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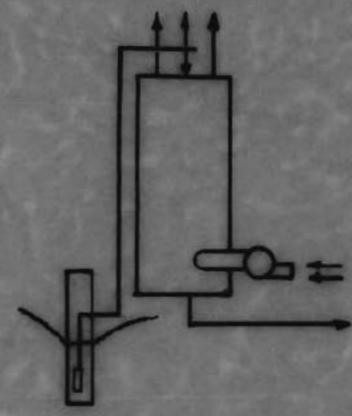
Melbourne, Florida



GROUNDWATER REMEDIATION SYSTEM
BRAULT LAGOON SITE – WEST CHAZY, NY

OPERATION & MAINTENANCE MANUAL

1987

Volume I

LAWLER, MATUSKY & SKELLY ENGINEERS
Pearl River, New York

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CHAPTER 1

INTRODUCTION

1.1 USERS GUIDE

The Brault Lagoon Groundwater Remediation System is designed to pump water containing volatile organic compounds (VOCs) from the ground and treat this water by air stripping. Proper operation and maintenance of the system are required for satisfactory plant operation to avoid adverse impact on the environs and to assure compliance with the requirements specified in the Consent Judgement between Harris Corporation and the State of New York.

The purposes of this manual are to familiarize personnel with the equipment and facilities provided and to recommend operation and maintenance procedures for effective and economical function of the facility. The manual provides essential technical information and guidance and is intended to be used as a tool by plant operating and management personnel.

In order to remain a complete and flexible source of information, this manual must be reviewed and updated continuously as systems are started up, expanded, or altered. To facilitate these modifications, the manual's text is typed so that personnel can make handwritten additions, changes, and clarifications directly to the text, which should be periodically retyped.

This manual includes by reference the record construction drawings prepared in 1988 by Lawler, Matusky & Skelly Engineers (LMS).

1.2 OPERATIONAL AND MANAGERIAL RESPONSIBILITIES

The remedial system is owned and operated by Harris Corporation. A Harris manager or contract manager will:

- Have general knowledge of system.
- Interface with nearby homeowners during start-up.
- Oversee system operator.
- Provide for transition and continuity in operator staffing.
- Oversee repair contracts.

The system operator will:

- Have detailed knowledge of system.
- Interface with homeowners during startup.
- Make mechanical/electrical adjustments in accordance with O&M Manual.
- Make other adjustments in accordance with directions.
- Act as troubleshooter.
- Respond to alarms.
- Provide routine maintenance within skill levels and O&M Manual requirements.
- Oversee repair contractors.
- Handle record keeping and data summary.
- Perform sampling and water level measurements.

A Harris Corporation engineer will:

- Have detailed knowledge of the system.

- Review and coordinate purchase orders and expenditure requisitions.
- Interface with nearby homeowners.
- Act as backup for system operator.
- Oversee system operator.
- Assist with hydrologic start-up.
- Compile and review data on water levels and pump rates.
- Determine changes in water level and pump rate controls.

1.3 SYSTEM PROCESS AND FLOW PATTERN

This section provides an overview of the functioning of the remedial pumping and treatment system. The detailed operation and maintenance for the individual components of the system are given in Chapters 3 and 6, respectively.

The land on which the treatment building and three pumping wells are located is owned by Harris Corporation. The remaining pumping wells are on private lands for which Harris Corporation has acquired the necessary easements. Access to these private lands should be made through the dirt road adjacent to the underground transmission system.

Much of the alignment of the treated effluent outfall is in a public right-of-way, for which permission has been obtained from NYSDOT.

1.3.1 General Descriptions

The general layout of the remediation facilities is shown schematically on Figure 1-1. A simplified piping arrangement is shown in

FIGURE 1-1

COLLECTION SYSTEM

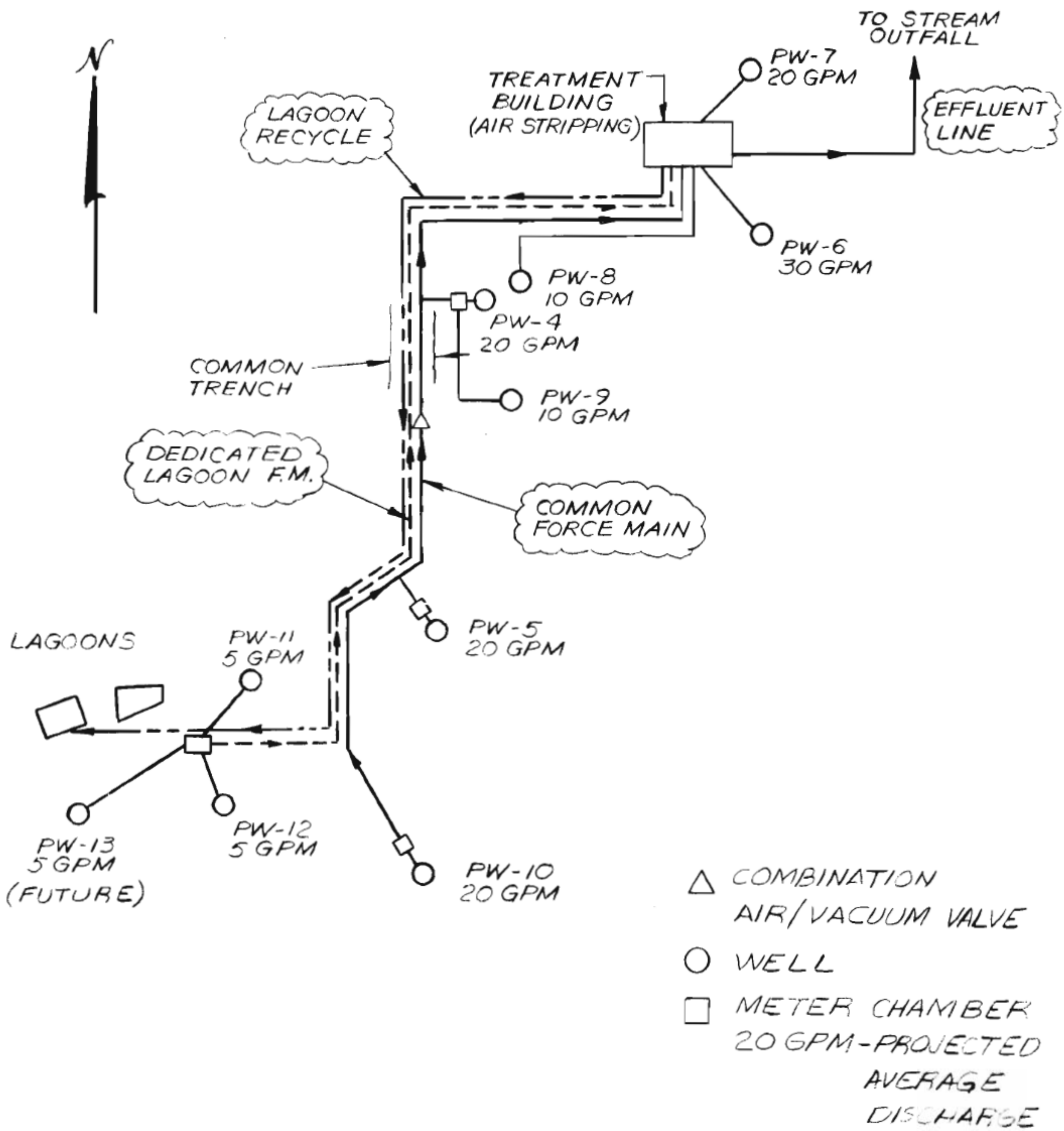


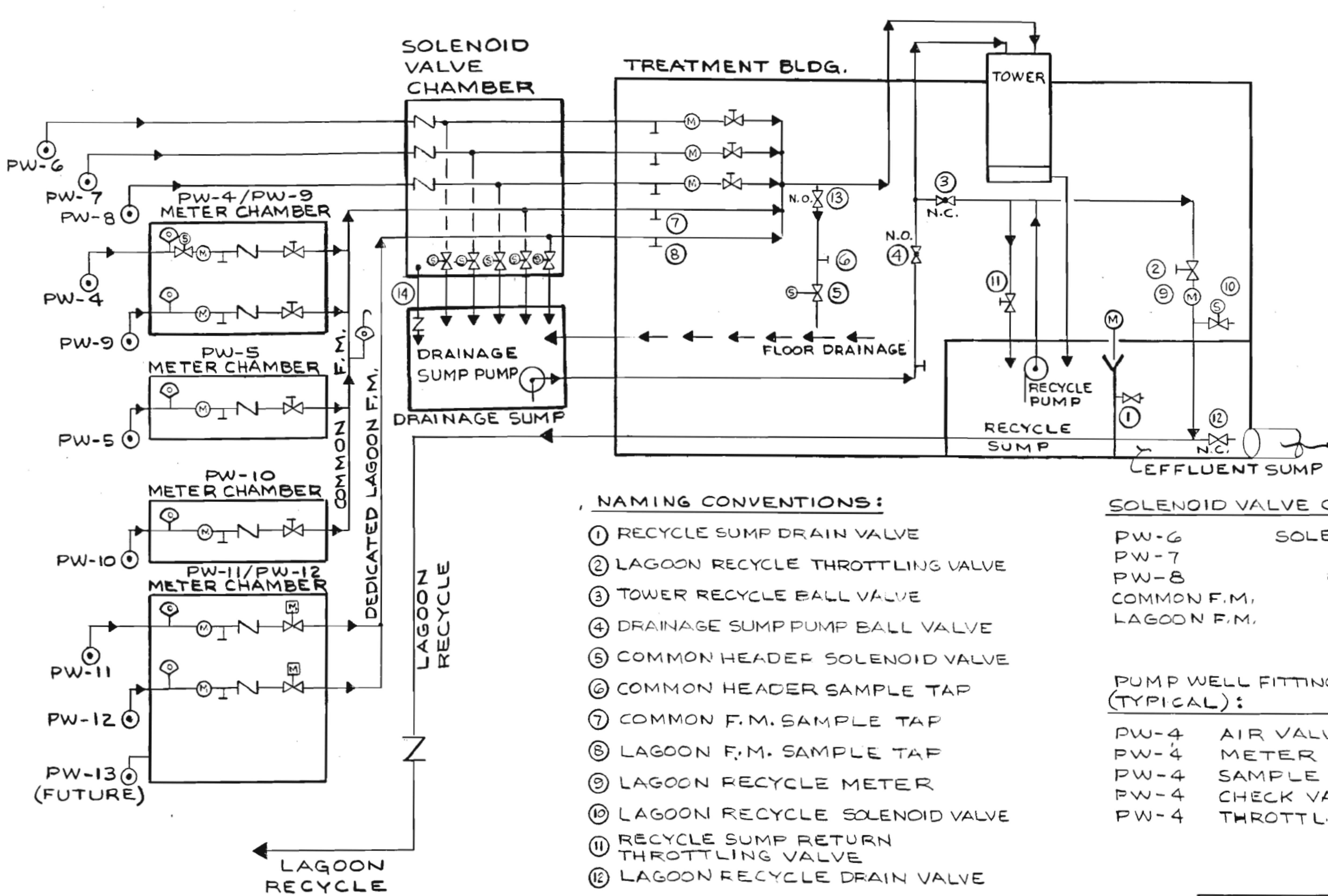
Figure 1-2. The reader is referred to the Piping and Instrumentation Diagram of the construction drawings for additional detail. The plan consists of pumping groundwater from nine wells to an air-stripping treatment facility housed in a prefabricated metal building situated on the Harris Corporation property.

The discharge pipes from two wells (PW-11 and PW-12) in the vicinity of the lagoons join in a 2-in. polyethylene common dedicated force main at a meter chamber serving these two wells. Each well has its flow measured by a separate water meter before it is discharged to the dedicated force main ending at the treatment building.

A 2-in. polyethylene recycle line can be used to return treated water from the treatment building to the lagoons for groundwater recharge at a rate somewhat less than the lagoon area pumping wells total yield. The Lagoon Recycle Force Main is laid along the same route (in the same trench) as the Dedicated Lagoon Force Main.

Four additional wells (PW-4, PW-5, PW-9, and PW-10) along the route of the lagoon force mains also pump groundwater to the treatment building. The discharge lines from PW-5 and PW-10 have individual meter chambers and are connected to a 6-in. PVC pipe Common Force Main (header) leading to the treatment building. The Common Force Main is laid in the same trench as the Dedicated Lagoon Force Main and Lagoon Recycle Force Main.

To economize on construction costs, the discharge from PW-9 is piped in a 2-in. polyethylene force main to a meter chamber near PW-4. This chamber contains the meters and valves for regulating the flows for both wells. Near this chamber these flows enter the 6-in. PVC Common Force Main. As the remaining three wells (PW-6, PW-7, and PW-8) are close to the treatment building, the meter chambers were eliminated to reduce construction cost. The 2-in.



SYMBOLS:

- PUMPING WELL
- AIR VALVE
- COMBINATION AIR/VACUUM VALVE
- WATER METER
- SAMPLE TAP
- THROTTLING VALVE (MANUAL)
- THROTTLING VALVE (MOTORIZED)
- SOLENOID VALVE (N.C)
- BALL VALVE
- BALL CHECK VALVE

N.O. = NORMALLY OPEN
N.C. = NORMALLY CLOSED

NAMING CONVENTIONS:

1. RECYCLE SUMP DRAIN VALVE
2. LAGOON RECYCLE THROTTLING VALVE
3. TOWER RECYCLE BALL VALVE
4. DRAINAGE SUMP PUMP BALL VALVE
5. COMMON HEADER SOLENOID VALVE
6. COMMON HEADER SAMPLE TAP
7. COMMON F.M. SAMPLE TAP
8. LAGOON F.M. SAMPLE TAP
9. LAGOON RECYCLE METER
10. LAGOON RECYCLE SOLENOID VALVE
11. RECYCLE SUMP RETURN THROTTLING VALVE
12. LAGOON RECYCLE DRAIN VALVE
13. COMMON HEADER ISOLATION VALVE
14. SOLENOID VALVE CHAMBER DRAIN

SOLENOID VALVE CHAMBER:

PW-6	SOLENOID VALVE
PW-7	" "
PW-8	" "
COMMON F.M.	" "
LAGOON F.M.	" "

PUMP WELL FITTINGS/CONTROLS (TYPICAL):

PW-4	AIR VALVE
PW-4	METER
PW-4	SAMPLE TAP
PW-4	CHECK VALVE
PW-4	THROTTLING VALVE

FIGURE 1 - 2

SIMPLIFIED PIPING DIAGRAM

polyetheylene discharge lines from these wells go directly to the building (via a solenoid valve chamber, discussed below) and are metered inside before being connected to the common header.

Treatment consists of an air-stripping tower located inside the treatment building and extending through the roof. Untreated water enters the top of the tower while air is forced into the bottom of the tower by a blower. Treated effluent collects in a sump at the base of the tower and is discharged through a 6-in. PVC gravity line to an unnamed stream 800 ft to the north.

1.3.2 Well Systems

A pumping system that maintains a relatively constant drawdown is installed in each well. The magnitude of the drawdown increases the well's areal influence in controlling the water table. However, the location of significant water bearing zones in the well restricts the allowable drawdown (these zones cannot be dewatered). Except for the two lagoon area wells (PW-11 and PW-12), drawdown is controlled by manual adjustment of a throttling valve in the meter chamber such that the pumping rate maintains a certain water elevation in the well. Changes in the natural yield of the wells will require periodic adjustment of the valves. As lagoon area wells PW-11 and PW-12 exhibit wide ranging flows because they are shallow and dependent on short-term changes in precipitation and recycling, the discharge from these wells is controlled by self-modulating valves. On/off level controls protect the wells from overpumping.

The upper section of each well is protected by a steel casing fitted with a locking cap with a padlock. All pumping and monitoring well padlocks are keyed alike. Each well has a heavy duty submersible well pump of the required size and horsepower to pump the specified flow to the treatment building. A pitless adapter installed on the discharge line from each pump permits the discharge line to pass through the steel well casing below the maximum depth of frost penetration (6 ft). Flexible black polyethylene coil pipe connects the pump to the pitless adapter, and the adapter to the meter chamber.

The design called for an electric junction box connected to the well casing which provides a location for connection of the pump power cable and level sensors. However, there are continuous runs of cable from the control panel to pump and sensors for some wells. A post-mounted electric panel containing power and control instrumentation is installed adjacent to each well and/or meter chamber except for PW-6 and PW-7, for which the panels are located in the treatment facility. Pump operation is controlled by the water level in each well. The pumps should be turned off manually during routine maintenance and repair, automatically during power failures, or by interlock, if there is a failure in the treatment system.

The discharge line from each well enters a meter chamber adjacent to the well where a flowmeter transmits an instantaneous flow signal to a flow indicator in the meter chamber (except for PW-6, PW-7, and PW-8, which are metered on the treatment building, and PW-9, which is metered near PW-4) and signal to a flow totalizer in the treatment building. PW-5 and PW-10 each have their own meter chambers. PW-11 and PW-12 share a common meter chamber, as do PW-4 and PW-9. Each chamber is constructed of precast concrete with an aluminum hatch and manhole steps. The exterior walls and the underside of the top slab are insulated to prevent freezing during a power failure or pump outage. All pipes and fittings are protected from freezing by insulation. In the event of a long duration power outage or pump shutdown, the sample taps installed with the meter chamber piping must be manually opened (this is not required for PW-6, PW-7, and PW-8). The opening of this valve will permit the draining of water back to the well. This same valve also permits the collection of water samples before the flow from the well is mixed with the flow of other wells in the common force main. A check valve and throttling/shutoff valve are installed in the meter chamber. The check valve prevents flow from other pumps connected to the force main from flowing back into a well when the pump from that well is shut down.

Immediately following its construction, pumping well PW-4 was found to contain elevated amounts of iron bacteria. To control the potential buildup of this organism, a dry pellet-type chlorinator was constructed adjacent to the PW-4 casing. This equipment is explained in detail in Section 3.2.

1.3.3 Trench Systems

The utility trench system incorporates:

- The electrical power cables (the only overhead electrical wire is for the service directly from Route 22)
- Instrumentation signal cables
- Force mains or lines for conveying pumpage from the wells together with a heat-traced gravity line for conveying treated effluent water to the outfall. The trench runs from the lagoon area meter chamber to Miner Road, thence along Miner Road to PW-10, thence northerly to the treatment building, and thence northerly to the treated effluent outfall. Depending on location, the trench will have different numbers, sizes, and types of pipe and cable. These variations are specified as Trench Types A, B, C, D, and E in Construction Drawings 1 and 4.

All cables are buried below marking tape, which must be replaced after any excavation.

1.3.4 Treatment Facilities

Treatment of pumpage is provided by a countercurrent, forced-air, packed air-stripping tower. The base of the tower is housed in a prefabricated metal building constructed on a concrete slab supported by foundation piers and grade beams. The tower extends through the roof. The projected average flow for the treatment facilities is 145 gpm. Peak flow is estimated at 140% of average flow (203 gpm). The packed air-stripping tower, the major component of the treatment equipment, has a packed bed diameter and depth of 4 and 29 ft, respectively. Overall height of the tower is approximately 37 ft. Outside, unheated air is delivered to the blower via a manifold. This air, forced upward through the packed tower, strips VOCs from the falling water that enters the distributor tray at the top of the tower. The installed blower has a capacity of 2800 cfm (air:water ratio of 100-150:1 for maximum and average hydraulic loads). The exhaust from the tower is vented horizontally (at a velocity of 1500 ft per second) through a window in the top of the tower. The window directs the air to the northwest, away from Route 22.

Nine pipelines enter the treatment building through the floor slab:

1. Common Force Main
2. Dedicated Lagoon Force Main
3. Well PW-6 Discharge Line
4. Well PW-7 Discharge Line
5. Well PW-8 Discharge Line
6. Lagoon Recycle Force Main
7. Treated Effluent Discharge Line
8. Treatment Building Floor Drain
9. Drainage Sump Pump Discharge Line

The first five lines bring untreated water to the treatment building. The next two discharge treated effluent either to the lagoons (Lagoon Recycle Force Main) or to the discharge stream (Treated Effluent Discharge Line). The floor drain is described below and the Drainage Sump Pump Discharge Line conveys water to the tower for treatment. There are no meters on the Common and Dedicated Lagoon force mains. Total flows to the tower are to be determined by (1) addition of the metered flows from the individual wells, or by (2) addition of the metered flows of the Lagoon Recycle Force Main and the Treated Effluent Discharge Line. Meter bypasses are not provided. If all meters are operating properly, Additions 1 and 2 should be equal.

Throttling valves for the lines from wells PW-6, PW-7, and PW-8 are also located inside the building. The five incoming lines (common, lagoon, PW-6, PW-7, and PW-8) join inside the building and a single 6-in. PVC line (the Common Header) feeds water to the tower. Sampling taps are provided on the five incoming pipes and the Common Header.

One floor drain is provided to convey stray water inside the treatment building to the drainage sump located in a below-grade chamber adjacent to the building. A pump inside the sump discharges this water through a 2-in. PVC line to the top of the tower for treatment. Averaged over the year, total flows from the sump should be minimal; therefore, they are not metered. This PVC line also receives recycle flow from the tower effluent sump (referred to as the Recycle Sump). The tower recycle capabilities permit the control of bacteria or iron buildup inside the tower by rinsing with a dilute acid solution inhibited for aluminum in the case of iron buildup, or sodium hypochlorite solution in the case of bacteria buildup. In both cases the recycle for treating tower buildup is initiated manually while normal treatment operations are shut down and the Building Sump Pump Ball Valve is closed. The water must be neutralized once the rinsing is complete and discharged via the plant outfall. The tower recycle operates with the same pump used for the lagoon recycle (see Chapter 3).

The building drainage sump pump will run only infrequently and when running, power to the pumping wells is cut by an interlock. Therefore, separate sample taps are provided for the influent Common Header and Drainage Sump Pump Discharge.

In the event of a power outage during the winter, the building will begin to lose heat. To prevent freezing of the pipes, solenoid-activated valves will open automatically upon power failure, allowing the pipes to drain onto the floor and then into a below-grade drainage sump.

Located below grade, adjacent to the drainage sump, is a chamber that houses the solenoid-activated valves for the five influent flow lines (Common Force Main, Dedicated Lagoon Force Main, and PW-6, PW-7, and PW-8 discharge lines). The solenoid valves are energized from the main power panel. Therefore, the valves should only open in the event of an overall power failure. This chamber also houses the ball check valves for PW-6, PW-7, and PW-8.

The drainage sump pump should be running only during scheduled maintenance or if there are leaks or other malfunctions inside the building. Therefore, if the pump engages, a non-emergency alarm (Alarm No. 4) will be issued through the "dial-up" system. In addition, all pumping wells are shut down automatically until the sump pump off-cycle is reached. The capacity of the sump is greater than the volume of the pipes being drained.

Since only one blower is provided, failure of the blower or a high pressure condition inside the air duct to the tower will also cause power to the recovery well pumps to be disconnected. A high pressure signal will indicate a possible tower blockage; low pressure, motor or blower failure. Blower failure causes an emergency alarm (see Section 3.8 for alarms/dialups).

1.3.5 Treated Effluent Discharge Line

Treated effluent overflows from the above-grade tower sump to adjacent concrete sumps inside the treatment building. Effluent then flows 800 ft by gravity through a 6-in. PVC line to a stream approximately 400 ft north of Little Rock Road and is discharged to the stream on the west side of Route 22. Because of shallow bedrock encountered during construction, the line is not deeply buried and therefore is heat-traced and insulated to prevent freezing when the system is shut down.

The concrete sumps adjacent to the tower are partitioned such that effluent initially enters the first sump (referred to as the Recycle Sump), fills the partitioned volume, and then overflows a weir to the second sump (referred to as the Effluent Sump) before entering the gravity line. This arrangement allows installation in the flooded compartment of the lagoon area Recycle Sump Pump and a level sensor. This sensor is used for measuring flow over the weir.

1.3.6 Electrical Power Supply

Electric power supply is conventional overhead single-phase 120/240 volt three-wire service at 300 amps from the New York State Electric & Gas Corporation. Total load is approximately 60 kVA.

Conventional electrical main service with a utility meter is provided to a power distribution panel in the treatment plant building.

Four main feeders are extended from the treatment building to the wells. One feeder services the two wells at the lagoon area; the other services PW-4, PW-5, PW-8, PW-9, and PW-10. There are separate feeders for wells PW-6 and PW-7. The feeders to the wells are direct burial-type cables installed in the same trench with the underground pipes.

At each well the incoming feeder is connected to a Westinghouse Magnetic motor starter with a Hand-Off-Auto (H-O-A) selector switch and then to a capacitor Franklin Electric starter unit for the well pump operation. The power feeder is then connected to the pump motor. The starter unit contains a run capacitor, a starting capacitor, and a relay which switches the starting capacitor off after the motor has started. Adjacent to the motor starter is a level control panel that houses a bubbler system, including air compressor, air tank, and pressure and flow regulating equipment. A plastic bubbler tube is extended from the compressor down into the well. The control panel includes a level indicator (pressure gauge) for the well and four adjustable pressure switches connected to the level sensing system. Switching is provided as follows:

LS 1 - Low level alarm plus pump OFF control

LS 2 - Pump OFF control

LS 3 - Pump ON control

LS 4 - High level alarm

Each pressure switch is connected to a corresponding control relay. The control relays provide control signals to operate the pump through the "H-O-A" switch on the magnetic start, as well as alarm signals. Section 3.1.2 provides tables that summarize these control and alarm settings. Back pressure from the air bubbler system provides a signal via a transducer in the control panel to allow monitoring and control of the well's water level. The well panel also provides alarm indications for the high level alarm, the low level alarm, pump starter trip and power failure alarm. The type of alarm is indicated only at the remote well panel. At the treatment building the display system will show that an unspecified alarm condition exists at a particular well. The display is a push-to-test red light on the control panel. Transducer drift will occasionally have to be monitored (initially monthly, and then at less frequent intervals if drift is not significant - see Section 3.11.14). High water in either of lagoon area wells PW-11 and PW-12 will not only result in an alarm, but also, via an interlock, result in a cut of power to the lagoon area Recycle Pump.

The pump motor starter and the level control panel are mounted in a heavy duty weatherproof cabinet post-mounted near each well except for PW-6 and PW-7, for which the panels are inside the treatment building. The exterior electrical equipment enclosures contain thermostatically controlled space heaters and convenience receptacles. The motor starter has a "hand(on)-off-automatic" selector switch for pump control. In the automatic position the level sensing system described above turns the pump on and off automatically. The starter includes a running time meter. For each well the signal wiring extended to the treatment building includes alarm, water level, and water flow meter circuits.

In the meter chamber adjacent to each well (except as noted above for PW-6, PW-7, PW-8, and PW-9) is a positive displacement mechanical flowmeter. A transmitter is attached to the meter. The signal is circuited to the individual well control panel and then to the treatment building. From the well control panel the signal is also fed to a local flow rate indicator in the meter chamber (in the treatment building for wells PW-6, PW-7, and PW-8). In the treatment building the main instrument panel contains a digital flow rate indicator and counter-type totalizer, in addition to a digital level indicator for each well.

Motor starters and circuit breakers are provided for each motor at the plant (excluding well pumps), including one air blower, one lagoon recycle pump, and one drainage sump pump. Each motor starter includes an amber power light, green running light, and "hand-(on)-off-automatic" selector switch.

The air blower and recycle pump are normally running at all times, except for interlocks. The Drainage Sump Pump has a float switch control as well as manual control.

Interlocks are provided for the recycle pump so that, if a pump trips at lagoon area wells PW-11 or PW-12, the recycle pump will stop operation. A pump trip is defined as stopping of pump operation as a result of overload or a circuit breaker tripping due to a short circuit. An interlock also stops the recycle in the event of high water in either of these two wells.

There is an air pressure guage mounted on the blower manifold to signal any malfunction in tower air flow (high pressure - tower blockage; low pressure - blower or motor outage). In the event of too high or low pressure, interlocks are provided to disconnect the power supply to all the pumping wells.

A high level alarm float switch is provided in the Recycle Sump, which gives an alarm signal to the dialer and a light on the Main Instrument Panel and also to the interlocks to shut off the blower and all well pumps.

A high level alarm float switch in the Drainage Sump provides a high level alarm signal on the Main Instrument Panel. The next lower float switch starts and stops the sump pump. Operation of the sump pump shuts off, by interlock, all well pumps until the lowest float switch is reached to shut off the sump pump.

Table 1-1 summarizes the locations and functions of the various indicators and controls. Table 1-2 summarizes the functioning of the automatic interlocks and shutoffs.

1.4 CAPABILITY FOR EXPANSION

1.4.1 Consent Judgement

Any contemplated modifications to the capacity of the remedial pumping and treatment system must be checked against the requirements of the Consent Judgement between Harris Corporation and the State of New York.

1.4.2 Air-Stripping Tower

The distributor trays located at the top of the tower limit its hydraulic throughput to 300 gpm. To increase this throughput to 400 gpm, the distributor tray holes can be enlarged by drilling. Any planned increases to tower throughput must be accompanied by an examination of blower modifications, since the air to water ratios that govern treatment efficiency will be affected.

If system flows are found to be less than currently planned, or wells are permanently shut off because removal of VOCs from portions of the groundwater has been completed, then the tower distributor can be modified to operate more efficiently at the lower flow by inserting sleeves into the existing holes.

1.4.3 Blower

A Class II blower is provided to allow an increase in air delivery from 2800 cfm at 3.5 in. to 3800 cfm with a 7.5 horsepower motor. This increase can be made by changing the motor belts, pulleys, and motor.

TABLE 1-1

INDICATOR - CONTROL SUMMARY

	UNITS	LOCATIONS[a] METER PIT	WELL CONTROL PANEL	TREATMENT BUILDING
INDICATORS				
Well water level	Feet above air tube disch.		X	X
Well flow rate	Gal/min	X		X
Well flow totalizer	Gal			X
Well alarm lights				
General	-			X
High water	-		X	
Low water	-		X	
Pump running time	Hrs		X	
Plant effl. flow rate	Gal/min			X
Plant effl. flow totalizer	Gal x 10			X
Recycle flow rate	Gal/min			X
Recycle flow totalizer	Gal			X
CONTROLS				
Well throttling shutoff valve		X[b]		X[d]
Well pump local on-off/auto:				
Pump on (high water)			X	
Pump off (low water)			X	
Well level indicator adjust			X	
Well motorized valve[c]				
Level signal adjust			X	
Valve close setting		X		
Well power			X	X[e]
Recycle pump				
Power on/off/auto				X
Throttling shutoff				X
Recycle sump return throttling valve				

[a]Metering and Control Panel Locations:
PW-11 and PW-12 share common meter pit near lagoon.
Panels are mounted on top of pit.
PW-10 has its own meter pit and panel at pit.
PW-5 has its own meter pit and panel at pit.
PW-4 and PW-9 share common meter pit near PW-4.
PW-4 panel is on pit. PW-9 panel is post mounted near PW-9.
PW-6, PW-7, and PW-8 do not have pits and are piped directly to metering/controls in treatment building.
PW-6 and PW-7 panels are in treatment building.
PW-8 panel is post mounted near PW-8.

[b]Manual valves for Wells PW-4, PW-5, PW-9, PW-10; motorized valves for Wells PW-11 and PW-12.

[c]Wells PW-11 and PW-12, only.

[d]Manual valve for Wells PW-6, PW-7, PW-8.

[e]Circuits for (1) PW-4, PW-5, PW-8, PW-9, and PW-10; (2) PW-11 and PW-12; (3) PW-6; and (4) PW-7.

TABLE 1-2

WELL AND RECYCLE INTERLOCKS AND SHUTOFFS

CONDITION	SHUTOFF
Low water in well	One well
High water in Recycle sump (flood or effluent block)	All wells
High back pressure in tower (blockage)	All wells
Blower failure (low pressure)	All wells
Low water in Recycle Sump	Recycle
High water in PW-11 or PW-12	Recycle
Trip in PW-11 or PW-12	Recycle
Drainage sump pump	All wells

The treatment building and underground utilities were designed to allow the construction of a 10 x 20 ft building expansion east of the existing structure.

1.4.4 Treatment

The area about the lagoons has been used to dispose of various wastes, including septage and municipal wastewater treatment plant sludges that may introduce chemicals that cannot be removed by the treatment system. During the design of the remedial system, the concentrations of these other chemicals were not considered high enough to warrant additional treatment. However, the Dedicated Lagoon Force Main was provided to allow ready segregation of the lagoon area pumpage should treatment of these flows ever be required.

1.4.5 Pump Wells

Sufficient spare instrumentation circuits are available to install one more pump well near the lagoons and three more pump wells elsewhere on the site. The lagoon area meter chamber has sufficient space to house the fittings for the additional well. The 6-in. common header was designed for minimum dynamic head loss to allow easy balancing of the pumping systems during the 1987 start-up. Therefore, there is ample hydraulic capacity of that line to accept the pumpage from four additional wells. The treated effluent line is designed to discharge 400 gpm by gravity; even higher flows are obtainable by surcharging, however.

Additional spare circuits in the instrumentation cable servicing the lagoon area allow for possible automatic water level readings in up to three groundwater monitoring wells and one additional control in PW-11 and PW-12, if ever needed.

1.4.6 Chlorinator

The housing for the PW-4 chlorinator (described in Section 3.2) has sufficient room for one additional chlorinator.

CHAPTER 2

PERMITS AND STANDARDS

The standards governing the performance of the remedial system are specified in the 15 October 1986 Consent Judgement (86-CV-649) agreed to by Harris Corporation and the State of New York. No permits are required. The treated effluent limits for VOCs specified in the Consent Judgement are set forth below:

CHEMICAL	CONCENTRATIONS LIMIT (ug/l)
Benzene	15
Bromoform	5
Carbon tetrachloride	50
Chloroform	20
1,1-Dichloroethane	50
1,2-Dichloroethane	15
1,1-Dichloroethylene	50
Ethylbenzene	200
Toluene	500
1,1,1-Trichloroethane	500
Trichloroethylene	20

These values are instantaneous daily maximums, i.e., the concentrations in any grab effluent sample must be below these limits.

The system, as designed, and given expected influent concentrations, is expected to achieve significantly lower discharge VOC concentrations:

	CONCENTRATIONS (ug/l)		
	PROJECTED	EXPECTED EFFLUENT	
CHEMICAL	INFLUENT	(145 gpm)	(203 gpm)
1,1-Dichloroethane	990	1.4	1.9
1,1-Dichloroethylene	730	0.2	0.6
Toluene	710	1.8	2.1
1,1,1-Trichloroethane	17,900	9.9	19.7

Non-VOCs are also limited by the Consent Judgement:

CHEMICAL	CONCENTRATIONS LIMIT (mg/l)
Copper (Cu)	0.025
Zinc (Zn)	0.050
Iron (Fe)	4
5-day BOD (BOD)	5
Total suspended solids (TSS)	10
Total kjeldahl nitrogen (TKN)	9
Total residual chlorine (TRC)	1

Note the difference in units for VOCs and non-VOCs. With the exception of total residual chlorine, the treatment system will not remove the above chemicals from the influent. It is important that the total residual chlorine concentrations be monitored if chlorine is used to control algae buildup in the tower media (see Chapter 6).

In addition to the above, pH in the effluent is limited to 6.5 S.U., or higher if acid is used to control possible iron buildup in the tower.

CHAPTER 3

DESCRIPTION, OPERATION, AND CONTROL OF FACILITIES

3.1 WELL PUMP INSTALLATION AND PIPING

3.1.1 Description

For the groundwater pumping system, water is pumped from nine wells at the site to the air-stripping tower in the treatment building. Each well has a protective steel casing fitted with a locking cap and padlock. Each of the nine wells is fitted with a submersible pump that discharges to a meter chamber where the flow is measured. Pump wells PW-11 and PW-12 discharge to a common meter pit in the vicinity of the lagoon. The combined discharge from these two pumps is then pumped via the Dedicated Lagoon Force Main to the treatment building. PW-4 and PW-9 also share the same meter pit. PW-10, PW-5, and the discharge from PW-4 and PW-9 are pumped to the treatment building by the Common Force Main; PW-6, PW-7, and PW-8 are pumped directly to the treatment building, which houses the meters for these pumps.

Each well pump is a Grundfos stainless steel submersible pump fitted with a Franklin Motors Company motor. Table 3-1 summarizes the major specifications of each pump. The internal check valve from each pump has been removed to enable water to drain back into the well in case of power failure to prevent freezing of the lines. A pitless adapter is installed in the discharge line from each pump to permit the discharge line to pass through the steel well casing below the maximum depth of frost penetration (6 ft). The pitless adapter, manufactured by Dicken Manufacturing Co., also enables the pumps and discharge hose to be pulled from the well easily. The pumps for wells PW-4 and PW-10 are fitted with a Lakis sand separator to prevent sand from plugging and damaging the pump.

TABLE 3-1

WELL PUMP SPECIFICATIONS

LOCATION AND UNIT No.	COMMON FORCE MAIN				DIRECT LINES			LAGOON WELLS DEDICATED FORCED MAIN	
	PW-4	PW-5	PW-9	PW-10	PW-6	PW-7	PW-8	PW-11	PW-12
Design Flow (gpm)	20	20	10	20	30	20	10	5	5
Nominal Flow Rate (gpm)	30	30	20	30	40	30	20	10	10
Flow Range (gpm)	20-40	20-40	11-28	20-40	22-56	20-40	11-28	5-14	5-14
TDH (ft)	150	164	100	128	126	126	103	84	84
Grundfos Pump Model	SPO-6-10	SPO-6-10	SPO-4-6	SPO-6-8	SPO-8-9	SPO-6-8	SPO-4-6	SPO-2-7	SPO-2-7
Motor HP (Hp)	2	2	1/2	1 1/2	3	1 1/2	1/2	1/3	1/3
Pump Discharge Connection (in.)	2	2	1 1/2	2	2	2	1 1/2	1	1
Pump Discharge Line Connection (in.)	1 1/2	1 1/2	1 1/2	1 1/2	2	1 1/2	1 1/2	1	1
Well Discharge Line (in.)	2	2	2	2	2	2	2	1	1

Black coil pipe made of polyethylene, used as the discharge hose, connects the pump to the pitless adapter and the adapter to the meter chamber.

A panel located adjacent to each well provides electricity for each pump and contains the controls. (PW-6 and PW-7 control panels are in the treatment building.) Each well control panel contains a hand(on)-off-automatic switch for the well pump and alarms. There is also a level control panel that houses four adjustable pressure switches connected to the level sensing system. The levels are set as follows:

LS 1 - Low level alarm plus pump OFF control

LS 2 - Pump OFF control

LS 3 - Pump ON control

LS 4 - High level alarm

Each well is also provided with an air bubbler/transducer system to allow monitoring and control of the water level in the well. The water level, measured in feet above the air tube discharge, is indicated on the panel and is also transmitted to the main control panel in the treatment building. The well control panel also provides separate alarm indicators for the high level alarm, low level alarm, and pump starter trip or power failure alarm. Activation of any of these alarms will also activate an alarm in the treatment building. (The treatment building alarm does not indicate the separate types of alarm shown in the well panel.)

During normal operation the hand-off-automatic switch is set to the automatic position where the level switch turns the pump on and off. The motor starter includes a running time meter (Cramer Model 635 E) to keep track of the hours of pump operation.

Pump on and off switches and high and low water level alarms are activated by a control circuit consisting of a compressed air bubbler system and pressure transducer. Each well panel contains a complete pneumatic system for this operation. Air is supplied by an ITT compressor and 2-gal receiver mounted on vibration isolators.

Air flow rate is controlled by a Dwyer air flow controller and regulator. The receiver is equipped with a drain valve and tubing, which is connected to the bottom of the well panel. This permits removal of water from the receiver. The air intake is protected by a filter to prevent dust and dirt from being drawn into the compressor. The air is pumped from the air flow controller to the bubbler at the bottom of the well. A pressure gauge indicates the feet of water over the bubbler. The range will vary depending on the well. As the water level rises or falls in the well, the pressure will rise or fall. At preset levels in the well (feet of water above the bottom of the bubbler tube) the level switches will be activated to turn the pump on or off or to issue the high or low level alarms. The air flow can be controlled by the air flow control valve. The depth at which the level switches are activated can be adjusted, as explained below.

Each well panel is equipped with a thermostatically controlled electric heater manufactured by Rittal, operating on 110 volts with 200 watts of power. The heater will prevent condensation and freezing of any parts or equipment in the control panel. The heater should be set to go on when the ambient temperature reaches 50°F.

The water from the well passes through the polyethylene black coil pipe to the meter chamber for wells PW-4, PW-5, PW-9, PW-10, PW-11, and PW-12. The meter chambers are precast concrete chambers set into the ground to a depth of 8 ft. The chamber for wells PW-10 and PW-5 is 5 ft by 5 ft and the combined chamber for pump wells PW-4 and PW-9 is 5 ft by 5 ft 8 in. The chamber for PW-11 and PW-12 is sized to hold three meters and is 5 ft by 6 ft 4 in. Each chamber is fitted with a 3 ft by 2 ft 6 in. aluminum access door. Manhole steps spaced 1 ft apart are set into the wall of the chamber to provide access to the equipment. A 12-in. diameter by 3-in. deep sump in the bottom of the pit is fitted with a 4-in. diameter plug. The outside walls are insulated with 2-in. thick foam glass. The inside of the concrete roof slab and the inside of the aluminum hatch are also insulated as above. All piping, meters, valves, etc., in the chamber are also insulated.

The black coil polyethylene discharge line from the pitless adapter in each well is coupled with schedule 80 PVC pipe just outside the insulation of the chamber. The size of the PVC pipe is identical to that of the polyethylene pipe. The PVC discharge line then passes through the walls of the meter chamber. A 1/2-in. air valve is coupled to a tee on the PVC pipe. When the pump is started the valve is open to allow air to escape from the orifice. When water reaches the valve, the valve closes and stays water tight. The valve also permits air to reenter the orifice when the pump is stopped to allow drainage of water in the pipe riser from the pump. A reducer, 2 in. x 1 in., connects to schedule 80 PVC pipe and a flowmeter for PW-4, 5, 9, and 10. No reducer is needed for PW-11 and 12. The meter is a Badger Meter Inc. Model SC-ER industrial disc meter capable of measuring flow from 3 to 50 gpm. It is connected to a transmitter (Badger Meter Inc. Model FT-420) that will transmit total flow and instantaneous flow to the indicator in the meter chamber and the main control panel in the treatment building (except for the PW-6, PW-7, and PW-8 instantaneous flow indicators, which are located in the treatment building).

A Transmation model 210M indicator in the meter pit shows the instantaneous flow rate and a Newport model 202P indicator shows flow at the Main Control Panel. Totalized flow is produced by a KEP Model K0720 totalizer on the Main Control Panel.

A 3/4-in. angle valve (Angle Model 52301) is located after the meter and permits sampling of the pump well discharge. In case of long-term shut-down or power failure during freezing weather, the valve also must be opened to drain water from the meter back down to the well (see Chapter 8). A reducer located before the angle valve for PW-4, PW-5, PW-9, PW-10, and after the angle valve in PW-11 and PW-12 changes the piping to the same size as originally entered the chamber. A PVC ball check valve, GF Type 360, prevents flow from other pumps from flowing back into the well when the pump from that well is shut down or off during normal operation.

Meter chambers for PW-4, PW-5, PW-9, and PW-10 are fitted with a globe valve (GF-4 Type 301) that permits flow to be shut off and on and also controls the rate of flow from the well pump. Lagoon area wells PW-11 and PW-12 are shallow and therefore their discharges will tend to be more dependent on short-term changes in precipitation than those for the other recovery wells. The discharges from the wells will also depend on the operation of the lagoon area recycling systems. Therefore, these wells will exhibit a wide range of flows whose control is enhanced by self-modulating ball valves (McCanna Plast) fitted with an electronic activator (Ramcon Model 25 BR-4). An electronic positioner (Ramcon Auto-AMP D) supplied by an as part of the actuator modulates the valve controller in response to the input signal. The input signal to these self modulating valves is supplied by an air pressure transducer in the well control panel. The valve opens and closes in response to the water level in the well. Operation is described in Section 3.1.2.

The size of the piping out of the throttling valves for each well is 2-in. PVC, which connects to a 2-in. black coil polyethylene pipe outside the meter chambers. The 2-in. polyethylene pipe connects to the 6-in. diameter PVC common force main using 2-in. PVC flanged connections. Even though the meters for PW-4 and PW-9 are housed in the same meter chambers, the discharges from the meter pit are separate, with separate connections to the Common Force Main.

The piping from the modulating valves at the lagoon meter chamber passes through the concrete walls and is increased to 2 in. diameter. The two pipes then join to the 2-in. diameter Dedicated Lagoon Force Main, which is made of black coil polyethylene pipe.

At the high point in the trench carrying the common force main is a combination air/vacuum valve chamber. Constructed of precast concrete, it is the same size as one single meter chamber. The center line of the Common Force Main is 1 ft off the bottom. A 1-in. combination air vacuum valve (APCO Model 143 C.1 by Valve and Primer Corporation) opens when the pumps are turned off (power failure) to permit air to enter, releasing the vacuum and allowing the water to drain back to the wells. When the pumps turn on, air is released through the valve as the pipes fill with water. Space and sleeves are provided so that the Dedicated Lagoon Force Main can be diverted to the valve chamber, if an air/vacuum valve is deemed necessary in the future.

Because PW-6, PW-7, and PW-8 are pumped directly to the treatment building in separate 2-in. diameter black coil pipe force mains, the metering equipment and globe throttling valves are located in the treatment building. Control panels for PW-6 and PW-7 are also in the building; the control panel for PW-8 is outside near the well.

The material of the dedicated lagoon force main and PW-6, PW-7, and PW-8 force mains switches from polyethylene to PVC before the solenoid valve chamber. The Dedicated Lagoon Force Main, Common Force

Main, and PW-6, PW-7, and PW-8 force mains enter the solenoid valve chamber before going to the treatment facility. The chamber is precast concrete and measures 7 x 5 x 7-ft-4-in.-deep. A 3 x 2 ft-6 in. aluminum access door is provided as well as manhole steps to gain access to the piping and valves. Insulation, similar to that utilized on the meter chambers, is also provided.

Force mains for PW-6, PW-7, and PW-8 are fitted with a 2-in. ball check valve GF Model 150.360.536 to prevent backflow from other sources to the wells during power failure. The four 2-in. force mains (PW-6, PW-7, and PW-8 and the dedicated lagoon) are equipped with a 2-in. by 2-in. by 1/2-in. tee, to which is connected a 1/2-in. schedule 80 PVC pipe. The 6-in. common force main is fitted with a 1-in. nipple connection for the 1-in. schedule 80 PVC pipe. Each PVC line has a solenoid valve (ASCO Model 8210C34 for the 1/2-in. lines and ASCO Model 8210B57 for the 1-in. line) designed for normally open operation, i.e., valves are closed when energized, open when deenergized. Therefore, the valves open in case of power failure, which allows the water to drain from the force mains to the drainage sump. A 2-in. diameter schedule 80 PVC pipe at the bottom of the solenoid valve chamber will drain any water from the chamber to the drainage sump.

Each force main passes from the solenoid valve chamber underneath the treatment building, where a right angle bend allows the piping to come up through the floor of the treatment building approximately 2 ft off the western wall. The PW-6, PW-7, and PW-8 discharge lines have separate angle valves for sampling, as does the Dedicated Lagoon Force Main. The Common Force Main Sample Tap angle valve allows sampling of the combined discharge of PW-4, PW-5, PW-9, and PW-10. The Dedicated Lagoon Force Main and Common Force Main Sample Taps are 9 in. from the floor and are 3/4-in. Angle Model 5230 globe valves. As stated previously, the meters (Badger Meter) and throttling valves (GF Y globe valve Type 301) for PW-6, PW-7, and PW-8 are in the treatment building. The meters are 5, 4, and 3 ft from the floor for PW-8, PW-6, and PW-7, respectively. The 6-in. PVC Common Force Main makes a right angle bend to the north 8 ft 6 in. from the floor. The four 2-in. force mains join the Common Force Main at 1 ft 6 in., 4 ft 5 in., 5 ft 1 in., and 5 ft 10 in. along the Common Header force main from the right angle bend for the Dedicated Lagoon, PW-8, PW-6, and PW-7 force mains, respectively.

At a height of 6 ft 6 in. over the floor, a 3/4-in. PVC pipe is connected to the Common Header force main that permits sampling of the combined discharge of all pump wells. The sampling valve is 9 in. from the floor. A solenoid valve situated below the angle valve will open during power failure to drain the sample line and to aid in the draining of the Common Header Force Main from the top of the tower to the sample line. The Common Header Force Main is sloped slightly downward along the ceiling to aid in the drainage of this line. A 4-in. PVC floor drain carries any water in the floor of the treatment building to the drainage sump.

The Common Header Force Main makes another right angle bend through the roof of the building to the top of the tower.

3.1.2 Operation and Control

Since the yield of each well varies on a seasonal and daily basis due to variations in infiltration, each well is equipped with a control circuit consisting of a compressed air bubbler system with a pressure transducer located in the control panel to control the pumping water level within design limits, thereby permitting on/off cycling of the pump within a narrow 5- to 10-ft interval. Table 3-2 presents the various trigger points for which the control system will be set during start-up of the system. (Adjustments may be made to these depths during start-up.) Yields at individual wells

TABLE 3-2

NORMAL RANGE OF PUMPING WATER LEVELS AND ALARM WATER LEVELS

Brault Lagoon

WELL	PUMP DEPTH (BG)	AIRLINE DISCHARGE (BG)	LOW ALARM		PUMP OFF		PUMP ON		HIGH ALARM		NORMAL RANGE OF PUMPING	
			(BG)	(AA)	(BG)	(AA)	(BG)	(AA)	(BG)	(AA)	(BG)	(AA)
PW-4	116	67	63	4	40	27	30	37	25	42	30-40	37-27
PW-5	75	47	45	2	41	6	31	16	26	21	31-41	16-6
PW-6	85	54	50	4	45	9	35	19	30	24	35-45	19-9
PW-7	75	46	42	4	40	6	35	11	30	16	35-40	11-6
PW-8	75	45	41	4	39	6	30	15	25	20	30-39	15-6
PW-9	75	43	40	3	35	8	30	13	25	18	30-35	13-8
PW-10	75	44	40	4	38	6	30	14	25	19	30-38	14-6
PW-11	45	47	43	4	40	7	35	12	25	22	35-40	12-7
PW-12	44	44	40	4	30	14	25	19	20	24	25-30	19-14

BG - Depth (ft) below ground surface.
AA - Depth (ft) above the bottom of the airline.

will vary on a seasonal and daily basis due to changes in infiltration, precipitation, and snow melt (and recycle for the lagoon area wells). The estimated annual yield for these wells is presented in Table 3-3, but values during operation may vary from these figures and more accurate estimates can be determined after continued operation of the system. Table 3-4 provides summary information on the trigger points as depicted on the control panels; these points are in units of feet of water above the bottom of the air line.

As the yield of each pumping well varies during operation, the system operator must manually adjust the well throttling valve to compensate for these changes. If a recharge event (precipitation, snowmelt) were to occur when a well was significantly valved back, the well yield may exceed the restricted pumping rate capacity, causing water level in the well to rise above the desired target, thereby compromising effective capture. Since the primary purpose of the system is to maintain a continuous drawdown within design limits to facilitate capture of groundwater, the well throttling shutoff valve must be sufficiently open to allow for the likelihood of such recharge events during operation. The system operator must therefore maintain the instantaneous pumping rate 10% above the measured average pumping rate for the well. The average flow rate is equal to the total gallons pumped (given on the main control panel) over a long period of time, e.g., a week, divided by the time duration. The instantaneous flow rate is given by the instantaneous flow indicator in the meter chamber. (See Chapter 5 for tables with instructions on this calculation.) This 10% value can be adjusted in the future to limit on/off cycling, thereby extending pump life, as experience is gained by the system operator with respect to responses at individual wells during recharge events. The ideal method to do this is to use the running time meter in the well control panel and the flow totalizer (on the main instrument control panel). The totalizer flow volume divided by the minutes of actual operation yields the average gallons per minute. If this

TABLE 3-3

ESTIMATED ANNUAL AVERAGE PUMPING RATES

Brault Lagoon

WELL	RATE (gpm)
PW-4	14
PW-5	14
PW-6	21
PW-7	14
PW-8	7
PW-9	7
PW-10	14
PW-11	5
PW-12	5

TABLE 3-4

INDICATOR SETTINGS FOR PUMPING LEVELS AND ALARMS[a]

WELL	LOW ALARM	PUMP OFF	PUMP ON	HIGH ALARM
PW-4	4	27	37	42
PW-5	2	6	16	21
PW-6	4	9	19	24
PW-7	4	6	11	16
PW-8	4	6	15	20
PW-9	3	8	13	18
PW-10	4	6	14	19
PW-11	4	7	12	22
PW-12	4	14	19	24

[a]Depth (ft) of water above the bottom of the airline.

average is significantly more or less than 10% above the measured average flow, then the instantaneous rate should be adjusted accordingly by opening or closing the throttling valve. In other words, the pumps should be running about 90% of the time.

The pumps are turned on at the well feeder panel in the treatment building by throwing the circuit breaker switch. The hand-off-automatic switch at each well control panel is placed in the automatic position. The pumps will then be operated by the pressure switches in the well. The flow from the pump is controlled by the throttling valve in the meter pits for PW-4, PW-5, PW-9, and PW-10 and in the treatment building for PW-6, PW-7 and PW-8. Opening and closing the valve should change the flow rate, as seen in the flowmeter indicators. Initially the valves will have to be adjusted almost daily until the desired flow rates are obtained.

The self-modulating valves on PW-11 and PW-12 operate between two water levels in the well. The primary purpose of the self-modulating valve is to reduce flow out of the well as the water level drops. In other words, when the pump is turned on, the water level in the well is high (high level pump on switch) and maximum flow will occur. As the water level drops, the valve begins to close in order to reduce flow rate and thereby reduce the speed at which the pump dewaters the borehole. This operation will prevent excessive cycling of the pump. The valve is totally open at the pump on level and is 90% closed at the bottom of the air line in each well. Between these two levels (pump on and airline bottom), the valve setting will be between fully open and 90% closed. The valve will never be 90% closed, however, since the pump off position is above the bottom of the airline.

It is important to note that when the pumps are placed in operation the throttling valves will be opened to prevent the pump from burning out.

The pneumatic system in the well control panel is operated automatically. When the pressure reaches 30 psi for the receiver, the compressor will automatically start and continue operating until the pressure reaches 50 psi in the receiver when the compressor will shut off. The air flow rate can be controlled by using the air flow control valve. Initially, this should be set at 0.5 ft^3/hr. The location of the level switches that control the on/off feature of the pump and high and low alarms can be changed by turning the air supply on and off and/or manually turning the pump on and off and noting the levels at which the pressure switches operate (see Section 3.11.1 for specific operating instructions).

All wells are equipped with a warning system to detect high and low water level conditions outside the design limits. This system is operated by a control circuit consisting of the compressed air bubbler system and pressure transducer. If the water level in the well bore should fall outside the design limits, the pressure transducer will activate a general system warning light for that well in the treatment plant. The system also activates either a high or low water alarm light at individual well control panel to further identify the in-well problem for the system operator. At this point the system operator should proceed with the troubleshooting procedures outlined in Chapter 8.

Alarm lights are reset automatically when the water level recedes (in the case of high water) or recovers (in the case of low water) from the preset alarm water level setting. The hand-off-automatic control in the level control panel will allow the operator to turn off the pump during routine maintenance procedures (Chapter 6).

Appendix A also contains a specific troubleshooting guide published by the pump manufacturers for use in case of pump failure. The compressed air bubbler tube is tied off to the pump discharge line and can only be removed by removing the pump (see Chapter 6).

3.2 CHLORINATOR

3.2.1 Description

The chlorinator is used to control iron bacteria in PW-4 identified during its construction. The iron bacteria may, because of its filamentous structure, cause the pump or meter to clog; it may also coat the borehole walls such that the efficiency of the well would be severely affected. The bacteria may also lead to contravention of the TSS limit established in the Consent Judgement for the discharge from the treatment system outfall.

The chlorinator is an Autotrol Land-O-Meter Model LP-3000 dry pellet chlorinator with an electrical rating of 115V, 60/50 Hz, capable of feeding a maximum of six dry chlorine pellets per minute. The pellets slip through a pellet plate which is turned by the motor. The speed of the pellet plate can be adjusted to obtain the required rate of chlorination.

The pellets are 70% calcium hypochlorite (70% available chlorine) shipped in 35-lb pails. The chlorinator holds 15 lb of pellets in the chlorine storage housing. The chlorinator is mounted over the PW-4 casing in an above-ground precast concrete housing 5 ft^2 x 6 ft-8 in. high. A 3 x 3 ft aluminum access door in the roof and manhole steps are provided to permit access. There is space for another chlorinator if deemed necessary in the future. Flexible tubing (3/4 in.) carries the pellets into the well. The tubing is approximately 65 ft long and ends in a stainless steel screen basket. The basket prevents the pellets from being drawn into the pump housing and provides a place for the pellet to dissolve and initiate chlorination. A 1-1/4 in. pipe provides support for the chlorinator and is anchored into the ground to a depth of 4 ft. The access cover of the chlorinator chamber is fashioned similarly to those for the meter chambers.

3.2.2 Operation and Control

Access to the chlorinator is by a roof hatch to the chamber over the well casing. The chlorinator is operated continuously once turned on.

3.3 AIR-STRIPPING TOWER

3.3.1 Description

The air-stripping tower removes volatile organic compounds (VOCs) from the pump well discharge. Air is forced upward by a blower to strip the VOCs from the falling water that enters at the top of the tower. The aluminum tower, manufactured by Hydro Group Inc., is 37 ft high and 4 ft in diameter. Its base is housed in the treatment building; the top 26.5 ft are above the roof. The water enters the southeast side of the tower via the Common Header at 34 ft above the building floor. The 2-in. recycle line enters the tower at the same elevation 10.5 in. south of the header. The water then falls to a distributor tray capable of handling a flow range of 100-300 gpm. The tray is made of structural grade aluminum and includes an influent velocity breaker, air exhaust stacks, and distributor orifices.

The air exhaust stacks are sized to provide a gas velocity of 25 ft/sec. There are eight stacks each 8 in. in diameter. The velocity breaker, 10 in. in diameter, is situated in the center of the distributor tray. Its purpose is to prevent short circuiting of water in the distributor tray and to spread the water evenly over the tray.

The distributor orifices are sufficient in number to provide even distribution and are sized to retain water in the tray over the full range of projected flow rates. The distributor is capable of expansion to handle up to 400 gpm in the future by enlarging the orifices.

There are currently 112 1/2-in. water inlet orifices in the distributor tray. There are five additional redistributors, 5 ft apart, from 7 ft 11 in. to 27 ft 11 in. above the floor. The redistributors are 2-in. rings attached to the inside walls of the tower. The rings divert any water that may be short circuiting down the sides of the tower back toward the center of the packing.

The water exits the tower 8 in. above the treatment building floor via an 8-in. diameter pipe that is 10.5 in. east of the inlet. The water enters the effluent sump, which is described in more detail in Section 3.5.

The air enters the tower through an 15-7/8 in. high by 11-15/16 in. wide inlet 24-5/8 in. above the floor on the south side of the tower. The blower, related piping, and other information on the air system are described in Section 3.4.

Air exits the tower via the screened outlet, on the northwest quadrant of the tower. The outlet encompasses a 95° span of the tower, a 3 x 1 ft-3 in. area. A mist eliminator, York Demister Style 241, made of polypropylene mesh, eliminates water droplets from the exhaust air system. All air inlet and outlet openings are also provided with mesh screens.

The packing material is 2-in. diameter polypropylene Jaeger Tripacks. The packed height is 29 ft. The packing is supported by a packing support grating 37 in. above the floor. An 18-in. manhole above the grating provides access to the packing material and grate. There is another 18-in. manhole above the distributor tray on the north side of the tower to provide access to the distributor tray and mist eliminator. Five feet above the floor is a 6-in.

flanged inspection port that enables observation of the packing and operation of the tower.

3.3.2 Operation and Control

The tower is put in operation by turning on the power to the pump wells and blower. Treatment efficiency is controlled primarily by the relative loadings of air and water (the air/water ratio). At the projected average and maximum hydraulic flows (Chapter 2) the ratio should be 150:1 and 100:1, respectively.

3.4 BLOWER

3.4.1 Description

The air to the stripping tower is provided by a blower that delivers a minimum of 2800 cfm at a static pressure of 3.5 in. of water. The blower motor is rated at 3 HP, 110/220 volts single phase and 60 Hz and is enclosed in a weatherproof housing. The unit, Model 150 SWSI BCV, is manufactured by Twin City Fans. The air flow rate can be increased to 3800 cfm by installing a 7.5 HP motor and changing the belts and pulleys. The blower is installed 6 ft 6 in. south of the center of the tower and 3 ft from the west wall. The tower inlet air duct is 2 ft 7.5 in. from the floor and enters the south side of the tower. A vibration isolator is placed between the fan and the tower. A normally open pressure switch is on the air inlet duct. The switch will close on high and/or low pressure. It is adjustable from 0 to 8 in. of water. A pressure gauge, also located on the air inlet duct, measures air pressure from 0 to 8 in. of water. The switch and gauge are Dwyer Series 3000 photohelic. The controls for the blower are located on the power panel on the east side of the treatment building.

3.4.2 Operation and Control

The blower is turned on by an on-off switch at the power panel. An alarm condition indicated by the low pressure to the pressure switch will cut power to all pumping wells via an interlock. Low pressure would indicate a motor failure or air inlet blockage. High pressure would indicate a tower or manifold blockage. A non-emergency alarm is issued by a high pressure condition.

3.5 EFFLUENT LINE AND MONITORING

3.5.1 Description

The treated effluent overflows the above-grade tower sump via a discharge line to the adjacent concrete chamber inside the treatment building. The 8-in. discharge pipe from the air stripping tower enters the chamber 1 ft 9 in. from the southeast quadrant of the tower. After passing through the top of the sump, the pipe continues and discharges 11 in. from the bottom of the chamber. The chamber is 4 ft wide by 5 ft long by 5 ft deep. A 6-in. wide, 4.5-ft high concrete slab divides the chamber into two compartments, each 2 ft 3 in. wide. The side closest to the tower (referred to as the Recycle Sump) has 4 in. of concrete grout on the floor, whereas the other side (referred to as the Effluent Sump) has 2 in. of grout. The Recycle Sump is normally flooded with treated effluent; the Effluent Sump, normally empty. A 2-in. diameter PVC pipe (regulated by the normally closed Recycle Sump Drain Valve) through the upright slab at the bottom permits drainage from the Recycle Sump to the Effluent Sump so that the compartment can be fully drained in the event of a power outage. The Recycle Sump Drain Valve (Figure 1-2) at the bottom of the discharge side must be manually opened in case this drainage is required (see Chapter 8).

A 90° V-notched weir in the center of the slab between the two sumps allows measurement of the flow of water as it overflows the Recycle Sump to the Effluent Sump. The effluent flow is measured by a Drexelbrook Engineering Co. flowmeter Model 303-321-2-CD; the flow is indicated at the treatment building on the main instrument control panel by a Newport 202P indicator. The flow is recorded by a Foxboro Model Recorder 40 PR-RFELF-ES-A-21.

The effluent leaves the Effluent Sump via a 6-in. diameter PVC pipe on the north side of the sump. This gravity line pipe travels 39 ft to the north where a cleanout is provided, then turns northeast for a distance of 220 ft where another cleanout is provided. The line then turns north, paralleling Route 22, for a distance of 221 ft to another cleanout and then proceeds another 355 ft to a concrete headwall where the effluent is discharged to an unnamed stream. Cleanouts are easily accessible and are at the surface, ending in an 18-in. manhole. The insulation is 2-in. foamglass with Pittwrap jacketing and the heat tracing is Chemeler ATU-4 rated at 4 watts/ft and operating on 230 V.

3.5.2 Operation and Control

During normal operation the Recycle Sump Drain Valve is closed, and treated water will discharge from the base of the tower into the Recycle Sump before overflowing the V-notched weir to the Effluent Sump. The meter transmits a signal to the Foxboro recorder which provides a direct reading circular chart which must be changed weekly.

In case of a prolonged power failure during freezing weather, the Recycle Sump should be drained by opening the Recycle Sump Drain Valve at the base of the concrete slab on the discharge side of the sump.

The effluent line heat trace is thermostatically controlled and will go on when the outside temperature reaches about 45°F. The thermostat is adjustable and is located at the northeast corner of the treatment building.

3.6 RECYCLE PUMP

3.6.1 Description

The recycle pump is in the Recycle Sump. The pump enables treated groundwater to be pumped back to the lagoon area via the lagoon recycle force main for the flushing of chemicals in the soil and rock in the lagoon area. A special pump which can also be hooked up in place of the recycle pump and used to pump water to the top of the tower in case the tower needs cleaning. Chemicals such as dilute acid for removing iron buildup and sodium hypochlorite for destroying bacteria can be added to the sump. During any cleaning, the main pump wells are to be shut off.

The recycle pump is an Enpo-Cornell Model 151-4 1.5 HP submersible pump with an electrical rating of 230 V, 60 Hz, single phase with built-in thermal overload protection. The pump operates at 3450 rpm and is rated at 29-44 gpm at 108 to 94 ft of TDH. The recycle pump will normally pump to the lagoon area. Recycle flows must be less than the combined pumping of PW-11 and PW-12. An interlock is provided on the recycle pump to shut it off in the case of power outage or high level alarm signal at either PW-11 or PW-12. The pump is provided with a hand-off-automatic switch, and automatic level switches in the Recycle Sump control the on-off operation of the pump. The off switch is set at 3 ft 9 in. (3 in. above the pump inlet) below the top of the sump. The pump on switch is set at 9 in. below the top of the sump. During normal operation, the pump should be running continuously.

The discharge from the pump is through a 1.5-in. diameter PVC pipe to a 2 by 2 by 1-1/2 in. tee. The north side of the tee goes to the top of the tower; a throttling valve (Tower Recycle Ball Valve) is normally closed. The south side of the tee goes to another tee 2 by 2 by 2 in., with a reducing bushing fitted with a pressure gauge. The gauge measures the pressure in the line. A third tee (2 by 2 by 1-1/2 in.) provides a connection back to the Effluent Sump. A 1-1/2 in. throttling globe valve on this line (Recycle Sump Return Valve) is normally closed and permits drainage of the line in case of power failure. The rest of the line at the tee continues to another globe valve (Lagoon Recycling Throttling Valve) that controls the rate of flow back to the lagoon area. A meter after the valve measures the instantaneous flow and allows totalizing of flows at the main panel. The meter is similar to those used in the meter chambers for the wells. Another 2 x 2 x 1/2 in. tee is used to enable the placement of a 1/2-in. solenoid valve. The solenoid valve is normally closed when energized and opens on deenergization. The valve will automatically open during power failure to drain the line into the Recycle Sump. Another 2 x 2 x 2 in. tee is used to connect another valve (Lagoon Recycle Drain Valve), which is in the bottom of the Recycle Sump. This valve is opened only when the Recycle Sump Drain Valve is opened, and drains the line from the solenoid valve to the floor.

The pipe (2-in. black coil polyethylene), referred to as the Lagoon Recycle Force Main, is buried in the same trench as the Dedicated Lagoon and Common Force Mains and proceeds to the lagoon area. The recycle discharges to Lagoon No. 1 near PW-11 and PW-12, to percolate water into the ground.

3.6.2 Operation and Control

During normal operation, the hand-off-automatic switch on the power panel near the east wall of the treatment facility is in the automatic position. The following valves should be opened:

- o Lagoon Recycle Throttling Valve
- o Recycle Sump Return Throttling Valve (slightly open, as determined by experience - see discussion below)

The following valves are closed:

- o Tower Recycle Ball Valve
- o Lagoon Recycle Solenoid Valve
- o Lagoon Recycle Drain Valve
- o Recycle Sump Drain Valve

During normal operation, the Lagoon Recycle Throttling Valve is left fully open. The flow rate in the Lagoon Recycle Force Main is controlled by adjustment of the Recycle Sump Return Throttling Valve. With the Recycle Sump Return Throttling Valve fully open, all of the discharge from the Recycle Pump will recycle to the Recycle Sump. With the Recycle Sump Return Throttling Valve closed, all flow from the pump is transmitted to the Lagoon Recycle Force Main. The opening of the Recycle Sump Return Throttling Valve (and thereby the lagoon recycle flow rate) is to be set after the average pumping rates of PW-11 and PW-10 and their impact on dewatering the gravel deposits near the lagoon are evaluated. Once this rate is known, the pump rate can be set by adjusting the Lagoon Recycle Throttling Valve and reading the instantaneous flow rate on the indicator mounted near the meter.

The flow rate from the recycle will be less than that from the combined pumpage of PW-11 and PW-12 because of the natural recharge that occurs in the area. However, the natural recharge plus the recycle should approximately equal the combined pumpage of PW-11 and PW-12. Experience in the field will determine the flow rates to be utilized.

In case cleaning of the tower is deemed necessary, either by visual inspection of the packing or effluent or testing of the effluent, the manufacturer, Hydro Group, should be called before proceeding with cleaning. If cleaning is necessary, the following should be done:

1. In case of iron buildup:

   - Shut off power to well pumps at the well feeder panel by tripping the circuit breaker.

   - Shut off power to the recycle pump, sump pump, and blower at the power panel.

   - Close the following valves:

     - Lagoon Recycle Throttling Valve

     - Recycle Sump Drain Valve

     - Lagoon Recycle Drain Valve

     - Building Sump Ball Valve

After closing the valves, do the following:

- Open the port at the top of the tower and inspect the distributor tray for evidence of sand, clay, or scum.

- If buildup is observed, clean distributor tray with hand-held brush and mild acid or chlorine solution. Rinse any cleaning solutions after cleaning. Replace port hatch and bolt down tight.

- Remove Recycle Pump and replace with rental pump capable of handling acids

- Open the Recycle Sump Return Throttling Valve

- Turn on the acid pump

- Add acid (Drycid acid powder by Oakite Products, Inc.) to the recycle sump to the desired concentration needed to dissolve the iron (pH 1; do not exceed 8 oz/gal); recirculate through the piping, sump and pump until a stable pH level is obtained.

- Once the pH has stablized, the acid pump is turned off, the Recycle Sump Return Throttle Valve closed, and the Tower Recycle Ball Valve opened.

- The acid pump can then be turned on and the water will then cycle through the tower.

- Continue cycling until the iron is visually removed from the tower, i.e., red coloration disappears.

- Once recycling is completed, the pump should be shut off and the Tower Recycle Ball Valve closed. The Recycle Sump Return Throttling valve can be opened to drain the line.

- The acid in the sump is neutralized to pH 7 by the addition of Oakite Enprox 714. This procedure is the same as when acid is added to the sump.

- Once neutralized, the pump is turned off.

- The Tower Recycle Ball Valve and Recycle Sump Return Throttling valve are closed.

- The Building Sump Pump Ball Valve and Lagoon Recycle Throttling Valve are opened (the latter is reset to the same rate as previously used).

- The acid pump is removed and replaced with the recycle pump

- The sump pump, recycle pump, and blower are turned on at the power panel to the automatic positions.

2. In case of bacteria buildup:

   - Follow the same sequence as described in item 1 (above) including using a rental pump that can handle sodium hypoclorite, except add sodium hypochlorite to the Recycle Sump to achieve a concentration of 10 mg/l.

   - After cycling the chlorinated water through the tower for a period of 10 min, continue the cycling until the residual chlorine level is $\leq$ 1 mg/l before ceasing to recycle.

   - Continue as in item 1.

An alternative or supplemental algae control would be to stop well pumping for a period of time to dry the tower packing.

3.7 DRAINAGE SUMP

3.7.1 Description

The Drainage Sump is 7 ft west of the treatment building and 4 ft north of the valve chamber. The Drainage Sump collects the water that accumulates in the treatment building floor and exits the building in a 4-in. diameter line. The sump also collects the water that drains out of the PW-6, PW-7, PW-8, Common and Dedicated Lagoon force mains when there is a power outage and the solenoid valves in the Solenoid Valve chamber open. (For description of piping see Section 3.1.) The Drainage Sump is a 7 ft 8 in. x 13 ft 6 in. x 6 ft 2 in. deep precast concrete structure with the bottom sloped to an area on the east wall. The structure is buried to a depth of 4 ft 7 in.

A 3 ft by 3 ft opening fitted with an aluminum access door is at the top. There is a 3 ft by 3 ft precast concrete riser section to the sump fitted with manhole steps. A 4-in. diameter air inlet/outlet pipe north of the doorway vents the sump. It ends in an elbow fitted with a stainless steel bird screen.

The Drainage Sump Pump in the bottom of the sump is an Enpo-Cornell model 151-1 pump rated at 1.5 HP with electrical ratings of 230 V, 60 Hz, and single phase. The pump has a built-in thermal overload protector and operates at 3450 rpm. Pump capacity is 44-70 gpm at 84-48 TDH, respectively. The pump is controlled by a hand-off-automatic switch on the power panel in the treatment building. On automatic, the pump operates on level switches in the sump. The low level switch (pump off) is 2 in. above the bottom of the sump and the high level switch (pump on) is 6 in. above the bottom. When the pump is running, electric power to the pumping wells will be cut. When the pump stops running, power to the wells is automatically resumed. A high water alarm level switch is 2 in. below the roof of the sump; the switch will issue an alarm in the treatment building.

The pump discharge connection is 2-in. and the piping is 2-in. schedule 80 PVC. The pipe exits the sump on the east wall, approximately 7 ft 9 in. below the top of the access cover, and enters the treatment plant building from underneath 6 ft 6 in. from the northwest corner and 1 ft from the west wall.

The pipe travels vertically to a height of 4 ft where it connects with the recycle line to the top of the tower. Once at the top of the tower, the water is distributed over the distributor tray and is then treated in the same way as the influent from the Common Force Main.

3.7.2 Operation and Control

During normal operation, the pump is in the automatic position and turns on and off by the level switches. The Drainage Sump Pump Ball Valve should be opened and the Tower Recycle Ball Valve should be closed.

Unless the sump pump is operating because of drainage from the treatment building, its operation usually indicates an emergency condition, e.g., a leak or opening of the valves in the Solenoid Valve Chamber during a power failure or malfunction. For a description of the operation in case of a power failure or if the high level alarm in the sump is on, see Chapter 8.

3.8 TELEPHONE AND ALARM CHANNELS

Telephone service is provided by Chazy-Westport Telephone Company. A push-button wall-mounted phone fitted with a 25-ft cord is on the south wall of the treatment building. An automatic telephone dialer is mounted on the main instrument control panel. The unit, a National Butler Model ADAS IX, is equipped to handle four alarm input circuits plus internal power failure. These four alarm zones are as follows:

ZONE	ALARM
1	Fire
2	Intrusion
3	Emergency response
4	Non-emergency response

The zones to which each alarm signal is channeled are presented in Table 3-5.

The alarms for wells PW-11 and PW-12 are now connected to the non-emergency response zone. However, the interlock signal for shut-

TABLE 3-5

ALARM ZONES

SIGNAL	ZONE[a]
Well No. 4	4
Well No. 6	4
Well No. 7	4
Well No. 8	4
Well No. 9	4
Well No. 10	4
Well No. 11	4
Well No. 12	4
Effluent Sump - High Water (possibly plugged eff. line)	3
Effluent Sump - Low Water	4
Drain Sump High Water	3
Blower - High Pressure (all shut down)	3
Blower - Low Pressure (possibly no treatment)	3
Temperature Low (no heat in bldg)	3
Fire (call fire department)	1
Intrusion (call police department)	2

ZONE	ALARM
1	Fire
2	Intrusion
3	Emergency response
4	Non-emergency response

NOTE: Currently, all alarms are directed to Mr. Robert Morgan.

ting down the lagoon recycle pump is dependent on the high level alarm signal from these wells. If a local power outage occurs at PW-11 or PW-12, there would be no high water alarm signal to shut down the lagoon recycle. An alarm signal would be sent from the well panels but the operater would not know the cause until going to the site. Therefore, consideration should be give to channeling the alarm for these wells to the emergency response zone when the recycle system is operating.

3.8.1 Operation and Control

Currently an alarm signal will automatically call Mr. Robert Morgan at his home telephone number. As operation continues, other numbers may be added to the three remaining automatic dial up circuits.

3.9 HEAT AND VENTILATION

3.9.1 Description

Heat and ventilation are provided in the treatment building to prevent pipe freezing and to provide air circulation. Heat is provided by two electric unit heaters, one west of the main instrument control panel and one over the effluent sump. The heaters are Square D model UP 2415 5 KW heaters operating on single phase 240 volt current. Each heater is equipped with a built-in thermostat. A thermostat also provides a heat failure alarm. The thermostat is located on the east wall on the north side of the door.

The adjustable heating thermostats are set to automatically go on when the ambient air reaches 50°F and will go off when the temperature reaches about 53°F. An emergency alarm will be indicated when the temperature reaches 40°F and the heater is not on.

A ceiling fan is located over the main instrument control panel in the treatment building. The fan is a 10-in. 1725 rpm 1/4 HP Chelsea Model RDP105 fan fitted with a 115 V motor which produces 1285 cfm of air. An adjustable thermostat is set to automatically turn the fan on when the temperature exceeds 85°F and off at 82°F. The thermostat is located next to the thermostat for the heaters.

3.10 ELECTRICAL

3.10.1 Power Feed

Electric power supply is described in Section 1.3.6.

3.10.2 Main Panel

The main electric service (120/240 volts, single-phase, 3-wire, grounded neutral) enters the Main Panel "M" with a 225 amp main 2-pole circuit breaker. The arrangement is shown on design drawing No. 442-048-8, and the panel schedules are shown on drawing No. 442-048-9. In addition to various building circuits the Main Panel provides two branch circuit breakers: 100 Amp - 2 pole to Well Feeder Contactor "C1" and 100 Amp - 2 pole to the Power Panel.

3.10.3 Well Feeder Contactor

The Well Feeder Contactor "C1" is a 100 Amp - 2 pole magnetic contactor. The feeder passes through this contactor to Well Feeder Panel "F".

3.10.4 Well Feeder Panel "F"

Well Feeder Panel "F" includes four feeder circuit breakers as follows:

40 Amp - 2 Pole: Well No. 6

40 Amp - 2 Pole: Well No. 7

50 Amp - 2 Pole: Well Nos. 11, 12, 13

90 Amp - 2 Pole: Well Nos. 4, 9, 5, 10, 8

Thus operation of the control circuit of contractor "C1" switches all the well power feeders on and off. Interlock operation of the contractor is explained in Section 1.3.6.

3.10.5 Branch Circuits

The four branch circuits listed above supply underground direct burial feeders to the well control panels. Along the same routing are the "signal" cables, as indicated on drawing No. 442-048-10. These convey the instrumentation and alarm signals from the meter chambers and Well Control Panels to the Main Instrument and Control Panel in the building.

3.10.6 Building Services

Building Services include:

1. Building interior fluorescent lighting with wall toggle switch and several convenience receptacles.

2. Building exterior incandescent wall bracket lights, with photo-electric cell automatic control. A toggle switch inside provides "MANUAL-OFF-AUTOMATIC" control.

3. Two unit heaters with built-in contactor and thermostatic control. A separate thermostat is set and wired to provide a low temperature alarm.

4. A roof exhaust fan has manual motor starter for protection and disconnect and also a "HAND-OFF-AUTO" selector switch for operation. In "AUTO" a thermostat will operate the fan when the temperature rises to thermostat setting.

3.10.7 The Power Panel

The power panel provides combination circuit breaker and magnetic motor starter for:

1. The Blower
2. The Lagoon Recycle Pump
3. The Sump Pump

Selector switches and running lights for these units are provided on the Main Instrument and Control Panel. Operations are described in Sections 3.4, 3.6, and 3.7.

3.10.8 Solenoid Valves

Solenoid valves are provided on taps of the well pipelines coming to the Treatment Building. These are located in the Solenoid Valve Chamber adjacent to the building. There are also similar taps with solenoid valves in the building on piping to the stripping tower. These solenoid valves are open when de-energized and closed when energized. When open they will drain the pipes in the system. The intent is to prevent freezing of the pipe if there is a power outages (and loss of heat), by automatically draining the lines upon a power outage. All of these normally closed solenoids are connected to one circuit in the Main Instrument and Control Panel. An indicating light shows the circuit is energized. A test pushbutton on the panel de-energizes this circuit.

There is a normally open solenoid valve in the PW-4 meter chamber. Power interuption to PW-4 will close the valve to stop possible PW-4 artesian flow from discharging into the Common Force Main.

3.11 INSTRUMENTATION

3.11.1 Well Power and Control Panel

The Well Power and Control Panel is shown on design drawing No. 442-048-11. The instrumentation schematic diagram is shown on No. 442-048-7. Description of operation is given in Section 1.3.6 and in Sections 3.1 and 3.2. Also see I.T.S. drawings No. 103-PL-200 and 103-WD-201.

3.11.2 Main Instrument and Control Panel

The Main Instrument and Control Panel is shown on design drawing No. 442-048-10, with related diagram on No. 442-048-7. Note on the latter drawing the schedule of all signals brought to this panel not only for initial indication, alarm, and interlocking, but also for future data-logger or computer input. Also see I.T.S. drawing Nos. 103-PL-100, 103-WD-101, 102, and 103.

3.11.3 Interlocks and Alarms

Interlocks and alarms are described in Chapter 3.

3.11.4 Pump Controls

1. The well panel contains a Westinghouse magnetic motor starter with running time meter, red running light, and "HAND-OFF-AUTO" selector switch for the well pump. The pump may be turned on and off with "HAND-OFF" positions of the selector switch. In the "AUTO" position the well pump is operated from the level control system. The air bubbler system in the panel includes a bubbler tube which is extended down the well to a position above the pump. The air pressure gauge on the panel (in the bubbler line) shows the height, in feet, of the water level in the well above the bottom of the bubbler tube. In the panel there are two dual pressure switches, on the same bub-

bler line, which are set to provide four level signals. The four level signals LS 1, LS 2, LS 3, and LS 4 are connected to four corresponding control relays R1, R2, R3, R4. Operating functions are as follows:

- LS 1 provides for low level alarm signal and stops the pump. (This functions in both "HAND" and "AUTO".)
- LS 2 provides for stopping the pump in "AUTO".
- LS 3 provides for starting the pump in "AUTO".
- LS 4 provides for high level alarm signal, and also starts the pump in "AUTO".

  (High and low alarm signals function regardless of position of selection switch.)

2. Following construction of the system, the level signals were set to provide the on/off and alarm signals as presented in Tables 3-2 and 3-4. Level signals LS-1 and LS-2 are activated by falling water levels and can be adjusted by turning the dials on the switches either clockwise or counter-clockwise. The dials provide an imprecise indication of the level switch settings. Therefore, upon adjustment of the dials, the actual settings need to be verified according to the procedure described below. With the pump off, the bubbler tube connection of the pressure gage should be loosened thereby slowly releasing the pressure, simulating a falling water level. When the appropriate relay trips, the true settings for LS-1 and LS-2 can be read on the water level indicator. Level switches LS-3 and LS-4 are activated by rising water levles which can be simulated by opening the air flow regulator needle to increase back pressure. Whenever the level settings are changed, the new settings should be checked several times as described above and the new settings documented in Tables 3-2 and 3-4.

3. The minimum spacing between the pump on and off settings (LS-2 and LS-3) is 3.23 ft.

4. At least once a month the level reading of the bubbler system should be checked against a manual

water level measurement. Differences should be referred to the manufacturer for correction.

5. An alarm relay in the panel is connected across the hot leg of the control circuit and the line side of the overload relay contact. It is normally energized. When de-energized, the normally-closed contact will provide an alarm signal. It will be de-energized on each of the following occasions:

   - Loss of power.

   - Tripping or opening of pump circuit breaker.

   - Blowing of control circuit fuse.

   - Tripping of thermal overload relay in motor starter.

6. The power feeder extends from the Westinghouse magnetic motor starter with an H-O-A selector switch to a capacitor Franklin Electric "starter unit", furnished with the pump and installed in the bottom of the Well Panel. The power feeder passes through this circuit, and is then connected to the pump motor. The "starter unit" contains a run capacitor, a starting capacitor, and a relay for switching the starting capacitor off after the motor has started. There is also a thermal protector. The thermal protector will stop the the motor on overload. Most units will cool off and reset automatically; the reset takes several minutes. The 3 HP unit (Well No. 6) must be reset manually, by pushing a button on the bottom of the unit. The overload relay units in the Westinghouse magnetic starters are coordinated so that they should trip before the Franklin overload protectors. Tripping of an overload relay in the Westinghouse starter will give an alarm signal; manual reset is required (push the reset button on the cover of the starter). Tripping of the Franklin overload will not give an alarm signal. The operator should be aware that although tripping of the Franklin unit is not likely (the Westinghouse unit should trip first), it is possible. Therefore if it ever occurs that a pump is not running and there is no alarm, this possibility should be investigated. The vendors literature provides instructions for testing the Franklin unit.

CHAPTER 4

LABORATORY TESTING

4.1 SAMPLING PROGRAM

Quarterly VOC samples are to be collected from the sampling petcocks of each pumping well and Common Header Sample Tap (common influent header after input from PW-6, PW-7, and PW-8) leading to the top of the tower and from the effluent meter weir overflow. This quarterly sampling is to be coordinated (on the same day if practical) with the quarterly residential and surface water sampling.

Prior to sampling, the petcocks must be purged of stagnant water. For the pump well samples, only 1 oz of water needs to be purged. For the combined influent sample, at least 1.6 gal must be purged.

Samples must be collected on a semiannual basis from the effluent for analysis of copper, zinc, iron, BOD, TSS, TKN, and TRC. This sampling should be coordinated with the ongoing quarterly and semiannual residential, surface water, and groundwater monitoring sampling.

Sample containers and preservatives are specified in Table 4-1. All other samples are to be shipped to a contract laboratory. Chain-of-custody sheets are to be shipped with the samples.

Instantaneous flowmeter readings are to be recorded during the sampling.

In addition to the quarterly and semiannual sampling, pH or residual chlorine is to be measured from samples collected from the effluent weir sump whenever acid or chlorine is used for scheduled tower maintenance. No water should be allowed to exit the treated effluent line until the pH and residual chlorine levels are within required limits (Chapter 2).

The Consent Judgement requires that samples be collected from groundwater monitoring wells, surface waters, and residential water supplies. Except as noted below, all samples are to be analyzed for priority pollutant VOCs plus xylenes by GC EPA Method 601.

The following monitoring wells are to be sampled twice a year (semi-annual):

MW-1(S)	MW-13	MW-23
MW-1(M)	MW-14	MW-24
MW-1(D)	MW-17	MW-26
MW-7(S)	MW-21S	
MW-7(M)	MW-22	
MW-7(D)	MW-22S	

The following monitoring wells are to be sampled once a year (annual) with samples analyzed for priority pollutant VOCs plus xylenes by GC/MS EPA Method 624:

MW-4(S)

MW-12(S)

The following surface waters are to be sampled four times a year (quarterly):

South Spring (pool)

South Spring (spring)

South Spring (north outlet of wetland fed by this spring)

Jubert Spring

The following surface waters are to be sampled twice a year (semi-annual):

Outlet of wetland fed by Jubert Spring

Middle Spring

North Spring

Lake Alice Reserve Spring

The following residential supplies are to be sampled four times a year (quarterly):

[redacted] - house

[redacted] - rental

[redacted]

Samples at houses with carbon treatment systems are to be collected at the following taps:

Raw water

Between filters

Final effluent

Though not required by the Consent Judgement, samples are also tested for pH, residual chlorine, and pathogens (effluent only).

The following residential supplies are to be sampled once a year (annually):

[redacted]

One year after remedial system startup, proposals to the State will be made for modifying the above sampling. The schedules of all the above samplings are to be coordinated so that quarterly, semi-annual, and annual events occur on the same day, to the extent practical.

4.2 LABORATORY REFERENCES

The VOC samples collected from the pumping wells are to be analyzed for priority pollutant volatiles plus xylenes by gas chromatography (GC) EPA Method 601. The VOC samples collected from the influent and effluent are to be analyzed for priority pollutant volatiles plus xylenes by GC/mass spectrophotometry (GC/MS) EPA Method 624. A New York State-approved laboratory must be used to perform these tests.

The analytical methods for the remaining parameters must conform to the latest edition of the following references, or to any approved alternate or special method:

- Standard methods for the examination of water and wastewaters. 1985. American Public Health Association, New York, NY 10019. 16th edition.
- ASTM Standards. Part 31. Water, atmosphere analysis. American Society for Testing and Materials, Philadelphia, PA 19103. Latest issue.
- Methods for chemical analysis of water and wastes. March 1983. U.S. Environmental Protection Agency, Water Quality Office, Analytical Quality Control Laboratory, NECR, Cincinnati, OH 45768.

A New York State-approved laboratory must be used to perform these analyses except for pH. At least one of the above documents should be obtained to outline the pH and residual chlorine measurement procedures.

4.3 EQUIPMENT LIST

- pH probe and color-coded calibration standards
- Rain gage
- Calculator
- M-scope or water tape to measure groundwater levels in monitoring wells
- Residual chlorine test kit

CHAPTER 5

RECORDS

Duplicate copies of all records should be filed at the site and the Harris Corporation central office.

5.1 SAMPLING AND ANALYTICAL INFORMATION

Records descriptive of sampling conducted by plant personnel must be made:

- Date
- Time
- Sample location
- Sample type
- Sample inventory number
- Preservative added
- Sample container type
- Collector
- Meter readings

Chain-of-custody sheets supplied by the laboratory can be used for this purpose (Figure 5-1). If pH and residual chlorine measurements are to be made on-site, calibration sheets need to be filled out and filed (Figure 5-2).

5.2 MAINTENANCE

The basic four-card equipment file should consist of:

- Equipment data sheet (Figure 5-3)
- Inspection lubrication record (Figure 5-4)
- History of repairs (Figure 5-5)
- Spare parts (Figure 5-6)

FIGURE 5-1

LAWLER, MATUSKY & SKELLY ENGINEERS
CHAIN OF CUSTODY RECORD

PROJECT NUMBER:__________________ PROJECT TITLE:________________________

LMS FACILITY:____________________ FIELD PERSONNEL:______________________

SAMPLE TYPE (Circle): Drinking Water / Industrial Waste / Bottom Sediment / Soil / River/Ocean / Other__________ / Monitoring Wells / Treatment Facility / Leachate / Stream/Pond

SAMPLE ID NUMBER	DATE	TIME	STATION	PARAMETERS	REMARKS

Relinquished By:	Date/Time:	Received By:	Comments:
Relinquished By:	Date/Time:	Received By:	Comments:
Relinquished By:	Date/Time:	Received By:	Comments:
Method of Shipment:	Shipped By:	Received By:	
Received at Laboratory By:		Date/Time:	Comments:

FIGURE 5-2

LAWLER, MATUSKY & SKELLY ENGINEERS
LABORATORY QUALITY CONTROL DATA SHEET
pH METER CALIBRATION

Facility:______________ Month/Year:______________

DATE/TIME	JOB No.	CALIB. BY	METER No.	THERM. No.	TEMP. (C)	EXPECTED pH	OBSERVED pH	ADJUST. OB - EX	COMMENTS

Analytical pocket pH meters (Model 107) can only be adjusted for the first STD and then checked against the other STDs.

Orion Research pH meters (Model 230) can be adjusted for the first STD, slope adjusted for 2nd STD, and then checked against the 3rd STD.

FIGURE 5-3

SAMPLE CARD - EQUIPMENT DATA

EQUIPMENT DATA SHEET

☐ Pump ☐ Motor
☐ Generator ☐ Eng Driven
☐ Other

EQUIPMENT NAME	ID No.	REFERENCE No.	LOCATION

MANUFACTURER	LOCAL REPRESENTATIVE OR STORE	MODEL OR PART No.	SERIES No.

REFERENCE DWG.	REFERENCE CATALOG	INSTRUCTION BOOK	DATE PUT IN SERVICE

ELECTRICAL MOTOR	PUMP	DRIVE OR REDUCER
Hp / FRAME / RPM	CAPACITY / TDH / R.P.M.	Hp / RPM IN / RPM OUT
VOLTS / HERTZ / PHASE / AMP	SIZE / PACKING	RATIO
TYPE: ☐ SERIES ☐ SHUNT ☐ SYNCHRONOUS ☐ INDUCTION ☐ ________	TYPE: ☐ CENTRIFUGAL ☐ PLUNGER ☐ DIAPHRAGM ☐ GEAR ☐ SCREEN ☐ ________	TYPE: ☐ GEAR ☐ V-BELT ☐ CHAIN ☐ VARIDRIVE
SPECIFICATION: ☐ OPEN ☐ EXP. PROOF ☐ DRIP PROOF ☐ TOTALLY ENCLOSED ☐ ________	INSTALLATION: ☐ HORIZONTAL ☐ VERTICAL ☐ SUBMERGED LUBRICATION: ☐ WATER ☐ OIL ☐ GREASE	
BEARINGS: ☐ SLEEVE ☐ BALL ☐ ROLLER	BEARINGS: ☐ SLEEVE ☐ BALL ☐ ROLLER	BEARINGS: ☐ SLEEVE ☐ BALL ☐ ROLLER
LUBRICATION	LUBRICATION	LUBRICATION

OTHER EQUIPMENT	TYPE	FRAME	CAPACITY	RPM
	HP / VOLTS / HERTZ		PHASE / KW	KVA

ENCLOSURE	POWER FACTOR	OTHER FEATURES

NOTE:

FIGURE 5-4

SAMPLE CARD - INSPECTION AND LUBRICATION RECORD

INSPECTION AND LUBRICATION RECORD

TAG (ID) No.	EQUIPMENT NAME	LOCATION

MECHANICAL AND ELECTRICAL INSPECTION SCHEDULE

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
MECHANICAL	DATE																		
	INIT.																		
ELECTRICAL	DATE																		
	INIT.																		

		19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
MECHANICAL	DATE																		
	INIT.																		
ELECTRICAL	DATE																		
	INIT.																		

OIL CHANGE AND LUBRICATION SCHEDULE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
DATE																					
INIT.																					

	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
DATE																					
INIT.																					

PREVENTIVE MAINTENANCE INSTRUCTIONS

FIGURE 5-5

SAMPLE CARD - HISTORY OF REPAIRS

HISTORY OF REPAIRS					
DATE	DESCRIPTION OF REPAIRS (INC. PART No.)	SUPPLIER	COST		INITIALS
			MATERIAL	LABOR	

TAG (ID) No.	DESCRIPTION	LOCATION
NOTE:		

FIGURE 5-6

Sample Card - Spare Parts

SPARE PARTS IN STOCK

PART No.	Stock No.	DESCRIPTION	QUANTITY

5.3 SYSTEM PERFORMANCE

System performance must be monitored routinely. An initial monitoring schedule has been established for daily and twice weekly review of flow rates and water levels. After sufficient experience is obtained, the frequency of this monitoring will be reduced.

Daily monitoring requires review of meters and indicators in the treatment building. Two forms are provided for this purpose (Figure 5-7, Pumping Data; Figure 5-8, Recycle System).

The twice weekly reports require tabulation of flow rates for individual wells (Figure 5-9) and should be accomplished by an inspection of the individual well meter chamber and instrument panel to identify any abnormalities. However, all required information to complete the form is telemetered to the treatment plant with the exception of pump running time. If on any given day the individual pumping sites cannot be visited, then an alternate form is provided to obtain sufficient information (Figure 5-10). A form for monthly static water level readings is provided in Figure 5-11.

FIGURE 5-7

BRAULT LAGOON
DAILY TREATMENT PLANT
INSPECTION LOG

Date__________________

1. Average Flow

Last Measurement			Present Measurement		
A.	Time	____________ hrs.	D.	Time	____________ hrs.
B.	Date	____________	E.	Date	____________
C.	Gallons	____________ gal.	F.	Gallons	____________ gal.

Calculation

G. Time passed between measurements____________min. (D, E - A, B)

H. Gallons pumped between measurements____________gal. (F - C)

I. Average flow ____________gpm (H ÷ G)

J. Average flow ____________gpd (I x 144Ø)

2. Instanteaneous flow

A. Gallons pumped ____________gal.

B. Time to pump above volume ____________sec.

C. Instantaneous flow ____________gpm (A x 6Ø) ÷ B)

3. A. Instantaneous flow (plant effluent) ____________gpm

4. Warning lights

Well	Light On	Light Off
PW-4	________	________
PW-5	________	________
PW-6	________	________
PW-7	________	________
PW-8	________	________
PW-9	________	________
PW-1Ø	________	________
PW-11	________	________
PW-12	________	________

5. Precipitation (inches):______________________________

____

____

FIGURE 5-8

T01761(85) Form #2

BRAULT LAGOON
DAILY RECYCLING SYSTEM
INSPECTION LOG

Date__________________

1. Average Flow

Last Measurement			Present Measurement		
A.	Time	____________ hrs.	D.	Time	____________ hrs.
B.	Date	____________	E.	Date	____________
C.	Gallons	____________ gal.	F.	Gallons	____________ gal.

Calculation

G. Time passed between measurements____________min. (D, E - A, B)

H. Gallons pumped between measurements____________gal. (F - C)

I. Average flow ____________gpm (H ÷ G)

J. Average flow ____________gpd (I x 1440)

2. Instantaneous flow

A. Gallons pumped ____________gal.

B. Time to pump above volume ____________sec.

C. Instantaneous flow ____________gpm (A x 60) ÷ B)

3. Instantaneous flow (recycle indicator) ____________gpm

FIGURE 5-9

Form #3

TWICE-WEEKLY GROUNDWATER PUMPING WELL INSPECTION LOG

Well No. ___________

Date _______________

1. Average Flow

Last Measurement			Present Measurement		
A. Time	_________	hrs.	E. Time	_________	hrs.
B. Date	_________		F. Date	_________	
C. Gallons	_________	gal.	G. Gallons	_________	gal.
D. Run Time	_________	hrs.	H. Run Time	_________	hrs.

Calculation

I. Twice passed
between measurements _______________ hrs. (E,F - A,B)

J. Gallons pumped
between measurements _______________ gal. (G - C)

K. Average Flow _______________ gpm. (H/[G/60])

L. Average Flow _______________ gpd. (K x 1440)

M. Run Time _______________ hrs. (H - D)

2. N. Instantaneous Flow _______________ gpm.

3. Pumping Rate Ratio _______________ (N/K)

4. Run Time Ratio _______________ (I/M)

5. Water Level: _______________ ft.

5. Changes made to above: ____________________________________

____

____

____

6. Problems or Comments: ____________________________________

____

____

FIGURE 5-10

Form #3-ALT

TWICE-WEEKLY GROUNDWATER PUMPING WELL INSPECTION LOG

Well No. ____________

Date ________________

1. Average Flow

Last Measurement			Present Measurement		
A. Time	__________	hrs.	D. Time	_________	hrs.
B. Date	__________		E. Date	_________	
C. Gallons	__________	gal.	F. Gallons	_________	gal.

Calculation

G. Twice passed between measurements ________________ hrs. (D,E - A,B)

H. Gallons pumped between measurements ________________ gal. (F - C)

I. Average Flow ________________ gpm. (H/[G/60])

J. Average Flow ________________ gpd. (I x 1440)

2. K. Instantaneous Flow ________________ gpm.

3. Pumping Rate Ratio ________________ (K/I)

4. Water Level: ________________ ft.

5. Changes made to above: ____

____

____

____

6. Problems or Comments: ____

____

____

FIGURE 5-11

Form No. 4

WATER LEVEL LOG

Date ____________

WELL	TIME	DEPTH TO WATER LEVEL (TOC)	WELL	TIME	WATER LEVEL (TOC)
MW-1(S)			MW-19		
MW-1(M)			MW-20		
MW-1(D)			MW-21		
MW-2			MW-21S		
MW-3			MW-22		
MW-4(S)			MW-22S		
MW-4(M)			MW-23		
MW-4(D)			MW-24		
MW-5			MW-25S		
MW-5S			MW-26		
MW-6(D)			MW-27S		
MW-6S			MW-27D		
MW-7(S)			MW-28		
MW-7(M)			PW-1		
MW-7(D)			PW-2		
MW-8S			PW-3		
MW-9S			PW-4		
MW-10S			PW-5		
MW-11S			PW-6		
MW-12(S)			PW-7		
MW-12(M)			PW-8		
MW-12(D)			PW-9		
MW-12S			PW-9Y		
MW-14			PW-10		
MW-15			PW-11		
MW-16			PW-12		
MW-16S			SP-JS		
MW-17			SP-MS		
MW-18S			SP-SS		

CHAPTER 6

MAINTENANCE

6.1 GENERAL

Maintenance is the function of sustaining or restoring equipment so that the equipment performs its intended job effectively, safely, and economically. Efficient maintenance of the treatment facilities requires a well planned maintenance management system. The system, when carried out properly, should reduce breakdowns, extend equipment life, and encourage efficient manpower utilization.

6.1.1 Types of Maintenance

The three types of maintenance are preventive, corrective, and overhaul.

Preventive - Routine or scheduled care and inspection to prevent a breakdown or prolong equipment life.

Corrective - Unscheduled tasks required to restore equipment to operating condition following a breakdown or malfunction.

Overhaul - Major repairs, alterations, and replacement of parts to restore a unit to service, or to correct an operational problem.

Preventive maintenance of equipment is generally performed while it is in operation to maintain performance, reduce equipment wear, and extend equipment life. Routine inspection, scheduled lubrication, and minor equipment adjustments are typical preventive maintenance tasks. In general, preventive maintenance does not require removal of the equipment from operation. However, in some cases, the removal of equipment components to accomplish the prescribed maintenance during an outage of the equipment may be necessary. Preventive maintenance should be performed in accordance with procedures and schedules recommended by equipment manufacturers in their O&M Manuals. See List of O&M Manual in Appendix A.

Corrective maintenance is required for minor repairs and nonroutine maintenance functions such as replacing worn belts, bearings, or brushes after a breakdown, or when routine inspection indicates a need for a corrective task performance to assure a continued reliability of function of the equipment.

Overhaul means a complete disassembly of a piece of equipment. The equipment is carefully inspected, repaired or replaced in whole or in part, as required, and reassembled, tested and restored to service. Overhaul usually is a more costly and time consuming task and is sometimes awarded to an outside contractor to expedite restoration to service of a special equipment item.

6.1.2 Maintenance Plan

6.1.2.1 Equipment File. In order to have an affective maintenance plan, records of equipment must be kept to record all pertinent information.

Examples of records to be kept are shown in Figures 5-3 to 5-6.

The equipment file cards presented in Chapter 5 are for illustrative purpose and may be modified as necessary.

6.1.2.2 The Maintenance Planning and Schedule. Efficient maintenance requires the proper planning and scheduling of preventive maintenance, and to the extent possible, of corrective maintenance, repairs and alterations. To facilitate planning and scheduling, a schedule chart board, work order system, daily or weekly work-sheets, and general priority schedule sheet may be used. A well-planned and scheduled program should incorporate the following considerations:

- The manufacturer's O&M manuals are generally the best guide for preventive maintenance instructions and should be used accordingly. However, actual frequency of maintenance for each piece of equipment should be determined based on the plant overall maintenance schedule.

- Routine preventive maintenance tasks should be included as part of the standard operating procedures to the maximum possible extent.

- The maintenance program should consider priority. Overhaul and corrective maintenance is generally of higher priority than preventive because it affects the immediate functioning of the plant. The amount of work and time required for the overhaul and corrective maintenance can be initially estimated based on manufacturer's input and general experience and subsequently modified after sufficient maintenance data are recorded.

- The amount of work that can be accomplished will be determined by the size and capabilities of the maintenance staff. Excess work or work beyond plant capabilities, due to limitations in maintenance equipment and manpower, should be done by contractors.

- The maintenance schedule should be flexible to allow for changes in accordance with immediate needs and conditions. For example, indoor and outdoor tasks should be scheduled so that weather conditions will not affect the progress of maintenance work.

- Seasonal tasks such as snow removal, minor road and walkway repairs, exterior painting, and lawn and landscaping work and long-term work such as roofing, pavement and road repairing, fencing, and painting should be considered in the program.

- The ability to handle emergency conditions and repairs should be evaluated. Based on a review of the capabilities of maintenance staff, availability of tools and parts, and possible emergency conditions, the need for assistance from outside contractors can be determined. Advance arrangements for outside assistance should be made.

6.1.2.3 Schedule. A schedule for preventive maintenance can be used in scheduling all maintenance work. Preventive maintenance planned for each month can be filled in and moved or rescheduled to another day if corrective or overhead maintenance is required.

6.1.2.4 The Storeroom and Inventory System. A central storage area should be set up in the treatment building to store spare parts, equipment, special tools, and supplies.

Quantities of spare parts, chemicals, and supplies to be maintained is a function of the nature of the equipment, the delivery time consumption rate, and plant overall maintenance budget. The equipment manufacturer's recommendations are normally the best source of information for determinating the needs for spare parts and supplies.

To facilitate inventory filing, a card file system should be developed. A sample inventory card as shown in Figure 6-1 contains information on part description, Item (ID) No., quantity used or stocked, date, signature, quantity on hand, Work Order No. or Purchase No. Other information can be incorporated in the card as necessary. Stocked items should be replenished from time to time as the quantity of the items is depleted. The replenishment should be done in a timely manner. A purchase order similar to Figure 6-2 can be used or modified.

6.2 EQUIPMENT AND TOOLS

6.2.1 Special Tools

A special tool required for the maintenance of specific items of equipment is a pressure switch calibration tool which is used to

FIGURE 6-1

SAMPLE - INVENTORY CARD

STOREROOM INVENTORY CARD　　Item No. ______________

Item Description　　Aisle No. ______________

Bin No. ______________

Quantity Maximum ________________ Minimum ________________

Reorder ________________

INVENTORY INFORMATION

Quantity Used or Stocked	Date	Signed	Quantity on Hand	USAGE OR SUPPLY INFORMATION Usage - Work Order No. Supply - Purchase Order No.

FIGURE 6-2

SAMPLE PURCHASE ORDER FORM

TO ____________________

____

____

SHIP TO ____________________

____

____

IMPORTANT

Our Purchase Order Number must appear on Invoices, Packages, and Correspondence.

PURCHASE ORDER No. ____________

WORK ORDER No. ____________

DATE INITIATED ____________

DATE REQUIRED ____________

SHIP VIA ____________

F.O.B. ____________

TERMS ____________

____

____

QUANTITY	STOCK NUMBER/DESCRIPTION	PRICE	PER	TOTAL

APPROVED BY:____________________ DATE:____________

SHEET ____ OF ____

test the pressure gauges. Everyday handy man tools such as screw drivers, wrenches, hammers, etc., are provided by the operator.

6.3 PROTECTIVE COATING

6.3.1 General

All exposed metal surfaces, both internal or external must be adequately protected against deterioration due to corrosion. Application of protective coating on exposed surfaces is a common method of corrosion prevention. When installed, all equipment, piping, structural steel, iron work and miscellaneous items such as valves, fittings, supports, hangers, etc. are coated with protective paints. These coatings must be carefully maintained.

Examination of protective coatings should be part of the routine inspection schedule. Repainting should be done whenever necessary. Quality of the replacement paint should be at least equal to or better than the original coating and applied in complete accordance with the manufacturer's instructions.

6.3.2 Paint Schedule

Specific requirements for painting and protective coating are presented in Section 9.1 of the Specifications. When repainting is required, the painting schedule shown in Table 6-1 should be followed.

6.4 GENERAL MAINTENANCE

Table 6-2 lists all the equipment at the West Chazy treatment facility, the manufacturer, model number, frequency of maintenance and malfunctions operation and maintenance (O&M) Manual reference number. Manufacturers O&M Manuals are included in Appendix A.

TABLE 6-1

PAINTING SCHEDULE

SURFACES	PAINT (CARBOLINE CO.)	PAINT (TNEMEC)
Exterior ferrous metal	1 - Rustbond 8 HB primer at 2 mil 1 - 133 HB finish at 5 mil	1 - 37-77 Chem Prime @ 2 to 3 mils 1 - 66 Epoxoline @ 4 to 5 mils 1 - 71 Endurashield @ 1.5-2.5 mils
Interior Ferrous Metals, non-submerged, normal conditions	1 - Rustbond 8 HB primer at 2 mil 1 - 133 HB finish at 5 mil or 1 - 190 HB finish at 5 mil	1 - 37-77 Chem Prime @ 2-3 mils 1 - 66 Epoxoline @ 4-6 mils
All submerged or intermittently submerged ferrous metal	2 - 191 primer @ 4-6 mils/coat	2 - 66 Epoxoline @ 4-6 mils/coat

TABLE 6-2 (Page 1 of 3)

MAINTENANCE SCHEDULE

EQUIPMENT	MANUFACTURER	MODEL No.	FREQUENCY	O&M MANUAL REFERENCE (APPENDIX A)
Well submersible pumps	Grundfos	SPO-6-10	Quarterly	A
		SPO-6-8	Quarterly	A
		SPO-8-9	Quarterly	A
		SPO-4-6	Quarterly	A
		SPO-4-7	Quarterly	A
Air Compressor/ Receiver	ITT Pneumotive	LGH-305-H02	Monthly	B
Enclosure Heater-200W	Rittal	SK 3107		___[a]
Thermostat	Mercoid	860-2-61		___[a]
Pressure Switches	Transamenca Delaval	CD2H		___[a]
Pressure Gauge Transmitter	Foxboro	841GMA		___[a]
Air Flow Controller	Dwyer	VFA-SSV-RKA		___[a]
Elapsed Time Indicator 635E	Cramer	10055		___[a]
Flow Meter	Badger	SC-ER	Quarterly	C
Flow Transmitter	Badger	FT-420	Quarterly	C
Flow Indicator	Transmitter, Inc.	210 m		___[a]
Air Valve	Apco	141 TWD		___[a]
Angle Valve	Angle	5230		___[a]
Ball check Valve	GF	Type 360		___[a]

[a]Manufacturers O&M manual not submitted.

Table 6-2 (Page 2 of 3)

MAINTENANCE SCHEDULE

EQUIPMENT	MANUFACTURER	MODEL No.	FREQUENCY	O&M MANUAL REFERENCE (APPENDIX A)
Ball Valve	GF	Type 342		___[a]
Modulating Ball Valve	McCannaplast	1 in.		___[a]
Chlorinator	Autotrol	Land-o-matic RP-3000		___[a]
Combination Air/Vacuum Valve	Apco	143C		___[a]
Y-Globe Valves	GF	Type 301		___[a]
Solenoid Valves	Asco	8210B57 8210C34		___[a]
Drainage Sump Pump	Enpo-Cornell	151-1		___[a]
Recycle Pump	Enpo-Cornell	151-4		___[a]
Electronic Actuators	Ramcon	25BR		___[a]
Electronic Positioner	Ramcon	Auto-amp#D		___[a]
Pittless Adapter	Dicken Manufacturing Co.			___[a]
Air Stripping Tower	HydroGroup	PCS-48.29	Semi-Annually	D
Packing Material	Jaeger	Tripacks	Quarterly	D
Pressure Switch Gauge	Dwyer	3008 Photohelic		___[a]
Mist Eliminator	York	Demister Knitted Mesh Style 241		E

[a]Manufacturers O&M Manual not submitted.

Table 6-2 (Page 3 of 3)

MAINTENANCE SCHEDULE

EQUIPMENT	MANUFACTURER	MODEL No.	FREQUENCY	O&M MANUAL REFERENCE (APPENDIX A)
Acid Cleaner	Oakite	Drycid	When iron builds up	E
Neutralizing Material	Oakite	Enprox 714	When iron builds up	
Blower	Twin City Fan	150 SWSI BCV		F
Effluent Flowmeter	Drexelbrook Engineering Co.	303-321-2-CD		G
Chart Recorder	Foxboro	40 PR RFELF ESA-21		H
Digital Indicator	Newport	202P		___[a]
Flow Totalizer Counter	Kessler-Ellis	K-Series		___[a]
Heat Trace	Chemelex	ATV-4		___[a]
Automatic Telephone Dialer	National Butler	ADAS II		___[a]
Building Heaters	Square D	UP 2415		___[a]
Heater Thermostat	Square D	G 860		___[a]
Ceiling Fan	Chelsea	RDP105		___[a]
Transmitter	AGM	TA4000		
Integrator	AGM	4011		

[a]Manufacturers O&M Manual not submitted.

6.4.1 Pump Removal Procedure

To pull the pump from the well, the following should be done:

- Take flow measurment at meter pit.
- Shut off pump at well control panel by moving hand-off-automatic switch to off position.
- Disconnect electrical at well control panel.
- Unlock and remove locking cap from well casing.
- Pump is removed by pulling up on galvanized pipe and nylon cord (nylon cord is attached to the pump as precautionary measure).
- Alternatively, the nylon cord can be fitted through a pulley attached to a tripod containing a winch. This method is safer and easier.
- Special precautions are required for the removal of the pumps in PW-4 and PW-11 (see Section 6.4.3).

When replacing the pumps, the following should be done:

- Lower the pump into the well by a tripod and winch system or by hand, using the galvanized pipe.
- If the pitless adapter is above water level in well, use flashlight to check that seating is proper. The removable portion of the pitless adapter attaches to the permanent portion by a sliding fit that requires a slight amount of pressure. The pump can be rotated by using the galvanized pipe.
- If the water level is above the pitless adapter, the seating will have to be done by feel.
- Once the electrical cord is reconnected and the power turned on to the automatic position, the flow rate in the meter should be checked. If it is approximately the same as the flow measurement taken prior to pump shut off, then the seat is tight.

- The seating can also be checked by observing the pump with a flashlight. If the water level is below the pitless adapter and the seating is improper, water will be observed discharging from the adaptor back into the well. If the water level is above the pitless adapter, some churning of the water will be observed if the adaptor is improperly sealed. Corrections should then be made in the seating if needed.

- The locking cap and padlock is put back on.

Once the pump is removed the following should be done:

- Inspect pump intake screen for build up of sand, grit, iron bacteria or other debris which could clog intake. Clean with tap water if needed.

- Check discharge hose and bubbler tube for any leaks or deterioration. Replace with new pipe if needed.

- Check electrical wiring for damage.

If after two successive quarters of pump inspection cleaning is not required, the maintenance schedule can be changed to require a semi-annual or annual inspection.

6.4.2 Meter Screens

Meter screens should be removed and cleaned quarterly. The pump must be turned off before the meter is removed. The procedure is shown in manufacturers O&M Manual C. This maintenance is particularly important, since clogging of the screen will reduce flow from the well. If after two successive quarters of removal, the screens need little or no cleaning, this schedule can be reduced to require semi-annual or annual cleaning. However, more frequent cleaning may also be necessary depending on the condition of the screens.

6.4.3 Pump Screens

Pump screens (sand separators) are installed on pumps in Wells PW-4 and PW-10. When these pumps are removed from the wells, these screens should be checked and manually cleaned if needed. Special precautions are required for the removal of the pumps as described below:

The separators are fabricated from hard, brittle plastic cylinders that extend 5 ft below the bottom of the pump. Before removing the pump (and attached separator) from the well, a working platform should be positioned 5-6 ft over the top of well casing. (A tripod with pulley may be a practical alternative for assistance in removing the pump.) The pump and separator assembly can then be removed from the well. The assembly must be kept vertical while being removed from the casing to avoid any sideways or tipping pressure on the separator. Any such pressure will break the separator. Likewise, during reinstallation, the assembly must be kept vertical until the pump is below the pitless adapter.

6.4.4 Drainage Sump

Maintenance in the drainage sump or on the Drainage Sump Pump can only be done after power is cut to the pump wells by opening these circuits in the main power feeder panels. (A power outage that would open the solenoid valves while personnel are in the drainage sump will result in a dangerous situation.) The drainage sump is by definition a confined space, and therefore no one should enter it without using confined space entry procedures. These procedures are: (1) air monitoring for oxygen level, explosive gases and toxic gases, (2) use of a safety harness on the person entering the sump, and (3) standby of two people outside to respond to an emergency.

CHAPTER 7

STARTUP AND SHUTDOWN

7.1 STARTUP

Assumes all circuits off and all valves closed.

1. Main Panel Circuits On

   M1 - Lighting, indoor
   M2 - Receptacles
   M3 - Lighting, outdoor
   M4 - Receptacles
   M5 - Fan
   M6 - Control and instrument panel
   M7 - Auto telephone dialer
   M8 - Control and instrument panel
   M11 - Unit heater
   M12 - Unit heater
   M13 - Power panel (verify sump and lagoon recycle pumps are off)
   M14 - Well feeder contactor
   M15 - Heat trace cable
   M16 - Heat trace cable

2. Light Switches - On (2)

3. Ventilator Fan - Auto

4. In-Plant Valves and Pumps

   a. Verify sample taps closed.

      PW-6
      PW-7
      PW-8
      Common Force Main

   b. Verify valves closed.

      Lagoon Recycle Drain Valve
      Recycle Sump Drain Valve

c. Valves open.

Building Sump Pump Ball Valve
PW-6 Throttling Valve
PW-7 Throttling valve
PW-8 Throttling valve

d. Verify recycle pump off.

e. Verify sump pump off.

5. Fill Recycle Sump

(Use house water to fill sump at least 4 in. above bottom of tower drain.)

6. Power Panel Circuits - On

Blower
Sump Pump
Lagoon Recycle Pump

7. Switches

a. Blower - on
b. Sump Pump - auto
c. Recycle - off
d. Push to test

8. Well Feeder Panel Circuits - On (First verify panel circuits for individual well panels are off.)

a. F1 - Well 6
b. F2 - Well 7
c. F4 - Wells 4, 9, 5, 10, and 8
d. F5 - Wells 11 and 12

9. Well Valving and Electrical Systems

a. PW-6 Well Panel Circuits - On

1 - Light
2 - Control panel
3 - Receptacle
4 - Control panel
5 - Space heater
8 - Well pump

b. PW-6 Control Panel

Light - on
Air compressor - on
Selector switch - auto or on, then off to test
Push to test
Heater - auto
Light - off

c. PW-7 Well and Control Panel (same as a and b)
d. PW-8 Well and Control Panel (same as a and b)
e. PW-4/PW-9 Meter Chamber

Sample taps - closed
Throttling valves - open

f. PW-4 Well Panel (same as a, plus Circuit No. 6, chlorinator on)
g. PW-4 Control Panel (same as b, plus chlorinator switch on)
h. PW-4 Chlorinator start (Chapter 3)
i. PW-9 Well and Control Panels (same as a and b)
j. PW-5 Panels and Chamber (same as a, b, and e)
k. PW-10 Panels and Chamber (same as above)
l. PW-11/PW-12 Panels and Chamber (same as above)

10. <u>To Start Lagoon Recycle</u> (assume drawdown established in PW-11 and PW-12)

a. Open Lagoon Recycle Throttling Valve
b. Switch Recycle Pump to auto

11. <u>Auto Telephone Dialer</u> (See Chapter 3).

7.2 SHUTDOWN

1. <u>Lagoon Recycle</u>

a. Switch Recycle Pump to off
b. Leave Lagoon Recycle Throttling Valve open

2. <u>Well Feeder Power Circuits</u>

a. Switch all circuits to OFF
b. Verify that solenoid valves in Solenoid Valve Chamber have opened

3. <u>Well Valving and Electric Systems</u>

a. Well Panel Circuits

1. All well power switches to OFF
2. PW-4 chlorinator switch to OFF only if artesian conditions are present
3. In cold weather, the panel heater switches should be left on
4. Remaining circuits can optionally be left on

b. Air Compressor

Drain water, if present, from accumulator valves

c. Sample Taps

1. Open taps to enhance drainage from pipes
2. Close taps

d. Throttling Valves - valves can optionally be closed

4. <u>Well Feeder Power Circuits</u>

a. All switches to ON in cold weather
b. Switch F4 to ON if PW-4 is not artesian

5. <u>Interior Valves</u>

a. Turn Main Panel circuit to OFF in order to open Common Header Solenoid Valve and Lagoon Recycle Solenoid Valve.
b. After Solenoid valves finish draining, turn Main Panel circuit to ON.

c. Sample Taps opened to drain and then close:

- Common Header
- PW-6
- PW-7
- PW-8
- Common Force Main
- Lagoon Force Main

6. <u>Blower</u>

a. Verify Drainage Sump is at low water. Additional water can optionally be removed by switching Drainage Sump Pump from AUTO to ON until air reaches the pump intake.
b. Blower switch to OFF.

7. Interior Valves

a. Valves to open:

- Recycle Sump Drain Valve
- Lagoon Recycle Drain Valve
- Recycle Sump Return Throttling Valve
- Lagoon Recycle Throttling Valve
- Tower Recycle Ball Valve

b. Above-listed valves to close after sumps/lines are drained.

8. Main Panel Circuits

Opening (switch to OFF) of circuits is optional except for M14, M15, and M16, if cold weather is present, or if the PW-4 chlorinator is to continue operating (Circuit M14).

CHAPTER 8

EMERGENCY OPERATION AND RESPONSE

8.1 RESPONSE TO POWER OUTAGE

No electrical generating backup facilities exist at the site. In the event of a power outage, the system will shut down until power is resumed. Not until power is resumed will the system automatically restart. Because groundwater moves slowly, there should be no escape of the chemical plume during even a prolonged outage.

As a protection against freezing water during the winter, the system is equipped with eight solenoid-activated valves, seven of which open when the electric power to them is cut, and one which closes (Figure 1-2). Five of these valves are located in the below-ground solenoid valve (S.V.) chamber:

PW-6 S.V.

PW-7 S.V.

PW-8 S.V.

Common Force Main S.V.

Lagoon Force Main S.V.

Two solenoid valves are located in the treatment building:

Common Header S.V.

Lagoon Recycle S.V.

As noted previously, these valves drain to the Building Sump when opened. The last solenoid valve is located in the PW-4 meter chamber and is in a normally open position. Under natural groundwater flow conditions, PW-4 is an artesian well. In the event of a prolonged power outage, the water level in this well may rise to the chamber. To eliminate possible artesian flow to the Common Force Main during a power outage, the solenoid valve will close.

The air valves provided in the meter chambers for PW-4, PW-5, PW-9, PW-10, PW-11, and PW-12 allow draining of their respective pump discharge lines when these pumps are shut down.

These features fully drain all water from the system, except as follows:

- Deeply buried segments of the Common Force Main, Lagoon Force Main, and Lagoon Recycle Force Main. These segments are protected from potential freezing by virtue of their depth.

- Building Sump, also deeply buried.

- Recycle Sump, this unit is exposed to freezing but is fabricated of steel reinforced concrete.

- Lagoon Recycle Line inside the treatment building below the Lagoon Recycle Solenoid Valve. This line is submerged in the Recycle Sump.

- Fittings and pipes in the PW-4 PW-9, PW-5, and PW-10 meter chambers. Suction created by the draining of the Lagoon Force Main should purge water from the fittings in the PW-11 PW-12 Meter Chamber. (The fittings in the other meter chambers may also purge, but this has not been evaluated.

In the event of a power failure, an alarm will be issued through the automatic dial-up system. The response to this alarm should determine the cause of the failure (areawide failure by New York State Electric & Gas Co. or local failure in, e.g., the overhead service line).

Assuming the on-site electrical system is intact, e.g., electric power company failure, no further action is required (the system will automatically self-start when power is resumed) if one of the following conditions exist:

1. Nonfreezing weather

2. Freezing weather, but outage not prolonged

In the event of a prolonged outage during freezing weather, the following actions are required:

1. Notify the Harris Corporation Engineer

2. Open Recycle Sump Drain Valve

3. Open Lagoon Recycle Drain Valve

4. Open circuits F1, F2, F4, and F5 in Well Feeder Panel so that power will be disconnected to all pumping wells when street service power is resumed.

5. On Instrument and Control Panel:
   Blower Switch - off
   Recycle Pump - off
   Sump Pump - off

6. Open all sample taps in PW-4/PW-9, PW-5, and PW-10 meter chambers (delete this step if the chamber fittings purge by vacuum)

After a prolonged freezing period shutdown, the following steps are required to restart the system:

1. Verify that treated effluent outfall is not blocked at stream crossing Route 22. Blockage from ice in the effluent pipe will be released by subsequent heating by the heat tape.

2. Close Recycle Sump Drain Valve.

3. Close Lagoon Recycle Drain Valve.

4. Fill Recycle Sump with house water until tower drain is submerged by 4 in.

5. Blower Switch - on

6. Sump Pump - auto

7. Close sample taps in PW-4/PW-9, PW-5, and PW-10 meter chambers.

8. Close Well Feeder Panel Circuits F1, F2, F4, and F5.

9. In five* days: Recycle Pump - auto

8.2 RESPONSE TO ALARMS

8.2.1 Pumping Wells and Controls

(This section has been prepared by R.E. Wright Associates, Inc. [REWAI].)

The following problems may be encountered on the collection well system. When one of these problems occurs, refer to the troubleshooting procedures in the accompanying figures.

Problem A - High Water Level Warning Light On (Figure 8-1)

Problem B - No Warning Light On, High Water Level Noted (Figure 8-2)

Problem C - Low Water Level Warning Light On (Figure 8-3).

Problem D - No Warning Light On, Low Water Level Noted (Figure 8-4).

The pump manufacturer's troubleshooting guide, which will assist with the above steps is found in Appendix A.

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*Subject to revision.

PROBLEM A

High water warning light on

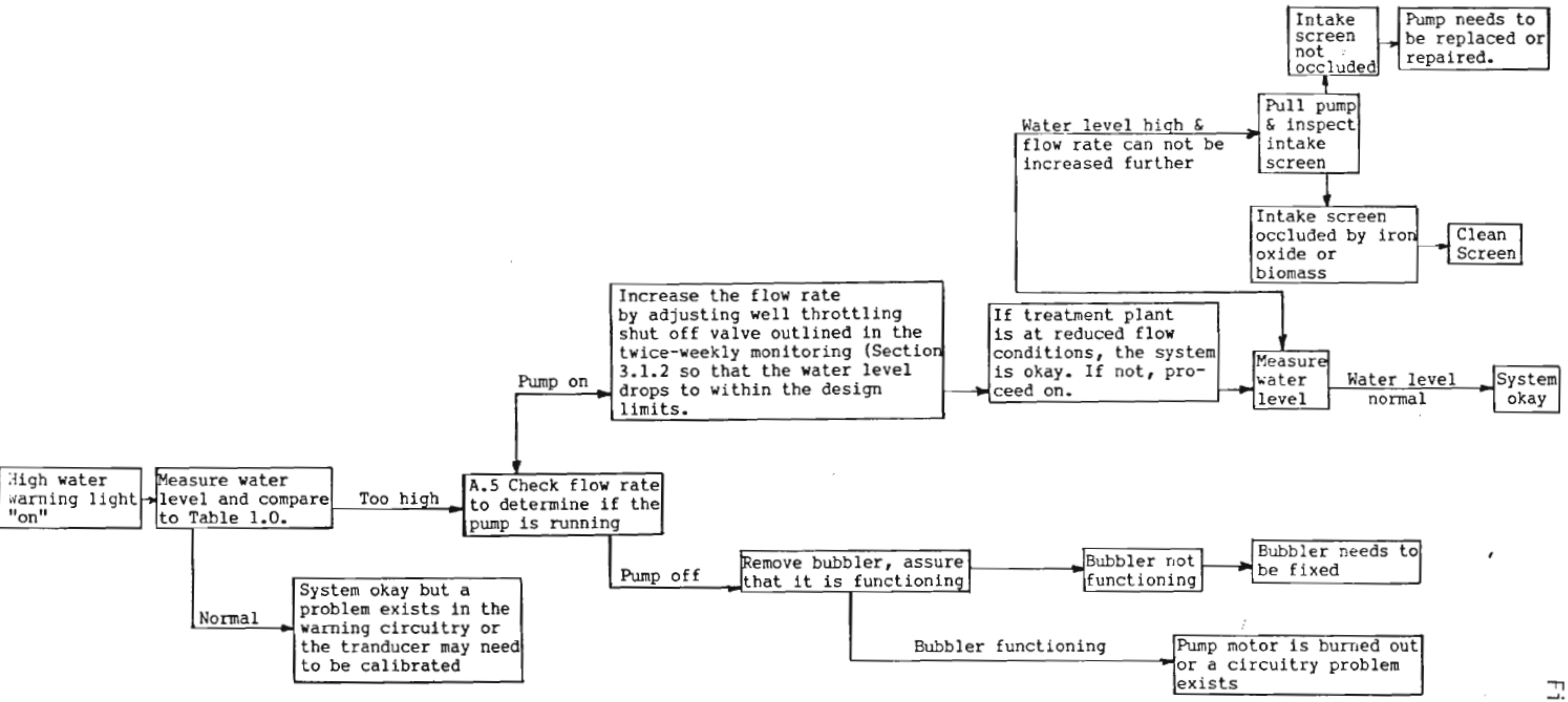

Figure 8-1

PROBLEM B

No warning light on, high water level noted

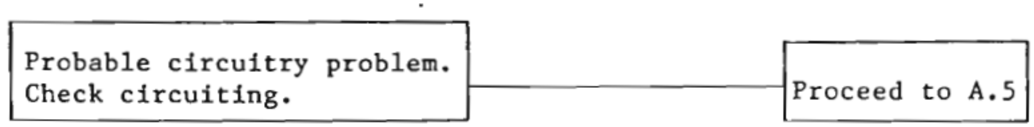

Figure 8-2

PROBLEM C

Low water level noted, warning light on

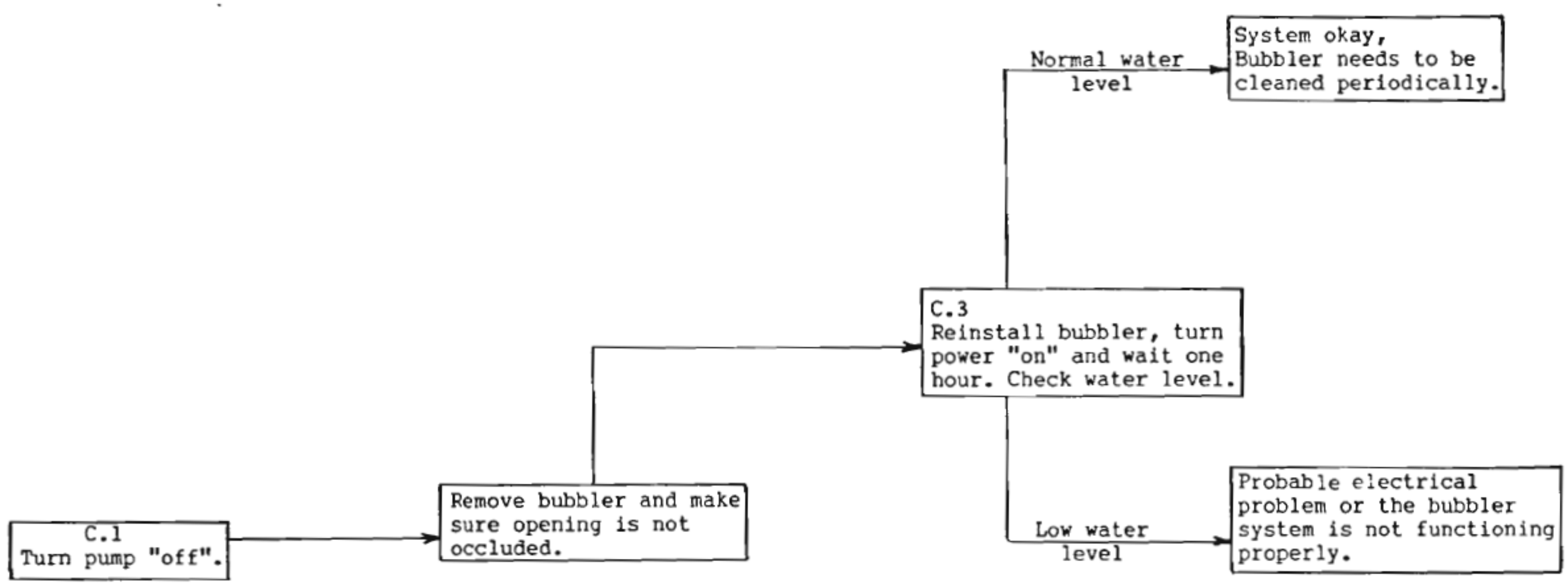

Figure 8-3

PROBLEM D

No warning light on, low water level noted

Probable bubbler system or circuitry problem. Clean bubbler and check circuiting.	Proceed to C.3

8.2.2 In-Plant Conditions

Problem E - System Shut Down

Cause 1. Power Failure

a. Niagara Mohawk area - wide power failure
b. On-site power failure

- service line down
- circuits open
- lines severed

Cause 2. Blower

a. Low pressure alarm

- motor failure
- blower failure

b. High pressure alarm

- tower blockage

c. Circuit failure

- electric circuit open
- instrumentation failure

Cause 3. Effluent Sump - high water

- treated effluent line blocked
- outfall blocked
- instrumentation failure

Cause 4. High Water in Drainage Sump

(See Problem F.)

Problem F - Drainage Sump Flooding

Cause 1. Multiple Power Failures (Sump Pump Running)

- Shut down pumping wells until Sump Pump has emptied sump.

Cause 2. Solenoid Valves Jammed Open (Sump Pump Running)

- Inspect valves in plant or Solenoid Valve Chamber
- Press-to-test indicator light for valves in Solenoid Valve Chamber

Cause 3. Break in Force Mains (Sump Pump Running)

- Visible problem in plant
- Inspect Solenoid Valve Chamber

Cause 4. Sump Pump Failure (Sump Pump Not Running)

- Pump off
- Circuit open
- Pump failed

Cause 5. Building Sump Pump Ball Valve Closed

Cause 6. Recycle Pump On, Tower Recycle Ball Valve Open, and Building Sump Pump Ball Valve Open

<u>Problem G - Tower Overflowing</u>

Cause 1. Distributor Tray Plugged (inspect) (See tower maintenance procedures)

Cause 2. Packing Clogged (inspect)

Cause 3. Drain Pipe Clogged

<u>Problem H - Low Temperature Alarm On</u>

Cause 1. Heaters Not Functioning

- Electric circuit open
- Heaters broken

Cause 2. Doors Open

<u>Problem I - Recycle Pump Not Running</u>

Cause 1. High Water in PW-11 or PW-12 (see Section 7.2.1)

Cause 2. Electric Circuit Open

Cause 3. Pump Failure

Cause 4. Float Failure

Cause 5. Recycle Sump Drain Valve Open

[redacted]

CHAPTER 9

SAFETY

The operation of water treatment plants, like other similar municipal or industrial facilities, can be a dangerous occupation if proper safety procedures are not followed. Physical injuries, chemical burns, explosions, and asphyxiation from gases or oxygen deficiency are potential hazards. All personnel should be aware of hazards, preventive measures, and emergency procedures to avoid any possible accidents.

The objectives of a safety program are to protect employees and visitors from potential hazards, eliminate all possible sources of accidents, and prevent loss or damage to equipment and property. Injuries are indicative of improper operational procedures at the treatment plant, and can seriously affect the efficiency and cost of operation.

The Occupational Safety and Health Act (OSHA) of 1970 (PL 91-596) requires that employers provide safe working conditions and that records be kept of all accidents. It is important that these accident records be accurate to provide personal and legal protection to the individual and Harris Corporation.

The lagoon site is a hazardous waste site for which OSHA regulations (29 CFR Part 1910) governing hazardous waste operations apply.

The objective of this chapter is to specify the minimum selected equipment that should be used until a final health and safety program is established:

- Explosimeter/oxygen meter to be used before entering confined spaces
- Hard hat
- Safety shoes
- Work clothes (Tyvek optional)
- Harness to be used when entering confined spaces (meter chambers, sumps)
- OVA or PID to be used on interim basis until operating record is established
- Latex gloves to be used while collecting samples
- First aid kit
- Flash lights

CHAPTER 10

UTILITIES

Electric service (120/240 volt three-wire) is supplied by overhead wire from Route 22 to the treatment building and the adjacent house and barn. Convenience outlets (110 v) are located both in these structures and in pumping well meter panels. The convenience receptacle is at the top of the well panel and also contains the light and light switch. The outlet for the compressor is a squared GFDR-11-SBC ground fault receptacle. The convenience receptacle on the main control panel is an Eagle 877, 20 amp receptacle.

Telephone service is available in the treatment building and adjacent house. Operation of the automatic dial-up feature of the treatment building telephone is described in Chapter 3.

Water and sanitary services are available only in the adjacent house. If water is required in the treatment building, a garden hose must be connected to the house outside hose bib.

The house water is treated by an activated carbon system pretreated with chlorine to remove iron. As the house is unoccupied, water use is low and sporadic. Because of this pattern of use, there may be objectionable bacteria and taste, and the house water should not be drunk.

APPENDIX A

MANUFACTUER'S BROCHURES, SHOP DRAWINGS, AND OPERATION AND MAINTENANCE MANUALS

EQUIPMENT	MANUFACTURER	MODEL No.	TYPE
Well Submersible Pumps	Grundfos	SPO-6-10 SPO-6-8 SPO-8-9 SPO-4-6 SPO-4-7	B, S, O&M
Air Compressor/ Receiver	ITT Pneumotive	LGH-305-HO2	B, O&M
Enclosure Heater-200W	Rittal	SK 3107	S
Thermostat	Mercoid	860-2-61	S
Pressure Switches	Barksdale	CD2H-A80	S
Pressure Gauge Transmitter	Foxboro	841GMA	S
Air Flow Controller	Dwyer	VFA-SSV-RKA	S
Elapsed Time Indicator 635E	Cramer	10055	S
Nema 12 Enclosure	Hammond	1418T16, 14182W2A	S, B[a]
Floor Stand Kit	Hammond	1481FC16K	S
Nema 12 Enclosure Drip Shield	Hammond	1481S36K	S
Nema 1 Enclosure, Subpanel	Hoffman	A-20N20B	S

B - Brochure
S - Shop Drawing
O&M - Operation and Maintenance Manual

[a]Previously submitted

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EQUIPMENT	MANUFACTURER	MODEL No.	TYPE
Load Center	Square D	Q08-16L100DS	S
Non-reversing Combination Starter	Westinghouse	SIBAW	S
Current/Current Converter	AGM	PTA-400-IID	S
Nema 13 pilot lights	Allen Bradley	800T-PT16	S
Nema 13 HOA switch	Allen Bradley	800T-J2-KCIB	S, B[a]
Pressure Gauge	Ashcroft	4 1/2"1017a-1/4"NPT back conn.	S
Groundfault Receptable	Square D	GFDR-115BC	S
Duplex Recepta-cle	Eagle	877	S
Switch	Medalist	720-AG-BR	S
Relays	Potter Brumfield	KUP-14A15	S
Time Delay Relay	SSAL	TDM120AL	S
Relay Bases	RDI	211BS1	S
Handle Kit	Hammond	1427VR3F	S
Nema 1 Lay in Wireway	Hoffman	F44G36	S

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EQUIPMENT	MANUFACTURER	MODEL No.	TYPE
Terminal Blocks	Buchanan	0525	S
Full Subpanel	Hammond	722WFW	S
Center Panel Support	Hammond	1418ZCS	S
Nema 13 Push Button Momentary Contact Type	Allen Bradley	800T-A2A	S
Flour. Light Strip Fixture	Keystone	CHI20L	S
Nema 13 Neon Pilot Lights	Allen Bradley	800T-R104	S
Legend Plate "Power On"	Allen Bradley	800T-X639	S, B[a]
Legend Plate "Run"	Allen Bradley	800T-X540	S, B[a]
Legend Plate "HOA"	Allen Bradley	800T-X511	S, B[a]
Legend Plate "Test"	Allen Bradley	800T-X554	S, B[a]
Legend Plate "High"	Allen Bradley	800T-X512	S, B[a]
Legend Plate "Low"	Allen Bradley	800T-X524	S, B[a]
Legend Plate "off-on"	Allen Bradley	800T-X529	S, B[a]

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EQUIPMENT	MANUFACTURER	MODEL No.	TYPE
Main Load Center	Square D	Q0121100DS	S, B[a]
5 amp Circuit Breaker	Square D	Q0115	S, B[a]
Integrator	AGM	PTA 4011	S, B, O&M
Transmitter	AGM	TA4000	S, B, O&M
Duplex Receptacles (Building)	Pass & Seymour	CR6300	S, B[a]
Switches	Pass & Seymour	20ACI	S, B[a]
Ball Check Valve	GF	Type 360	S, B
Ball Valve	GF	Type 342	S, B
Modulating Ball Valve	McCannaplast	1"	S, B
Chlorinator	Autotrol	Land-o-matic RP-3000	S, B
Combination Air/ Vacuum Valve	Apco	143C	S, B
Y-Globe Valves	GF	Type 301	S, B
Solenoid Valves	Asco	8210B57; 8210C34	S, B, O&M
Drainage Sump Pump	Enpo-Cornell	151-1	S, B
Recycle Pump	Enpo-Cornell	151-4	S, B

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EQUIPMENT	MANUFACTURER	MODEL No.	TYPE
Electronic Actuators	Ramcon	25BR	S, B
Electronic Positioner	Ramcon	Auto-amp#D	S, B
Pittless Adapter	Dicken Manufacturing Co.		S, B
Air Stripping Tower	HydroGroup	PCS-48.29	S, B, O&M
Packing Material	Jaeger	Tripacks	S, B, O&M
Pressure Switch Gauge	Dwyer	3008 Photohelic	S, B
Mist Eliminator	York	Demister Knitted Mesh Style 241	S, B, O&M
Acid Cleaner	Oakite	Drycid	B, O&M
Neutralizing Material	Oakite	Enprox 714	
Blower	Twin City Fan	150 SWSI BCV	S, B, O&M
Effluent Flowmeter	Drexelbrook Engineering Co.	303-321-2-CD	S, B, O&M
Chart Recorder	Foxboro	40 PR RFELF ESA-21	S, B[a],O&M
Digital Indicator	Newport	202P	S, B[a]
Flow Totalizer Counter	Kessler-Ellis	K 07020	S, B[a]

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EQUIPMENT	MANUFACTURER	MODEL No.	TYPE
Heat Trace	Chemelex	ATV-4	S, B[a]
Automatic Telephone Dialer	National Butler	ADAS IX	S, B[a]
Building Heaters	Berko	HUH 524T	S, B[a]
Ceiling Fan	Centrifugal Dome	RDD 105 CAV	S, B[a]
Flow Meter	Badger	SC-ER	S, B, O&M
Flow Transmitter	Badger	FT-420	S, B, O&M
Flow Indicator	Transmation	210M	S, B
Air Valve	Apco	141 TWD	S, B
Angle Valve	Angle	5230	S, B
Ball Valve	McCannaplast		S, B
Pump Screen	Lakis		

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