



DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

10 JULY 2008

FROM: HQ AFCESA/CEOA
139 Barnes Drive, Suite 1
Tyndall AFB FL 32403-5319

SUBJECT: **Engineering Technical Letter (ETL) 08-10: Alternative Water Sources
– Use of Non-Potable Water**

1. Purpose. This ETL provides technical requirements for using alternative water sources to supply non-potable water where it is appropriate for use in Air Force facilities and on Air Force property. This ETL does not apply to the use of alternative water sources for use as potable water. This ETL does not apply to the use of non-potable water used for fire protection or non-potable surface water used for cooling, industrial processes, or irrigation, with the exception of metering and monitoring requirements applicable to non-potable surface water. This ETL does not apply to privatized water systems unless cited in the privatization contract documents.

This ETL supersedes ETL 02-17, *Use of Non-Potable Water to Replace Potable Water*.

2. Summary of Revisions: This ETL is substantially revised and must be completely reviewed.

3. Application: All Air Force facilities (continental United States [CONUS] and overseas), regardless of fund source.

3.1. Authority: Air Force instruction (AFI) 32-1067, *Water Systems*.

3.2. Effective Date: Immediately.

3.3. Intended Users:

- Installation civil engineer (CE) personnel
- Water managers
- Energy managers
- Utility superintendents
- Project managers (PM)
- Design consultants
- Design agents
- Bioenvironmental engineers

3.4. Coordination:

- Office of the Air Force Civil Engineer, Asset Management and Operations Division (AF/A7CAQ)

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- MAJCOM/A7 points of contact (POC) for potable water issues
- Air Force Center for Environmental Excellence, Technical Division (HQ AFCEE/TDNQ)
- Air Force Medical Operations Agency, Bioenvironmental Engineering Division (AFMOA/SG3PB)
- U.S. Air Force School of Aerospace Medicine, Risk Analysis Branch (USAFSAM/OEHA)

4. References:

4.1. Federal:

- Safe Drinking Water Act, Public Law (P.L.) 93-523 (including amendments), available at <http://www.epa.gov/ogwdw/sdwa/index.html>
- Clean Water Act (Water Pollution Control Act), P.L. 845 (including amendments), available at <http://www.epa.gov/watertrain/cwa/>
- Executive Order (E.O.) 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*, 26 January 2007, available at <http://www.archives.gov/federal-register/executive-orders/2007.html>
- Environmental Protection Agency EPA/625/R-04/106, *Guidelines for Water Reuse*, September 2004, available at <http://www.epa.gov/nrmrl/pubs/625r04108/625r04108.pdf>

4.2. Air Force:

- AFI 32-1066, *Backflow Prevention Program*, available at <http://www.e-publishing.af.mil/>
- AFI 32-1067, *Water Systems*, available at <http://www.e-publishing.af.mil/>
- AFI 32-7041, *Water Quality Compliance*, available at <http://www.e-publishing.af.mil/>
- Technical Order (T.O.) 1-1-691, *Aircraft Weapons Systems - Cleaning and Corrosion Control*, available at <https://www.toindex-s.wpafb.af.mil/>

4.3. Department of Defense (DOD):

- Unified Facilities Criteria (UFC) 3-420-01, *Plumbing Systems*, available at http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4
- Unified Facilities Guide Specification (UFGS) 33 12 33.00 30, *Water Meters*, available at http://www.wbdg.org/ccb/browse_org.php?o=70

4.4. Trade Organizations:

- Uniform Plumbing Code (UPC), published by the International Association of Plumbing and Mechanical Officials, 2001 Walnut Drive South, Walnut, CA 91789-2825, <http://www.iapmo.org/>
- International Plumbing Code (IPC), published by International Code Council, 5203 Leesburg Pike Suite 708, Falls Church, VA, 22041-3401, <http://www.iccsafe.org/>

- *Dual Water Systems*, Manual of Water Supply Practices (M24), American Water Works Association (AWWA), 6666 West Quincy Ave., Denver, CO 80235, <http://www.awwa.org/> (Revised manual expected in 2009; currently out of print)

5. Acronyms:

AFI	- Air Force instruction
AWWA	- American Water Works Association
BE	- bioenvironmental engineering
CDC	- child development center
CE	- civil engineer
E.O.	- Executive Order
ETL	- Engineering Technical Letter
IPC	- International Plumbing Code
MFH	- military family housing
P.L.	- Public Law
POC	- point of contact
ppm	- part per million
TLF	- temporary lodging facility
T.O.	- Technical Order
UFC	- Unified Facilities Criteria
UPC	- Uniform Plumbing Code

6. Policy.

6.1. General Policy. The Air Force encourages and allows the use of alternative water sources as a water conservation best management practice (BMP) and will:

- Ensure dual water systems (i.e., potable and non-potable) are clearly distinguishable from each other with proper labels and colors;
- Ensure alternative water sources comply with the most stringent of applicable federal, state and local regulations;
- Maintain accurate records on the procurement, production, and use of water from alternative sources;
- Consider the use of alternative water sources early in the design of new and upgrade facility projects;
- Use alternative water sources in an effective and efficient manner consistent with water conservation principles;
- Through the application of customary safeguards on all non-potable water systems on the installation, ensure the workforce and general population are protected from mistaken or unknowing access or exposure to non-potable water.

6.2. Background. E.O. 13423 directs federal agencies to reduce potable water use intensity by 2 percent per year over the next eight years (2008 to 2015) compared to a 2007 baseline. The Air Force has already reduced its potable water use intensity

by 25 percent in the six years preceding the 2007 baseline. The replacement of potable water with non-potable water from alternative water sources made up a considerable portion of this 25 percent reduction and it is anticipated that it will play a significant role in achieving the 16 percent reduction required over the next eight years. Installations will need to adopt and balance the use of alternative water sources with potable water sources to meet their overall water consumption requirements.

7. Alternative Water Sources.

7.1. There are a number of categories of alternative water sources potentially available to Air Force facilities: municipal-supplied reclaimed water; on-site supplied reclaimed water; treated gray water from sanitary sources; treated gray water from industrial sources; recycled water; non-potable well water; and rainwater harvesting (see Table 1). Storm water is another alternative water source but is not covered in this ETL.

7.2. *Municipal-supplied reclaimed water* is highly treated effluent from a publicly owned reclamation plant, so that as a result of that treatment it is suitable for a beneficial use or controlled use that would not otherwise occur, is no longer considered wastewater, and is approved and made available for non-potable use. This water is often available at a significantly lower rate than potable water; however, use of municipal-supplied reclaimed water may be restricted by local codes.

7.3. *On-site supplied reclaimed water* is effluent from an on-installation reclamation plant. This effluent, like that from a municipal reclamation plant, is also highly treated but this usually requires upgrades to the former on-site wastewater treatment plant to achieve the required level of treatment. Plants upgraded to produce reclaimed water may no longer be subject to National Pollution Discharge Elimination System (NPDES) requirements, but these may be replaced by state or local codes regulating the production and use of reclaimed water.

7.4. *Treated gray water from sanitary sources* is water collected from bathroom sinks, tubs and showers, clothes washers and laundry trays for treatment and reuse primarily for sub-surface irrigation or, when highly treated, for toilet and urinal flushing. Gray water does not usually include kitchen water because of increased treatment requirements for oil, fat and grease. At a minimum, gray water from sanitary sources is filtered to remove hair and lint and, when treated to higher levels, may consist of biological treatment with membrane filtration, activated carbon, and ultraviolet light or ozone disinfection to destroy pathogens.

7.5. *Treated gray water from industrial sources* (i.e., industrial gray water) is un-recycled process water discharged from industrial processes or equipment such as reverse osmosis reject water, cooling tower condensate or other industrial processes that may contain chemicals, minerals, and solids. Industrial gray water is treated to

reduce the level of contamination so it is acceptable for its intended reuse. This is a distinction from recycled water which is reused in the original process from which it was generated.

7.6. *Untreated gray water* is not a viable option for an alternative water source on an Air Force installation.

7.7. *Recycled water* is process water that is reused in the same system from which it was collected.

7.8. *Non-potable well water* is water produced from a former potable well that has become contaminated or deteriorated so that it no longer meets primary drinking water standards, or water produced from a well specifically developed to produce non-potable water. Non-potable well water may require treatment to meet the requirements for its intended use. BE can conduct a health risk assessment to determine whether treatment is necessary.

7.9. *Rainwater harvesting* is the practice of collecting rainwater before it has a chance to soak into the ground or run off. Rainwater harvesting is classified as either land-based or roof-based. Land-based rainwater harvesting occurs when rainwater runoff from the land or specifically designed catchments is collected in ponds or basins before it has a chance to reach the storm water collection system. Roof-based harvesting involves collecting rainwater that falls on a roof before the water reaches the ground. Captured rainwater is often used in landscaping, when the water is free of salts and other harmful minerals and does not have to be treated.

8. Non-potable Water Systems.

8.1. Design Considerations.

8.1.1. General. The development of any non-potable water system must be done in concert with the installation's overall plan for potable and non-potable water use. The Air Force preferred alternative is to explore the use of reclaimed water to the maximum extent possible before developing other alternative sources of non-potable water. This alternative, besides requiring a determination of the availability and suitability of reclaimed water for its intended uses, should focus on adding or extending the non-potable water distribution system. The other alternatives focus more on developing localized systems for single facilities or a small group of facilities. Thus, the design of any non-potable water system must take into account the water systems in operation preceding it and those anticipated to come after.

Table 1. Non-Potable Water Systems

	Reclaimed	Gray Water	Industrial Gray Water	Recycling	Non-Potable Well Water	Rainwater
Spray irrigation	x				x	x
Subsurface irrigation	x	x	x		x	x
Drip irrigation	x		x		x	x
Toilet and urinal flushing	x	x			*	x
Cooling tower makeup	x		x	x	*	
Single-pass cooling equipment	x		x		*	
Decorative uses	x		x		*	
Process water	*		x	x	*	
Washracks	*			x	*	
Unrestricted urban reuse	x					
Restricted urban reuse	x					
Environmental reuse	x					
Industrial reuse	x					
x Approved use * When reclaimed or non-potable well water is the source for a non-potable water distribution system and the treated or untreated water meets the intended requirements for use.						

8.1.2. Regulations and Permits. Check with state and local regulatory authorities to take advantage of their experience with the use of alternative water sources within their purview and to determine any regulatory or permitting requirements. The Air Force will conform to the reuse categories specified in AWWA, *Dual Water Systems*, M24, but may need to adapt them to conform to local or state requirements. State and local authorities may set requirements for notification, permitting, acceptable use, treatment, sampling/monitoring, quality, system testing, labeling/coloring, plumbing and storage, operation and maintenance, and recordkeeping.

8.1.3. In keeping with Air Force policy to ensure the general population is protected from mistaken or unknowing access or exposure to non-potable water, extra care must be taken at facilities where children are present. For this reason, non-potable water should not be used inside military family housing (MFH), child development centers (CDC), temporary lodging facilities (TLF), schools, youth centers, daycare facilities, or any other facility where significant numbers of

children are present. Non-potable water systems at these types of facilities are limited to subsurface irrigation systems only.

8.2. Reclaimed Water.

8.2.1. Approved uses for reclaimed water include:

- Irrigation (spray, subsurface, and drip systems);
- Toilet and urinal flushing;
- Cooling tower makeup;
- Single-pass cooling equipment;
- Decorative uses (e.g., fountains, ponds)
(**Note:** Use of reclaimed water for filling swimming pools or as makeup water for swimming pools is strictly prohibited.);
- Vehicle and equipment washing (comply with T.O. 1-1-691, *Aircraft Weapons Systems - Cleaning and Corrosion Control*, when applicable);
- Environmental restoration/habitat improvement;
- Industrial processes;
- Any uses for which the reclaimed water meets the guidelines for these reuse categories specified in AWWA M24, *Dual Water Systems*; that is, unrestricted urban reuse, restricted urban reuse, environmental reuse, and industrial reuse.

8.2.2. Reclaimed water distribution systems and their use in facilities will comply with the requirements of Appendix J of the Uniform Plumbing Code (UPC). **Note:** Compliance with Appendix J should not conflict with any requirements of the International Plumbing Code (IPC) which the Air Force is directed to comply with per UFC 3-420-01, *Plumbing Systems*. Some key requirements of Appendix J for reclaimed water systems are:

- Minimum treatment standards (Minimum treatment standards in the UPC apply only to on-installation reclaimed water production where no local or state standards for reclaimed water exist. These UPC treatment standards do not apply to reclaimed water purchased from off-installation sources.);
- Signs in bathrooms and equipment rooms where reclaimed water is used;
- Initial and periodic inspection and cross-connection testing;
- Piping and valve identification requirements;
- Piping separate from the potable water system;
- Prohibition of hose bibs on reclaimed water systems (see paragraph 8.2.4 of this ETL for an exception to this UPC requirement.).

Note: This list is not inclusive of all UPC requirements for reclaimed water used in Air Force systems.

8.2.3. Reclaimed water may contain high amounts of dissolved solids, salts, and/or biological nutrients so its use in cooling towers requires the approval of the installation corrosion engineer. The use of reclaimed water in boilers is

prohibited. **Exception:** Major commands (MAJCOM) may grant waivers to allow the use of reclaimed water in boilers at total energy power plants or where water is treated by demineralization or reverse osmosis before being used in boilers.

8.2.4. Reclaimed water may not be piped inside or connected to any MFH or used inside the dwelling for any purpose. Use of reclaimed water in MFH is limited to permanently installed irrigation systems; however, MAJCOMs may grant waivers to allow reclaimed water hose bibs in MFH for irrigation with portable sprinklers if the following criteria are met (see Figure 1):

- Hose bibs are located away from buildings in a below-grade valve box (more than one hose bib per valve box is allowed);
- Use freeze-proof hose bibs if the climate dictates;
- Valve box must be labeled “Reclaimed Water”;
- Valve box must display the warning “Non-Potable Water – Do Not Drink”;
- Valve box lid must be permanently attached with a cable or hinge;
- Valve box lid color must be lavender (light purple);
- Hoses, when not in use, should not be connected to reclaimed water hose bibs;
- Shutoff devices (i.e., nozzles) should not be used on hoses connected to the reclaimed water system.
- MAJCOMs may impose additional requirements on reclaimed water use when granting waivers for hose bibs in MFH (e.g., special hose connectors or “quick-connect fittings”; childproof locking device on valve boxes; rules for use).

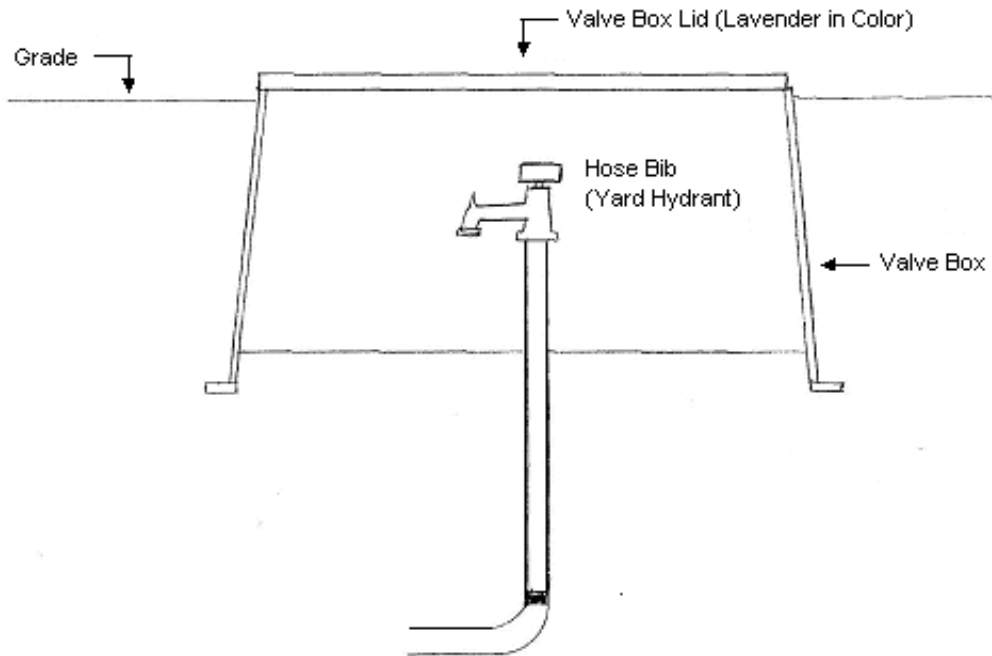


Figure 1. MFH Reclaimed Water Hose Bib

8.2.5. Potable water connections to systems, fixtures, or devices that use reclaimed water must have an approved backflow preventer.

8.2.6. When designing new facilities, consideration should be given to toilet, urinal, and irrigation system piping to allow easy conversion to reclaimed water should such a source become available in the future.

8.3. Gray Water Systems (Treated Gray Water from Sanitary Sources).

8.3.1. Approved uses for gray water include:

- Toilet and urinal flushing;
- Subsurface irrigation only (i.e., no potential for human contact).

8.3.2. Systems collecting gray water from sanitary sources will comply with the requirements of Appendix C of the IPC. Refer to Appendix G of the UPC for content (i.e., not compliance) for gray water systems in single-family dwellings. Some key aspects of the requirements of Appendix C of the IPC are:

- Piping requirements;
- Identification;
- Filtration (media, sand, or diatomaceous earth filter);
- Disinfection;
- Coloring (water must be dyed either blue or green before reuse);
- Makeup water supply with a backflow protection device.

Note: This list is not inclusive of all IPC Appendix C requirements for gray water used in Air Force systems.

8.3.3. In addition to the IPC requirements in paragraph 8.3.2, the following requirements also apply to gray water systems:

8.3.3.1. Gray water system piping must be completely separate from the potable water system. This separation must be maintained by an approved backflow prevention assembly between any make-up or back-up potable water connection to systems, fixtures, or devices that are part of the gray water system.

8.3.3.2. A cross-connection test will be performed upon installation of the system and once every two years. At a minimum, the test will consist of the following steps:

1. The potable water system will be pressurized and the gray water system depressurized for a minimum of one hour.
2. Each fixture and access point on the gray water system will be checked for water pressure.
3. The gray water system will be pressurized (use potable water for the initial test) and the potable water system depressurized for a minimum of one hour.

4. Each potable fixture in the facility will be checked for water pressure.

8.3.3.3. CE will coordinate with the installation bioenvironmental engineering (BE) to determine if any state or local sampling requirements apply or if any other sampling for pathogens or biological or chemical constituents is required for the gray water system. Sampling frequency will be at the discretion of BE. Based on the sample results, the system will be treated at the discretion of the bioenvironmental engineer.

8.3.3.4. The minimum residual disinfection level in the gray water storage tank will be maintained at an average 1 part per million (ppm) of free available chlorine (or equivalent residual levels for other forms of disinfection); however, higher residual disinfection levels will be maintained if required by the bioenvironmental engineer.

8.3.3.5. Per C101.12 and C101.13 of the IPC, gray water storage tanks must have an overflow and drain connected to the installation sanitary sewer system. Treated gray water stored in a tank for more than 48 hours should be drained to the sanitary sewer. Gray water used for irrigation should be shut off and overflowed to the sanitary sewer during rainy periods when gray water ponding is possible.

8.3.3.6. The system will be inspected bi-weekly by CE, including checking the residual disinfection levels, disinfection chemical supply, and dye supply.

8.3.3.7. All bathrooms using gray water will be identified with signs stating:

**To Conserve Water, This Building Uses Non-Potable Water
To Flush Toilets and Urinals**

8.3.3.8. Tank-type toilets flushed with gray water will be labeled:

Non-Potable Water – Do Not Drink

8.3.3.9. Gray water systems used solely for subsurface irrigation are exempt from disinfection and dyeing requirements. Holding tanks for these irrigation systems will be marked:

**Gray Water Irrigation System
Danger - Unsafe Water**

8.3.3.10. Gray water may not be used inside MFH, CDC, TLF, schools, youth centers, daycare facilities, or any other facility where significant numbers of children are present. Gray water systems in these types of facilities are limited to subsurface irrigation systems only.

8.3.3.11. Hose bibs are prohibited on gray water systems.

8.3.3.12. Recoverable gray water may be limited at facilities on slab foundations as most of the plumbing to be modified for the gray water system would be under the slab and not easily accessible without additional expense. Allowing for gray water systems early on in the design stage can help alleviate this problem.

8.4. Gray Water from Industrial Sources and Recycled Water.

8.4.1. Approved Uses. Industrial gray water can be used as feed water for other industrial systems or for irrigation. Recycled water can be used in washrack systems or any other system for which the wastewater discharge can be treated and reused.

8.4.2. The design of any industrial gray water or recycled water system must determine and specify what water quality criteria must be met by the system to be suitable for its intended use. This will usually require a specific degree of treatment to ensure this water meets established standards for its use. T.O. 1-1-691 provides quality criteria for water used on aircraft systems. Consult the applicable T.O.'s, manufacturer's recommended criteria, user's manuals, and engineering studies to determine what the quality of the water should be for a specific process or use.

8.4.3. Industrial gray water and recycled water is non-potable water and assurance must be provided that it does not become biologically contaminated, even though it is less likely for this type of water stream. Store industrial gray water and recycled water in closed tanks with a drain and overflow to the approved discharge location. Industrial gray water and recycled water stored for more than 48 hours should be drained to the approved discharge location. Coordinate with the installation BE to determine if sampling for disease vectors or other contaminants is required for the industrial gray water or recycled water system. Sampling frequency will be at the discretion of BE. Based on the sample results, the system will be treated or disinfected at the discretion of the bioenvironmental engineer.

8.5. Non-potable Well Water.

8.5.1. Non-potable well water has the potential to provide an alternative water source for many uses, depending on the quality or degree of contamination of the well source. Each non-potable well must be evaluated on a case-by-case basis to determine the degree of treatment required, if any, for its specific intended use.

8.5.2. If a non-potable well is developed from the same aquifer that the installation and the surrounding community use to produce potable water, do not

disregard the pumping effects the well may have on the aquifer. In this case, it is incumbent upon the user to ensure that the non-potable water is used efficiently and effectively. Prepare an irrigation plan when non-potable well water is the source.

8.6. Captured Rainwater.

8.6.1. Approved Uses:

- Irrigation (subsurface, spray, and drip systems);
- Toilet and urinal flushing.

8.6.2. System Requirements.

8.6.2.1. Vehicle parking areas or other areas subject to chemical contamination must not be used for collecting rainwater for toilet and urinal flushing.

8.6.2.2. A cross-connection test will be performed upon installation of the system and once every two years. At a minimum, the test will consist of the following steps:

1. The potable water system will be pressurized and the captured rainwater system depressurized for a minimum of one hour.
2. Each fixture and access point on the rainwater system will be checked for water pressure.
3. The rainwater system will be pressurized (use potable water for the initial test) and the potable water system depressurized for a minimum of one hour.
4. Each potable fixture in the facility will be checked for water pressure.

8.6.2.3. Piping must be identified as non-potable. Pipe and valve identification will comply with Section 608.8 of the IPC.

8.6.2.4. Water used for toilet and urinal flushing must be filtered (media filter, diatomaceous earth filter, or sand filter) and disinfected.

8.6.2.5. The system (i.e., tanks, cisterns, valves, pipes, connections, devices and disinfection system) will be inspected monthly by CE, which will include checking the residual disinfection levels and disinfection chemical supply.

8.6.2.6. Consider using a “roof washer” or other similar device that diverts the first few gallons of rainwater away from the storage tank. This first flush of water will remove most of the dirt, debris, and contaminants (such as bird droppings) that may have been deposited on the collection area since the previous rain.

8.6.2.7. Systems used to flush toilets and urinals will have provisions for makeup water in case of drought. Makeup supply must be protected against backflow with an approved device.

8.6.2.8. CE will coordinate with the installation BE to determine if any state or local sampling requirements apply or if any other sampling for pathogens or biological or chemical constituents is required for the captured rainwater system. Sampling frequency will be at the discretion of BE. Based on the sample results, the system will be superchlorinated at the discretion of the bioenvironmental engineer.

8.6.2.9. The minimum residual disinfection level in the rainwater storage tank will be maintained at an average 0.25 ppm of free available chlorine (or equivalent residual levels for other forms of disinfection); however, higher residual disinfection levels will be maintained if required by the bioenvironmental engineer.

8.6.2.10. All bathrooms using captured rainwater will be identified with signs stating:

**To Conserve Water, This Building Uses Non-Potable Water
To Flush Toilets and Urinals**

8.6.2.11. Tank-type toilets flushed with captured rainwater will be labeled:

Non-Potable Water – Do Not Drink

8.6.2.12. Hose bibs are prohibited on rainwater systems.

8.6.2.13. Rainwater systems used solely for irrigation that use open ponds (lined or unlined) for water storage are exempt from the sampling and disinfection requirements of this ETL. These systems may also use vehicle parking areas or other paved surfaces for water collection.

9. Monitoring and Metering. Installations must reliably and accurately determine the amount of non-potable water used installation-wide.

9.1. All systems constructed or retrofitted to provide an alternative water source must be accompanied by a means or method (i.e., a procedure or process) to reliably determine the amount of non-potable water used by the system. This can be accomplished by either installing a meter or through the use of temporary or non-intrusive metering to establish use patterns for the system.

9.2. All Air Force-owned production wells with a capacity to provide non-potable water to the installation's alternative water system must be metered.

9.3. All Air Force-owned wells providing non-potable water to irrigate a golf course or other substantial plot of Air Force property must be metered.

9.4 Any end use of non-potable water greater than 30,000 gallons per month must be metered.

9.5. Use the applicable Unified Facilities Guide Specification (UFGS) or AWWA specification for procuring water meters to monitor non-potable water use.

10. Backflow Prevention Program. Installations must ensure the installation's backflow prevention program covers all circumstances on the installation where there is potentially a connection between a potable and non-potable water system (see AFI 32-1066, *Backflow Prevention Program*).

11. POC. Recommendations for improvements to this ETL are encouraged and should be furnished to the Water Systems Program Manager, HQ AFCESA/CEOA, 139 Barnes Drive, Suite 1, Tyndall AFB, 32403-5319, DSN 523-6190, (850)-283-6190, or via e-mail at AFCESAReachbackcenter@tyndall.af.mil

//SIGNED//

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Acting Director, Operations and Program Support

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1. Distribution List

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