Lincoln-Lancaster County Health Department
Environmental Health Division
3140 "N" Street • Lincoln, NE 68510-1514
Phone: 402-441-8022

A

Permit Number:

Sewage Disposal System

Request for Site Clearance and Permit

Include Form B, Form C and Applicable Fees with this Application.

☐ Septic System ☐ Lagoon ☒ Other (Refer to Form C)

The undersigned hereby requests site clearance and permit to construct a Sewage Disposal System in conformance with appropriate resolution or ordinance, as described herein:

PLEASE PRINT OR TYPE

A. System Location (Indicate correct number and street)

Address 185th/Adams (no rural route) City Lincoln NE, Zip 68527

Legal Description SW (1/4) SE (1/4) 12 (Section) 10N (Township) 8E (Range) ____ (Subdivision) ____ (Addition) ____ (Block) ____ (Lot)

Geographical Location (if known): Longitude ____ Latitude ____

☐ Check if system mail address is not the same as the owner's address

B. Owner

Name Univ. NE - Bio. Systems Eng. Signature ____

Address P.O. Box 830726 City/State/Zip Lincoln, NE 68583

☐ Check if owner designed system Home Phone ____ Work Phone (402) 472-2824

C. Contractor

Name Clint Presnell Company Name Wellman Plumbing, Inc.

Address 3301 S. 6th, Suite B City/State/Zip Lincoln, NE 68502

☐ Check if contractor designed system Work Phone 434-2400

D. Engineer/Installer ☒ Check and complete if engineer designed system

Designer Name Dennis D. Schulte, P.E. Firm Private/UNL Work Phone 472-3930

E. This System Will Serve a

☒ Residential Dwelling Number of Bedrooms 4 Is there a Whirlpool Bathtub YES (NO)

☐ Commercial Establishment/Other Facility Specify ____

Design flow in gallons per day____ Type of Wastewater: ☐ Domestic ☐ Non-Domestic.

DO NOT WRITE BELOW THIS LINE

Approval Process ☐ Municipal Code 24.38 ☐ County Resolution No. 2832

1. **Health Department** Date rec'd ____ Date frwd ____ **ACTION** ☐ Approved ☐ Disapproved Signature ____
2. **Supt. Bldg. Insp. or Village Clerk** Date rec'd ____ Date frwd ____ **ACTION** ☐ Approved ☐ Disapproved Signature ____
3. **City or County Engineer** Date rec'd ____ Date frwd ____ **ACTION** ☐ Approved ☐ Disapproved Signature ____

Installation Final Written Approval

By ____

Date ____

Business Office Use Only

Date Rec'd ____

Amt Paid ____

Rec'd By ____ Cash/Check No. ____

INFORMATION ONLY
NO PERMIT REQUIRED

FORM 23-100 10-96 White - Health Dept. Yellow - Engineer Pink - Bldg. Inspector

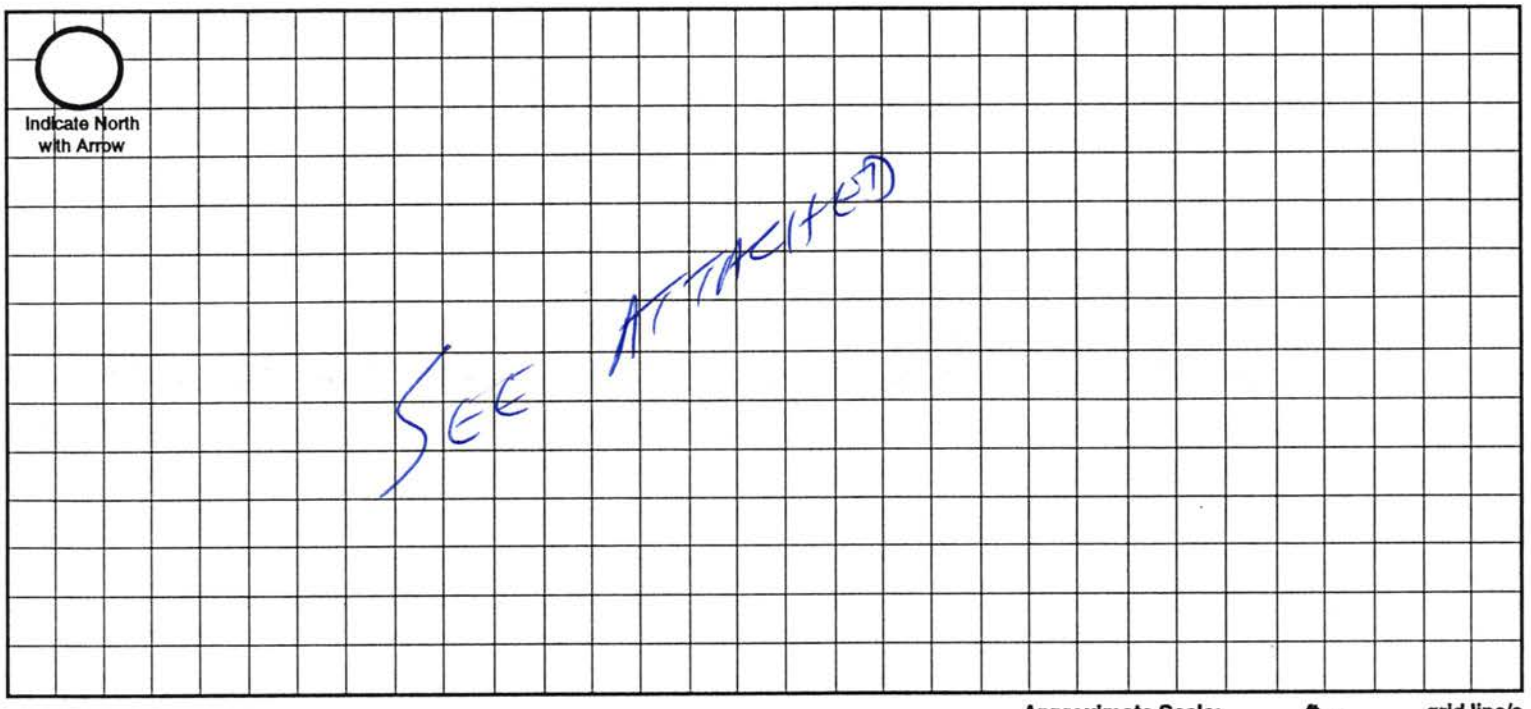
Lincoln-Lancaster County Health Department
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3140 "N" Street • Lincoln, NE 68510-1514
Phone: 402-441-8022

C

Permit Number:

Sewage Disposal System
Preliminary Plan Specifications

Draw a plot plan showing system location, lines, distribution box, tank and laterals, percolation test hole locations, well, residence, compass direction and property lines. Indicate on drawing if residence and well are existing or proposed.



Approximate Scale: _____ ft. = _____ grid line/s

A. System Location (Indicate correct number and street)

Address (no rural route) 185th/Adams City Lincoln NE, Zip 68527

B. Proposed Septic Tank/s

Tank Material: ☒ Concrete ☐ Plastic ☐ Other _____

C. Proposed Absorption System (See Form B for Percolation Information)

Percolation Rate 220 (min. per inch) Soil Type: Silty Clay Loam Land Slope: 2.0 %

Type of Absorption System: ☐ Trench ☐ Bed ☐ Other _____

Total Square Feet of Field Required: _____ sq. ft.

Type of Lateral: ☐ Half-Moon ☐ Perforated Pipe ☐ Other Lateral Material: _____

Capacity of Septic Tank _____ gals Number of Absorption Beds: _____ Number of Distribution Laterals per Bed _____

Total Length of Laterals _____ ft. Number of Trenches _____ Trench Width _____

D. Setbacks Check the Boxes Below if the Required Setback has been Satisfied

Distance From	Private Well	Public Well	Surface Water	Gound Water	Pressure Water Lines	Property Lines	Foundations Yours	Foundations Neighbors	All Other Setbacks
Tank (ft)	50 ☒	500 ☒	50 ☒	NA ☐	25 ☒	20 ☒	15 ☒	25 ☒	☐
Field (ft)	100 ☐	500 ☐	50 ☐	4 ☐	30 ☐	20 ☐	30 ☐	40 ☐	☐
Lagoon (ft)	100 ☒	500 ☒	50 ☒	N/A ☐	30 ☒	50 ☒	100 ☒	200 ☒	☐

E. Required Signatures

Home Building Contractor _____ Date _____

Installer _____ Date _____

Permit Application For A Single Family Wastewater Treatment Design Using Constructed Wetlands

Abstract

The University of Nebraska Lincoln(UNL) is interested in conducting research on the feasibility of constructed wetlands(CW) for treatment of residential wastewater. Funding is available to establish and initiate research on constructed wetland wastewater treatment for a single-family household. The proposed site for this constructed wetland is at 185th and Adams streets on property owned by UNL. This wetland will be monitored for at least two years to evaluate its performance with respect to wastewater treatment and temperature. UNL will also include a set of smaller cells that will be used for research on other possible applications for constructed wetlands. The completed system design will include a septic tank and evaporation pond that can be used as a backup system. The entire system is based on "zero discharge" to eliminate the requirement for an NPDES permit.



Introduction

Wastewater treatment has always been a consideration of any society. Each society has run into problems that keep them looking for new solutions. Our society is no different. The public has become very interested in protecting the environmental quality while trying to encourage growth and development. Even more recently people have become interested in "green designs", which are designs that require little energy to be supplied by humans. These designs are dependent upon nature to supply the energy.

Nebraska has some characteristics that limit the use of traditional methods for on-site wastewater treatment. The two traditional options are the lagoon and septic tank-drain field. The septic tank and drain field option is currently the most widely employed option. Unfortunately, the soils in eastern Nebraska tend to have a low permeability that will greatly increase the cost of this type of system. This generally leaves the homeowner with only one inexpensive option, a lagoon. Lagoons are not aesthetically pleasing, may also produce odors and provide an environment for mosquitoes to flourish.

Various regions of the United States have reported success in using constructed wetlands. They have been used in applications involving large towns as well as single family dwellings. As one might expect, there is little information on how these systems respond to climates that have freezing temperatures during the winter. Informal inquiries with neighboring states indicate that little progress has been made to incorporate wetlands for single family systems. One exception is a group wetlands in southern Kansas. These wetlands didn't have any ice formation through winter. The Firethorn system in Lincoln, Nebraska develops a layer of ice several inches thick. There are a few systems in Nebraska at the current time, with each system being individually permitted by the

Nebraska Department of Environmental Quality (NDEQ). For these reasons, UNL would like to establish our own wetland to research the effects of a cold climate on wetland performance.

Design

The septic system on the Rogers Memorial Farm needs to be updated. The farm is located on E1/2, Sec. 12, T10N, R8E of the sixth prime meridian. The system will be upgraded to meet current regulations for a traditional evaporation pond with a supplemental septic tank. It will also have the ability to route the wastewater through a constructed wetland for research purposes. Percolation tests conducted at four separate locations at the site indicate that a typical percolation rate is 220 minutes per inch.

The new on-site system will have four main components. It will include a new septic tank, two areas of constructed wetlands(wastewater and research) and an evaporation pond. The design will have flexibility to allow research on different system configurations. The system will have a bypass valve that will allow wastewater bypass around the wetland system and go directly to the evaporation pond. To increase the flexibility of this system for research purposes, a water supply line and an electrical supply will be installed. The four primary components of the design will be described.

The first component of the design will be a new septic tank. The new tank will have a minimum capacity of 1250 gallons, and filter to help with removing the solids. The existing tank will be pumped and filled with gravel after a hole has been knocked in the bottom. The existing riser will also be removed. There will also be approximately 150 feet of 4 inch PVC pipe that will lead form the house to the septic tank. There will

be a flow metering device located about 50 feet downstream from the septic tank. The wetland will be approximately 70 feet downstream from the flow metering device.

The second system component includes the wetland cells used for the wastewater treatment. The design of the constructed wetland system uses published data and design guidelines while also considering the current designs used in Nebraska. The main sizing and selected aspect ratio were determined by following the Tennessee Valley Authority(TVA) guidelines (Steiner, 1993). The constructed wetland at Firethorn (Vanier, 1996) was used to modify the TVA design for substrate depth and species of plants that are to be used within the wetlands.

The first step in determining the size of the wetland was to estimate the daily loading rate. Using water billing records that were supplied by Cliff Hunter, farm manager, it was determined that the approximate residential water usage is 600 gpd. Emphasis was given to winter usage to eliminate the water incorporated with farming activities. The design is then based on a daily loading rate of 600 gallons, which is reasonable for a four-bedroom house. There was also an interest in designing for a situation where the residents of the farm might change and the daily water usage might drop to 50 gallons per day(gpd). A synthetic liner will keep all inflows available for the plants to use for evapotranspiration. The TVA design criteria state that we need approximately 1.3 square feet of surface area for each gpd of water. This means that approximately 780 square feet of surface area is required according to their design approach.

The constructed wetland design integrates several possible scenarios to ensure project success. It was decided that a single cell would be used for preliminary studies.

A second cell may be added later to research the possibility of a zero discharge system, and enhance the treatment efficiency without the need for an evaporation pond. The first cell will be lined with a 45 mil PVC Liner that will prevent wastewater from leaching into the surrounding soil. This will protect the environment and keep the plants well established during periods of extremely low flow(50 gpd). The second cell, when it is built, will be an unlined cell to allow infiltration for final treatment of the wastewater.

The dimensions of the wetland cells are based on engineering calculations and existing systems in Nebraska. Again, the TVA procedure was followed to determine a first approximation for the dimensions. A substrate depth of 18 inches is recommended for cold weather regions (Steiner, 1993). The cross sectional flow area is based on desired hydraulic retention time(HRT) and Darcy's Law. There are two assumptions made in this calculation both of which were supplied by TVA. 1) The saturated conductivity will be 850 ft/day, which takes into account the recommended porous media type and that the pores will become partially clogged. 2) Cells that are built with no bottom slope will use a slope value of 0.5% or 0.005 ft/ft for use in calculations. With these assumptions, the cross sectional area was determined to be approximately 19 square feet. Cross sectional flow area was also computed by examining the BOD levels, but this was considerably smaller. This might be expected since there is a relatively high flow rate for only four people.

The recommended substrate depth of 18 inches was changed to a new depth of 24 inches based on the Firethorn system. This change was made because of the possible problems with Nebraska's cold climate. The Firethorn project also used foam board insulation to reduce the amount of heat lost through the walls of the wetland cell. Wall

insulation (1 inch blue board with R value of 5.4) will also be included in this design. Using a substrate depth of two feet, it was determined that the minimum width should be 10 feet. After examining the cost of materials and the constraints imposed by the proposed site, it was determined that the CW cell will be 13 feet wide by 45 feet long. This will produce a surface area of 585 square feet and an aspect ratio of 3.5 to 1. The CW cell will be excavated to a total depth of three feet although there will only be a substrate depth of two feet. The total depth of the wetland cell was increased to provide against the extreme weather conditions in Nebraska. Area comparisons (normalized for flow rate) for the Firethorn system (0.4 ft^2/gpd) and the single family (1.0 ft^2/gpd) design indicate that the Rogers Farm system will use more than twice the normalized surface area. This increased normalized area will compensate for using 585 square feet rather than the 780 recommended by TVA. The hydraulic loading rate for the two systems will be approximately 1.6 and 3.9 inches/day for the single family and Firethorn system, respectively. Using these numbers, we can see that the hydraulic retention time for the single family system will be more than double that of the Firethorn system. The longer hydraulic retention time will allow for greater treatment of the wastewater. A flow metering device will be installed to measure discharge from the wetland cell.

A second cell has been included in the design. This second cell will not be part of the initial construction. This cell will be added at a later date as research needs demand. The approximate location has been established but the actual size will be dependent on the performance of the initial cell. There will be a minimum elevation change between the two wastewater cells of 24 inches, with thirty inches being preferred. The water level

and hydraulic gradient within the cells will be controlled using a moveable elbow designed to the TVA guidelines.

The components within the cell will deviate from the TVA recommendations based on the availability of certain products. The 2-inch PVC distribution manifold will be replaced with a 12 inch half moon device that is similar to those currently being used on the Firethorn system. The substrate will be composed of pea gravel sized in the range of ¼ inch to ¾ inch. The plants in the wetland will be cattails and reeds.

The plants that will be used are similar to those that are successfully being used by the Firethorn project. The first twenty five feet will be planted with Cattails(Typha spp.). These will be planted at a density of about one per three square feet. The last twenty feet will be planted with Common Reed(Phragmites spp.) at a density of about one per square foot.

The third primary component of the design is the evaporation pond (lagoon). The pond will be constructed by a local business with experience in this area. It will be sized for a four bedroom home to meet or exceed Lancaster County standards if the wetland is ever abandoned. If this situation occurs the farm will install the required fences, for untreated wastewater, at that time.

The final component of this design includes research cells that will be used to test treatment of various waste streams. There will be one group of eight research cells. Each research cell will be approximately 4 feet by 10 feet. The cells will be constructed in the same manner as the main cells. The cells will also be lined to protect the surrounding soils and to improve monitoring of the water balance. The effluent from these research cells will be contained in a buried tank before being discharged. The catch tank will be

approximately 100 gallons and will be equipped with a pump. It is anticipated that the research cells will use a total of 400 gallons per day when being used for research. If they are not being used, they should only require 500 gallons or less per week to maintain plant life. The final destination of the water will be based on the influent that is being tested. Hazardous materials will be pumped into a transport tank and disposed of properly. Effluent from nutrient studies will be applied on to nearby fields. There will also be plumbing that will allow the water to be transported to the evaporation pond. If resources allow, and site conditions permit, these cells will be connected to the system in such a manner that discharge from the main CW cell can be routed through the research cells.

Conclusion

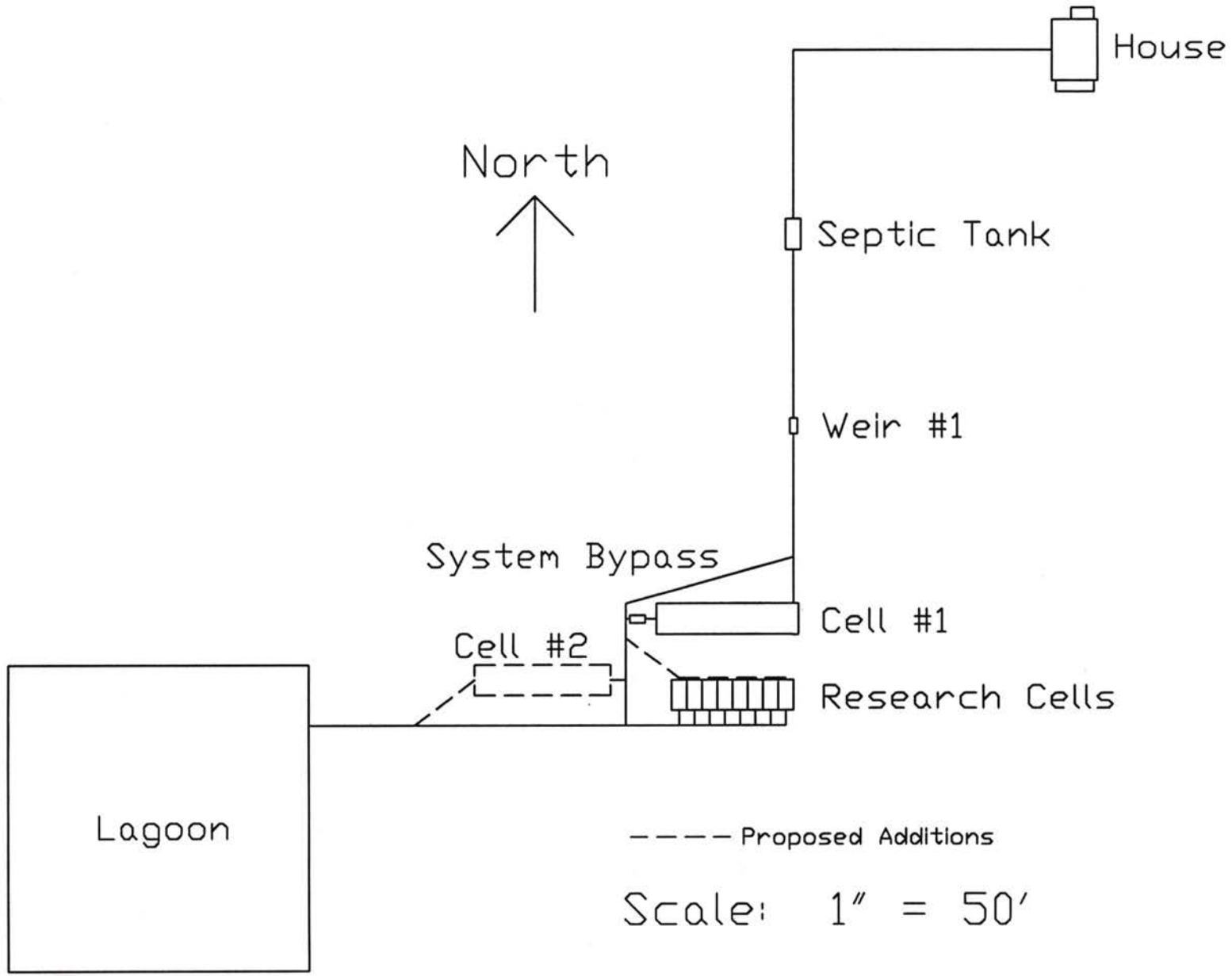
This design has been carefully examined to provide a constructed wetland that will be successful in the changing Nebraska climate. The research on temperature effects and the "zero discharge" design will be beneficial to all Nebraska citizens. The longevity of these systems is often a concern, but by designing for different scenarios, the probability of success has been maximized. The design also includes a research option with several different routes that may be followed.

References

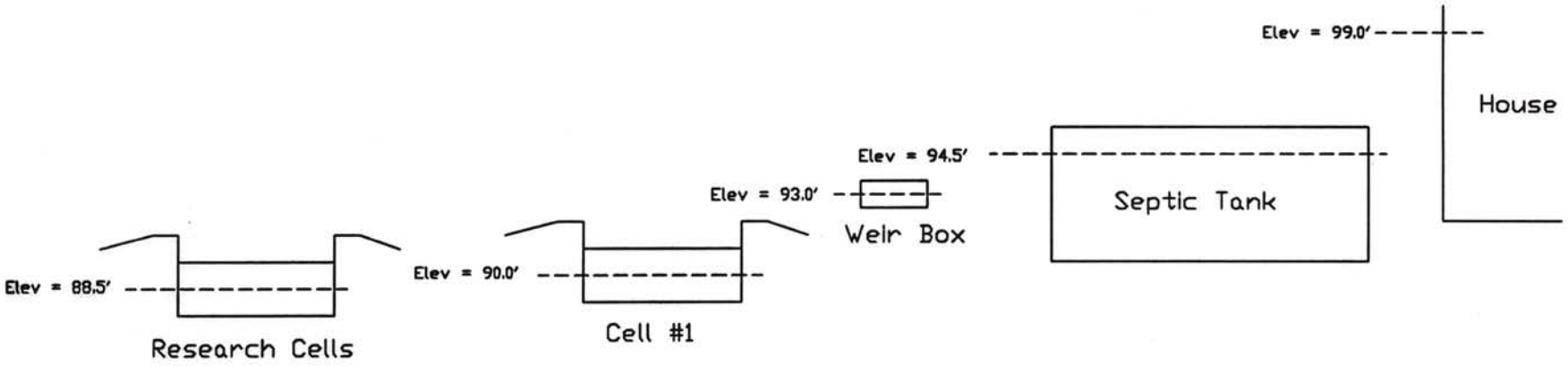
Steiner, Gerald R. and James T. Watson. 1993. *General design, construction, and operation guidelines: Constructed wetlands wastewater treatment systems for small users including individual residences, Second Edition.* TVA/WM—93/10. Chattanooga, TN.

Vanier, Scott. 1997. *Evaluation of a subsurface flow constructed wetland system for small-community wastewater treatment in southeastern Nebraska.* Master's Thesis at the University of Nebraska. Lincoln, NE.

Proposed Wetland System For Rogers Farm



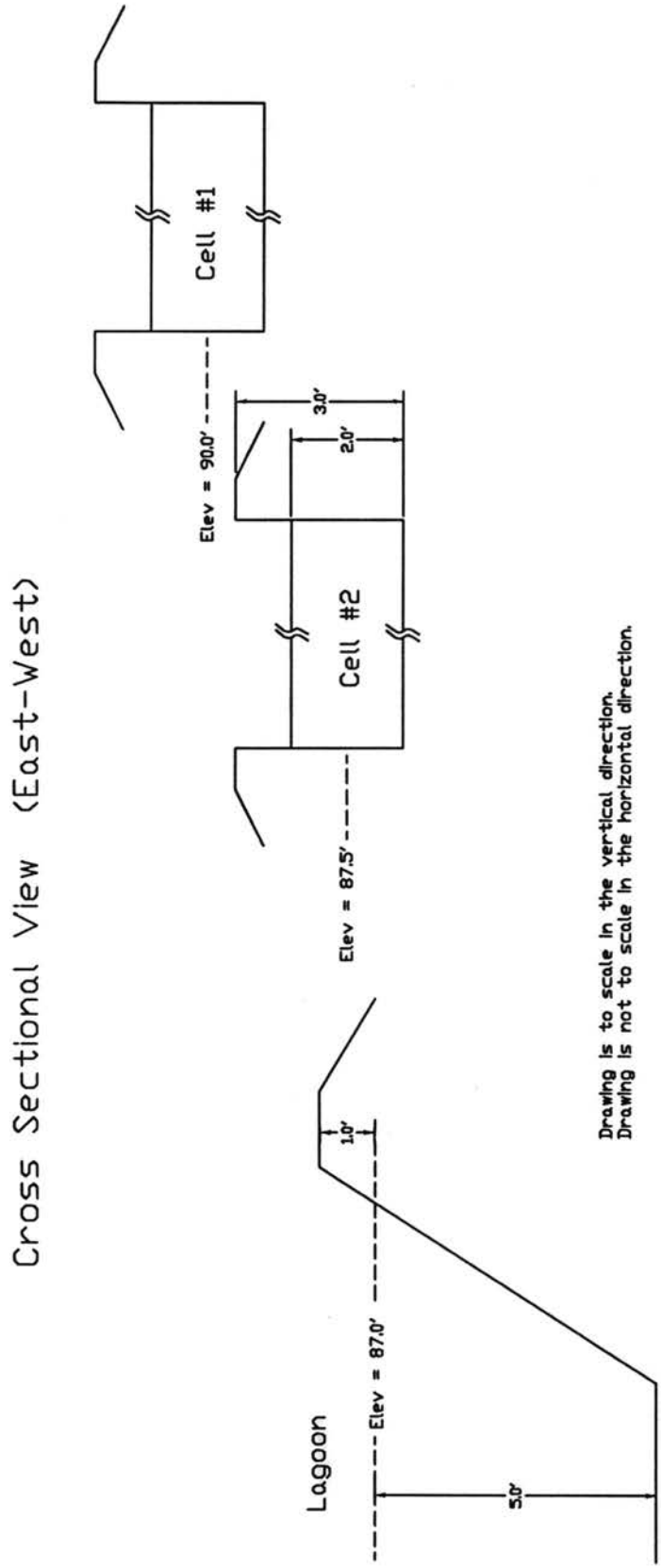
Cross Sectional View (North-South)

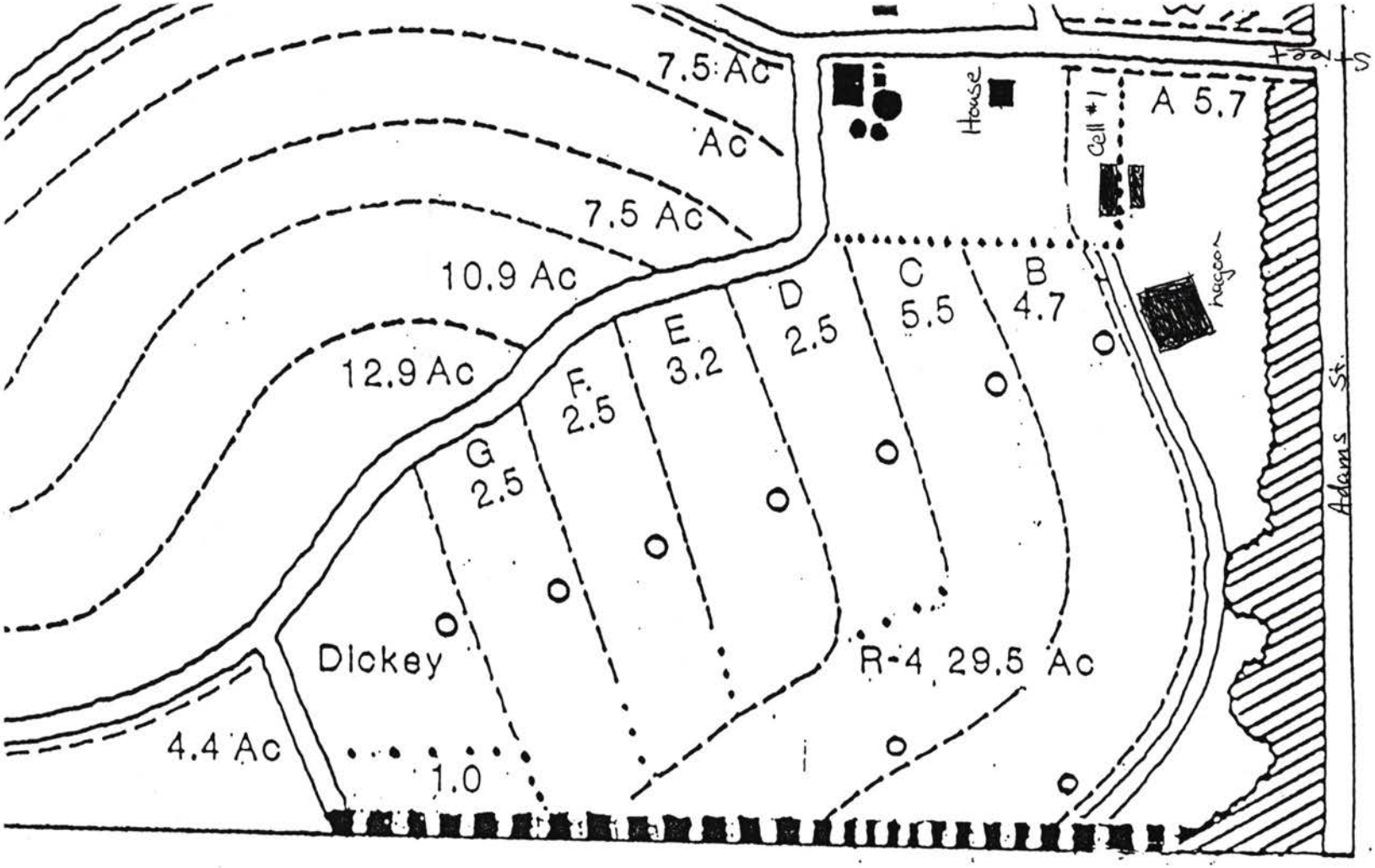


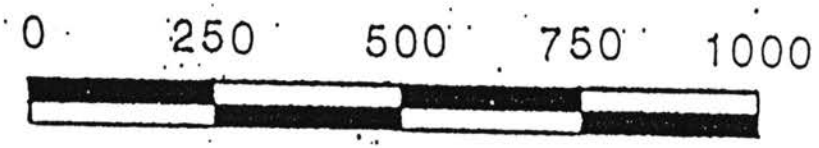
Drawing is to scale in the vertical direction.
Drawing is not to scale in the horizontal direction.

Approximate Line Slopes:

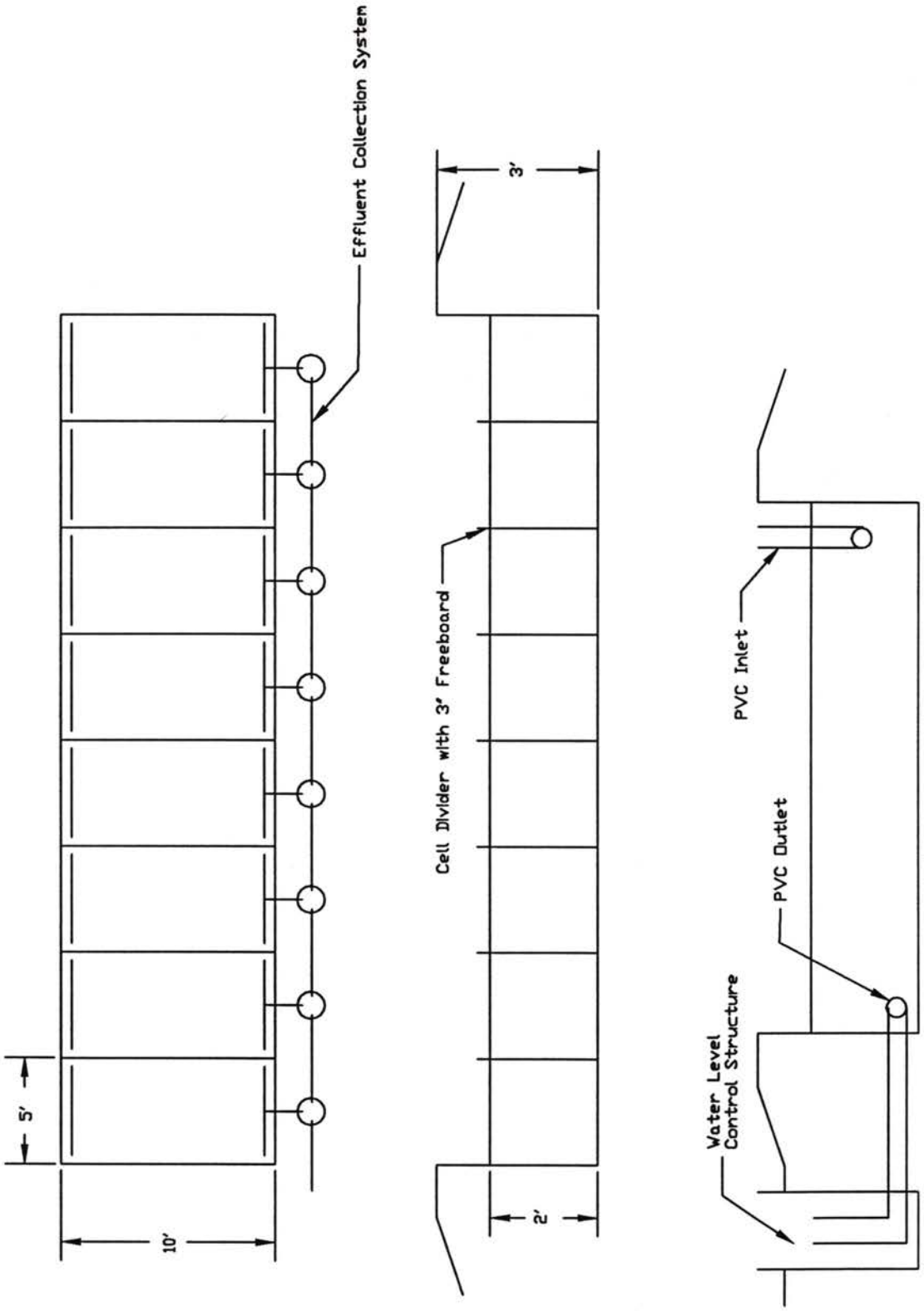
House-Septic Tank	=	1/3" per 1'
Septic Tank-Weir Box	=	1/4" per 1'
Weir Box-Cell #1	=	1/2" per 1'
Bypass Line	=	1/4" per 1'


Cross Sectional View (East-West)
Cell #1
Cell #2
Elev = 90.0'
Elev = 87.5'
Elev = 87.0'
3.0'
2.0'
1.0'
5.0'
Lagoon
Drawing is to scale in the vertical direction.
Drawing is not to scale in the horizontal direction.

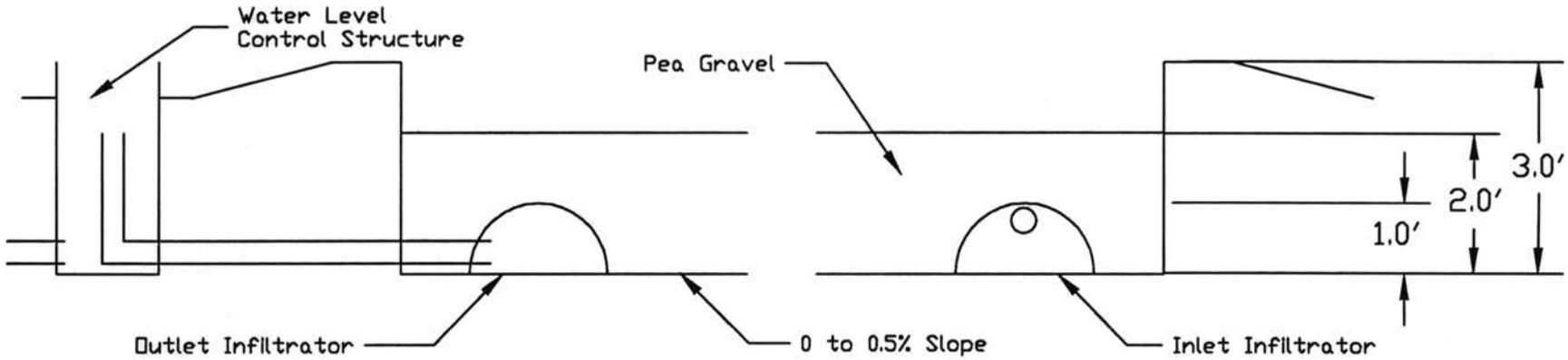

7.5 Ac
Ac
7.5 Ac
10.9 Ac
12.9 Ac
House
Cell #1
A 5.7
B 4.7
C 5.5
D 2.5
E 3.2
F 2.5
G 2.5
Adams St.
Dickey
R-4 29.5 Ac
4.4 Ac
1.0


0
250
500
750
1000
Scale : feet

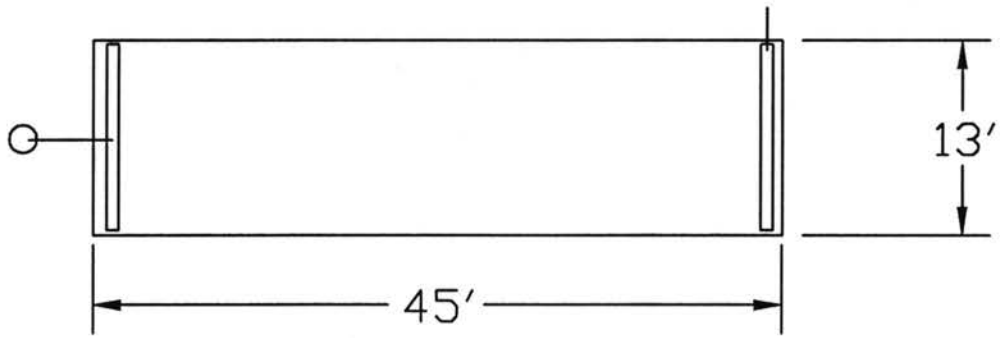
Research Cell Design



Waster Water Cell Design

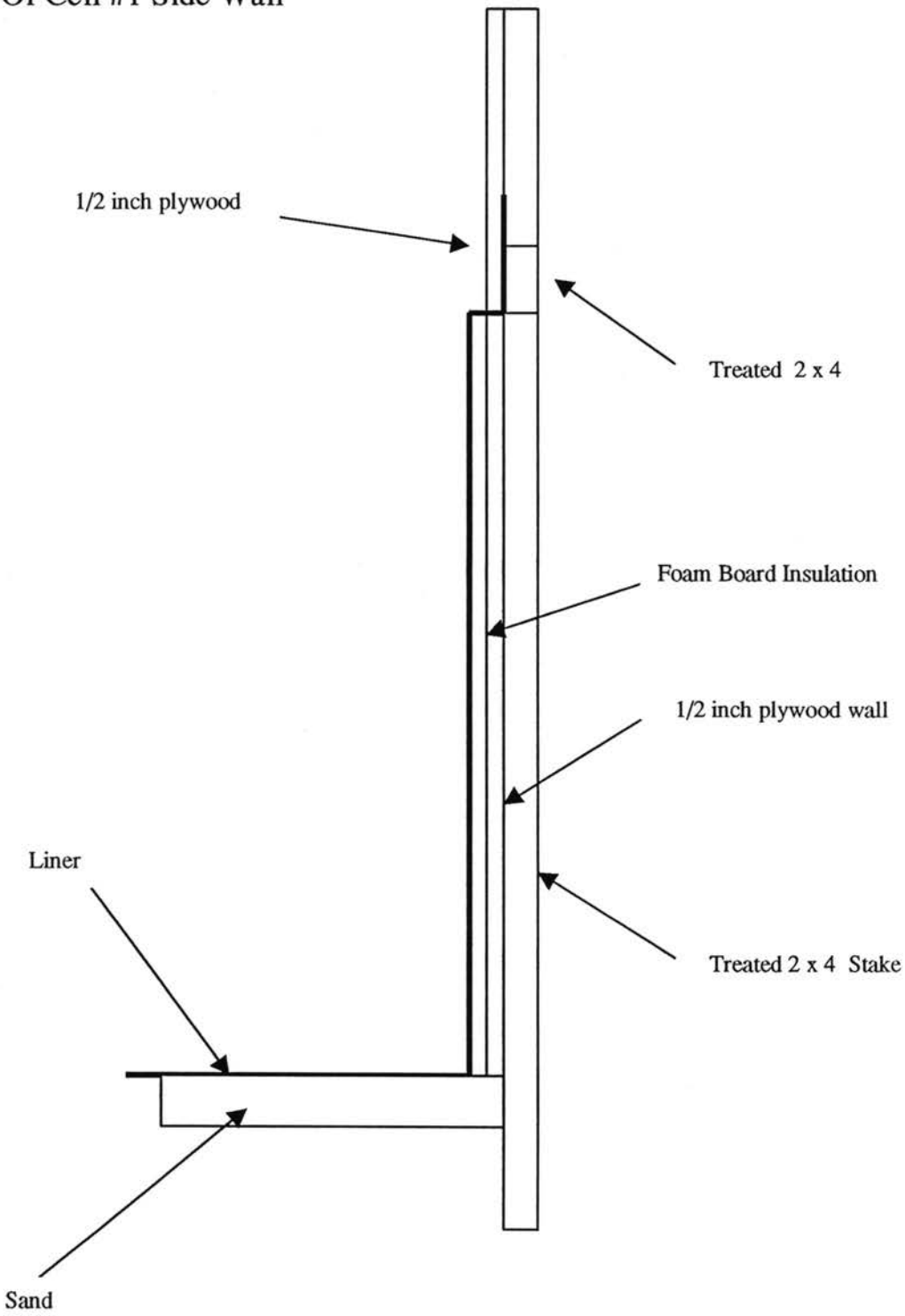


Cross Section

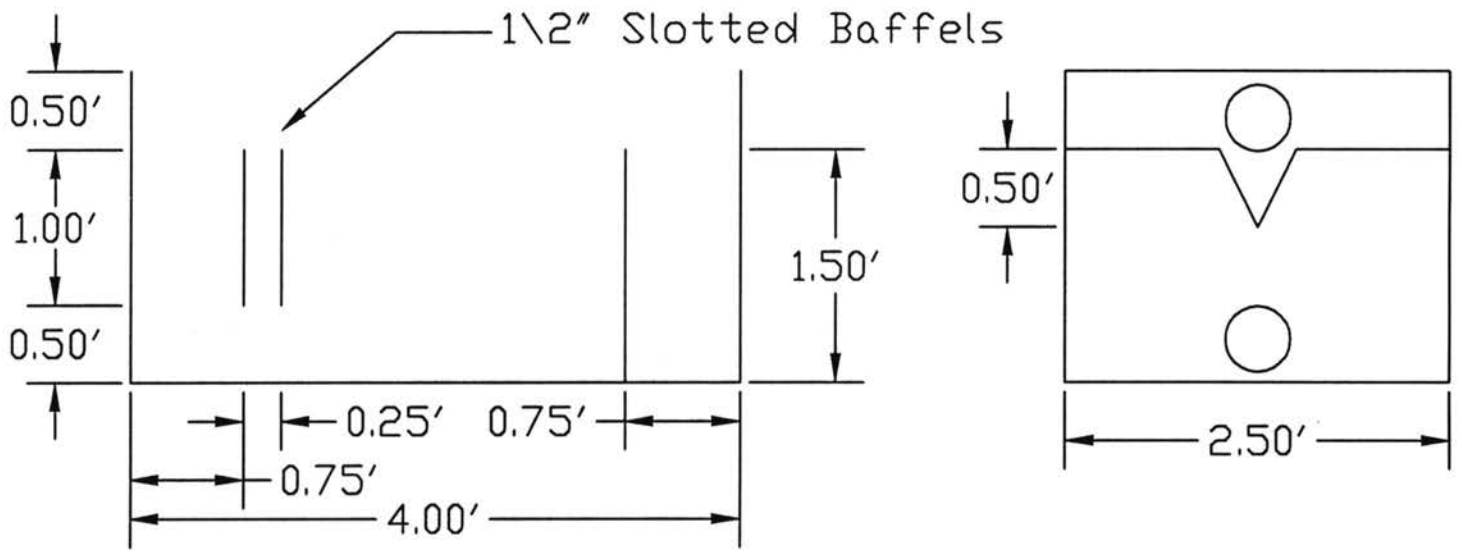


Plan View

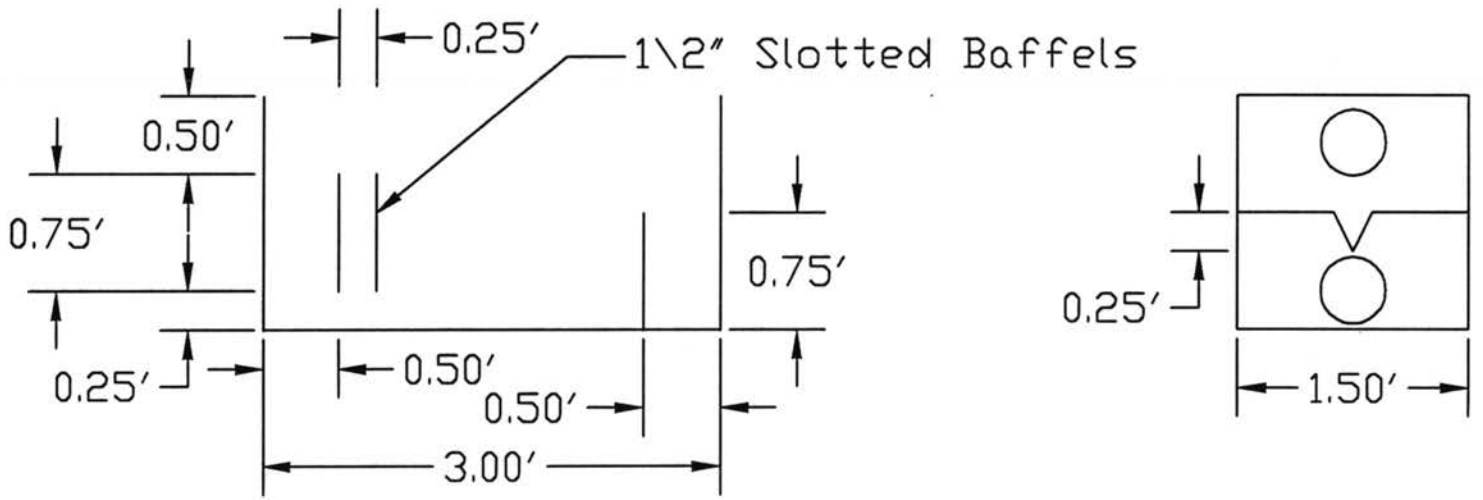
Diagram Of Cell #1 Side Wall



Weir Boxes For Rogers Farm Wetland



Large Weir



Small Weir

Openings for 4" PVC
22.5 Degree V-notch Weirs