



PRESBY ENVIRONMENTAL, INC.

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TECHNICAL BULLETIN

Advanced Enviro-Septic™ Treatment System Functional and Theoretical Overview

Introduction:

The Advanced Enviro-Septic™ Treatment System (AES), available exclusively from Presby Environmental (PEI), is an innovative, alternative onsite wastewater treatment system that utilizes natural, non-mechanical processes to treat and disperse effluent that has received primary treatment in a conventional septic tank. Expected effluent quality after treatment in an AES System meets US EPA Tertiary Treatment guidelines, NSF Standard 40 Class I requirements and BNQ (Bureau de Normalisation du Quebec) Secondary and Advanced Secondary requirements.

How AES treats wastewater:

The Advanced Enviro-Septic™ Wastewater Treatment System in essence creates a self-sustaining, self-regulating biological ecosystem which is highly effective at purifying effluent. The bacterial population within the system adjusts as it is exposed to cycling aerobic and anaerobic (wet and dry) conditions. The aerobic and anaerobic bacteria populations automatically adjust based on what they are “fed” (the waste that is introduced to the system for processing) and the amount of oxygen present in the system. The biomat (a microscopic layer created by the waste-products of anaerobic bacterial activity) is responsible for treating the wastewater and regulating the rate at which fluid moves through the system. Slowing down the liquid enables the bacteria (both aerobic and anaerobic) the time it needs to digest the waste materials (suspended solids) in the effluent. The aerobic bacteria digest the biomat, enhancing its permeability and preventing it from clogging. So while anaerobic bacteria (which exist in the part of the pipe that is regularly wet and oxygen free) are continually building the biomat, the aerobic bacteria are continually eating away at it, creating a natural balance that results in passive, effective, long-term wastewater treatment. The result is a healthy biomat that is not subject to clogging and which regulates the passage of fluid so that it is not too fast (which would release untreated wastewater into the environment) nor too slow (which would potentially create a hydraulic overload).

Physical description of proposed technology:

(Please refer to the attached cross-section and AES System diagram.) The AES system is designed to provide combined treatment and dispersal of wastewater that has received primary treatment in a septic tank. Effluent travels from the septic tank to the treatment system by gravity or, if necessary, using a pump system to gain elevation. AES is a passive/non-mechanical treatment system that does not require electricity, pressure distribution, mechanical devices or replacement media. The AES system develops a multi-stage, permeable, self-regulating biomat that is highly effective at purifying wastewater and protects receiving soils from clogging. The primary system component is the patented AES pipe, which is a high-density plastic pipe that is ridged and perforated; a skimmer tab extends inwardly from each perforation. A layer of geo-textile fabric (Bio-Accelerator™) partially surrounds the outer surface along the bottom the pipe. A mat of coarse, randomly-oriented plastic fibers completely surrounds the outside of the pipe, and another layer of geo-textile fabric surrounds the pipe circumference and is stitched together to hold the fiber mat in place. The finished product is approximately 12 inches in diameter; AES pipe comes in ten foot sections which are joined together with couplings and connected at each end using offset adapters or double offset adapters which have openings used to make connections using 4 in. PVC pipe. All components are extremely durable, lightweight for ease of transport and handling, and non-biodegradable. The system is installed within a bed or trench of specified System Sand which facilitates gas exchange and controlled infiltration into underlying soils. All systems include ventilation to assure aerobic conditions are maintained.

Advantages over conventional technology/reduction of possible risks:

Repeated third-party testing confirms the System's ability to significantly reduce CBOD5, fecal coliforms and TSS compared to conventional technology. In addition, the AES system maintains a stable pH in the range of 7.0 to 8.5, providing the ideal conditions for aerobic bacterial processes. AES provides treatment of wastewater prior to releasing it into the ground, reducing risks to public health, surface and ground waters, and the environment. AES has a proven ability to develop a treatment biomat in as little as three weeks after the system is first put into use (or during periods of intermittent use), minimizing any discharge of untreated effluent during the start-up period. Advanced Enviro-Septic™ protects the underlying soils from clogging--facilitating infiltration, preventing leachate from surfacing, and extending system life. The AES components are highly durable and non-biodegradable; in addition, the system is entirely passive and uses no mechanical devices. Once properly installed, there is virtually nothing in the system to break down, wear out or malfunction, significantly reducing the possibility of accidental discharge of inadequately treated effluent. Ease of maintenance prevents system malfunction associated with lack of proper system maintenance.

The effect of the proposed technology on the area of land required for operation:

The AES system requires a fraction of the land area needed for a pipe and stone system (40 to 70% less depending on state regulations). Since the system does not rely on the underlying soils to treat wastewater (like pipe and stone and chamber leaching systems do), and since the system prevents the bacterial surfaces and the underlying soil from clogging, it can be both smaller and closer to restrictive features. Bio-Accelerator™ protects the soils and groundwater from contamination by filtering out additional solids from effluent, enhancing and accelerating treatment, facilitating quick start-up after periods of non-use, providing additional surface area for bacterial growth, promoting even distribution, and further protecting outer layers and the receiving surfaces so they remain permeable. The System's ability to be installed in a sloping configuration also preserves the natural terrain. Since the System preserves the underlying soils, a "reserve area" is not required since a replacement system can be installed in the same location.

Minimum Site Requirements for an AES onsite system:

In order to be suitable for an AES onsite system, the site must have a minimum of 12 in. of unsaturated soil below the AES System and System Sand bed (either naturally occurring soil or suitable fill material). We require a minimum of 18 in. separation distance from the bottom of the AES pipes to the seasonal high water table or restrictive layer; this 18 in. includes a minimum of 6 in. of System Sand installed directly below the pipes. Since an AES System can be 40 to 70% smaller than a conventional system, and since it does not require a replacement area, AES provides a realistic solution for small or odd-shaped lots that otherwise could not accommodate an onsite system. (Note: state regulations typically dictate minimum System Sand bed sizes). Surface diversions (grading, swales) are installed upslope of the System to redirect surface water flows. The following Theoretical Overview explains the factors to be considered in designing/installing an AES System and their importance in terms of system function.

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Theoretical Overview Advanced Enviro-Septic™ (AES) System Design

PHYSICAL AND BIOLOGICAL TREATMENT PROCESSES:

<i>Design Parameter:</i>	<i>Design Requirements:</i>	<i>Comments:</i>
<p>Advanced Enviro-Septic Pipe Requirements</p> <p>(length of all rows combined, expressed in ft.)</p>	<p>AES is designed to treat wastewater that has received primary treatment in a septic tank. Based on loading rate used in NSF (BNQ) testing: 9 Liters per day per foot (≈2.4 gallons per day per foot). Commonly expressed in PEI sizing tables in terms of 70 ft. of pipe per bedroom for residential systems (which includes a factor of safety). Minimum system size is 300 GPD.</p>	<p>Treatment of wastewater is accomplished by the biomat that forms within the AES pipe's geotextile layers; the volume of design flow (in gallons per day or number of bedrooms) determines the amount of pipe needed. The AES System does not rely on the soil or System Sand for treatment processes.</p>
<p>Protected Receiving Surface and Biomat formation</p>	<p>The biomats that provide treatment in an AES System form on the inside of the geotextile fabrics that surround the pipe. The fabric is protected from physical clogging by the skimmer tabs, plastic fiber mat, aerobic conditions and bacterial activity.</p> <p>For design purposes and system functionality, no appreciable secondary biomat forms at the System Sand/soil interface due to the highly purified nature of the wastewater that exits the pipes.</p>	<p>In a pipe and stone system, a thick, slimy anaerobic biomat forms on the interface between stone and soil, gradually clogging the soil and leading to progressive failure. By retaining solids within the pipe and providing the perfect environment for aerobic bacteria, AES produces a healthy, self-regulating biomat that remains permeable, resulting in a sustainable Long Term Acceptance Rate (LTAR). Underlying soils retain their ability to absorb treated wastewater; for this reason, a replacement area is not required for AES (unless state regulations state otherwise).</p>
<p>Combined Treatment & Dispersal</p>	<p>Wastewater is treated as it is drawn gradually through the developed biomats that form within the geotextile layers of the pipe. Solids and F.O.G. are retained within the pipes, protecting receiving surfaces. The treated wastewater then moves away from the pipes at a controlled rate via the System Sand. Finally, treated wastewater gradually infiltrates into underlying receiving soils.</p>	<p>Combining treatment and dispersal in the same footprint means less impact on the site, less excavation, and less expense. The reduced size needed for an AES system, and the fact that a replacement area is not needed, makes it possible to develop land parcels that otherwise would not have sufficient suitable space to accommodate an onsite system.</p>
NON-MECHANICAL METHOD OF OPERATION		
<i>Design Parameter:</i>	<i>Design Requirements:</i>	<i>Comments:</i>
<p>Passive Processes</p>	<p>No electricity, alarms or mechanical devices are required (other than if a pump is used to gain elevation).</p> <p>In most cases, AES Systems can be constructed with gravity-fed distribution from the septic tank to the AES System by delivering effluent to a distribution box.</p>	<p>The passive processes through which AES treats wastewater make the system more affordable to construct and maintain. There are no parts to replace, no replacement media and no mechanical devices to break down or wear out. AES is ideal for remote or "off the grid" properties since it doesn't require electricity to function; this also means the system continues to work during power outages.</p>
<p>Pressure distribution is NOT used in AES Systems</p>	<p>AES is designed to provide even distribution throughout the system without the use of pressure distribution. It is completely passive, requiring no electricity or mechanical devices. Pumps are used ONLY to gain elevation.</p>	<p>The use of "pressure distribution" would actually be detrimental to the functioning of an AES system, since the velocity of the wastewater entering the system would disrupt the settling and retention of solids within the pipes. This could lead to damage to the developed biomat and clogging of the underlying soils, interfering with treatment, infiltration processes and shortening system life.</p>
<p>Maintenance Requirements</p>	<p>The only required maintenance for an AES system is periodic pumping of the attached septic tank to remove accumulated solids. Pumping frequency varies depending on size of septic tank and amount of solids in the waste stream (typically every 2-5 years).</p>	<p>Minimal required maintenance reduces the costs to the system owner. Since there is virtually nothing to "go wrong," the proper functioning of the system is not dependant on owner's compliance with maintenance requirements and/or repairs. All components are made of non-biodegradable, highly durable plastics. Rejuvenation is possible if System malfunctions due to abuse or installation errors.</p>

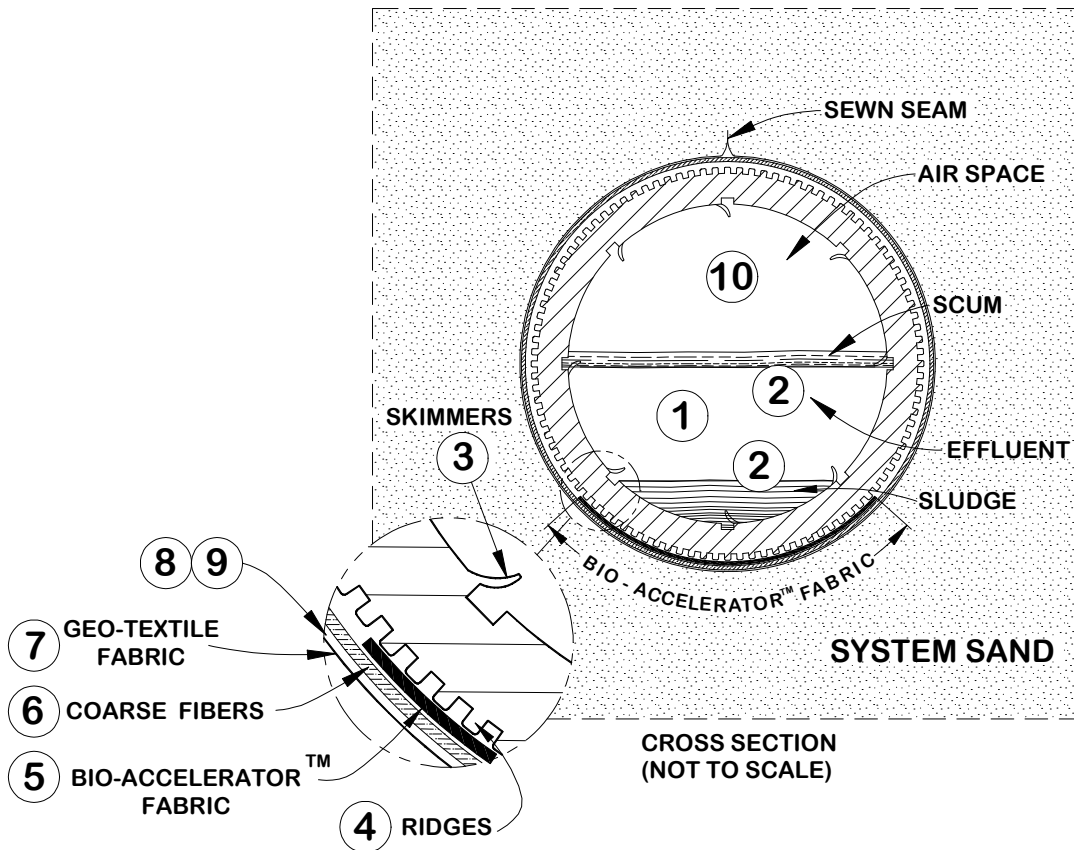
HYDRAULIC INFILTRATION AND DISPERSAL PROCESSES:

Design Parameter:	Design Requirements:	Comments:
<p>System Sand Bed Area</p> <p>(bed length x bed width expressed in sq. ft.)</p>	<p>Takes into consideration the Daily Design Flow and underlying soil's permeability (expressed as Loading Rate, Perc Rate, Soil Class, etc.) (Note: Designation of soil type varies from state to state.)</p> <p>Many states allow for a reduced bed size (40 to 70% smaller than pipe and stone) for alternative systems with specified treatment capabilities; testing has shown AES consistently exceeds the US EPA Tertiary effluent treatment standards. Latest testing results (BNQ 2008) resulted in the following effluent quality averages: CBOD5: < 2 mg/Liter TSS: < 2 mg/Liter Fecal Coliforms: 218 CFU/100 mL pH: 7.5</p>	<p>The System Sand bed has to be large enough to allow for absorption of treated wastewater into the underlying soil. The size needed varies in inverse relationship to the soil's permeability (i.e., the bed area required gets bigger as the soil gets "slower" or "tighter.") Advanced Enviro-Septic beds can be smaller than pipe & stone because they produce highly purified wastewater; underlying soils remain permeable since there is no appreciable secondary biomat formed at the System Sand/soil interface which could create a restrictive layer. The AES system can be smaller because it is not subject to progressive failure as a pipe and stone system is.</p>
<p>System Sand Bed Length</p>	<p>Minimum line lengths increase as soil permeability decreases. Minimum line lengths also increase as the depth of Infiltrative Zone decreases. (Some states impose minimum Linear Loading Rates.) (AES pipe comes in 10 ft. sections, installation is simplified by rounding row lengths up to multiples of 10 ft.)</p>	<p>Systems should ideally be designed as long and narrow as practical for the site, this provides better absorption into underlying soils.</p> <p>Minimum row length is 30 ft.; maximum row length is 100 ft. If calculations result in a bed length longer than 102 ft., the design becomes "Multiple Bed")</p>
<p>System Sand Bed Width</p>	<p>System Sand Bed Area divided by System Sand Bed Length = Minimum Bed Width</p>	<p>The width of the bed adjusts in relation to the System Sand bed area, row length, the center-to-center spacing, the number of rows of pipe, whether a System Sand extension is required, etc. Typical center-to-center spacing is 1.5 ft., providing the minimum required 6 in. of System Sand between each row of pipe.</p>
<p>System Elevation (vertical placement relative to restrictive feature)</p>	<p>Bottom of the AES Pipes must have a separation distance of 18 in. or more from SHWT or other restrictive feature (ledge, bedrock, impermeable soil layers, etc.)</p> <p>Minimum 6 in. System Sand beneath pipes + 12 in. = 18 in.)</p> <p>Site must have minimum of 12 in. unsaturated soil (or suitable fill material) to be suitable for an AES system.</p> <p>Note: vertical separation distance is required for hydraulic purposes only, not for treatment.</p>	<p>Providing sufficient "unsaturated" zone beneath the System gives the treated wastewater somewhere to go. It also prevents the system from being flooded by ground water. AES does not rely on the soil to purify wastewater; therefore, separation distance to restrictive features required is based solely on hydraulic conductivity of soils.</p> <p>If there is not sufficient distance from original grade to restrictive feature, the system will be constructed as a mound, and permeable fill material (typically defined by state regulations) will be added to create sufficient separation distance. In mound systems, side-slope tapering is required to protect the System from surface water flows and erosion.</p>
<p>Sloping Sites and Sloping Beds</p>	<p>Site slope maximum 33% System slope maximum 25%</p> <p>Sloped bed configurations</p>	<p>Sloping sites tend to have well-drained, less compacted soils that are better able to absorb treated wastewater. Sloping sites are also less subject to surface water concentrations.</p> <p>Sloping systems are subject to gravitational forces that facilitate the movement of water away from the AES system and into the underlying soil; sloped sites/beds are not subject to toe-of-slope breakout due to the gradual, controlled method in which AES releases treated effluent.</p> <p>It is also preferable to blend a "mound" system into sloping terrain (requires less fill and is more aesthetically pleasing).</p>

OXYGENATION AND GAS EXCHANGE:		
Design Parameter:	Design Requirements:	Comments:
System Sand (ASTM C-33 with less than 2% fines)	<p>It is critical to use correct type and amount of "System Sand." System Sand is coarse to very coarse sand with less than 2% fines (passing the #200 sieve). Manufactured sand that meets these specs. is also acceptable for System Sand.</p> <p>Fines content can be confirmed by having a wet sieve analysis performed or requiring the supplier to provide a bill of lading that confirms acceptable System Sand specifications (required by some states and highly recommended by PEI).</p> <p>System Sand is placed 6 in. below and 6 in. above pipes (total depth of 24 in.) There is always a minimum of 6 in. of System Sand between pipes and 6 – 12 in. beyond the outermost edges of the pipe.</p>	<p>The System Sand in which the AES pipes are installed provides several important functions: it allows essential oxygen to reach the system and allows gases to be released; think of it as the "lungs" of the system. It also wicks treated wastewater away from the system by capillary action. System Sand also provides storage capacity for treated wastewater allowing it to be released gradually into underlying soils.</p> <p>We specify a maximum of 2% fines content because, if the sand used contains too much fine material, the fines may settle and create a restrictive layer beneath the System.</p>
Venting required for all AES Systems	<p>A low vent (intake) is installed at the end of a row or section. In most cases, the house plumbing vent serves as the high vent (exhaust). Pumped systems incorporate a high vent from the distribution box.</p> <p>Oxygen enters the AES System through the low vent, travels through the rows of the system in the head space above the wastewater in the AES pipes and in the septic tank, and gases exhaust through the high vent.</p>	<p>A sufficient supply of oxygen is essential to maintain the aerobic bacteria and healthy, permeable biomats that have a sustainable LTAR. Providing the system with sufficient oxygen enhances both its performance and longevity.</p> <p>The visual impact of vent stacks can be minimized by Remote Venting or Vent Disguises.</p>
Effluent Filters & Charcoal Odor Filters not recommended by PEI	<p>Effluent Filters require regular, on-going maintenance by the system owner to prevent blockage. If the effluent filter is not properly maintained and it becomes clogged, this restricts the oxygen supply to the system and can compromise its function.</p> <p>Charcoal filters, which are sometimes installed on vent stacks, likewise, can restrict essential oxygen, for instance, if condensation freezes in the filter.</p>	<p>While many states require the use of effluent filters to retain solids within the septic tank. While superficially this sounds like a good idea, our experiences in the field over the past 15 years have demonstrated that the reality is that system owners do not tend to comply with required maintenance, the effluent filter becomes clogged, and it then causes more problems than it prevents.</p> <p>Charcoal odor filters merely "mask" an underlying problem that needs to be addressed, and the sooner the better. A properly functioning and vented AES system does not produce offensive odors.</p>
EXCEPTIONAL PRODUCT SUPPORT & CUSTOMER SERVICE:		
Training Provided	<p>PEI provides state-specific training for designers, installers, inspectors, homeowners and regulators free of charge. In order to become a PEI Certified Designer, Installer or System Evaluator, candidates are required to pass a test to confirm adequate understanding of core design and installation requirements.</p>	<p>AES works differently than other products; product-specific training enables industry professionals and system owners to use AES to its full advantage. Classes are available online or via DVD for added convenience.</p>
Technical Assistance	<p>Our experienced Technical Staff is available to answer questions by telephone or email. Troubleshooting, plan review for new designers or unique projects, and referrals to industry professionals are also available.</p>	<p>PEI is committed to providing exceptional product and customer support in order to assure that our products are used to their fullest advantage.</p>
Manuals & Other Design Tools	<p>PEI provides state-specific design & installation manuals, design templates, owner's operation and maintenance manual, ACAD design library, technical bulletins, newsletters, and checklists for design, installation and inspection. Coming soon – AES Design Software!</p>	<p>Manuals and other technical info. can be downloaded from our website, or call Customer Service @ (800) 473-5298 to request they be sent by mail.</p>

ADVANCED ENVIRO-SEPTIC™ WASTEWATER TREATMENT SYSTEM

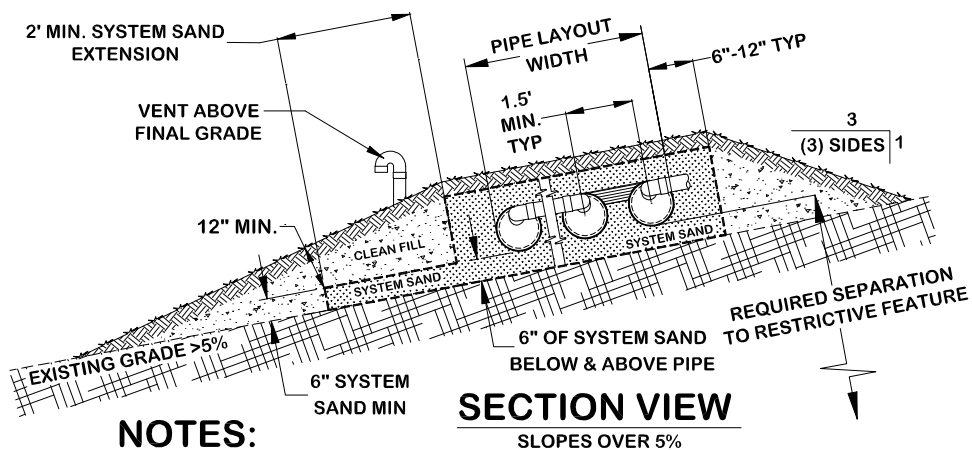
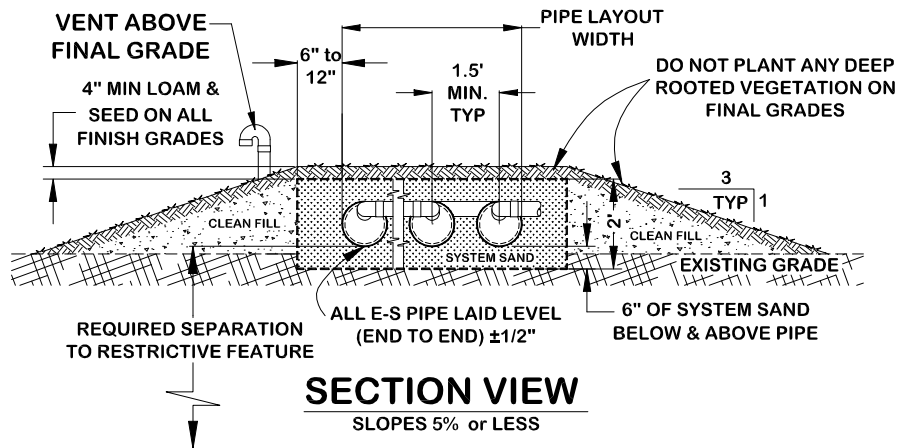
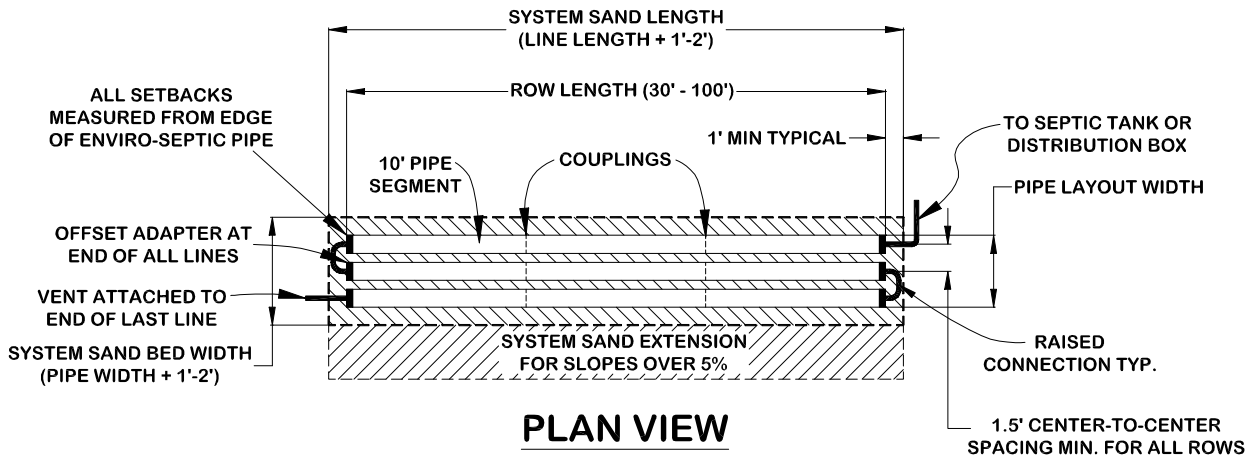
TEN STEPS OF WASTEWATER TREATMENT: ADVANCED ENVIRO-SEPTIC™ TREATS EFFLUENT MORE EFFICIENTLY TO PROVIDE LONGER SYSTEM LIFE AND TO PROTECT THE ENVIRONMENT.



- STAGE 1: WARM EFFLUENT ENTERS THE PIPE AND IS COOLED TO GROUND TEMPERATURE.
- STAGE 2: SUSPENDED SOLIDS SEPARATE FROM THE COOLED LIQUID EFFLUENT.
- STAGE 3: SKIMMERS FURTHER CAPTURE GREASE AND SUSPENDED SOLIDS FROM THE EXITING EFFLUENT.
- STAGE 4: PIPE RIDGES ALLOW THE EFFLUENT TO FLOW UNINTERRUPTED AROUND THE CIRCUMFERENCE OF THE PIPE AND AID IN COOLING.
- STAGE 5: BIO-ACCELERATOR™ FABRIC SCREENS ADDITIONAL SOLIDS FROM THE EFFLUENT AND DEVELOPS A BIOMAT WHICH PROVIDES TREATMENT AND ENSURES ACCELERATED BIOMAT DEVELOPMENT.
- STAGE 6: A MAT OF COARSE RANDOM FIBERS SEPARATES MORE SUSPENDED SOLIDS FROM THE EFFLUENT.
- STAGE 7: EFFLUENT PASSES INTO THE GEO-TEXTILE FABRICS AND GROWS A PROTECTED BACTERIAL SURFACE.
- STAGE 8: SAND WICKS LIQUID FROM THE GEO-TEXTILE FABRICS AND ENABLES AIR TO TRANSFER TO THE BACTERIAL SURFACE.
- STAGE 9: THE FABRICS AND FIBERS PROVIDE A LARGE BACTERIAL SURFACE TO BREAK DOWN SOLIDS.
- STAGE 10: AN AMPLE AIR SUPPLY AND FLUCTUATING LIQUID LEVELS INCREASE BACTERIAL EFFICIENCY.

Advanced Enviro-Septic™ System Diagram:

ENVIRO-SEPTIC® SYSTEM DIAGRAM



NOTES:

- ALL ROWS 1.5' SPACING MINIMUM.
- ROWS CENTERED IN SYSTEM SAND IF SLOPE IS 5% OR LESS.
- ROWS GROUPED TO UPSLOPE SIDE OF SYSTEM SAND IF SLOPE > 5%.
- VENTING REQUIRED FOR ALL CONFIGURATIONS.
- DIFFERENTIAL VENTING REQUIRED FOR ALL PUMP SYSTEMS.