AUSTRALIAN CAPITAL TERRITORY

Public Health Act 1997

INSTRUMENT NO. 260 OF 1999

DETERMINATION OF CODE OF PRACTICE

Pursuant to Section 133 of the *Public Health Act 1997*, **I, MICHAEL JOHN MOORE**, Minister for Health and Community Care, do by this instrument, hereby determine that the Public Swimming and Spa Pools Code of Practice to be Code of Practice for the purposes of the *Public Health Act 1997*.

DATED this 26TH day of October 1999

Michael Moore
Minister for Health and Community Care

AUSTRALIAN CAPITAL TERRITORY

Public Health Act 1997

IINSTRUMENT NO. 260 OF 1999

Determination of a Code of Practice for the Operation of Swimming and Spa Pools

Section 133(1) of the *Public Health Act 1997* (the Act) provides that the Minister may, by instrument, determine Codes of Practice setting minimum standards or guidelines for the purposes of the Act.

Section 133(2) of the Act provides that the Code of Practice may apply, adopt, incorporate any matter contained in the instrument or other writing as in force from time to time.

This instrument declares the Swimming and Spa Pools Code of Practice to be a Code of Practice for the purposes of the Act.

Any Code of Practice determined under Section 133 is enforceable through the Act. Legal proceedings may follow for failure to comply with Codes of Practice.

A determination under Section 133 of the Act is a disallowable instrument for the purposes of Section 10 of the *Subordinate Laws Act 1989.*

ACT DEPARTMENT OF HEALTH AND COMMUNITY CARE

A CODE OF PRACTICE TO MINIMISE THE PUBLIC HEALTH RISKS FROM SWIMMING/SPA POOLS

PART A: GENERAL GUIDELINES

CONTENTS

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Whilst considerable care has been taken in compiling this document, the ACT Department of Health and Community Care accepts no responsibility for errors or omissions, or for decisions or actions taken or not taken as a result of any information, statement or advice, express or implied, in this document.

TABLES

CODE OF PRACTICE TO MINIMISE THE PUBLIC HEALTH RISKS FROM SWIMMING/SPA POOLS
PART A: GENERAL GUIDELINES

PURPOSE

The essential purpose of this code of practice is to specify **minimum** levels of chemicals and disinfectants for the treatment of public swimming pools and public spa pools. The standards referred to in this Code of Practice may be amended from time to time unless otherwise stated.

It is the owners/operator's responsibility to ensure that recommended levels of chemicals used in the disinfection and treatment of water comply with the manufacturer's safety data sheets.

The code of practice applies to:

- public swimming pools and spa pools,
- pools where the public, members and their guests, customers and patrons may have reasonable access as part of a service or workplace and includes:
- hotels, motels and serviced apartments
- clubs
- schools
- gymnasiums & health resorts
- squash and tennis centres
- recreational resorts
- hospitals (hydrotherapy pools)
- workplaces, and
- places of adult entertainment
- pools used to provide swimming lessons

The code of practice is not specifically designed to apply to private residential premises.

DEFINITIONS

activated carbon filter’	filter of granular carbon that removes excess ozone from the pool water.
algaecide’	a chemical that is capable of killing algae.
authorised officer’	means an officer holding appointment as an authorised officer under the *Public Health Act 1997*
BCDMH’	1-Bromo-3-chloro-5,5-dimethylhydantoin.
bleed-off’	constant removal of water to waste.
bromine’	Br_2 - a halogen with disinfecting properties.
chloramines’	unwanted, unpleasant smelling by-products of the reaction between chlorine and ammonia compounds.
chlorine’	Cl_2 - a halogen with disinfecting properties that is converted to hypochlorous acid in water (HOCl.)
coliforms’	coliform organisms are used as indicators of faecal contamination of water supplies, or as indicators of the breakdown of barriers against contamination.
combined chlorine’	chlorine that has combined with ammonia, ammonium compounds or organic matter containing nitrogen.
cyanuric acid’	is a chemical added to pool water to stabilise chlorine.
disinfectants’	a compound or substance which, when applied as instructed to swimming or spa pool water, may kill micro-organisms.
free bromine’	hypobromous acid/hypobromite ion (irrespective of the mode of addition or formation).
free chlorine’	hypochlorous acid/hypochlorite ion (irrespective of the mode of addition or formation).
hydrogen peroxide’	is an oxidising agent which, in its concentrated form, is a clear liquid with a sharp odour.
hydrotherapy pool’	a pool containing heated water and specially designed to meet the therapeutic needs of persons of any age with impairments due to illness, injury, disease, intellectual handicap or congenital defects or for fitness exercising.
hydrotherapy’	external application of, or partial immersion in water for the treatment of illness or injury or for fitness exercising.
mg/L’	milligram per litre.
ORP’	oxidation reduction potential - the electro-chemical voltage measured by a suitable electrode which indicates the ratio of oxidising to reducing species present in the water being monitored i.e. used to measure disinfection power which can be equated to disinfectant concentration if calibrated.

‘occupier’	refers to an owner of a place, a person who is in charge of the place and a person authorised to be present at the place as an agent of an occupier, owner or person in charge of the place.
‘ozone’(O_3)	a gaseous molecule composed of three atoms of oxygen. It has a distinct odour, is soluble in water and is an effective water disinfectant.
‘ozonisation’	the addition of ozone to water for the purposes of disinfection.
‘pH’	a scale (ranging from 0 to 14) that indicates the amount of acid or alkali present in the water. Water with a pH of 7 is neutral.
‘shock dose’	the addition to pool water of at least 10 mg/L of chlorine, 20 mg/L of bromine, or 100 mg/L hydrogen peroxide for the destruction of combined chlorine or combined bromine, algae, and other impurities.
‘spa pool’	means a pool or other water-retaining structure designed for human use: (a) that is capable of holding more than 680 litres of water, *and* (b) that incorporates, or is connected to, equipment that is capable of heating any water contained in it and injecting air bubbles or water into it under pressure so as to cause general turbulence in the water.
‘stabiliser’	a compound which is added to pool water to reduce chlorine loss due to sunlight.
‘superchlorination’	the addition of sufficient chlorine to pool water to raise the concentration of free chlorine to at least 10 mg/L and maintained for 1 hour.
‘swimming pool’	includes any waterslide, wave pool, hydrotherapy pool or other similar structure designed for human use, other than a spa pool.
‘total alkalinity’	a measure of the total amount of dissolved alkaline compounds in the pool water measured as calcium carbonate ($CaCO_3$).
‘total chlorine’	the sum of combined chlorine and free chlorine concentrations.
‘total dissolved solids’ (TDS)	a measure of the total amount of dissolved matter in the pool water.
‘turnover rate’	the period of time required to achieve complete exchange of total water volume through the filter.
‘UV’	ultraviolet light with a wave length of 254 nanometres.
‘waterslide’	consists of a specially designed flume on a supporting structure with a receiving splash pool at the base of the flume.
‘$\mu W.s/cm^2$’	microwatt second per square centimetre.
‘µg/L’	concentration expressed as micrograms per litre of water.

$\mu g/m^3$’	concentration expressed as micrograms per cubic meter, at a standard temperature and pressure.

CODE OF PRACTICE FOR PUBLIC SWIMMING POOLS/SPA POOLS

1. INTRODUCTION

All people who use public swimming pools and spa pools are susceptible to infection. Public pools are more likely to be exposed to a greater diversity of disease causing organisms than domestic swimming pools because they are open to community contamination. Disease causing organisms may be introduced from many sources but are mainly associated with bathers. These organisms may be brought into a pool on the bathers skin, and in their saliva, urine and faeces. The organisms may also be introduced from dust, birds'droppings, make-up water and soil carried on bathers'feet. Some of these disease causing organisms live and may even grow in pool water unless the pool water is properly and continuously disinfected.

Disease causing organisms must be quickly and effectively killed in the pool water in which they are introduced, otherwise a disease may be transmitted. The swimming pool or spa pool needs to be designed and operated to enhance the action of the disinfectant. **All treated water in public swimming pools and public spa pools shall be equipped with an effective water circulation system and filter. It is recommended that public swimming/spa pools also be fitted with an automatic disinfectant dosing system and pH correction system using automatic controllers receiving feedback information from chemical sensing probe.** Continuous dosing should include a metering device to feed a chemical at a relatively constant rate. Continuous dosing does not include the use of a floating dispenser containing a dissolving chemical.

This code of practice specifies the **minimum** chemical criteria (see Annexures B and C) by which a swimming pool and spa pool must be operated to minimise public bather risk to acceptable levels. It is important for people who are responsible for pool operation to maintain their pools at a standard equal to or greater than these guidelines at all times the pool is open to the public.

Where a swimming pool, spa pool, hydrotherapy pool or waterslide is available for use by the public, the owner of the facility must ensure that the pool is under the control and management of a person who is knowledgeable and competent in the operation of the plant and maintenance of pool water quality. Whilst the facility is available for use by the public it is the responsibility of the owner and the pool operator to ensure pool water quality is maintained in accordance with the requirements of this code of practice. The knowledge and competence of the operator may be assessed by the standard of the water quality within the swimming pool or spa pool.

Owners of pools covered by this code of practice are responsible for ensuring the pool is correctly operated. Failure to do so may result in legal proceedings being commenced for non-compliance. Where the operator of a pool fails to maintain pool water quality in the manner prescribed, the Department may deem the operator not to be competent and require the owner to provide a person who is competent.

2. HEALTH RISKS

In poorly maintained swimming pools and spa pools people may be at risk from infections caused by a number of microorganisms some of which may be naturally present on our hair or skin or in our ears, mouths, noses, intestinal and uro-genital tracts. The infections may be transmitted by inadequately treated pool water or surfaces (such as shower floors).

2.1 BACTERIAL PATHOGENS

Pseudomonas aeruginosa is the most common disease causing agent associated with waterborne disease outbreaks. It is an opportunistic pathogen and has been identified as the causative agent of eye, ear and skin infections. Its normal habitats are water, soil and vegetation but may also be of human origin. Although relatively resistant to a range of disinfectants, chlorination of normal swimming pools should be sufficient to kill the bacterium. In environments such as spas where water can be turbid, temperatures elevated and bather-loads heavy, considerably greater care is needed to ensure eradication of this organism.

Legionella spp. causes a serious pneumonic disease known as Legionnaires' disease and a less debilitating disease called Pontiac fever. They are found in the natural environment, such as soil, rivers, lakes and creeks. The great majority of outbreaks have been associated with air conditioning cooling systems although spa pools have also been implicated. Legionellosis is caused through inhalation of contaminated aerosols.

Coagulase positive staphylococci have been regularly isolated from swimming pools and spa pools as they are normal microflora of the skin, ear and nose. These microorganisms can cause skin infections, such as boils, carbuncles and wound infections. They are fairly resistant to disinfection but have not been shown to be a public health problem in well maintained pools.

Mycobacterium marinum causes chronic skin ulceration known as ‘swimming pool granuloma’ which may last up to three years if untreated.

2.2 PROTOZOAN PATHOGENS

Cryptosporidium and *Giardia*, are protozoan single celled organisms which may be excreted by infected humans into swimming pools through faecal accidents and may cause outbreaks of diarrhoea. A carrier state exists where humans may be infected without showing obvious symptoms. Chlorination at recommended levels has limited effect on *Giardia* and is completely ineffective against *Cryptosporidium* oocysts. Regular ‘dumping’ of pool water and filtration using flocculation and coagulation agents of pool water and regular superchlorination to 10 mg/L aid in the removal of these parasites. It is more important to prevent the entry of these organisms into the pool and strategies such as requiring all bathers to wear swimming costumes at all times or exclusion of incontinent persons must be considered as appropriate strategies.

Naegleria fowleri is a pathogenic free-living amoeba which has been shown to cause a fatal disease called primary amoebic meningo-encephalitis. The disease is contracted by invasion of the amoeba through the nose into the brain. In nature, the organism thrives in mineral springs, thermal bores, rivers and lakes. These waters are generally heated above 25 C, which assists the parasite in its metabolism and survival.

2.3 VIRAL PATHOGENS

Enteroviruses are the major causative agents of swimming pool gastroenteritis, They are most frequently found in wading pools used by infants and young children where bather hygiene is poor and water volume is small.

Adenoviruses types 3 and 4 cause pharyngoconjunctival fever amongst bathers. The disease is characterised by sore throat, fever and conjunctivitis frequently associated with diarrhoea.

The Herpes simplex virus causes fever and an unwell feeling. It has been reported to be able to survive for long hours in warm, humid conditions and is spread by persons with cold sores.

Plantar warts are caused by a papovavirus transmitted through contaminated floor surfaces.

2.4 Yeast And Fungal Pathogens

Large numbers of fungi can be found in indoor swimming pools. Athlete's foot or tinea pedis is caused by *Trichophyton mentagrophytes* which can be isolated from the wooden flooring of shower stalls.

3. DISINFECTANTS - GENERAL PROPERTIES

An ideal swimming pool and spa pool disinfectant would produce two extremely important distinct effects:

- a residual bactericidal effect;
- an oxidation effect; and
- radiation.

While some chemicals can provide both, some chemicals can only disinfect or oxidise. Some chemicals may be bactericidal for a short time but rapidly dissipate to leave the pool without a residual protection. It is important to be able to measure the amount of disinfectant in the pool water or to be able to measure the disinfection power of the disinfectant. There is no ideal disinfectant as all disinfectants have their relative strengths and weaknesses. Before a disinfectant or disinfectant system is installed it is recommended that advice from a pool professional or consulting engineer be sought.

When a particular disinfectant or disinfecting system is chosen the criteria specified in the Annexures B or C must be followed. Some suitable disinfectants are:

3.1 Chlorine

The disinfectant form of chlorine is free residual chlorine' It is also known as free available chlorine'or free chlorine'and all terms refer to the concentration of hypochlorous acid and the hypochlorite ion in equilibrium concentration in pool water. It is strong and safe when used properly and is still the most popular form of disinfection. There is much material available on the techniques of chlorination and "breakpoint chlorination" in particular; and breakpoint should be achieved before the first chlorine measurements are taken each day. Breakpoint chlorination means that all of the chlorine is available as free chlorine. This is achieved by adding sufficient chlorine to burn out all the combined chlorine, so that free chlorine equals total chlorine.

The higher the pH above 7 the less the disinfection power of free chlorine. The pH needs to be properly controlled in a swimming pool and spa pool when chlorine is used and automatic adjustment is recommended to levels between 7.2 and 7.8.

Free residual chlorine can also oxidise ammonia, some other organic compounds and some organic nitrogen introduced into the pool by urine or perspiration. Free chlorine however can combine with ammonia to form compounds, known as chloramines, which cause eye stinging and which also reduces the ability of chlorine to disinfect particularly in indoor pools. Chloramines are also known as ‘combined residual chlorine’and should be kept to a minimum. This is done by adding more chlorine to oxidise them over a period of time without bathers in the pool. To explain this more fully an appropriate text should be studied (for example Australian Standard AS 3633).

Chlorine is available in many forms and not all forms are appropriate for all applications. Calcium hypochlorite (powdered or granular chlorine) for example should not be used in hot spas as it may promote scaling on heat exchangers and on hot water control valves which may lead poor temperature control and, in the worst case, to scalding. Cyanurated chlorine (stabilised chlorine) should not be used in indoor pools. Bromine may be used as a trace disinfectant to reduce the adverse effects of chlorine.

3.2 BROMINE

Bromine is a weaker disinfectant than its chlorine equivalent and to achieve similar disinfection bromine needs to be at concentrations of at least 50 % to 60 % higher than chlorine and this is recognised in the chemical criteria of this code of practice. Bromine reacts with nitrogenous compounds in a similar way to chlorine to produce bromamines. They do not however, cause the serious bather discomfort as do chloramines. There are fewer complaints of eye irritation and obnoxious chemical related odours when bromine is used as a disinfectant. This makes bromine more suited to indoor pools. The test method cannot differentiate between free and combined bromine. This is not so important because free bromine and combined bromine have a similar disinfection efficiency.

Bromine may be used as bromochlorodimethylhydantoin (BCDMH) or alternately as a bromide bank system with activation by chlorine. Bromine is less stable than chlorine when exposed to ultra violet light but unlike chlorine cannot be stabilised and is therefore less suitable for outdoor pools than chlorine. A stabilised chloro/bromide system may also be considered.

As pH increases disinfection power is lost. However, the loss of disinfection power is less than that experienced by chlorine over the swimming pool and spa pool pH range of 7.2 to 7.8.

3.3 SALT WATER CHLORINATION (ELECTROLYSIS)

Salt water chlorination is the process of electrolysis of salt water. The electrodes produce chlorine and hydrogen in gaseous form at a constant rate determined by the salinity of the pool water. It is important to maintain correct salinity levels or the chlorination production rate declines. While hydrogen may be liberated as a gas the chlorine rapidly dissolves to form free chlorine’and follows the usual chlorine swimming pool chemistry, except that the chloride ion may reform and be available again for conversion in electrolysis. Salt water chlorination does not have the ability to respond adequately to shock loadings and a backup continuous dosing system or a bank of electrolysis units should also be provided. Overnight and supplementary slug hand dosing with chlorine compounds may be required. Slug dosing should never be done within three hours before bathers are admitted to the swimming pool or while people are bathing.

3.4 *ISOCYANURATED CHLORINE COMPOUNDS (STABILISER)*

Isocyanurated chlorine compounds and isocyanuric acid are used to stabilise chlorine against losses due to ultra violet light in direct sunlight. Chlorinated isocyanurates, when dissolved in water, provide free chlorine. All isocyanurated chlorine compounds (except sodium dichloroisocyanurate) when added to water tend to lower the pH by varying amounts. The use of isocyanurated chlorine is optional.

Isocyanurates must not be used under any circumstances in an indoor pool or indoor spa because of decreased rates of kill of some disease causing organisms and the increase in the delay of initiation of kill. Isocyanurates do not have any effect on bromine nor do excessive levels pose a health risk.

3.5 *OZONE*

Ozone (0_3)is an unstable blue gas with a characteristic pungent odour. It is produced commercially from clean, cool, dry air or oxygen formed by the discharge of high voltage (4000 to 30,000 V) electricity. Ozone may also be produced as a by product' by specific wavelength ultraviolet lamps. At air concentrations of 0.25 mg/m^3 it is considered injurious to health. Its occupational threshold limit value is 0.2 mg/m^3 in air. At 1.0 mg/m^3 in air it is extremely hazardous to health.

It is a short lived, unstable but powerful oxidising and disinfection agent which does not react with porcelain or glass. Ozone disappears quickly from water. This is advantageous from the point of view that such a hazardous agent quickly disappears but disadvantageous from the point of view that no satisfactory disinfectant residual is provided in the pool itself. Ozone may not be used as the sole disinfectant in a public swimming pool or public spa pool but may be used in conjunction with chlorine or bromine. Where ozone is used with chlorine a reduction of free chlorine is permitted provided mainstream ozonation is practised and the ozone is quenched using a bed of activated carbon preventing ozone from degassing in the swimming pool.

Where ozone is used in conjunction with bromine an activated carbon filter bed is not required provided that there is always an excess concentration of bromide in the water to ensure the complete destruction of residual ozone.

3.6 *UV LIGHT*

Ultraviolet light (UV) has been used as a swimming pool and spa pool water disinfectant throughout the world for many years. Hydrotherapy pools and spa pools disinfected with UV light and hydrogen peroxide are becoming popular with bathers who are sensitive to chlorine or bromine products. Since UV light itself processes no residual effect a secondary disinfectant must be added to the water. Either chlorine or hydrogen peroxide may be used as the residual disinfectant. UV light plus hydrogen peroxide does not cause unpleasant odours, taste and does not cause skin or eye irritation. UV light plus chlorine reduces the problems of chloramine production, which can make pool facilities unpleasant for swimmers. Chloramines can cause eye and respiratory irritation and have a strong and unpleasant odour especially in indoor centres.

The following must be observed when using UV light as a method to disinfect pool water.

- UV light plus hydrogen peroxide or chlorine is approved for disinfecting indoor pools up to 500,000 litres in capacity.
- The UV light dose must be ≥30,000 μW.s/cm^2.
- Each UV light cabinet must have a device with a meter to indicate the number of hours each light tube has been in operation. Each tube must be replaced on or before 7500 hours of use.
- A photo-electric cell that measures the UV light intensity through the water column whilst the system is in operation is to be used with the intensity displayed on a meter visible to the operator or an Authorised Officer.
- The system must shut down automatically with the activation of an alarm when the UV light dose rate drops below 30,000 μW.s/cm^2. Alarms must comprise audible and visible (indication light) components, with muting facilities for the audible components. The alarm must be located in a prominent location with an external flashing light.
- Disinfection only occurs when water is passed through the UV unit. There is no anti-microbial effect in other parts of the pool. Therefore, in order to provide residual disinfection, hydrogen peroxide or chlorine must be used in conjunction with ultraviolet light.
- The water should have a pH value between 7.2 and 7.6.
- The total alkalinity should be between 60 mg/L and 200 mg/L.

3.7 Hydrogen Peroxide And UV

Hydrogen peroxide is a strong oxidising chemical that can be used with UV disinfection. It is a clear colourless non-flammable liquid. Compared with chlorine, hydrogen peroxide has a 1.3 times greater oxidising potential. Hydrogen peroxide decomposes in the presence of contaminants, sunlight or heat. Although it is a strong oxidiser, when used alone it is not a bactericide and only selectively effects certain organisms.

Hydrogen peroxide will tend to increase the pH of the water. High pH will cause greater consumption of hydrogen peroxide. Scaling, corrosion and bather comfort is also affected by pH and although less critical for other disinfection systems, pH needs to be monitored and maintained in the usual range for swimming pool water. When combined with UV light hydrogen peroxide provides a potent means of disinfection.

When irradiated with UV light the hydrogen peroxide molecule is split in half to form two hydroxyl radicals which are highly reactive. They are quickly consumed by reaction with any matter that can be oxidised, such as the genetic material in micro-organisms. Oxygen and hydrogen are also released, and are rapidly used up in reactions with organic matter including micro-organisms. These reactions are extremely rapid, occurring entirely within the UV cabinet, hence posing no risk to bathers.

Hydrogen peroxide can also improve the water quality by oxidising dissolved or suspended organic matter. This process can improve the clarity of pool water and hence the efficiency of disinfection by UV light.

Hydrogen peroxide concentrations can be measured either as a percentage of hydrogen peroxide or as the amount of oxygen it would release if all reacted. Medicinal hydrogen peroxide used as an antiseptic for wounds is usually 3 % (30,000 mg/L). A 3 % solution is said to contain 10 volumes'of oxygen. Industrial hydrogen peroxide is usually 30% and is said to contain 100 volumes'of oxygen or 300,000 mg/L of hydrogen peroxide.

Table 1: Disinfectant Summary

Satisfactory Disinfectant
Chlorine
Isocyanurated Chlorine in outdoor pools
Bromine
Chlorine/Bromine Systems
Ozone with Chlorine
Ozone with Bromine
Hydrogen Peroxide and UV

4. CHEMICALS

4.1 OTHER CHEMICALS

There is a wide range of chemicals which may need to be used in the treatment of swimming pool water apart from disinfectants. The main common named chemicals are:

Soda Ash - (Sodium carbonate) is a strong alkali powder or liquid, which is used to quickly raise the pH of a pool. Soda ash should not be added to a pool by slug dosing but should be added slowly and gradually over an extended period. This is a dangerous chemical and should be handled with care.

Dry Acid - (sodium bisulphate) is a strong acid powder, which may used to quickly reduce pH. Dry acid should not be added to a pool by slug dosing, but should be added slowly and gradually over an extended period. This is a dangerous chemical and should be handled with care.

Muriatic Acid - (hydrochloric acid) is a strong acidic liquid which may also be used to reduce pH quickly particularly when the reserve alkalinity is greater than 120 mg/L. This is a dangerous chemical and should be handled with care.

Carbon Dioxide - is a gas which when added to water forms a weak acid (carbonic acid) and may be used to reduce pH when the reserve alkalinity is less than 120 mg/L. It is best used in an automated pH correction system.

Bicarb - (sodium bicarbonate) is a weak alkali powder, which is used to raise total alkalinity. Slug dosing will not raise the pH to greater than 8.3.

Algaecides - algae are relatively harmless to humans but they may make the pool unsightly, may cause colours, promote bacterial growth, assist in the formation of chloramines and their presence indicates poor pool maintenance. From a safety point of view algae cause slippery pool walls, pool bottoms and walkways. Algae can be introduced into a pool in the form of airborne spores, blowing free in the air attached to dust or enveloped by raindrops. They are mainly associated with outdoor pools as they require sunlight to grow.

The most uniformly accepted algal control procedure is to maintain a free chlorine residual of between 1 to 2 mg/L or where pools are warmer than 26°C a minimum 3 mg/L concentration. A successful technique for algal control is to frequently superchlorinate the swimming pool to 10 mg/L particularly after windy conditions and rainfall. The use of a pool cover to prevent contamination and reduce light intensity may also be helpful. There are a range of algaecides available on the market and their compatibility with the disinfectant system should be determined at the point of sale. Algaecides are an adjunct to pool conditioning for winter.

5. HYGIENE

5.1 Pool Contamination

Each pool premises must prepare a suitable management plan that provides strategies for the:

- prevention of contamination from faecal incontinence; and
- response to contamination from faecal incontinence.

Suitable signs should be erected at appropriate sites within the pool premises.

The pool should be maintained in a clean condition, free from debris and floating materials by frequent vacuuming and skimming. Walls, floors, overflow weirs and scum gutters should be kept free from debris, body grease and algal blooms. No animals except guide dogs should be permitted on the pool premises.

5.2 Emergency Contamination Management

Where blood or vomit is introduced into a pool it should be temporarily cleared and the contamination dispersed until there is no further trace. Tests for disinfectant levels should be satisfactory before allowing people to swim.

Blood spillage on the poolside should not be washed into pool side drains. It should be neutralised with a 1% chlorine solution (appropriate dilution of household bleach) for two minutes before being washed away.

For emergency management of faecal accidents, refer to Part B of this code

6. TESTING

6.1 FREQUENCY OF TESTING

Testing should be carried out in accordance with the frequency specified by Table 4:

Table 2: Testing Frequencies

Test	Minimum Manual Testing Frequency
Continuous non-automatic control dosing: •Free Chlorine •Total Chlorine (Combined Chlorine) •Free Bromine •pH	Prior to opening and thence three hourly
Automatic control dosing: •Free Chlorine •Total Chlorine (Combined Chlorine) •Free Bromine •pH •Redox Potential	Prior to opening and then once during the day to confirm automatic readings. (Automatic readings should be logged four hourly).
•Ozone •Reserve (Total) Alkalinity	Daily
•Isocyanuric Acid •Clarity •Water Balance •Bromide (Sodium bromide systems) •Total Dissolved Solids	Daily
Microbiological Sampling (first two months)	At commissioning or after refill, weekly, else monthly.

6.2 SAMPLING LOCATION

Water samples for testing all chemical parameters except ozone should be collected immediately prior to carrying out the test. Water should be sampled from a depth of at least 300 mm using an inverted plastic beaker in a location representing a point furthermost from inlets, or by assessment of various locations to determine the area of lowest readings.

Water samples for testing **ozone** should be collected immediately prior to carrying out the test. Water should be sampled from a depth of at least 300 mm using an inverted plastic beaker in a location representing a point **closest** to an inlet.

Samples for confirming automatic control dosing should be taken from a sample tap strategically located on the return line as close as possible to the probes in accordance with the manufacturers instructions. As the difference between manual pool readings and automatic control measurements will vary, it is the consistency of variation that is paramount. Diverging or converging readings should be investigated.

Bacteriologic samples should be collected prior to its complimentary chemical parameter sampling. (Note: Bacteriological samples must be collected in sterile containers containing sodium thiosulphate and during times of high bather load.)

6.3 Testing Apparatus

Suitable commercially available testing apparatus shall be used to ensure accurate results. Fresh reagents sealed in foil and in accordance with manufacturers specifications should be purchased just prior to the swimming season or at least once a year. All glassware and plasticware should be thoroughly washed and rinsed after each testing session. The test methodology specified by the manufacturer of the test kit should be strictly followed.

There is no test specified at this time for water clarity. Water clarity should be maintained so that lane markings or other features on the pool bottom at its greatest depth are clearly visible when viewed from the side of the pool.

7. RECORD KEEPING

A register or log should be used to record the results of every test performed at a swimming pool, spa pool or pool complex. There is a wide variety of test register sheet designs which vary according to the type of pool and disinfectants used. There is no ideal test register sheet. Each pool or pool complex should design its own test register sheet according to local needs and recognising the requirements of Section 7.

A register/log is required. This should include details of the test undertaken, the result, date and time.

Other entries may include:

- backwashing,
- total dissolved solids,
- chlorine bottle usage,
- cyanuric acid concentration,
- water meter reading,
- electricity meter readings,
- admission data,
- dose settings,
- mechanical maintenance items,
- chemical stocks on hand,
- weather,
- addition of make-up water;
- water drainage;
- water balancing, and
- general remarks.

The pool manager/operator is responsible for ensuring that pool testing and recording of results is undertaken.

8. TOTAL DISSOLVED SOLIDS

Total dissolved solids (TDS) is a measure of all soluble matter dissolved in pool water. Mains water often has a TDS of several hundred mg/L. All chemicals added to a pool, particularly chlorides and sulphates, increase the TDS level and a high level is an indication of chemical overload or lack of dilution of pool water. The TDS of the pool should be regularly compared to that of the mains water. As a general rule TDS should not rise greater than 1,000 mg/L above the mains water and should not be permitted to rise to an absolute of 3,000 mg/L. TDS is lowered by regularly dumping of water and adding fresh water. This has lead to the popular conception in spa pool management that a minimum of one quarter of the spa water should be dumped each week.

9. BACTERIOLOGICAL STANDARD FOR TREATED WATER PUBLIC POOL

To ensure that a public swimming pool or public spa pool does not pose a risk to the health of the general public the pool water should be tested for certain organisms using the methods set out in Table 3 of Annexure A. Other test methods may be used provided that they have superior or equivalent sensitivity. Public swimming pool water and public spa pool water which is tested according to Table 3 of Appendix A is considered safe at the time of sampling when the test results comply with the bacteriological standard set out in Table 4 of Annexure A.

It is recommended that a bacteriological sample for each public swimming pool and public spa pool be submitted to a NATA or equivalent registered private analyst every month of continuous operation. Immediate resampling for bacteriological analysis should be performed when unsatisfactory results are obtained.

The results of a single sample do not give an indication of overall pool management. The bacterial results obtained should be entered into a database together with the complimentary chemical analysis so that baseline data is obtained on the pool management performance. These results should also be compared to bathing loads at the time of sampling to reflect the impact of this important pool operating parameter.

10. CHEMICAL STANDARD FOR TREATED WATER PUBLIC SWIMMING AND SPA POOLS

The water in a public swimming pool or public spa pool shall be maintained in conformity with the following minimum standards at all times the pool is available for use by bathers, unless the Department grants specific dispensation for the use of a material, process, apparatus or device which is not capable of conforming with the listed standards.

10.1 PUBLIC SWIMMING POOLS STANDARDS

10.1.1 **Chlorination Of A Public Swimming Pool** - ANNEXURE B1

10.1.2 **Bromination Of A Public Swimming Pool** - ANNEXURE B2

10.1.3 **Ozonation With Chlorination Of A Public Swimming Pool** - ANNEXURE B3

10.1.4 Ozonation With Bromination Of A Public Swimming Pool - ANNEXURE B4

10.2 PUBLIC SPA POOLS STANDARDS

10.2.1 Chlorination of a Public Spa Pool - ANNEXURE C1

10.2.2 Bromination of a Public Spa Pool - ANNEXURE C2

10.2.3 Ozonation with Chlorination of a Public Spa Pool - ANNEXURE C3

10.2.4 Ozonation with Bromination of a Public Spa Pool - ANNEXURE C4

10.3 WATER BALANCE

10.3.1 Determination of Chemical Water Balance - ANNEXURE D

ANNEXURE A

Table 3: Test Methods

Type of test	Test Method
Heterotrophic Colony Count	Pour plate method. Incubation for 48 hours at 35 C in accordance with Australian Standard Method AS 4276.3.1 - 1995, or equivalent peer reviewed method.
Thermotolerant coliforms	Australian Standard Method AS 4276.6 - 1995 (MPN Method) or AS 4276.7 - 1995 (Membrane Filtration Method), or equivalent peer reviewed method.
Pseudomonas aeruginosa	Australian Standard Method AS 4276.12 - 1995 (MPN Method) or AS 4276.13 - 1995 (Membrane Filtration Method), or equivalent peer reviewed method.

Table 4: Bacteriological Criteria

Type of Organism	Maximum Count Allowable
Heterotrophic Plate Count	100 Colony Forming Units (cfu) per mL.
Thermotolerant coliforms	Nil per 100 mL
Pseudomonas aeruginosa	Nil per 100 mL

ANNEXURE B1

CHLORINATION OF A PUBLIC SWIMMING POOL

Where water in a public swimming pool is being disinfected with a chlorine disinfectant it shall be maintained, when the pool is open for bathing, in accordance with the following parameters:

1. The swimming pool water shall be disinfected using continuous dosing equipment.

2. The chemical parameters of the swimming pool water shall conform to Table 7:

Table 5: Chemical Requirements for Chlorinated Public Swimming Pools

Chemical Parameters for Pool Type					
Pool Type	Free Chlorine (mg/L) minimum	Total Chlorine (mg/L) maximum	Combined Chlorine (mg/L) maximum	pH range	Total Alkalinity (mg/L) range
Outdoor	1.0	10.0	1.0	7.2 - 7.8	80 - 200
Outdoor stabilised with isocyanuric acid <26°C	3.0	10.0	Not Applicable	7.2 - 7.8	80 - 200
Outdoor stabilised with isocyanuric acid ≥ 26°C	4.0	10.0	Not Applicable	7.2 -7.8	80 - 200
Indoor - temperature < 26°C	1.5	10.0	1.0	7.2 - 7.8	80 - 200
Indoor - temperature ≥ 26°C	2.0	10.0	1.0	7.2 - 7.8	80 - 200

NOTE: Combined chlorine shall not exceed half the total chlorine concentration.

3. The maximum chlorine stabilising isocyanuric acid level in an outdoor pool is 100 mg/L . No isocyanurate containing chemical shall be used in indoor swimming pools.

4. Where automatic dosing equipment using oxidation reduction potential (ORP) is installed the ORP shall be set to the equivalence of the minimum free chlorine concentration in Table 7 and shall not be less than 720 mV.

5. Where automatic dosing using amperometric control is installed it shall be set to follow the requirements of Table 7.

6. Results of all chemical tests and the date and time of testing are to be entered into a log and kept onsite.

ANNEXURE B2

BROMINATION OF A PUBLIC SWIMMING POOL

Where water in a public swimming pool is being disinfected with a bromine disinfectant it shall be maintained, when the pool is open for bathing, in accordance with the following parameters:

1. The swimming pool water shall be disinfected using continuous dosing equipment.

2. The chemical parameters of the swimming pool water shall conform to Table 8:

Table 6: Chemical Requirements for Brominated Public Swimming Pool

Chemical Parameters for Pool Type				
Pool Type	Free Bromine (mg/L) minimum	Total Bromine (mg/L) maximum	pH range	Total Alkalinity (mg/L) range
Outdoor	2.25	9.0	7.2 - 7.8	80 - 200
Indoor - temperature < 26°C	3.5	9.0	7.2 - 7.8	80 - 200
Indoor - temperature ≥ 26°C	4.5	9.0	7.2 - 7.8	80 - 200

3. Where the sodium bromide plus hypochlorite process is used the minimum bromide concentration shall be 9 mg/L.

4. Where bromochlorodimethylhydantoin is used the maximum dimethylhydantoin concentration shall be 200 mg/L.

5. Where automatic dosing equipment is installed it may control pH and disinfectant concentrations.

6. Where automatic dosing equipment using oxidation reduction potential (ORP) is installed the ORP shall be set at the equivalence of the minimum free bromine concentration in Table 8 and shall be not less than 700 mV.

7. Where automatic dosing using amperometric control is installed it shall be set to follow the requirements of Table 8.

8. Results of all chemical tests and the date and time of testing are to be entered into a log and kept onsite.

ANNEXURE B3

OZONATION AND CHLORINATION OF A PUBLIC SWIMMING POOL

Where water in a public swimming pool is being disinfected with ozone and chlorine it shall be maintained, when the pool is open for bathing, in accordance with the following parameters:

1. The swimming pool water shall be disinfected using continuous dosing equipment.

2. The ozone shall be generated by the corona discharge method and dosed in a closed system.

3. Residual excess ozone in the treated water shall be quenched with an activated carbon filter bed prior to the water being returned to the swimming pool.

4. Where **slipstream** ozonation is used (where 20 % of the total water flow is ozonated) the chemical parameters of the pool water shall conform to Table 9:

Table 7: Chemical Requirements for Slipstream Ozonation and Chlorination of a Public Swimming Pool

Chemical Parameters for Pool Type					
Pool Type	Free Chlorine (mg/L) minimum	Total Chlorine (mg/L) maximum	Combined Chlorine (mg/L) maximum	pH range	Total Alkalinity (mg/L) range
Outdoor	1.0	10.0	1.0	7.2 - 7.8	80 - 200
Indoor - temperature < 26°C	1.5	10.0	1.0	7.2 - 7.8	80 - 200
Indoor - temperature ≥ 26°C	2.0	10.0	1.0	7.2 - 7.8	80 - 200

NOTE: Combined chlorine shall also not exceed half the total chlorine concentration.

5. Where automatic dosing equipment using oxidation reduction potential (ORP) is installed in the sidestream ozonation process the ORP shall be set to the equivalence of the minimum free chlorine concentration in Table 9 and shall be not less than 750 mV.

6. Reduced Chlorine Concentrations

6.1 Where mainstream ozonation is used the chemical parameters of the pool water shall conform with Table 10 (provided the chlorination dosing plant is capable of delivering the chlorine levels specified in Table 9 where ozonation fails):

6.2 Where automatic dosing equipment using redox potential (ORP) is installed in the mainstream ozonation process the ORP shall be set to the equivalence of the minimum free chlorine concentration in Table 10 and shall be not less than 720 mV .

Table 8: Chemical Requirements for Mainstream Ozonation and Chlorination of Public Swimming Pools

Chemical Parameters for Pool Type					
Pool Type	Free Chlorine (mg/L) minimum	Total Chlorine (mg/L) maximum	Combined Chlorine (mg/L) maximum	pH range	Total Alkalinity (mg/L) range
Outdoor	1.0	10.0	1.0	7.2 - 7.8	80 - 200
Indoor - temperature < 26°C	1.0	10.0	1.0	7.2 - 7.8	80 - 200
Indoor - temperature ≥ 26°C	1.5	10.0	1.0	7.2 - 7.8	80 - 200

7. The contact time between the pool water and ozone shall be at least 2 minutes at an ozone concentration of 1 mg/L with injection prior to filtration and 0.8 mg/L with injection after filtration.

8. Where automatic dosing equipment is installed it may control pH and disinfectant concentrations.

9. Where automatic dosing using amperometric control is installed it shall be set to follow the requirements of Tables 9 and 10.

10. Results of all chemical tests and the date and time of testing are to be entered into a log and kept onsite.

ANNEXURE B4

OZONATION AND BROMINATION OF A PUBLIC SWIMMING POOL

Where water in a public swimming pool is being disinfected with ozone and bromine it shall be maintained, when the pool is open for bathing, in accordance with the following parameters:

1. The swimming pool water shall be disinfected using continuous dosing equipment.

2. The ozone shall be generated by the corona discharge method and dosed in a closed system.

3. The chemical parameters of the swimming pool water shall conform to Table 11:

Table 9: Chemical Requirements for Ozonation and Bromination of a Public Swimming Pool

Chemical Parameters for Pool Type				
Pool Type	Free Bromine (mg/L) minimum	Total Bromine (mg/L) maximum	pH range	Total Alkalinity (mg/L) range
Outdoor	2.25	9.0	7.2 - 7.8	80 - 200
Indoor - temperature < 26°C	3.5	9.0	7.2 - 7.8	80 - 200
Indoor - temperature ≥ 26°C	4.5	9.0	7.2 - 7.8	80 - 200

4. The minimum calculated bromide concentration shall be 15 mg/L.

5. Where automatic dosing equipment is installed it may control pH and disinfectant concentrations.

6. Where automatic dosing equipment using oxidation reduction potential (ORP) is installed the ORP shall be set to the equivalence of the minimum free bromine concentration in Table 11 and shall be not less than 720 mV.

7. The contact time between the pool water and ozone shall be at least 2 minutes at an ozone concentration of 2 mg/L or sufficient to maintain the free bromine concentrations specified in Table 11.

8. Where automatic dosing using amperometric control is installed it shall be set to follow the requirements of Table 11.

9. A backup disinfection system shall be installed in the case of ozone plant failure.

10. Results of all chemical tests and the date and time of testing are to be entered into a log and kept onsite.

ANNEXURE C1

CHLORINATION OF A PUBLIC SPA POOL

Where water in a public spa pool is being disinfected with a chlorine disinfectant it is recommended that it is maintained, in accordance with the following parameters:

1. The spa pool water shall be disinfected using continuous dosing equipment.

2. The chemical parameters of the spa pool water shall conform to Table 12:

Table 10: Chemical Requirements for Chlorination of a Public Spa Pool

Chemical Parameters for Pool Type					
Pool Type	Free Chlorine (mg/L) minimum	Total Chlorine (mg/L) maximum	Combined Chlorine (mg/L) maximum	pH range	Total Alkalinity (mg/L) range
Spa	2.0	10.0	1.0	7.2 - 7.8	80 - 200

3. Where automatic dosing equipment is installed it may control pH and disinfectant concentrations.

4. Where automatic dosing equipment using oxidation reduction potential (ORP) is installed the ORP shall be set to the equivalence of the free chlorine concentration in Table 12 and shall be not less than 750 mV.

5. A notice shall be exhibited on the premises advising of the dangers of immersion in hot spa pools for longer than 20 minutes.

6. The water temperature shall not exceed 40°C.

7. Isocyanuric acid or isocyanurated compounds shall not be used as disinfection agents.

8. Where automatic dosing using amperometric control is installed it shall be set to follow the requirements of Table 12.

9. Results of all chemical tests and the date and time of testing are to be entered into a log and kept onsite.

ANNEXURE C2

BROMINATION OF A PUBLIC SPA POOL

Where water in a public spa pool is being disinfected with a bromine disinfectant it is recommended that it is maintained, in accordance with the following parameters:

1. The spa pool water shall be disinfected using continuous dosing equipment.
2. The chemical parameters of the spa pool water shall conform to Table 13:

Table 11: Chemical Requirements for Bromination of a Public Spa Pool

Chemical Parameters for Pool Type				
Pool Type	Free Bromine (mg/L) minimum	Total Bromine (mg/L) maximum	pH range	Total Alkalinity (mg/L) range
Spa	4	9.0	7.2 - 7.8	80 - 200

3. Where automatic dosing equipment is installed it may control pH and disinfectant concentrations.
4. Where automatic dosing equipment using oxidation reduction potential (ORP) is installed the ORP shall be set to the equivalence of the minimum free bromine concentration in Table 13 and shall not be less than 720 mV.
5. A notice shall be exhibited on the premises advising of the dangers of immersion in hot spa pools for longer than 20 minutes.
6. The water temperature shall not exceed 40°C.
7. Where automatic dosing using amperometric control is installed it shall be set to follow the requirements of Table 13.
8. Results of all chemical tests and the date and time of testing are to be entered into a log and kept onsite.

ANNEXURE C3

OZONATION AND CHLORINATION OF A PUBLIC SPA POOL

Where water in a public spa pool is being disinfected with ozone and chlorine it shall be maintained, when the pool is open for bathing, in accordance with the following parameters:

1. The spa pool water shall be disinfected using continuous dosing equipment.

2. The ozone shall be generated by the corona discharge method and dosed in a closed system.

3. Residual excess ozone in the treated water shall be quenched with an activated carbon filter bed prior to the water being returned to the spa pool.

4. Where ozonation is used the chemical parameters of the pool water shall conform with Table 14:

Table 12: Chemical Requirements for Ozonation and Chlorination of a Public Spa Pool

Chemical Parameters for Pool Type					
Pool Type	Free Chlorine (mg/L) minimum	Total Chlorine (mg/L) maximum	Combined Chlorine (mg/L) maximum	pH range	Total Alkalinity (mg/L) range
Spa	2.0	10.0	1.0	7.2 - 7.8	80 - 200

NOTE: Combined chlorine shall not exceed half the total chlorine concentration.

5. Where automatic dosing equipment is installed it may control pH and disinfectant concentrations.

6. Where automatic dosing equipment using oxidation reduction potential (ORP) is installed the ORP shall be set to the equivalence of the minimum free chlorine concentration in Table 14 and shall be not less than 750 mV.

7. A notice shall be exhibited on the premises advising of the dangers of immersion in hot spa pools for longer than 20 minutes.

8. The water temperature shall not exceed 40°C.

9. Isocyanuric acid or isocyanurated compounds shall not be used as disinfection agents.

10. Where automatic dosing using amperometric control is installed it shall be set to follow the requirements of Table 14.

11. The contact time between the pool water and ozone shall be at least 2 minutes at an ozone concentration of 1 mg/L with injection prior to filtration and 0.8 mg/L with injection after filtration.

12. A backup disinfection system shall be installed in the case of ozone plant failure.

RESULTS OF ALL CHEMICAL TESTS AND THE DATE AND TIME OF TESTING ARE TO BE ENTERED INTO A LOG AND KEPT ONSITE.

ANNEXURE C4

OZONATION AND BROMINATION OF A PUBLIC SPA POOL

When water in a public spa pool is being disinfected with ozone and bromine it is recommended that it is maintained in accordance with the following parameters:

1. The spa pool water shall be disinfected using continuous dosing equipment.

2. The ozone shall be generated by the corona discharge method and dosed in a closed system.

3. The chemical parameters of the swimming pool water shall conform to Table 15:

Table 13: Chemical Requirements of Ozonation and Bromination of a Public Spa Pool

Chemical Parameters for Pool Type				
Pool Type	Free Bromine (mg/L) minimum	Total Bromine (mg/L) maximum	pH range	Total Alkalinity (mg/L) range
Spa	4.5	9.0	7.2 - 7.8	80 - 200

4. The minimum calculated bromide concentration shall be 15 mg/L.

5. Where automatic dosing equipment is installed it may control pH and disinfectant concentrations.

6. The contact time between the pool water and ozone shall be at least 2 minutes at an ozone concentration of 2 mg/L or sufficient to maintain the bromine level in Table 15.

7. Where automatic dosing equipment using oxidation reduction potential (ORP) is installed the ORP shall be set to the equivalence of the free bromine concentration in Table 15 and shall be not less than 720 mV.

8. A notice shall be exhibited on the premises advising of the dangers of immersion in hot spa pools for longer than 20 minutes.

9. The water temperature shall not exceed 40°C.

10. Where automatic dosing using amperometric control is installed it shall be set to follow the requirements of Table 15.

11. Results of all chemical tests and the date and time of testing are to be entered into a log and kept onsite.

ANNEXURE D

DETERMINATION OF CHEMICAL WATER BALANCE

Refer to Australian Standard 3633 - 1989

ACT DEPARTMENT OF HEALTH AND COMMUNITY CARE

PUBLIC HEALTH RISKS FROM SWIMMING/SPA POOLS

PART B:

INFORMATION ON THE CONTROL OF CRYPTOSPORIDIUM AND GIARDIA

CONTENTS

For enquires related to the Code of Practice, please contact :

Health Protection Service (02) 62051700

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INFORMATON ON PUBLIC HEALTH RISKS FROM SWIMMING/SPA POOLS CONTROL OF CRYPTOSPORIDIUM AND GIARDIA

INTRODUCTION

Cryptosporidium and *Giardia* can be found in surface waters *(lakes, rivers)* and treated waters *(drinking water, swimming pool water)* contaminated by animal and human faeces. Mode of transmission of the diseases can be faecal-oral including person to person, animal to person, foodborne and waterborne.

Cryptosporidium is a minute protozoan parasite of about four to seven micrometres in diameter. It is very resistant to common disinfectants. The parasite infects the intestine and ingestion of as few as one to ten *Cryptosporidium* oocysts may result in infection. An infected person often displays no symptoms but in those who become ill the symptoms may include diarrhoea, vomiting, stomach pains, loss of appetite and low grade fever. The incubation period is between one and twelve days with an average of seven days. The duration of illness in otherwise healthy people is less than two weeks but may last four to six weeks. The disease (cryptosporidiosis*)* may be severe and prolonged in immuno-compromised people. There is no specific treatment for cryptosporidiosis.

Giardia is a minute protozoan parasite of about eight to twelve micrometres in diameter. It is resistant to common disinfectants though not to the same extent as *Cryptosporidium*. Like *Cryptosporidium*, the parasite infects the intestine and ingestion of as few as one to ten *Giardia* cysts may result in infection. An infected person often displays no symptoms, but in those who become ill the symptoms may include diarrhoea, stomach pain, fatigue and weight loss. The incubation period is between three and 25 days with an average of seven to ten days. Specific drug treatment is available for the disease (giardiasis*).*

Cryptosporidiosis and Gardiasis are notifiable diseases in the ACT. Medical practitioners, hospitals and pathology laboratories are required to notify the Chief Health Officer of cases.

SCOPE

This document sets out information concerning the procedures recommended for a multi-barrier risk management approach for the control of *Cryptosporidium* and *Giardia* in swimming pools, leisure pools, spas and hydrotherapy pools in the ACT whether they be commercial, private or public. It provides the **additional** control measures to be initiated over and above those provided for in existing guidelines for the management of pools.

There are many existing guidelines for the management of pools and spas including:

- Standards Australia AS 3633 - 1989 Private Swimming Pools Water Quality.
- National Environmental Health Forum Guidance on Water Quality for Heated Spas Water Series No 2 1996.

- Various state publications e.g. New South Wales Health Department Public Swimming Pool and Spa Pool Guidelines 1996.

DISINFECTION

In addition to disinfection measures recommended in existing guidelines, operators should implement one or more of the following options for ongoing *Cryptosporidium* and *Giardia* control in pool water.

The microscopic size of *Cryptosporidium* and *Giardia* means that common sand and cartridge filters are not totally effective in removing these parasites. They are also resistant to usual pool water disinfectants *(e.g. chlorine, bromine)* at normal operating levels. These characteristics present problems for pool operators in attempting to prevent the spread of disease in the event of the pool becoming contaminated. The following options are available for ongoing *Cryptosporidium* and *Giardia* control in pools:

1. full stream ozone
2. side stream ozone
3. shock dose chlorine dioxide
4. full stream micro-filtration
5. side stream micro-filtration
6. side stream diatomaceous earth filtration
7. ongoing chlorine dosing
8. shock dose chlorine.

Only stabilised chlorine dioxide *(liquid)* is recommended for use in this code of practice.

These options can be categorised by the treatment classification system displayed below in **Table 1**.

Table 1: Treatment Classification System

	Full Stream	Side Stream	On-going Residual	Shock Dose	Chemical	Physical	Inactivation	Removal
1	✓				✓		✓	
2		✓			✓		✓	
3				✓	✓		✓	
4	✓					✓		✓
5		✓				✓		✓
6		✓				✓		✓
7			✓		✓		✓	
8				✓	✓		✓	

Clarification of the terminology used in the treatment classification system is detailed below:

APPROACH

Full Stream

This approach allows treatment by the disinfection method on the entire flow of water in the filtration cycle. This in theory allows disinfection of all water in the pool in one complete water turnover period. However, in practice it may take up to four full water turnover periods in a functioning, well designed pool with excellent circulation and mixing characteristics to achieve 99.5% treatment of the water.

Side Stream

The side stream approach is an alternative to full stream. By treating a smaller percentage of the water flow, this approach hopes to provide acceptable levels of risk management while reducing costs to a level which may be commercially viable for a wider range of pool complexes.

By way of explanation of the side stream concept, if the existing chlorine and filtration system treats all pool water every four hours *(water turnover period)* and the side stream system is designed at 20% of main system capacity, then theoretically every 20 hours all water would be treated by the disinfection method. Again it should be noted that in practice it may take up to four turnover periods to achieve effective treatment of the water with full stream systems. This would require up to 20 water turnover periods for a 20% side stream system.

Ongoing Residual

A method of inactivation in which a constant residual of disinfectant is maintained in the pool water at all times.

Shock Dose

This approach does not offer an on-going treatment but relies on regular shock dosing of the pool water by a disinfection treatment. The theoretical time period for disinfection is therefore not related to the water turnover period of the pool, but to the interval between effective shock dosing *(i.e. daily, weekly, monthly etc.).*

DISINFECTION TREATMENT

Chemical

This category includes all liquids, gases and solids which are added to the pool water to cause a chemical reaction which results in disinfection of the water by inactivation of *Cryptosporidium* oocysts and *Giardia* cysts.

Physical

Any method which relies on physical removal or entrapment of the *Cryptosporidium* oocysts and *Giardia* cysts.

DISINFECTION TYPE

<u>Inactivation</u>

The result of a disinfection treatment which inactivates the *Cryptosporidium* oocysts and *Giardia* cysts causing them to become non-viable.

Removal
The result of a filtration treatment which physically removes *Cryptosporidium* oocysts and *Giardia* cysts from the pool water.

The following section discusses treatment options including effectiveness and cost. It is suggested that pool operators seek advice from industry as to specific costs for individual needs.

Full Stream Ozonation

Research undertaken into proven methods of disinfection for *Cryptosporidium* and *Giardia* consistently identifies ozonation as the most effective treatment. This literature suggests a contact time *(C.t)* value *(multiplication of the disinfection concentration in mg/L and the time in minutes required to inactivate a particular parasite)* for ozone of between five and ten. This results in inactivation of >99% in normal swimming pool temperatures and pH levels. If sufficient concentrations and contact time are assured, then this process should theoretically provide >99% inactivation of *Cryptosporidium* and *Giardia* in one water turnover period. Again it should be noted that in practice it may require up to four turnover periods to provide effective treatment of all of the water.

Side Stream Ozonation

The literature suggests a C.t value of between five and ten for *Cryptosporidium* and *Giardia.* This results in inactivation of > 99% in normal swimming pool temperatures and pH levels. The side stream approach only treats a specified percentage of the water each water turnover period and is therefore less effective than full stream ozone. The theoretical time period for inactivation is related to the water turnover period, pool design, actual circulation pattern and is dependent on the percentage of the main stream flow which is being treated. In practice, effective treatment of the water may not be achieved in less than four turnover periods in a full stream system. A side stream system needs to be adjusted proportionately. A range of 25-40% of full flow is suggested.

Shock Dose Chlorine Dioxide

Research has identified chlorine dioxide as an effective *Cryptosporidium* and *Giardia* disinfectant agent. This research suggests a C.t value of 78 and results in inactivation of >90% for both parasites at normal swimming pool temperatures and pH levels.

The effectiveness of the shock dosing method as a *Cryptosporidium* and *Giardia* control option is not only reliant on the concentration and contact time of the dosing, but on the regularity of these doses. This shock dosing method should be carried out overnight due to degradation by sunlight and is recommended on a weekly basis during peak season for commercial operations. A 0.25 mg/L concentrated dose for six hours is suggested for this option.

Full Stream Micro-Filtration

Literature suggests that an *'absolute one micron rated filter'* will remove *Cryptosporidium* oocysts and *Giardia* cysts.

Side Stream Micro-Filtration

The literature suggests that an *'absolute one micron rated filter'* will remove *Cryptosporidium* oocysts and *Giardia* cysts. However, the side stream micro-filtration approach requires a greater number of water turnovers to achieve the same result as full stream micro-filtration.

Side Stream Diatomaceous Earth Filtration

Diatomaceous earth filtration has the capacity to remove particles of three to five microns in size and whilst not guaranteeing 100% removal of *Cryptosporidium* oocysts, does provide another barrier in the control of *Cryptosporidium* and *Giardia*.

On-Going Chlorine Dosing

On-going chlorine dosing of pools is not necessarily an additional method of control as this may be part of best practice pool management. However, an increase in the average level of free chlorine should result in some measure of control over *Cryptosporidium* and more particularly *Giardia* which is more susceptible to disinfectants.

Research on the effectiveness of chlorine as an effective *Cryptosporidium* and *Giardia* disinfection solution conflicts. A C.t value of 7,200 for 90% inactivation has been adopted based on the consensus of the literature reviewed. Increasing the average level of free chlorine above that recommended for normal pool operation (e.g. 2 mg/L to 4 mg/L) should result in a reduction in the inactivation time period, but this should not be assumed to be a direct linear increase.

Shock Dose Chlorine

It has been assumed for the purposes of this Code of Practice that chlorine has a C.t value of 7,200 for 90% *Cryptosporidium* and *Giardia* inactivation at normal pool water temperatures and pH. Using this value, concentrations and contact time can be measured for shock dosing at regular intervals.

Similar to chlorine dioxide shock dosing, the effectiveness of this option is reliant on the concentration and contact time of the dosing as well as the regularity of these doses. Shock dosing should be carried out overnight on a weekly basis during peak season for commercial operations.

A 40 mg/L concentrated dose for three hours is suggested for this option.

Following shock dosing, the water should be dechlorinated using sodium thiosulphate and the water chemistry balanced.

For commercial operators where pool water is not discarded annually, consideration should be given to the form of chlorine used for shock dosing. Advice should be sought from industry.

POOL SAMPLING AND REMEDIATION PROCESSES

Pool water becomes contaminated with *Cryptosporidium* or *Giardia* when an infected person excretes the oocysts or cysts into the water. Sampling of the water for *Cryptosporidium* and *Giardia* will only provide a result for the actual volume of water sampled at a point in time and will not ensure ongoing safety from infection.

A regular program of sampling for *Cryptosporidium* and *Giardia* is **not** recommended as proper attention to pool design, maintenance and operation are the most effective measures to control the risks of disease. However, it is recognised that some pool operators may choose to carry out sampling on their own initiative at any time.

Where evidence suggests a particular pool may be associated with cases of disease, the ACT Department of Health and Community Care will undertake an investigation including sampling of the pool. Where *Cryptosporidium* oocysts or *Giardia* cysts in samples are obtained from a pool, the ACT Department of Health and Community Care may recommend the pools closure.

Where a pool operator chooses not to act on this recommendation, the ACT Department of Health and community Care may invoke legislative powers under the *Public Health Act 1997* to minimise risk to public health.

Pool remediation will be required to be conducted.

The re-opening of pools closed voluntarily by the pool operator or by the ACT Department of Health and Community Care will be based on a nil viable oocyst or cyst presence in the water. If viability testing is not available, re-opening will be based on no oocysts or cysts being detected.

Where pools have tested positive, the following methods of pool remediation have been proven to be successful:

DISINFECTION BY SHOCK DOSING WITH CHLORINE

1. close the pool
2. backwash filters
3. flocculate filters with alum
4. raise the chlorine level to 90 mg/L and operate the plant in filtration mode for one water turnover period
5. ensure all pool elements are activated and therefore treated
6. steam clean all amenities in contact with the pool water
7. backwash filters
8. flocculate filters with alum
9. reduce the chlorine level if necessary to normal operating range using sodium thiosulphate
10. balance water chemistry.
11. sample the pool water for *Cryptosporidium* and *Giardia*
12. a negative test result is required for re-opening

DISINFECTION BY SHOCK DOSING WITH CHLORINE DIOXIDE

1. close the pool
2. backwash filters
3. flocculate filters with alum

4. operate the plant in filtration mode for one water turnover period
5. repeat steps 2 and 3
6. steam clean all amenities in contact with the pool water
7. chemical dose pool water with chlorine dioxide at 2.6 mg/L
8. circulate water for one turnover period
9. ensure all pool elements are activated and therefore treated
10. backwash filters
11. balance water chemistry
12. sample the pool water for *Cryptosporidium* and *Giardia*
13. a negative test result is required for re-opening.

NB This method has proved successful. However further research indicates that a lesser concentration of chlorine dioxide viz 1.25 mg/L for two hours or one water turnover period is equally effective.

PHYSICAL REMOVAL OF POOL WATER

1. empty the pool water to a sanitary sewer or storm water drain following consultation with Environment ACT.
2. thoroughly scrub down the pool surfaces with a commercial detergent/disinfectant
3. drain and steam clean all pipes, pumps, fittings etc.
4. steam clean all amenities in contact with the pool water
5. change the filter medium
6. refill the pool and return chlorine levels to the normal operating range
7. balance water chemistry
8. sample the pool water for *Cryptosporidium* and *Giardia*
9. two negative test results are required for re-opening

The full completion of any one of the above processes should provide a satisfactory remediation of the pool. The choice of process is dependent upon the size and nature of the pool complex, and available funds and costs.

METHODS FOR THE DETECTION AND ISOLATION OF CRYPTOSPORIDIUM AND GIARDIA IN WATER

Most currently available methods for the detection of *Cryptosporidium* and *Giardia* do not have the ability to detect different species, nor do they have the ability to differentiate between viable and non-viable organisms.

The acceptability of the method used in any private sampling process will be decided by the ACT Department of Health and Community Care when assessing sample results.

Where viability testing is not available, a nil presence of *Cryptosporidium* oocysts or *Giardia* cysts is required to allow re-opening of a pool previously found to be positive. Where viability testing is carried out, a nil presence of viable organisms is required to allow re-opening.