

Managing vessel wastewater for black and/or grey water

Updated May 2010

EPA 709/10: This guideline identifies options and management techniques for wastewater containment and/or treatment on vessels travelling in South Australian waters. The techniques are considered to assist vessel owner/operators in complying with the requirements of the 2008 Code of practice for vessel and facility management (marine and inland waters).

Introduction

The *Code of practice for vessel and facility management (marine and inland waters)* contains the **mandatory requirements** for vessel operators managing black and grey wastewater whilst travelling in state waters and should be read and understood prior to utilising this guideline.

Definitions:

- black water is any waste from toilets or urinals
- grey water is wastewater that has been used for washing, laundering, bathing or showering
- both black water and grey water are classed as wastewater.

The Environment Protection Authority (EPA) is satisfied that reasonable and practical opportunities exist for vessel operators to provide onboard wastewater management systems suitable for the vessel and its operational requirements in either marine or inland waters. This will reduce the environmental and public health risks associated with discharging vessel wastewaters into South Australia's aquatic environments.

There is evidence that our aquatic environments are declining in water quality and whilst this is attributed to pollutants from a number of sources, namely effluent discharges from sewage treatment works, industrial wastewater, farming practices and urban stormwater runoff, there are increasing calls for all contributors to accept responsibility and reduce their environmental impacts for reasons of future sustainability.

One small recreational vessel can cause significant harm through the release of its wastewater, especially in sensitive aquatic areas. Recent closures of marine shellfish collection and farming areas due to the presence of faecal contamination have impacted significantly on the fishing industry itself and the wider community. Increasing numbers of houseboats with ensuites, spas, dishwashers and washing machines moored alongside one another on the River Murray can pose health risks, both to those on board and other recreational river users through the discharge of grey water.

Principles of wastewater management systems to be observed

Any onboard wastewater management system will only remain effective if operated and serviced to manufacturer's standards. All systems have the potential to pose health risks, present operational problems and cause environmental impacts—although improperly designed and fitted systems carry far greater risks and should be avoided as a matter of course. Pollutants are best avoided from being generated in the first instance and any waste should always be reduced,

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reused or recycled before treatment is considered. Vessel operators should, where possible observe the following practices:

- use land-based amenity facilities to go to the toilet, shower, wash dishes and clothing
- install low-flush toilets. There are systems that use as little as 0.4 litres per flush. Vessels travelling on inland waters have an unlimited supply of flushing water and will often have toilets on board that do not conserve water. This results in holding tanks filling up far quicker than is necessary and more regular visits to wastewater disposal stations. Provided the onboard toilets incorporate macerating devices, operators need not be concerned with solids blocking pipe systems through the use of low-flush systems
- install onboard wastewater treatment systems that surpass the discharge standards outlined in the Code of practice for vessel and facility management (marine and inland waters) to reduce even further the impacts on the aquatic environment
- install water-saving devices such as low-flow shower heads and tap aerators
- scrape all food stuff into a garbage or compost container for land-based disposal before immersing dishes in water
- cooking oils, greases and dairy products such as milk and cream decrease the performance of an onboard wastewater treatment system. Vessel operators should make every effort to prevent these products going down the sink and into an onboard treatment system
- use low nitrogen and no phosphorus detergents
- use all soaps and cleaners sparingly
- retain vessel-user instruction information on board the vessel. This can include signage (stickers or labels) placed strategically around the vessel to advise on practices for operating holding tank and/or treatment systems and whilst cooking, cleaning utensils, washing clothes, showering and swimming adjacent to the vessel

There are costs to vessel operators in installing and maintaining onboard wastewater management systems but it is believed that these costs are necessary to protect public health, maintain current vessel operator freedoms and to ensure environmental sustainability of our state's waters. These costs should be commensurate to the size of the vessel and the manner in which it is operated.

The Code of practice for vessel and facility management (marine and inland waters) should be consulted to determine the **minimum mandatory requirements** for the management of black water and grey water.

The Department of Transport, Energy and Infrastructure's Marine Safety Division also has **Commercial Vessel Survey requirements** that must be complied with. Please visit <www.transport.sa.gov.au/safety/marine/index.asp>.

There are different requirements for the management of black water and grey water depending on whether the vessel is travelling in **marine or inland waters** of South Australia. If your vessel travels within both environments, compliance with all requirements is essential. This is particularly important for the management of black water. While there are areas of the marine environment where discharge of black water is permitted; there are no such areas within inland waters.

If a vessel, through its use, will not generate wastewater, there are no requirements.

The following information is supplementary to the mandatory requirements and is for guidance only. The information should be used to assist both vessel owner/operators and manufacturers of vessel wastewater management systems in purchasing and producing systems that meet acceptable standards of design and operation.

Choosing a system that works best for you and your vessel depends on several factors. The answer to a few questions about how the vessel is used should help you narrow the choices and determine the most cost-effective and practical management system:

- How many people are usually on board for a trip?

- Is the vessel used mostly for day trips or for overnight stays? Sometimes day trips will not result in the generation of wastewater. Overnight virtually guarantees it.
- Will the vessel be occupied and moored within a marina or operate within other sensitive areas, such as bays, estuaries or alongside aquaculture leases? The release of black and grey water into marinas is not permitted, even if it is treated. Wastewater will need to be contained for appropriate disposal either into acceptable discharge areas (of certain marine waters) or, ideally, into land-based wastewater collection facilities. Of course vessel operators are encouraged to utilise the marina's toilet and amenity facilities.
- Consider your travel destinations. Are wastewater collection facilities available and what onboard systems/wastewaters can they service? Refer to location listings of facilities provided at the end of this guideline.
- What are the vessel's design and space limitations? There are increasing numbers of options for vessels with minimal hull space for the fitting of wastewater holding devices, namely, flexible bladders and portable toilet designs.
- Is the power supply adequate for an electrically operated system?
- Are you committed to the vessel wastewater management system's service and maintenance requirements? Both wastewater holding devices and treatment systems require ongoing servicing and regular maintenance, from flushing to replacement of componentry (eg filters, anodes). Ensure you discuss and understand these requirements with manufacturers before purchase.

What systems are available?

Holding devices (portable toilets, vacuum toilets, flexible bladders and fixed tanks)

Portable toilets

A portable toilet may be the simplest, least expensive way to comply with the intent of the law. They require minimal space, are low cost, simple and reliable to operate, and provide for a variety of disposal/discharge options. Their disadvantage is that they have limited capacity and require chemical dosing and frequent emptying to prevent build-up of hydrogen sulfide. Chemicals used to dose portable toilets must be compatible with those suitable for use in a septic tank. Many chemical disinfectants, deodorants, and antiseptic or germicidal powders and fluids can adversely affect the operation of septic tanks, to which a number of vessel wastewater collection facilities are connected.

Formaldehyde is no longer an acceptable chemical for portable toilets or other holding devices. It is now understood to be an unnecessary hazard to both humans and the environment. Human exposure to formaldehyde irritates the eyes, nose and throat, and can cause skin and lung allergies. Contact can cause severe eye and skin burns. These may appear hours after exposure, even if no pain is felt. Formaldehyde can cause an asthma-like allergy and is classified as a 'probable human carcinogen' by Worksafe Australia. Formaldehyde has high chronic toxicity to aquatic life. Birds and terrestrial animals exposed to formaldehyde may develop cancer or other chronic effects. Formaldehyde can persist in water between 2–20 days.

Formaldehyde-based products control odour by killing both aerobic (none odorous) and anaerobic bacteria; thus when the effluent is disposed of to sewage treatment facilities, particularly septic tanks, the process of treating the sewage aerobically can be adversely affected. Look for formaldehyde-free chemical treatments that meet the *Australian Standard AS1792 Biodegradability*.

Vacuum toilets

There are lightweight vacuum toilets with remote removable cassettes, which can be installed anywhere that is suitable on your vessel. When the toilet is flushed the vacuum in the system is released. The bowl is instantly cleared and the waste is moved through the piping to the remote cassette. The powerful vacuum flushing action also enables very low energy and water consumption of approximately 4–6 amps and 0.4 litres per flush.

The cassette can be installed at a distance away from the toilet; thus configurations can be tailored to suit individual vessel requirements. The strong, high velocity vacuum-flushing action breaks down the waste enroute to the remote

cassette; therefore no chemicals are required to break down the waste and reduce odours. Cassettes come in various sizes to suit the number of persons on board your vessel and spares can be stored on board if required. Cassettes also provide for a variety of disposal/discharge options. Vacuum toilets cost more than portable toilets and basic holding tank configurations to install, but their ongoing maintenance requirements should be less.

Flexible bladders

These come in a range of volumes to suit vessels where rigid holding tanks will not fit into the space available. They are susceptible to leakage due to chafing and flexing at pipe connections. They are low cost, provide for a variety of disposal/discharge options and may suit vessels that have few passengers and require infrequent wastewater containment only.

Fixed fitted toilets and tanks

It is **recommended** that vessel operators ensure their onboard wastewater management system complies with *Australian Standard AS3542 Pleasure Boats–Toilet Waste Collection, Holding and Transfer Systems*. For vessels travelling on South Australia’s inland waters there are also **mandatory design requirements** for fixed fitted toilets and fixed holding tanks. These are outlined in the appendices of the Code of practice for vessel and facility management (marine and inland waters).

Fixed fitted toilets should incorporate a purpose built macerating device. This is necessary for wastewater that either is to be contained on board or passed through a treatment system. Please note vacuum systems are considered to effectively macerate the waste via their operational effect. Valves (such as clack or joker valves) common to marine toilet pipework systems are not considered effective macerating devices. Aquatic discharges of untreated and treated black water into acceptable areas of the marine environment *must* involve the black water passing through a macerator device. The onboard macerator must effectively reduce: for example, by grinding, shredding or pulping, solid wastes in the black water into, at least, a fine slurry.

The size of the holding tank selected should be based on the vessel’s intended usage and the number of people using the toilet. Suggested minimum holding tank capacities are shown in Table 1 for both conventional and marine style toilets.

Table 1 Minimum toilet wastewater generation rates

Holding tank pump out interval in days	Conventional toilet (dual-flush cistern) litres/person	Marine toilet (subject to model and type*) litres/person
1	32	7–15
2	64	14–30
3	96	21–45
4	128	28–60
5	160	35–75
6	192	42–90
7	224	49–105

* Vacuum toilets require 0.4 L per flush

From the practical experience of vessel operators, the following considerations are important when selecting a wastewater holding tank:

- **Cleaning**

Look for tanks that can be disassembled so that they can be examined internally for maintenance purposes. Uric acid salts ('crystals' from urine and salt water flushes) and other more solid waste deposits from faeces and papers do build up over time. A round or cylindrical shape/design produces a whirlpool effect in the tank. This keeps the tank's contents from settling and dramatically reduces the opportunity for solids to build up. Remember that any internally blocked vent should be considered dangerous, as the gas produced is explosive and poisonous.

- **Construction material**

A tank without welds will offer more peace of mind. Joins and welds can flex and stress with vessel movement over time, resulting in splitting, which can spill tank contents inside the vessel.

- **Installation**

Fitting a tank down inside the hull of a vessel can be difficult. A modular tank option that can be taken inside the vessel in sections and assembled to the necessary size requirement may offer a solution to otherwise expensive vessel refit/joinery alterations.

- **Ventilation**

Ensure the holding tank has an effective means of ventilation to the atmosphere to avoid dangerous gas build up. An insect screen should be incorporated on the vent cap.

Wastewater treatment systems

(Physical, chemical and biological wastewater treatment, seawater electrolysis, composting toilets, incinerating toilets)

Black and grey water can be treated to standards that will permit vessel operators to discharge the water in acceptable discharge areas. Please refer to the Code of practice for vessel and facility management (marine and inland waters) for mandatory requirements. Some treatment processes, such as composting and incineration, result in small amounts of solid waste for land-based disposal and have no need for aquatic discharge.

Wastewater treatment technologies are advancing all the time and it is likely that discharge standards will alter over time to reflect this. The following information details the type of treatment technologies that are currently available and what a manufacturer of a treatment system must demonstrate for the system to be considered acceptable for use on board a vessel.

Physical, chemical and biological wastewater treatment

The purpose of most wastewater treatment systems generally is to remove from the wastewater enough solids to permit the remainder to be discharged to a receiving water body without interfering with its ecological integrity and avoiding public health risks. Treatment must also then be provided for this removed 'sludge'. In addition, there must be some measure of treatment to control odours, retard biological activity and destroy pathogenic organisms. There are numerous devices on the market currently, which combine physical, chemical and biological methods to treat **black and/or grey water**. They can generally be grouped under five methods:

- **Preliminary treatment**

This component is designed to remove or cut up the larger suspended and floating solids (often know as maceration), to remove the heavy inorganic solids and to remove oils and greases.

- **Primary treatment**

In this treatment, most of the settled out solids are separated or removed from the wastewater by the physical process of sedimentation. When certain chemicals are used with sedimentation, some of the colloidal solids (very fine particles) are also removed.

- **Secondary treatment**

This primarily depends on aerobic organisms that biochemically decompose the organic solids to inorganic or stable organic solids. Devices consist of activated sludge tanks and sand filters.

- **Disinfection**

This process is designed to kill most micro-organisms, including pathogenic (disease-causing) bacteria. There are several ways to disinfect, with chlorine being the most common. If the chemicals are not subsequently removed from the wastewater stream prior to discharge, they too can add to the subsequent environmental impact of the wastewater. In view of the toxicity of chlorine for fish as well as other living organisms, many manufacturers of packaged treatment systems are either incorporating chlorine removal processes prior to final discharge or using other forms of disinfection such as ozone and ultraviolet light. It is also important to note that concentrated powdered forms of chlorine can act as an oxidising agent which will intensify fires, may ignite spontaneously if damp or heated, or may explode if involved in a fire in a confined area; therefore storage on vessels is not recommended.

- **Tertiary treatment**

The term 'tertiary' treatment has developed over recent times with advancements in technology to describe additional processes that have been developed to *further* remove suspended solids and nutrients, primarily nitrogen and phosphorous. This degree of treatment is usually achieved by chemical (for example, coagulation) methods as well as physical methods (flocculation and activated carbon adsorption). Increasingly, membrane filtration can be used as an alternative for flocculation, sediment purification techniques, adsorption (sand filters and active carbon filters, ion exchangers), extraction and distillation.

Most vessel wastewater treatment systems were manufactured to treat black water alone and primarily designed (configured) around marine travelling vessels. Increasingly, these systems are being utilised to treat grey water and are being marketed for inland travelling vessels, such as houseboats. The EPA advises vessel operators to ensure that they understand the difference between the two wastewater streams and what that means for treatment, especially in relation to which environment (marine or inland) the final wastewater will be discharged.

A wastewater treatment system for grey water must, for example, be able to manage the greater flows generated from grey water sources on board and incorporate oil/grease separating devices as a minimum. Grey water can contain pathogenic (disease-causing) bacteria, so disinfection is an essential treatment component. Vessel operators are strongly advised to consider the long-term operation and maintenance requirements of an onboard wastewater treatment system and be prepared for a level of commitment not generally required for retaining wastewater on board for land-based disposal.

Seawater electrolysis

This marine **black water** treatment system operates by electrolysis of sea water with the production of hypochlorous acid, a natural disinfectant. Many of these systems also macerate the waste into small particles. This hydrolytic system is promoted as removing or inactivating both bacteria and viruses from faecal material as it passes through the receiving tank. It is important to ensure that these systems are operated under optimal conditions. A number of variables could influence the efficiency of the operation. These include stability and voltage of electric current, salinity of water (systems are not for use in fresh water), amount of pumping required for material to flow through tanks and out to discharge, the time faecal material is left in tanks between treatments and before discharge, and the quantity of excrement treated at one time. Due to these variables, the system is not considered acceptable for use in sensitive marine areas or in waters closer than half a nautical mile of the nearest land, aquaculture lease or people in the water.

Composting toilets

Composting toilets break down **black water** and can do so without chemicals and odour. They break down human waste and toilet paper through the natural process of decomposition. Because most of this waste is evaporated, only a very limited quantity of finished compost is produced. Oxygen, moisture, heat and organic material are needed to allow minute natural organisms to transform the waste to fertilising soil. It is recommended that this compost not be placed on garden beds where food is grown for human consumption. It is important to ensure the system evaporates residual leachate (this will usually require power to generate heat) or else this wastewater will have to be contained in a holding tank for appropriate land-based wastewater disposal. Configuring compost toilets to fit into vessels may prove difficult and their manual maintenance requirements may dissuade some vessel operators.

Incinerating toilets

These usually consist of a toilet connected to a holding tank and a gas-fired or electric heating system to incinerate **black water** deposited in the holding tank. Recent developments have seen diesel-fuelled systems enter the market designed to produce no ash following incineration. Previous models produced a small amount of fine, sterile ash particles that required disposal. Systems usually have a significant energy requirement, although new models can be designed to be solar and wind generated. Some of this energy can be recovered to create hot water for other uses on board the vessel. Systems can usually be integrated with existing fixed fitted toilets, require no chemicals and minimal-to-zero water usage. They are relatively odourless when compared to portable, chemically dosed toilets. Units are not entirely pollution free, with some air pollutants produced. Their installation cost entirely depends on the vessel into which they are installed and the configuration requirements.

Wastewater treatment system standards

Vessel operators will find numerous wastewater treatment systems available on the market and it can be a daunting exercise to assess their suitability. The EPA advises consumers to ensure manufacturers can supply onboard wastewater treatment systems that will facilitate compliance with the Code of practice for vessel and facility management (marine and inland waters).

The following **checklist** should be used to assess a wastewater treatment system's integrity.

- The system should include documentation from the manufacturer or supplier that states:
 - the system's performance specifications, under normal operating conditions, which includes a statement of the levels of water quality characteristics remaining in the wastewater after it has been treated in the system
 - the name and address of an independent registered laboratory accredited by the National Association of Testing Authorities (visit <www.nata.asn.au> for more information) that has assessed the performance of the system against the performance specifications mentioned in the first point)
 - the date of the assessment and the results of the assessment.

- The system should:
 - include comprehensive and durable manuals for operating and maintaining the system
 - have a durable label/identification mechanism attached to it, stating the following:
 - the manufacturer's name and address
 - the type and model number of the system.
 - be installed in accordance with the manufacturer's instructions
 - be fitted with an indicator to indicate if the system is malfunctioning.

- The system service manual must state the following particulars for the system:
- operating instructions
 - maintenance schedules and requirements
 - authorised service provider.

Manufacturers should demonstrate that they have tested the wastewater treatment system under actual operating conditions and not just under simulated conditions onshore. It is recommended that a five-day test period of the treatment system on board a vessel be conducted, timed to capture normal operating conditions and the number of persons and hydraulic loading for which the wastewater treatment system is to be performance rated. Samples of the water entering and exiting the treatment system should be collected for testing. The critical period for sampling is the 24-hour period covering the fifth and final day of testing. The wastewater released, when sampled three times or more over 24 hours, should meet or exceed the aquatic discharge standards set by the Code of practice for vessel and facility management (marine and inland waters).

The Boating Industry Association of Australia has agreed to list manufacturers of vessel wastewater treatment systems who have successfully demonstrated that their system meets acceptable standards of design and operation as detailed in this EPA guideline. Please visit <www.boatingsa.com.au> for more information.

Vessel wastewater collection facilities in South Australia

The following list was accurate at the time of printing. For more information on government provided wastewater collection facilities along the River Murray please contact the Department for Water, Land and Biodiversity offices at Berri (phone: 08 8595 2053) or Murray Bridge (phone: 08 8531 1420).

Table 2 Marine vessel wastewater collection facilities

Station	Location
St Vincent Marina	Sunset Cove Resort Complex, Second Valley (contact marina operator for conditions of use)
North Haven Boat Ramp	Lady Gowrie Drive, North Haven SA (available to the public; contact the Cruising Yacht Club of South Australia for conditions of use)
North Arm Marina	North Arm, Port River, Port Adelaide (for use by commercial fishing vessels moored at marina only)
Port Lincoln Marina (commercial marina)	Port Lincoln (contact DTEI marina operator) for conditions of use; does not accept saline wastewaters). Telephone contact is displayed on wastewater collection facility

Table 3 Inland waters government provided vessel wastewater collection facilities

Station	Distance from river mouth* (km)	Distance between stations* (km)
Lock 6	617	–
Renmark	566	51
Berri	524	42
Loxton	487	37
Lock 3	432	55
Waikerie	382	50
Morgan	319	63
Blanchetown	275	44
Swan Reach	246	29
Walker Flat	209	37
Mannum	150	59
Murray Bridge	112	38
Goolwa	12	100

* The nearest public waste disposal stations upstream of Lock 6 are at Wentworth on the Darling River, and at Dareton, Buronga and Euston in New South Wales.

Vessel operators are advised to consider the wastewater collection facilities they are most likely to make use of and ascertain their conditions of use, including vessel length and weight restrictions, nature of hose connection fittings, pump-pressures (holding tanks may collapse if too high), flushing service, capacity to manage salt and freshwater inflows and hopper/sink provision for portable toilets to ensure compatibility with their onboard wastewater management system.

Disclaimer

This publication is a guide only and does not necessarily provide adequate information in relation to every situation. This publication seeks to explain your possible obligations in a helpful and accessible way. In doing so, however, some detail may not be captured. It is important, therefore, that you seek information from the EPA itself regarding your possible obligations and, where appropriate, that you seek your own legal advice.

Further information

Legislation

Legislation may be viewed on <www.legislation.sa.gov.au>

Copies of legislation are available for purchase from:

Service SA Government Legislation Outlet
Adelaide Service SA Centre
108 North Terrace
Adelaide SA 5000

Telephone: 13 23 24
Fax: (08) 8204 1909
Web: <shop.service.sa.gov.au>

For general information please contact:

Environment Protection Authority
GPO Box 2607
Adelaide SA 5001

Telephone: (08) 8204 2004
Facsimile: (08) 8124 4670
Freecall (country): 1800 623 445
Web: <www.epa.sa.gov.au>
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