Advanced Enviro-Septic™ (AES) Achievement Summary

Introduction: Advanced Enviro-Septic® (AES) and its predecessor product, Enviro-Septic® (ES), have been subjected to numerous testing protocols since being introduced to the onsite septic industry in 1995. Through third-party testing, AES's treatment processes, efficient dispersal, and reliable, maintenance-free operation have been quantified and proven. With the number of systems installed world-wide approaching 250,000, the effectiveness of AES and ES systems has been confirmed in the field. Our systems demonstrate a minimal failure rate and exceptional system life, while using no energy and needing no special maintenance or replacement parts.

Patented Technology: AES and ES are proprietary products invented by David W. Presby and manufactured exclusively by Presby Environmental, Inc. (PEI) of Whitefield, New Hampshire. The technology has been the subject of numerous US and International patents, with other patents pending. PEI is committed to ongoing product development in order to maximize the performance of our systems, focusing on methods that are cost-effective for the consumer and do not require electricity, replacement parts or special maintenance in order to provide exceptional environmental protection. All components are non-biodegradable and are made using recycled plastic to the fullest extent possible while retaining durability and H10/H20 load bearing capacity. Our manufacturing facility is audited regularly by NSF International ("NSF") and Bureau de Normalization du Quebec ("BNQ") to assure product quality and consistency.

Summary of the Official Certificates

Organisation	Standards	Reference Number	Effective date	Last update
SAI Global	QPW:2012 Queensland Plumbing and Wastewater Code – Part 1 – On-site wastewater management systems	ABN: 74 148 175 455 Licence No. SMK40495	August 2, 2015	-
Bureau de Normalisation du Québec *(« Quebec Standard Office »)*	NQ 3680-910 / 2000	Certificate No. 890, Class II –secondary treatment Class III – advanced secondary treatment.	January 26th, 2007 October 6th, 2008	January 24th, 2013 January 24th, 2013
Ministère Développement durable, Environnement, Lutte aux changements climatiques	Approval procedure for the performance of new domestic wastewater treatment technologies	TA-7 data sheet – standard level, Commercial, Institutional and Community projects	July, 2004	March, 2010
Building Material Evaluation Commission (Ontario)	BMEC Approval	08-03-340	September 25th, 2008	September 25th, 2013
NSF International	NSF-40	Advanced Enviro-Septic® Treatment System, Class I	October, 2009	-
CEBEDEAU (Belgium)	EN 12566-3	National approval number 5 PE 2011 / 12 / 101 / B National approval number 6 – 20 PE, 2011 / 12 / 102 / A	April 7th, 2010	December 6th, 2011

CSTB (France)	EN 12566-3	National approval number 6 PE, 2011-014 bis National approval number 5 à 20 PE, 2012-011 mid 02	September 13th, 2011	December 27th, 2013

Wastewater Treatment, Third-Party Test Results:

AES Technology has consistently produced treated wastewater that exceeds EPA's Secondary Treatment levels (CBOD5 and TSS less than 30 mg/L.) and Tertiary Treatment levels (CBOD5 and TSS reduced to less than 10 mg/L.) AES achieves removal of contaminants comparable to Aerated Treatment Units and mechanical devices, while also providing infiltration and dispersal in the same footprint. Full reports are available documenting the results of the studies summarized below.

SAI Global certification was given to AES based on a real-life onsite wastewater trial monitored by the National Association of Testing Authorities, Australia. SAI Global is an international company which provides product certification services; SAI Global is part of JAS-NZ – The Joint Accreditation System of Australia and New Zealand. Their StandardsMart™ represents reliability, quality assurance and safety.

NSF International is an independent, non-profit organization recognized throughout the world as a leader in standards development and product certification. Their mission is to protect and improve human health on a global scale by certifying food, water and consumer products. To learn more about NSF standards and their certification programs, visit www.nsf.org. NSF is accredited by the American National Standards Institute (ANSI).

ANSI/NSF Standard 40 sets performance standards for onsite wastewater treatment devices for residential systems with hydraulic capacities from 400 to 1500 gallons per day. In order to receive Standard 40 Class I certification, systems are tested for a minimum of six months following NSF's protocol and must achieve exceptional effluent quality.

BNQ ANNEX A RESULTS SUMMARY Testing of Full Sized AES System per ANSI/NSF Standard 40 and BNQ NQ 3680-910 30th October 2005 – 26th April 2006 (Resulted in NSF 40 Class I Certification & BNQ Class II Certification) Loading Rate 2.4 gallons/day/foot of pipe + Stress Testing				
Parameter Measured	**Average**	**Range**	**BNQ Class II Standard**	**NSF-40 Class I Standard**
pH	7.2	7.0 to 7.5	n/a	6.0 to 9.0
CBOD5	8 mg/L	<2 to 22 mg/L	<25 mg/L	<25 mg/L
TSS	4 mg/L	<2 to 15 mg/L	<30 mg/L	<30 mg/L
Color	None	<1 color unit	n/a	None
Odor	None	"Non-offensive"	n/a	Non-Offensive
Oily Film/Foam	None	Not visually detected	n/a	Not visually detected
Noise	None*	None*	n/a	< 60 dbA
BNQ ANNEX B "Performance & Reliability" RESULTS SUMMARY 30th April 2006 – 11th November 2006				
Parameter Measured	**Average**	**Range**	**BNQ Class II Standard**	**NSF-40 Class I Standard**
pH	7.3	7.1 to 7.5	n/a	6.0 to 9.0
CBOD5	3 mg/L	<2 to 5 mg/L	<25 mg/L	<25 mg/L
TSS	4 mg/L	<2 to 7 mg/L	<30 mg/L	<30 mg/L

AES was tested at the **Bureau de Normalisation du Québec ("BNQ")** and received simultaneous NSF-40 and BNQ Class II certification. BNQ is accredited by the Standards Counsel of Canada. BNQ Certification requires an additional six months of testing to confirm system performance and reliability in all weather conditions. AES is one of only 4 products in its field that have been BNQ Certified, achieving both Secondary (Class II) and Advanced Secondary (Class III) certifications.

BNQ ANNEX A RESULTS SUMMARY 23rd September 2007 – 15th March 2008 (Resulted in BNQ Class III and Class V Certifications) Loading Rate 2.4 gallons/day/foot of pipe + Stress Testing				
Parameter Measured	**Average**	**Range**	**BNQ Class III Standard**	**NSF-40 Class I Standard**
pH	7.6	7.0 to 8.2	n/a	6.0 to 9.0
CBOD5	2 mg/L	<2 to 5 mg/L	<15 mg/L	<25 mg/L
TSS	2 mg/L	<2 to 5 mg/L	<15 mg/L	<30 mg/L
Fecal Coliforms	2,900 CFU/100 mL	7 to 90,000 CFU/100 mL	<50,000 CFU/100 mL	n/a
Color	None	<1 color unit	n/a	None
Odor	None	"Non-offensive"	n/a	Non-Offensive
Oily Film/Foam	None	Not visually detected	n/a	Not visually detected
BNQ ANNEX B "Performance & Reliability" RESULTS SUMMARY 6th April 2008 – 4th October 2008				
Parameter Measured	**Average**	**Range**	**BNQ Class III Standard**	**NSF-40 Class I Standard**
pH	7.5	7.1 to 8.0	n/a	6.0 to 9.0
CBOD5	<2 mg/L	<2 mg/L continuously	<15 mg/L	<25 mg/L
TSS	<2 mg/L	<2 to 4 mg/L	<15 mg/L	<30 mg/L

The **Cebedeau** Bench Test conducted in Belgium utilized a European test protocol and reflected water use conditions more typical in European households. While the majority of PEI's testing and field data is conducted at a higher loading rate, the organic load in this Cebedeau test was higher, since the wastewater supplied for this testing contained high levels of BOD and TSS (over 300 mg/L. of each).

CEBEDEAU BENCH TEST (per European Standard EN12566-3 Appendix B) Lieze, Belgium 2009-2010 (11 months) RESULTS SUMMARY Full Size AES System, Loading Rate (constant) 1.97 gallons/day/ft. of pipe				
Parameter Measured	**Average Effluent Quality Produced**	**Range**	**BNQ Class III Standard**	**NSF-40 Class I**
pH	7.4	6.9 to 7.8	n/a	6.0 to 9.0
COD	62.2 mg/L	32 to122	n/a	6.0 to 9.0
BOD5	10.1 mg/L	<3 to 29 mg/L	<15 mg/L	<25 mg/L
TSS	12.2 mg/L	2 to 25 mg/L	<15 mg/L	<30 mg/L
Total Nitrogen	55.4 mg/L	27.5 to 123.5 mg/L	n/a	n/a
Kjeldahl Nitrogen	11.7 mg/L	2.2 to 40.2 mg/L	n/a	n/a
Ammonia Nitrogen	9.4 mg/L	1.1 to 35.7 mg/L	n/a	n/a
Nitrates	34.1 mg/L	16.1 to 54.4 mg/L	n/a	n/a
Nitrites	.61 mg/L	0 to 1.60 mg/L	n/a	n/a
Total Phosphorus	4.3 mg/L	1.86 to 5.9 mg/L	n/a	n/a

Testing at **MASSTC** described below was conducted using a protocol in development in connection with the researcher's work on a "gravelless" system certification standard for NSF. AES test cells obtained exceptional results using half as much sand (6 in.) below the pipes compared to BNQ testing.

Massachusetts Alternative Septic System Test Center (MASSTC), 2009-2011 AES RAW DATA SUMMARY (Data obtained using 6 in. System Sand below AES pipes in test cell configuration)			
Parameter Measured	**Effluent Quality (Geometric Means)**	**BNQ Class III Standard**	**NSF-40 Class I Standard**
BOD5	3.84 mg/L	<15 mg/L	<25 mg/L
TSS	4.75 mg/L	<15 mg/L	<30 mg/L

Field Testing & Performance:

Long-term Performance in NH: ES and AES have been used extensively in New Hampshire since 1995, and NH's approximately 80,000 installations account for nearly one-third of all ES/AES systems in use. William Evans, P.E., former administrator of the NH Subsurface Bureau and the first regulator to approve ES for use, was asked to comment on his experiences with the technology. He noted that AES and ES are used in 9 out of 10 onsite system plans that are submitted for approval, and that these systems have demonstrated both an extremely low failure **- 4 - r**ate and exceptional longevity. Mr. Evans' full report is available upon request or from our website; his conclusions are summarized below:

> *As former administrator of the Subsurface Systems Bureau of the New Hampshire Department of Environmental Services (NH DES), I was directly involved in the approval process, permitting, plan review and inspection of Enviro-Septic systems from 1995 through 2009 … During this time period, there were approximately 80,000 Enviro-Septic systems installed in New Hampshire; in fact, about 9 out of 10 plans for onsite wastewater treatment systems that come to the NH Subsurface Systems Bureau for approval today are for Enviro-Septic system designs. It has been my experience that when properly installed, Enviro-Septic systems have an extremely low failure rate (less than 1%) and, even after as much as 14 years in service, these systems are continuing to work as expected with only minimal required maintenance. These systems have consistently performed with a very high degree of reliability and have demonstrated superior durability and longevity.*
> *Based on the results of third-party testing (Stokes, Canada and BNQ/NSF), NH DES determined that the treatment capabilities of the Enviro-Septic system were so far superior to other alternatives that the Enviro-Septic system was approved for use with a smaller required separation distance from restrictive features than what has been granted for any other product approved for use in New Hampshire.*
> *… In my opinion, Enviro-Septic's superficial resemblance to leaching system products which only provide dispersal of septic tank effluent and rely on the soil to provide treatment has been misleading to some regulators, industry professionals and consumers. Enviro-Septic has been proven to provide exceptional treatment (consistently meeting US EPA Tertiary standards or better) while also providing efficient dispersal via non-mechanical processes. The fact that the system is releasing clean water from the pipes means that the system is not subject to progressive failure; the underlying soils are preserved, maintaining their ability to accept treated wastewater. This eliminates the need for a replacement area with the AES system, extends system longevity, and reduces any possibility of discharge or surfacing of inadequately treated wastewater….In conclusion, I feel Enviro-Septic® technology is an effective and practical innovation in the field of onsite wastewater treatment technology….As a former regulator, I can attest to the fact that the availability of a smaller, less expensive, longer-lasting onsite wastewater treatment system has encouraged the replacement of failed or failing systems that jeopardize the soils, surface waters and ground waters in their vicinity.*
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> - W.M. Evans Engineering, June 1, 2010

BNQ Monitoring of Systems in Operation: As a condition of maintaining the BNQ Class II and III certifications, a percentage of all Canadian installations are subject to annual sampling and inspection. These AES systems in operation consistently demonstrate superior treatment results and minimal malfunctions of any kind; all AES systems being monitored in the field have achieved the required effluent quality to confirm secondary (Class II) and advanced secondary (Class III) treatment results.

BNQ 2009-2013 FIELD AUDITS RESULTS SUMMARY CLASS II SECONDARY LEVEL OF TREATMENT					
Parameter Measured	**Average Effluent**	**Data Range**	**BNQ Class II Standard**	**NSF-40 Class I Standard**	**EPA Tertiary Standard**
CBOD (mg/L)	< 7	< 2 to 21	< 25	< 25	10
TSS (mg/L)	< 9	1 to 20	< 30	< 30	10
Fecal Coliforms (CFU/100 mL)	n/a	n/a	n/a	n/a	1,000
BNQ 2009-2013 FIELD AUDITS RESULTS SUMMARY CLASS III ADVANCED SECONDARY LEVEL OF TREATMENT					
Parameter Measured	**Average Effluent**	**Data Range**	**BNQ Class III Standard**	**NSF-40 Class I Standard**	**EPA Tertiary Standard**
CBOD (mg/L)	< 5	< 2 to 22	<15	<25	10
TSS (mg/L)	< 7	< 1 to 28	<15	<30	10
Fecal Coliforms (CFU/100 mL)	< 2,772	< 2 to 29,000	50,000	n/a	1,000

Ohio Experimental Concurrence Program: The State of Ohio has conducted an Experimental Concurrence program with Enviro-Septic® technology since 2008. In connection with the program's sampling and monitoring requirements, ES systems were inspected at least monthly during their first winter (November to April) of operation, which constitutes their "wet" season. Jason Menchhofer, R.S. of the Van Wert County Department of Health compiled his collected data and shared his observations in an article entitled "*Van Wert County's Enviro-Septic Experimental Program—The First Two Years*." Notably, Mr. Menchhofer observed no hydraulic loading concerns or surfacing, and lab analysis of collected samples from residential systems in use confirmed that ES effluent is "*very clean*" when released into surrounding soils. He also noted that contractors "*appreciate the system's simplicity and ease of installation and maintenance*

Van Wert County, Ohio Experimental Concurrence RESULTS SUMMARY					
Parameter Measured	**Average**	**Range**	**BNQ Class II Standard**	**BNQ Class III Standard**	**NSF-40 Class I Standard**
E. Coli (CFU/100 mL)	379	< 10 to 8700	n/a	n/a	n/a
Fecal Coliforms (CFU/100 mL)	2056.71	< 10 to > 20000	n/a	< 50,000 CFU/100 mL	n/a
BOD5 (mg/L)	9.36	< 2 to 48	< 25 mg/L	< 15 mg/L	< 25 mg/L
Total Suspended Solids (mg/L)	17.40	0.051 to 214	< 30 mg/L	< 15 mg/L	< 30 mg/L
Ammonia (mg/L)	0.22	< 0.05 to 0.94	n/a	n/a	n/a
Nitrate+Nitrite (mg/L)	12.27	0.1 to 24	n/a	n/a	n/a
Total Phosphorous (mg/L)	0.28	0.01 to 1.09	n/a	n/a	n/a

Blodgett Landing Treatment Plant, Newbury, NH: Located in southwestern NH, this facility was designed to deal with four problems plaguing the former plant: 1) freezing during winter operation; 2) cold weather affecting treatment levels; 3) increased de-nitrification requirements; and 4) handling the increased population of the community. The Treatment Plant is a Multi-LevelTM Enviro-Septic® configuration with recirculation for de-nitrification. This system is designed to handle an average daily flow of 50,000 GPD and fluctuations ranging from 2,500-88,000 GPD. There are four ES beds, each measuring 90 ft. long by 50 ft. wide, and consisting for 48 rows of ES pipe that are each 86 ft. long, making a total of 16,400 ft. of ES (approximately 3 gallons per linear foot per day). The wastewater goes through an initial screening process, and then proceeds to one of two Imhoff tanks where sedimentation and separation occurs. After the Imhoff tank, the effluent then proceeds to an equalization tank where it is dispersed into 1 of 4 treatment beds. The treatment beds are lined to capture the treated effluent. Once captured, the treated effluent is then pumped into a recycling tank. 50% of the treated effluent is then sent back through the Imhoff tanks via recirculation pumps for de-nitrification and the rest is dosed into the dispersal area.

BLODGETT LANDING TREATMENT PLANT 15th May 2013 – 11th August 2014 LABORATORY RESULTS SUMMARY						
Parameter Measured	**Average**	**Range**	**BNQ Class II Standard**	**BNQ Class III Standard**	**NSF-40 Class I Standard**	**EPA Tertiary Standard**
TSS (mg/L)	5.04	95%	< 30	< 15	< 30	10
Nitrite – N (mg/L)	0.5	3.57%	n/a	n/a	n/a	n/a
Nitrate – N (mg/L)	6.4	n/a	n/a	n/a	n/a	Nitrate – N (mg/L)
Ammonia – N (mg/L)	0.43	97%	n/a	n/a	n/a	n/a
TKN (mg/L)	0.89	96%	n/a	n/a	n/a	n/a
Total Nitrogen (mg/L)	7.14	69%	n/a	n/a	n/a	n/a
Total Phosphorus (mg/L)	1.55	49%	n/a	n/a	n/a	n/a
BOD (mg/L)	6.0	93%	< 25	< 15	< 25	10
pH (SU)	7.49	9.44%	n/a	n/a	6.0 to 9.0	n/a
Total Coliforms (MPN/100 mL)	14,739	100%	n/a	n/a	n/a	n/a
Fecal Coliforms (MPN/100 mL)	3,632	99.98%	n/a	50,000	n/a	1,000

Bidners Road, Australia: The system was installed on the 3rd week of July 2014 to service a 3 bedroom/600 litre/day house. Regular testing began 8 weeks after installation by NATA Certified Analytical Facility - Unity Water, using a regulated testing periond (every 6 days for 26 weeks) as set down by the Queensland Plumbing Code. (QPC). Unity Water can be contacted to verify the accuracy of these results. To provide for a more easily understood graph, where no influent sample was taken the result for the previous week was included. This is shown in the full spreadsheet. The system was intentionally undersized; 2000 litre septic tank, no outlet filter and AES pipes spaced at only 150mm centres. An overload of bleach around the 6th or 7th Oct 2014 lead to an increase of TSS and BOD over the following two weeks. Results showed this took 23 days fully recover although effluent results stayed low.

BIDNERS ROAD, AUSTRALIA 23rd September 2014 – 24th March 2015 LABORATORY RESULTS SUMMARY						
Parameter Measured	**Average**	**Range**	**AS/NZS1546.3:2008**	**OSET-NTP (A)**	**OSET-NTP (B)**	**OSET-NTP (C)**
TSS (mg/L)	9.58	2 - 43	< 30	< 10	< 20	<30
BOD (mg/L)	13.57	3 - 31	< 20	< 10	< 20	<30
Total Nitrogen (mg/L)	75	56 - 103	n/a	<15	<25	<30

Hydrology, Groundwater Mounding & Load Bearing Analyses:
Groundwater Mounding Analysis: Cabral & Parent were retained by PEI to evaluate system bed sizing further utilizing SEEP/W 2007 software. The study evaluated groundwater mounding in a variety of soil conditions and for a variety of system dimensions, and examined the required depth of System Sand below the AES pipes to prevent groundwater mounding. Even employing a "worst case scenario" of continuous, full design loading, the study confirmed that PEI's design recommendations regarding System Sand depth and bed sizing and dimensions incorporate a factor of safety, preventing groundwater mounding below the system.

Load Bearing Analysis: Gregsak Engineering, Inc. was retained by PEI to evaluate the pipe's load bearing capabilities. This is important since in some jurisdictions AES systems are approved for installations under traffic bearing surfaces such as parking lots and driveways. Gregsak's analysis, based on American Association of State Highway Transportation Officials (AASHTO) Guidelines, confirmed the pipe's structural capability to withstand H10 and H20 loading in a subsurface application when installed with the minimum depth of cover material above the pipes recommended by PEI. (Refer to Gregsak Report and PEI's H10/H20 Loading Guidelines.)

AES featured in WERF Review of Advanced Technologies: In June, 2012, the Water Environment Research Foundation (WERF) published research conducted by Colorado State University (Lauwo, et. al.), *A Review of Advanced Sewer System Designs and Technologies*. This research paper presented a thorough overview of various types of septic systems, offering a list of advantages and disadvantages for each product. Note, however, that the document listed **no disadvantages** for Advanced Enviro-Septic® System technology. The researchers concluded that AES technology facilitates a "*naturally balanced, secondary treatment that utilizes both aerobic and anaerobic bacteria….it more effectively reduces CBOD5, fecal coliforms and TSS when compared with conventional drainfield technology and recharges groundwater with better quality effluent….All of these advantages contribute to a cost-effective system*."

References (Available on request from Environment Technology):

State Design & Installation Manuals
AES/ES Approval Letters
Owner's Operation & Maintenance Guide
PEI's H10/H20 Loading Guidelines
Jason Menchhoffer, R.S., Van Wert County Health Department *Van Wert County's Enviro-Septic Experimental Program—The First Two Years,* Ohio Journal of Environmental Health, 2nd Quarter, 2010. Also see Menchhoffer's slideshow presentation: http://www.slideshare.net/jmenchhofer/richland-co-installer-mtg-12-1010
William Evans, PE, (former New Hampshire Subsurface Bureau administrator) Opinion Letter dated 06/01/10

Test Data, Reports and Studies Cited (Available Upon Request from PEI):

NSF Report – Also available directly from NSF (www.nsf.org) or (steiner@nsf.org) NSF Manuals Excerpt
BNQ Reports Cebedeau Bench Test Report MASSTC Raw Data Report Research Paper, "*Treatment of Septic Tank Effluent: Comparison of Enviro-Septic and Conventional Pipe and Stone Leaching Systems*" March 1, 2004 Gillespie Hydrology Study Cabral & Parent Groundwater Mounding Study Gregsak Engineering Opinion Letter re: H10/H20 Loading
SAI Global Certification

AES/ES Technology Patents (others pending):
Coupling, US Pat. No. 6,899,359, Canadian Pat. No. 2,359,255
End Cap, US Pat. No. 6,792,977, Canadian Pat. No. 2,365,453
ES Pipe, US Pat. No. 6,461,078, Canadian Pat. No. 2,300,535
AES Pipe, Pat. App. No. 60/683,994
Multi-Layer Fabric, US Pat. No. 5,954,451, Canadian Pat. No. 2,185,087
Multi-Level Leaching System, US Pat. No. 6,290,429, Canadian Pat. No. 2,286,995
Pipe Making Method, US Pat. 5,606,786, Canadian Pat. No. 2,187,126
Segmented Trench Apparatus, Pat. App. No. 61/547,321
Skimmer Tab Former, US Pat. No. 7,270,532, Canadian Pat. No. 2,415,194

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