-Inch x 25-Foot, White Stripe	6
12	Ball Valve Assembly, 3-Inch, w/Female x Male QDs, White Stripe	4
13	Ball Valve Assembly, 2-Inch, w/Female x Male QDs, White Stripe	15
14	Discharge Hose Assembly, 2-Inch x 25-Foot, White Stripe	10
15	Bladder Water Level Controllers, Electric, w/2-Inch Female x Female QDs and 25-Foot Outdoor Extension Cord, White Stripe	5
16	3,000-Gallon Collapsible Fabric Tank assembly, w/2-Inch Male x Male x Male QDs, White Stripe	4
17	Tee Assembly, 2-Inch x 2-Inch x 2-Inch, w/Male x Male x Female QDs, White Stripe	5
18	Reducer, w/2-Inch Female x 1 1/2-Inch Female QDs White Stripe	3

Table 6.3. (Continued)

Ref #	Description	Qty
19	Reducer, w/2-Inch Female x 3/4-Inch Male QDs, White Stripe	4
20	Reducer, w/2-Inch Female x 1-Inch Female QDs, White Stripe	3
21	Reducer, w/2-Inch Female x 1-Inch Male QDs, White Stripe	3
22	Adapter, 4-Inch Male QD x 4-Inch Victaulic/Grooved, Purple Stripe	3
23	Sewage Ejector System (Latrine), with 4-inch Female QD Inlet x 2-Inch Male QD Outlet, plus 2-Inch Check Valve, 2-Inch NPT 90 Degree Elbow, and 25-Foot Extension Cord, Purple Stripe	2
24	Discharge Hose Assembly, 2-Inch x 25-Foot, Purple Stripe	5
25	Discharge Hose Assembly, 2-Inch x 50-Foot, Purple Stripe	10
26	Check Valve Assembly, 2-Inch, w/Female x Male QDs, Purple Stripe	10
27	Wye Assembly, 3-Inch x 3-Inch x 2-Inch, w/3-Inch Female x 3-Inch Male x 2-Inch Female QDs, Purple Stripe	8
28	Discharge Hose Assembly, 3-Inch x 25-Foot, Purple Stripe	10
29	Discharge Hose Assembly, 3-Inch x 50-Foot, Purple Stripe	8
30	Check Valve Assembly, 3-Inch, w/Female x Male QDs, Purple Stripe	4
31	Sewage Ejector Lift Station (Kitchen), w/4-Inch Female Inlet and 2-Inch Male Outlet QDs, 2-Inch Check Valve, 2-Inch NPT 90-Degree Elbow	1

Table 6.3. (Continued)

Ref #	Description	Qty
32	Reducer, w/4-Inch Male x 3-Inch Female QDs, Purple Stripe	3
33	Plug, 3-Inch Male QD, Purple Stripe	1
34	Macerator Pump Sewage Lift Station Assembly, w/4-Inch Female QD Inlet x 3-Inch Male QD Outlet, Purple Stripe	1
35	Discharge Hose Assembly, 3-Inch x 100-Foot, Purple Stripe	5
36	Tee Assembly, 3-Inch x 3-Inch x 3-Inch, w/Female x Male x Male QDs, Purple Stripe	2
37	Reducer, w/3-Inch Male x 2-Inch Female QDs, Purple Stripe	1
38	Suction Hose Assembly, 2-Inch x 25-Foot, White Stripe	1
39	Suction Hose Assembly, 2-Inch x 50-Foot, White Stripe	1
40	Discharge Hose Assembly, 2-Inch x 100-Foot, White Stripe	1
41	Swing Check Valve, 2-Inch, PVC, w/Female x Male QDs, White Stripe	1
42	Hose Bridge System, 4-Inch	20
43	Tunnel, 4-Inch	10
44	Tunnel Connector, 4-Inch	10
45	Pump Assembly, 2-Inch Diesel, w/2 Inch Female x Male QDs, White Stripe	1
46	Reducer, w/4 Inch Female x 2-Inch Male QDs, White Stripe	1

Table 6.3. (Continued)

Ref #	Description	Qty
47	Reducer, w/4 Inch Male x 2-Inch Female QDs, White Stripe	1
48	Reducer, w/4-Inch Female x 3-Inch Male QDs, White Stripe	1
49	Wrench, Ratchet, 5/16 Inch Drive, 60 Inch-Pounds Torque, (For Worm Gear Hose Clamps)	2
50	Clamp, Hose, Worm Gear, 1/2 Inch Band Width (Or Wider), Slotted Hex Screw, Range 1 3/4 Inch To 8 9/16 Inch	25
51	Hose Clamp, Worm Gear, 1/2 Inch Band Width, Slotted Hex Screw, Range 3 1/2 Inch to 5-Inch	25
52	Meter, Water, 3-Inch, Mechanical, w/Female x Male QDs	1
53	Adapter, 4-Inch Male x 4-Inch Male QDs	1
54	Coupler, 4-Inch Female x 4-Inch Female QDs	1
55	Adapter, 2-Inch Male x 2-Inch Male QDs	2
56	Coupler, 2-Inch Female x 2-Inch Female QDs	2
57	Adapter, 1 1/2 Inch Male x 1 1/2-Inch Male QDs	1
58	Coupler, 1 1/2 Inch Female x 1 1/2 Inch Female QDs	1
59	Adapter, 3-Inch Male x 3-Inch Male QDs	2
60	Coupler, 3-Inch Female x 3-Inch Female QDs	2
61	Adapter, 1-Inch Male x 1-Inch Male QDs	2

Table 6.3. (Continued)

Ref #	Description	Qty
62	Coupler, 1-Inch Female x 1-Inch Female QDs, White Stripe	2
63	Adapter, 3/4 Inch Male x 3/4 Inch Male QDs	1
64	Coupler, 3/4 Inch Female x 3/4 Inch Female QDs, White Stripe	1
65	Coupler, 3/4 Inch Female QD x 3/4-Inch Female NPT	2
66	Faucet, 3/4-Inch Hose Bibb x 3/4-Inch Male NPT	2
67	Hose Assembly, Water, Garden, 3/4 Inch x 50-Foot, 2 Ply	1
68	Cold Weather Kit, 550 Follow-On Subsystem (Optional), (Not Currently Available)	1

Chapter 7

INDUSTRIAL OPERATIONS AND FLIGHTLINE EXTENSION SUBSYSTEM

7.1. General Information. The Industrial Operations and Flightline Extension Subsystem is a potable water expansion subsystem for the 550-Initial, 550-Follow-On, or Water Production Subsystems. The extension subsystem can branch off any part of the 3-inch pressurized feed line from these systems, and can supply potable water to isolated user facilities such as latrines, showers, and kitchens. Additionally, hose rollover protection ramps (hose bridges) safeguard hoses in the event potable water distribution lines need to cross roadways or similar heavy vehicular traffic areas.

7.2. Components. The major components of the Industrial Operations and Flightline Extension Subsystem are listed in **Table 7.1** and illustrated in **Figure 7.1**. However, for a complete list of all subsystem components, including nomenclature and quantity per subsystem, refer to **Table 7.3** in this handbook and the Industrial Operations and Flightline Extension Subsystem IPB in T.O. 40W4-21-1.

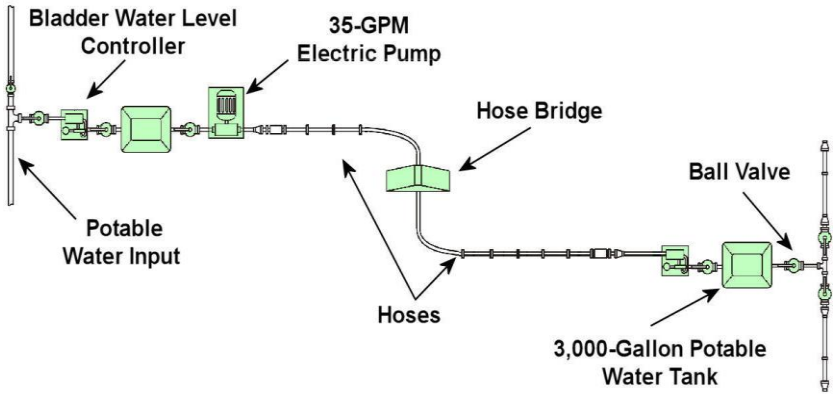
Table 7.1. Industrial Operations and Flightline Extension Subsystem Major Components.

Item	Function/Use
3,000-Gallon Collapsible Fabric Tanks	Stores potable water at user facilities.
Bladder Water Level Controllers	Maintains a preset maximum and minimum volume of potable water in 3,000-gallon water storage tanks.
35-GPM Electric Pump Assembly (Potable Water)	Pumps potable water up to 2500 feet to fill potable water storage tanks. An accumulator tank and pressure switch at the pump outlet controls pump output flow between 20 and 40 PSI.

Table 7.1. (Continued)

Item	Function/Use
Hose Bridge System	Provides rollover protection for potable water and/ or wastewater distribution hoses when routed across roadways or similar heavy vehicular traffic areas.
Hoses	Routes potable water to storage or user facilities. The hoses are color-coded white for potable water.
Ball Valves	Controls water flow, including potable water input for storage, storage tank isolation for maintenance and repair actions, and isolation of each user facility branch feed from the distribution loop.

Figure 7.1. Industrial Operations and Flightline Extension Subsystem.



7.3. Installation. Before installing the Industrial Operations and Flightline Extension Subsystem orient the subsystem in relation to the other subsystems. Then, refer to component layout diagrams in this chapter and the list in **Table 7.3** to identify each numbered component when performing the steps below.

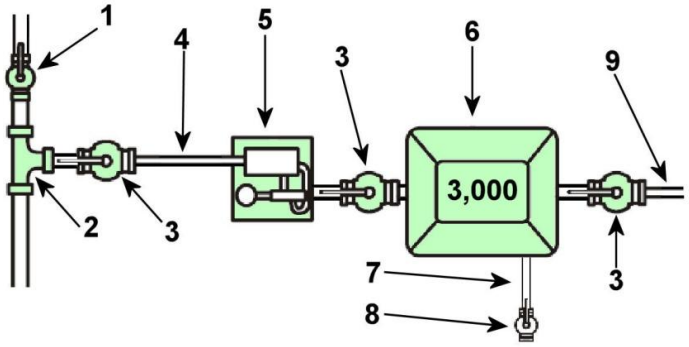
7.3.1. Preposition all subsystem equipment at their designated installation locations and ensure the water-using facilities are no more than 2500 feet from the water distribution loop tie-in area. Then, temporarily shut down the water distribution loop and begin assembling the potable water distribution extension as illustrated in **Figure 7.2.**

7.3.1.1. Locate a preferred quick disconnect fitting on the 3-inch water distribution loop. Then disassemble the quick disconnect fitting and insert a 3-inch x 3-inch x 2-inch tee (2) onto one end of the loop. Next, attach a 3-inch ball valve (1) onto the branch end of the 3-inch tee, and reconnect the loop.

7.3.1.2. After reconnecting the loop, attach a 2-inch ball valve (3) to the branch outlet of the newly installed tee. Ensure the 2-inch ball valve is closed and the 3-inch ball valve is open. Afterward, charge the water distribution loop. Next, attach a 2-inch x 50-foot discharge hose (4) to the 2-inch ball valve, and connect the other hose end to the inlet side of the bladder water level controller (5). Then, attach another 2-inch ball valve to the outlet side of the controller.

> **Note:** Always ensure neoprene gaskets are installed before connecting suction or discharge hoses.

Figure 7.2. Extension Subsystem Potable Water Loop Connection.



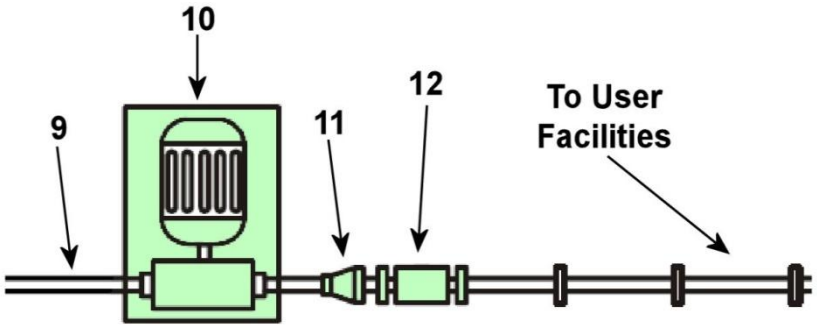
CAUTION

To prevent injury to personnel and/or damage to equipment, ensure adequate personnel and lifting equipment are available to preposition equipment.

7.3.1.3. Position the 3,000-gallon tank (6) inlet in line with the 2-inch ball valve and connect them together. Then, connect the drain and vent assemblies (7, 8) to the 3,000-gallon tank. Next, connect another 2-inch ball valve (3) to the 3,000-gallon tank outlet, followed by a 2-inch x 25-foot suction hose (9).

7.3.1.4. Connect the 35-GPM electric pump (10) as illustrated in **Figure 7.3.** Attach the inlet side of the pump to the 2-inch x 25-foot hose (9). Then connect a 3-inch x 2-inch reducer (11) to the pump outlet followed by a 3-inch check valve (12). Now, proceed to the facility tie-in area to complete the subsystem assembly.

Figure 7.3. Pump Placement and Connections Layout.

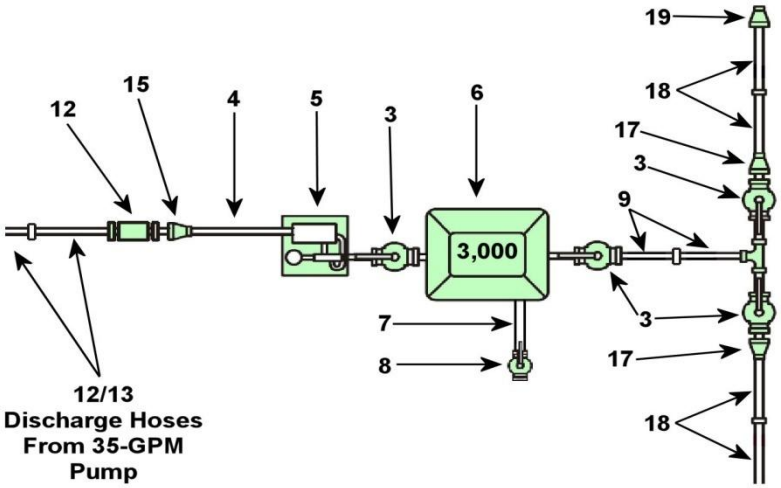


7.3.1.5. At the user-facility area, assemble the remaining extension subsystem as depicted in **Figure 7.4.**

7.3.1.5.1. Position the second 3,000-gallon potable water tank (6) no more than 50 feet away and centered between two facilities (or directly behind a single facility). Then, connect the drain and vent assemblies to the tank.

7.3.1.5.2. On the outlet side of the 3,000-gallon tank (6), connect a 2-inch ball valve (3) followed by two 2-inch x 25-foot suction hoses (9). Next, connect the branch end of a 2-inch x 2-inch x 2-inch tee (16) to the suction hoses. Afterward, attach 2-inch ball valves (3) to the ends of the tee.

Figure 7.4. Extension Subsystem User-Facility Connections.



7.3.1.5.3. At each 2-inch ball valve assembly, connect a 2-inch x 1-inch reducer (17), followed by two 1-inch x 25-foot discharge hoses (18). If needed, attach a 1-inch x 3/4 inch reducer (19) to the end of one of the discharge hoses. Then connect the discharge hoses to the user facilities.

7.3.1.5.4. On the inlet of the 3,000-gallon tank, connect a 2-inch ball valve (3); then, connect the bladder water level controller (5). Next, connect a 2-inch x 50-foot discharge hose (4) to the controller, then attach a 3-inch x 2-inch reducer (15) to the other end of the hose. Then, connect a 3-inch check valve (12) to the reducer.

7.3.1.5.5. Starting at the check valve (12), connect enough 3-inch discharge hoses (13, 14) to reach the 35-GPM pump and complete the connection to the water distribution loop.

7.3.2. If any of the subsystem plumbing is routed across roadways or similar heavy vehicular traffic areas, use the hose bridge system to provide hose rollover protection. Assemble the hose bridge system as shown in **Attachment 4**. This completes basic installation of the Industrial Operations and Flightline Extension Subsystem assembly.

7.4. Operation. The following procedures address basic steps to operate the Industrial Operations and Flightline Extension Subsystem after installation. If necessary, refer back to the basic layout diagrams presented throughout this chapter for component identification.

7.4.1. **Perform Extension Subsystem Preoperational Checks.** Before operating the subsystem, complete the preoperational checks outlined in **Table 7.2**.

WARNING

To prevent injury or death to personnel, make sure Source Power is OFF before connecting power input to the 35-GPM Electric Pump Assembly.

Table 7.2. Industrial Operations and Flightline Extension Subsystem Preoperational Checks.

PREOPERATIONAL CHECKS			
A	**User-Facility 3,000-Gallon Potable Water Tank:**	**Y**	**N**
	(1) Inlet 2-inch ball valves are open, and outlet 2-inch ball valve and tank drain ball valves are closed.		
	(2) 2-inch ball valve to the inlet of the Bladder Water Level Controller is open.		
	(3) All hose assemblies, valves, and fittings connected properly and connections are tight.		
	(4) All components are color-coded white.		

Table 7.2. (Continued)

B	First 3,000-Gallon Potable Water Tank:	Y	N
	(1) 2-inch ball valve on the inlet of the Bladder Water Level Controller is open.		
	(2) Ball valve assembly at the inlet to the 3,000-gallon tank is open.		
	(3) Ball valve assembly at the outlet of the 3,000-gallon tank is closed.		
	(4) Tank drain and ball valve assembly to the 3,000-gallon tank are closed.		
	(5) 2-inch ball valve assembly on the inlet to the 2-inch hose line is closed.		
	(6) All hose assemblies, valves, and fittings connected properly and connections are tight.		
	(7) All components are color-coded white.		
	(8) 35-GPM Electric Pump Assembly connected to an adequate power source.		

7.4.2. **Initiate and Verify Potable Water Flow.** Initiate and verify water flow to the extension subsystem as follows:

7.4.2.1. Open the 2-inch ball valve on the inlet to the 2-inch hose line and connect the bladder water level controller for the first 3,000-gallon tank to an adequate power source. Ensure the first 3,000-gallon tank begins to fill with water, and then recheck hoses, valves, and fittings to the outlet of the tank for leaks. Repair as required.

7.4.2.2. Once the 3,000-gallon tank is full, open the outlet ball valve and position the power ON/OFF switch for the electric pump to the ON position. Verify water is flowing from the first 3,000-gallon tank through the pump to the bladder water level controller on the facility tank. Then connect the

second bladder water level controller to an adequate power source and verify water is flowing into the facility tank.

7.4.2.3. Recheck all hoses, valves, and fittings from the electric pump to the facility tank for leaks. Make any necessary repairs.

> **Note:** Contingency water systems have a tendency to leak a little, so small leaks are usually unavoidable and should not be a major cause of concern. Always ensure neoprene gaskets are installed before connecting suction or discharge hoses.

7.4.2.4. When the 3,000-gallon facility tank is full, it is ready for service if the using facilities are connected. The 35-GPM electric pump operates automatically and should not require any user input to maintain water level in the facility tank.

7.5. Component Descriptions. Table 7.3 provides a detailed description and quantity for each Industrial Operations and Flightline Extension Subsystem component and its corresponding reference number. See T.O. 40W4-21-1 for other subsystem component information.

Table 7.3. Industrial Operations and Flightline Extension Subsystem Component Description, and Item Number.

Ref #	Description	Qty
1	Ball Valve Assembly, 3-Inch, w/Female x Male OD's, White Stripe	1
2	Tee Assembly, 3-Inch x 3-Inch x 2-Inch w/3-Inch Female x 3-Inch Male x 2-Inch Male OD's, White Stripe	2
3	Ball Valve Assembly 2-Inch w/Female x Male QDs, White Stripe	8
4	Discharge Hose Assembly, 2-Inch x 50-Foot, White Stripe	2
5	Bladder Water Level Controller, Electric, w/ 2-Inch Female x Female QDs and 25-Foot Outdoor Extension Cord, White Stripe	2

Table 7.3. (Continued)

Ref #	Description	Qty
6	3,000-Gallon Collapsible Fabric Tank Assembly, w/2-Inch Male x Male x Male QDs, White Stripe	2
7	Suction Hose Assembly, 2-Inch x 8-Foot, White Stripe	2
8	Ball Valve Assembly, 2-Inch, w/Female QD x Female NPT, White Stripe	2
9	Suction Hose Assembly, 2-Inch x 25-Foot, White Stripe	3
10	35-GPM Electric Pump Assembly, 2-Inch, w/Female x Male QDs, White Stripe	1
11	Reducer, w/3-Inch Male x 2-Inch Female QDs, White Stripe	1
12	Check Valve Assembly, 3-Inch, w/Female x Male QDs, White Stripe	2
13	Discharge Hose Assembly, 3-Inch x 50-Foot, White Stripe	6
14	Discharge Hose Assembly, 3-Inch x 100-Foot, White Stripe	20
15	Reducer, w/3-Inch Female x 2-Inch Male QDs, White Stripe	1
16	Tee Assembly, 2-Inch x 2-Inch x 2-Inch, w/Male x Male x Female QDs, White Stripe	1
17	Reducer, w/2-Inch Female x 1-Inch Male QDs White Stripe	3
18	Discharge Hose Assembly, 1-Inch x 25-Foot, White Stripe	5
19	Reducer, w/1-Inch Female x 3/4-Inch Male QDs, White Stripe	1
20	Hose Bridge System, 4-Inch	20
21	Tunnel Connector, 4-Inch	10

Table 7.3. (Continued)

Ref #	Description	Qty
22	Tunnel, 4-Inch	10
23	Adapter, 3-Inch, Male QD x 3-Inch Male QD	1
24	Coupler, 3-Inch Female QD x 3-Inch Female QD	1
25	Adapter, 1-Inch Male QD x 1-Inch Male QD	1
26	Coupler, 1-Inch Female x 1-Inch Female QDs, White Stripe	1
27	Adapter, 3/4-Inch Male x 3/4-Inch Male QDs	1
28	Coupler, 3/4-Inch Female x 3/4-Inch Female QDs, White Stripe	1
29	Cold Weather Kit, Industrial Operations and Flight Line Extension Subsystem (Optional), (Not Currently Available)	1

HERBERT J. CARLISLE, Lt Gen, USAF
DCS/Operations, Plans, and Requirements

Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

References

AFDD 4-0, *Combat Support*, 23 March 2005

AFH 10-222, Volume 1, *Guide to Bare Base Development*, 1 February 2006

AFH 10-222, Volume 2, *Guide to Bare Base Assets*, 1 April 2006

AFH 10-222, Volume 9, *Reverse Osmosis Water Purification Unit Setup and Operation*, 1 April 2011

AFI 10-211, *Civil Engineer Contingency Response Planning*, 22 September 2008

AFI 10-210, *Prime Base Engineer Emergency Force (BEEF) Program*, 15 November 2010

AFI 32-1064, *Electrical Safe Practices*, 25 May 2006

AFMAN 33-363, *Management of Records*, 1 March 2008

AFPAM 10-219, Volume 5, *Bare Base Conceptual Planning Guide*, 1 June 1996

AFPD 10-2, *Readiness*, 30 October 2006

T.O. 40W4-13-41, *Operation Manual—Water Purification, Reverse Osmosis, 600GPH Skid Mounted ROWPU Model WPES-20*, 15 August 1992

T.O. 40W4-20-1, *Operation and Maintenance Instruction With IPB – 1500 Reverse Osmosis Water Purification Unit (ROWPU)*, 1 April 2007

T.O. 40W4-21-1, *Basic Expeditionary Airfield Resources (BEAR) Water System PN 3000001*, 1 May 2007

Commercial Operator's Manual Power Tech 4.5/6.8 L. Tier 2 OEM Diesel Engines OMRG33324 Issue 16, February 2004

Prescribed Forms

No prescribed forms are implemented in this publication.

Adopted Forms

AF IMT 847, *Recommendation for Change of Publication*.

Abbreviations and Acronyms

ACC—Air Combat Command

AF—Air Force

AFCESA—Air Force Civil Engineer Support Agency

AFH—Air Force Handbook

AFI—Air Force Instruction

AFMAN—Air Force Manual

AFRIMS—Air Force Records Information Management System

BEAR—Basic Expeditionary Airfield Resources

CIP—Common Installation Picture

GPH—Gallons Per Hour

GPM—Gallons Per Minute

GPPPD—Gallons Per Person Per Day

GPS—Global Positioning System

HQ—Headquarters

IMT—Information Management Tool

IGI&S—Geospatial Information and Services

IPB—Illustrated Parts Breakdown

LBS—Pounds

MAJCOM—Major Command

NPT—National Pipe Thread

NST—National Standard Threads

OPR—Office of Primary Responsibility

PPE—Personal Protective Equipment

PSI—Pounds Per Square Inch

PVC—Polyvinyl Chloride

QD—Quick Disconnect

RBC—Reach-Back Center

RDS—Records Disposition Schedule

ROWPU—Reverse Osmosis Water Purification Unit

SRS—Source Run Subsystem

TF—Tank Farm

TM—Technical Manual

TO—Technical Order

V—Volts

VAC—Volts Alternating Current

WOA—Water Operations Area

WPS—Water Production Subsystem

Terms

Air Force Civil Engineer Support Agency (AFCESA)—A field operating agency (FOA) located at Tyndall Air Force Base, Florida. The Directorate of Readiness Support (HQ AFCESA/CEX) acts as the Air Force program manager for Base Civil Engineer (BCE) Contingency Response Planning.

Bare Base—An installation having minimum essential facilities to house, sustain, and support operations to include, if required, a stabilized runway, taxiways, and aircraft parking areas. A bare base must have a source of water that can be made potable. Other requirements to operate under bare base conditions form a necessary part of the force package deployed to the bare base.

Basic Expeditionary Airfield Resources (BEAR)—Facilities, equipment, and basic infrastructure to support the beddown of deployed forces and aircraft at austere locations; a critical capability to fielding expeditionary aerospace forces. Also known as BEAR, the resources include tents, field kitchens, latrine systems, shop equipment, electrical and power systems, runway systems, aircraft shelters, and water distribution systems needed to sustain operations.

Chemical, Biological, Radiological and Nuclear (CBRN) Defense—The methods, plans, procedures and training required to establish defense measures against the effects of attack by nuclear weapons or chemical and biological agents.

National Pipe Thread—A U.S. standard for tapered threads used to join pipes and fittings.

Attachment 2

COMPONENTS ILLUSTRATIONS

A2.1. The following table provides illustrations of different components of the Air Force's Contingency Water System. Although not all-inclusive, they provide a brief description of some of the more common components used in the various subsystems that makeup the contingency water system. Users should refer to T.O. 40W4-21-1 for more detailed descriptions of these and other subsystem components.

Figure A2.1. Component Illustration.

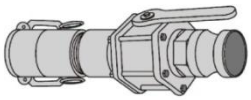
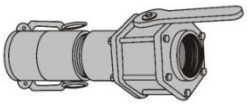
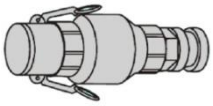
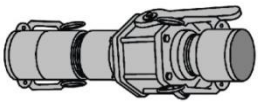
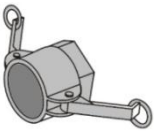
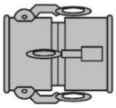
 **Ball Valve Assembly w/Female X Male QD**	 **Ball Valve Assembly**
 **Swing Check Valve Assembly**	 **Ball Valve Assembly w/Female X Female QD**
 **Coupler, Female QD X Female NPT**	 **Coupler, Female X Female QD**

Figure A2.1. Component Illustration. (Continued)

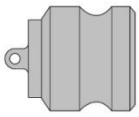
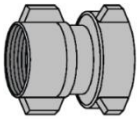
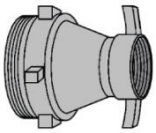
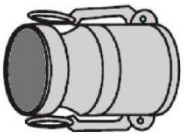
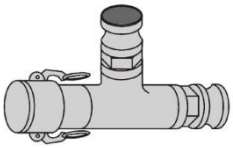
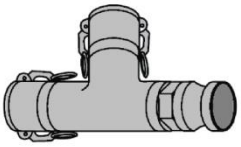
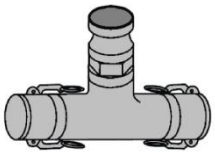
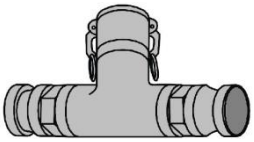
 **Plug, Male QD**	 **Adapter, Swivel,** **Female NST X Female NPT**
 **Adapter, Swivel,** **Female NST X Male NPT**	 **Reducer, Male X Female**
 **Pipe Tee Assembly,** **Female X Male X Male**	 **Pipe Tee Assembly,** **Female X Male X Female**
 **Pipe Tee Assembly,** **Female X Female X Male**	 **Pipe Tee Assembly,** **Male X Male X Female**

Figure A2.1. Component Illustration. (Continued)

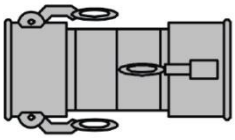
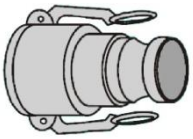
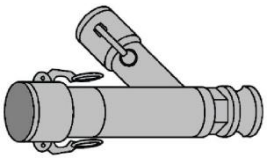
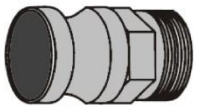
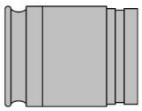
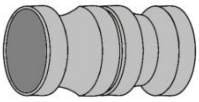
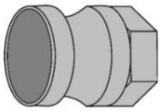
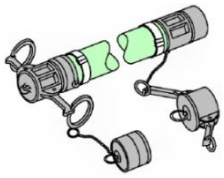
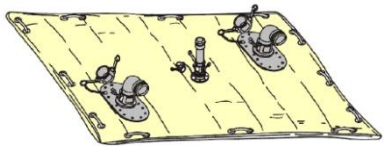
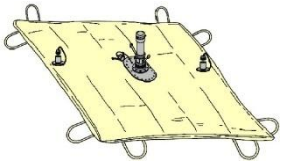
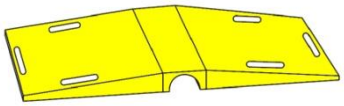
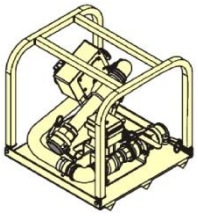
 **Reducer, Female X Female QD**	 **Reducer, Female X Male**
 **Wye Assembly,** **Female X Male X Female**	 **Adapter, Male QD X Male NPT**
 **Adapter,** **Male QD Victaulic/Grooved**	 **Adapter, Male QD X Male QD**
 **Adapter,** **Male QD X Female NPT**	 **Hose Assembly**

Figure A2.1. Component Illustration. (Continued)

 **20,000-Gallon Bladder Tank**	 **3,000-Gallon Bladder Tank**
 **Hose Bridge System**	 **Bladder Water Level Controller**

Attachment 3

HOSE QUICK DISCONNECT (QD) COUPLING CONNECTIONS

A3.1. Quick Disconnect Couplings. Hoses are equipped with female quick disconnect couplings on one end and male couplings on the other.

A3.2. The following procedures describes the two quick disconnect coupling connections. See **Figure A3.1** and proceed as follows:

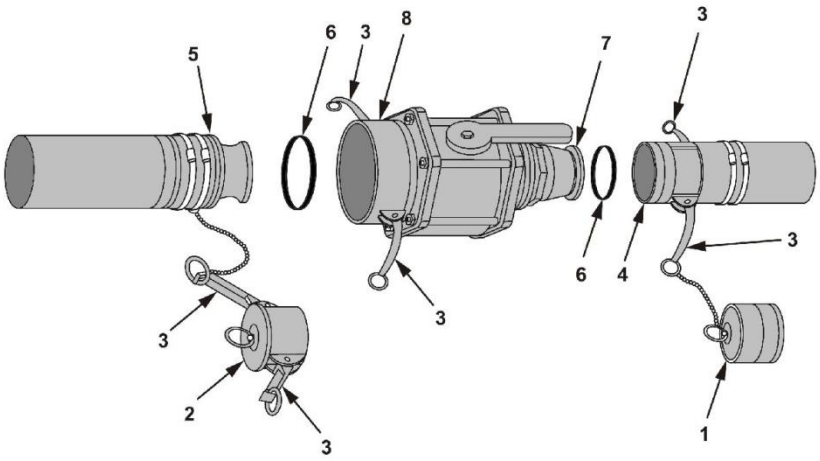
A3.2.1. If the plug (1) and cap (2) are installed; pull locking handles (3) forward to release them from the hose assemblies.

A3.2.2. Ensure that both female (4/8) and male (5/7) couplings are free of dirt, not corroded or damaged, and have serviceable gaskets (6).

A3.2.3. Make sure the locking handles (3) on female couplings (4 and 8) are facing forward (away from coupling).

A3.2.4. Ensure gasket (6) is inserted in female coupling (4) then position female coupling (4) over male coupling (7).

Figure A3.1. Typical Quick Disconnect Coupling.



A3.2.5. Rotate locking handles (3) backward and press down until they are in horizontal alignment with the hose assembly.

A3.2.6. Ensure gasket (6) is inserted in the female coupling (8), then position male coupling (5) in female coupling (8).

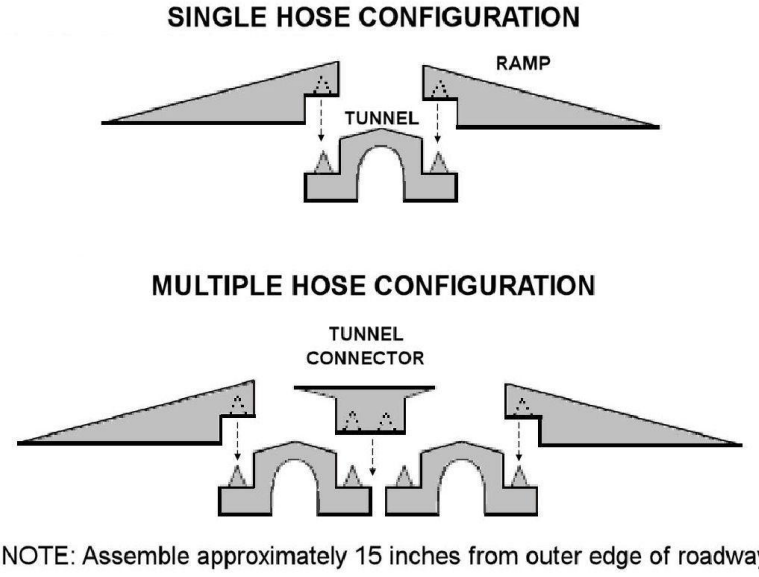
A3.2.7. Rotate the locking handles (3) backward and press down until they are in horizontal alignment with the hose assembly.

Attachment 4

HOSE BRIDGE SYSTEM ASSEMBLY

A4.1. The hose bridge system includes three types of components; ramps, hose tunnels, and tunnel connectors. The components assemble easily and provide good rollover protection to raw water, potable water, or wastewater hose assemblies.

Figure A4.1. Hose Bridge System Assembly.



Attachment 5

NORMAL OPERATION OF THE CONTINGENCY WATER SYSTEM

Table A5.1. Normal Operating Procedures.

NORMAL OPERATION	
The following procedures highlight basic operation of the Contingency Water System and do not have to be performed in the order presented here. These procedures assume the system was initially fully filled and currently functioning normally. Users should read and understand these and all subsystem operational procedures prior to system operation.	
A.	Inspect all tanks, hoses, valves, and connections for leaks and repair as required.
B.	Regularly check the level of the 20,000-gallon potable water tanks of the 550 Initial and 550 Follow-On (if equipped) Subsystems and proceed as follows: (1) If the height of all potable water tanks is at least 36 inches, proceed to Step C. (2) If the height of all potable water tanks is less than 36 inches and the source of potable water is the Water Production 1500 (or 600) ROWPU Subsystem, proceed to Step C. (3) If the height of all potable water tanks is less than 36 inches and the source of potable water is the 125-GPM Diesel Pump that is part of the 550 Initial Subsystem, proceed to Step E.
C.	Check the height of the 20,000-gallon raw water tanks from the Water Production 1500 (or 600) ROWPU Subsystem(s) and Source Run Subsystem (if installed) and proceed as follows: (1) If the height of the tanks is at least 36 inches and potable water is not required for the 550 Initial and 550 Follow-On (if installed) Subsystems, continue to monitor tank levels. No action is required at this time.

Table A5.1. Normal Operating Procedures. (Continued)

NORMAL OPERATION	
	(2) If the height of the tanks is at least 36 inches and potable water is required for the 550 Initial and 550 Follow-On (if installed) Subsystems operate ROWPUs in accordance with applicable T.O. as required. NOTE If operation of ROWPUs is required, it may be necessary to operate the 400-GPM Diesel Pump (or 125-GPM Diesel Pump if used) as required to supply sufficient raw water for ROWPU operation (refer to Step F). (3) If the height of the tanks is less than 36 inches and the Source Run Subsystem is installed, proceed to Step D. to startup 400-GPM Diesel Pump. (4) If the height of the tanks is less than 36 inches and the Source Run Subsystem is not installed proceed to Step E. to startup 125-GPM Diesel Pump.
D.	Monitor the height of the 20,000-gallon raw water tanks and proceed as follows: (1) Startup the 400-GPM Diesel Pump in accordance with Operator's Manual Power Tech4.5/6.8 L Tier 2 OEM Diesel Engines. (2) Allow pump to run and fill 20,000-gallon raw water tanks. Proceed to Step F.
E.	Energize the 125-GPM Diesel Pumps at the 550 Initial and Follow-On Subsystems in accordance with the following steps: CAUTION Do not operate 125-GPM Diesel Pump Assembly without water in pump case. Operating pump without liquid flowing through it will damage pump seals and make pump inoperative.

Table A5.1. Normal Operating Procedures. (Continued)

NORMAL OPERATION	
	(1) Remove pump plug and fill pump case with water. Reinstall pump plug. (2) Remove engine fuel fill cap and fill and/or verify tank is full. Reinstall engine fuel fill cap. (3) Remove engine oil fill cap and check oil level. Add oil as required and reinstall fill cap. (4) Open fuel valve. (5) Move throttle lever to run position (right). NOTE When pulling engine pull start handle, pull with constant steady force. Do not jerk pull start handle cable violently. (6) Grip engine pull start handle (3) with both hands. Commence pulling the pull start handle repeatedly with strong and even motion until engine starts. If engine starts, proceed to step (7). (7) If after several unsuccessful attempts to start the pump the exhaust begins to emit white smoke, move the throttle lever to the STOP position (vertical). Pull engine pull start handle out slowly five times then repeat steps (5) and (6). WARNING Serious injury or death to personnel could occur if tanks are overfilled and explode. When filling tanks, ensure height of 20,000-gallon tanks do not exceed a maximum height of 64 inches. Tanks fill at different rates and it will be necessary to turn-on and turn-off pumps as required to ensure they do not overfill.

Table A5.1. Normal Operating Procedures. (Continued)

NORMAL OPERATION	
F.	Run all pumps and ROWPUs as required, until all raw water and potable water 20,000-gallon tanks are filled (maximum height of 64 inches), proceed as follows: (1) Shutdown 400-GPM diesel pump in accordance with Operator's Manual Power Tech 4.5/6.8 L Tier 2 OEM Diesel Engines. (2) Shutdown ROWPUs in accordance with T.O. 40W4-20-1 and/or T.O. 40W4-13-41. (3) If used, shutdown 125-GPM diesel pump(s) as follows: (a) Move throttle lever to idle position and maintain idle for approximately five minutes. (b) Stop engine. (c) Close fuel cock.