Washtenaw County

Department of Environment and Infrastructure Services
Environmental Health Division

ENGINEERING GUIDELINES FOR ON-SITE SEWAGE DISPOSAL SYSTEMS

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INTRODUCTION

This engineering guideline is a result of our continuous effort to provide up to date information regarding on-site sewage and water supply systems in Washtenaw County. Through this revision, it is our hope to capture the changes and modifications that have been introduced in recent years in one single engineering guideline.

Further modification to this document is to be expected as the need arises in the future. The use of technology-based on-site sewage treatment and disposal systems are expected to be on the rise, as the demand of such systems becomes a necessity. Our commitment to use technology-based systems will be demonstrated in future guidelines and design manuals.

The Engineering Guidelines are specifically applied for residential sites. Non-residential properties may need to adhere to the Michigan Department of Environmental Quality publication titled “Michigan Criteria for Subsurface Sewage Disposal System”.

The Washtenaw County Regulation for the Disposal of Sewage and Human Excreta provides for non-conventional sewage systems. Section 4:6 states “Nothing contained herein shall prevent the use of special construction methods to develop subsurface, permeable soil formations or use of other techniques providing the engineering design of such systems is first approved and their operation is in accord with the standards of Article II, Section 2:3”.

A copy of this engineering guideline and other information can be obtained from our website at *www.co.washtenaw.mi.us/depts/eis/htm#eh.*

I want to acknowledge the assistance of our staff at the Washtenaw County Environmental Health Division (WCEHD) and consulting engineers in private practice for their support and review of this document. Their effort is greatly appreciated.

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Majed Ghussaini, P.E
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Washtenaw County Environmental Health Division
Date: January 25, 2002

I. PERMITS REQUIRED

On-site sewage and water supply system permits are required for all new single-family residences not connected to a public system, as well as all new on-site sewage systems of less than 10,000 gallons per day, which do not have a Michigan Department of Environmental Quality (MDEQ) discharge permit.

In addition, under Section 3:3 of the Washtenaw County code, permits are required on existing premises with an on-site sewage system where a substantial increase in size or change in water use is proposed. When any alterations to a structure with an on-site sewage system are proposed, the existing sewage system must be reviewed by the WCEHD to determine if it is adequate for the intended use. On-site wells and sewerage systems serving more than one property owner must meet the requirements of Act 98, Public Acts of 1913 as amended, and current requirements of the WCEHD.

II. AVAILABILITY OF PUBLIC SEWER

A public sewer shall be used in place of on-site sewage systems when permission can be obtained for connection from the municipality and it is possible to connect from an engineering standpoint. Prior to evaluation of the site where the availability of the sewer is in question, a statement regarding the availability of the sewer must be obtained from the appropriate governmental entities.

Act 368, P.A. 1978 as amended by Act 421, 1980 defines an available public sewer system as “a public sewer located in a right-of-way, easement, highway, street, or public way which crosses, adjoins, or abuts upon the property and passing not more than 200 feet at the nearest point from a structure in which sanitary sewage originates”. For further information and definitions refer to MDEQ publication titled “The Michigan Criteria for Subsurface Sewage Disposal”, dated April 1994, Appendix B, Page 20.

III. ENGINEERING INVOLVEMENT

Where buildings other than single-family dwellings are to be constructed, a registered engineer or architect, registered to practice in the State of Michigan, shall design the sewage system. Plans must be signed and sealed by the registered Professional Engineer. Where the cost of the total project is $15,000 or greater, Act 299, P.A. of 1980 requires that plans be submitted by a registered Professional Engineer only.

For single-family dwellings, the WCEHD requires an engineering plan when site conditions are such that a standard on-site sewage system could not be

installed or where site conditions are unsuitable for any of the conventional installations. Some examples of situations where engineers must be involved are:

A. Design and construction of Modified Fill Type Drainfields (MFTDF)
B. Sand filter systems
C. Where multiple splits are proposed (5 splits or more each is five acres or less)
D. Where drainage is required to lower high water table
E. Where unusual topographical conditions exist between the house and the drainfield
F. When a system is to serve more than two families on a property under one owner
G. Where a non-standard sewage system design is proposed
H. All new pumped sewage systems and all pressure distribution network for new and replacement systems

*On existing homes, provided no significant changes are to be proposed on the system and provided that the Pump Data Sheet **(see Appendix IX**) is completed and signed by the homeowner or his legal assigned representative, WCEHD staff may generate a pump design system curve that can be used to purchase a pump capable of meeting the demand of the system*.

IV. PLOT PLANS

A plot plan should be drawn to a scale of one-inch equals 40 ft or larger. On large parcels an enlargement of the drainfield area at one-inch equals 40 ft could be provided with the location shown on an outline of the entire parcel.

Unless the topography of a given site dictates otherwise, grading and cross sections are not routinely required on a plot plan. They <u>are</u> necessary on fill type fields, built up fields, and some other special designs.

When installing a drainfield, well or septic tank, minimum isolation distances as indicated in the following chart must be met.

ISOLATION	SEPTIC TANK	DRAINFIELD	WELL
Property line	10 ft	10 ft	——
Building foundation (no basement)	5 ft	10 ft	3 ft
Basement wall	10 ft	15 ft	3 ft
Residential water supply 25 feet or deeper	50 ft	100 ft	——
Lake or stream	25 ft	50 ft	___

Isolation distances may be increased as required for wells serving other than individual dwellings or if the wells are drawing water from an unprotected aquifer. A well shall not be located in an area subject to flooding.
No swimming pool shall be located within 20 ft of any drainfield or its expansion area.
Other isolation distances shall conform to Part 127 of Act 327 known as the Groundwater Quality Control Act.

V. SATURATED FORMATIONS

If a saturated sand formation is encountered, a sufficient number of test holes shall be dug to confirm:

A. Area of consistent sand formation a minimum of 3 ft thick
B. The degree of saturation throughout the area (Are portions of the formation dry?)
C. Color and texture indicators of the soil formation
D. Water table elevation in relation to the sand formation [ideally no less than one (1) hour after hole has been exposed] and confining layer, if any

In general, formations that show sufficient thickness of at least 3 ft, have dry areas or brown/bright colored sand, and a water table that does not rise into the confining layer, can be approved by the sanitarian. Saturated formations under hydraulic head shall be denied.

Sand formations that cannot be confirmed as to thickness of formation, or cannot demonstrate a uniform formation over at least a 4000 sq ft area will be denied regardless of the degree of saturation. This minimum area may be increased depending on the proposed use and the texture of sand encountered.

VI. SEASONAL HIGH-WATER TABLE EVALUATION AND PROPOSALS TO LOWER HIGH GROUNDWATER ELEVATION

In cases where soil mottling indicates a seasonal high water table (SHWT) in the upper 12 inches of the soil, the parcel is to be denied. The owner may elect to install site drainage improvements or perform a seasonal high water table evaluation using monitoring tubes. This procedure shall be followed when site drainage improvements are proposed to lower the SHWT elevation or in instances where only monitoring wells are installed. This procedure and accompanying diagram (Appendix VI) must be followed explicitly to help assure accurate, reliable results.

1) Monitoring high groundwater elevations shall be done during the normally wettest time period of the year and at least from February 1 to June 1. Any of the following persons shall provide monitoring results to the department:

a) A licensed professional engineer
b) A professional surveyor
c) A registered sanitarian
d) A certified professional geologist
e) A certified professional soil scientist

2) The designated person shall monitor high groundwater elevations by placing a monitoring well at representative locations approved by the department. The designated person shall make observations on the first day of the monitoring period and at least once every 7 days thereafter until the monitoring period is complete.

3) The designated person shall provide representative precipitation data for the time period of September 1 to May 31. Results of high groundwater elevation monitoring are inconclusive if recorded precipitation totals are less than 90% of normal averages during the time period of September 1 to May 31.

Site Drainage Improvement

Systems to lower the water table should be attempted only as a last resort as they are frequently ineffective in permanently lowering the water table. The drainage system shall be at least 20 ft from the drainfield and expansion area.

Engineering plans prepared by a Professional Engineer showing the proposed design of the under-drainage system must be submitted to this office for review and approval prior to construction. Approval from the County Drain Commissioner or other responsible governmental agency may be required if drainage is to be directed to drains designated as “County Drains”.

If the water table has not been lowered to provide at least 12 inches of naturally existing permeable soil above the high water table, a permit will not be issued. The design engineer shall substantiate that high groundwater elevation has been lowered to meet the requirement of Section 4:8 of the sewage code.

Refer to the most recent literature distributed by the Natural Resources Conservation Services on material specifications of agricultural drain tiles.

Suggested Monitoring Tubes Installation Procedure

A. Monitoring tubes must be installed prior to February 1st

B. Bore at least 2 ft into the permeable sand formation and set a minimum of three (3) monitoring tubes in the 4,000 square foot area provided that one tube be set at the lowest drainfield elevation. (Ex. 40' X 100' or 50' X 80'). Four-inch diameter tubes are recommended, but two-inch diameter tubes would be an acceptable minimum
C. The tubes shall be rigid, smooth wall plastic pipe (no corrugated tubing) and must be perforated from the bottom to within 12 inches of ground surface and solid pipe above that. Tubes must extend not less than 18 inches, and not more than 36 inches above grade
D. Backfill around monitoring tubes with pea stone to the top of the permeable formation, then backfill with spoils to grade. Mound clay around the tubes at grade to divert surface water away from the tubes. Note: A geotextile material silt sleeve may be substituted for the stone as long as coarse sand is allowed to collapse around the sleeved, perforated portion of the monitoring tube
E. Easily removable caps are required on all tubes

Installation of monitoring tubes is the responsibility of the owner or engineering firm hired by the owner. In the case of an engineering firm doing the monitoring, these tubes must be set by the engineering firm or installation supervised by them. Improperly set monitoring tubes may result in false evaluations. Consequently, if it is determined by the field sanitarian that tubes were improperly set, denial of the parcel will be upheld.

Applications for seasonal high water table evaluations shall be submitted not later than February 1st of the evaluation year. Applications made after this time will not be accepted. Furthermore, applications shall not be accepted without a prior soil evaluation having been conducted by this office The application shall be accompanied by a plan showing all proposed monitoring wells location and any previously existing farm tiles on the property.
WCEDH will conduct independent site visits to check monitoring tubes on a periodic basis.

VII. SURVEYS AND EASEMENTS

Section 2:4 of the sewage code requires a sewage system to be wholly located upon the property served. The best practical way to ensure this is to have a formal certified survey completed.

A. Boundary Surveys

Boundary surveys that are prepared, signed and sealed by a Registered Land Surveyor are required on the majority of parcels not in an approved subdivision or site condominium. Exception may be granted on large

parcels or 10-acre parcels located on an identifiable section line and corner. Lots in subdivisions may require a boundary survey where lot lines are not identifiable in the field. In general, a boundary survey will be required when:

1. The property is 40 acres or smaller in area
2. The property is not a part of a platted subdivision or a site condominium
3. Soil test pits are in close proximity to the property line
4. The property is a lake lot or located in densely populated areas

If work is performed on property that is intended to be split, WCEHD may withhold soil approval until a legal survey is submitted showing the accurate soil test pit location in relationship to the new property lines formed by the parcel split(s). Additionally, sewage systems may not encroach upon any type of easement (utility, ingress, egress, drain, etc.).

Where property lines are readily evident for existing homes, a survey may not be required.

B. **Easements**

Easements for on-site sewage and groundwater supply systems will generally not be accepted, but may be approved on a case-by-case basis after review by WCEHD staff. Easements or gerrymandering of lot lines that result in systems not in close proximity to the homes served will not be accepted. Variances to this policy may still be sought from the Washtenaw County Health Board Appeals Board-Public Health Advisory Committee (WCHCAB/PHAC).

C. **Seasonal Use**

In certain instances where the property is not large enough to comply with installation requirements or that does not permit use of a residence on a year round basis, the WCHCAB/PHAC has considered occupancy on a seasonal basis through the use of a “Seasonal Use Agreement”. A Seasonal Use Agreement is a signed document, recorded with the Register of Deeds, and runs with the land as a restriction on that property, limiting occupancy to approximately six months of the year. The procedure is to have the Seasonal Use Agreement drawn up along with any supporting plans or documents required, submitted to the WCHCAB/PHAC for approval, and signature, and then recorded by the owner with the Register of Deeds. The Seasonal Use Agreement would set forth any conditions or requirements on the use of that property as relates to a sewage system or a water supply system.

VIII. DRAINFIELD CONSIDERATIONS

A. Backfill Sand

If the excavation is at such a depth that it will require backfilling, then the sand backfill shall meet the specifications provided in section XV of this document. “Bank run” material must undergo sieve analysis to determine acceptability prior to use. A copy of the sieve analysis must be provided to the WCEHD.

B. Installation

1. Excavating should not be done when the soil is wet since open surfaces may be “smeared”, and compacted or otherwise have absorption characteristics negatively affected
2. Any water encountered during excavation must be removed at the time of the excavation inspection
3. The header must be leveled with watertight joints
4. The drainfield pipe lines between the header and the footer must be 4 ft on center and should not exceed 60 ft in length for a gravity system. If for any reason the length of the pipe is to exceed 60 ft in length, a dosing mechanism must be utilized
5. Drainfields may not be placed under driveways or paved areas
6. Drainfield pipe should be laid nearly level with no more than 1-in fall /50 ft
7. Drainfield stone in a vertical cross-section must be added as follows: 4 inches under the pipe lines; 4 inches beside; and 2 inches over, for a total thickness of 10 inches. For other than residential applications, the stone shall be a minimum of 12 inches in thickness, with 6 inches of stone beneath the pipe
8. In instances where a sewer line crosses a driveway or a drainage ditch, “sleeving” of the sewer line will be required

> *For further detailed information on drainfield construction, please refer to General Construction Requirements.*

C. Stone

The stone used in the construction of the drainfield shall be 6-A stone and shall meet the specification provided in section XV of this document. **Crushed 6A limestone is not acceptable.**

D. Sewer Line Slope

The sewer line from the house to the septic tank shall meet the Plumbing Code of the Building Department having jurisdiction. The sewer line between two tanks and from the tank to the drainfield shall be sloped at a minimum fall of 1%. If this minimum fall cannot be attained, then the septic tank(s) should be reset at a higher elevation or a pump system must be considered**.**

E. Clean-Outs

Clean-outs shall be provided at every 80 ft of the sewer line connecting the tanks and the drainfield. The clean-out shall consist of a sweep tee fitting or a “WYE” and a riser slightly above grade with a threaded cap.

F. Cover

The drainfield shall have a minimum of one(1) ft and a maximum of two (2) ft of cover over the stone. The cover should be uncompacted loamy sand, mulched and seeded to provide vegetative cover. The final grade shall be completed in such a manner to prevent ponding and divert surface runoff away from the drainfield area.

G. Inspection Ports

Monitoring ports are highly recommended and sometimes required to be installed to allow evaluation of the performance of the drainfield once it is in operation. These ports are usually 4-inch diameter plastic PVC pipe perforated with ½ inch holes over the lower 6-inch length. The inspection port opening at the soil surface is covered with a friction fit or screw cap. Refer to Appendix X for further information on port installation.

I. Diverter/Alternator Valves

These valves, if required, shall be properly housed and installed. A riser would be required to facilitate easy access for repairs and maintenance.

IX. SEPTIC TANKS

The invert inlet of a septic tank shall be a minimum of three inches above the liquid level in the tank. An outlet tee or baffle shall extend below to the middle third of the liquid level and above the liquid level to within one inch of the top of the tank.

At a minimum, septic tanks shall have either two (2) separate single compartments tanks or one dual compartment. For dual compartment tanks, the first tank volume should be 2-3 times the capacity of the second.

When tank capacity exceeds 1800 gallons, two (2) tanks in series are highly recommended.

Septic tank lid(s) are required over all inlet/outlet baffle or tees. All dual compartment tanks shall have separate lids or a common one over the partition wall to provide easy access to both compartments.

It is advised that the tank supplier be consulted in instances where tank location is subject to vehicular traffic or excessive earth pressure. Such cases may necessitate additional reinforcement of the tank(s) to avoid structural failure.

Septic tanks other than precast concrete may be installed if site conditions restrict or prohibit the installation of a precast concrete tank. However, WCEHD approval is required prior to installation.

When the top of a septic tank is deeper than 18 inches below the ground surface, it shall have a manhole to bring the depth of the manhole to within 18 inches of the top of the ground for access. If located under a paved area, the manhole shall be flush with the pavement surface and surface water shall be diverted away from the manhole.

All septic tanks must be placed in an area and at an elevation that will allow for ease of maintenance and service.

All septic tank outlet/inlet seals must have pre-cast seals that meet **ASTM Standards C-923**. Mastic tar, mortar, cement or other seals are not acceptable.

The following chart describes the size requirement for a typical on-site sewage system in Washtenaw County. Sizes are based on estimated sewage flows utilizing the number of bedrooms as a basis of occupancy capacities.

TYPICAL SEPTIC TANK AND DRAINFIELD SIZES

(SINGLE FAMILY DWELLINGS)

Number of bedrooms	Total septic tank capacity (Gallons)	Drainfield size (sq.ft.). Coarse sand and gravel	Drainfield size (sq.ft.). Clean med sand	Drainfield size (sq.ft.) Fine/loamy sand	Fill type drainfield
2	1500	800	1000	1500	2500
3	2000	1000	1200	1800	2880
4	2500	1200	1600	2000	3200
5	3000	1600	1800	2200	3500
6	3500	1800	2000	2500	3500

The above listed sizes are for primary drainfield areas. The total drainfield area required is the sum of the primary and reserve areas. The reserve area is 1.5 times that of the primary drainfield.
Effluent filters are highly recommended and may be required on certain sites and alternative on-site sewage systems. Refer to manufacturer's recommendation. In some instances, they may be required at the discretion of the health officer or his representative.
Each additional bedroom shall increase septic tank capacity by 500 gallons and drainfield by 300 square feet.

Tank Tightness Test

Tank tightness testing is a method used to determine whether a septic tank and/or pump chamber leaks. In certain instances, WCEHD will require tightness testing as a permit condition. Typically, such instances would include engineered/alternative septic system installations, and locations where tank placement into saturated soils is likely. The testing shall be conducted in accordance with American Society for Testing and Materials (ASTM) Standard C1227, Section 9.2 Testing for Leakage (*9.2.1 Vacuum Testing* – Seal the empty tank and apply a vacuum to 2 in. or 50 mm of mercury. The tank is approved if 90% of vacuum is held for 2 minutes. *9.2.2 Water-Pressure Testing* – Seal the tank, fill with water, and let stand for 24 hours. Refill the tank. The tank is approved if water level is held for 1 hour.) In the event that a tank or chamber fails testing, repairs or replacement shall be required to the extent necessary to resolve the leaking condition.

Tank First

In certain areas where a SHWT is encountered, it may be necessary to install a septic tank(s) prior to issuance of a sewage permit. The purpose of this is to assure that the tanks are set at the proper elevation to support gravity flow from the tanks to the drainfield. If the WCEHD requires that the tank(s) be installed prior to issuance of a sewage permit, the homeowner would be informed via a letter or a written report may be left in the field.

X. WASTEWATER FLOWS

Wastewater estimates are based on the number of bedrooms in the house. It is always estimated that each bedroom will generate 150 gal/day (GPD). This is based on 75 gal/person and 2 persons per bedroom. For example a 3-bedroom home will generate 3*150 or 450 GPD.

Wastewater estimates for developments other than a single-family dwelling shall be obtained from Table 1 or Appendix C of the Michigan Criteria for Subsurface Sewage Disposal.

XI. PUMP AND HAUL POLICY STATEMENT

Pump and haul for new developments shall not be permitted except as an interim measure when municipal sanitary sewer or approved on-site sewage disposal system are under construction. Pump and haul facilities to serve existing developments may be permitted only if all other alternatives for sewage disposal have been thoroughly investigated and are determined to be unavailable and unsuitable.

Once a proposal and an application for a pump and haul are submitted and reviewed by WCEHD staff, and the proposal is found acceptable, this department shall issue a permit.

The following are required as part of the proposal:

1. Design of the on-site storage facility
2. The size of the tank(s) and all proposed alarms
3. Written description of how the storing, transporting and disposing of sewage will be accomplished
4. A contingency plan to be followed should a break down occur
5. Contracts of agreements necessary to assure the continuity of a satisfactory operation
6. Completed forms of MDEQ Water Resources Commission application for pump and haul

XII. Proposed Multiple Splits

Regardless of the number of splits proposed, the developer is encouraged to consult with the WCEHD before final plans are prepared. This preliminary free consultation will examine the potential utilization of the site for on-site sewage and groundwater supply systems. The Division will make initial recommendations utilizing the following:

- Examination of existing available records
- Soil maps

Well information of surrounding homes

- Municipal sewer and water plans
- Other available records

A. Proposed Parcel Splits (less than one acre)

All parcel splits resulting in development sites that are less than 1 acre in size shall be approved under MDEQ Administrative Rules (R560.401 to R560.428) of on-site water supply and sewage disposal for Land Divisions and Subdivisions.

B. Proposed Parcel Splits of Five (5) or more Parcels (each is less than 5 acres in size)

The following items are required as part of the initial submittal prior to conducting a site visit:

- A site plan that shows the proposed parcel layout and individual lot area
- Legal description of the property and parcel ID number
- Clear, legible contour lines with either 1 ft or 2 ft increments shall be submitted to this office if the site exhibits severe topographical changes
- All streams, drains and ponds that are contained on or within 50 ft of the proposed development are to be shown on the plans
- All easement and utility lines are to be shown on the plans
- The 100-year flood plain of streams, if any, must be shown on the plans
- Any existing wells, septic tanks and/or drainfields must be shown on the plans
- Completed application along with the applicable fees for soil evaluation
- Location of any proposed roads or driveways
- Location of any known contaminated sites within 800 ft from proposed splits

B.1. Soil Evaluation

Call the WCEHD to schedule a site visit to determine soils suitability of the proposed splits. It is the responsibility of the engineer/surveyor to accurately locate all soil test pits on subsequent plans given to this office for approval. It is the responsibility of the owner/developer to hire an excavating contractor to dig the test pits.

B.2. Grading of Drainfield Areas

If the drainfield area is to be located on slopes in excess of 6%, it is the responsibility of the developer to have engineering plans showing the proposed grading of each drainfield area. The grading plan must be reviewed and approved by this office prior to commencing the work. In some instances, it may be required to have the grading completed and certified by the engineer prior to issuing a sewage permit on the property.

B.3. Test Well Requirements

To ensure that a proper groundwater supply in terms of quantity and quality is available, a minimum of one test well must be drilled.

B.3.1. Number of Test Wells

The number of test wells required is dependent on the number of parcel splits proposed. The table below summarizes the number of test wells required:

NUMBER OF PARCELS	NUMBER OF TEST WELLS
5-10	1
11-20	2
21 and up	3

B.3.2. Test Well Development

1. The test well shall be a minimum of 4 inches in inside diameter
2. An accurate well log describing the formation and related information as required under Act 368 must be submitted to the WCEHD for review and approval
3. The well should be drilled to a minimum depth of 50 ft with a 10 ft protective clay layer above the aquifer being utilized. The clay layer shall extend at least 25 ft from ground surface. If a protected aquifer cannot be obtained as described above, then the well must be drilled to a minimum of 100 ft in depth, with 50 ft of well screen submergence below the static water level

B.3.3. Pump Test

The well shall be pumped until clear. A pumping test shall be made with the pumping rate and the pumping level noted. A minimum of a 4-hour pump test is required with a minimum yield of 10 GPM. A drawdown and recovery table must be submitted to this office by the well driller. All test wells must be drilled by a State of Michigan registered well drilling contractor.

A recommended schedule for drawdown measurements from the start of pumping is:

a. Every minute for the first 10 minutes
b. Every 2 minutes from 10-20 minutes
c. Every 5 minutes from 20-30 minutes
d. Every 15 minutes from 30-60 minutes
e. Every 30 minutes from 60-180 minutes
f. Every 60 minutes from 180 minutes to the end of the test

A recommended schedule for recovery is:

a. Every 2 minutes for the first 10 minutes
b. Every 5 minutes from 10-30 minutes
c. Every 15 minutes from 30-90 minutes
d. Every 30 minutes for the next 2 hours
e. Every 60 minutes through the end of the test

B.3.4. Water Samples

In general, all test wells shall be tested for partial chemical analysis upon completion. If the development is located in an area where other tests are warranted, then those samples shall be collected as outlined in the permit condition sheet for the test well. The following parameters are defined as partial chemical analysis:

Parameter	MCL
Chloride	250 mg/L
Fluoride	4.0 mg/L
Hardness	<200 mg/L
Iron	0.3 mg/L
Nitrate	10 mg/L
Nitrite	1.0 mg/L
Sulfate	250 mg/L
Specific Conductance	850 mmhos
Arsenic	0.05 mg/L

C. Unconfined Aquifers and Drainfields

If the test well(s) or available water well records show that a protected aquifer does not exist, a certified hydro-geologist or a professional engineer shall complete an area study of all wells within 500 ft from the proposed development. Such a study will evaluate the following:

- The impact of the proposed development on the groundwater supply
- The general and local direction of the groundwater flow
- Proposed isolation distances based upon groundwater flow direction

Upon completion of such study, a written report shall be submitted to this office for review and approval/denial.

D. Final Approval

A final approval letter for each individual proposed parcel will be issued when the following are completed:

1. Soils are investigated and approved by a representative from this office
2. Groundwater information and samples are submitted to this office as outlined above
3. A legal description and a certified survey for the parcel(s) in question shall be prepared by a Registered Land Surveyor and submitted to this office
4. A plan showing the location of the test holes, along with a soil log describing the formation encountered, must be submitted to this office
5. An overall grading plan of both the site and the drainfield areas, if required, shall be submitted to this office for review and approval
6. If other work, such as well studies and seasonal high water table evaluations are required, they shall be completed in accordance with existing established guidelines prior to issuance of the WCEHD letter

XIII PUMP SYSTEMS FOR ON-SITE SEWAGE DRAINFIELDS

A. Introduction

A pump system (a pump and a dosing chamber) is used to elevate treated septic tank effluent to a drainfield. A pump system is required when:

1. The invert elevation of the drainfield prohibits gravity flow from the septic tank(s) at a 1% slope
2. The amount of effluent is greater than 2,000 gallons per day (GPD)
3. Standard and experimental alternative on-site sewage systems
4. A pressure distribution network is utilized
5. Excessive distance from tank(s) and drainfield, with undulating terrain in between

B. Pump System Components

A pump system is composed of the following:

1. A pump chamber
2. A pump with on/off/alarm floats
3. Control panel
4. A force main

C. Pump Chamber Design

Pump chambers are usually precast concrete tanks that store pre–treated septic tank effluent for timely discharge to a drainfield. The pump chamber must:

1. Be water–tight to a level above any possible seasonal groundwater. Leak testing may be required
2. Be set so that the seasonal high water table is below the pump–off level. This will prevent the chamber from floating out of position due to the hydrostatic pressure on the nearly empty chamber
3. The internal volume of the pump chamber must be sufficient to provide the daily design flow volume, dead space below the pump inlet for sludge accumulation, and sufficient depth to provide full time pump submergence, when required. An additional emergency storage volume of at least 100% of the daily flow design is also required (may include volume to flood capacity in both the pump tank and the septic tanks). Reductions in pump chamber volume may be considered when " Duplex" pumps are used
4. Have an audio and visual alarm
5. Use an effluent filter at the outlet of the last septic tank
6. Have mercury float or magnetic level control switches only. The switches should withstand the humid and corrosive atmosphere inside the tank(s). Pump failures can usually be traced to switch failures resulting in pump burn–out, so high quality switches are good investments
7. Have the alarm switch on a separate circuit from the pump switches
8. Have a union provided for easy removal of the pump from the force main. The union must be at an elevation that the pump can be removed without entering the manhole or pump chamber
9. All electrical connections shall be made in accordance with applicable Electrical Code
10. All pump chambers must be equipped with a twenty–four (24) inch minimum diameter, watertight riser with a secured lid that extends to the ground surface. Lids must be equipped with an airtight gasket to eliminate nuisance odors. Riser must be constructed to facilitate easy access to the tank and removal of the pump without entering the tank
11. An event counter for the purpose of flow measurements and trouble shooting

All commercial and alternative pumped on-site sewage systems shall be equipped with a pump event counter. A pump run time meter may be required if a timed dose mechanism is employed.

D. Pumps

Pump selection is based on the wastewater characteristics, the desired discharge rate, and the pumping head. The pump size is determined from pump performance curves provided by the manufacturer. Selection

is based on the flow rate needed and the pumping head. The specific application determines the flow rate needed. The pumping head is calculated by adding the elevation difference (static head) between the drainfield invert and pump–off level in the dosing chamber to the friction losses incurred in the discharge pipe. This is called the total dynamic head or TDH. Velocity head ($V^2/2_g$) can be neglected in most applications. Pumps must be set on concrete blocks to avoid pumping solids. Pumps must be kept submerged at all times.

Pumps must be easily installed so that they can be easily removed and/or replaced from the ground surface.

If any portion of the pump fittings or transport line is at a higher elevation than the drainfield, the system must be equipped with an air vacuum release valve to avoid siphoning.

If a check valve is used in the system, a vent hole should be installed upstream from the check valve so the pump volute is kept filled with effluent. This will prevent pump cavitation.

E. Force Main

The force main is typically 1½ inch to 2-inch diameter, Schedule 40 PVC plastic pipe or HDPE 100. The force main must be set at least 42 inches below ground surface to protect the line from freezing. If the force main is not buried below frost line, the pipe must be drained between doses. Sloping the discharge pipe back to the dosing chamber and eliminating the check valve at the pump may do this. In this manner, the pipe is able to drain back into the dosing chamber through a weep hole in the pump discharge line inside the pump chamber. The dosing volume must be sized to account for this backflow.

Check valves will be required when dual pumps are utilized to keep the effluent from being pumped through the non–activated pump, as well as to keep from pumping the volume of sewage left in the force main after the pump is shut off.

F. Design Steps and Procedures

1. Determine field size
2. Determine total length of drainfield tiles including footer and header in linear feet (LF)
3. Convert the total LF to gallons (see Table I). This is the field capacity
4. The liquid volume between pump–on and pump–off is the dose volume. Dose the field between:
    a. 65%–100% of field capacity when utilizing a 4 inch drainfield tile
    b. Five (5) to ten (10) times the pipe capacity when utilizing a pressure distribution network

5. Set alarm 0.25 to 0.5 ft above pump–on level
6. Determine the storage capacity above alarm level
7. Determine the TDH. TDH = friction losses + elevation head
8. Determine proper pump size using performance curves or nomograph
9. Determine dose time in minutes

Dose time =

$$\frac{\text{Gallons (field capacity+force main volume if sewage is to drain back via a weep hole)}}{\text{GPM (pump spec.)}}$$

Dose must take 20 minutes or less.

G. Determining Equivalent Length (Le)

Fittings:

45° bend	k	= 0.6	# of bends	x	0.6	=	
90° bend	k	= 0.9	# of bends	x	0.9	=	
check valve	k	= 3.0	# of valves	x	3.00	=	
ball/gate valve	k	= 0.20	# of valves	x	0.20	=	
exit loss	k	= 1.0	# exits	x	1.00	=	
Entrance loss	k	= 0.5	# entrances	x	0.5	=	
Flow increaser	k	= 1.0	# of increasers	x	1.0	=	
Flow decreaser	k	= 1.0	# of decreasers	x	1.0	=	

Le = equivalent length = K_t d/f

Where: K_t = sum of all K_t values
d = diameter of force main (ft)
f = friction coefficient

Pipe Type	Pipe Diameter (inches)	Pipe Diameter (ft)	F
PVC	1.0	.083	0.042
PVC	1.25	.104	0.039
PVC	1.5	.125	0.037
PVC	2.0	.167	0.033
PVC	2.5	.208	0.031
PVC	3.0	.250	0.029

Total length of force main = Le + length of force main from pump chamber to drainfield.

H. Using Nomograph

1. Assume a flow rate (GPM)
2. Select the pipe size (inside diameter) of the force main
3. Place a straight-line edge on these two points
4. The points at which the straight line intersects the head loss line and the velocity line give these two values under the given conditions
5. Nomograph reading x total length of force main /100
6. TDH = Number 5 above + static head
7. Plot this point (i.e., 1 and 6 on performance curve)
8. If point #7 intersects performance curve, this will yield the operating point. This is the number of gallons per minute pumped against a given head
9. If point #7 does not intersect pump performance curve, assume a new flow rate and repeat steps 2–7 until point intersects performance curve. This point is called the operating point

I. Using Hazen–Williams equation

In lieu of using the above nomograph, the designer may choose to use the following equation to calculate head losses:

$$\text{Head Loss: } HL = \frac{0.000995 * L * Q^{1.85}}{d^{4.87}}$$

Where:

HL	=	Head loss in feet
Q	=	Discharge in GPM
L	=	Force main length in feet
d	=	Force main diameter in inches

XIV. TYPES OF SEWAGE DISPOSAL SYSTEMS

A. Conventional On-Site Sewage Disposal Systems: A conventional on-site sewage system consists of a septic tank and gravity flow or pump/ pressure distribution to a gravel-filled drainfield. These systems meet WCEHD standards for sizing criteria. Engineering involvement is not required except in instances where site conditions dictate extensive grading and or a pumping station. Current conventional systems in Washtenaw County include the standard bed, the built- up and the deep-cut drainfields.

A.1. Standard Bed Drainfield

The standard bed drainfield is the typical installation when three (3) ft of permeable soil is found within the upper 10 ft of the soil horizon. Either a gravity fed system or a pump may be utilized to distribute effluent into the drainfield**.**

A.2. Built-Up Drainfield

A.2.1. Theory

A 2 ft layer of permeable soil above the high water table is necessary to provide an aerobic (oxygen rich) environment in the drainfield. This aerobic condition yields a longer life for the drainfield and better treatment of sewage before sewage reaches the groundwater. Artificially building up or elevating the drainfield can provide a portion of this 2 ft aerobic zone where it does not occur naturally. However, existing natural soil must ultimately accept the sewage and therefore must be permeable.

A.2.2. Criteria for Site Evaluation

a. The presence of a suitable formation of permeable soil (at least a 3 ft thickness) shall be determined by test borings
b. There must be at least 12 inches of naturally existing soil above highest indicated groundwater (as determined by mottling or observation). This may include the topsoil if it is sandy topsoil. If the 12 inches of naturally existing soil is impermeable then the fill around the edge of the drainfield must be at least a 4 ft width of this same material
c. If the sandy material is saturated, then it shall be determined as to whether the water is perched or confined

A.2.3. Construction Requirements - see diagram (Appendix III)

a. The size of the drainfield shall be determined by soil type and average quantity of daily sewage flow
b. Unless a pump system is utilized, the septic tanks shall be required to be set prior to issuing the health permit to insure construction of the drainfield at the proper elevation
c. The bottom of the excavation shall be clean and free of any traces of heavy soil or surface wash. The interface between the natural permeable soil and sand backfill shall be uncompacted and friable prior to commencing backfilling
d. Any filling which is necessary to bring the field to the proper elevation shall be done with a sand meeting the sand fill specification as stated in section XVI, A
e. A standard drainfield shall then be constructed on top of the sand fill and shall meet all other requirements of a standard drainfield
f. The bottom of the drainfield pipe shall be set as specified on the drawing for a Built-up Drainfield
g. Arrangements shall be made with the WCEHD for an excavation inspection and drainfield installation inspection prior to covering
h. Loam sand to sandy loam soil cover shall be placed over the top of the drainfield to a depth of 12 - 24 inches and shall extend 4-8 ft

beyond the edge of the drainfield. The edge of this embankment of fill shall be sloped to the natural grade at a slope not to exceed 1 ft vertical to 4 ft horizontal. If clay is used for constructing the embankment, then 4 ft of clay fill is required beyond the edge of the drainfield. If a sandy material is used for the berm, then 8 ft of sand fill is required beyond the edge of the drainfield

i. The finish grade shall be crowned to reduce precipitation infiltrating into the field area

A.3. Deep Excavation Drainfields

A.3.1. Theory

Where suitable soil for construction of a standard drainfield cannot be found in the top 10 feet of soil, there may be dry porous sand or gravel soil at greater depths, which can be developed by excavation and backfilling for disposal of septic effluent.

A.3.2. Criteria for Site Evaluation

a. The presence of a suitable formation of permeable soil (at least a 2 ft thickness of dry, loose, coarse sand and gravel) shall be determined from test borings or excavations. Permeable soil that is finer in size would require a minimum of a 3 ft layer

b. If it is determined that the excavation will penetrate to an aquifer that is being used as a source of drinking water, increased isolation distances may be necessary between wells and drainfields or it may not be possible to use the aquifer for a drainfield**.** A hydro-geologic study shall be conducted to determine the effect of the sewage system on the groundwater supply. If it is determined that there is a hydraulic connection between the formation used for the disposal of sewage and the aquifer, the following shall be maintained:

- Increase horizontal isolation distance between the well and the drainfield area to a minimum of 150 ft
- Construct water supply wells in a deeper protected aquifer
- The well must be installed upgradient from the sewage system. A gradient study will be required to determine the local direction of the groundwater flow
- A minimum of 50 ft vertical isolation distance shall be maintained between the static water level and top of the well screen

c. If the permeable material is saturated then it must be determined if the water is perched or confined. If the water is perched then the site shall not be approved for a drainfield. Monitoring tubes shall be set to determine the static water level in each of the tubes to determine the groundwater gradient. This type of waste requires

engineering involvement **(See Appendix VI on how to install groundwater-monitoring tubes)**

A.3.3. Construction Requirements – see diagram (Appendix IV)

a. The size of the field shall be determined by soil type at the bottom of the excavation and average quantity of daily sewage flow
b. The sides of the excavation shall be vertical for six feet and then slope to the bottom with a slope of no flatter than 1-foot vertical to 10-foot horizontal. The area of the bottom of the excavation shall be no less than $^1/_2$ the area of the top of the excavation or 800 square feet, whichever is greater
c. T- trench excavation is acceptable. See Appendix IV
d. The bottom of the excavation shall be clean and free of any traces of surface wash. The interface between the natural sand formation and fill sand must be uncompacted and friable prior to filling
e. The open excavation should be protected from surface runoff to prevent the washing of silt and debris into the hole if it rains. If "smearing", compaction or silting does occur, the soil face in the excavation shall be raked or loosened before the sand fill is added
f. Arrangements shall be made with the WCEHD for an inspection after the excavation is completed and prior to backfilling
g. The finish grade shall be crowned to divert surface water away

Generally formations that are greater than 20 ft below grade are not acceptable. The Public Health Engineer or Department Director may make certain exceptions following an administrative review

B. Standard Alternative On-Site Sewage Systems: are systems that have established WCEHD design criteria and are only allowed when site conditions does not permit the installation of a conventional system. Engineering involvement is required. Examples of these systems are the Modified Fill Type Drainfield (MFTDF) and the Sand Filter System (SFS). SFS design criteria can be found under a separate design manual.

B.1. Modified Fill Type Drainfields

B.1.1. Theory

Clay loam on certain slopes, when given enough area, can be "modified" to provide absorption of filtered sewage effluent.

B.1.2. Background

In the early 1970's, evaluations were conducted on sixty (60) sewage systems constructed over approximately 14 inches of existing sandy loam soil on slopes varying from 2%-16%. Twenty percent (20%) of the systems were failing at the time of evaluation. Those that failed were on slopes of 5% or less, or greater than 15%. Based on that evaluation, the criteria for fill-type drainfields were developed.

In 1976, an experimental sewage system was constructed following the fill-type criteria, but modifying the soil preparation. The modification was the mixing of 8 inches of sand into 6 inches of clay loam topsoil. That installation was evaluated for five (5) years. The results led to the specifications for a modified fill-type drainfield design. The WCHCBA/PHAC approved this type of field in 1981 for standard use in Washtenaw County. The following criteria detail the conditions of the approval by the WCHCBA/PHAC for installation of these systems.

B.1.3. Criteria for Site Suitability

a. A continuous slope between 6%-15% is required. The slope shall extend a minimum of 50 ft beyond the proposed top of slope. The width of the slope parallel to the contour shall be a minimum of 120 ft. This area is necessary for expansion of the drainfield and to control seepage. An alternative is for the slope to be 150 ft continuously down the hill and a minimum of 300 ft parallel to the slope. This would allow for expansion of the drainfield area to be parallel to the slope and next to the original drainfield
b. All uphill surface drainage shall be controlled so that all uphill surface drainage is directed off and around the prepared sand fill area
c. 14 inches of existing sandy loam soil on slopes between 6-15% shall be required

B.1.4. Review Procedure

a. A plan showing existing grade elevations of the drainfield area, developed by a Registered Professional Engineer, is to be submitted to WCEHD. Elevations shall be sufficient to describe the 6%-15% area. Elevations shall be provided at least every 50 ft down the hill and 50 ft across the hill
b. If it is the judgment of the design engineer that the site meets the elevation criteria, the owner or his/her legal representative will submit a completed application along with the applicable fees
c. The engineer or the owner shall schedule a site visit with WCEHD staff. The purpose of the site visit is to check site conformance with the criteria. Other features will be reviewed during this site visit related to house location, drainage, neighboring properties, etc. It is important that the four corners of

the proposed system be clearly staked prior to the WCEHD visit. We recommend that all requests for site visits be scheduled at least two weeks in advance of the desired date

d. Following a site evaluation, an approval or denial letter is sent. An approval letter will state any specific conditions and restrictions of the property in question
e. When construction of the house and drainfield is desired, detailed plans of the site, sewage system, survey, and property use restriction must be submitted. A generic form of the property use agreement may be found in Appendix VII
f. When the plans conform to the requirements, and the property use restriction is recorded with the Register of Deeds, the sewage permit can be issued

B.1.5. Construction Requirements – see diagram (Appendix V)

a. Soil shall be prepared by thoroughly mixing 8 inches of sand that meets the WCEHD sand fill specification with 6 inches of existing topsoil by plowing, discing, or use of a spring-tooth drag. Furrows must be parallel to the contour of the slope. This soil preparation can be only done at times of the year when the soil is dry and friable typically during the months of June through September. Soil preparation must be done under the supervision of the engineer. The engineer is to determine that the area to be prepared is in the right location; that the soil preparation conditions are suitable; that the equipment can efficiently complete the job; and to verify that the mixing meets the criteria
b. Soil preparation must be beneath the drainfield and at least 50 ft downhill from the proposed drainfield pipe on the downhill side. The width of the prepared area must extend 10 ft from the uphill pipe and 20 ft from the header and footer
c. Care must be taken to prevent equipment or anything else from compacting the prepared soil. The prepared soil area shall be backfilled with sand meeting the WCEHD sand fill specification. Sand shall be placed to provide a level area for the drainfield and stone. Sand shall also be placed so that the final grade above the end of the stone extends downhill 20 ft parallel to the slope, and then at a maximum slope of a 4 horizontal to 1 vertical slope to meet the existing ground (see typical cross-section in Appendix V)
d. Uphill surface drainage must be diverted completely around the drainfield and soil preparation area
e. A pressure distribution network is highly recommended
f. A pump system is required. Siphons are not acceptable for use as a dosing mechanism
g. A metering device is required to measure the sewage flow. Wastewater quantities are not to exceed the design rate. Readings are to be recorded monthly and submitted annually to

WCEHD for three (3) years. An alternative is to use event counter in the pump control panel

h. A property use restriction must be recorded which identifies the design rate for the sewage system and also stipulates any special features of the system (low-flow toilets, restriction on garbage grinders, etc)
i. The drainfield must meet all the requirements of a standard drainfield. The bottom of the stone is to be a minimum of 1 ft above the existing ground directly under the uphill drainfield pipe
j. Final cover over the drainfield and sand mound shall be a sandy loam or loamy sand soil
k. The finish grade of the drainfield shall be crowned to shed precipitation
l. The design engineer must supervise construction. Upon completion of construction, the engineer shall submit written certification that the construction has been done in accordance with the approved plans
m. A Registered Professional Engineer must sign and seal all engineering plans

B.1.6. Installation

Since MFTDF's are usually constructed on sites with very limiting soil and site conditions, good construction techniques are essential if a MFTDF is to function properly and provide many years of trouble-free operation. The following procedures shall be adhered to when constructing a properly designed MFTDF.

The soil is too wet to plow if a soil sample taken from the plow depth forms a ribbon (e.g., 1/8-inch diameter) when rolled between the palms. If it crumbles, plowing may proceed. This pre-tillage investigation is essential to prevent possible system failure. Construction must not take place if soil is too wet. Seepage may occur between the MFTDF and the soil surface if surface preparation is done poorly or if the soil is too wet during the tillage operation.

Plow the area within the MFTDF perimeter 9-12 inches deep and parallel to the contour of the slope using a moldboard or chisel plow. Do not use a single-bottom moldboard plow because the trace wheel will compact the soil at the bottom of each furrow. Each furrow slice should be thrown up-slope. If a chisel plow is used, make two passes. On sites that cannot be plowed (e.g., wooded areas with stumps) roughen the surface to a depth of 9-12 inches with the backhoe teeth. Rototilling unplowed areas is not allowed recommended because of potential damage to the soil structure, but it may be used in granular soils such as sands.

If construction must be temporarily discontinued, cover the plowed area with at least 8 inches of sand-fill material or a temporary removable cover so that the plowed area is not exposed to rainfall. This prevents compaction and sealing. If left uncovered during a rainfall, another pass with the plow after the soil dries will be necessary.

B.1.7. Covering

Place a barrier material over the drainfield stone. Suitable materials can be synthetic filter fabric or 2-4 inches of marsh hay or straw. The stone must be covered with permeable material to keep backfill soil from filtering down into the stone.

Cover the bed and sand fill with at least 6 inches of fine textured subsoil such as sandy loam.

Finally, place 2-3 inches of good quality topsoil over the entire surface to provide a good medium for grass or similar vegetation, and to increase surface drainage away from the mound.

Sow seed or lay sod over the MFTDF using grasses adapted to the area. Shrubs can be planted around the base and up the sideslopes. Plantings on the downslope side should be somewhat moisture tolerant since this area may be rather moist during early spring. Plantings on top of the fill, on the other hand, should be drought tolerant since the upper portion of the MFTDF can become quite dry during the summer.

C. Experimental Alternative On- Site Sewage Systems: are systems that do not have WCEHD design criteria. Typically these systems are approved on existing homes with a failed septic system where a conventional system cannot be installed. Engineering involvement, system monitoring and maintenance are all required. Approval of experimental systems on new homes requires a variance from the WCHCAB/PHAC.

Further information regarding experimental alternative on-site sewage systems will be published in the near future.

XV. BACKFILL SAND AND STONE SPECIFICATIONS

Where backfill sand is required, one of the following specifications shall be met:

A. Backfill Sand Specifications

1. MDSH&T 2 NS sand
2. MDSH&T Class I granular material
3. See table below

Passing number 4 sieve in Percent	90-100 %
Passing number 60 sieve in Percent	0-50 %
Passing number 100 sieve in Percent	0-20 %
Passing number 200 sieve in Percent (Including loss by washing)	0-5 %

B. Stone Specification

The stone used in drainfield construction shall be 6-A and meet the following specifications:

Passing the 1½ inch sieve in Percent	100 %
Passing the 1 inch sieve in Percent	95 % - 100 %
Passing the ½ inch sieve in Percent	30 % - 50 %
Passing the # 4 sieve in Percent	0 % - 8 %
Loss by wash in Percent	0

XVI. INSPECTIONS

An excavation inspection by the WCEHD or the project engineer (if specified in the permit condition sheet) shall be required on all fields.

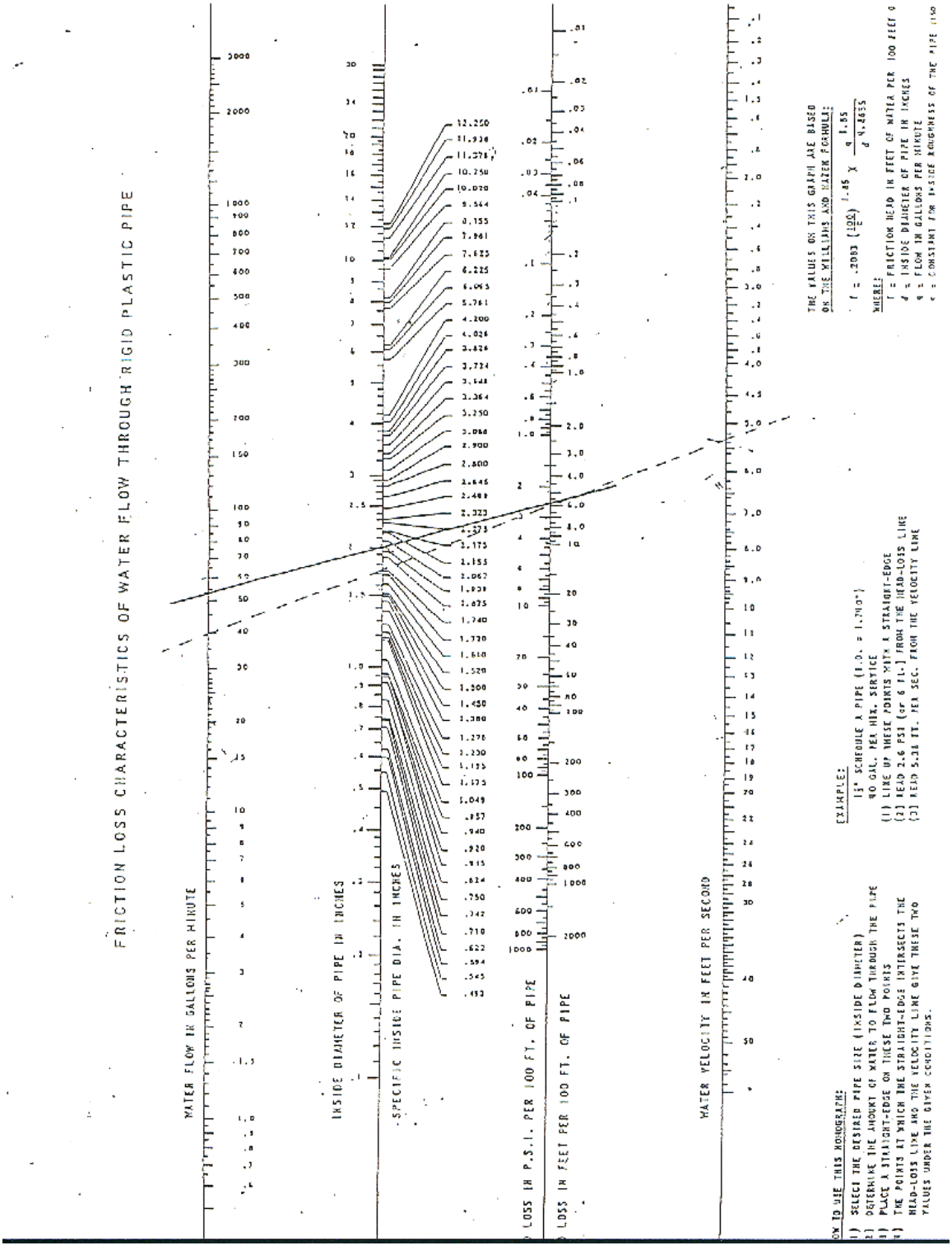
Other inspections shall be conducted by the WCEHD as stipulated in Section 6:1 of the Washtenaw County Regulations for the Disposal of Sewage of Human Excreta.

APPENDIX I: Capacities of Various Pipes

Pipe Capacities in Gallons per 100 ft of Pipe Length

Diameter of pipe in inches	SDR-26 PVC	SDR-21 PVC	SCH. 40 PVC
11/4	9.57	9.13	7.76
1½	12.55	11.97	10.57
2	19.64	18.77	17.44
2½	28.65	27.68	24.91
3	42.55	40.92	38.39
4	70.39	67.47	66.12
6	152.6	146.23	150.0
8	258.0	248.11	

APPENDIX II: Hazen–Williams Nomograph



COUNTY OF WASHTENAW - HUMAN SERVICES DEPARTMENT

PUBLIC HEALTH DIVISION
ENVIRONMENTAL HEALTH BUREAU

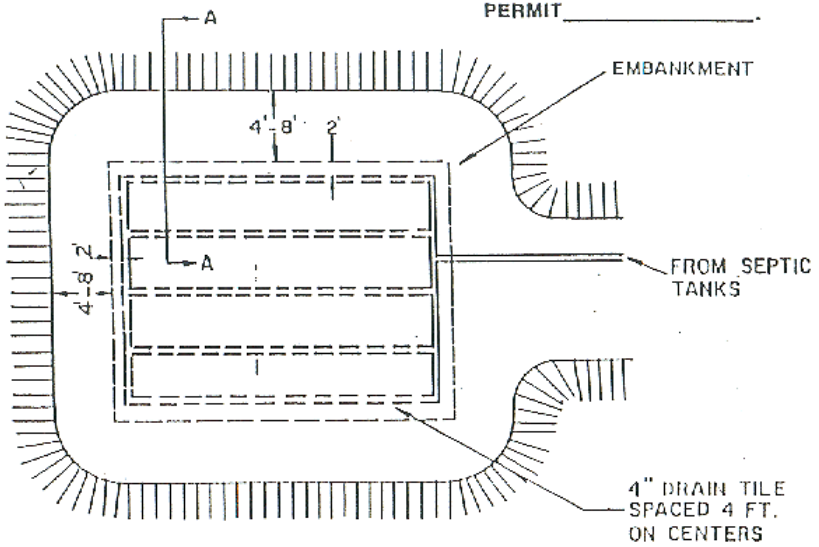
BUILT-UP DISPOSAL FIELD

NOTICE:

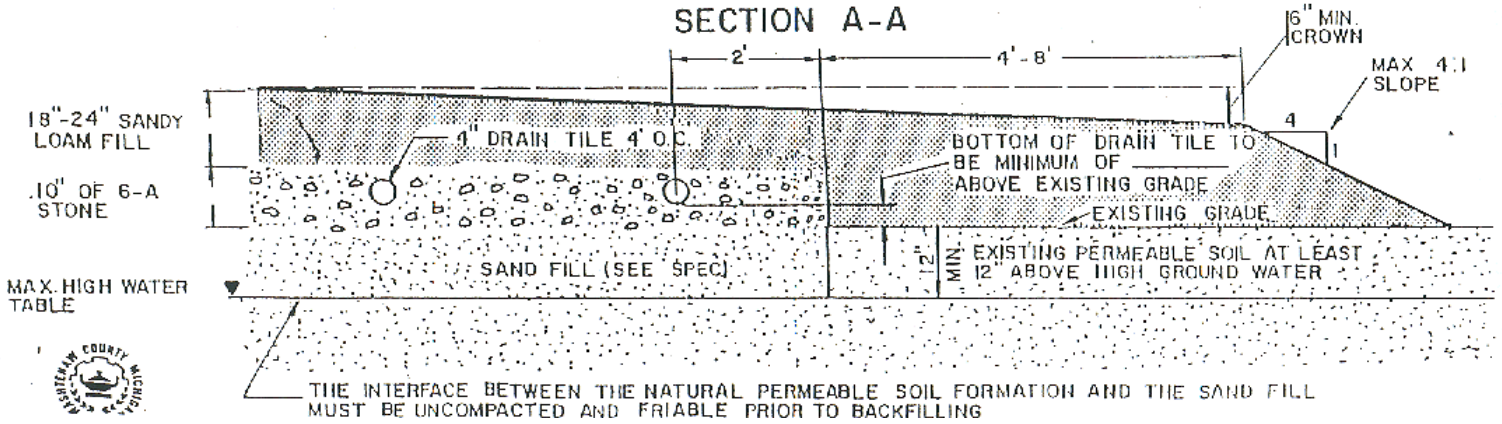
THIS TYPE OF DISPOSAL FIELD SHALL BE CONSTRUCTED ONLY UNDER CERTAIN CONDITIONS OF SOIL, TOPOGRAPHY, AND LAND AREA AS SHALL BE APPROVED BY THE HEALTH DEPARTMENT.

PLAN

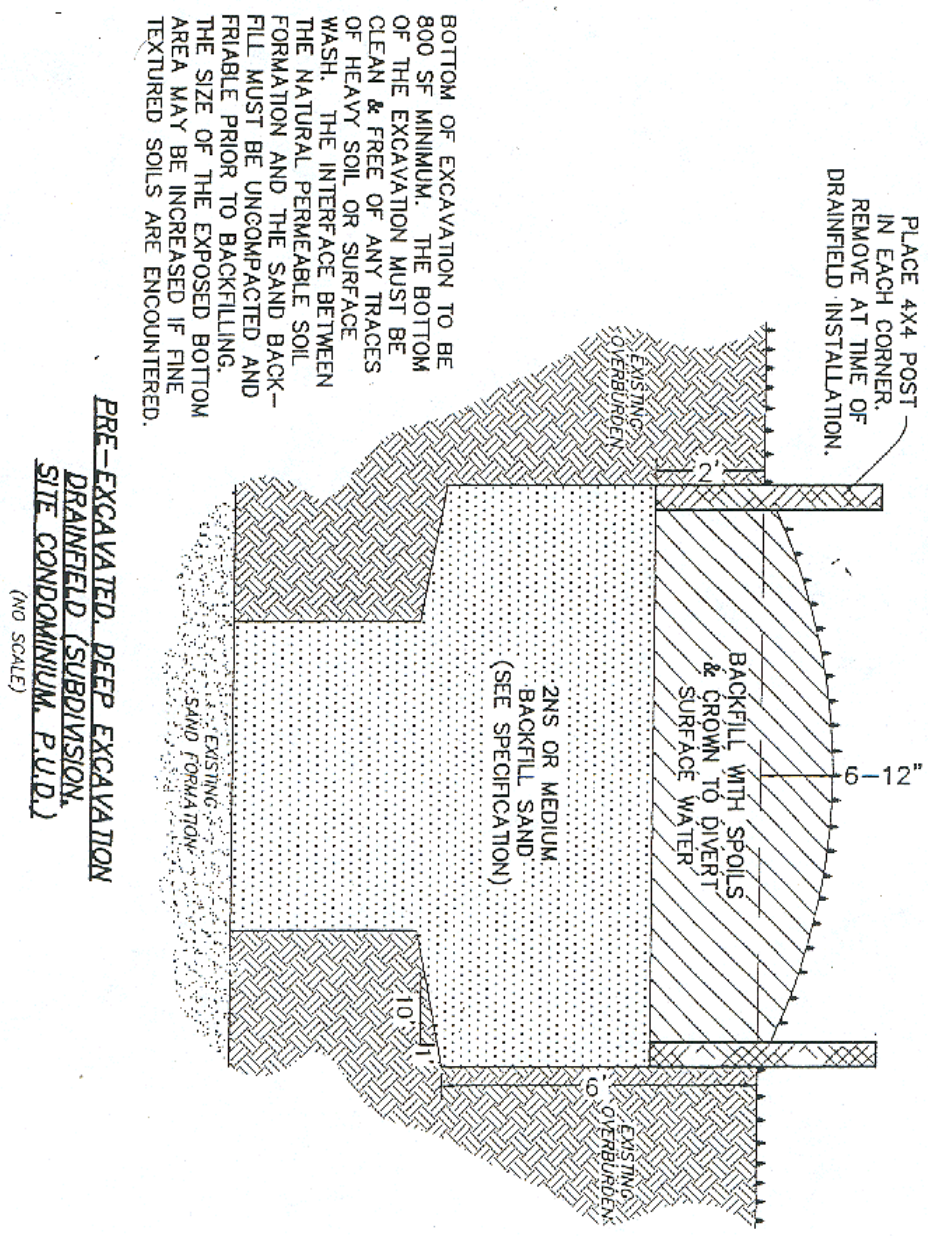
THIS DRAWING IS PART OF THE APPROVED PLANS FOR HEALTH PERMIT_____.



SECTION A-A



APPENDIX IV: Deep Excavation Drainfield



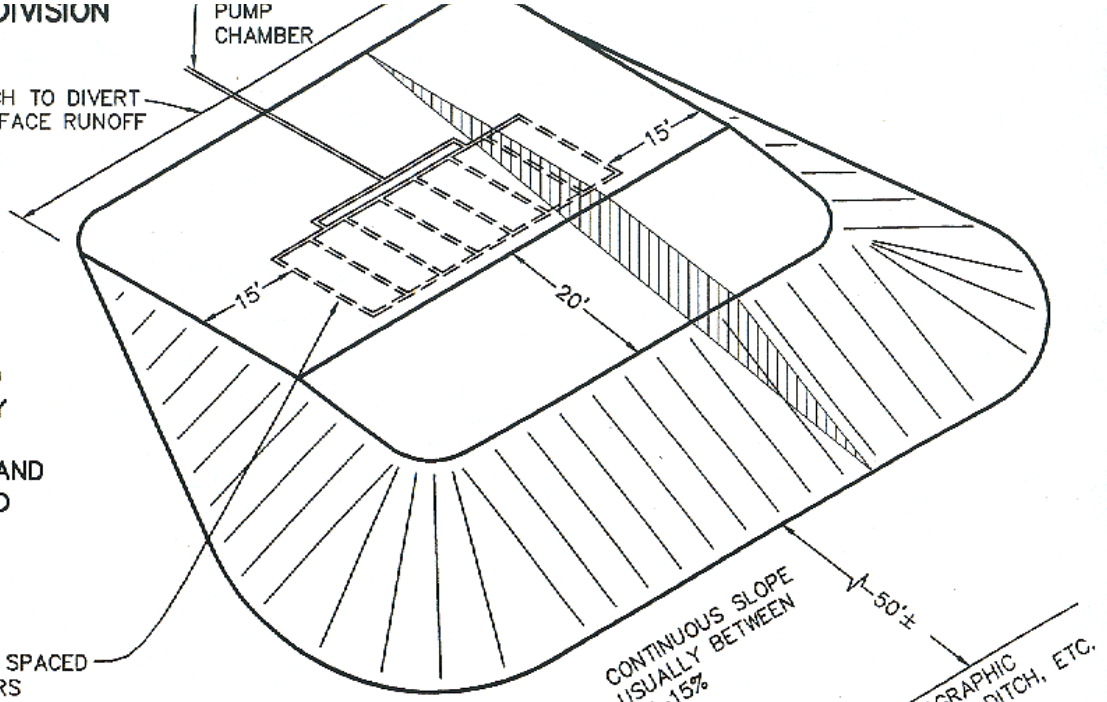
PRE-EXCAVATED DEEP EXCAVATION DRAINFIELD (SUBDIVISION, SITE CONDOMINIUM, P.U.D.)

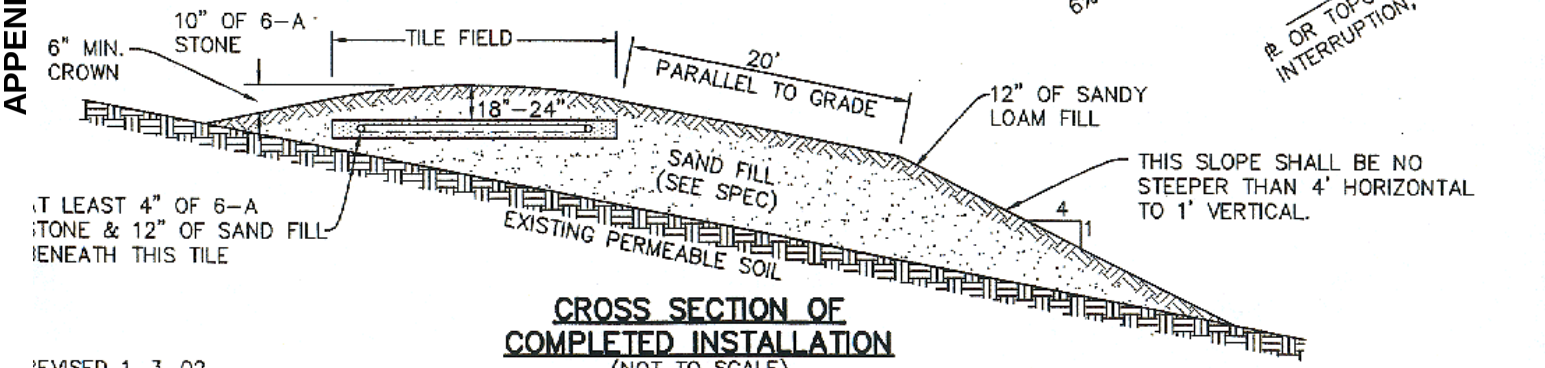
(NO SCALE)

ENVIRONMENTAL HEALTH DIVISION

FILL TYPE DISPOSAL FIELD

NOTICE:
THIS TYPE OF DISPOSAL FIELD SHALL BE CONSTRUCTED ONLY UNDER CERTAIN CONDITIONS OF SOIL, TOPOGRAPHY AND LAND AREA AS SHALL BE APPROVED BY THE HEALTH DEPARTMENT.

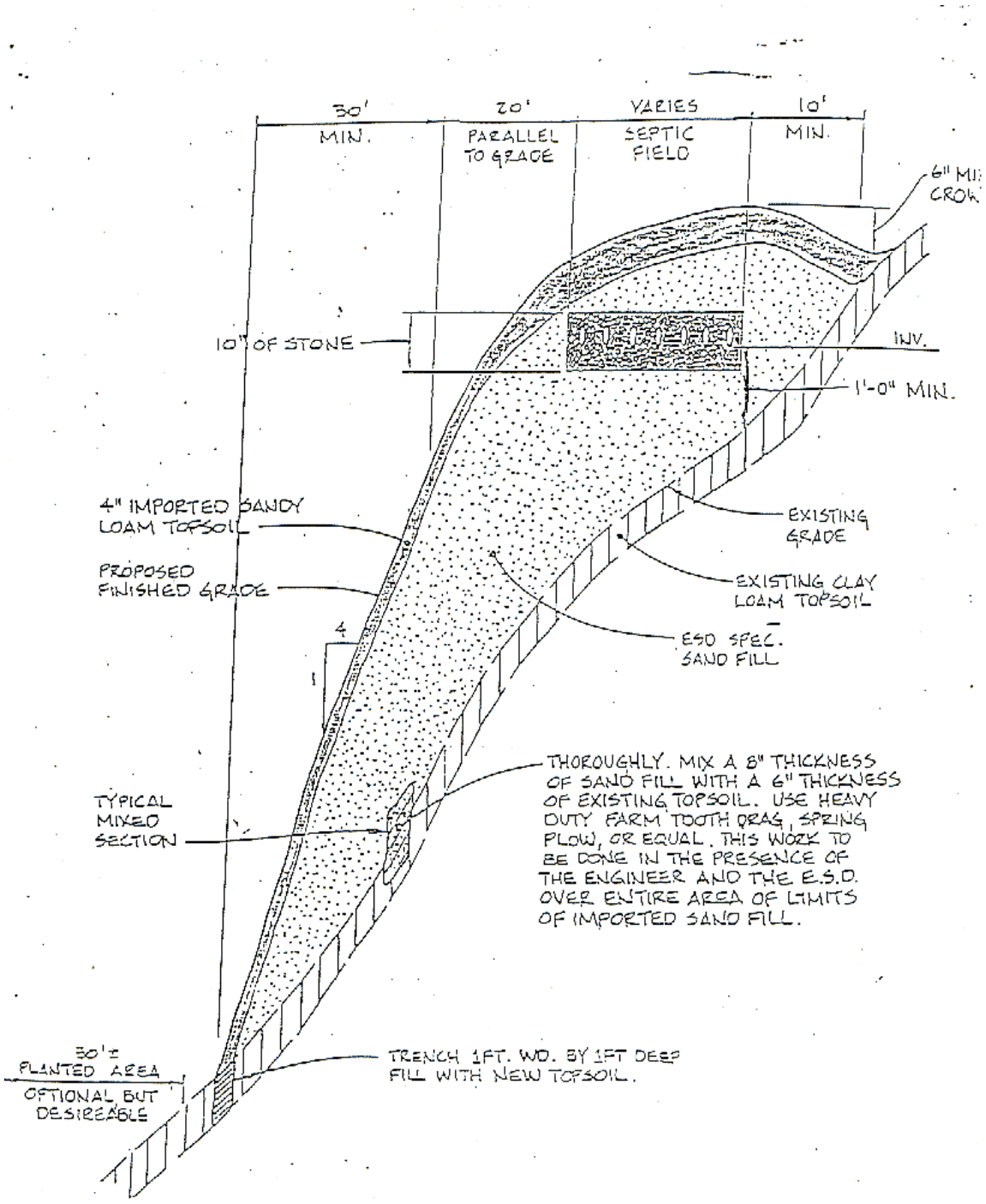




CROSS SECTION OF COMPLETED INSTALLATION

(NOT TO SCALE)

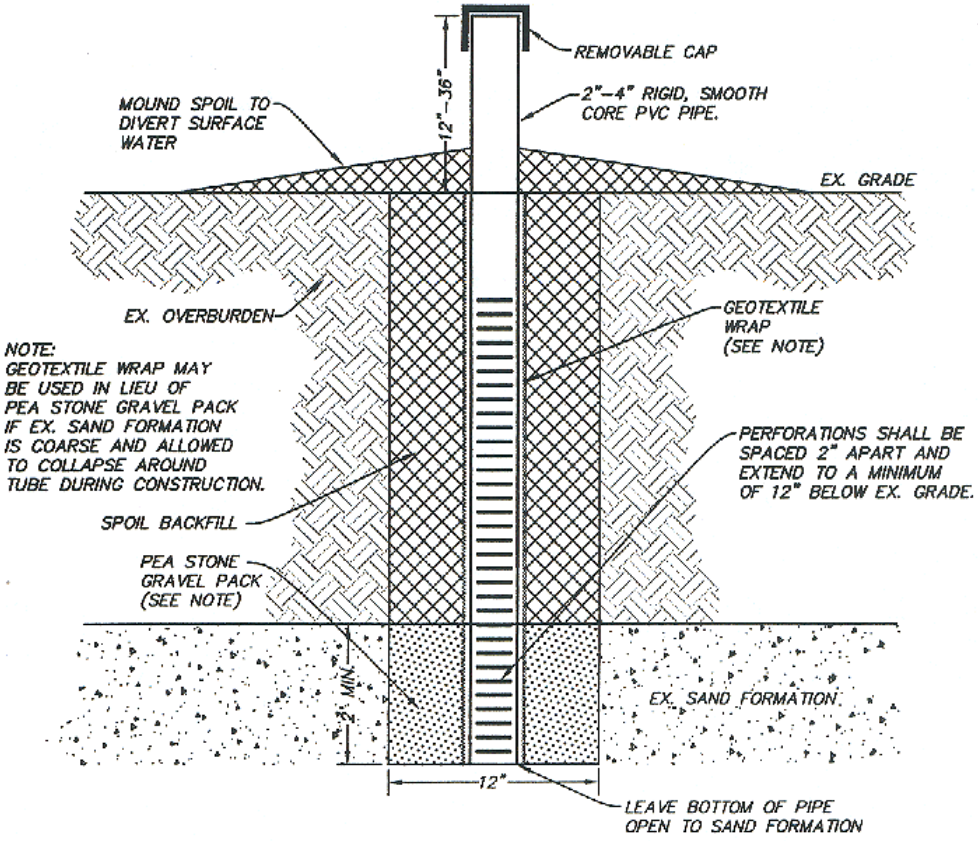
EVISED 1-3-02



TYPICAL SECTION FOR MODIFIED FILL TYPE DISPOSAL FIELD

(NOT TO SCALE)

APPENDIX VI: Groundwater Monitoring Tubes



GROUNDWATER MONITORING TUBE DETAIL

(NO SCALE)

APPENDIX VII: Generic Deed Restriction

AGREEMENT AND PROPERTY USE RESTRICTIONS FOR SEPTIC TANK SEWAGE DISPOSAL PERMIT

THIS INDENTURE, made this _____ day of _____, 20_____, by and between _____and_____, _____, whose residence is_____, Michigan**,** _____, hereinafter called "Owner(s)", and the WASHTENAW COUNTY ENVIRONMENTAL HEALTH DIVISION, having its principal place of business at 4101 Washtenaw Avenue, Ann Arbor, Michigan 48107.

WITNESSETH:

WHEREAS, _____is/are the Owner(s) in fee simple of the following described property located in _____Township, Washtenaw County, Michigan.

Legal Description

The above-described premises contain _____ acres, more or less.

WHEREAS, the Owner(s) has/have an application for a sewage disposal system on the property described above; and

WHEREAS, an investigation has been made of the land area and proposed use of said property; and

WHEREAS, the Washtenaw County Health Officer is of the opinion that the available land is not suitable for a permit for a conventional septic tank drainfield system necessary to serve a building on a year-round basis; and

WHEREAS, said Owner(s) have indicated his/her/their desire to construct an experimental septic system to serve a _____ bedroom, _____ bathroom house

NOW, THEREFORE, in consideration of the covenants and agreements and restrictions contained in this Agreement, the parties mutually agree as follows:

1. That the Owner(s) agree to install an (experimental/alternative/modified fill type etc.) septic system as designed by _____, Professional Engineer, and as described in his/her engineering plan and report titled " _____".

2. That the design engineer oversees the installation, construction, and monitoring of the system for a period of four (4) years after installation of the system.

3. That the design engineer submits an annual report to the Washtenaw County Environmental Health Division which indicates the measurement of water use, observation of the system during February or March of each year by _____, a professional engineer, and report on the system and how it is functioning.

4. That all construction complies with the sewage permit which the Washtenaw County Environmental Health Division will issue and complies with the approved plan and sewage system design as submitted by _____ and approved by the Environmental Health Division.

5. Owner(s) waive all claims he/she/they may have against the Washtenaw County Environmental Health Division which may arise as a result of Owner's installation and use of the experimental septic system.

6. The house size shall not exceed _____ bedroom(s), _____ bathroom(s).

7. At the end of four (4) years, the design engineer or his/her representative shall prepare recommendations on the sewage system design, operation, and maintenance. This report will be submitted to the Washtenaw County Environmental Health Division to determine if the system can be accepted as a standard sewage system.

8. In the event of a sewage disposal failure, as determined by the Washtenaw County Environmental Health Division, Owners shall either:

a. Immediately eliminate any health hazard created on the premises or on any neighboring properties;

b. Vacate the property until the soil in the vicinity of the sewage system has dried and a new septic disposal system is built and approved by the Environmental Health Division, or a court determination is made that the sewage disposal system is adequate; or

c. Construct the modified fill-type drainfield as approved to be the back-up system for the experimental sand filter system.

9. This Agreement and any required permits, together with the covenants and restrictions, shall run with the land, and shall bind, and inure to the benefit of the heirs, executors, administrators, devisees, successors, legal representatives, and assigns of

the respective parties to whom the whole or any part of the land so made subject to said permit shall at any time become or belong. Any violation of the restrictions and covenants contained in this Agreement shall void any required permits.

10. Failure of the Washtenaw County Environmental Health Division to enforce any covenant or restriction contained in this Agreement shall not be construed as a waiver of any further breach of same covenant or restriction in the future.

11. This Agreement and any amendments hereto shall be recorded by the Owner(s) within three (3) calendar days from the date of this Agreement with the Washtenaw County Register of Deeds.

12. This Agreement shall be modified only upon written approval of the Washtenaw County Environmental Health Division.

WITNESSES:

_____

_____
Owner

_____

_____

_____
Owner

_____

STATE OF MICHIGAN

COUNTY OF WASHTENAW

On this day of _____ , 200___ , before me a Notary Public, appeared _____who being duly sworn stated that the above statements are true to the best of their knowledge and belief.

_____
Notary Public, Michigan

My Commission Expires: _____, 200_____

IN WITNESS WHEREOF, the parties hereto have executed this document on the day and year first written above.

STATE OF MICHIGAN

COUNTY OF WASHTENAW

WITNESSES:

WASHTENAW COUNTY
ENVIRONMENTAL HEALTH DIVISION

_____

_____

_____

On this _____ day of _____, 200____, before me a Notary Public appeared _____ who being duly sworn stated that the above statements are true to the best of his/her knowledge and belief.

_____
Notary Public, Michigan

My Commission Expires: _____, 200_____

When recorded, please return to:

Majed Ghussaini, P.E.
Public Health Engineer
Washtenaw County Environmental Health Division
705 North Zeeb Road
Ann Arbor, MI 48107-8645

DETERMINATION OF TANK FIRST ELEVATION

THE FOLLOWING INFORMATION MUST BE KNOWN TO CALCULATE SEPTIC TANK INVERT ELEVATIONS:

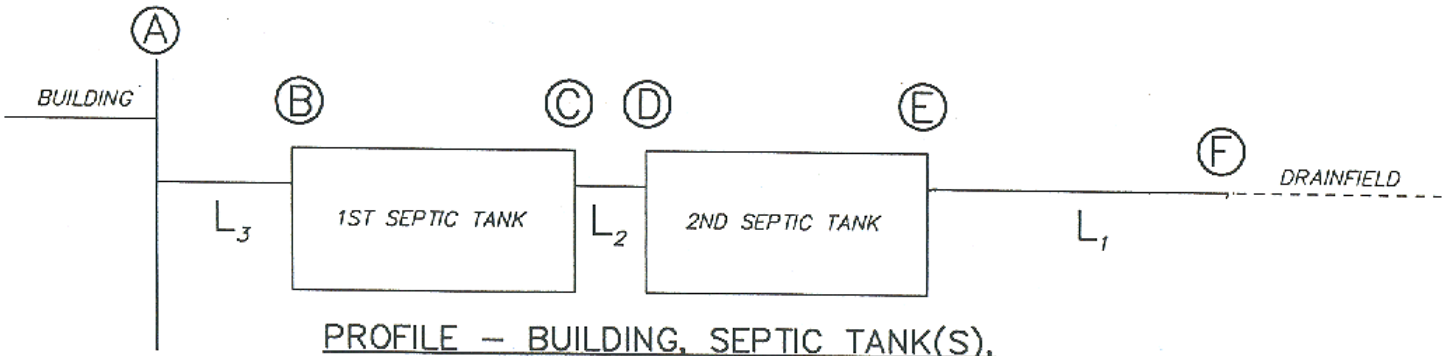
1. EXISTING GRADE ELEVATIONS AT THE TESTPITS IN THE PROPOSED DRAINFIELD AREA.
2. THE MINIMUM INVERT OF THE DRAINFIELD AS DICTATED BY THE SEASONAL HIGH WATER TABLE (SHWT) AND/OR SOIL CONDITIONS.
3. LENGTH OF THE SEWER LINE BETWEEN THE LAST SEPTIC TANK AND THE DRAINFIELD.

-- FALL FROM THE BUILDING TO THE FIRST SEPTIC TANK = 1/4" PER FOOT = 2%
-- FALL FROM THE SECOND SEPTIC TANK TO THE DRAINFIELD = 1/8" PER FOOT = 1%

THE FOLLOWING FORMULAS ARE USED TO COMPUTE THE ELEVATIONS REQUIRED IN WHICH A SEWAGE DISPOSAL SYSTEM CAN FUNCTION PROPERLY USING MINIMUM FALL.

$$E = 0.01L_1 + F$$
$$D = E + 0.25$$
$$C = 0.01L_2 + D$$
$$B = C + .025$$
$$A = 0.02L_3 + B$$

Ⓐ *INVERT OF SEWER LINE AT HOUSE*
Ⓑ *INLET INVERT OF 1ST SEPTIC TANK*
Ⓒ *OUTLET INVERT OF 1ST SEPTIC TANK*
Ⓓ *INLET INVERT OF 2ND SEPTIC TANK*
Ⓔ *OUTLET INVERT OF 2ND SEPTIC TANK*
Ⓕ *INVERT OF DRAINFIELD HEADER*
L_1 *DISTANCE BETWEEN Ⓕ & Ⓔ*
L_2 *DISTANCE BETWEEN Ⓓ & Ⓒ*
L_3 *DISTANCE BETWEEN Ⓑ & Ⓐ*



PROFILE – BUILDING, SEPTIC TANK(S), DRAINFIELD SYSTEM

APPENDIX IX: PUMP DESIGN DATA SHEET

Design Data Sheet for Pumped Sewage Systems

Owner Name: _____
Site Address: _____
Township: _____
Section #: _____

Note: Submittal of this Data Sheet must be accompanied with an accurate, scaled plot plan, which includes a local benchmark identified on the plan.

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1) System Sizing
   - # of Bedrooms: _____
   - # of Bathrooms: _____

2) Elevations
   - invert elevation at outlet of 1st septic tank: _____
   - invert elevation at outlet of 2nd septic tank: _____
   - invert elevation at inlet of pump chamber: _____
   - invert elevation of proposed drainfield (header elevation): _____

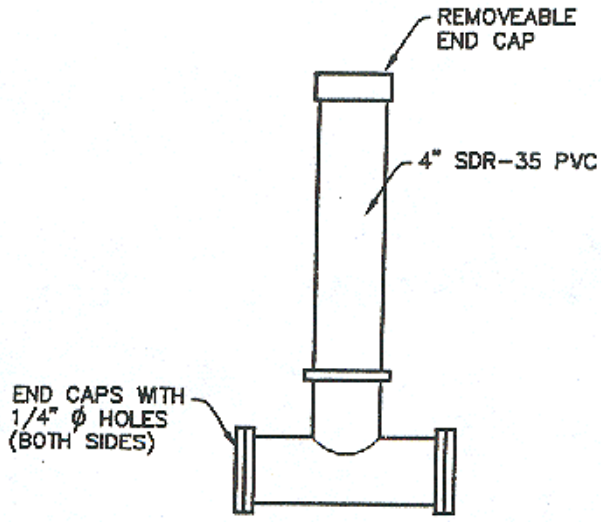
3) Friction Head Calculations
   - diameter of force main: _____ length of force main in ft: _____
   - # of Check Valves: _____
   - #of 90 degrees Bends: _____
   - # of 45 degrees Bends : _____
   - other valve assemblies (please specify): _____
   - specify type of force main piping material:_____
     (Sch. 40 or approved equal)

4) Pump Chamber
   - manufacturer/supplier: _____
   - telephone number: ( )_____
   - gallons/inch: _____
   * *provide a pump chamber shop drawing/schematic showing all interior dimensions*
   * *all systems must have access risers above finish grade over pump*

5) Effluent Filter
   - manufacturer/supplier: _____
   - telephone number: ( )_____
   - model: _____
   * *filter must have an access riser above finish grade*

Note: *The information provided above is assumed to be accurate, however, the Washtenaw County Environmental Health Division is not responsible for the accuracy of the information submitted on this form, nor errors that may occur due to reliance upon this information*.

Appendix X: Drainfield Observation Port Details



TRENCH OBSERVATION TUBE DETAIL

(NOT TO SCALE)