N65928.AR.001066
NTC ORLANDO
5090.3a

# BASIS OF DESIGN FOR GROUNDWATER TREATMENT SYSTEM UPGRADE AT OPERABLE UNIT 4 (OU 4) NTC ORLANDO FL

8/11/2000

CH2M HILL

00.08.04.0002
00677 OU4 IRA Sys

TECHNICAL MEMORANDUM

# Basis of Design for the Groundwater Treatment System Upgrade at Operable Unit 4, Naval Training Center, Orlando, Florida


**PREPARED FOR:** **Orlando Partnering Team:**

*Barbara Nwokike – SoDiv*
*Nancy Rodriguez – USEPA*
*Wayne Hansel – SoDiv*
*David Grabka – FDEP*
*Rick Allen - HLA*
*Steve McCoy – TetraTech NUS*

**PREPARED BY:** Steve Tsangaris – CCI
Tom Palaia - CH2M HILL

**COPIES:** Craig Haas – CCI
Flip Altman – CCI
Greg Brown - FDEP



**CONTRACT:** Navy Contract # N62467-98-D-0995

**CTO:** CTO 0017, Naval Training Center (NTC) Orlando

**DATE:** August 11, 2000


The purpose of this document is to summarize the basis of design for the upgrade of the existing groundwater recirculation well system at Operable Unit 4, Naval Training Center, Orlando, Florida. The primary purpose for the upgrade is to achieve the objective specified for the groundwater recirculation well system which is to mitigate migration of groundwater containing greater than 100 parts per billion (ppb) of total volatile organic compounds (VOCs) to Lake Druid.

The components of the upgrade discussed in this document include:

1. Upgrade Work Plan Overview
2. Extraction Well Pumping Rate Basis of Design
3. Groundwater Treatment and Discharge System Basis of Design
4. Process and Instrumentation Design
5. Operations and Maintenance Plan

# 1 Upgrade Work Plan Overview

The existing groundwater recirculation well system will be dismantled and replaced with a standard groundwater extraction and treatment system to achieve capture of the 100 ppb total VOC plume prior to migration to Lake Druid. The existing facilities will be used to the extent practical to cost-effectively implement the retrofit.

New groundwater extraction pumps will be installed in the two existing UVB wells and will be operated to extract groundwater containing greater than 100 ppb. The extracted groundwater will be directed to a central treatment facility, treated using a low-profile tray air stripper system, and discharged to the City of Orlando sanitary sewer system. The low-profile tray air stripper will treat the groundwater to below U.S. Environmental Protection Agency (EPA) Maximum Contaminant Levels (MCLs) prior to discharge to the sanitary sewer. Air stripper offgas will not be treated since estimates show that the emissions will be at least one order of magnitude less than the Florida Department of Environmental Protection (FDEP) limit of 13.7 pounds per day (lbs/day) of total hydrocarbons. Influent to the air stripper will be pretreated using a biocide to control biological deposits on the air stripper. Supporting details for the basis of this design are presented in the following sections.

Upon completion of construction, the new groundwater extraction system will be monitored intensely during a three to four day startup period during which daily monitoring of air stripper influent and effluent will be conducted to assess air stripper performance. Water levels will also be monitored using pressure transducers to assess the capture zone. Once startup testing is complete, the system will be set into routine, full-time operations. Weekly operations and maintenance (O&M) visits will be conducted for the next three weeks after startup, the quarterly O&M visits will be conducted to correspond to routine groundwater sampling events. Autodialer alarms will be responded to on an as needed basis. O&M will consist of checking all equipment for proper operation, routine service of equipment as recommended by the manufacturer, monitoring of system flow rates, pressures, total flow throughput, and water levels. Influent and effluent samples will be collected during the routine groundwater sampling events, or as necessary to comply with the City of Orlando discharge permit. The system will be operated until the remedial action (RA) is identified, at which point, its use will be reevaluated in light of its effectiveness for the site-wide remedy.

# 2 Extraction Well and Pumping Rate Basis of Design

An assessment was performed to evaluate the sole use of the two existing UVB wells for the proposed groundwater extraction system. Pump tests and groundwater modeling were performed to assess the condition of the existing well screens to produce water and affect the capture zone necessary for collection of the 100 ppb total VOC isoconcentration contour. The overall well use and pumping plan is presented first and supporting information follows.

## 2.1 Extraction Well Pumping Plan

Two new submersible pumps will be placed at the lower screened intervals of the two UVB wells. The two existing UVB wells will be pumped initially at a combined total flow rate of 57 gpm. The required capture zone will be attained relatively quickly (i.e., estimated to be within 24-hours) after which pumping rates and water levels will be observed using flow meters and pressure transducers to assess the migration of the extent of the capture zone. If excessive drawdown is noted at distances significantly greater than necessary, then throttling down the flow rate will be considered to reduce operations and maintenance costs (i.e., City of Orlando sanitary sewer discharge fees) and minimize impacts the surrounding water bodies and/or aquifer(s).

## 2.2 UVB Well Pump Tests

Pump tests were conducted on June 28 through July 1, 2000 to assess the maximum pumping capacity and capture zone of the proposed groundwater extraction system using the two existing UVB wells. Submersible pumps with a 55 gpm capacity were installed at the lower screened intervals, at approximately 45 feet below ground surface, of the two 10-inch diameter UVB wells. The pumps were operated to extract water from the upper and lower screened intervals of the wells. Three pump tests were performed:

- UVB1 step drawdown test at pumping rates of 18 gallons per minute (gpm), 27.5 gpm, and its maximum capacity of 30 gpm. The duration of each pump step was approximately 2 hours.
- UVB2 step drawdown test at pumping rates of 14.5 gpm, 21 gpm, and its maximum capacity of 30 gpm. The duration of each pump step was approximately 2 hours.
- UVB1 was pumped at 27 gpm and UVB2 was pumped at 30 gpm simultaneously. The dual-well pumping test was performed for 24 hours.

During all tests, water levels were measured in adjacent existing monitoring and observation wells before, during, and after well pumping.

### 2.2.1 Pumping Rate Test

In order to evaluate the usefulness of the existing wells and pumps for the new groundwater extraction and treatment system, the maximum sustained pumping rates from the UVB wells were evaluated during step drawdown and 24-hour combined pumping tests. Two Grundfos 4-inch 40S pumps, with an operating capacity of 55 gpm, were installed and run for the pump tests.

The maximum sustained pumping rate obtained in UVB1 and UVB2 during the step drawdown tests was approximately 30 gpm each. The maximum pumping rate was determined to be the rate above which the well would dewater to the level of the pump intake and not recharge. The maximum sustained pumping rates achieved in UVB1 and UVB2 during the 24-hour test were 27 and 30 gpm, respectively.

These values are considered the short-term maximum pumping rates for each well. Auditory observations made during the step drawdown pump tests indicated that the upper screen of UVB1 was dewatered during the 24-hour test. This was indicated by the absence of sound due to water cascading down to the bottom of the well from the upper screen. The upper screen in UVB2 was not dewatered; the cascade sound persisted during the entire 24-hour test. This observation shows the transient nature of the shape of the drawdown curve away from the pumping well during the test and indicates that the maximum pumping rates are subject to change in the long-term as the shape/slope of the drawdown curve reaches steady-state.

The conclusions from the step drawdown pump tests are that the existing UVB well screens produce water and that a maximum total flow rate of 57 gpm can be expected, at least initially, recognizing that it may change as the system reaches steady-state.

### 2.2.2 Extraction Well Capture Zone

An analysis of the monitoring well drawdown data was conducted in order to assess the short-term zone of influence of the pumping wells. Water levels measured during the pump test were subtracted from the pre-pumping water levels to determine the change in water level or drawdown. The maximum drawdown was extracted from the data set for each monitoring well to assess the zone of influence. These maximum drawdown data were plotted against the shortest distance to the pumping well.

Figures 1 through 3 present graphics of drawdown versus shortest distance to the pumping wells for each of the three pump tests. Note that the data point corresponding to the greatest distance on the curve is considered a background well, MW36A, which is located greater than 200 feet upgradient of the UVB wells. An exponential curve fit plot was included on the figures to illustrate the general data trend. The exponential equation and curve fit coefficient ($R^2$ value) are included in the upper right hand corner of the figures for reference purposes only; they were not used in the data analysis.

**Figure 1**
**UVB1 Zone of Influence**

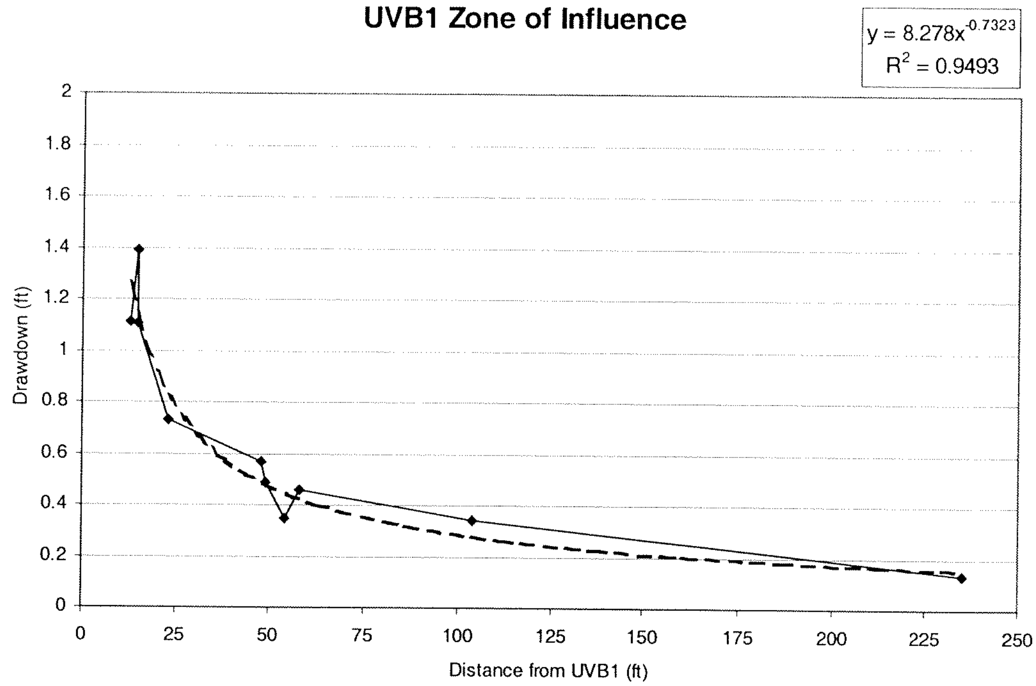



**Figure 2**
**UVB2 Zone of Influence**

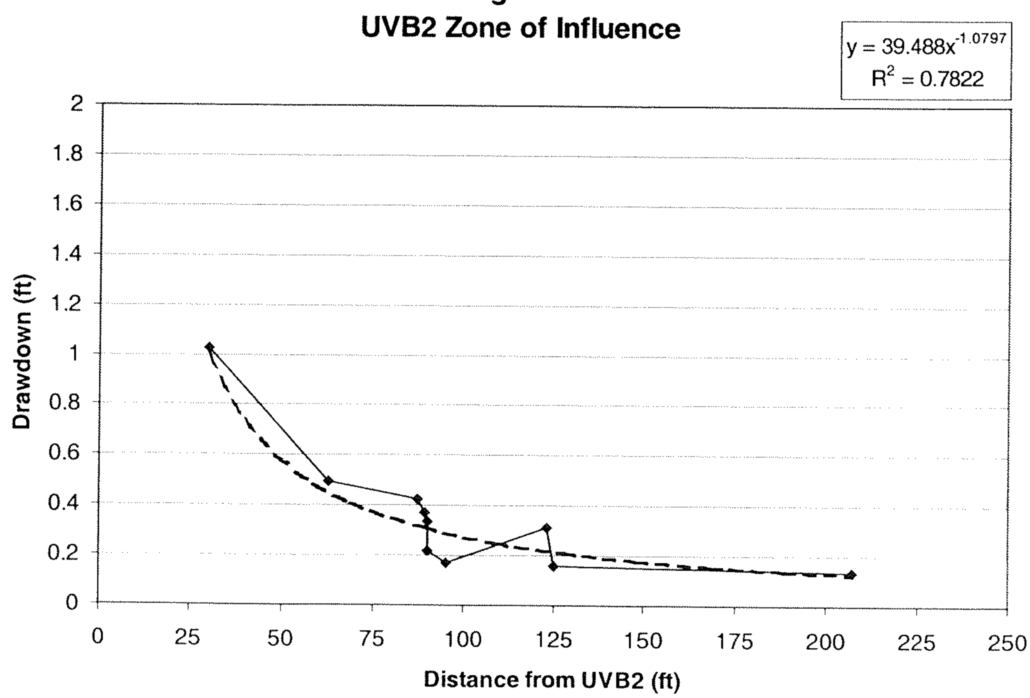
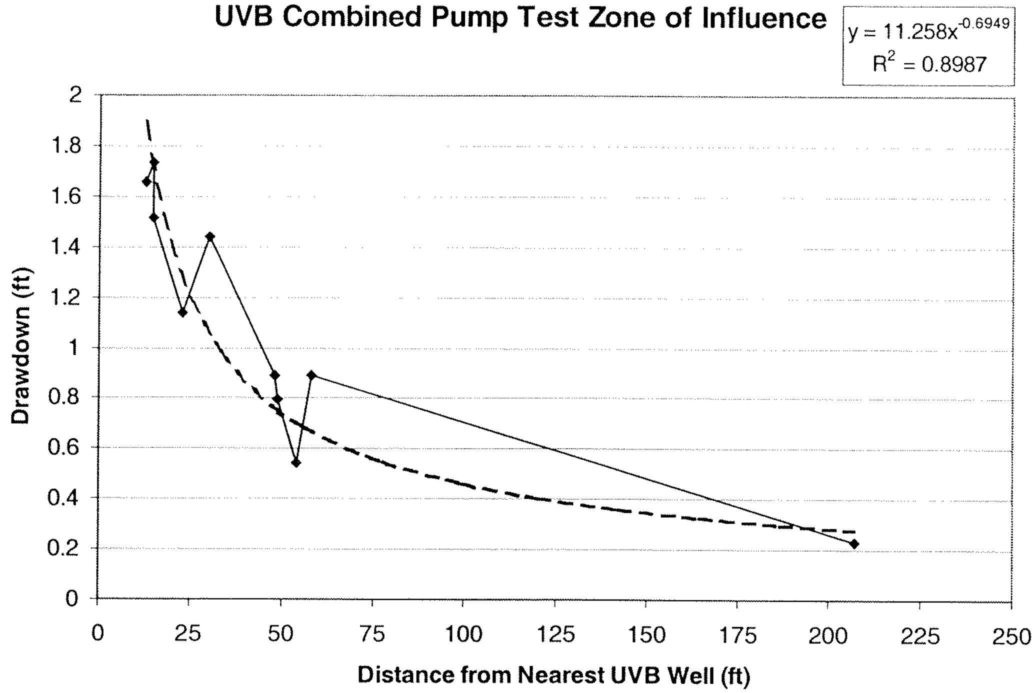


**Figure 3**
**UVB Combined Pump Test Zone of Influence**

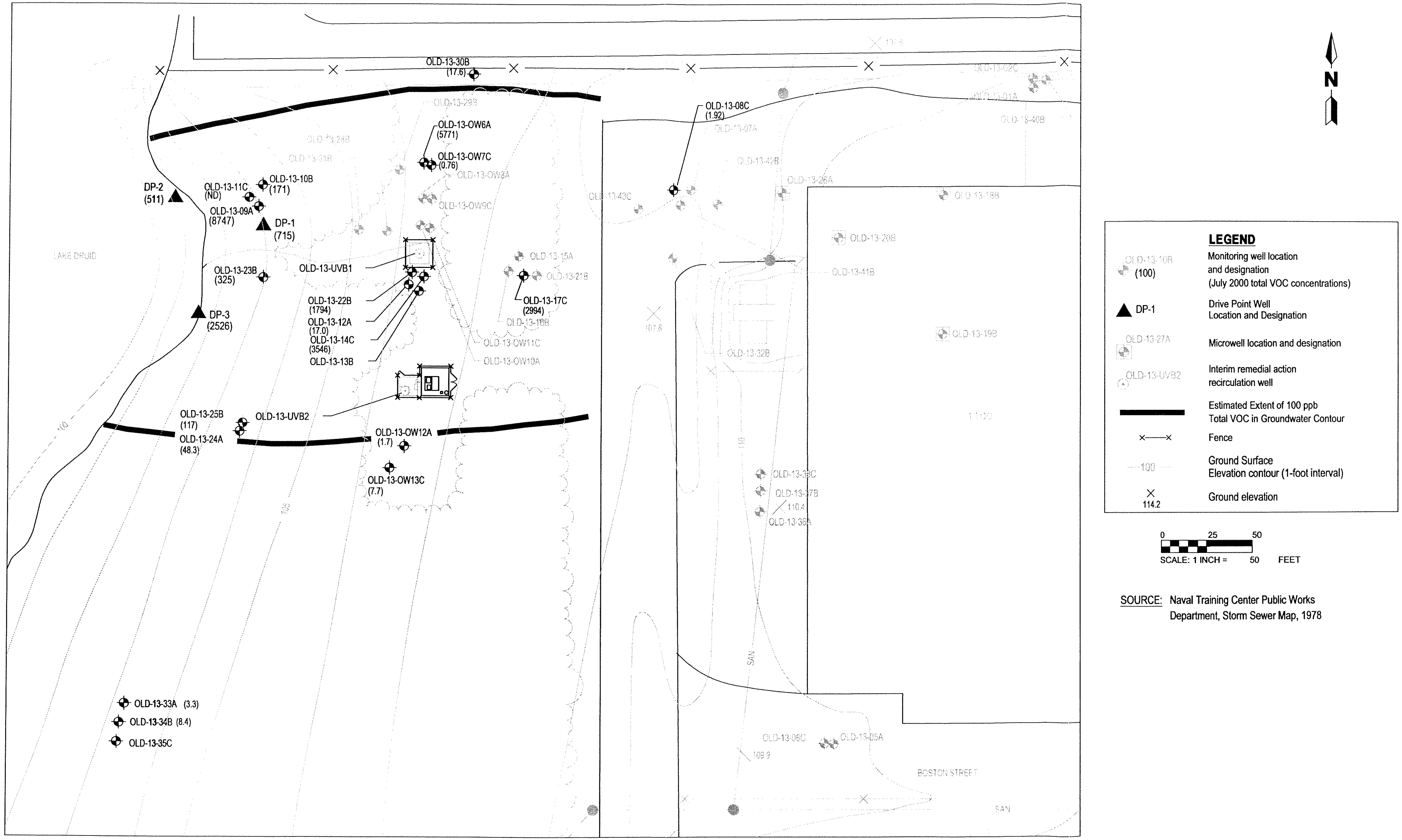



Figures 1 and 2 show that, individually, the UVB wells affected water levels in monitoring wells greater than 100 feet away. This is shown by measured drawdown greater than that in the background well MW36A. Figure 3 shows the additive effect of dual-well pumping on drawdown during the combined pumping test. At a point 100 feet away from the UVB pumping wells, the combined drawdown was greater than 0.5 feet, compared to approximately 0.3 feet during the individual UVB well pumping tests.

Figure 4 presents a site plan showing the estimated extent of the 100 ppb total VOC concentrations in groundwater over all aquifer zones plotted using groundwater sampling data from July 2000. It shows that the estimated extent of the 100 ppb total VOC contour along the alignment of the UVB wells, perpendicular to the groundwater flow direction, is approximately 100 feet north of UVB1 and 30 feet south of UVB2.

Due to the fact that the UVB well zone of influence is greater than 100 feet from the UVB wells and the estimated extent of the 100 ppb total VOC isoconcentration is within this zone, use of the two UVB wells solely for the groundwater extraction system is justified for attainment of the objective.

Attainment of the required capture zone within the 24-hour timeframe of the test indicates that the actual required long-term sustained pumping rate may be lower than 57 gpm. However, a conservative approach will be taken initially and the system will be started at the maximum sustained pumping rate of 57gpm to achieve capture of the plume immediately. Pumping rates and water levels will be observed during the initial weeks of operation. If excessive drawdown is noted at distances significantly greater than necessary,




SOURCE: Naval Training Center Public Works Department, Storm Sewer Map, 1978

FIGURE 4
JULY 2000 TOTAL VOC CONCENTRATIONS
IN GROUNDWATER

14-Aug-2000 Filename 2044g008.dwg

CH2MHILL

then throttling of the flow rate will be considered to reduce operations and maintenance costs (i.e., City of Orlando sanitary sewer discharge fees) and minimize impacts the surrounding water bodies and/or aquifer.

## 2.3 Groundwater Modeling

Water level data from the pump tests were used to model the steady-state capture zone of the proposed dual-well groundwater extraction system. The primary intent of the modeling was to estimate the steady-state extent of capture of the proposed pumping system.

Water level data from the July 2000 pump tests were evaluated using confined, semi-confined, and unconfined aquifer solutions. The best fit to the data was attained using a leaky aquifer solution. The parameters obtained using this solution were input into a MODFLOW groundwater model that essentially modeled groundwater flow at the site as one equivalent aquifer. Since the UVB wells are screened over two intervals (shallow and deep aquifer zones), and pumping was conducted from both zones, the parameters generated by evaluation of the data set were assumed to represent an the combination aquifer (i.e., the resultant hydraulic conductivity value does not represent either the shallow or deep aquifer alone, but a combination of the two).

A groundwater modeling effort was completed to establish capture zones for the wells UVB1 and UVB2 pumping at their proposed rates of 27 and 30 gpm, respectively. GMS-MODFLOW was used in this effort. The aerial extent of the existing site-specific model, provided by Harding Lawson Associates and based on the U.S. Geologic Survey model, was limiting because the capture zones for the wells at the proposed pumping rates were found to be beyond the boundaries of the model. An extended model was produced partially based on the parameter conditions and boundary conditions of the existing model. The modifications included conversion to a three layer model, extension of the model domain large enough to minimize potential for boundary interference due to the pumping wells, elimination of flow conditions along the north and the south boundaries, and use of an effective recharge rate of 19 inches per year. Some of the parameters, including hydraulic conductivity, were altered in this new model to better match model output to actual drawdown measurements obtained during the pump test.

Both transient and steady state runs were made to evaluate model set up and delineate the capture zone. Drawdowns from the transient model run were qualitatively compared to the drawdown observed near the pumping wells during the June-July 2000 pumping tests. The modeled and actual drawdowns after 8 hours of pumping compared reasonably well. The transient model was also used to qualitatively assess the time to reach steady-state conditions. The transient model runs established that steady state conditions were attained earlier than the life of the proposed pumping scheme (30 years). Hence, steady state capture zones were used for the analysis.

The results from MODFLOW were input into MODPATH for the steady-state condition (40+ years) to obtain the particle flow path lines over the long-term. MODPATH was used to simulate the particle paths which establishes an estimate of the steady-state capture zone. The MODPATH analysis used a porosity value of 0.3.

Figure 5 illustrates the steady-state capture zone of the proposed dual-well groundwater extraction system operating at pumping rates of 60, 30, and 6 gpm. The steady-state capture zone for the proposed system at 60 gpm is estimated to cover an area of approximately 1,200 feet wide by 1,200 feet long, or approximately 30 acres. This is far beyond the required capture zone; therefore, additional model runs were made to qualitatively estimate the reduction in capture zone as pumping rates are reduced. The results, including drawdown and water table elevation head plots, of all model runs are included in Attachment A. The capture zone analysis indicates that, in the long-term, a 90 percent flow turn down, to approximately 6 gpm total flow rate, may be possible to maintain a capture zone to meet the system objectives. The modeling performed to assess this turn down ratio; however, was very approximate and not checked against any actual field data from pump tests. Further evaluation will be conducted after system startup to determine the ultimate long-term operational pumping rate (See Section 5).

As was previously mentioned, the model results presented here are an estimate and uncertainty related to the parameter and boundary condition variability was not addressed as part of this screening-level effort. Groundwater levels at designated monitoring locations will be monitored periodically during the operation of the pumping wells to confirm the level of capture attained by the wells.

# 3 Groundwater Treatment and Discharge System Basis of Design

A historic data review, pump test water sampling, and an air stripper performance analysis were conducted to evaluate the scope of work necessary to implement aboveground treatment of the groundwater.

## 3.1 Historic Data Review

The scope of the historic data review primarily involved review of the following documents:

- Remedial Investigation (HLA, 2000 and Draft Appendices 1998)
- Focused Feasibility Study (ABB, 1997)
- Feasibility Study (HLA, 1999)
- Operation and Maintenance Manual for Recirculation Well Remediation Systems (SBP and Roy F. Weston, 1999)

Pertinent components of the Focused Feasibility Study (FFS) are summarized in detail below since they have direct bearing on the proposed system upgrade.

### 3.1.1 Focused Feasibility Study (ABB, 1997)

The FFS investigated three options for the Interim Remedial Action (IRA), pump and treat with ex-situ air stripping, in-situ air stripping, and groundwater circulation well technology. The groundwater circulation well technology was implemented and has been determined to be ineffective due to poor reinjection capacities. The proposed alternative for the upgrade is pump and treat with ex-situ air stripping, which was the most economical alternative discussed in the FFS.

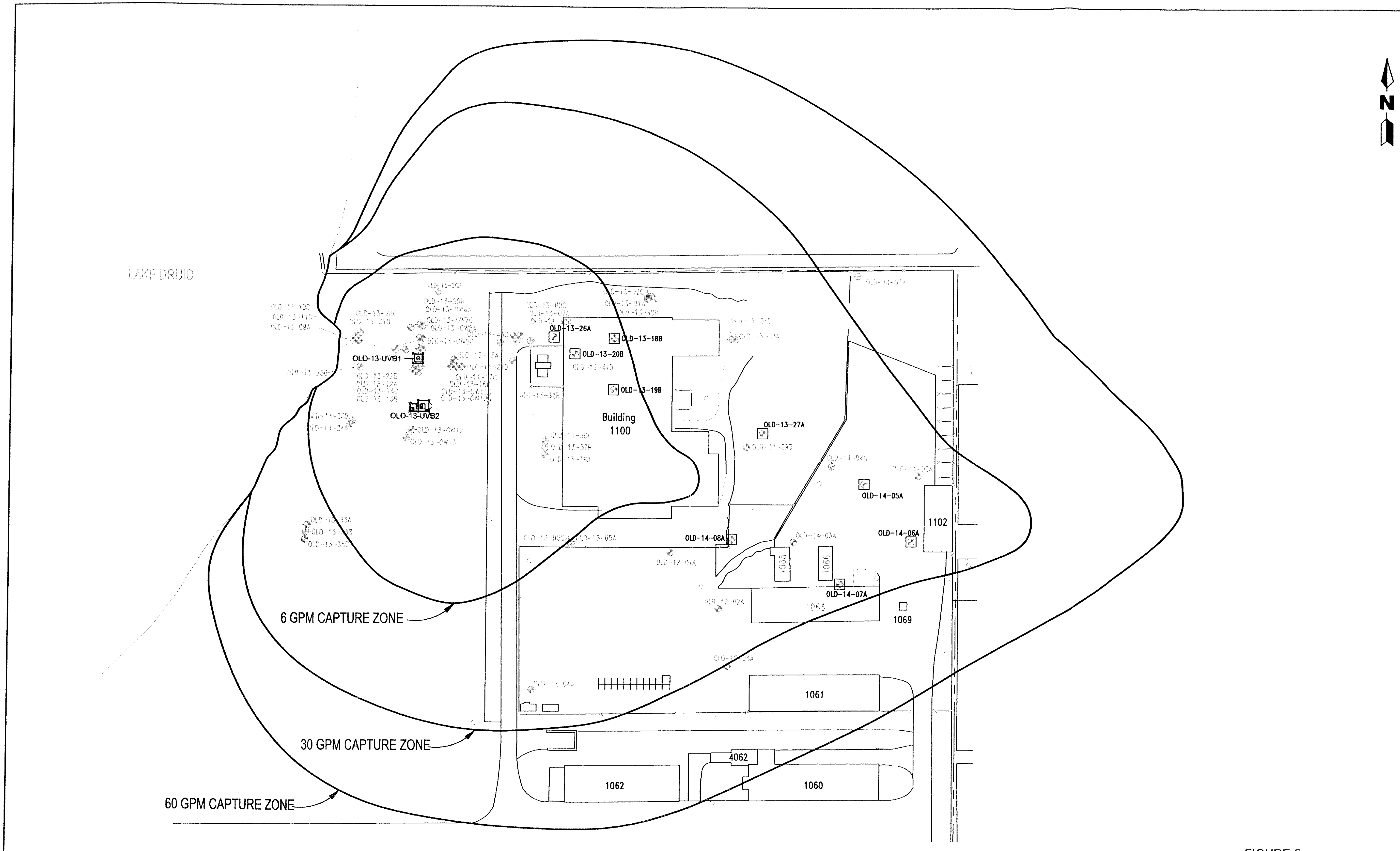



FIGURE 5
CAPTURE ZONE ANALYSIS
CH2MHILL

10-Aug-2000 Filename 2044g009.dwg

The pump and treat system discussed in the FFS is very similar to the proposed upgrade described herein. The FFS pump and treat alternative assumed two extraction wells, at 30 gpm per well would capture the 100 ppb total VOC zone. However, these parameters were qualified as being subject to change during detailed design. Discharge was planned to the Orlando sanitary sewer. Pretreatment was assumed required for tetrachloroethylene (PCE), trichloroethylene (TCE), and cis-1,2 dichloroethylene (cis-,1,2 DCE). Inorganics concentrations were assumed below the City of Orlando discharge limits. Air emissions testing and calculations showed that air emissions treatment would not be required.

The FFS pump and treat alternative used discharge to the POTW because only pre-treatment to 100 ppb for each chemical is required, permit is in place already, and additional treatment would be required for inorganics if discharge to surface water were implemented (undocumented which constituent and why not reinjection to aquifer).

### 3.1.2 Historic Influent Characteristics

Historic data review of the above listed references was performed to estimate the influent characteristics for the groundwater treatment system. This was performed prior to groundwater sampling during the pump test to expedite preparation of the air stripper specification. The primary chemicals of concern (COCs) are PCE, TCE, and cis-1,2 DCE.

Table 1 presents historic data from wells in the vicinity of the extraction wells UVB1 and UVB2. This data represents an average of all data presented in Appendix D of the Remedial Investigation Report.VOCs, pH, calcium, iron, and manganese were considered the primary COCs for the air stripper design.

**TABLE 1**
Monitoring Well Data Pertaining to Air Stripper Influent Characteristics

| Well ID | Depth (ft bgs) | Location[1] | DTW (ft bgs) | VOC Contaminants (μg/L) | Average Inorganics (μg/L) |
|---|---|---|---|---|---|
| 13-12A | 11.5 | central | 2.0 | TCE – 8 | pH – 5.67, Ca – NA, Fe – 100U, Mn – 15U |
| 13-22B | 32 | central | 1.8 | TCE – 190J, cis-1,2 DCE - 590J | pH – 5.36, Ca – 344U, Fe – 46.9J, Mn – 12.1U |
| 13-15A | 12.5 | fringe, upgradient | 2.2 | PCE – 26 | pH – 6.46, Ca – NA, Fe – 110, Mn – 15U |
| 13-21B | 32 | fringe, upgradient | 2.4 | TCE – 625, cis-1,2 DCE – 890 | pH – 4.75, Ca – NA, Fe – 287.5, Mn – 15U |
| 13-23B | 31 | fringe, downgradient | 1.7 | TCE - 2,475, cis-1,2 DCE - 1,650 | pH – 4.68, Ca – NA, Fe – 415, Mn – 15U |
| 13-07A | 18.5 | far fringe, upgradient | 4.7 | PCE – 29,800 | pH – 6.04, Ca – 25,100U, Fe – 83.34J, Mn – 12.2U |
| 13-41B | 28 | far fringe, upgradient | 4.7 | TCE - 2,100, cis-1,2 DCE – 560, PCE – 370 | pH – 4.36, Ca – 3,480U, Fe – 1,180, Mn – 22.5U |
| 13-38C | 55 | far fringe, upgradient | 6.1 | ND for VOCs | pH – 5.97, Ca – 4,490U, Fe – 2120, Mn – 34.2U |

**TABLE 1**
Monitoring Well Data Pertaining to Air Stripper Influent Characteristics

| Well ID | Depth (ft bgs) | Location[1] | DTW (ft bgs) | VOC Contaminants (μg/L) | Average Inorganics (μg/L) |
|---|---|---|---|---|---|
| 13-36A | 14 | far fringe, upgradient | 6.1 | TCE – 3 | pH – 6.42, Ca – 16,800U, Fe – 447, Mn – 2.7U |
| 13-09A | 11 | far fringe, downgradient | 1.5 | TCE – 410, PCE – 71J, cis-1,2 DCE - 1,220 | pH – 5.09, Ca – 3,350J, Fe – 51.4J, Mn – 12.1U |
| 13-11C | 62 | far fringe, downgradient | 0.5 | Not sampled | pH – 4.57, Ca – 56,000U, Fe – 106, Mn – 2.9U |
| 13-24A | 12.7 | far fringe, downgradient | 2.4 | TCE – 19J | pH – 5.54, Ca – NA, Fe – 190, Mn – 15U |
| 13-25B | 23.5 | far fringe, downgradient | 2.3 | PCE - 250, TCE –24 | pH – 4.89, Ca – NA, Fe – 105, Mn – 15U |

NOTES:
1 – Location refers to relative distance from extraction wells (UVB1, UVB2) as related to 100 foot capture zone.

For the purposes of designing the air stripper, TCE and cis-1,2 DCE are considered the drivers for equipment performance specification. It was assumed that the extraction wells will pull average water quality from all three zones (shallow, intermediate, and deep). A steady-state mix of 25% central, 25% fringe upgradient, 25% far fringe upgradient, 20% fringe downgradient, and 5% far fringe downgradient water was assumed to compute a weighted average influent water quality. The following lists the area-specific contaminant concentrations.

| | | |
|---|---|---|
| Central Conditions (25%): | TCE - 99 ppb | cis-1,2 DCE - 295 ppb |
| Fringe, Upgradient Conditions (25%): | TCE – 313 ppb | cis-1,2 DCE – 445 ppb |
| Far Fringe, Upgradient Conditions (25%): | TCE – 526 ppb | cis-1,2 DCE – 140 ppb |
| Fringe, Downgradient Conditions (20%): | TCE – 2,475 ppb | cis-1,2 DCE – 1,650 ppb |
| Far Fringe, Downgradient Conditions (5%): | TCE – 151 ppb | cis-1,2 DCE – 407 ppb |
| Average Overall Conditions: | TCE ~ 750 ppb | cis-1,2 DCE ~ 600 ppb |

PCE was detected less frequently than TCE and cis-1,2 DCE. To assess its impact on the influent water quality, its weighted average was estimated using the same method as TCE and cis-1,2 DCE. The resultant average of 1,900 ppb PCE shows that the upgradient source area water, even when diluted with surrounding groundwater with much lower concentrations of PCE, still greatly affects the quality of water extracted by the UVB wells. Therefore, PCE will be considered in the design.

The following inorganic data was compiled from the Feasibility Study and Remedial Investigation background water quality assessment:

- Calcium – 52.9 mg/L (shallow), 7.7 mg/L (deep), 36.8 mg/L (RI Background Value), <5.0 total mg/L in 8/96 IRA Pump Test (FS, 1999)

- Iron – 0.057 mg/L (shallow), 1.4 mg/L (deep), 1.2 mg/L (RI Background Value), 0.35 to 0.49 total mg/L in 8/96 IRA Pump Test (avg. 0.4 mg/L) (FS, 1999)
- Manganese – 0.0038 mg/L (shallow), 0.0069 mg/L (deep), <0.005 mg/L in 8/96 IRA Pump Test (FS, 1999)
- Alkalinity – 5.9 to 7.7 (mean 6.6 mg/L as $CaCO_3$) (IRA Pump Test Data 8/96, FS, 1999)
- pH – overall weighted average pH is estimated to be 5.4

## 3.2 Influent Water Quality Design Conditions

Table 2 presents the design values used for the air stripper performance specification. The maximum estimated concentrations were arbitrarily assumed to be double the average concentrations for air stripper specification purposes. Note that these values were based solely on the historic groundwater data discussed in Section 3.1.

**TABLE 2**
Air Stripper Design Conditions

| Parameter | Average | Maximum |
|---|---|---|
| Tetrachloroethylene (μg/L) | 1,900 | 3,800 |
| Trichloroethylene (μg/L) | 750 | 1,500 |
| cis-1,2 dichloroethylene (μg/L) | 600 | 1,200 |
| Temperature (°F) | 72 | Range of 64 - 77 |
| pH (pH units) | 5.4 | Range of 4.4 - 6.5 |
| Total Iron (mg/L) | 0.4 | Range of <0.005 – 2.1 |
| Total Manganese (mg/L) | <0.005 | Range of <0.003 - <0.034 |
| Calcium (mg/L) | <5.0 | Range of <0.3 - <56.0 |
| Total Alkalinity (mg/L and $CaCO_3$) | 6.6 | Range of 5.9 – 7.7 |

## 3.3 Pump Test Water Sampling Results

Untreated water samples were collected at three times during the June-July 2000 combined UVB well pump test to assess the specified air stripper design conditions in Table 2. Table 3 presents a summary of the sampling results.

The total VOC concentrations were significantly lower than those used for air stripper specification (See Table 2). The total VOC concentration of the effluent ranges from 301 to 214 ppb. There was a 30 percent decrease in the concentration from approximately 12 hours into the test versus 22 hours into the test (10 hour period). The primary VOC detected was cis-1,2 DCE which comprised 75 to 80 percent of the total VOC measured. TCE comprised the remaining balance of total VOC measured. PCE was not detected, however, vinyl chloride was detected at low concentrations (less than 2 ppb). The pH of the final water sample collected 22 hours into the test was 5.81.

The results of the pump test water sampling confirm that the air stripper as designed and specified in Section 3.2 will adequately treat the water as pumped from the combined UVB well extraction system. One order of magnitude contingency exists between the air stripper design parameters and the actual initial groundwater quality to allow for potential future fluctuations in groundwater concentrations as the system capture zone expands with time to the source area.

**TABLE 3**
**JUNE 2000 PUMP TEST WATER QUALITY DATA**
SA13, OU4, Naval Training Center, Orlando, FL
152044.34.02.04.09

Sample data provided for combined UVB1 (27 gpm) and UVB2 (30 gpm) water samples collected at 3 times during pump test.
[box] indicates above Florida MCLs.
All water sample were in compliance with the City of Orlando discharge limits.

| | | | 06/30/2000 8:00 | 06/30/2000 12:30 | 06/30/2000 17:00 |
|---|---|---|---|---|---|
| Detected Constituents (COCs only) | FL MCL (μg/L) | Orlando (μg/L) | W1 (μg/L) | W2 (μg/L) | W3 (μg/L) |
| pH | NA | 5.5<pH<9.5 | NA | NA | 5.81 |
| trans 1,2 dichloroethene | 70 | NA | 2.2 | 1.5 | 1.5 |
| Trichloroethene | 3 | NA | 50 | 45 | 43 |
| Vinyl chloride | 1 | NA | 1.6 | 1.2 | <1 |
| cis 1,2 dichloroethene | 70 | NA | 240 | 190 | 160 |
| 1-methylnaphthalene | NA | NA | 1.6 | 1.7 | 2.0 |
| 2-methylnaphthalene | 120 | NA | 1.2 | 1.1 | 1.9 |
| Acenaphthene | 20 | NA | 1.5 | 1.1 | 1.8 |
| Fluorene | 280 | NA | 0.84 | 0.96 | 1.2 |
| Naphthalene | 6.5 | NA | 1.9 | 2.2 | 2.2 |
| Total Toxic Organics (TTO) | NA | 2,130 | 300.8 | 244.8 | 213.6 |

## 3.4 Effluent Standards

The initial plan for discharge is to discharge the treated groundwater to the City of Orlando sanitary sewer system. Attachment B contains the City of Orlando discharge standards. The standard most applicable to this site is the total toxic organic (TTO) limitation of 2.13 milligrams per liter (mg/L). Although sampling during the June-July 2000 pump test indicated that TTO (i.e., total VOC) concentrations are below this limit, an air stripping treatment system will be provided and used to pretreat the groundwater prior to discharge. Provision of the air stripper will provide insurance for future potential rises in TTO levels as the groundwater extraction system taps into a source zone.

Attachment C contains performance modeling results for the air stripper proposed for the treatment system. The proposed air stripper will treat a flow rate of 60 gpm containing the maximum estimated concentrations of TCE, PCE, and cis-1,2 DCE (See Section 3.2) to MCLs after 4 trays of processing. An extra tray is proposed for redundancy and added security should one of the trays be removed for cleaning.

## 3.5 Pretreatment

Pretreatment is typically performed to reduce the fouling potential, either inorganic scale or biological growth, on the treatment system components. The inorganic analytical data discussed in Section 3.1.2 and data from a small June 2000 groundwater sampling event of a well nearby UVB1 was used to calculate the potential for calcium carbonate scale formation on the air stripper. The Langlier Index (LI) is used to estimate the scaling potential. An LI Index of 1 indicates little or no tendency of the water to form calcium carbonate scale. The LI calculated for this water is less than –2.9 and indicates zero scaling potential. Attachment D contains all design calculations that support this basis of design.

North East Environmental Products, a major manufacturer of tray air strippers, recommends pretreatment for influent waters that contain greater than 0.5 mg/L of total iron and total manganese. Historic data shows that the concentration of iron and manganese is consistently below 0.5 mg/L. Therefore, the concentrations of iron and manganese do not cause alarm for precipitate fouling.

The former groundwater recirculation well system was previously operated using a biocide to control buildup associated with iron bacteria activity. The problem is evident as a rust/brown colored coating on the outside of the equipment that was submersed in the water when the existing pumps were pulled from the UVB wells. This same buildup was present on the inside of the piping used for the June-July 2000 pump tests. The same biocide used to control the problem previously will be used for the upgrade. The exact dosage will be determined during system startup.

## 3.6 Offgas Treatment

VOC emissions from the air stripper are estimated to be below the FDEP maximum allowable emission rate of 13.7 lbs/day. Support calculations are included in Attachment D. Assuming a water flow rate of 60 gpm and 100 percent treatment (i.e., 100 percent emission) of the average estimated concentrations of contaminants in the groundwater, the estimated total VOC emission rate is 2.34 lbs/day. Therefore, no offgas treatment system will be installed. Routine O&M will include periodic total VOC emission estimation and confirmation that no offgas treatment is required.

# 4 Process and Instrumentation Design

The design drawings for the groundwater treatment system upgrade are included in Attachment E. A low-profile tray air stripper will be installed on a new concrete pad located adjacent to the existing UVB2 compound. The two new submersible pumps will pump water from the two UVB wells to the air stripper system. Each well discharge will be equipped with its own flow measuring and sampling devices. The groundwater from the two UVB wells will combined and biocide added to control iron deposits. The dosed groundwater will cascade through the counter-current low-profile tray air stripper for removal of VOCs. The air stripper sump will be equipped with an effluent pump to direct treated groundwater to a nearby City of Orlando sanitary sewer manhole. A process and instrumentation diagram for the system is included in Attachment E.

The field piping will be exterior-rated PVC pipe (Sch80 PVC and Yelomine Certa-Lok PVC pipe) and installed above grade for easy access and maintenance. Attachment E contains a field piping plan that shows the proposed locations of the untreated and treated water pipes.

The new pumps and air stripper will be integrated into the existing control system. The new pumps will be connected to the existing submersible pump control circuit; however, the existing variable frequency drives (VFDs) will not be utilized. Rather, a manual flow control valve will be used to manually throttle the flow rate as necessary. The air stripper system will be inserted in the control circuit where the former blower for the recirculation well system resided. The air stripper will be supplied with its own, independent control panel (mounted on the skid with the air stripper). Attachment F contains the detailed air stripper specifications. To summarize, the air stripper will be provided with the following functional controls:

a. When the blower motor fails, send signal to extraction well control panel to alarm and shut down extraction well pumping system immediately. When an alarm shutdown occurs, the equipment is locked out and will require operator intervention to reset.

b. When the effluent pump motor fails, send signal to extraction well control panel to alarm and shut down extraction well pumping system immediately. When an alarm shutdown occurs, the equipment is locked out and will require operator intervention to reset.

c. When blower discharge pressure is HIGH, stop blower (blower must still have 5-minute delay) and send signal to extraction well control panel to alarm and shut down extraction well pumping system immediately. When an alarm shutdown occurs, the equipment is locked out and will require operator intervention to reset.

d. Blower discharge low pressure alarm shall be active only when blower is on. During blower start, pressure alarm will be bypassed for the appropriate length of time to allow blower to reach operating pressure. When blower discharge pressure is LOW, shut down blower (blower must still have 5-minute delay) and send signal to extraction well control panel to alarm and shut down extraction well pumping system immediately. When an alarm shutdown occurs, the equipment is locked out and will require operator intervention to reset.

e. Blower discharge air flow rate alarm shall be active only when blower is on. During blower start, air flow rate alarm will be bypassed for the appropriate length of time to allow blower to reach the operating air flow rate. When blower inlet air flow rate is LOW, shut down blower (blower must still have 5-minute delay) and send signal to extraction well control panel to alarm and shut down extraction well pumping system immediately. When an alarm shutdown occurs, the equipment is locked out and will require operator intervention to reset.

f. When air stripper sump level is HIGH-HIGH, send signal to extraction well control panel to indicate an alarm condition and to shut down extraction well pumping system immediately.

The existing autodialer will be reprogrammed to call a pager for the appropriate active operations personnel upon activation of any alarm condition.

# 5 Operations and Maintenance Plan

O&M of the new groundwater treatment system will be conducted according to the following visitation program:

- Daily during startup period of approximately three days
- Weekly for the next three weeks
- Quarterly, corresponding to routine groundwater sampling events, thereafter

In addition, alarms sent by the autodialer will be responded to as necessary.

Upon completion of construction, the new groundwater extraction system will be monitored intensely during a three to four day startup period during which daily monitoring of air stripper influent and effluent will be conducted to assess air stripper performance. Water levels will also be monitored using pressure transducers to assess the progress of the capture zone.

Once startup testing is complete, the system will be set into routine, full-time operations. Weekly operations and maintenance (O&M) visits will be conducted for the next three weeks after startup, then quarterly O&M visits will be conducted to correspond to routine groundwater sampling events.

O&M shall consist of the following general activities:

- checking all equipment for proper operation
- routine service of equipment as recommended by the manufacturer
- monitoring of system water flow rates
- air stripper pressure
- total effluent flow throughput
- water levels

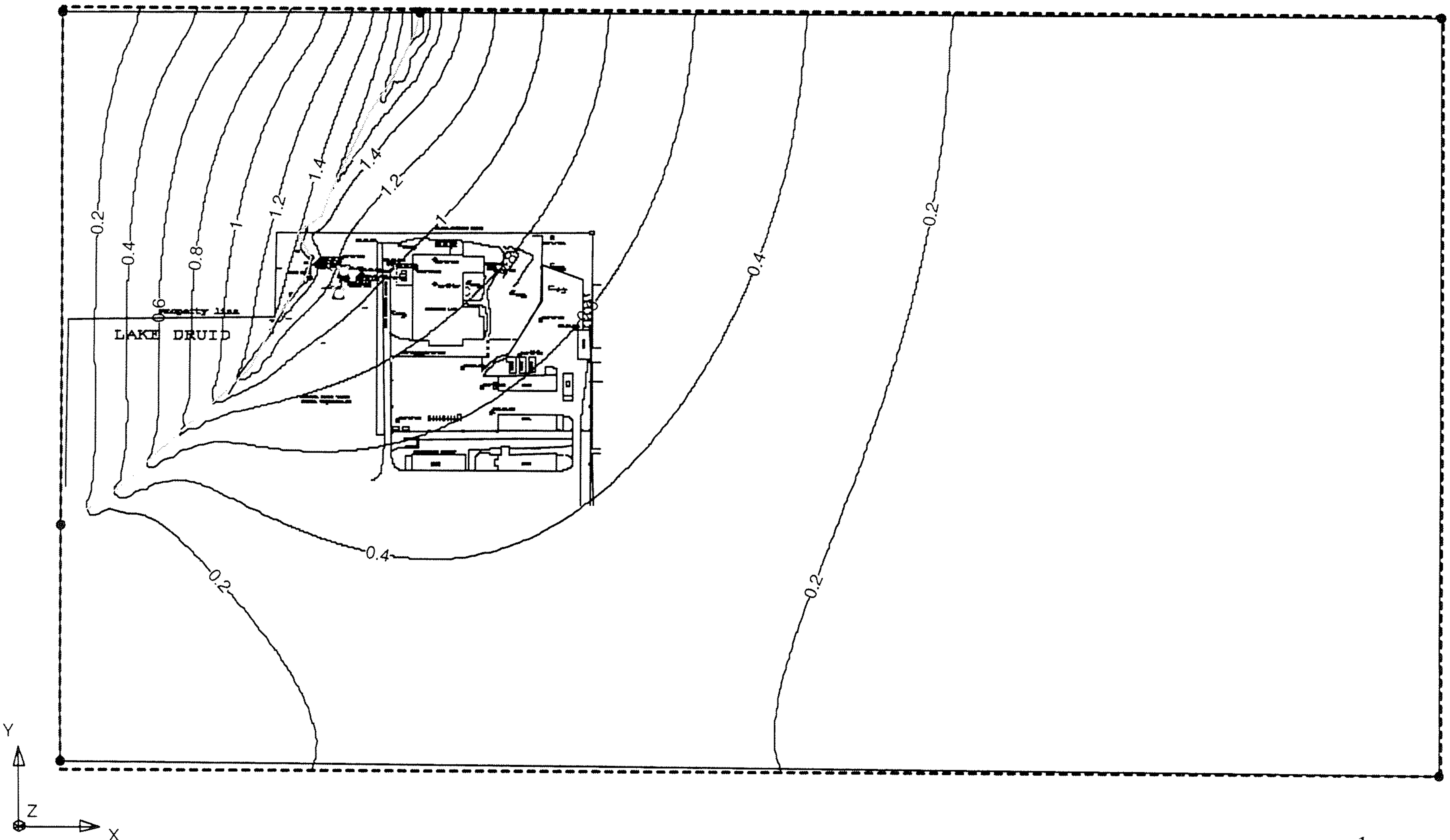
Influent and effluent samples will be collected during the routine groundwater sampling events, or as necessary to comply with the City of Orlando discharge permit. The system will be operated until the remedial action (RA) is identified, at which point, its use will be reevaluated in light of its effectiveness for the site-wide remedy.

The primary focus of the O&M is to ascertain that the required capture zone is achieved. Order-of-magnitude modeling suggests that the steady-state pumping rate necessary to capture the 100 ppb total VOC plume may be lower than 57 gpm. However, a conservative approach will be taken initially and the system will be started at the maximum sustained pumping rate of 57gpm to achieve capture of the plume within a short timeframe. Pumping rates and water levels will be observed during the initial days and weeks of operation according to the program outlined above. If excessive drawdown is noted at distances significantly greater than necessary, then down throttling of the pumping rate will be considered to reduce operations and maintenance costs (i.e., City of Orlando sanitary sewer discharge fees) and minimize impacts the surrounding water bodies and/or aquifer.

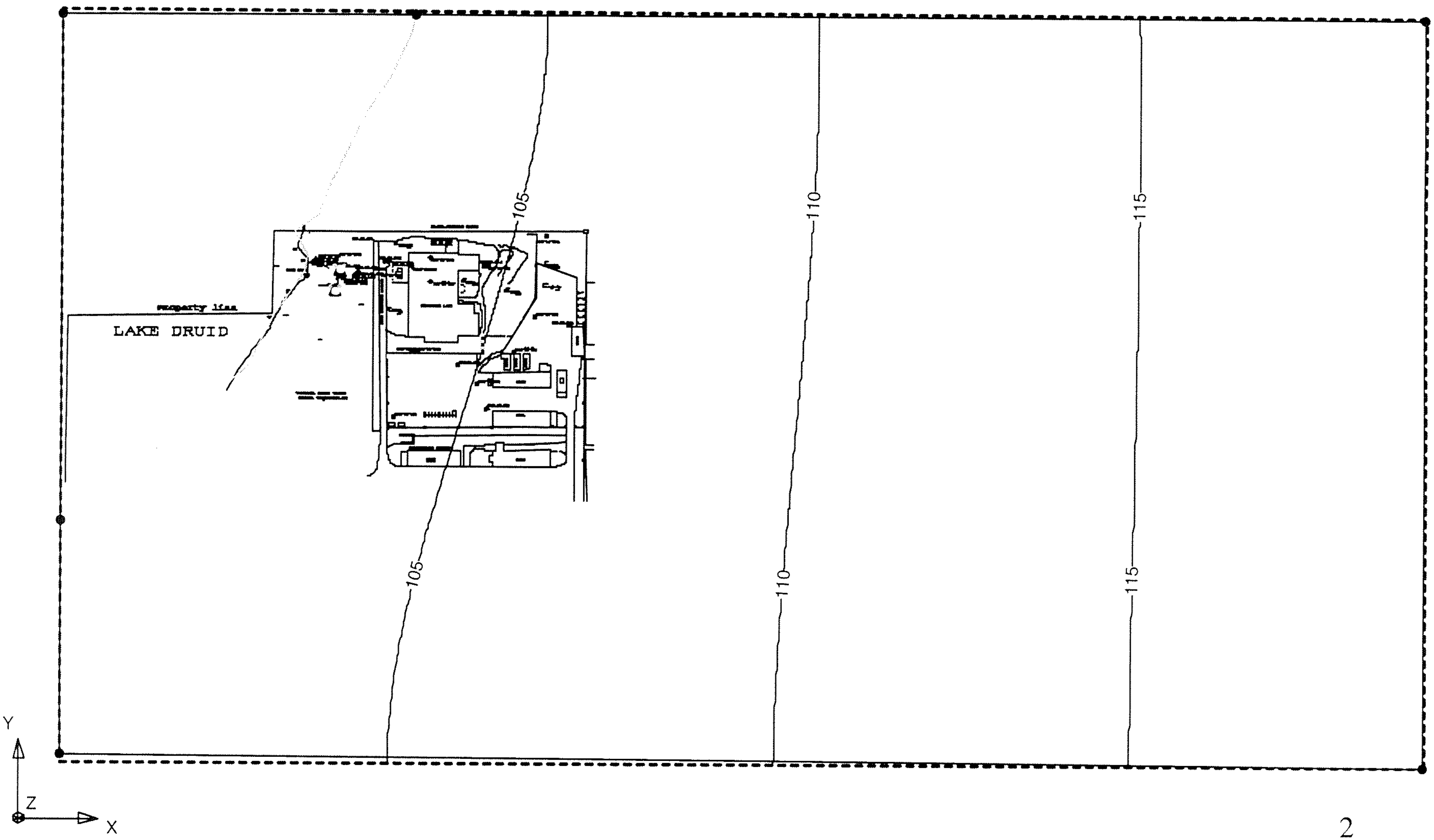
# Attachment A

## Groundwater Modeling Results

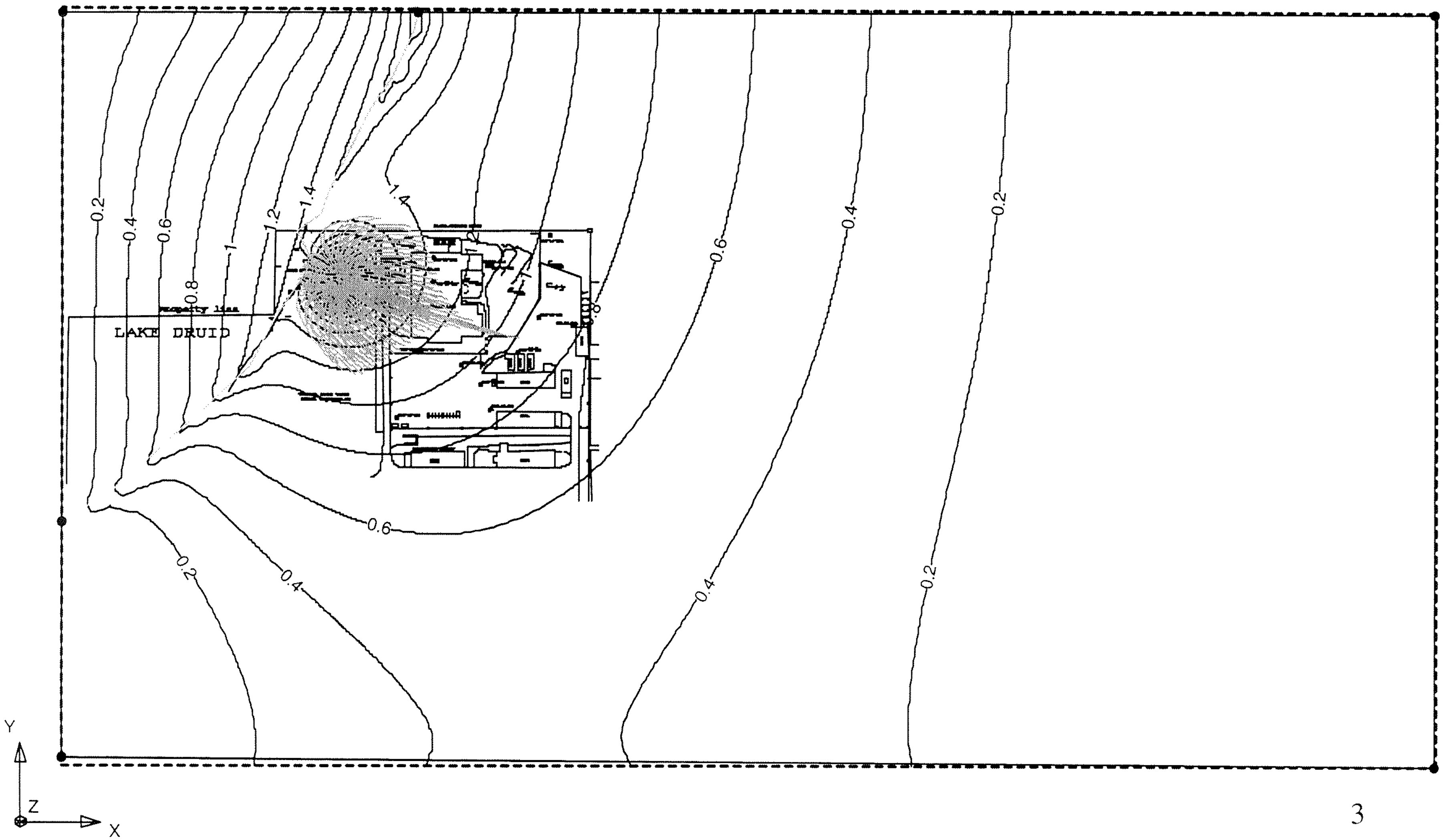
# Steady-State Drawdown under Background Conditions



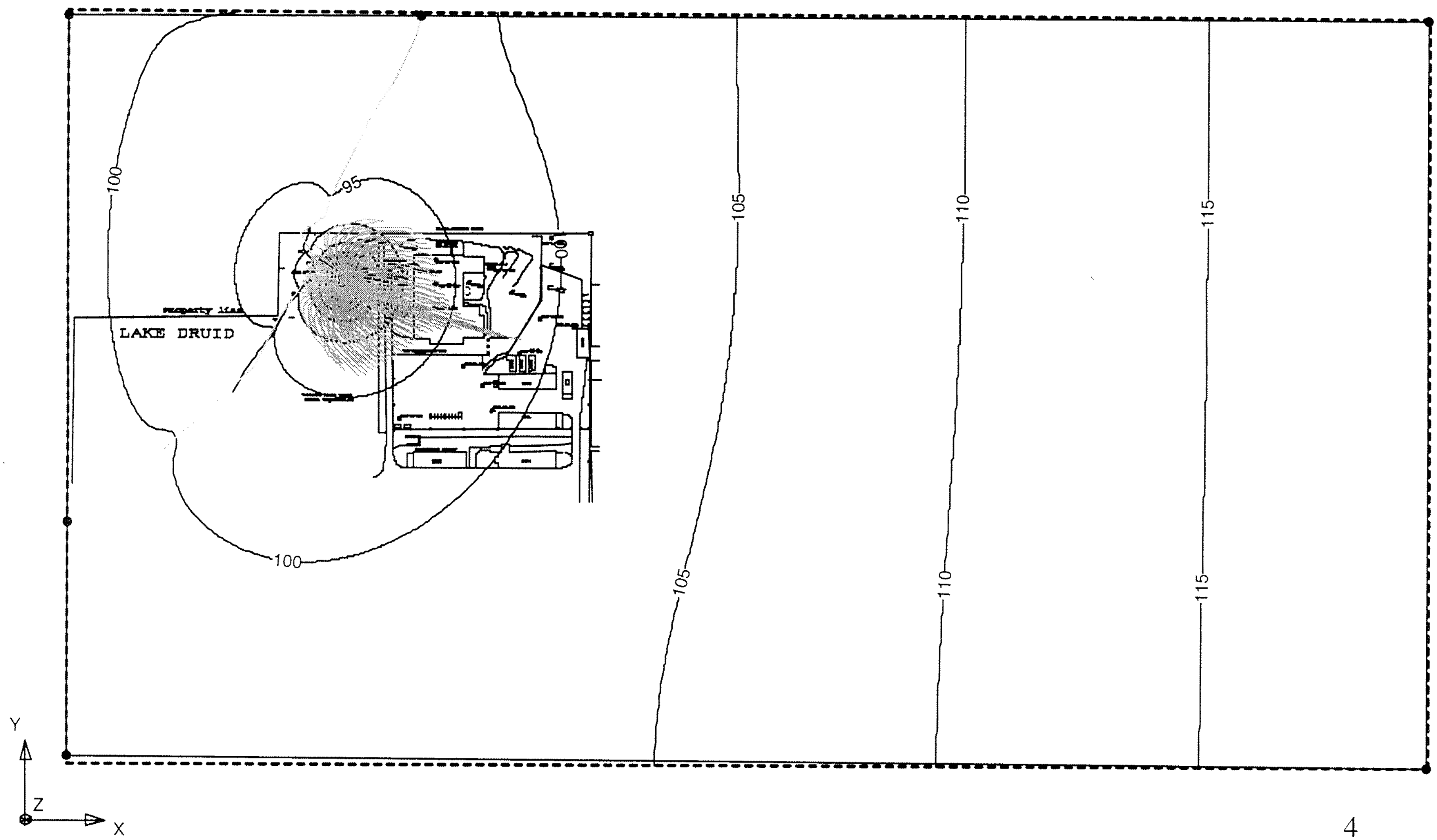
# Steady-State Water Table Elevation Head under Background Conditions



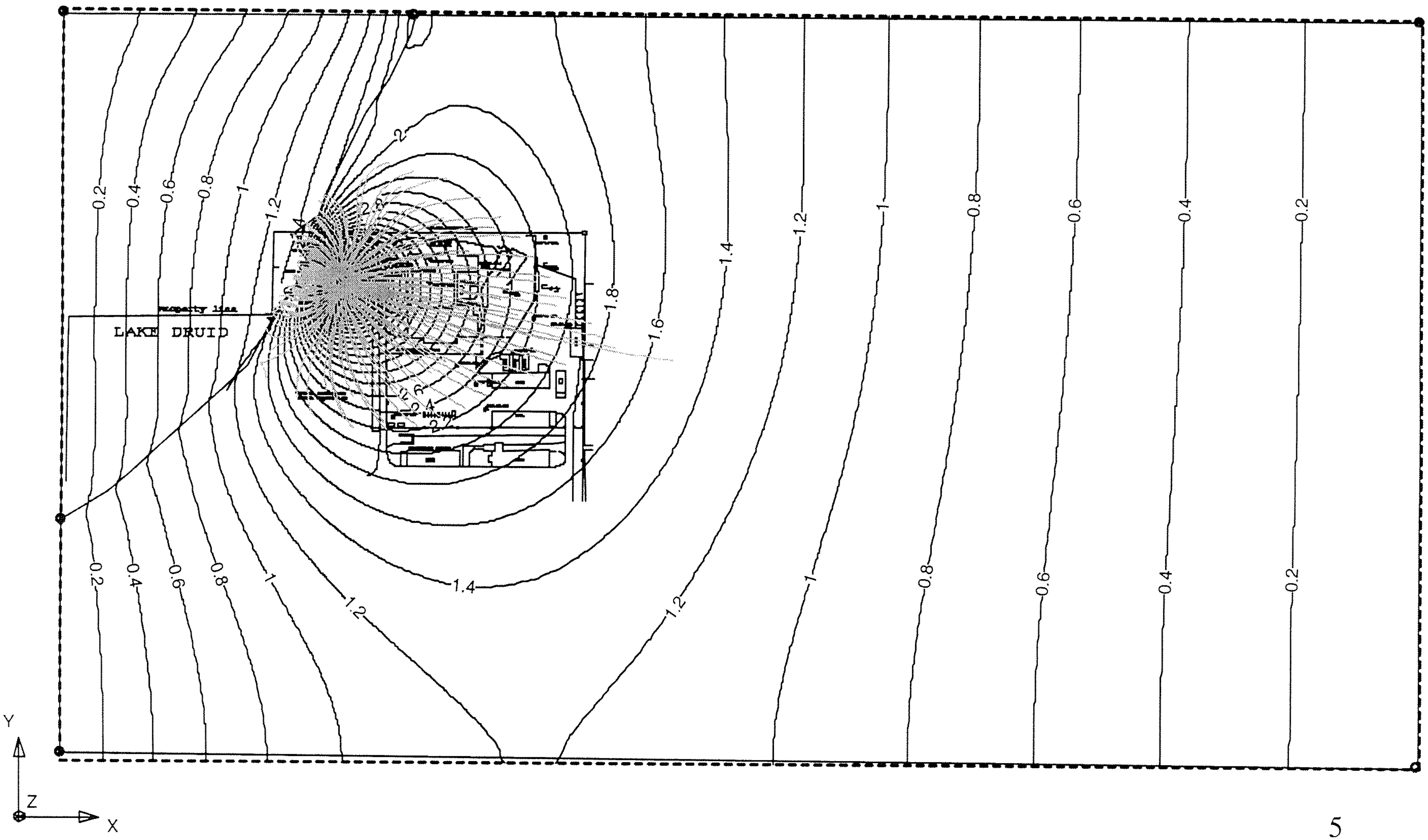
Steady-State Drawdown
under UVB Combined Well Pumping Rate of 6 gpm



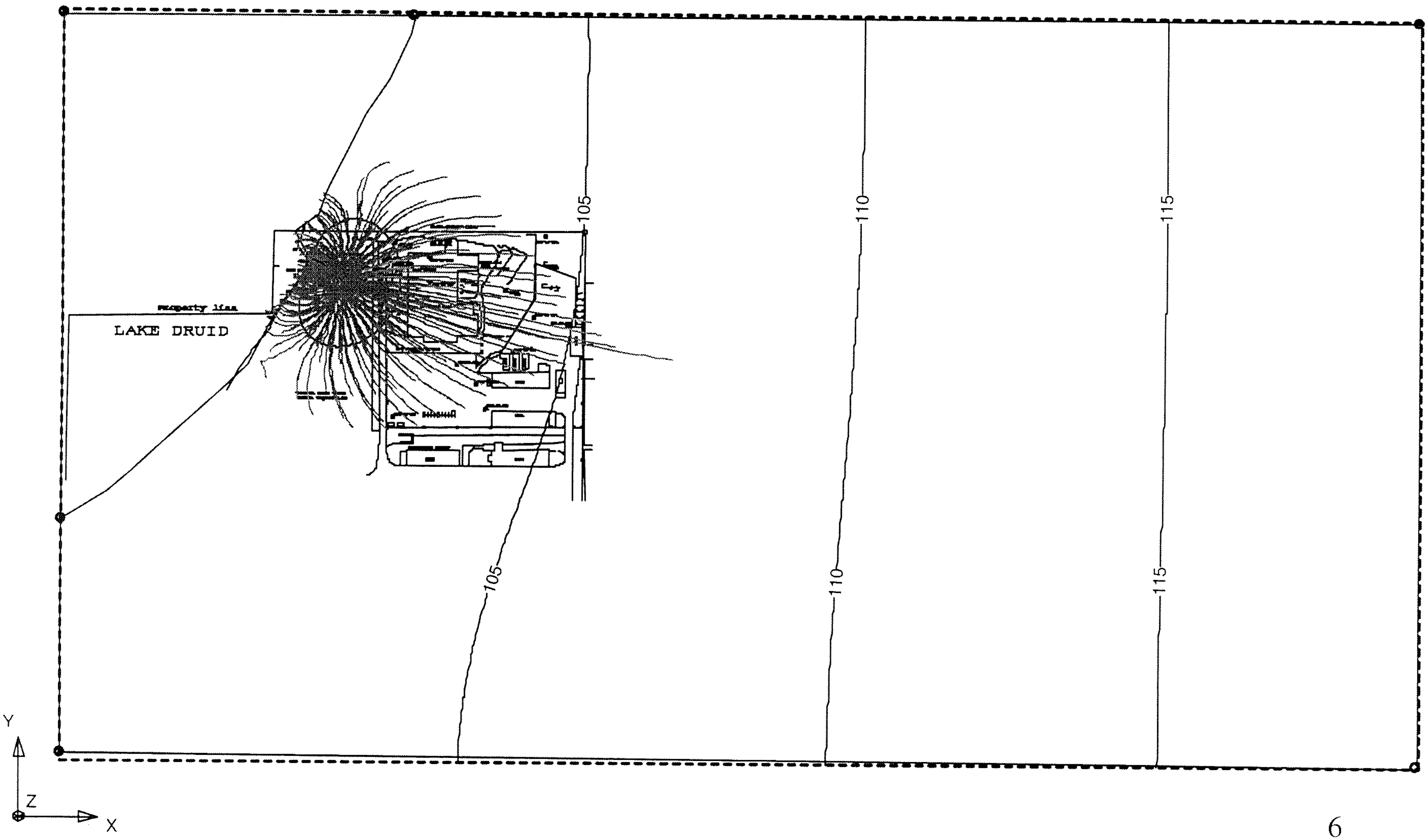
# Steady-State Water Table Elevation Head under UVB Combined Well Pumping Rate of 6 gpm



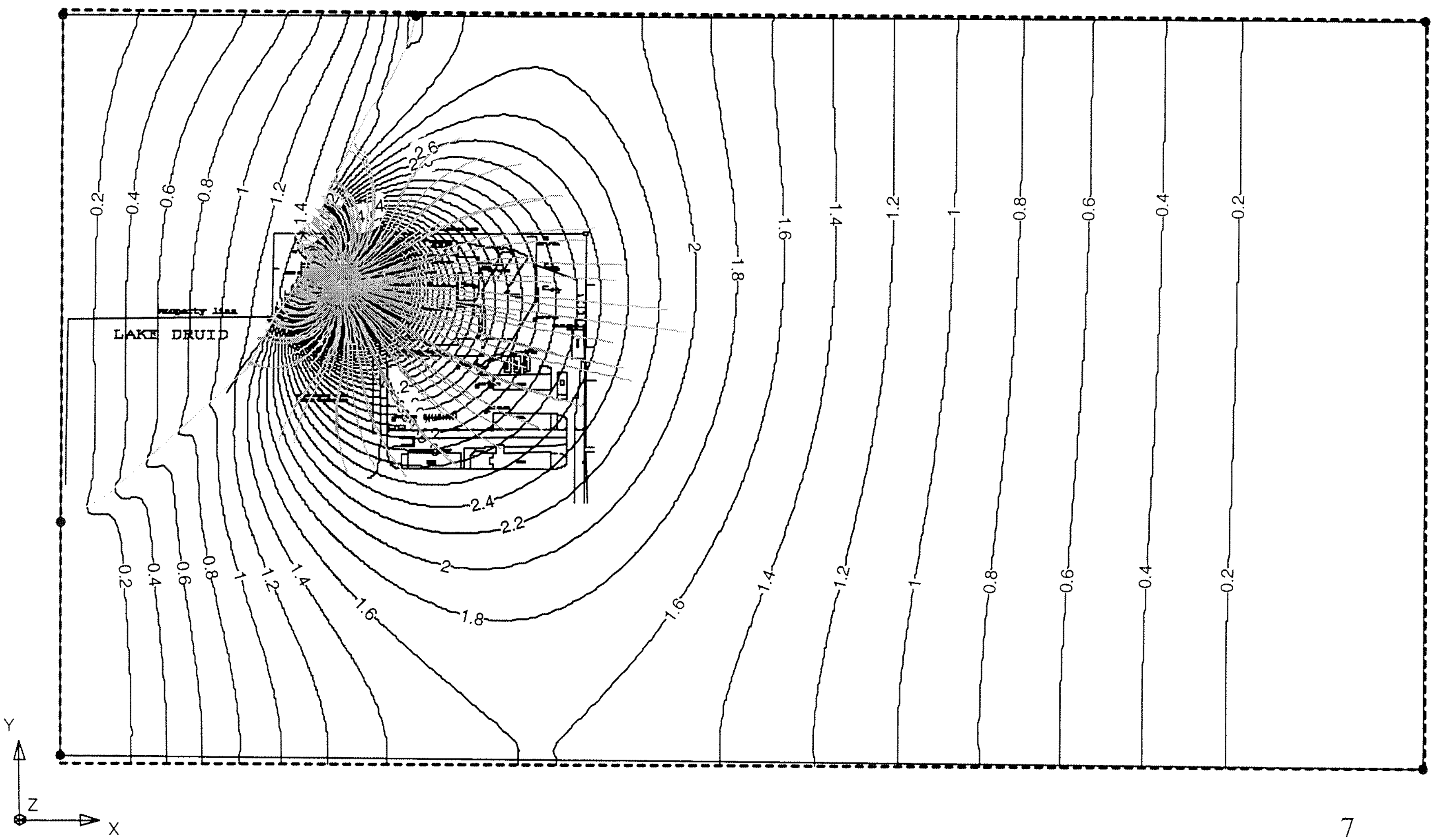
Steady-State Drawdown
under UVB Combined Well Pumping Rate of 30 gpm



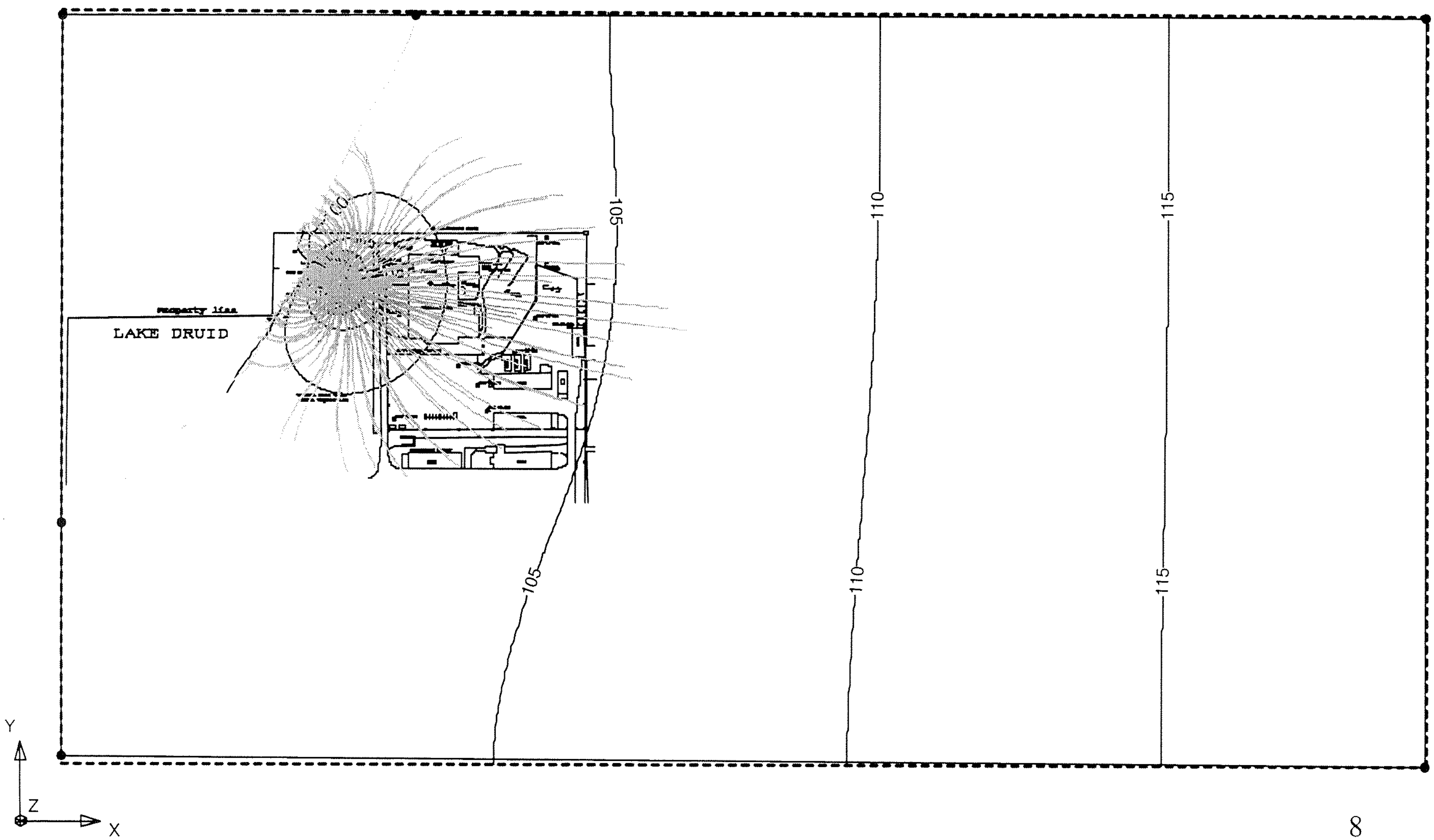
Steady-State Water Table Elevation Head
under UVB Combined Well Pumping Rate of 30 gpm



# Steady-State Drawdown
# under UVB Combined Well Pumping Rate of 60 gpm



# Steady-State Water Table Elevation Head under UVB Combined Well Pumping Rate of 60 gpm



# Attachment B

## City of Orlando Discharge Limits

| Permittee: | INDUSTRIAL USER DISCHARGE PERMIT | |
|---|---|---|
| | Number: | CO83TA |
| Naval Training Center Orlando | Category: | 9999 |
| (Area C) | Expiration Date: | 07/01/02 |

2. The wastewater constituents listed below shall at no time be discharged in concentrations which exceed the limitations given:

| Constituent (to be limited) | Maximum Concentrations, mg/l |
|---|---|
| Antimony | 1.0 |
| Arsenic | 0.25 |
| Barium | 10.0 |
| Beryllium | 0.25 |
| Biological Oxygen Demand (BOD) | 300.0 |
| Boron | 1.0 |
| Cadmium | 0.26 |
| Chromium (Total) | 1.0 |
| Cobalt | 0.3 |
| Copper | 2.0 |
| Cyanide | 0.5 |
| Grease | 100.0 |
| Lead | 0.4 |
| Lower Explosion Limit(LEL) | less than 5% (of LEL on the meter) |
| Lithium | 0.03 |
| Manganese | 1.5 |
| Mercury | 0.005 |
| Nickel | 0.7 |
| pH* | not less than 5.5 or greater than 9.5 |
| Selenium | 0.5 |
| Silver | 0.24 |
| Sodium | 300.0 |
| Tin | 5.0 |
| Zinc | 1.0 |
| Total Metals | 10.0 |
| Total Phenols | 0.5 |
| Total Suspended Solids (TSS) | 300.0 |
| Total Toxic Organics (TTO) | 2.13 |

* (pH excursions of 15 minutes or longer are considered pH violations)

# Attachment C

## Air Stripper Performance Modeling Results

Carbonair Environmental Systems
2731 Nevada Avenue North
New Hope, MN 55427-2864
612-544-2154 800-526-4999
Fax: 612-544-2151

08/03/00
12:06:12

------------STAT 180-------------
VERSION 3.1

| | |
|---|---|
| WATER FLOW RATE: | 60.0 gpm |
| AIR FLOW RATE: | 900.0 cfm |
| WATER TEMPERATURE: | 65.0 F |
| AIR-TO-WATER RATIO: | 112:1 |

Influent Conc. for TRICHLOROETHENE 1500.0 ppb

| NO OF TRAY | REMOVAL EFF % | EFF CONC ppb | OFF-GAS CONC ug/l | AIR EMISSION lb/d |
|---|---|---|---|---|
| 1 | 90.49498 | 142.5753 | 12.1199 | 0.9778 |
| 2 | 99.07749 | 13.8377 | 13.2693 | 1.0705 |
| 3 | 99.91029 | 1.3457 | 13.3808 | 1.0795 |
| 4 | 99.99127 | 0.1309 | 13.3917 | 1.0804 |
| 5 | 99.99915 | 0.0127 | 13.3927 | 1.0805 |
| 6 | 99.99992 | 0.0012 | 13.3928 | 1.0805 |

Influent Conc. for TETRACHLOROETHENE 3800.0 ppb

| NO OF TRAY | REMOVAL EFF % | EFF CONC ppb | OFF-GAS CONC ug/l | AIR EMISSION lb/d |
|---|---|---|---|---|
| 1 | 91.00017 | 341.9934 | 30.8751 | 2.4909 |
| 2 | 99.17903 | 31.1967 | 33.6500 | 2.7147 |
| 3 | 99.92502 | 2.8492 | 33.9031 | 2.7352 |
| 4 | 99.99315 | 0.2603 | 33.9262 | 2.7370 |
| 5 | 99.99937 | 0.0238 | 33.9284 | 2.7372 |
| 6 | 99.99994 | 0.0022 | 33.9286 | 2.7372 |

Influent Conc. for 1,2-DICHLOROETHENE (CIS) 1200.0 ppb

| NO OF TRAY | REMOVAL EFF % | EFF CONC ppb | OFF-GAS CONC ug/l | AIR EMISSION lb/d |
|---|---|---|---|---|
| 1 | 86.01159 | 167.8609 | 9.2155 | 0.7435 |
| 2 | 97.95252 | 24.5697 | 10.4949 | 0.8467 |
| 3 | 99.69837 | 3.6196 | 10.6820 | 0.8618 |
| 4 | 99.95552 | 0.5337 | 10.7095 | 0.8640 |
| 5 | 99.99344 | 0.0787 | 10.7136 | 0.8643 |
| 6 | 99.99903 | 0.0116 | 10.7142 | 0.8644 |

Influent Conc. for TOTAL VOCs 6500.0 ppb

| NO OF TRAY | REMOVAL EFF % | EFF CONC ppb | OFF-GAS CONC ug/l | AIR EMISSION lb/d |
|---|---|---|---|---|
| 1 | 89.96262 | 652.4296 | 52.2104 | 4.2121 |
| 2 | 98.92917 | 69.6042 | 57.4142 | 4.6319 |
| 3 | 99.87978 | 7.8145 | 57.9659 | 4.6764 |
| 4 | 99.98577 | 0.9249 | 58.0275 | 4.6814 |
| 5 | 99.99823 | 0.1152 | 58.0347 | 4.6820 |
| 6 | 99.99977 | 0.0150 | 58.0356 | 4.6821 |

# Attachment D

## Design Calculations

# MAXIMUM FLOW AND AVERAGE CONTAMINANT CONCENTRATION CONDITION
# AIR STRIPPER TREATMENT SYSTEM DESIGN

NTC OU4, Orlando, FL

| Contamination Characterization | Historic Low | Historic High | Wtd Avg* | Limit | Unit | Source |
|---|---|---|---|---|---|---|
| TCE concentration range | ND | 2,475 | 750 | 3 | ppb | FL MCL |
| cis-1,2 DCE concentration range | ND | 1,650 | 600 | 70 | ppb | FL MCL |
| PCE concentration range | ND | 29,800 | 1,900 | 3 | ppb | FL MCL |

NOTE: * - See Basis of Design document for backup data to support the Wtd. Avg. values.

Air Stripper Conceptual Design Parameters

Stripper design flowrate 60 gpm

Governing contaminant PCE at 1,900 ppb (with 2X safety factor)

Governing contaminant is based on consideration of a combination of low Henry's Constant and high concentration versus MCL.

Influent temperature 65 °F (Assume conservatively low temperature modeling purposes only)

Assume 100% of PCE is stripped and discharged untreated to the atmosphere.

Assume a STAT180 using a blower airflow rate of 900 cfm

PCE emissions 0.057 lbs/hr or 1.37 lbs/day or 498.9 lbs/yr

Average PCE emissions concentration is 16.9 $mg/m^3$ or 2.5 ppm

The OSHA TWA of PCE is 100 ppm or 678 $mg/m^3$

Assume 100% of TCE is stripped and discharged untreated to the atmosphere.

Assume a STAT180 using a blower airflow rate of 900 cfm

TCE emissions 0.022 lbs/hr or 0.54 lbs/day or 197.0 lbs/yr

Average TCE emissions concentration is 6.7 $mg/m^3$ or 1.2 ppm

The OSHA TWA of TCE is 100 ppm or 537 $mg/m^3$

Assume 100% of cis-1,2 DCE is stripped and discharged untreated to the atmosphere.

Assume a STAT180 using a blower airflow rate of 900 cfm

cis-1,2 DCE emissions 0.018 lbs/hr or 0.43 lbs/day or 157.6 lbs/yr

Average cis-1,2 DCE emissions concentration is 5.3 $mg/m^3$ or 1.3 ppm

The NIOSH REL of cis-1,2 DCE is 200 ppm or 794 $mg/m^3$

Since the average potential emission concentrations are estimated to be less than the NIOSH/OSHA limits, the offgas treatment is not required for worker safety.

The FDEP has an emissions limitation of 13.7 lbs/day total VOC.

The estimated average potential emissions from the air stripper is 2.34 lbs/day of PCE, TCE, and cis-1,2 DCE

Therefore, since emissions don't exceed FDEP limit and don't exceed NIOSH/OSHA worker safety standards, then **NO OFFGAS TREATMENT IS PLANNED.**

# Langlier Index Calculation

NTC OU4, Orlando, FL

Average Groundwater Conditions in the Extraction Well Area
(See Basis of Design Memorandum for backup information)

**Concentrations of constituents represent an average estimate for influent based on RI and pump test analytical data.**

| Contaminant | Value | |
|---|---|---|
| pH | 5.4 | Actual pH |
| $[H^+]$ (M) | 3.98E-06 | Calculated from pH |
| Alkalinity (mg/l as HCO3-) | 8.0 | |
| $[Ca^{2+}]$ (mg/l) | 37 | |
| Langlier Index (LI) | -3.70 | |

Langlier Index less than 1 indicates low potential for CaCO3 scaling.

The Nalco Water Handbook (Kemmer, 1988) Figure 4.9 incorporates temperature.
Effluent temperature = 26.5°C (80°F)

| | |
|---|---|
| Alkalinity as $CaCO_3$ = | 6.6 mg/l |
| Calcium as $CaCO_3$ = | 92 mg/l |
| pHs from Figure 4.9 = | 9 (minimum value, low alkalinity off scale of figure) |
| LI = 7.34 - 7.3 = | -3.6 |

The LI estimates are in close agreement and indicate a no tendency for calcium carbonate precipitation.

**June 14, 2000 groundwater sampling from OLD-13-OW10A and OW11C**

| Contaminant | Value | |
|---|---|---|
| pH | 5.67 | Actual pH |
| $[H^+]$ (M) | 2.14E-06 | Calculated from pH |
| Alkalinity (mg/l as HCO3-) | 50.4 | |
| $[Ca^{2+}]$ (mg/l) | 18.5 | |
| Langlier Index (LI) | -2.93 | |

Langlier Index less than 1 indicates low potential for CaCO3 scaling.

The Nalco Water Handbook (Kemmer, 1988) Figure 4.9 incorporates temperature.
Effluent temperature = 26.5°C (80°F)

| | |
|---|---|
| Alkalinity as $CaCO_3$ = | 41.3 mg/l |
| Calcium as $CaCO_3$ = | 46.3 mg/l |
| pHs from Figure 4.9 = | 8.55 |
| LI = 7.34 - 7.3 = | -2.88 |

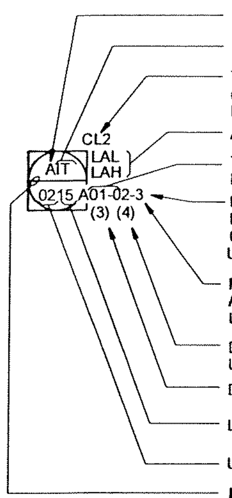
The LI estimates are in close agreement and indicate a no tendency for calcium carbonate precipitation.

# Attachment E

## Design Drawings

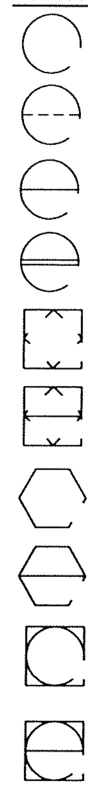
# INSTRUMENT IDENTIFICATION

## BUBBLE SYMBOL




- FIRST LETTER(S)
- SUCCEEDING LETTERS
- TYPE, ACTION OR CONTROL (SEE ABBREVIATIONS & LETTER SYMBOLS)
- AUXILIARY PROCESSOR FUNCTIONS
- TRAIN/UNIT NO. (IF THE PROCESS DOES NOT HAVE TRAINS, THE LETTER IS THEN A DASH.)
- MULTIPLE SUB-UNIT NUMBER (USED WHEN MULTIPLE UNITS HAVE MULTIPLE COMPONENTS OF THE SAME UNIT IN A UNIT PROCESS AND LOOP)
- MULTIPLE UNIT NUMBERS (USED WHEN THERE ARE MULTIPLE COMPONENTS OF THE SAME UNIT IN A UNIT PROCESS AND LOOP)
- DENOTES TOTAL NUMBER OF MULTIPLE UNITS
- DENOTES TOTAL NUMBER OF UNITS
- LOOP NUMBER
- UNIT PROCESS NUMBER
- INSTRUMENT LOCATION. TYPE OR ABSENCE OF LINE DENOTES LOCATION OF INSTRUMENT OR ACCESSIBILITY

## INSTRUMENT LOCATION SYMBOL

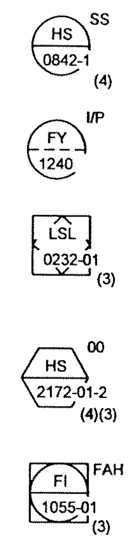


- FIELD MOUNTED INSTRUMENT
- INSTRUMENT
- PANEL MOUNTED INSTRUMENT
- MOTOR CONTROL CENTER MOUNTED INSTRUMENT
- DIGITAL LOGIC CONTROL INTEGRAL TO THE DISTRIBUTED CONTROL SYSTEM. (FUNCTION NOT NORMALLY ACCESSIBLE TO THE OPERATOR)
- DIGITAL LOGIC CONTROL INTEGRAL TO THE DISTRIBUTED CONTROL SYSTEM. (FUNCTION OPERATOR ACCESSIBLE)
- COMPUTER INTERFACE WITH PROCESS (FUNCTION NOT NORMALLY ACCESSIBLE TO THE OPERATOR)
- COMPUTER INTERFACE WITH PROCESS (FUNCTION OPERATOR ACCESSIBLE)
- CONTROL OR DISPLAY FUNCTION VIA THE OPERATOR INTERFACE WITH THE DISTRIBUTED CONTROL SYSTEM. (FUNCTION NOT NORMALLY ACCESSIBLE TO THE OPERATOR)
- CONTROL OR DISPLAY FUNCTION VIA THE OPERATOR INTERFACE WITH THE DISTRIBUTED CONTROL SYSTEM. (FUNCTION OPERATOR ACCESSIBLE)

## TRANSDUCERS

| | |
|---|---|
| A | ANALOG |
| D | DIGITAL |
| E | VOLTAGE |
| F | FREQUENCY |
| I | CURRENT |
| P | PNEUMATIC |
| PF | PULSE FREQUENCY |
| PD | PULSE DURATION |

## EXAMPLE CASES




- START-STOP HAND SWITCH (MOMENTARY CONTACT). UNIT PROCESS 08, LOOP 42, TRAIN A OF 4 TRAINS.
- CURRENT TO PNEUMATIC TRANSDUCER. REAR-OF-PANEL MOUNTED INSTRUMENT.
- DIGITAL LOGIC CONTROLLER "LOW" LEVEL SOFTWARE SWITCH. UNIT PROCESS 02, LOOP 32, UNIT 1 OF 3.
- COMPUTER SOFTWARE (MAINTAINED) HAND SWITCH. UNIT PROCESS 21, LOOP 72, UNIT 1 OF 4. THIS IS NUMBER 2 UNIT OF UNIT-01 WITH A TOTAL OF 3.
- DISPLAY OF A FLOW SIGNAL AT THE OPERATOR INTERFACE, UNIT PROCESS 10, LOOP 55, UNIT 1 OF 3 WITH A HIGH FLOW ALARM AT THE OPERATOR INTERFACE.

## INSTRUMENT SOCIETY OF AMERICA TABLE (ISA)

| LETTER | FIRST LETTER(S) | | SUCCEEDING LETTERS | | |
|---|---|---|---|---|---|
| | PROCESS OR INITIATING VARIABLE | MODIFIER | READOUT OR PASSIVE FUNCTION | OUTPUT FUNCTION | MODIFIER |
| A | ANALYSIS (*) | | ALARM | | |
| B | BURNER FLAME | | USERS CHOICE (*) | USERS CHOICE (*) | USERS CHOICE (*) |
| C | CONDUCTIVITY | | | CONTROL | |
| D | DENSITY (S.G.) | DIFFERENTIAL | | | |
| E | VOLTAGE | | PRIMARY ELEMENT | | |
| F | FLOW RATE | RATIO | | | |
| G | GAUGE | | GLASS | GATE | |
| H | HAND (MANUAL) | | | | HIGH |
| I | CURRENT | | INDICATE | | |
| J | POWER | SCAN | | | |
| K | TIME OR SCHEDULE | | | CONTROL STATION | |
| L | LEVEL | | LIGHT (PILOT) | | LOW |
| M | MOTION | | | | MIDDLE |
| N | TORQUE | | USERS CHOICE (*) | USERS CHOICE (*) | USERS CHOICE (*) |
| O | USERS CHOICE (*) | | ORIFICE | | |
| P | PRESSURE (OR VACUUM) | | POINT (TEST CONNECTION) | | |
| Q | QUANTITY OR EVENT (*) | INTEGRATE | INTEGRATE | | |
| R | | | RECORD OR PRINT | | |
| S | SPEED OR FREQUENCY | SAFETY | | SWITCH | |
| T | TEMPERATURE | | | TRANSMIT | |
| U | MULTIVARIABLE (*) | | MULTIFUNCTION (*) | | |
| V | VISCOSITY | | | VALVE | |
| W | WEIGHT OR FORCE | WELL | | | |
| X | UNCLASSIFIED (*) | | UNCLASSIFIED (*) | UNCLASSIFIED (*) | UNCLASSIFIED (*) |
| Y | USERS CHOICE (*) | | | RELAY OR COMPUTE (*) | |
| Z | POSITION | | | DRIVE, ACTUATE OR UNCLASSIFIED FINAL CONTROL ELEMENT | |

(*) WHEN USED, EXPLANATION IS SHOWN ADJACENT TO INSTRUMENT SYMBOL. SEE ABBREVIATIONS AND LETTER SYMBOLS.

## ABBREVIATIONS & LETTER SYMBOLS

| | |
|---|---|
| AC | ALTERNATING CURRENT |
| AM | AUTO-MANUAL |
| ACK | ACKNOWLEDGE |
| ALT | ALTERNATOR |
| CAM | COMPUTER-AUTO-MANUAL |
| CCS | CENTRAL CONTROL SYSTEM |
| CIF | CHEMICAL INTERFACE PANEL |
| CL2 | CHLORINE (TYPICAL: USE STANDARD CHEMICAL ELEMENT ABBREVIATION) |
| CM | COMPUTER-MANUAL |
| COND | CONDUCTIVITY |
| CP-VVWXX | CONTROL PANEL (CONTROL PANELS ASSOCIATED WITH A PACKAGED SYSTEM) VV = UNIT PROCESS NUMBER WW = LOOP NUMBER |
| DC | DIRECT CURRENT |
| FCC-XX-AA | FILTER CONTROL CONSOLE (SPACIFIED UNDER PROCESS INSTRUMENTATIION AND CONTROLS) VV = UNIT PROCESS NUMBER AA = PANEL UNIT NUMBER |
| FOS | FAST-OFF-SLOW |
| FP-XX-AA | FIELD PANEL ( SPECIFIED UNDER PROCESS INSTRUMENTATION AND CONTROLS) VV = UNIT PROCESS NUMBER AA = PANEL UNIT NUMBER |
| FR | FORWARD-REVERSE |
| HOA | HAND-OFF-AUTO |
| HOR | HAND-OFF-REMOTE |
| LCP-XX-AA | LOCAL CONTROL PANEL ( SPECIFIED UNDER PROCESS INSTRUMENTATION AND CONTROLS) VV = UNIT PROCESS NUMBER AA = PANEL UNIT NUMBER |
| LOS | LOCKOUT STOP |
| LR | LOCAL-REMOTE |
| M | MANUAL |
| MA | MANUAL-AUTO |
| MCC-X | MOTOR CONTROL CENTER NUMBER-X |
| MCP | MAIN CONTROL PANEL (SPECIFIED UNDER PROCESS INSTRUMENTATION AND CONTROLS) |
| NIC | NOT IN CONTRACT |
| OC | OPEN-CLOSE |
| OCA | OPEN-CLOSE-AUTO |
| OO | ON-OFF (MAINTAINED CONTROL) |
| OOA | ON-OFF-AUTO |
| OODT | ON-OFF-DIFFERENTIAL-TIME |
| OSC | OPEN-STOP-CLOSE |
| PLC | PROGRAMMABLE LOGIC CONTROLLER |
| PMP | PLANT MONITORING PANEL (SPECIFIED UNDER PROCESS INSTRUMENTATION AND CONTROLS) |
| POT | POTENTIOMETER |
| R | RESET |
| RESID | CHLORINE RESIDUAL |
| RTM | RUN TIME METER |
| SCU | SPEED CONTROL UNIT |
| SO2 | SULFUR DIOXIDE |
| SS | START - STOP (MOMENTARY CONTROL) |
| TURB | TURBIDITY |
| < | GREATER THAN |
| > | LESS THAN |
| X | MULTIPLIER |
| 1/2 | ONE TWO SELECTOR |
| + | SUMMATION |
| SqR | SQUARE ROOT |

## GENERAL NOTES

1. COMPONENTS AND PANELS SHOWN WITH DIAMOND (◆) ARE TO BE PROVIDED UNDER SECTION PROCESS INSTRUMENTATION AND CONTROLS".
2. COMPONENTS AND PANELS SHOWN WITH A DOUBLE ASTERISK (✱✱) ARE TO BE PROVIDED AS PART OF A PACKAGED OR MECHANICAL SYSTEM.
3. COMPONENTS AND PANELS SHOWN WITH A TRIANGLE (△) ARE TO BE PROVIDED BY OTHERS (NIC).
4. THIS IS A STANDARD LEGEND SHEET. THEREFORE, NOT ALL OF THE INFORMATION SHOWN MAY BE USED ON THIS PROJECT.

| | | NO. | DATE | REVISION | BY | APVD |
|---|---|---|---|---|---|---|
| DSGN | T. PALAIA | | | | | |
| DR | E. KRISTEL | | | | | |
| CHK | M. OKEY | | | | | |
| APVD | C. HOOD | | | | | |

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

CH2MHILL

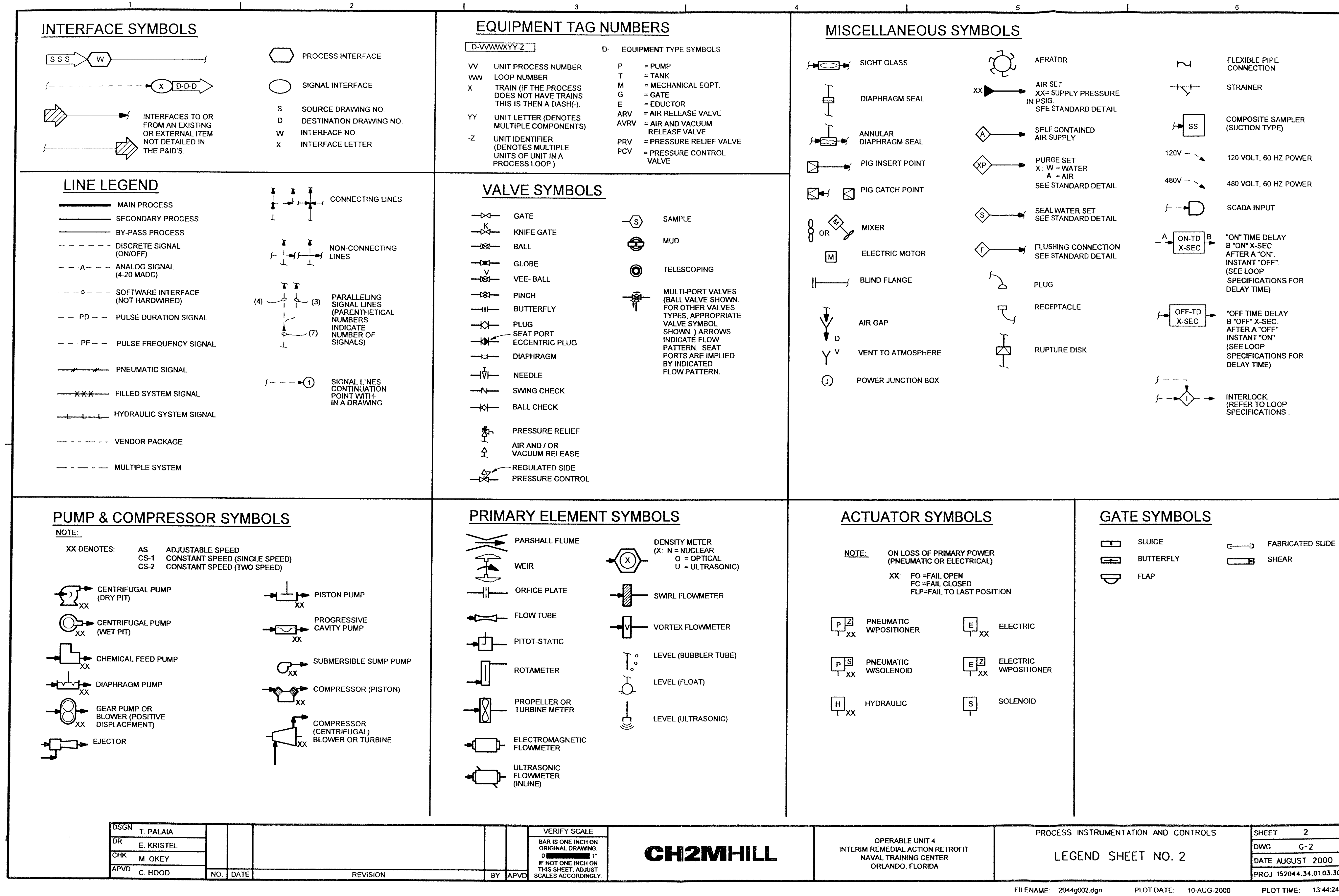
OPERABLE UNIT 4
INTERIM REMEDIAL ACTION RETROFIT
NAVAL TRAINING CENTER
ORLANDO, FLORIDA

PROCESS INSTRUMENTATION AND CONTROLS

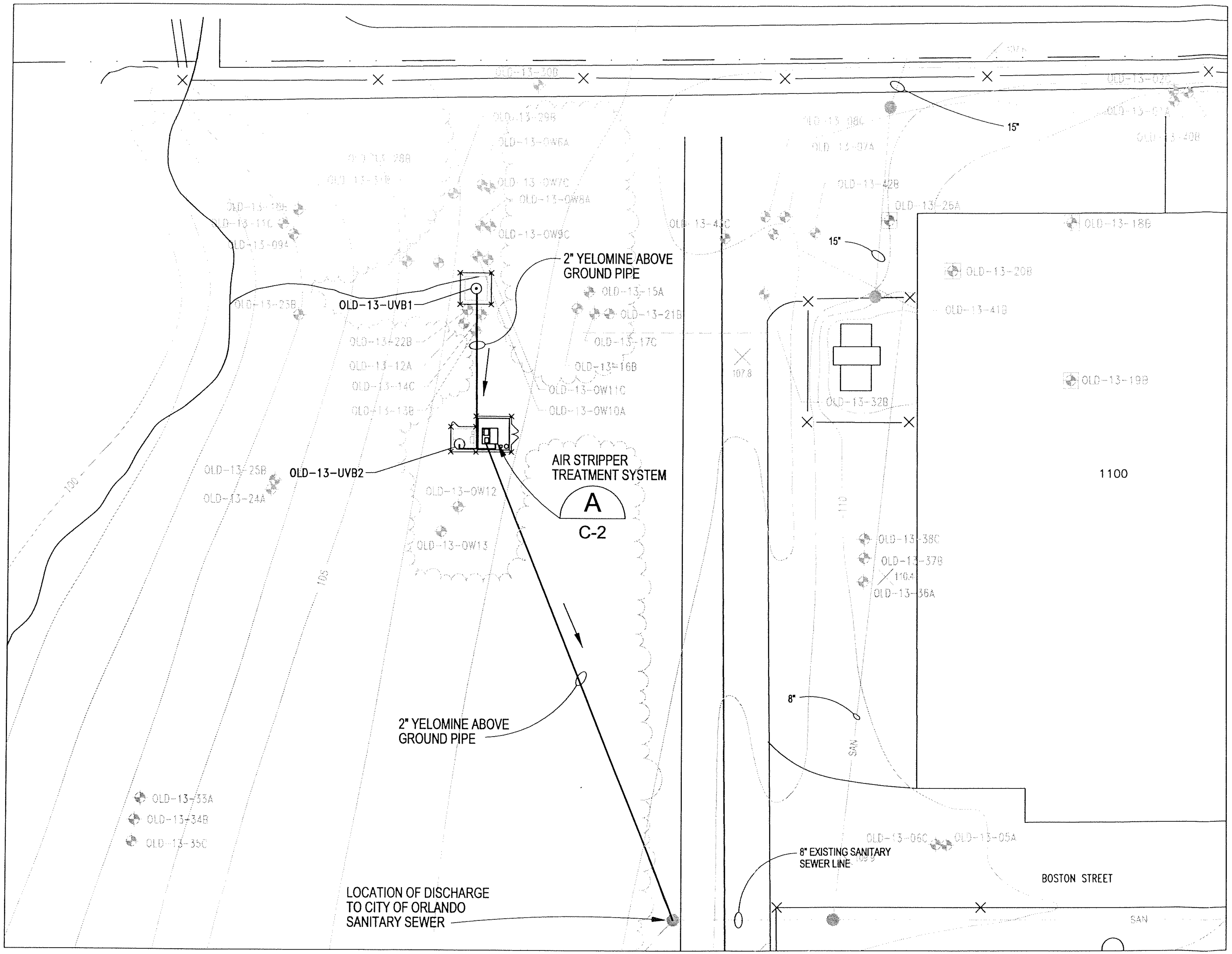
LEGEND SHEET NO. 1

SHEET 1
DWG G-1
DATE AUGUST 2000
PROJ 152044.34.01.03.30

FILENAME: 2044g001.dgn PLOT DATE: 10-AUG-2000 PLOT TIME: 13:43:12



INTERFACE SYMBOLS
S-S-S
W
X
D-D-D
PROCESS INTERFACE
SIGNAL INTERFACE
INTERFACES TO OR FROM AN EXISTING OR EXTERNAL ITEM NOT DETAILED IN THE P&ID'S.
S SOURCE DRAWING NO.
D DESTINATION DRAWING NO.
W INTERFACE NO.
X INTERFACE LETTER
EQUIPMENT TAG NUMBERS
D-VVWWXYY-Z
VV UNIT PROCESS NUMBER
WW LOOP NUMBER
X TRAIN (IF THE PROCESS DOES NOT HAVE TRAINS THIS IS THEN A DASH(-).
YY UNIT LETTER (DENOTES MULTIPLE COMPONENTS)
-Z UNIT IDENTIFIER (DENOTES MULTIPLE UNITS OF UNIT IN A PROCESS LOOP.)
D- EQUIPMENT TYPE SYMBOLS
P = PUMP
T = TANK
M = MECHANICAL EQPT.
G = GATE
E = EDUCTOR
ARV = AIR RELEASE VALVE
AVRV = AIR AND VACUUM RELEASE VALVE
PRV = PRESSURE RELIEF VALVE
PCV = PRESSURE CONTROL VALVE
MISCELLANEOUS SYMBOLS
SIGHT GLASS
DIAPHRAGM SEAL
ANNULAR DIAPHRAGM SEAL
PIG INSERT POINT
PIG CATCH POINT
OR
MIXER
M
ELECTRIC MOTOR
BLIND FLANGE
D
AIR GAP
V
VENT TO ATMOSPHERE
J
POWER JUNCTION BOX
AERATOR
XX
AIR SET XX= SUPPLY PRESSURE IN PSIG. SEE STANDARD DETAIL
A
SELF CONTAINED AIR SUPPLY
XP
PURGE SET X: W = WATER A = AIR SEE STANDARD DETAIL
S
SEAL WATER SET SEE STANDARD DETAIL
F
FLUSHING CONNECTION SEE STANDARD DETAIL
PLUG
RECEPTACLE
RUPTURE DISK
FLEXIBLE PIPE CONNECTION
STRAINER
SS
COMPOSITE SAMPLER (SUCTION TYPE)
120V
120 VOLT, 60 HZ POWER
480V
480 VOLT, 60 HZ POWER
SCADA INPUT
A
ON-TD X-SEC
B
"ON" TIME DELAY B "ON" X-SEC. AFTER A "ON". INSTANT "OFF". (SEE LOOP SPECIFICATIONS FOR DELAY TIME)
OFF-TD X-SEC
"OFF TIME DELAY B "OFF" X-SEC. AFTER A "OFF" INSTANT "ON" (SEE LOOP SPECIFICATIONS FOR DELAY TIME)
I
INTERLOCK. (REFER TO LOOP SPECIFICATIONS .
LINE LEGEND
MAIN PROCESS
SECONDARY PROCESS
BY-PASS PROCESS
DISCRETE SIGNAL (ON/OFF)
A
ANALOG SIGNAL (4-20 MADC)
SOFTWARE INTERFACE (NOT HARDWIRED)
PD
PULSE DURATION SIGNAL
PF
PULSE FREQUENCY SIGNAL
PNEUMATIC SIGNAL
FILLED SYSTEM SIGNAL
HYDRAULIC SYSTEM SIGNAL
VENDOR PACKAGE
MULTIPLE SYSTEM
CONNECTING LINES
NON-CONNECTING LINES
(4)
(3)
(7)
PARALLELING SIGNAL LINES (PARENTHETICAL NUMBERS INDICATE NUMBER OF SIGNALS)
1
SIGNAL LINES CONTINUATION POINT WITH-IN A DRAWING
VALVE SYMBOLS
GATE
K
KNIFE GATE
BALL
GLOBE
V
VEE- BALL
PINCH
BUTTERFLY
PLUG
SEAT PORT ECCENTRIC PLUG
DIAPHRAGM
NEEDLE
SWING CHECK
BALL CHECK
PRESSURE RELIEF
AIR AND / OR VACUUM RELEASE
REGULATED SIDE PRESSURE CONTROL
S
SAMPLE
MUD
TELESCOPING
MULTI-PORT VALVES (BALL VALVE SHOWN. FOR OTHER VALVES TYPES, APPROPRIATE VALVE SYMBOL SHOWN. ) ARROWS INDICATE FLOW PATTERN. SEAT PORTS ARE IMPLIED BY INDICATED FLOW PATTERN.
PUMP & COMPRESSOR SYMBOLS
NOTE:
XX DENOTES: AS ADJUSTABLE SPEED
CS-1 CONSTANT SPEED (SINGLE SPEED)
CS-2 CONSTANT SPEED (TWO SPEED)
XX
CENTRIFUGAL PUMP (DRY PIT)
CENTRIFUGAL PUMP (WET PIT)
CHEMICAL FEED PUMP
DIAPHRAGM PUMP
GEAR PUMP OR BLOWER (POSITIVE DISPLACEMENT)
EJECTOR
PISTON PUMP
PROGRESSIVE CAVITY PUMP
SUBMERSIBLE SUMP PUMP
COMPRESSOR (PISTON)
COMPRESSOR (CENTRIFUGAL) BLOWER OR TURBINE
PRIMARY ELEMENT SYMBOLS
PARSHALL FLUME
WEIR
ORFICE PLATE
FLOW TUBE
PITOT-STATIC
ROTAMETER
PROPELLER OR TURBINE METER
ELECTROMAGNETIC FLOWMETER
ULTRASONIC FLOWMETER (INLINE)
X
DENSITY METER (X: N = NUCLEAR O = OPTICAL U = ULTRASONIC)
SWIRL FLOWMETER
V
VORTEX FLOWMETER
LEVEL (BUBBLER TUBE)
LEVEL (FLOAT)
LEVEL (ULTRASONIC)
ACTUATOR SYMBOLS
NOTE: ON LOSS OF PRIMARY POWER (PNEUMATIC OR ELECTRICAL)
XX: FO =FAIL OPEN
FC =FAIL CLOSED
FLP=FAIL TO LAST POSITION
P Z XX
PNEUMATIC W/POSITIONER
P S XX
PNEUMATIC W/SOLENOID
H XX
HYDRAULIC
E XX
ELECTRIC
E Z XX
ELECTRIC W/POSITIONER
S
SOLENOID
GATE SYMBOLS
SLUICE
BUTTERFLY
FLAP
FABRICATED SLIDE
SHEAR
DSGN T. PALAIA
DR E. KRISTEL
CHK M. OKEY
APVD C. HOOD
NO. DATE REVISION BY APVD
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.
CH2MHILL
OPERABLE UNIT 4
INTERIM REMEDIAL ACTION RETROFIT
NAVAL TRAINING CENTER
ORLANDO, FLORIDA
PROCESS INSTRUMENTATION AND CONTROLS
LEGEND SHEET NO. 2
SHEET 2
DWG G-2
DATE AUGUST 2000
PROJ 152044.34.01.03.30
FILENAME: 2044g002.dgn
PLOT DATE: 10-AUG-2000
PLOT TIME: 13:44:24
1
2
3
4
5
6
A
B
C
D




N

**LEGEND**

- OLD-13-10B — Monitoring well location and designation
- OLD-13-27A — Microwell location and designation
- OLD-13-UVB2 — Interim remedial action recirculation well
- ×—× — Fence
- Structure removed; topography no longer accurate.
- 100 — Elevation contour (1-foot interval)
- × 114.2 — Ground elevation

0 25 50

SCALE: 1 INCH = 50 FEET

SOURCE: Naval Training Center Public Works Department, Storm Sewer Map, 1978



| | | | | | | |
|---|---|---|---|---|---|---|
| DSGN M. JOHNS | | | | | | |
| DR L. WALTER | | | | | | |
| CHK T. PALAIA | | | | | | |
| APVD S. TSANGARIS | NO. | DATE | REVISION | BY | APVD | |

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

CH2MHILL

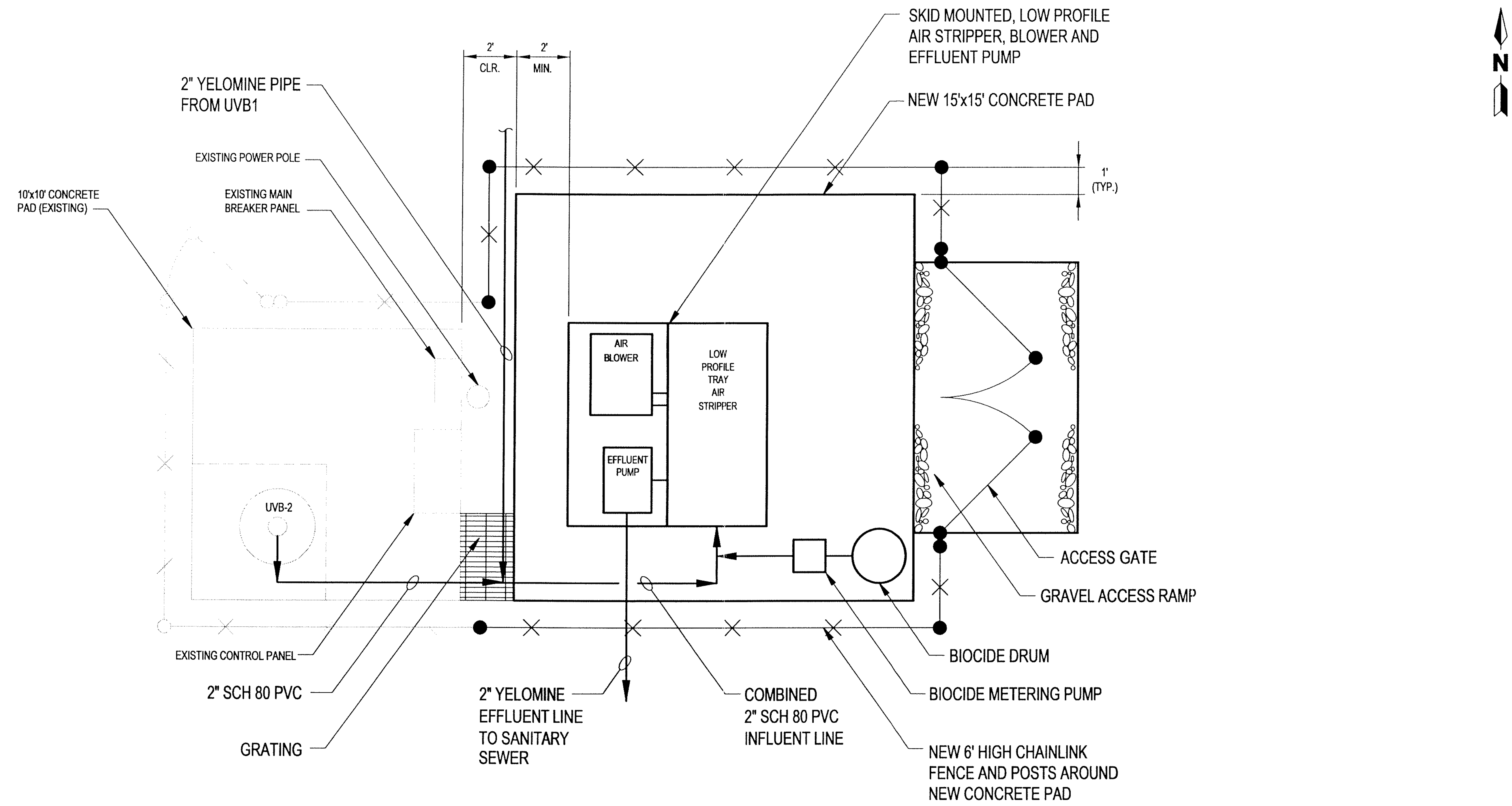
OPERABLE UNIT 4
INTERIM REMEDIAL ACTION RETROFIT
NAVAL TRAINING CENTER
ORLANDO, FLORIDA

CIVIL

FIELD PIPING PLAN

| | |
|---|---|
| SHEET | 3 |
| DWG | C-1 |
| DATE | AUGUST 2000 |
| PROJ | 152044.34.01.03.30 |

FILENAME: 2044g006.dwg PLOT DATE: 10-Aug-2000 PLOT TIME: 16:23:03




# LAYOUT PLAN (A / C-1)

1/4" = 1'-0"

| | | | | |
|---|---|---|---|---|
| DSGN M. JOHNS | NO. | DATE | REVISION | BY / APVD |
| DR L. WALTER | | | | |
| CHK T. PALAIA | | | | |
| APVD S. TSANGARIS | | | | |

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 — 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

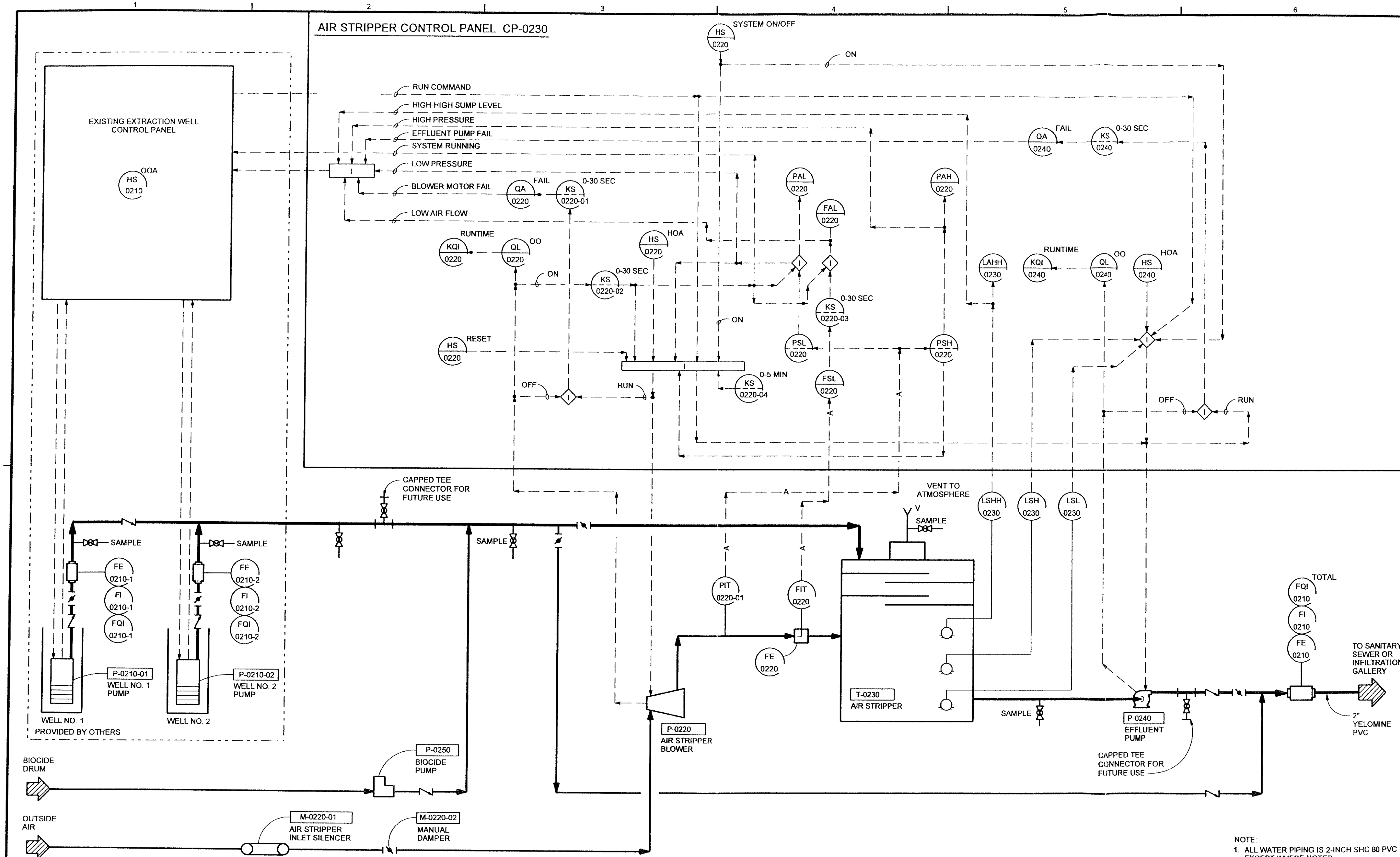
CH2MHILL

OPERABLE UNIT 4
INTERIM REMEDIAL ACTION RETROFIT
NAVAL TRAINING CENTER
ORLANDO, FLORIDA

CIVIL
AIR STRIPPER TREATMENT SYSTEM
LAYOUT PLAN

SHEET 4
DWG C-2
DATE AUGUST 2000
PROJ 152044.34.01.03.30

FILENAME: 2044g007.dwg PLOT DATE: 10-Aug-2000 PLOT TIME: 16:25:32




NOTE:
1. ALL WATER PIPING IS 2-INCH SHC 80 PVC EXCEPT WHERE NOTED.

| | | | | | | |
|---|---|---|---|---|---|---|
| DSGN | T. PALAIA | | | | | |
| DR | E. KRISTEL | | | | | |
| CHK | M. OKEY | | | | | |
| APVD | C. HOOD | NO. | DATE | REVISION | BY | APVD |

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

CH2MHILL

OPERABLE UNIT 4
INTERIM REMEDIAL ACTION RETROFIT
NAVAL TRAINING CENTER
ORLANDO, FLORIDA

PROCESS INSTRUMENTATION AND CONTROLS

## PROCESS INSTRUMENTATION AND CONTROL DIAGRAM

| | |
|---|---|
| SHEET | 5 |
| DWG | I-1 |
| DATE | AUGUST 2000 |
| PROJ | 152044.34.01.03.30 |

FILENAME: 2044i001.dgn PLOT DATE: 10-AUG-2000 PLOT TIME: 13:38:40

# Attachment F

## Air Stripper System Specification

# SECTION 11301
# LOW-PROFILE TRAY AIR STRIPPING SYSTEM

## PART 1 GENERAL

### 1.01 SUMMARY

A. This specification section covers the Work necessary to furnish, test, and train operators for a low-profile, tray air stripping system.

### 1.02 DEFINITIONS

A. CONTRACTOR – CH2M HILL Constructors, Inc.

B. SUBCONTRACTOR - Offeror

### 1.03 REFERENCE STANDARDS

A. Comply with the applicable provisions and recommendations of the following:

1. American National Standards Institute (ANSI).
2. American Society for Testing and Materials (ASTM).
3. Instrument Society of America (ISA).
4. National Electrical Code (NEC).
5. National Electrical Manufacturers Association (NEMA).
6. National Fire Protection Association (NFPA).
7. Occupational Safety and Health Administration (OSHA).
8. Underwriters Laboratories, Inc. (UL).

### 1.04 SYSTEM DESCRIPTION

A. Provide a package low profile tray air stripping system that includes the following :

1. A low-profile tray air stripper.
2. An instrumentation and control system.
3. All necessary piping to provide connection to the existing facilities.
4. All necessary electrical components to provide a fully functional, and operational system.

### 1.05 SUBMITTALS

A. CONTRACTOR may request submittals in addition to those listed when deemed necessary to adequately describe the Work covered in the respective sections.

B. Provide submittals in complete and in sufficient detail for ready determination of compliance with the Subcontract requirements.

C. Provide the following submittals with the Proposal:

1. Submit a list of proposed equipment including manufacturer name, equipment name, model number, and design capacity (where applicable) for the following:

   a. Low-profile tray air stripper system (include information for blower and effluent pump)

   b. Air stripper instrumentation and control system (include information for major instruments and control system package)

2. Submit complete set of catalog cut sheets for the above listed proposed equipment. At a minimum, include the following information as it pertains to the proposed equipment:

   a. Low-Profile Tray Air Stripper: Number of trays, dimensions of trays, system hydraulic capacity, total system dimensions, description of materials of construction, description of factory finish system.

   b. Motors: Complete motor nameplate data, as defined by NEMA MG 1, motor manufacturer, and description of motor modifications, if any.

   c. Pump: Performance data curves showing head, capacity, horsepower demand, required net positive suction head, and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity. Indicate separately the head, capacity, horsepower demand and overall efficiency at guarantee point.

   d. Blower: Performance data curves showing pressure, capacity, horsepower demand, and temperature rise over the entire operating range of the blower, from shutoff to maximum capacity. Indicate the minimum capacity to avoid surge (if applicable).

   e. Control System: Installation requirements, required power supply, materials of construction, general description, and layout of components

   f. Instrumentation: Operating range, accuracy, required power supply, pressure range, operating temperature range, calibration requirements, operating procedures, materials of construction, and description of all options selected.

3. Submit a completed Compensation Schedule in accordance with the Solicitation.

D. Provide the following submittals prior to Performance Tests:

1. Submit not less than 10 working days prior to Performance Tests.

2. Submit an Air Stripper System Hydraulic and Performance Test Plan for the hydraulic and performance tests for the air stripper and control systems in sufficient detail to fully describe the specific tests to be conducted and the data to be collected to demonstrate full compliance with PERFORMANCE TESTS. At a minimum, include the schedule for testing, test plan, procedures, sampling and analysis plan, and log format.

E. Provide the following submittals prior to Final Acceptance of the Work:

1. Submit a complete Operations and Maintenance Manual. Submit an outline of the Manual for approval by the CONTRACTOR. Submit the Manual in hardcopy and electronic formats. Submit the Manual text in Microsoft Word™ and the as-built drawings in AutoCad 14 (or lower) or MicroStation J (or lower) format. Submit the Manual in a 3-ring binder format that contains tabbed dividers between the operations and maintenance requirements for each separate piece of equipment. Provide a Table of Contents for each section of material that is provided. Provide the following detailed information in the Manual:

   a. A 30 year life cycle analysis for all equipment.

   b. Detailed treatment system operations safety precautions.

   c. Detailed, easy-to-follow procedures for air stripper treatment system startup, normal operations, and shut down.

   d. Detailed, easy-to-follow procedures for performing routine, Manufacturer recommended equipment maintenance.

   e. Detailed, easy-to-follow procedures for trouble-shooting common treatment system malfunctions.

   f. As-built drawings including electrical schematics.

   g. A list of equipment with corresponding equipment manufacturer name, address, and telephone numbers for maintenance/warranty issues.

   h. Approved catalog cut sheets for all equipment including manufacturer's installation and operation and maintenance procedures and recommendations.

   i. List of special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.

   j. Schedule of recommended spare parts to maintain the equipment in service for a period of 30 years. Include current price information.

2. Submit a complete Performance Test Report as specified in PERFORMANCE TESTS.

3. Submit a signed and dated Performance Warranty. Minimum requirements for the Performance Warranty are specified below:

a. The Performance Warranty shall be for a period of 1 year from the date of Final Acceptance.

b. The Performance Warranty shall cover all air stripping system components for defects in materials and workmanship.

c. The Performance Warranty shall cover the air stripping system for failure to meet the PERFORMANCE REQUIREMENTS at the SERVICE CONDITIONS.

d. Include the Manufacturer's Warranty for appropriate equipment.

F. Final Acceptance of the Work will be given by CONTRACTOR upon receipt and approval of all submittals as specified in FINAL ACCEPTANCE.

1.06 PROJECT CONDITIONS

A. Location: Former Base Laundry and Dry Cleaning Facility, Naval Training Center, Orlando, Florida. The site is located approximately 200 feet west of Building 1100, at Study Area 13, Operable Unit 4, Area C, approximately 1 mile west of the Main Base off Maquire Avenue. Refer to the site location map presented on Figure 1.

B. Ambient Air Temperature Range: minimum 20 degrees Fahrenheit, maximum 110 degrees Fahrenheit.

C. Relative Humidity: Up to 100 percent.

D. Site Elevation: approximately 105 feet above mean sea level.

1.07 WARRANTIES and BONDS

A. Provide Bonds from a surety acceptable to the CONTRACTOR.

B. Provide Performance and Payment Bonds in the amount of 100 percent of the Subcontract price as specified in the General Provision entitled Performance and Payment Bonds.

C. Provide a Maintenance Bond in the amount of 10 percent of the Subcontract price as specified in the General Provision entitled Performance and Payment Bonds.

D. This project shall be under warranty as set forth in the General Provision entitled Warranty and in SUBMITTALS.

1.08 HAZARDOUS WASTE HEALTH AND SAFETY REQUIREMENTS

A. This section outlines the hazardous waste related health and safety requirements for the performance of the Work specified in the Subcontract Documents.

B. Submittals

1. Submit a Site Safety Plan.

2. Submit Medical and Training Certification Letter.

C. Safety Requirements

1. The Occupational Safety and Health Act (OSHA) Standards for Construction (Title 29, Code of Federal regulations Part 1926 and Part 1910 as revised from time to time) are applicable to this Work.

2. Any cutting, welding, brazing, or other hot work shall comply with OSHA 1910.252.

D. Subcontractor's Responsibility for Health and Safety

1. The SUBCONTRACTOR shall be solely responsible for health, safety, and protection of all its personnel and lower tier subcontractor's personnel during the performance of the Work. SUBCONTRACTOR health and safety requirements shall be in accordance with the guidelines established by OSHA in the March 6, 1989 Federal Register (29 CFR 1910.120) "Hazardous Waste Operations and Emergency Response; Final Rule."

2. The SUBCONTRACTOR shall inform the CONTRACTOR of all accidents on the site and related claims within 24 hours of their occurrence.

3. The SUBCONTRACTOR shall develop and implement a site-specific health and safety plan (Site Safety Plan) that meets the requirements of 29 CFR 1910.120(i). The Site Safety Plan shall be submitted to the CONTRACTOR for approval no less than 10 working days prior to initiation of any field construction activities. The SUBCONTRACTOR will be provided a copy of CONTRACTOR's Health and Safety Plan developed for Work at the site.

4. The SUBCONTRACTOR shall be required to submit to the CONTRACTOR prior to initiation of any field construction activities, the attached "Contractor Medical and Training Certification Letter" to certify that the SUBCONTRACTOR's personnel and lower tier subcontractor's personnel are participating in a medical surveillance program according to 29 CFR 1910.120(f) and 29 CFR 1910.134, and that SUBCONTRACTOR's personnel and lower tier subcontractor's personnel have been trained according to 29 CFR 1910.120(e). Each employee who will be performing activities with potential for exposure to hazardous waste must meet these requirements and must be listed on the certification letter by name. Addition of any employees after initiation of field construction activities shall require a resubmittal of this letter.

5. Exposure to hazardous waste is expected only during activities involving handling of water from the extraction wells (UVB1 and UVB2). The CONTRACTOR has information relating to the site that can be reviewed at the CONTRACTOR's office upon request. This information may be useful to the SUBCONTRACTOR in developing a Site Safety Plan and preparing the Proposal; however, the CONTRACTOR makes no warranty as to the completeness or adequacy of the information. The SUBCONTRACTOR shall collect added information as needed to prepare the Site Safety Plan.

6. The SUBCONTRACTOR shall provide a designated Health and Safety Officer to implement, monitor, and enforce the Site Safety Plan. The

SUBCONTRACTOR's job supervisory staff may be designated the Health and Safety Officer supplemented as necessary by additional personnel. The SUBCONTRACTOR's staff member designated as the Health and Safety Officer for the Subcontract must be a qualified engineer or technician and be able to demonstrate ability to perform correctly the duties required to the satisfaction of CONTRACTOR and must be employed full-time at the project site whenever Work is in progress. The Health and Safety Officer must have the following qualifications:

a. Satisfactory completion of 40 hours initial training in Hazardous Waste Site Field Investigation, 3 days on-site apprenticeship, and 8 hours of specialized training.

b. Current certification in cardiopulmonary resuscitation (CPR) and multimedia first aid.

c. Attendance at refresher training within the past 12 months.

d. Knowledge of emergency preparedness techniques and considerations, including:

   i. Onsite accidents/exposure.

   ii. Procedures for medical emergencies.

   iii. Heat stress and cold stress prevention, symptomology, and treatment.

e. Specific familiarity with OSHA regulations for general industry (29 CFR 1910) and the construction industry (29 CFR 1926).

f. Experience in implementing the above-cited OSHA regulations as a designated Health and Safety Officer.

g. Experience working on one or more hazardous waste sites.

h. Experience with the types of activities that will be conducted at the site.

i. Upgrade to Level A, Level B, or Level C protection is not anticipated. This information is provided for Proposal purposes only. The SUBCONTRACTOR is responsible for determining the appropriate level of protection.

E. Site Security

1. The SUBCONTRACTOR shall require all personnel and visitors having access to the site to sign-in and sign-out, and shall keep a record of all site access.

2. All visitors, SUBCONTRACTOR, and lower tier subcontractor's personnel shall read, review, and be briefed on the Site Safety Plan and sign documentation stating that they have read and understand the same.

3. All visitors to the site shall be briefed on safety and security by the SUBCONTRACTOR.

4. The CONTRACTOR will provide their own personal protection equipment during site visitation.

F. Contaminated Water Handling

1. Handling of water that may be produced during performance testing is the full responsibility of the SUBCONTRACTOR and must be in accordance with all rules and regulations for handling and disposing of contaminated water or as approved by the CONTRACTOR.

2. The SUBCONTRACTOR shall be responsible for all handling, temporary storage, and disposal of the water and for obtaining all approvals, scheduling in advance with the CONTRACTOR, and meeting all the requirements of the disposal facility. Coordinate disposal of all water with the CONTRACTOR prior to discharge.

1.09 SUBCONTRACTOR QUALITY CONTROL

A. Establish and maintain an effective Quality Control Program.

B. The quality of Work shall be the responsibility of the SUBCONTRACTOR. Perform sufficient inspections and tests of all Work to ensure conformance to applicable specifications and drawings with respect to the quality of materials, workmanship, construction, finish, functional performance, and identification on a continuing basis.

C. Furnish qualified personnel, appropriate facilities, instruments and testing devices necessary to perform the quality control function. The SUBCONTRACTOR's job supervisory staff may be used for quality control supplemented as necessary by additional personnel. The SUBCONTRACTOR's staff member designated as the Quality Control Supervisory Engineer for the Subcontract must be a qualified engineer or technician and be able to demonstrate ability to perform correctly the duties required to the satisfaction of CONTRACTOR and must be employed full-time at the project site whenever Work is in progress.

D. Maintain current daily records of quality control operations, activities, tests, and inspections including the work of suppliers and lower tier subcontractors. Keep these records on an acceptable form and indicate a description of trades working on the project, the number of personnel working, the weather conditions encountered, any delays encountered, and acknowledgement of deficiencies noted along with the corrective actions taken on current and previous deficiencies. These records shall contain factual evidence that required activities or tests have been performed, including but not limited to the following:

1. Type, number, and results of control activities and test involved.

2. Nature of defects and causes of rejection.

3. Proposed remedial action.

4. Corrective actions taken.

5. These records shall cover both conforming and defective features and shall include a statement that supplies and materials incorporated in the Work comply with the Subcontract. Furnish legible copies of these records to CONTRACTOR daily.

E. CONTRACTOR will notify the SUBCONTRACTOR of any non-compliance with the requirements. The SUBCONTRACTOR shall, after receipt of such notice, take immediate corrective action. CONTRACTOR may issue an order to stop all or part of the Work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the SUBCONTRACTOR.

F. Completion and Final Acceptance Inspections:

1. SUBCONTRACTOR's Quality Control Completion Inspection: Based on CONTRACTOR's concurrence that the Work is nearing substantial completion, and at least 2 working days prior to pre-final inspection, the SUBCONTRACTOR's quality control inspection personnel shall conduct a detailed inspection. Notify CONTRACTOR at least 2 working days prior to the inspection so that they may participate, if desired.

2. Pre-Final Inspection: CONTRACTOR will conduct the pre-final inspection of the Work at the manufacturing location. The SUBCONTRACTOR shall give notice to CONTRACTOR at least 10 working days prior to the desired date of the pre-final inspection. The SUBCONTRACTOR must assure CONTRACTOR that all specific items previously identified as being unacceptable, along with all remaining Work, will be complete and acceptable by the date scheduled for the pre-final inspection. During the inspection, CONTRACTOR will produce a list of incomplete and/or unacceptable Work performed under the Subcontract and will subsequently furnish the list to the SUBCONTRACTOR. Failure of CONTRACTOR to detect and list all incomplete and/or unacceptable Work during this inspection will not relieve the SUBCONTRACTOR from acceptably performing all Work required by the Subcontract Documents.

3. Final Acceptance Inspection. CONTRACTOR will conduct the final inspection of the Work at the Site. The SUBCONTRACTOR shall give notice to CONTRACTOR at least 5 working days prior to the desired date of the final inspection. The SUBCONTRACTOR must assure CONTRACTOR that all specific items previously identified as being unacceptable, along with all remaining Work, will be complete and acceptable by the date scheduled for the final inspection. Failure of the SUBCONTRACTOR to have all Subcontract Work acceptably complete for this inspection will be cause for CONTRACTOR to bill the SUBCONTRACTOR for additional inspection costs.

## 1.10 MEASUREMENT AND PAYMENT

A. Administrative Submittals:

1. Compensation Schedule: Submit schedule on CONTRACTOR's standard form.

2. Application for Payment: In accordance with General Provisions and as specified herein.

B. Compensation Schedule:

1. Break down Lump Sum Work as requested on the Compensation Schedule.

   a. Provide a lump sum price for each item on the Compensation Schedule.

   b. Since a design flow rate has not been determined at the time of Solicitation, the SUBCONTRACTOR shall provide a price for three air stripping systems of various sizes as requested on the Compensation Schedule. One system will be selected by the CONTRACTOR for purchase at the time of Award.

   c. <u>Solicitation Item 100</u> includes all cost for initial preparation and delivery of the submittals required in the Subcontract, including but not limited to the following as specified herein: Site Safety Plan, Air Stripper System Hydraulic and Performance Test Plan, Operations and Maintenance Manual, and the Performance Test Report. Also included are the incorporation of CONTRTACTOR comments into the documents and the re-submittal of the revised documents until acceptable to CONTRACTOR.

   d. <u>Solicitation Item 200</u> includes all material and fabrication cost for a fully functional package air stripper treatment system with a hydraulic capacity of <u>50 gallons per minute (gpm)</u> including the tray air stripper, effluent pump, control system, special tools and spare parts, and all other parts and appurtenances as specified herein. Include transportation and delivery costs for this unit in this item.

   e. <u>Solicitation Item 300</u> includes all material and fabrication cost for a fully functional package air stripper treatment system with a hydraulic capacity of <u>100 gpm</u> including the tray air stripper, effluent pump, control system, special tools and spare parts, and all other parts and appurtenances as specified herein. Include transportation and delivery costs for this unit in this item.

   f. <u>Solicitation Item 400</u> includes all material and fabrication cost for a fully functional package air stripper treatment system with a hydraulic capacity of <u>150 gpm</u> including the tray air stripper, effluent pump, control system, special tools and spare parts, and all other parts and appurtenances as specified herein. Include transportation and delivery costs for this unit in this item.

   g. <u>Solicitation Item 500</u> includes all cost (materials, labor, travel) to test the air stripper treatment system as specified herein. It also includes all cost for training CONTRACTOR personnel.

h. Solicitation Item 600 includes all cost to obtain all necessary bonds as specified in WARRANTIES and BONDS.

2. Include proportional amount of SUBCONTRACTOR's overhead and profit in each item.

C. Application for Payment

1. Reference General Provisions.

2. Use detailed Application for Payment Form suitable to CONTRACTOR in accordance with General Provisions.

a. Include accepted Compensation Schedule for each portion of Work.

b. Form(s) to conform to the examples furnished by CONTRACTOR for Lump Sum Work and materials on hand.

c. Submit Application for Payment, a listing of material on hand, and such supporting data as may be requested by the CONTRACTOR.

D. Payment

1. General: Payment for Work will be on a lump sum basis. Progress payments will be made in accordance with General Provisions.

2. Payment for all work shown or specified in the Subcontract Documents is included in the Subcontract Price. No measurement or payment will be made for individual items.

E. Final Application for Payment

1. Reference General Provision entitled Final Payment and as may otherwise be required in Subcontract Documents.

2. Prior to submitting final application, make acceptable delivery of required documents as specified in FINAL ACCEPTANCE.

1.11 PROPRIETARY NAMES

A. Names indicated for colors, textures, patterns, and other characteristics of materials or names identifying specific mechanical and electrical equipment are for selection only. Other manufacturers' materials and equipment are acceptable provided they closely resemble all specified salient characteristics and conform to all other requirements of those products mentioned by name.

1.12 PATENT PROTECTION

A. SUBCONTRACTOR shall, at it's sole expense, defend and pay for all damages and costs awarded in any proceeding brought against CONTRACTOR, it's employees and agents, and the U.S. Navy, in which it is claimed that the manufacture, sale, or use of any material and equipment or parts thereof furnished hereunder constitutes an infringement of any patent or other proprietary information right, provided SUBCONTRACTOR is promptly notified of the commencement of any such proceeding. SUBCONTRACTOR's indemnity, as to use, applies only when infringement occurs from the normal use for which such material and equipment were designed. CONTRACTOR may, at it's option, be represented at any such proceeding.

B. If such manufacture, sale, or use is held in any such proceeding to constitute an infringement is enjoined, SUBCONTRACTOR, at it's sole expense, shall either procure for CONTRACTOR the right to manufacture, sell, or use such material and equipment; or replace same with substantially equal but non-infringing material and equipment; or modify same to make them substantially equal but non-infringing; or remove same and refund the purchase price, transportation and installation costs, and CONTRACTOR costs associated with lost time and procurement of a replacement system.

1.13 FINAL ACCEPTANCE

A. Approval for Final Payment will be made when the following are complete:

1. SUBCONTRACTOR successfully passes the Final Acceptance Inspection as specified in SUBCONTRACTOR QUALITY CONTROL.
2. All Submittals required in this section are submitted to CONTRACTOR and deemed complete and acceptable.
3. The air stripper treatment system successfully passes the factory, functional, and performance tests specified in PERFORMANCE TESTS.
4. The air stripper treatment system successfully completes the trouble-free continuous operations period as specified in CONTINUOUS OPERATIONS.

## PART 2 PRODUCTS

2.01 GENERAL

A. Provide a Proposal for three (3) fully functional, package, low-profile tray air stripping systems as requested on the Compensation Schedule.

B. The following defines the Maximum and Average Flow Rates as referenced in PERFORMANCE REQUIREMENTS.

| Solicitation Item No. | Average Flow Rate (gpm) | Maximum Flow Rate (gpm) |
|---|---|---|
| 200 | 30 | 50 |
| 300 | 80 | 100 |
| 400 | 120 | 150 |

C. All components shall be rated for exterior use and shall be capable of withstanding typical site weather conditions.

## 2.02 SERVICE CONDITIONS

| Design Parameter | Units | Design Value |
|---|---|---|
| Maximum Influent Tetrachloroethylene (PCE) Concentration | µg/L | 3,800 |
| Average Influent PCE Concentration | µg/L | 1,900 |
| Maximum Effluent PCE Concentration | µg/L | 3 |
| Maximum Influent Trichloroethylene (TCE) Concentration | µg/L | 1,500 |
| Average Influent TCE Concentration | µg/L | 750 |
| Maximum Effluent Trichloroethylene (TCE) Concentration | µg/L | 3 |
| Maximum Influent cis-1,2 Dichloroethylene (DCE) Concentration | µg/L | 1,200 |
| Average Influent cis-1,2 DCE Concentration | µg/L | 600 |
| Maximum Effluent cis-1,2 DCE Concentration | µg/L | 70 |
| Liquid Temperature | °F | 64 to 77 (72) |
| pH | pH Units | 4.4 to 6.5 (5.4) |
| Total Iron Range (average in parenthesis) | mg/L | <0.005 to 2.1 (0.4) |
| Total Manganese Range (average in parenthesis) | mg/L | <0.003 to <0.034 (<0.005) |
| Calcium Range (average in parenthesis) | mg/L | <0.3 to <56.0 (<5.0) |
| Total Alkalinity (as $CaCO_3$) Range (average in parenthesis) | mg/L | 5.9 to 7.7 (6.6) |

## 2.03 PERFORMANCE REQUIREMENTS

A. The low-profile tray air stripping system shall reduce Influent Concentrations to below the Maximum Effluent Concentrations for each contaminant specified in

SERVICE CONDITIONS under the following conditions when operating without use of influent spray nozzles:

1. Maximum Flow Rate containing the average contaminant concentrations specified in SERVICE CONDITIONS.
2. Average Flow Rate containing the maximum contaminant concentrations specified in SERVICE CONDITIONS. For this condition, the air stripping system must meet the Maximum Effluent Concentrations for each contaminant with one tray removed from the system.

2.04 DESIGN REQUIREMENTS

A. Design and construct the Air Stripper Treatment Plant to provide a minimum life expectancy of 30 years.

2.05 EQUIPMENT DESCRIPTION

A. Tray Air Stripper (Component T-0230):

1. Materials of construction for sump, trays, and cover shall be Type 304L stainless steel.
2. Materials of construction for all piping must be chemically compatible with contaminants and concentrations listed under SERVICE CONDITIONS and provide the minimum project life as specified in DESIGN REQUIREMENTS.
3. Minimum hydraulic capacity of the tray air stripper shall be the Maximum Flow Rate.
4. Air shall be evenly distributed over the cross-sectional area of the tray air stripper.
5. Liquid shall be distributed evenly over the entire surface of the aeration trays, with no visual evidence of low flow areas or dead channels on the aeration trays.
6. The tray air stripper shall be skid mounted on a structural steel or cast iron frame. The skid shall contain provisions for lifting using the overhead lifting and transfer system to be provided by this specification and lifting by forklift.
7. The blower (Component P-0220) shall be mounted on a steel or cast iron frame. Blower discharge shall be factory connected to the air stripper sump.
8. The blower airflow and static pressure shall be adequate to achieve the performance specified in PERFORMANCE REQUIREMENTS at all operating conditions.
9. Provide inlet silencer for the blower. Silencer (Component M-0220-01) shall capable of reducing the noise level to below 80 dB within 2 feet of the blower.
10. The tray air stripper shall contain the following equipment:
    a. Transparent, polyurethane, vertical tube sump level sight gauge.

b. Removable trays with chemically resistant gaskets.

c. Clean-out ports for each baffled channel on each tray with watertight caps with diameter large enough to access with high-pressure washer wand.

d. Sump inspection port with a minimum 8-inch diameter for manual access.

e. Sump drain valve connected to the existing sanitary sewer line.

f. Stainless steel mist eliminator.

g. Blower inlet damper (Component M-0220-02).

h. Stainless steel tray latches. Minimum number to prevent leakage under full hydraulic capacity.

i. Brass or stainless steel internal spray nozzle(s).

j. Sampling valves at water inlet and discharge as shown on the Drawings.

k. A high-pressure water washer wand in 3-foot 1/4-inch NPT threaded sections with an ON/OFF trigger, spray nozzle, and an adapter to connect the wand to the pressure washer hose end. The wand shall be capable of delivering a minimum flow of 2 gpm at a pressure of 900 psi.

l. The air stripper shall vent directly to the atmosphere via an offgas exhaust stack that shall extend a minimum of 10 feet from the ground surface and vent directly to the atmosphere. The vent shall be equipped with a rain guard.

m. Any other equipment not specifically enumerated herein needed for a complete and functional system which will produce treated water in continuous compliance with the PERFORMANCE REQUIREMENTS.

11. The trays shall be removable to allow periodic manual cleaning. Each aeration tray shall have four lifting lugs located at each corner to allow a hoist to remove it from the stack.

12. The interior of each tray of the air stripper shall be accessible via a 4-inch minimum diameter cleanout ports installed at the end of each of the aeration trays. Each channel on the aeration tray shall have a separate cleanout port. The cleanout ports shall be designed to allow insertion of a high pressure washer for cleaning of the entire length of the aeration tray.

13. The air stripper influent piping will include a capped tee connector, or like piece of equipment, to allow for the connection of an acid feed system at a later time. The connector will be located upstream of the air stripper inlet, as shown on the Drawings.

14. The air stripper effluent piping will include a capped tee connector, or like piece of equipment, to allow for the connection of an acid feed recirculation

line at a later time. The connector will be located downstream of the effluent pump as shown on the Drawings.

15. Information presented here are minimum requirements. SUBCONTRACTOR shall be fully responsible for system design.

B. Effluent Pump (Component P-0240):

1. The effluent pump shall be a frame-mounted, mechanical seal, end-suction, centrifugal pump and shall be skid mounted on a steel or cast iron frame.
2. The effluent pump shall be sized to deliver the maximum hydraulic capacity of the low-profile tray air stripper at a static head of 10 feet plus friction loss through 400 feet of 2 inch cast iron pipe with four 2-inch cast iron 90 degree elbows.
3. Maximum pump speed shall be 1,800 rpm.
4. The pump motor shall be squirrel cage induction type, TEFC, 460V, three-phase, 60-Hz, 1.15 service factor. Motors shall be designed, manufactured, and tested in accordance with NEMA MG 1.
5. The pump shall be equipped with lifting lugs if greater than 100 pounds.
6. The pump shall have the Manufacturer's standard baked enamel finish.

2.06 TREATMENT SYSTEM CONNECTIONS

A. Influent Piping:

1. The tray air stripper treatment system influent piping shall be equipped to connect to a 2-inch cast iron blind flange protruding 6-inches vertically from the ground surface, 12-inches from the edge of the air stripper skid.
2. The influent piping shall be arranged and constructed in a manner to minimize headloss through the system.

B. Effluent Piping:

1. The tray air stripper treatment system effluent piping shall be equipped to connect to a 2-inch cast iron blind flange protruding 6-inches vertically from the ground surface, 12-inches from the edge of the air stripper skid, on the opposite side of the skid that the influent piping is located.
2. The effluent piping shall be arranged and constructed in a manner to minimize headloss through the system.

C. Electrical

1. Provide 10-foot long, 3PH 480V power cord for connection to existing power panel by Others.

2.07 CONTROL SYSTEM

A. General:

1. The Process Instrumentation and Control Diagram and these Specifications depict the minimum functional requirements of the control system. Provide all instrumentation and controls necessary to provide a safe and operable system. The specific control system proposed is subject to the approval of the CONTRACTOR.

B. Panel – Component CP-0230: NEMA 4X enclosure, stainless steel, skid mounted type, containing all operator interface and local control devices, main circuit breaker, combination motor starters, circuit breakers, control power transformer, and any other equipment necessary for a complete and operable system.

C. Operator Controls and Indicators:

1. System ON switch. Component HS-0220.
2. HAND/OFF/AUTO selector switch for each motor. Components HS-0240 and HS-0220.
3. RUN indicating light for each motor. Components QL-0240 and QL-0220.
4. ALARM indicator lights for all alarm conditions. Components QA-0240, QA-0220, LAHH-0230, PAH-0220, PAL-0220, and FAL-0220.
5. Elapsed time meter for each motor. Components KQI-0240 and KQI-0220.
6. RESET pushbutton to reset alarm conditions for the air stripper blower. Component HS-0220 (Reset).

D. External Interfaces:

1. Accept a dry contact closure for air stripper treatment system operations start and stop control from the extraction well pumping system (Provided by Others).
2. Provide a dry contact closure for interface with common alarm condition to the existing extraction well control panel (Provided by Others).

E. Instruments: Provide the following instruments:

1. Liquid filled pressure indicator and transmitter to monitor air stripper inlet pressure. Component PIT-0220-01.
2. Provide HIGH air discharge pressure switch and alarm indication at CP-0230. Components PSH-0220 and PAH-0220.
3. Provide LOW air discharge pressure switch and alarm indication at CP-0230. Components PSL-0220 and PAL-0220.
4. Direct acting float switches with an enclosed mercury switch and integral cable for air stripper sump water level. Components LSL-0230, LSH-0230, and LSHH-0230.

5. Provide HIGH-HIGH air stripper sump water level switch and alarm indication at CP-0230. Components LSL-0230, LSH-0230, LSHH-0230, and LAHH-0230.
6. Programmable logic controller to implement all logic, switch and timer functions. Component CP-0230.
7. Effluent pump discharge water flow indicator and totalizer. Components FE-0210, FI-0210, and FQI-0210.
8. Blower discharge air flow indicating transmitter, low flow switch, and alarm indication on CP-0230. Components FE-0220, FIT-0220, FSL-0220, and FAL-0220.
9. Annunciator panel, analog indicators, hand switches and indicator lights as shown on the Drawings.
10. Provide blower and pump fail alarm indication on CP-0230. Components QA-0240 and QA-0220.

F. Functional Requirements: Complete automatic and manual operation of the air stripper system. Provide the following functions:

1. In the HAND mode, the effluent pump shall operate continuously. In the AUTO mode, with a permissive contact closure from the system ON switch and a permissive contact closure from the extraction well pumping system (Provided by Others), the effluent pump shall start when the level in the air stripper sump is HIGH and stop when the level in the air stripper sump is LOW. Without a permissive contact closure from the from the extraction well pumping system, the effluent pump shall not run in AUTO mode. In the OFF mode, the effluent pump shall not run.
2. In the HAND mode, the air stripper blower shall operate continuously. In the AUTO mode, with a permissive contact closure from the system ON switch and a permissive contact closure from the extraction well pumping system (Provided by Others), the blower starts and stops after an adjustable time delay of 5 minutes after the feed pump stops (Component KS-0220-04). Without a permissive contact closure from the extraction well pumping system, the air stripper blower shall not run in AUTO mode. In the OFF mode, the air stripper blower shall not run.
3. Provide time delay relay to delay alarm indication to avoid nuisance alarms at startup, 0 to 30 seconds. Components KS-0240, KS-0220-01, KS-0220-02, and KS-0220-03.
4. Alarm Functions for All Equipment:
   a. When the blower motor fails, send signal to extraction well control panel (Provided by Others) to alarm and shut down extraction well pumping system immediately. When an alarm shutdown occurs, the equipment is locked out and will require operator intervention to reset.

b. When the effluent pump motor fails, send signal to extraction well control panel (Provided by Others) to alarm and shut down extraction well pumping system immediately. When an alarm shutdown occurs, the equipment is locked out and will require operator intervention to reset.

c. When blower discharge pressure is HIGH, stop blower (blower must still have 5-minute delay) and send signal to extraction well control panel (Provided by Others) to alarm and shut down extraction well pumping system immediately. When an alarm shutdown occurs, the equipment is locked out and will require operator intervention to reset.

d. Blower discharge low pressure alarm shall be active only when blower is on. During blower start, pressure alarm will be bypassed for the appropriate length of time to allow blower to reach operating pressure. When blower discharge pressure is LOW, shut down blower (blower must still have 5-minute delay) and send signal to extraction well control panel (Provided by Others) to alarm and shut down extraction well pumping system immediately. When an alarm shutdown occurs, the equipment is locked out and will require operator intervention to reset.

e. Blower discharge air flow rate alarm shall be active only when blower is on. During blower start, air flow rate alarm will be bypassed for the appropriate length of time to allow blower to reach the operating air flow rate. When blower inlet air flow rate is LOW, shut down blower (blower must still have 5-minute delay) and send signal to extraction well control panel (Provided by Others) to alarm and shut down extraction well pumping system immediately. When an alarm shutdown occurs, the equipment is locked out and will require operator intervention to reset.

f. When air stripper sump level is HIGH-HIGH, send signal to extraction well control panel to indicate an alarm condition and to shut down extraction well pumping system immediately.

G. Power Requirements: 3PH 480V AC, 60 Hz power supply.

2.08 ELECTRICAL

A. All Air Stripper Devices (Pump and Blower Motors):

1. Pre-wire to the Air Stripper Control Panel.
2. Identify all wiring with permanent labels at both ends, terminated with solderless lug, and terminated on numbered terminal blocks.
3. Wire Type: stranded copper, THHN/THWN insulation.
4. Minimum Wire Size: No. 12 AWG tin-plated copper.
5. Color-coded (provide a wire color coding legend posted in a prominent location inside control panel access).
6. Wiring shall be complete to internal terminal strips in the Control Panel.

7. Conform to all federal, state, and local electrical codes.
8. Raceway (conduits) shall be rigid galvanized steel conduit. Washers, bolts, nuts, and other fittings shall be galvanized steel. Final connections to all motors shall be flexible, liquid tight.

B. Provide control panel powered by a single 3PH 480V circuit for the air stripper treatment system.

2.09 SPECIAL TOOLS AND SPARE PARTS

A. Provide all necessary special tools not readily available within 20 miles of the site required for equipment maintenance during the 30-year life expectancy.

B. Provide one complete set of spare fuses for the main power panel and Air Stripper Control Panel.

C. Provide two extra air stripper tray gaskets.

D. Provide four extra clean-out port caps.

E. Provide one extra spray nozzle.

F. Provide one complete set of spare light bulbs for the Air Stripper Control Panel.

G. Provide one service kit for the effluent pump.

H. Provide one complete package of lubricants for routine service of the mechanical equipment for a period of one year from the date of Final Acceptance.

## PART 3 EXECUTION

3.01 SEQUENCE OF WORK

A. Site Safety Plan: Prepare a Site Safety Plan in accordance with HAZARDOUS WASTE HEALTH AND SAFETY REQUIREMENTS and all personnel assigned to work on the site shall be in full compliance with such Site Safety Plan prior to beginning field work on this Subcontract.

B. Fabrication of Package Air Stripping System: Fabricate and factory test the low-profile, tray air stripping system as specified. Coordinate factory testing with the CONTRACTOR as specified.

C. Delivery of the Package Air Stripping System: Transport and unload the system at the location designated by the CONTRACTOR.

D. Coordination of Work with the CONTRACTOR. The CONTRACTOR must complete construction of the discharge pipeline, electrical connection, and programming of the control panel prior to treatment system startup testing.

E. Treatment Plant Startup Testing: Perform functional and performance tests upon completion of construction by the CONTRACTOR. Submit test results to CONTRACTOR for review and approval.

F. Training: Perform training of appropriate personnel after all other activities are complete.

3.02 FACTORY TEST

A. Factory test individual components and the completed air stripper treatment system prior to delivery to the site. The test should ensure that the treatment system meets specifications stated herein and contains no leaks in the process piping. Notify the CONTRACTOR a minimum of 5 working days before factory testing so that CONTRACTOR may send a representative to observe the testing. The SUBCONTRACTOR is responsible for rectifying any problems with the system prior to delivery. SUBCONTRACTOR is responsible for all costs incurred by the SUBCONTRACTOR and CONTRACTOR as a result of failed tests including CONTRACTOR costs for oversight or retests.

3.03 DELIVERY AND INSTALLATION

A. Provide a fully-functional, factory tested unit to the site. The unit shall be pre-wired, pre-ducted, pre-piped, and otherwise pre-assembled to be fully-functional. The unit shall be delivered as one skid. Unloading and placement of the unit is the responsibility of the SUBCONTRACTOR. The CONTRACTOR will designate the exact location of unit at the time of delivery. Foundation will be provided by others.

3.04 ON-SITE PERFORMANCE TESTS

A. General:

1. No water will be discharged to the sanitary sewer, adjacent surface water, or ground surface during on-site testing.
2. All processed water from on-site startup testing shall be diverted to a temporary storage tank capable of containing the water from the testing. Coordinate and schedule performance testing with the CONTRACTOR.
3. Furnish qualified Manufacturer's Representatives when required to assist in testing.
4. Utilize the Manufacturer's Certificate of Proper Installation form, supplemented as necessary, to document functional and performance procedures, results, problems, and conclusions.
5. Schedule and attend pretest (functional and performance) meetings related to test schedule, plan of test, materials, chemicals, and liquids required, facilities' operations interface, CONTRACTOR involvement.
6. Provide temporary valves, gauges, piping, test equipment, storage tank, and other materials and equipment required to conduct testing.

B. Cleaning and Checking: Prior to starting functional testing:

1. Calibrate testing equipment for accurate results.

2. Inspect and clean equipment, devices, connected piping, and structures so they are free of foreign material.

3. Lubricate equipment in accordance with Manufacturer's instructions.

4. Turn rotating equipment by hand and check motor-driven equipment for correct rotation.

5. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.

6. Check power supply to electric-powered equipment for correct voltage.

7. Adjust clearances and torques.

8. Test piping for leaks.

9. Obtain completion of applicable portions of Manufacturer's Certificate of Proper Installation.

C. Ready-to-test determination will be by CONTRACTOR based on the following:

1. Notification by CONTRACTOR of equipment and system readiness for testing.

2. Acceptable testing plan.

3. Receipt of Manufacturer's Certificate of Proper Installation, if specified.

4. Adequate completion of Work adjacent to, or interfacing with, equipment to be tested.

5. Availability and acceptability of Manufacturer's Representative, when requested by CONTRACTOR, to assist in testing of respective equipment, and satisfactory fulfillment of other specified Manufacturer's responsibilities.

6. All spare parts and special tools delivered to the CONTRACTOR.

D. Functional Test:

1. Notify CONTRACTOR at least 5 working days prior to scheduled date of functional test.

2. Conduct functional test until each individual component item or system has achieved 2 continuous hours of satisfactory operation. Demonstrate all operational features and controls function during this period while in the automatic modes.

3. If, in CONTRACTOR's opinion, each system meets the functional requirements specified, such system will be accepted as conforming for purposes of advancing to performance testing phase. If, in CONTRACTOR's opinion, functional test results do not meet requirements specified, the systems will be considered non-conforming. SUBCONTRACTOR shall be responsible for any repairs, if necessary, to ensure that the treatment system meets proper specifications.

4. Performance testing shall not commence until the equipment or system meets functional tests specified.

E. Pump Performance Test:

1. Notify CONTRACTOR at least 5 working days prior to scheduled date of performance testing.
2. Conduct on the effluent pump.
3. Perform under simulated operating conditions.
4. Test for a continuous 2-hour period without malfunction.
5. Test Log: Record the following:

a. Total head.

b. Capacity.

c. Horsepower requirements.

d. Throttle discharge valve to obtain pump data on curve at 2/3, 1/3, and shutoff conditions.

6. Adjust, realign, or modify units and retest if necessary.
7. Hydrostatic Tests: Pump casing(s) tested at 150 percent of shutoff head. Test pressure maintained for not less than 5 minutes.

F. Air Stripper System Hydraulic Test:

1. Submit a proposed Hydraulic Test Plan in sufficient detail to fully describe the specific tests to be conducted and the data to be recorded to demonstrate full compliance with these specifications. The Hydraulic Test Plan is subject to review, comment, and approval by the CONTRACTOR. Minimum requirements for the Hydraulic Test are specified below.
2. The SUBCONTRACTOR is responsible for performing the Hydraulic Test.
3. Conduct one Hydraulic Test for the air stripper for a minimum continuous period of 1 hour.
4. The Hydraulic Test may be performed in conjunction with the Air Stripper Performance Test using water designated for the Performance Test.
5. Notify the CONTRACTOR a minimum of 5 working days prior to the tests.
6. The Hydraulic Test shall include processing water through a fully installed air stripper system. The system shall include all parts as specified in EQUIPMENT DESCRIPTION.
7. Conduct the Hydraulic Test at the hydraulic capacity of the air stripper.
8. The Hydraulic Test results shall prove the following:

a. Air stripper can process the hydraulic capacity.

b. No water or air leakage from system components.

c. No emission of mist from the exhaust stack.

d. Air is distributed evenly over the entire cross-sectional area of the tray air stripper.

e. Liquid is distributed evenly over the entire surface of the aeration trays, with no visual evidence of low flow areas or dead channels on the aeration trays.

f. The influent sprays nozzles are functioning correctly.

9. If the above requirements are not met, the SUBCONTRACTOR shall, at their own expense, determine the problem(s) and rectify any flaws in the system prior to conducting the performance test.

G. Air Stripper System Performance Test:

1. Submit a proposed Performance Test Plan in sufficient detail to fully describe the specific tests to be conducted and the data to be collected to demonstrate full compliance with these specifications. The Performance Test Plan is subject to review, comment, and approval by the CONTRACTOR. The Performance Test Plan shall contain at a minimum, the field sampling materials and methods, data recording and analysis plan, laboratory name and analytical methods, and quality assurance and quality control procedures. Minimum requirements for the Performance Test are specified below.

2. The SUBCONTRACTOR is responsible for performing Performance Tests.

3. Conduct two Performance Tests for the air stripper to show removal efficiency for the conditions specified in PERFORMANCE REQUIREMENTS. These Performance Tests shall be conducted on contaminated water of a source selected by the CONTRACTOR.

4. Notify the CONTRACTOR 5 working days prior to the tests.

5. The Performance Test shall include processing water for a minimum of 2 hours through the tray air stripper without the inlet spray nozzle(s).

6. All piping and appurtenances integral to the testing will be supplied by the SUBCONTRACTOR and subject to approval by the CONTRACTOR. Following successful completion of the tests, the testing system will be disassembled and removed by the SUBCONTRACTOR.

7. During the Performance Tests, three sets of influent and effluent water samples will be collected. These will be timed to occur during the first 15 minutes, mid-point, and final 15-minutes of the test period. In addition, one set of quality control samples will be collected during one of the sampling events. The quality control samples will include a duplicate sample, a field blank, and a trip blank. The influent and effluent samples will be collected from the sampling valves provided as part of the system.

8. The samples will be analyzed for the constituents specified in PERFORMANCE REQUIREMENTS.

9. All samples during the Performance Test will be collected and analyzed by the SUBCONTRACTOR with analytical results submitted to the CONTRACTOR for approval.

10. If discharge limits are exceeded during the Performance Test, the SUBCONTRACTOR shall, at their own expense, determine why discharge standards were not met and rectify any design flaws in the treatment system. The Performance Test shall be conducted until the tray air stripper system meets the required discharge limits.

H. Control System Performance Test

1. Test individual components for appropriate operation.

2. Test individual signals between supplied components and the Air Stripper Control Panel.

3. Coordinate and test individual signal interface with the existing extraction well control panel.

4. During startup of the system the SUBCONTRACTOR shall be responsible for testing all normal functions including alarm conditions and simulated component failures of the system. SUBCONTRACTOR shall provide written test procedures to adequately test the specified operation of the system components and interface with the existing extraction well control panel.

I. Startup Test Report: As applicable to the equipment furnished, certify in writing that:

1. Necessary hydraulic structures, piping systems, and valves have been successfully tested.

2. Equipment systems and subsystems have been checked for proper installation, started, and successfully tested to indicate that they are operational.

3. Systems and subsystems are capable of performing their intended functions.

4. Facilities are ready for intended operation.

5. Attach all results, test logs, analytical data from the laboratory, pertinent calculations, etc., to the test report.

3.05 TRAINING

A. The SUBCONTRACTOR shall provide training for CONTRACTOR personnel on the air stripper treatment system. The instruction period shall be of sufficient length to explain the operation, maintenance, repair, and checkout procedures of the system.

B. Coordinate the training with the CONTRACTOR at least 10 working days prior to the training date.

3.06 CONTINUOUS OPERATIONS

A. CONTRACTOR will accept system as substantially complete and ready for continuous operation only after successful facility startup and 30 calendar days of continuous trouble-free operation is completed and documented, reports submitted, and Manufacturer's services completed for training of CONTRACTOR personnel. Trouble-free operation will be defined as:

1. Continuous attainment of the Maximum Effluent Carbon Tetrachloride Concentration in the effluent of the air stripper treatment system.
2. No air or water leaks from equipment provided by SUBCONTRACTOR.
3. No unscheduled system shutdown or repair due to equipment provided by SUBCONTRACTOR.

3.07 SUPPLEMENTS

A. The supplements listed below, following the "END OF SECTION", are a part of this specification.

1. Manufacturer's Certificate of Proper Installation.
2. Drawings.

**END OF SECTION**

# MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

OWNER ______________________ EQPT SERIAL NO: ______________________

EQPT TAG NO: ______________________ EQPT/SYSTEM: ______________________

PROJECT NO: ______________________ SPEC. SECTION: ______________________

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

- ☐ Installed in accordance with Manufacturer's recommendations.
- ☐ Inspected, checked, and adjusted.
- ☐ Serviced with proper initial lubricants.
- ☐ Electrical and mechanical connections meet quality and safety standards.
- ☐ All applicable safety equipment has been properly installed.
- ☐ System has been performance tested, and meets or exceeds specified performance requirements. (When complete system of one manufacturer)

Comments: ______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

I, the undersigned Manufacturer's Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate his equipment and (iii) authorized to make recommendations required to assure that the equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: ______________________, 2000

Manufacturer: ______________________________________________

By Manufacturer's Authorized Representative: ______________________________

(Authorized Signature)

## Drawings

(See Design Drawings in Attachment E)

**MAXIMUM FLOW AND AVERAGE CONTAMINANT CONCENTRATION CONDITION**
**AIR STRIPPER TREATMENT SYSTEM DESIGN**
NTC OU4, Orlando, FL

| Contamination Characterization | Historic Low | Historic High | Wtd Avg* | Limit | Unit | Source |
|---|---|---|---|---|---|---|
| TCE concentration range | ND | 2,475 | 750 | 3 | ppb | FL MCL |
| cis-1,2 DCE concentration range | ND | 1,650 | 600 | 70 | ppb | FL MCL |
| PCE concentration range | ND | 29,800 | 1,900 | 3 | ppb | FL MCL |

NOTE: * - See Basis of Design document for backup data to support the Wtd. Avg. values.

Air Stripper Conceptual Design Parameters
Stripper design flowrate 60 gpm
Governing contaminant PCE at 1,900 ppb (with 2X safety factor)
Governing contaminant is based on consideration of a combination of low Henry's Constant and high concentration versus MCL.
Influent temperature 65 °F (Assume conservatively low temperature modeling purposes only)

Assume 100% of PCE is stripped and discharged untreated to the atmosphere.
Assume a STAT180 using a blower airflow rate of 900 cfm
PCE emissions 0.057 lbs/hr or 1.37 lbs/day or 498.9 lbs/yr
Average PCE emissions concentration is 16.9 mg/m$^3$ or 2.5 ppm
The OSHA TWA of PCE is 100 ppm or 678 mg/m$^3$

Assume 100% of TCE is stripped and discharged untreated to the atmosphere.
Assume a STAT180 using a blower airflow rate of 900 cfm
TCE emissions 0.022 lbs/hr or 0.54 lbs/day or 197.0 lbs/yr
Average TCE emissions concentration is 6.7 mg/m$^3$ or 1.2 ppm
The OSHA TWA of TCE is 100 ppm or 537 mg/m$^3$

Assume 100% of cis-1,2 DCE is stripped and discharged untreated to the atmosphere.
Assume a STAT180 using a blower airflow rate of 900 cfm
cis-1,2 DCE emissions 0.018 lbs/hr or 0.43 lbs/day or 157.6 lbs/yr
Average cis-1,2 DCE emissions concentration is 5.3 mg/m$^3$ or 1.3 ppm
The NIOSH REL of cis-1,2 DCE is 200 ppm or 794 mg/m$^3$

Since the average potential emission concentrations are estimated to be less than the NIOSH/OSHA limits, the offgas treatment is not required for worker safety.
The FDEP has an emissions limitation of 13.7 lbs/day total VOC.
The estimated average potential emissions from the air stripper is 2.34 lbs/day of PCE, TCE, and cis-1,2 DCE
Therefore, since emissions don't exceed FDEP limit and don't exceed NIOSH/OSHA worker safety standards, then **NO OFFGAS TREATMENT IS PLANNED.**