From: BDC_Lgoima
To: [redacted]
Subject: Official Information Request for communication records regarding fluoridation, including policy Ref: OIA 043/23
Date: Tuesday, 27 June 2023 4:28:00 pm
Attachments: image003.png
image005.png

Dear [redacted]

Further to our email to you of 13 June (below), please find attached information related to your LGOIMA request via the below link:

[redacted]

Kind regards

Sean Judd | Acting Chief Executive Officer
DDI 03 788 9614 | Mobile 022 31 00 883 | Email sean.judd@bdc.govt.nz

Buller District Council | Phone 0800 807 239 | bullerdc.govt.nz
PO Box 21 | Westport 7866

Community Driven | One Team | Future Focused | Integrity | We Care

From: BDC_Lgoima
Sent: Tuesday, June 13, 2023 2:01 PM
To: [redacted]
Subject: Official Information Request for communication records regarding fluoridation, including policy Ref: OIA 043/23

Dear [redacted]

We refer to your official information request dated 15 May 2023 for:

1. all communication between the mayor and anyone else that discusses the subject of fluoridation/fluoride anywhere within the communication, Please note fluoridation and fluoride are often mis-spelt flouridation and flouride so please include these misspelled words in your search.
2. All policy papers and/or advice prepared for the mayor and/or councillors about

fluoridation

We have decided to grant your request. However, it will take us some time to prepare the information for release. **We will send you this information by 27 June (10 working days).**

You have the right to seek an investigation and review by the Ombudsman of this decision. Information about how to make a complaint is available at www.ombudsman.parliament.nz or freephone 0800 802 602.

If you wish to discuss this decision with us, please feel free to contact the Buller District Council by return email to lgoima@bdc.govt.nz.

Please note that it is our policy to proactively release our responses to official information requests where possible. Our response to your request will be published shortly at https://bullerdc.govt.nz/district-council/your-council/request-for-official-information/responses-to-lgoima-requests/ with your personal information removed.

Kind regards

Sean Judd | Acting Chief Executive Officer
DDI 03 788 9614 | Mobile 022 31 00 883 | Email sean.judd@bdc.govt.nz

Buller District Council | Phone 0800 807 239 | bullerdc.govt.nz
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BULLER DISTRICT COUNCIL
Te Kaunihera O Kawatiri

WEST COAST
UNTAMED NATURAL WILDERNESS

Update Workshop

14 December 2022

Community Water Fluoridation

INFORMATION

BULLER DISTRICT COUNCIL

1

Community Water Fluoridation Workstream

Agenda

1. Welcome and introductions

2. Upcoming deliverables from the Ministry of Health:

    a. Letter dated 11 November 2021, what it means for BDC
    b. Community Water Fluoridation FAQ's
    c. Letter dated 3 November 2022, Notification of Active Consideration

3. Community Water Fluoridation Papers/Reports:

    a. ERPRO, Drinking Water Fluoridation Background and Cost Estimate
    b. CH2M Beca, Water Fluoridation Engineering Costs
    c. Water NZ, Fluoridation of Drinking Water Supplies in New Zealand

4. Any questions or concerns

5. Future webinars

Community Water Fluoridation Workstream

Ministry of Health Community Water Fluoridation (workstream)

	What is it?	When will Councils receive it?	What happens next?
Key Content of the New Legislation (Letter 1)	Key Content of the New Legislation	Received	Implementation will be phased over time (12 mths)
Resources for Communities	Web based information	Received	www.fluoridefacts.govt.nz/ www.pmcsa.ac.nz/topics/fluoridation-an-update-on-evidence/
Notification of Active Consideration (Letter 2)	Formal active consideration whether to issue a direction	Received	Councils are asked to reply by 2 February 2023

Community Water Fluoridation Workstream

Community Water Fluoridation Papers/Reports

Content

The Director General of Health is required to consider for each individual drinking water supply:

- Scientific evidence on the effectiveness of adding fluoride to drinking water in reducing the prevalence and severity of dental decay
- Whether the benefits of adding fluoride to the drinking water outweigh the financial costs, taking into account:
  - The state or likely state of the oral health of the local community or population group associated with the water supply
  - The number of people who are reasonably likely to receive drinking water from the local authority supply
  - The likely financial costs and savings of adding fluoride to the drinking water, including any additional costs of ongoing management and monitoring

- Estimated costs for BDC to introduce fluoride to Westport & Reefton
- Timeline to implement and have operational
- No requirement for consultation with our communities????
- Timeline for BDC to reply with information to Ministry of Health (2 February 2023)
- designations
- Expected increase in targeted rates or levies

Next steps

We'll use the outcomes from this workshop to prepare the reply back to Ministry of Health by the 2 February 2023

Community Water Fluoridation Workstream

Any questions?

Community water fluoridation

Only around half of all New Zealanders receive fluoridated drinking water. Until now, it's been up to local authorities (councils) to make decisions around fluoridating their water supplies. The Director-General of Health now has the authority to decide if community drinking water supplies should be fluoridated.

What is water fluoridation?

Fluoride already exists in water. Water fluoridation is when the natural level of fluoride in the water supply is topped up to between 0.7 ppm and 1.0 ppm. This is the ideal amount for giving protection against tooth decay. This is recommended by many national and international health bodies, including the World Health Organization.

The Ministry of Health recommends water fluoridation as a safe and effective way to prevent and reduce tooth decay for everyone. The levels of fluoride in water are carefully monitored.

Is it safe?

The role of fluoride in water has been examined around the world – including in New Zealand – over the last 60 years. There is strong evidence that there are no adverse effects of any significance from fluoridation at the levels used in New Zealand, and that it is beneficial to New Zealanders of all ages. This is especially true for our most vulnerable communities

Is it effective?

Fluoride in water like a constant repair kit. It neutralises the effect of acids that cause decay and helps to repair damage before it becomes permanent.

The most recent New Zealand Oral Health Survey (2009) shows that children and adolescents have 40 percent less tooth decay over their lifetime if they live in areas with fluoridated water.

The government estimates that introducing community water fluoridation to all public drinking water supplies would result in net savings of more than $600 million over 20 years - mostly to consumers, and some to government?

How will decisions about community water fluoridation be made?

The new legislation allows the Director-General to make decisions about fluoridating public water supplies only. They cannot direct the fluoridation of privately-owned water supplies.

Before issuing a direction to fluoridate a water supply, the Director-General must invite the affected local authority to give information in writing on the estimated cost and timing for introducing fluoridation.

The new legislation requires the Director-General of Health to consider the scientific evidence of the effectiveness of fluoridation in reducing dental decay, and whether the benefits outweigh the financial costs. They must consider the oral health status (or likely oral health status) of the local community, the size of the water supply and how much it's likely to cost to introduce fluoridation.

The Director-General of Health is required under the new legislation to seek advice from the Director of Public Health before issuing a direction. They may also consider other factors or views. The new legislation does not require local authorities to consult with their communities on decisions around fluoridating their water supplies.

Local authorities that are currently fluoridating drinking water supplies must continue to do so.

When will the Director-General of Health start issuing directions?

We expect the Director-General of Health could start issuing directions regarding some community water supplies from mid-2022. It is expected that implementation will be phased over time. The Ministry will be engaging further with local authorities about implementation in late 2021 and early 2022.

The Director-General of Health will ensure when providing a date by which the local authority must comply with a direction, that it is reasonably practical. In instances of non-compliance, the Director-General of Health may take action to hold local authorities to account. See sections 116I and 116J of the new legislation for more information.

Do local authorities need to wait for a direction to start fluoridating?

No. Local authorities may wish to consider whether to fluoridate water supplies in the absence of the Director-General of Health issuing directions.

Who will pay for fluoridation?

Some funding will be available to support local authorities with the capital costs of fluoridation. The operational costs of fluoridation will remain with local authorities.

Who will ensure my water is safe to drink?

Local authorities and water suppliers will still be responsible for providing safe drinking water to their communities and need to meet water safety regulations. Water suppliers are required to meet the Drinking water standards for New Zealand, which set maximum acceptable values for a range of substances and organisms, including for fluoride.

How does the new legislation support equity?

Some communities and population groups in Aotearoa have worse oral health outcomes than others. New Zealand still has high rates of preventable tooth decay, particularly among Māori and Pacific children and adults, and those in vulnerable communities.

The benefits of community water fluoridation are broadly spread, but are greater for Māori, Pacific and those living in deprived communities.

Extending community water fluoridation aligns with the Treaty of Waitangi principles of equity and active protection. Te Ao Mārama (the Māori Dental Association) and the Pasifika Dental Association support community water fluoridation.

Find out more

www.fluoridefacts.govt.nz | www.health.govt.nz/water-fluoridation

Buller District Council
Drinking Water Fluoridation
Background and Cost Estimate

ERPRO
Assess + Optimise Performance

Franz Resl, 14/07/2022

14/07/2022

Drinking Water Fluoridation

Buller District Council

ERPRO
Assess + Optimise Performance

Franz Resl, 14/07/2022

Table of Contents

Attachments

Attachment 1: Water Fluoridation Engineering Costs, Prepared for Ministry of Health by CH2M Beca Ltd, 35 August 2015

Attachment 2: Fluoridation of Drinking-Water Supplies in New Zealand, Code of Practice, Water New Zealand, First Edition, December 2014

ERPRO
Assess + Optimise Performance

Franz Resl, 14/07/2022

1. BDC Drinking Water Fluoridation

1.1. Executive Summary

Buller District Council (**BDC**) was informed by the Ministry of Health (**MoH**) by letter dated 22/06/2022 that BDC drinking water systems might be included in a set of suppliers who will need to provide drinking water fluoridation by the end of 2022. This ERPRO Environmental Ltd (**ERPRO**) report explains some of the background work which occurred during the preparation of rough order costs (**ROC**) for drinking water. It presents findings from an industry query that ERPRO undertook and estimates of expected costs for the installation of fluoridation systems. Fluoridation systems for Westport, Reefton and Inangahua can be set up within the existing environment and for all other sites the costs for set up are economically unviable at this point as all these plants require a treatment plant rebuild which should then include fluoridation to reduce CAPEX expense.

1.2. Geographical Coverage

The townships covered in this assessment are:

- Westport
- Reefton
- Waimangaroa
- Punakaiki
- Ngakawau
- Mokihinui
- Little Wanganui
- Inangahua

1.3. Technical Requirements

Documents we have considered for drinking water fluoridation:

- Fluoridation of Drinking-Water Supplies in New Zealand, Water New Zealand Code of Practice, 2014
- Water Fluoridation Engineering Costs, Beca for the MoH, 2015
- Health (Fluoridation of Drinking water) amendment Act 2021

1.4. System Description

The dosing systems required for fluoridation of drinking water are best described in “Water Fluoridation Engineering Costs, Beca for the MoH, 2015”. This report lists all elements required for a functional and safe fluoridation dosing system.

Elements to be considered are:

- Type of chemical used
- Equipment choice including water softener requirement
- Fluoride analysis and flow meter for process media and water

- SCADA implementation
- Telemetry connection
- Safety equipment like safety shower
- Separate room or compartment for set up
- Chemical storage facility
- Site safety assessment
- Material handling
- Operator training

The systems proposed for BDC would exclusively use powder forms of fluoride, mainly due to safety reasons. Handling of fluorosilicic acid (**FSA**) is dangerous and not recommended for smaller plants. To keep the systems comparable and to use only one type of material across the District solid chemicals are preferred.

The Westport WTP will use material delivered in 25 kg bags and the operator would transfer this by vacuum system into a “saturator”, a device which provides a saturated solution for accurate dosing. Due to small consumption all other plants would use a 5kg saturator solution.

The chemical used for fluoride addition is sodium fluoride.

2. Cost Assessment

2.1. Rough Order Cost Assessment

The ROC assessment dated April 2022 included costs for the set up of fluoridation plants. For the two biggest plants, Westport and Reefton, these costs are stand alone costs as these plants are currently not undergoing substantial changes. Inangahua, which also does not require a plant rebuild, would only need a small extension and the assumption was made this could be housed in the existing plant building. All other plants require a WTP rebuild which would include certain elements which are required for operation of a fluoride dosing system like dosing shed, chemical storage facility including loading bay, flow metering and safety shower. All these items, when not installed with a plant set up, need to be installed upfront only to allow operation of the fluoridation equipment.

We have added a separate line to our cost estimate which is named “civil + safety + site adjustment + commissioning”. Commissioning would usually be part of the plant-wide commissioning activity and would require separate execution for the fluoridation plant which would further increase costs.

Consequently we do not think that currently the installation of fluoridation systems other than in Westport and Reefton would pass a cost benefit analysis for economic viability.

2.2. Industry Request Outcome

A request was sent out to a supplier for an update about the current price level and the current state of the art equipment layout for fluoridation systems. The recommendation from the supplier was to use powder chemicals rather than liquid chemicals for H&S reasons. Chemical preparation is more complex with powders than with liquids, however, since fluorosilicic acid is a dangerous good we agree that especially at remote sites, with probably only one person on the job, it is better to use safe chemicals despite the higher capital expense. The quote obtained includes water softeners as standard equipment. The requirement for that would need to be identified individually for each plant based on chemical analysis. We made no modifications to the quote in this respect and consider the potential reduction as project safety margin.

Table 1 below shows an overview of estimated expected total expenses per site as well as a split into individual components and a comparison to the ROC estimates from the previous project.

The elements civil, site adjustment, H&S and commissioning are partially taken from the supplier quote with some adjustment to the plant layout. These estimated costs need to be confirmed by detailed site investigation.

The table clearly shows that a separate set up of fluoridation units without a combined upgrade project of the water treatment plants is economically unviable.

Inangahua could be considered for fluoridation set up but would need individual on site assessment and chemical analysis for project specification and costing.

We exclude Punakaiki from the initial block of plants for set up as it makes no sense to set up a fluoridation system at the old Punakaiki WTP and relocate the system in a few years' time. The system would be incorrectly sized and the electrical layout and connection to telemetry would likely be outdated.

A project margin of approximately 15 % should be added on top of the CAPEX requirement to allow for estimate uncertainty and Council overhead costs.

Monitoring and maintenance costs have not been estimated at this stage.

Before any prices are made public to the MoH a detailed review is recommended including site visits and detail engineering.

Project Location	m^3/d max	l/s peak	M&E ROC assessment	M+E Supplier	Civil, Safety, Site Adjust., Commiss.	M&E Supplier + Site Adjustment	Design & Overhead (25%)	Total
Westport	5,500	191.0	$ 300,000.00	$ 103,000.00	$ 200,000.00	$ 303,000.00	$ 75,750.00	$ 378,750.00
Reefton	1,700	59.0	$ 180,000.00	$ 89,000.00	$ 150,000.00	$ 239,000.00	$ 59,750.00	$ 298,750.00
Waimangaroa	270	9.4	$ 48,000.00	$ 89,000.00	$ 100,000.00	$ 189,000.00	$ 47,250.00	$ 236,250.00
Punakaiki	200	6.9	$ 90,000.00	$ 89,000.00	$ 100,000.00	$ 189,000.00	$ 47,250.00	$ 236,250.00
Ngakawau	170	5.9	$ 48,000.00	$ 89,000.00	$ 100,000.00	$ 189,000.00	$ 47,250.00	$ 236,250.00
Mokihinui	40	1.4	$ 30,000.00	$ 89,000.00	$ 100,000.00	$ 189,000.00	$ 47,250.00	$ 236,250.00
Little Wanganui	60	2.1	$ 30,000.00	$ 89,000.00	$ 100,000.00	$ 189,000.00	$ 47,250.00	$ 236,250.00
Inanganhua	50	1.7	$ 30,000.00	$ 89,000.00	$ 100,000.00	$ 189,000.00	$ 47,250.00	$ 236,250.00
			$ 756,000.00	$ 726,000.00	$ 950,000.00	$ 1,676,000.00	$ 419,000.00	$ 2,095,000.00

M&E: mechanical and electrical equipment

Table 1: Project Costs Estimates for Fluoridation BDC Water Supplies

3. Appendices

3.1. Quote Chemfeed

Chemfeed QUOTATION

To:	ERPRO Environmental	Phone:	N/A		
Attn:	Franz Resl	Page:	**1**	of	**3**
Location	Buller DC	Date:	8/7/2022		
Email	franz@erpro.co.nz	Contact:	Deane Morris		
Mobile No.	022 364 1037	Budget No:	301316		
SUBJECT:	Budget pricing for Fluoridation systems Buller District Council				

Dear Franz,

We have pleasure in submitting our budget pricing for Fluoridation dosing systems for the site as noted in your email correspondence dated 1st July 2022 2022 and spread sheet there in.

We trust this budget meets with your approval. Should you require any further information please do not hesitate to contact this office.

Should the MOH Fluoridation requirements be enacted, Chemfeed would be available to assist you with detailed scoping and additional costings once site specific details are confirmed and available .

We refer you now to page 2 schedule below.

Kind regards,

D Morris

Deane Morris Technical Sales Mobile: 0274 988 375
Chemfeed | 6a Enterprise Drive, Henderson, Auckland 0612 | Tel: 09 837 6075
2/340 Flaxton Road, Rangiora 7400 | Tel: 03 313 8188 | www.chemfeed.co.nz

Chemfeed QUOTATION

Chemfeed Budget Pricing			
Site / flow rate		System type	TOTAL PRICE $
1. Westport	5,500 m3/d	Vacuum Saturator– sodium fluoride	$ 208,000.00
2. Reefton	1,700 m3/d	Bottle Saturator - sodium fluoride	$ 194,000.00
3. Waimangaroa	270 m3/d	Bottle Saturator - sodium fluoride	$ 194,000.00
4. Punakaiki	200 m3/d	Bottle Saturator - sodium fluoride	$ 194,000.00
5. Ngakawau	170 m3/d	Bottle Saturator - sodium fluoride	$ 194,000.00
6. Mokihinui	40 m3/d	Bottle Saturator - sodium fluoride	$ 194,000.00
7. Little Wanganui	60 m3/d	Bottle Saturator - sodium fluoride	$ 194,000.00
8. Inanganhua	50 m3/d	Bottle Saturator - sodium fluoride	$ 194,000.00
		Total GST excl	**$ 1,567,000.00**
		GST	**$ 235,050.00**
		Total GST inclusive	**$ 1,802,050.00**

Note: The following allowances are included in each site price.

- Site engineering and drawings - $ 16,000 plus GST
- Building and pad cost - $ 75,000 plus GST
- Installation and commissioning - $ 30,000 plus GST
- Fluoride Analyser (installed) - $ 15,000 plus GST

Plant	Peak Flow - m3/day	Kg/Day - Sodium Fluoride Used @ 4% Solution	Kg/Year - Sodium Fluoride Used @ 4% Solution	Budget cost of chemicals per year
Westport	5,500	10.06	3671.9	$17,625.12
Reefton	1,700	3.09	1127.85	$10,150.65
Waimangaroa	270	0.49	178.85	$1,609.65
Punakaiki	200	0.36	131.4	$1,182.60
Ngakawau	170	0.31	113.15	$1,018.35
Mokihinui	40	0.01	3.65	$32.85
Little Wanganui	60	0.11	40.15	$361.35
Inanganhua	50	0.09	32.85	$295.65
Total	7,990	14.52	5299.8	$32,276.22

3.2. Types of Fluoride Used

ProMinent® Chemfeed Chemical Dosing and Disinfection Systems

3

Fluoride – Types of Fluoride

Fluoride is available commercially in 3 different forms, 2 are powders, with the other supplied in liquid form. Each display different concentrations of available fluoride ions and solubility.

Forms:

1. **Sodium Fluoride** (NaF) – 44% by weight available fluoride ion, solubility is 4.05%.
2. **Sodium Silicofluoride** (Na_2SiF_6) – 60% by weight available fluoride ion, solubility is 0.4% with normal preparation design solution strength of 0.2%.
3. **Hydroflurosilicic Acid** (H_2SiF_6) – liquid, commonly commercial availability of 24% by weight available fluoride ion.

3.3. System for less than 3,000 m^3/d

ProMinent® Chemfeed Chemical Dosing and Disinfection Systems

4

Fluoride – Sodium Fluoride Saturator 5kg

ProMinent 5kg Fluoride Saturator

- Typical Installation - < 3 ML/day
- The 5kg Bottle Loader offered on this system has been designed by ProMinent® and Patent Approved.
- Sodium Fluoride has a reliable saturation solubility of 4.05%. By keeping excess sodium fluoride powder in a dissolving tank, a constant 4.05% Sodium Fluoride (NaF) saturated solution is maintained. This is then dosed into the water supply, via a ProMinent Gamma X Metering Pump, in proportion to the mains 4-20 milliamp flow signal.
- Please note that depending upon the conditions, water quality etc. that council may be required to clean the saturator tank every 12 months as the 4.05% saturation can decline.
- Make-up water to the saturator is controlled by high levels in the solution tank. It flows to the saturator via a down pipe (with air break) and enters via laterals at the base of the tank, slowly rising through the fluoride bed to form a saturated solution, ready for dosing.
- An electric stirrer is provided on the saturator tank to allow automatic turn over of the fluoride bed, maybe once a week to ensure full saturation is maintained.
- A calibration cylinder is provided to accurately calibrate the metering pump against the dosing conditions and various milli-amp flow signals.
- A water softener is required in all circumstances to ensure the water hardness is as low as possible to assist with the longevity of the fluoride bed. Salt levels need to be checked on a weekly basis to ensure that the softening process is being adhered to. The softener is an integral component of this system.

ProMinent® Chemfeed Chemical Dosing and Disinfection Systems

Fluoride – Sodium Fluoride Saturator 5kg

ProMinent 5kg Fluoride Saturator - Continued

- To ensure easy and <u>dust free loading</u> of the 5kg containers, ProMinent® designed and patented a special loader to accept the containers, slice the seal, and allow the Sodium Fluoride granules to dump into the saturator tank.
- Prior to removing the bottle, the operator can flush the bottle via the local control panel button; which provides the controls for a 10 second flushing cycle to commence. The bottle can be easily disposed of in the normal plastic recycling.
- There is two fill solenoid valves in series and an adjustable flow restrictor/rotameter that reduces the flow into the tank to just enough to keep the tank at a controlled level with the pump dosing at its maximum rate. The mains water enters the tank through a lateral pipe system that sits under the un-dissolved sodium fluoride powder. The water passes through the fluoride ready for dosing.
- Note: The metering pump has been factory set to dose at a maximum rate of approximately 1.1mg/l when accepting the plant flow signal and with the stroke setting of 100%. For the required 1 mg/litre set the stroke of the metering pump to approx. 90%. Fine tune stroke length to achieve 1 mg/l. This pump is then **code locked** at the appropriate setting so no further adjustment can be made above the maximum 1.1 mg/l.
- On the metering pump outlet, a load valve is used to ensure that the pump has a constant back pressure to dose against, and to help prevent siphoning of the fluoride solution. Also to protect against a blocked discharge, the pump has overpressure protection built into the electronics.

3.4.System for less than 15,000 m^3/d

ProMinent® Chemfeed

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Fluoride – Sodium Fluoride Saturator Vacuum Load

ProMinent Vacuum Load Fluoride Saturator (25kg)

- Typical Installation – 0.5 – 15 ML/day
- The ProMinent® Upflow Sodium Fluoride Saturator package described below has been specifically designed & developed for adding fluoride into town water supplies as determined by the respective Health Department. The overall Saturator Package is controlled via an Allen Bradley 1400 PLC w/ Ethernet module or equivalent.
- Sodium Fluoride has a reliable saturation solubility of 4.05%. By keeping excess sodium fluoride powder in a dissolving tank, a constant 4.05% Sodium Fluoride (NaF) saturated solution is maintained. This is then dosed into the water supply, via a ProMinent® metering pump, in proportion to the mains 4-20 milliamp flow signal.
- Please note that depending upon the conditions, water quality etc. that council may be required to clean the saturator tank every 12 months as the 4.05% saturation residual can gradually decline.
- Make-up water to the saturator is controlled by high levels in the 500 / 1000 litre solution tank. It flows to the saturator via a down pipe (with air break) and enters via laterals at the base of the tank, slowly rising up through the fluoride bed to form a saturated solution, ready for dosing.
- An electric stirrer is provided on the saturator tank to allow the operator to turn over the fluoride bed (perhaps once a week) to ensure full saturation is maintained. This stirrer will operate under a timer and will shut down the fluoride pump for approximately 1 hour whilst it is in operation.
- A calibration cylinder is provided to accurately calibrate the metering pump against the dosing conditions and various milliamp flow signals.

Fluoride – Sodium Fluoride Saturator Vacuum Load

ProMinent Vacuum Load Fluoride Saturator (25kg) Continued

- A water softener is required in all circumstances to ensure the water hardness is as low as possible to assist with the longevity of the fluoride bed. Salt levels need to be checked on a weekly basis to ensure that the softening process is being adhered to. The softener is an integral component of the system and must be maintained for Warranty and overall operational purposes.

- The ProMinent® vacuum transfer system easily allows the operator to transfer powder from the 20 / 25 kg bags to the hopper. The suction wand is inserted in the bag and the air is drawn upwards through a filter to remove any powder particles that are still airborne, before leaving the unit via the vacuum motor. As the powder enters the collection unit, the large volume inside the unit causes the air velocity to drop, allowing the powder to fall to the bottom of the unit.

- A 500 / 1000 litre UV stabilised translucent PE tank is first filled with make up water. Sodium fluoride powder is then added to the tank to create the fluoride solution. By having more powder than can readily dissolve, a saturated solution is formed ready to be dosed. You will need to draw up from your fluoridation bed for approximately 3 – 5 days to ensure a full bag of 25kg Sodium Fluoride can be vacuum transferred into the ProMinent Saturator Tank.

- Fluoride is added using ProMinent's specifically developed vacuum loader and is intended for use with fluoride supplied in 20 / 25 kg bags. It generally vacuums the entire contents of a 25kg bag under 6 minutes.

- The Vacuum bag Loader is mounted on the saturator tank and comes complete with in-built dust extractor, suction wand and a flexible hose allowing the operator to easily load the contents of the bag. The Vacuum Loader includes a 100 litre Exhaust Trap with float valve, overflow and drain

Fluoride – Sodium Fluoride Saturator Vacuum Load

ProMinent Vacuum Load Fluoride Saturator (25kg) Continued

- The ProMinent Vacuum Loader is fitted with positively actuated valves on vacuum hose inlet and dump valve positions rather than the more typical flap valve systems of alternate suppliers. These positively closing valves eliminate the chance of inadvertent:

  * Backflow of suction line

  * Blowing dust out of saturator tank if inspection opening is open during loading

  * Pressurisation of saturator tank

- Note: The metering pump has been factory set to dose at a maximum rate of approximately 1.1mg/l when accepting the plant flow signal and with the stroke setting of 100%. For the required 1mg/litre set the stroke of the metering pump to approx. 90%. Fine tune stroke length to achieve 1.0 mg/l. This pump is then **code locked** at the appropriate setting so no further adjustment can be made above the maximum 1.1mg/l.

- On the metering pump outlet, a load valve is used to ensure that the pump has a constant back pressure to dose against, and to help prevent siphoning of the fluoride solution. Also to protect against a blocked discharge, the pump has overpressure protection built into the electronics.

Water New Zealand Code of Practice

Fluoridation of Drinking-Water Supplies in New Zealand

First Edition December 2014

Contents

This edition was prepared with input from CH2M Beca Ltd, Ministry of Health and Water New Zealand with review by representatives of the Water Service Managers Group.

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MINISTRY OF HEALTH
MANATŪ HAUORA

Foreword

Water fluoridation is the adjustment of the natural content of fluoride in drinking-water to a level that helps protect teeth against dental decay. Tooth decay is a largely preventable disease that affects both children and adults. It can cause considerable pain and suffering as well as a significant cost, which is unaffordable for some low income earners. Fluoride in drinking-water acts like a constant repair kit that neutralises the effect of acids that cause decay and helps to repair damage before it becomes permanent. Water fluoridation is the most effective and socially equitable way to give everybody access to the caries-preventive effects of fluoride regardless of age, income or education level.

In New Zealand, the decision to adjust the level of fluoride in water supplies is held by drinking-water suppliers (Local Authorities and other owners).

The *Code of practice for fluoridation of drinking-water supplies in New Zealand* (this Code) specifies good practice for the design and operation of water fluoridation plants to ensure the safe and effective addition of fluoride to drinking-water supplies. Although compliance with this Code is not a legal requirement, water suppliers are encouraged to comply with the Code to ensure the safety of their consumers. Compliance with the Code is also a way to provide increased public confidence.

The Ministry of Health and Water New Zealand would like to acknowledge the assistance of the Victorian Department of Health, as well as the important contributions from a wide range of water suppliers and industry stakeholders who assisted in this process. Both the Ministry of Health and Water New Zealand are committed to working with the water industry to ensure the safe and effective addition of fluoride to drinking-water supplies.

This Code is endorsed by the Ministry of Health as representing good practice for the addition of fluoride to drinking-water for the promotion of dental health. Suppliers that are designing new fluoridation plants are encouraged to comply. Suppliers with existing plants should consider the Code and plan to upgrade so that compliance is reached in the future.

Dr Don Mackie
Chief Medical Officer
Ministry of Health

1 Introduction

There is no legislation in New Zealand that requires the addition of fluoride to a water supply. Fluoridation is undertaken by drinking-water suppliers at their discretion. In the Drinking Water Standards for New Zealand 2005 (revised 2008) the Ministry of Health recommends that the fluoride content in New Zealand drinking water should be in the range of 0.7 to 1.0 mg/L for oral health reasons. The Code of practice for fluoridation of drinking-water supplies in New Zealand (this Code) specifies good practice for the safe design and effective operation of a fluoridation plant.

Safe and effective fluoridation of drinking-water supplies requires the adoption of a preventive risk management approach in the design and operation of fluoridation plants. Preventive risk management systems are the most effective way to assure the safe and effective addition of fluoride into a drinking-water supply. These systems underpin the approach taken in Water Safety Plans.

1.1 Objective

The overall objective of this Code is to provide guidelines for safe and effective addition of fluoride into a drinking-water supply.

This objective is achieved by specifying:

- Optimum fluoride levels for drinking-water supplies as defined by the Ministry of Health and the design control limits for fluoridation plants.
- Minimum requirements for the safe and effective addition of fluoride chemicals to drinking-water supplies, covering the design and operation of a fluoridation plant.
- Monitoring and reporting requirements for fluoridation.

1.2 Scope

This Code should apply to all new and upgraded water fluoridation plants after 1 January 2015. After 1 January 2020 the Code will also apply to existing fluoridation plants that have not been upgraded.

The Code describes:

- The regulatory framework (Section 2).
- Safety in design (Section 3).
- Requirements for the design and control of fluoridation facilities (Section 4).
- Requirements for plant operation including monitoring, training of personnel, occupational health and safety, security and environmental protection (Section 5).

1.3 Terminology

1.3.1	*Code of practice for fluoridation of drinking-water supplies in New Zealand:*	This code
1.3.2	*Drinking-water Assessor (DWA):*	A person appointed under the Health Act 1956 (the Act) to assess drinking-water supplies.
1.3.3	*Drinking-water Supplier:*	The Act defines a drinking-water supplier as a person who supplies drinking water to people in New Zealand or overseas from a drinking water supply, and: a) Includes that person's employees, agents, lessees, and subcontractors while carrying out duties in respect of that drinking water supply; and b) Includes (without limitation) i. A networked supplier; and ii. A water carrier; and iii. Every person who operates a designated port or airport; and iv. A bulk supplier; and v. Any person or class of person declared by regulations made under section 69ZZY to be a drinking water supplier for the purposes of this Part (a prescribed supplier); but c) Does not include vi. A temporary drinking water supplier; or vii. A self-supplier; or viii. Any person or class of person declared by regulations made under section 69ZZY not to be a drinking water supplier for the purposes of this Part.
1.3.4	*Drinking-water Standards for New Zealand 2005 (revised 2008):*	The DWSNZ
1.3.5	*Fluoride concentration:*	The fluoride concentration refers to the total amount of fluoride present regardless of its form and is expressed in milligrams per litre (mg/L) (Note: 1 mg/L = 1 g/m^3 = 1 ppm).
1.3.6	*Fluoridation plant:*	The building and equipment required for fluoridation of drinking-water, including chemical storage and unloading areas, dosing and control equipment, safety equipment and other fixtures used for, or associated with, the purpose of fluoridation.
1.3.7	*Guidelines for Drinking-water Quality Management for New Zealand:*	Guidelines to help water suppliers to comply with the DWSNZ.
1.3.8	*Hazardous Substances and New Organisms Act 1996:*	HSNO
1.3.9	*Health Act 1956:*	The Act that aims to protect public health by improving the quality of drinking-water provided to communities.
1.3.10	*Independent Checks:*	A control system that is entirely independent of another that is used to prevent the overdosing of fluoride.
1.3.11	*Maximum Acceptable Value:*	'MAV' as defined by the DWSNZ.
1.3.12	*'Must' and 'should':*	The word **'must'** identifies a mandatory requirement for compliance with this Code. The word **'should'** refers to practices that are advised or recommended but are not mandatory for compliance with this Code.

2 Regulatory Framework

2.1 Legislation

2.1.1 Acts

The requirements for the supply of drinking-water are set out in the Local Government Act 2002 (for Local Authorities) and the Health Act 1956. Specifically, under Section 23 of the Health Act, territorial authorities have a duty to improve, promote and protect public health; and under Section 25, to provide sanitary works including drinking-water supplies when directed by the Minister.

The Health Act 1956 was amended by the Health (Drinking Water) Amendment Act in October 2007 and aims to protect public health by improving the quality of drinking-water provided to communities. The Act requires drinking-water suppliers to:

- Take all practicable steps to ensure they provide an adequate supply of drinking-water that complies with the Drinking-water Standards for New Zealand
- Prepare and implement Water Safety Plans (see Section 2.1.3)

2.1.2 Drinking-water Standards for New Zealand

The Drinking-water Standards for New Zealand 2005 (revised 2008) (DWSNZ) specify water quality standards and compliance criteria for microbiological, chemical and radiological contaminants (determinands) in drinking-water.

The DWSNZ set a Maximum Acceptable Value (MAV) of 1.5 mg/L for fluoride. The MAV of a chemical is the concentration of that chemical which does not result in any significant risk to the health of a 70 kg person over a lifetime of consumption of two litres of the water a day. The 1.5 mg/L MAV for fluoride is based on the latest World Health Organisation (WHO) Guidelines.

Fluoride is classified as a Priority 2a determinand in the DWSNZ. As such fluoridated drinking-water supplies must be sampled at least weekly to monitor fluoride levels in the water leaving the treatment plant.

2.1.3 Water Safety Plans

A Water Safety Plan requires a drinking-water supplier to consider the potential risks to the water supply and identify ways to manage these risks, and is therefore prepared for any problems that may arise. Large (more than 10,000 people), medium (5001 to 10,000 people) and minor (501 to 5,000 people) drinking-water suppliers are required under the Act to prepare and implement approved Water Safety Plans. Small drinking-water suppliers need to implement a Water Safety Plan at the request of a Medical Officer of Health or to demonstrate they are taking all practicable steps to comply with the DWSNZ.

Drinking-water suppliers are required to start implementing their Water Safety Plans within one month of approval.

2.1.4 This Code

This Code describes good practice for drinking-water fluoridation. There is no legislation in New Zealand that requires the addition of fluoride to a water supply. Fluoridation is undertaken at the discretion of a drinking-water supplier. While there is no legal requirement to comply with this Code, it consolidates good practice from the New Zealand water industry. It therefore represents an industry-endorsed Code and, if complied with, a means of documenting in the Water Safety Plan that the risks associated with fluoridation in the supplier's water supply plant have been satisfactorily mitigated.

The Code has been written to assist water-suppliers in designing a new drinking-water fluoridation system, or upgrading an existing system to ensure the safety of its consumers. This Code describes information that is suggested for inclusion in a drinking-water supplier's Water Safety Plan, but inclusion is not required for Water Safety Plan approval by the DWA.

2.1.5 Other Legislation

Other legislative requirements of relevance to the management of a water fluoridation scheme include:

- *Hazardous Substances and New Organisms (HSNO) Act 1996*
- *Health and Safety at Work Act 2014*[1]
- *Building Act 2004*
- *NZ Building Code*
- *Land Transport Act 1998*
- *Land Transport Rule* (Dangerous Goods 2005) *45001*
- *Resource Management Act 1991*

2.2 Roles and Responsibilities

2.2.1 Ministry of Health

The function of the Ministry of Health is improving, promoting, and protecting public health. Its role is to encourage drinking-water suppliers to consider the use of fluoride for improvement of consumers’ teeth, as well as to ensure that fluoride is added to drinking-water in a safe and effective way. The Ministry of Health's position is that the addition of fluoride to drinking-water is a safe, effective and affordable way to prevent and reduce tooth decay across the whole population. If subsidy for capital works to install fluoridation is available from the Ministry of Health, compliance with this Code among other factors would be assessed.

2.2.2 Drinking-water Supplier

For new and upgraded fluoridation plants, the drinking-water supplier should design, construct and operate the fluoridation plant in accordance with this Code.

Prior to the construction of a fluoridation plant, the drinking-water supplier should have the design peer-reviewed against this Code. Evidence of the peer review of the design should be provided to the DWA to demonstrate that the plant will operate in a safe and effective manner.

[1] As at 31 October 2014 it is the Government’s intention that the Health and Safety Reform Bill will be passed in 2014, with the new Act coming into force from 1 April 2015. It will replace the Health and Safety in Employment Act (1992).

When a drinking-water supplier is implementing a new or upgraded fluoridation plant, the DWA needs to be advised at the design phase, the construction phase, and immediately prior to introducing fluoride to the supply.

The drinking-water supplier is responsible for ensuring that the design, installation and operation of the fluoridation plant, and the storage and handling of chemicals, are in accordance with all the relevant legislative requirements. Specifically, the drinking-water supplier must ensure that the water fluoridation plant is incorporated into the Water Safety Plan for a drinking-water supply. Future intent to add fluoride should also be indicated in the Water Safety Plan. In relation to transport of chemicals, the drinking-water supplier is responsible for engaging contractors who comply with relevant legislative requirements. Shipping of the chemicals, unloading and storage should be in accordance with the Water New Zealand, Good Practice Guide: *Supply of Fluoride for Use in Water Treatment*.

3 Safety in Design

3.1 Approach

The Safety in Design process involves the application of a risk management framework early in the design process to eliminate or minimise the risk to public health and the environment and to ensure occupational health and safety throughout the life of the fluoridation plant. It encompasses all phases of the plant design including facilities, hardware, systems, equipment, products, tooling, materials, energy controls, layout and configuration. From April 2015, a new Health and Safety at Work Act will be introduced and it will include Safety in Design requirements[2].

In the context of water fluoridation, Safety in Design encompasses:

- Drinking-water safety for consumers
- Occupational health and safety
- Environmental safety
- Asset safety

A safe design basis, together with a formal safety management system and safety practices, procedures, and training, is critical for providing the level of confidence required.

3.2 Risk Assessment

Drinking water suppliers that are fluoridating or are planning on installing new plant to fluoridate must carry out and document a site-specific risk assessment covering all aspects of safety and environmental risk associated with the design and operation of the fluoridation plant. Where risks are identified, appropriate control measures (based on the hierarchy of controls) must be implemented. The preventive risk management system must include the development of considered and controlled responses to incidents or emergencies that can compromise the safety of fluoridating a drinking-water supply, worker safety or the environment.

Based on the hierarchy of controls, hazards should be eliminated wherever practicable, followed by minimising the remaining hazards through use of engineering controls.

The risk assessment for the fluoridation plant and the effectiveness of actual control measures should be reviewed on a regular basis. Initial design risk control measures should not be degraded through subsequent modifications of the fluoridation plant and/or the water supply system. This is consistent with the approach taken in Water Safety Plans.

3.2.1 Risk-based systems

Risk-based systems include ISO 9001, ISO 14001, HACCP and local standards such as the Australian and New Zealand *Risk management – principles and*

[2] Refer section 2.1.5.

guidelines (AS/NZS ISO 31000). A risk-based system must be used to systematically address and manage risks associated with the fluoridation plant prior to commissioning.

3.2.2 **Hazard and operability (HAZOP) studies**

The drinking-water supplier should also conduct a Hazard and Operability (HAZOP) study as one part of the Safety in Design assessment. The HAZOP should involve the application of a formal systematic critical examination of the process and engineering intentions of the fluoridation plant to assess the hazard potential of inappropriate operation or malfunction of individual items of equipment and their consequential effects on the water treatment plant as a whole.

Any actions arising from the HAZOP study should be incorporated into the design and/or operation of the fluoridation plant.

3.3 Drinking-Water Safety

The performance objective is to ensure the design, construction, installation, operation and maintenance of the fluoridation plant protects public health by:

- Maintaining the optimum fluoridation concentration in the drinking-water supply
- Preventing overdosing of fluoride
- Implementation of quality assurance processes to guarantee the chemical purity of the fluoridating agent

Controls for managing risks to drinking-water safety, as identified through the site-specific risk assessment, must be incorporated in the drinking-water supplier's Water Safety Plan.

3.4 Occupational Health and Safety

The design and operation of the fluoridation plant must ensure worker safety. The drinking-water supplier must conduct and document a site-specific safety hazard risk assessment covering all aspects associated with the design and operation of the fluoridation plant.

The drinking-water supplier must ensure risks are assessed and managed in accordance with the relevant occupational health and safety requirements. The *Health and Safety at Work Act 2014* provides information and advice on eliminating hazards and controlling risks at the design, construction and operational stage to those involved in the design or modification of products, and processes used for work. Health monitoring of staff must be carried out to ensure that the hazard risk controls employed are functioning as intended. This is an employer responsibility required under the *Workplace Exposure Standards and Biological Exposure Indices*.

3.5 Environmental Safety

The design and operation of the fluoridation plant must not cause environmental harm. HSNO provides further details of the requirements that must be implemented to avoid this. The drinking-water supplier must conduct and document a site-specific environmental risk assessment covering all aspects associated with the design and operation of the fluoridation plant, including the delivery, storage and handling of the fluoridating agent. Consideration of all aspects of environmental safety to do with the fluoridation chemical and plant should be evident.

4 Design of Fluoridation Plant

4.1 Design Criteria

4.1.1 Legislation, regulations, guidelines, standards and codes

The drinking-water supplier must ensure the design, construction and operation of the fluoridation plant complies with the relevant legislative requirements, guidelines and standards. These include, but are not limited to:

- Legislation - refer to Section 2
- NZS/AS 1319 *Safety signs for the occupational environment*
- AS 1345 *Identification of the contents of pipes, conduits and ducts*
- AS/NZS 1715 *Selection, use and maintenance of respiratory protective devices*
- AS 3780 *The storage and handling of corrosive substances*
- AS/NZS 4020 *Testing of products for use in contact with drinking water*
- AS/NZS ISO 31000 *Risk management – Principles and guidelines*
- AS/NZS 4452 *The storage and handling of toxic substances*
- AS/NZS 4801 *Occupational health and safety management systems—Specification with guidance for use*
- *NZS 5433.1&2: 2012, Transport of Dangerous Goods on Land*
- NZS 5807 *Code of practice for industrial identification by colour, wording or other coding*
- *Code of Practice for Manual Handling,* Published jointly by the Occupational Safety and Health Service of the Department of Labour and the Accident Compensation Corporation. June 2001
- Trade Waste Bylaws (if disposing of fluoride wastes to Council wastewater systems)
- Workplace Exposure Standards and Biological Exposure Indices

4.1.2 Chemical selection

The three chemicals used for the fluoridation of drinking-water in New Zealand are listed in Table 1.

The drinking-water supplier is responsible for selecting the most suitable fluoridating agent for the drinking-water supply. The selection process should consider chemical availability and security of supply, whether a quality management system is in place to ensure chemical purity, site constraints and how the drinking-water supplier will comply with the DWSNZ. Evidence of the selection process (including a risk assessment) should be recorded.

Water New Zealand's Good Practice Guide *Supply of Fluoride for Use in Water Treatment 2014* should be used for specifying the supply of the chemical. The Good Practice Guide includes requirements for meeting the appropriate specification limits for contaminants using the Maximum Acceptable Value (MAV) approach as described in Chapter 1.5 of the DWSNZ.

The drinking-water supplier must undertake a risk assessment to ensure that any material used in the dosing of fluoride, such as soluble bags, do not present a risk to public health. The risk assessment must also ensure that the addition of contaminants in the fluoridation chemical to the concentrations of these contaminants already present as Priority 2 determinands in the supply, do not result in any contaminant exceeding its MAV.

Table 1: Fluoridating agents

Common name	Formula	CAS No.*	Alternative name(s)	UN Class	Hazard Classification**
Fluorosilicic acid	H_2SiF_6	16961-83-4	Hydrofluorosilicic acid (HFA), hexafluorosilicic acid	8, PG II	8.2C, 8.3A
Sodium fluoride	NaF	7681-49-4	Sodium monofluoride	6.1; PG III	6.1C, 6.3A, 6.4A, 6.6B, 6.8B, 6.9A, 9.1D, 9.3B
Sodium fluorosilicate	Na_2SiF_6	16893-85-9	Sodium silicofluoride, sodium hexafluorosilicate	6.1; PG III	6.1C, 6.4A, 9.3B

* CAS Numbers are as per the Chemical Classification and Information Database (CCID) on www.epa.govt.nz. Note that there are other CAS numbers in use for these chemicals.

** Classification as per the CCID on www.epa.govt.nz (chemicals in the CCID are classified in accordance with the Hazardous Substances and New Organisms (HSNO) regulations)

4.1.3 Concentration of fluoride in water

The purpose of fluoridation is to adjust the natural fluoride content of drinking-water to the optimum level to provide a dental health benefit. The target concentration of fluoride in treated water is between 0.7 and 1.0 mg/L.

The selected dosing concentration and the basis for the selection (including allowance for the fluoride concentration in the raw water) should be included in the Water Safety Plan. The drinking-water supplier should maintain a historical record of the fluoride concentration in the raw water to ensure an appropriate allowance is made for the fluoride concentration in determining the dosing concentration. The fluoride concentration in the raw water should be analysed at an appropriate frequency for the expected variability.

4.1.4 Design control limits

The design of the fluoridation plant must:

- Use a fluoride dosing concentration as determined using Section 4.1.3, and be controlled to the limits specified in Table 2.
- At no time allow the fluoride concentration in the drinking-water supply to exceed 1.5 mg/L (as specified by the MAV in the DWSNZ).

Real-time monitoring of the fluoride concentration after the dosing point (either direct or indirect), linked to an appropriate alarm monitoring system and automatic shut-down, is required - refer section 4.1.6. The fluoride plant control limits in Table 2 apply specifically to the instruments used for real-time fluoride monitoring, namely those instruments used for calculating instantaneous water flow and fluoride dose rates, and analyser/s for monitoring the fluoride concentration, if fitted.

Any delay time associated with the process limits in Table 2 (to account for instantaneous spikes) should be kept to a minimum, justified and documented.

Table 2: Fluoride plant control limits and alarms

Parameter	Total fluoride concentration (mg/L)	Response to process limits
Operating target	As determined by section 4.1.3.	–
Operating range (≥95% of the time that the fluoridation plant is In operation)	Within ± 0.15 of operating target.	–
Lower action process limit	0.6*	Dosing corrected. No shut down required.
Upper action process limit	1.2^	Immediate fluoride plant shut down. (Online monitoring system must be interlocked with the dosing system.)
Emergency process limit	1.5†	Immediate fluoride plant shut down. (Online monitoring system must be interlocked with the dosing system.) Notify the DWA Immediately, investigate the cause of the exceedance and take appropriate action. See DWSNZ for more information.

* NHMRC 2007, *A systematic review of the efficacy and safety of fluoridation*

^ This action level is a slightly lower dose than the maximum level of fluoride permitted in the DWSNZ, and has been established to ensure that the MAV is never exceeded.

† Based on the Maximum Acceptable Value set in DWSNZ.

4.1.5 **Functionality of the fluoridation plant**

To comply with this Code the fluoridation plant must be designed to meet the following requirements as well as the Independent Check requirements specified in Section 4.1.6:

a) The design of the fluoridation plant must ensure that provision is made for operational staff to monitor and control the fluoridation process reliably, accurately and in a timely manner.

b) The fluoride concentration in the water supplied for drinking must comply with the requirements set out in Section 4.1.3 and 4.1.4.

c) The plant must be configured so that the functionality requirements set out in 4.1.5, 4.1.6 and 4.1.7 are fully automated, and operated by a control system that is based at the treatment plant.

d) Plant design must ensure dependable automatic operation with reliable stopping and starting of the system during plant shut-down and start-up.

e) The plant must have alarms (including after hours to duty operator) and automatic shut-downs for key process elements.

f) If a day tank is used (see Section 4.1.6 for information about when day tanks are required as one of the Independent Checks):

   a. fluoride transfer from the bulk tank to the day tank must occur nominally once in a 24-hour period. Refer to Section 4.1. 6.

   b. it must be equipped with either an online weight measurement device or an online level instrument that enables measurement of the quantity of fluoride used during each 24 hour period.

g) If a bulk tank is used it must be equipped with an online level indicator or instrument and an easily readable graduated volume scale to reduce the risk of overfilling. When fluorosilicic acid is used the tank level must be displayed at the delivery connection point for the bulk tanker supplier.

h) Fluoride dosing must be flow-paced based on the measured water flow into which the fluoride is being dosed. Typically dosing will be achieved through use of a suitable flow meter and variable speed metering pumps. A secondary flow-based control device (for example, a flow meter or flow sensing device such as a flow switch) should be provided as backup to the main flow meter (i.e. in series).

i) The maximum physical dosing capacity of the fluoridation chemical feeding equipment must be limited by design to a maximum value that is as close as practicable to the operating target dose rate at the maximum water flow rate. This maximum value should not exceed 110 per cent of the operating target dose rate at the maximum plant capacity. For metering pumps which have a manual stroke adjustment, the component of the dosing flow that is able to be changed by manual adjustment of the stroke is excluded from this requirement, as long as the stroke adjustment is locked in position and its maximum operating position is clearly marked.

j) The drinking-water supplier must ensure that upon failure of the control system, treated water exceeding the emergency process limit in Table 2 does not enter the drinking-water supply system. This fail safe system would include metering pumps stopping and supply valves closing.

k) Metering pumps should be in a duty/standby arrangement. A duty/assist arrangement is acceptable, however the additional risk of control malfunctions should be considered.

This is not an all-inclusive list and further functionality requirements may be identified in the HAZOP and/or the safety-in-design phases. Alternatives to any of the requirements above may be used, as long as an equivalent level of safety, control and risk minimisation can be demonstrated as part of the peer review of the design.

4.1.6 Dose monitoring

To minimise the risk of overdosing of fluoride, a number of Independent Checks are required. For water supply systems that serve more than 10,000 people, at least two of the three following Independent Checks must be used. If the water supply system serves 10,000 or fewer people, then at least one of the three Independent Checks is required.

The checks are listed below:

Independent Check 1: Use of a day tank that can only be filled once a day and is equipped with an online device to measure its contents

Day tanks are commonly used with fluorosilicic acid fluoridation plants and can be used for sodium fluoride or sodium fluorosilicate. A day tank acts as a physical barrier that minimises the risk of large quantities of chemicals from the bulk storage tank (or if using powders, from the saturator or mixing tank) being added into the water supply in error.

To meet the requirements of Independent Check 1, the day tank must be fitted with an online device to measure its contents. This measurement device can be either a load cell or a level sensor:

- Level sensors measure and display the liquid level in the tank and generate alarms where operating parameters are exceeded. The accuracy of the sensors must be within ±1 per cent over the full range of the operational capability.
- Load cells measure and display the loss of mass in the tank and generate alarms where operating parameters are exceeded. The accuracy of the load cells must be within ± 1 per cent of the range being measured. Load cells are recommended (but not required) for measuring mass loss in the day tank as they are more reliable than level sensors.

Both level sensors and load cells can be used together to provide a higher degree of assurance but this is not a requirement.

Daily changes in the volume/mass of fluoride chemical consumed in the process must be recorded and used as an additional check.

Arrangements for the transfer of the fluoridation chemical from the bulk tank (or saturator or mixing tank) to the day tank must meet the following basic principles:

a) Transfer should occur through controlled pumping. Gravity transfer should be prevented by appropriate design (for example, an anti-siphon loop).
b) All equipment, pumps and day storage facilities should be located within a bunded area and chemical spillage must be captured in a safe manner. The bund volume must be in accordance with the *Code of Practice HSNOCOP 47 Secondary Containment Systems*.

c) The day tank must be sized for a maximum of 110% of the volume required for the maximum capacity and target dose rate. The day tank must not be filled more than once in any 24-hour period.

If using fluorosilicic acid, the day tank must be vented to the outside atmosphere and all connections sealed to prevent corrosion of the equipment in the room, or 'clouding' of any windows and damage to any electrical panels. A water trap should be provided on the tank overflow. The building should also include appropriate levels of ventilation.

Independent Check 2: Use of a fluoride measuring flow meter on the fluoride dosing line before the dosing point (only for (a) fluorosilicic acid, or (b) sodium fluoride from a saturator)

A flow meter before the dosing point is used to measure the amount of fluoride being added to the drinking-water. This flow meter must be linked to an appropriate alarm monitoring system and an automatic fluoridation plant shut down. These measurements must be compared with the operational target as an independent check of the quantity of fluoride dosed.

The dose flow meter must not be used as part of a feedback control to alter the dose rate. The flow meter's purpose is for alarming only and deviations from the expected dose flow should alert the operator so that they can determine the appropriate action.

The flow meter should measure the rate of flow and the SCADA must record the rate and total volume of flow. An electromagnetic flow meter should be used to achieve an accuracy of ±1-2%.

Independent Check 3: Fluoride concentration analyser on the drinking-water line after dosing point

A fluoride ion analyser is used after the dosing point to measure the concentration of fluoride in the final treated water. The sample point supplying the analyser must be located such that the measurement reflects the real-time dosing performance of the fluoridation plant. To achieve this requirement:

- The sampling point must be located such that adequate mixing has taken place before the sampling point
- The time taken for the sample to travel from the sampling point to the instrument should be kept to a minimum
- The sampling point must be before the first draw off for a consumer, and should be located upstream of the clear (or treated) water storage or, if downstream, at such a location that the measurement reflects the real-time dosing performance of the fluoridation plant.

The fluoride ion analyser should use the ion-selective electrode (ISE) analysis method or an alternative method that has been proven to be just as accurate. Accuracy to at least ± 0.15 mg/L should be achieved by a properly calibrated and well-maintained instrument in a production environment.

Interferences in the measurement using ion selective electrodes should be considered. Interferences are typically not an issue if the water has:

- Consistently low aluminium and iron levels (i.e. consistently below the aesthetic guidelines values in DWSNZ – 0.1 mg/L for aluminium and 0.2 mg/L for iron), and

- A relatively stable pH that is between 5.5 and 8.5.

If the water to be sampled falls outside this range a Total Ionic Strength Adjustment Buffer (TISAB) should be used, with the instrument able to alarm on exhaustion of the buffer.

All ISE analyses, including online ISE analyses, should be performed at a constant temperature, or results corrected for temperature, as ISE measurements are water temperature dependent.

Grab samples should be analysed at least weekly to check the calibration of the on-line analyser and the procedures in DWSNZ Appendix A2 (section A2.1) followed as if the testing is required for compliance. The samples should be analysed using a bench-top analyser (the ISE method, SPADNS method[3], the ion chromatography method, or other validated test method can be used for this purpose) and the results compared with those from the online analyser to ensure the accuracy of the online analyser.

In terms of DWSNZ, the drinking-water supplier must ensure the fluoride level in the treated water leaving the plant is analysed once a week (refer 5.1.3), by a laboratory recognised by the Ministry of Health.

Those undertaking fluoride analysis must be certified as competent analysts as if the analysis is required for compliance (refer section 3.1.1 of DWSNZ).

The analytical method used for both on-line and bench-top analysers must conform to (or be validated against) the reference methods in DWSNZ or the latest edition of *Standard Methods for the Examination of Water and Wastewater*.

4.1.7 Other design considerations

a) *Water service off-takes*

No drinking-water service within the plant or to consumers must be taken directly off the water line to which fluoride is dosed. This will provide additional

[3] The SPADNS (Sodium 2-(parasulfophenylazo)1,8-dihydroxy-3,6-naphthalene disulfonate) method is a colourimetric method for determining fluoride concentration in water. Fluoride ions react with the zirconium-SPADNS dye lake resulting in a loss of colour. The residual colour of the dye is then measured at 570 nm in a spectrophotometer. The concentration of the fluoride ion is inversely proportional to the intensity of the colour. This method is suitable for fluoride ion analysis in on-site laboratories.

time and volume for a high concentration of fluoride to be diluted if it has been increased above the upper action process limit.

b) *Anti-siphonage, back-flow protection and pressure relief*

The dosing system must be fitted with anti-siphon and pressure-relief valves (refer 4.4.3).

Any water supply used for dissolving the fluoridating agent or as carry water must have a backflow prevention device fitted upstream of where the fluoridating agent is dissolved or diluted (such as mixing tanks), or injected (such as metering pumps). In some situations backflow prevention may be achieved simply through using an air gap. Any backflow device must comply with the current New Zealand standards and with the Boundary Backflow Prevention for Drinking Water Supplies Code of Practice, June 2013.

c) *Control equipment*

It must be physically impossible for any component of the fluoridation feeding or control equipment to be manually plugged into standard electrical outlets for continuous operation if isolation of the power supply is used for the stop/start control of the dosing equipment. Any manual mode (or 'test') switch for the fluoridation chemical feeding equipment should not permit permanent selection (such as spring-loaded switches) and should return to the off position when released to prevent unattended manual operation.

All key components of the fluoride dosing control system must be interlocked to ensure total fluoride dosing system shutdown in the event of failure of any individual equipment item and to ensure that the dosing system cannot operate unless water is flowing. These key components should include, but are not limited to:

- Stop/start/pacing signals;
- Feeders;
- Metering pumps;
- Solution transfer pumps;
- Solution tank levels or weight;
- Dilution water pumps; and
- An online monitoring system.

Refer to Section 4.1.6 for the key overdosing controls.

An assessment of the possible causes of overdosing must be conducted during plant design and, where appropriate, interlocks and alarms designed into the system to prevent overdosing of fluoride.

d) *Corrosion and dust suppression*

Corrosion prevention measures should be implemented for all fluoridation plants.

Dust control measures should be implemented where sodium fluoride and sodium fluorosilicate are the agents used.

These measures will help protect the equipment, the operational staff and the neighbours surrounding the plant.

4.2 Equipment

All equipment used for adding fluoride to a drinking-water supply is required to operate in a safe, reliable and precise manner.

The drinking-water supplier must ensure that the equipment and associated controls have safety measures against over dosing and under dosing of chemical through human or operational malfunctions and that the equipment is safe to operate and maintain.

4.3 Chemical Delivery, Handling and Storage

The delivery, handling and storage of chemicals must be in accordance with occupational health and safety and environment protection requirements (including HSNO) to ensure the safety of staff, the community, the environment and the drinking-water supply.

4.3.1 Chemical delivery and quality assurance

Fluoride supply should be in accordance with the Water New Zealand, Good Practice Guide: *Supply of Fluoride for Use in Water Treatment 2014*.

The drinking-water supplier should ensure that the chemical supplier has a quality assurance system for the supply and delivery of the fluoridating agent to ensure its chemical purity, safe delivery and use. The quality assurance system should be implemented to manage all the factors associated with the specification, contract management, supply (including transportation), purity, storage, use and handling of fluoride compounds that could adversely impact upon the health and safety of staff, contractors and consumers. This quality assurance system should be included as part of the Water Safety Plan.

4.3.2 Bulk chemical storage

The drinking-water supplier should ensure that there is sufficient chemical available and readily accessible to ensure continuity of water fluoridation. The drinking-water supplier should document its assessment of storage requirements (taking into consideration availability of the fluoridating agent, transport, procurement strategies and itinerant populations).

Design of the bulk chemical storage should take into consideration:

a) Material selection (fit for purpose)
b) Safety in design for access, operation and maintenance ensuring compliance with relevant codes, guidelines and regulations
c) Separate chemical storage where required by the *Code of Practice HSNOCOP 47 Secondary Containment Systems*
d) Chemical storage bunding requirements as per the *Code of Practice HSNOCOP 47 Secondary Containment Systems*
e) Handling equipment for dry fluoride must be suited to the form and unit size of the delivered chemical
f) Spill removal and clean-up procedures
g) Ventilation and dust extraction as appropriate for the selected chemical
h) Measures to prevent corrosion (such as sealing all connections, water traps and ventilation)

i) Weather protection as appropriate
j) Controls and instrumentation including alarms, and visual display of tank contents
k) Security from unauthorised personnel (access control methods should be addressed as part of the HAZOP)
l) Safety and compliance of the chemical delivery area

4.3.3 Bag loaders/Vacuum Loading Systems

Where a dry fluoridating agent is used, the design of the plant should minimise airborne dust and the need for manual handling. Where manual handling is necessary, it should be in accordance with the *Code of Practice for Manual Handling* and the *Health and Safety at Work 2014*[4].

4.4 Chemical Mixing and Dosing

4.4.1 Mixers

Fluoride solutions should be homogeneous, irrespective of preparation method. Mechanical mixers should be used for the preparation of sodium fluorosilicate solutions.

4.4.2 Softeners

If using sodium fluoride, the fluoridation plant should include a water softener where the total hardness[5] of the water used for dissolving sodium fluoride chemical exceeds 75 mg/L as calcium carbonate. This requirement applies only to the water used to make up the fluoride solution in the mixing tanks and not to the main water supply being treated.

4.4.3 Metering pumps

Metering pumps must be able to accurately deliver the required flow rate, and be sized to operate at maximum output during the maximum flow that the treatment plant is designed to operate at. A safe method for calibrating dose rates must be available and maintained to ensure that the metering pumps are providing an accurate flow rate.

Any risk of gravity flow or siphoning of the fluoride chemical through the metering pump must be prevented. Siphoning can be prevented through use of an anti-siphonage trap, air gap or similar. A loading valve (or alternative such as an air break) on the delivery side of the pump shall be provided if gravity flow from the metering pump is possible.

Pressure relief on the delivery side of the pump or built into the metering pump must be provided. The pressure relieved at this point must be directed safely (e.g. back to the tank or bund).

When located within any bunded area, the transfer pump and metering pumps should be positioned above the maximum spillage level of the storage tank.

[4] Expected to replace the Health and Safety in Employment Act (1992).

[5] If water harder than 75 mg/L as $CaCO_3$ is used for dissolving the sodium fluoride in a saturator (i.e. producing a 4% w/w concentration fluoride solution), this will lead to excessive precipitation of calcium fluoride and magnesium fluoride from the fluoride solution.

4.4.4 Dry feeder systems

Dry feeder systems must meet the following requirements:

- Ensure accurate delivery of the required volume or weight of fluoridation chemical for the quantity of water being treated and must be sized for the maximum flow of the treatment plant
- The dry feeder, tank solution level, mixer, and metering pump must be controlled to meet the functionality requirements of Section 4.1.5
- Include a dust extraction system as specified in Section 4.3.3

4.4.5 Injection point

The location and detailing of the chemical injection point must:

a) Provide homogenous mixing (minimum coefficient of variance of 0.95) of the chemical in the treated water (where necessary mixing devices should be used) before the first take off or sampling point

b) Minimise loss of fluoride by precipitation with other chemicals (such as those containing calcium, aluminium and magnesium) or treatment processes (such as coagulation, filtration and pH correction), by dosing the fluoride following filtration and as far away as practicable after final pH correction if using lime

c) Minimise the possibility of siphonage and overfeeding

d) Include provision of a sampling point following mixing

e) Be located upstream of buffer storage of treated water

f) Not allow any bypass or secondary pipework (or channel) into which the fluoride chemical will not be dosed (except for fire-fighting purposes or other non-potable water).

g) Consider the impact of any recycle flow streams to avoid "double dosing".

4.5 Process Control and Instrumentation

Dosing fluoride into drinking-water is a continuous process with the objective of providing a lifetime exposure to fluoride for most consumers. It is therefore essential that the drinking-water supplier has a validated and verified system of accurately controlling fluoride dosing in place at all times.

As described in Section 4.1.6, two Independent Checks are required for plants that supply more than 10,000 people, and one Independent check is required when 10,000 people or fewer will be served. This is a minimum requirement for drinking-water suppliers for compliance with this Code. Those suppliers serving 10,000 people or fewer should consider the use of two Independent Checks.

In addition to the one or two Independent Checks, the following instrumentation must be provided:

a) Flow meter on the process stream into which fluoride is being dosed

b) Level, pressure or weight indicators on bulk tank

c) Alarm system to notify dosing abnormalities, particularly during unsupervised and after-hours periods

The following instrumentation is not a requirement for compliance with this Code but may be used to improve control of the system:

a) Reference bench-top fluoride analyser to verify the performance of the online unit required by Independent Check 3
b) Both a load cell and level sensor on the day tank (only one is required for Independent Check 1).

All online instruments must be calibrated in accordance the manufacturer's recommendations as to method and frequency.

4.5.1 Flow measurement

A flow meter must be provided to measure and communicate the water flow, and to pace the fluoride dosing equipment over the full water flow rate range. The metered flow must be truly representative of the flow into which the fluoride is dosed.

The flow rate signal must be fed back from the meter to the fluoride dosing system to enable automatic adjustment of the fluoride dose rate. Use of electromagnetic flow meter or similar with an accuracy of ± 1 per cent over the complete range of flow is recommended. The accuracy must not exceed ± 3 per cent. The flow meter must be installed in accordance with the manufacturer's recommendations (particularly in relation to the length of straight pipe upstream and downstream of the meter).

4.5.2 Control and alarms

The fluoridation plant must generate alarms and respond to the fluoride action limits as specified in Table 2.

All dosing systems must be configured so as to be 'fail safe', that is, failure of a critical component automatically leads to the cessation of dosing and generation of an alarm. If it is not possible for the unit to fail safe, the PLC must be configured to ensure that fluoride will not be added to the water supply if a failure occurs. Loss of water to the online fluoride analyser must also generate an alarm.

All alarms, including fluoride concentration alarms, where online instrumentation is installed must inform a resource capable of immediate response even after hours. Where dosing is stopped during automatic operation that is outside of the normal operating parameters of the plant (either manually or by shutdown alarms), dosing must not restart automatically without manual on-site intervention.

Where automatic shutdown systems can be manually overridden (such as for maintenance purposes) any override events must be logged and the override facility configured such that the operator is aware that an override is activated (such as by the activation of a local or telemetry alarm).

The operation of shutdown systems must be fully tested at least annually and the outcome of these tests recorded. The testing procedure must be developed as part of the risk management planning as described in Section 3.2.

The fluoridation plant must generate alarms and respond to the fluoride action limits as specified in Table 2.

4.6 Plant Security

The drinking-water supplier must control access to the fluoridation plant to prevent unauthorised access which will minimise the risk of anyone being injured. Appropriate signage must be provided to indicate the presence of the fluoridating agent, any electrical or OHS hazard, and any required personal protective clothing or equipment, and that authorised entry only is permitted.

Access to the fluoridation plant should be restricted to authorised personnel through provision of a security locking system.

5 Operation and Maintenance

All plant and equipment used for adding fluoride to a drinking-water supply must operate in a safe, reliable and precise manner. The drinking-water supplier must ensure that the plant and equipment is well maintained.

5.1 Operational Monitoring and Verification Monitoring

5.1.1 **Monitoring of fluoride concentration in the raw water**

The fluoride concentration in the raw water should be analysed at least annually, but preferably biannually in summer and in winter. Prior to design, more frequent monitoring is suggested. The sample must be analysed for fluoride at a Ministry of Health recognised laboratory (which will be IANZ accredited). The analysis must be done using the same method as described in Section 4.1.6 for testing the fluoride concentration in drinking-water for Independent Check 3. The raw water fluoride concentration must be taken into account when designing and operating the fluoridation plant.

5.1.2 **Quantity of fluoride dosed**

Every 24 hours the mass of fluoride consumed by the plant (determined from the gross quantity of chemical used) must be calculated and divided by the volume of water that has passed the fluoride dosing point. This is another check of the average concentration dosed over each 24-hour period. Any inconsistencies must be investigated and remedial actions taken to bring the actual dose within the operating dose range (refer to Section 4.1.4).

5.1.3 **Monitoring of the treated water**

DWSNZ requires that the drinking-water leaving the treatment plant is tested for fluoride with a weekly sampling frequency at minimum. DWSNZ specifies that there cannot be more than 13 days between samples. Alternatively, fluoride sampling may be carried out in the distribution zone.

The sampling programme must be integrated into the Water Safety Plan under the DWSNZ for the drinking-water supplier and for any downstream water supplier receiving fluoridated water from the drinking-water supplier.

The drinking-water supplier must have a procedure to investigate and rectify 0.15 mg/L or more discrepancies between the monitoring results and the fluoride concentration as determined from the quantity of fluoride dosed and the Independent Checks.

5.2 Quality Assurance

The quality assurance system must ensure the fluoridation process is adequately monitored and maintained such that any discrepancy, equipment reliability issue or unacceptable variability in the final fluoride concentration is readily identified and effectively rectified.

The drinking-water supplier must also include the details of the quality assurance (QA) and quality control (QC) framework that will be implemented to verify the accuracy of the fluoride testing results, and the corrective actions and process by which operators will be informed in the event the fluoride dosing system is either under dosing or over dosing.

The QC framework must comprise activities (checks) designed to ensure:

- data integrity (consistency and accuracy)
- use of standardised procedures for sampling, analysis and data interpretation
- identification of errors or omissions, and estimation of uncertainties
- calibration of equipment
- credible results that relate to the data and analysis.

The drinking-water supplier must ensure that the Operations & Maintenance Manual (described in Section 6.3) is a controlled document with defined procedures/processes for amendment.

5.3 Maintenance and Calibration

The drinking-water supplier should carry out monthly plant inspections at a minimum and record in writing the outcome of the inspections and any resultant actions. In some instances, the HAZOP may determine that a more rigorous plant inspection regime is required. Plant inspections will help ensure effective process control, determine whether equipment is operating normally and identify the need for maintenance.

All equipment and instruments considered vital for process control must be maintained and calibrated regularly according to maintenance and calibration schedules documented or referenced to in the Operation & Maintenance Manual (see Section 6.3). Performance of metering pumps should be calibrated at least monthly by measuring the volume of solution pumped during a measured time interval.

Upon request, the drinking-water supplier must provide the DWA with evidence of maintenance and calibration of all plant items and equipment.

5.4 Operational Personnel

The drinking-water supplier must ensure that operational personnel (employees or contractors) are appropriately skilled and trained in the management and operation of the fluoridation plant, and that these competencies are maintained (and that this is documented in the Water Safety Plan). Operational personnel must have an adequate knowledge of the principles of fluoridation (including the risks), the type of plant or equipment and its operation and maintenance.

A National Certificate in Water Treatment (Site Operator) - Level 4 (or equivalent), or preferably a National Diploma in Drinking Water - Water Treatment (Site Technician) - Level 5 (or equivalent) is recommended as a minimum qualification for operators of fluoridation plants.

Operational personnel must have a sound knowledge base from which to make effective operational decisions. This requires training in the methods and skills required to perform tasks efficiently and competently. Operational personnel should be aware of the potential consequences of system failures, and how decisions made can affect the safety of the scheme.

5.5 Occupational Health and Safety

In the area of safety, and the handling and storage of dangerous goods, the *Health and Safety at Work Act 2014,* Hazardous Substance and New Organisms Act 1996 and associated regulations have precedence over this Code. If clarification is required in these areas then WorkSafe New Zealand will provide the defining interpretation.

The health and safety measures discussed below provide a basis for a drinking-water supplier to assess the control measures it should employ to manage occupational and safety risks associated with fluoridation systems. The control measures listed are not exhaustive and the use of these control measures (set out below) in no way ensures that compliance with the above mentioned Acts and Regulations is achieved.

Health and safety measures for consideration in the design and operation of a fluoridation plant include:

a) Safety in Design to ensure a safe working environment and facilitate safe working practices

b) Effective control measures are applied to mitigate risks as identified by the risk assessment

c) Adequate training for plant operators about the specific hazards associated with the fluoridating agent

d) Accessibility of the Material Safety Data Sheet (MSDS) for the fluoride chemical by maintaining the current MSDS in the Operation & Maintenance Manual, and providing a copy close to where the substance is used to enable reference to it by operators who handle the substance

e) Pipework and tanks used for storage and distribution of fluoride chemicals comply with the relevant standards and are appropriately distinguishable (for example, colour coded and labelled) from other plant pipework

f) The installation and arrangement of the equipment to ensure that the handling and operation of the equipment meet workplace health and safety requirements

g) Fluoridation equipment should be kept in a room or building separate from other water treatment plant equipment.

h) Electrical control panels for the fluoridation plant are protected and should be located outside the fluoridation room

i) The atmosphere of any areas where fluoridating agents are stored or used is safe for workers, and ventilation and dust extraction as appropriate is provided for the selected chemical

j) Appropriate personal protective equipment and hand washing facilities are supplied and maintained by the drinking-water supplier at the fluoridation plant for mandatory operator use

k) Emergency eyewash/showers are available where fluoridating agents are stored and handled

l) Emergency skin treatment such as calcium gluconate gel or similar

5.6 Environmental Safety

The drinking-water supplier should ensure that the design and operation of the fluoridation plant does not result in environmental harm.
In its management of the fluoridation plant and ancillary equipment and activities, the drinking-water supplier must consider the Resource Management Act 1991 and relevant regional or unitary plans.

5.6.1 Spills and leaks

The drinking-water supplier must ensure the fluoridation plant and equipment is designed and operated to minimise the risk of fluoridating agent spills or leaks. Any spills or leaks must be contained and must not come into contact with or be stored with incompatible chemicals.

Where fluorosilicic acid is used then appropriately sized bunding with chemical resistant lining and other measures (such as drip trays) must be provided to contain any spillage. The design of bunding must facilitate the safe removal of any spillage, and be consistent with the Code of Practice HSNOCOP 47 Secondary Containment Systems and other relevant New Zealand standards. In designing the fluoridation plant, the inclusion of all components containing fluorosilicic acid (including the chemical feeding equipment) in the storage bund area should be considered as an effective way of reducing environmental risks.

Operating procedures must include measures for managing spills and leaks of the fluoridating agent, including in-built detection devices, surveillance, corrective actions and remedial works, and notification and reporting to the appropriate authorities. Fluoride piping should be visible so that it can be easily inspected for integrity. Where pipes are not visible, leak detection measures should be in place.

5.6.2 Release to the atmosphere

Where dry fluoridating agents are used, measures must be implemented to control dust. This includes designing the plant to prevent the escape of powder into the fluoridation room and atmospheric discharges.

Dry sweeping of dry fluoride chemical should not occur. If powder is spilt then it should be cleaned by vacuuming that is fitted with a HEPA filter to prevent dust. Operators must use personal protective equipment and this should be dictated in the Operation and Maintenance Manual.

5.6.3 Waste disposal

The management or the disposal of waste containing fluoride must be in accordance with the Hazardous Substance and New Organisms (HSNO) Act 1996. Wastes include fluoride chemical and plant and equipment that have been in direct contact with fluoride chemical.

The drinking-water supplier must document and implement an environmental waste disposal plan for fluoridating agent spills and leaks, contaminated fluoridating agent and fluoridating agent containers.

6 Documentation

6.1 Design Report

Water suppliers should document the design of new and upgrading of existing fluoridation facilities in a Design Report, which should include:

- The name of the drinking-water supply proposed to be supplied, including the WINZ identification numbers
- Plans and specifications including:
  - General description of facility and process including an outline of the overall treatment process, description of fluoridation facility, and the design capacity of the plant, expected minimum and maximum flows in normal operations and the expected growth of flows with time
  - A process and instrumentation diagram showing all key items by appropriate symbol
  - A location map, a site plan, and a 'general arrangement' showing the fluoridation facility in the context of the overall treatment plant
  - Evidence of the chemical selection process, natural fluoride content, optimum fluoride level and the dosage concentration
  - Fluoride design control limits, maximum pumping rate, feed rate and dosage calculations
  - Functionality of the fluoridation plant including details of intended process control, process and instrumentation (including process and instrumentation design), control philosophy for the proposed facility and integration into overall treatment process
  - Risk assessment as per Sections 3, 4.1.2, and 4.3.1, including the fluoridating agent selection process, quality assurance processes, supply and delivery risks, storage risks and the prevention or control of dosing risks associated with human error, plant malfunction and plant performance
  - Supplier of the selected fluoridating agent and that supply is in accordance with the Water New Zealand, Good Practice Guide: Supply of Fluoride for Use in Water Treatment.
  - Plans showing the spatial relationship (including levels) between the storage and metering facility and the dosing point, the relationship between the dosing points for fluoride and for any other chemicals added 'post treatment', and the pipeline layout from the dosing point downstream to the next component in the plant such as the clear water storage
  - Measurement of fluoride ion concentration in the treated water, monitoring programme and quality assurance
- A gap analysis against this Code providing justification for any deviations from the requirements of this Code and demonstrating an equivalent or greater level of safety
- Project plan including timelines
- Commissioning plan

Documentation of the fluoridation plant design should be incorporated in the drinking-water supplier's quality management system. Plant operational staff must be sufficiently trained so that they have knowledge of the location of these documents and are familiar with their content before commissioning. Operators that were absent from this training must be trained once the plant has been commissioned.

6.2 Completion of Work

Upon completion of plant construction and commissioning, the drinking-water supplier should maintain the following documentation:

- Operation & Maintenance Manual (refer section 6.3.)
- Emergency Management Plan (refer section 6.4)
- Commissioning records verifying that the fluoridation plant installation is in accordance with the plans and specifications and its operation is safe and reliable

6.3 Operation and Maintenance Manual

The Operation & Maintenance Manual must contain sufficient information to facilitate the operation and maintenance of the fluoridation plant by the operational staff. At minimum it must include:

- Standard operating procedures for the plant
- Maintenance and calibration schedules for items of equipment and instrumentation
- As-constructed drawings, equipment manuals, and functional description

The Operation & Maintenance Manual should be a controlled document which must be integrated into the drinking-water supplier's quality management system.

6.4 Emergency Management Plan

The drinking-water supplier must develop and implement an Emergency Management Plan to manage incidents and emergencies, including fluoride overdosing, spills entering the environment and operator exposure.

The Emergency Management Plan must address how the system will be managed to prevent any duration of fluoride concentrations over 1.5 mg/L (the MAV) reaching consumers.

An Emergency Management Plan must address:

- Procedures for shutting down the equipment in the event of overdosing
- The actions required to identify and rectify the problem
- Action required to advise and protect the public in the event of a significant overdosing event
- Reporting protocols including a clear chain of command and designated responsibility.

The Emergency Management Plan must be integrated into the Water Safety Plan or reference within it.

6.5 Record Keeping

The drinking-water supplier should keep records verifying that the fluoride plant is managed and operated in accordance with this Code, and with DWSNZ and section 69ZD of the Health Act. The records must be maintained and made available for inspection upon request by the DWA. Records include:

- Regular chemical analysis of fluoridating agent delivered
- Regular analysis of concentration of fluoride in raw water
- Plant and equipment calibration certifications and maintenance data
- Routine testing of critical alarms and corrective actions and outcomes of the system shutdown tests
- Surveillance monitoring and audits records
- Staff training records

The drinking-water supplier must, at a minimum, also record the following parameters at the frequencies indicated:

a) Continuously (minimum 5 minute interval records) as required by DWSNZ
   - Water flow
   - Online fluoride concentration (if Independent Check 3 is used)
   - Fluoride solution flow

b) Daily
   - The volume of water treated
   - The quantity of fluoride added to the water
   - The level or weight of the day tank prior to and after refilling or the volume of fluoride solution used (if a level sensor or load cell is fitted to the day tank for Independent Check 1)
   - The stock of fluoride on hand
   - The results of fluoride analysis of the samples of water taken from the treated water at the intervals required
   - Average fluoride concentration each day on the basis of the online analyser records (if Independent Check 3 is used)
   - Average fluoride concentration each day on the basis of the loss of mass or volume in the day tank (if using Independent Check 1)
   - A reconciliation of each of the Independent Checks

c) Weekly
   - Results from weekly sampling for fluoride content in the treated water

7 Reporting and Auditing

7.1 Annual Reporting

Water suppliers should provide the DWA with a report each year of their fluoridation systems. The annual report should include information required to demonstrate that the fluoride P2 compliance criteria within the DWSNZ has been achieved for the July - June period, and:

- The annual average, minimum and maximum fluoride concentration at each fluoridation plant
- The annual average, minimum and maximum fluoride concentration from the weekly samples in the water sampling localities, including a summary of any missed samples
- A summary of incidents and emergencies that were reported during the year
- A summary of the fluoridation process and chemicals used at each fluoridation plant (including any fluoridation plants operated by others that feed into that water supply being reported on)

7.2 Notification Requirements

The DWA must be notified of emergency and exceptional situations as described in Table 3. If the fluoride concentration in the drinking-water is less than the lower action process limit for a continuous period of >72 hours, it is not mandatory that the DWA be notified but it is encouraged.

7.3 Auditing

The drinking-water supplier's water fluoridation activities should be integrated into the Water Safety Plan.

Table 3: Emergency and exceptional notifications

Emergency and exceptional situation	Method of notification
Fluoride concentration in drinking-water supplied in a water sampling locality exceeds or may exceed 1.5 mg/L.	Notify the DWA Immediately, investigate the cause of the exceedance and take appropriate action. See DWSNZ for more information.
Fluoride concentration measured at the fluoridation plant exceeds 1.5 mg/L, however, does not enter the drinking-water supply.	This does not require a mandatory notification but the DWA should be notified. In addition, an internal investigation into the cause of the incident should be carried out and action should be undertaken and documented.
Fluoride concentration in drinking-water supplied is less than the lower action process limit for a continuous period of >72 hours.	This does not require a mandatory notification but the DWA should be notified.
If the rolling annual average fluoride concentration of drinking-water in a water supply has exceeded, or is expected to exceed, 1.0 mg/L in each quarterly compliance period.	The DWA should be notified.

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9 Further Information

To find out what New Zealand Health professionals think about fluoridation see:

- www.fluoridefacts.govt.nz
- For free download of the Water New Zealand guides see:
- www.waternz.org.nz and click on *publications*.
- See the website of your local District Health Board, or visit:
- Ministry of Health www.health.govt.nz and click on *Our Work* and then *Preventative Health/Wellness*
- Your local District Health Board's website
- New Zealand Dental Association www.nzda.org.nz
- New Zealand Medical Association www.nzma.org.nz
- National Fluoridation Information Service www.rph.org.nz

www.ch2mbeca.com

Report

Water Fluoridation Engineering Costs -

Prepared for Ministry of Health

Prepared by CH2M Beca Ltd

25 August 2015

Revision History

Revision Nº	Prepared By	Description	Date
1	**Jessica Daly and Philip La Roche**	Draft for Client review	23/07/2015
2	Jessica Daly	Final	25/08/2015
3			
4			
5			

Document Acceptance

Action	Name	Signed	Date
Prepared by	**Jessica Daly and Philip La Roche**		25/08/2015
Reviewed by	**Andrew Watson**		25/08/2015
Approved by	**Andrew Watson**		25/08/2015
on behalf of	CH2M Beca Ltd		

Executive Summary -

The Ministry of Health (MoH) has commissioned CH2M Beca Ltd (Beca) via Allen + Clarke to provide engineering cost inputs into the cost-benefit analysis for water fluoridation in New Zealand.

In this report we have undertaken a series of capital cost estimates for different sized treatment plant capacities (the four population categories of Neighbourhood, Small, Minor and Medium), as well as four case studies on large supplies. We have presented the costs as a range (shown in the table below) to account for some of the variability in existing facilities and type of treatment process.

Capital Cost Summary for Fluoridation of Different Population Categories

Design Parameters	Neighbourhood	Small	Minor	Medium
Population Served	<100	101-500	501-5000	5001-10000
Capacity (m^3/d)	55	260	2050	6900
Fluoride Chemical	Sodium Fluoride	Sodium Fluoride	Sodium Fluoride	Fluorosilicic Acid
Cost Range	**$65,000 -$160,000**	**$75,000 - $160,000**	**$80,000 - $260,000**	**$145,000 - $260,000**

Capital Cost Summary for Fluoridation of Large Plants (Case Studies)

	Whangarei	Levin	Napier	Blenheim
Design Parameters				
Population Served	48,000	20,000	49,910	24,000
Peak Capacity (m^3/d)	36,000	13,000	50,000	34,000
Average Capacity (m^3/d)	23,000	8,500	29,000	13,000
Fluoride Chemical	FSA	SFS	FSA	FSA
Treatment Plants	Whau Valley Poroti Ruddles	Levin WTP	Ten wells	Central WTP Middle Renwick Road WTP
Total	**$725,000**	**$400,000**	**$2,250,000**	**$580,000**

We have undertaken five case studies on a range of plants that have existing fluoridation systems to estimate the cost required for each plant to meet the Fluoridation Code of Practice (CoP). These cost estimates (shown in the table below) are indicative only based on information gathered from the relevant water suppliers. A more detailed assessment of each plant would be required in order to more accurately assess and cost the upgrades required to meet the CoP.

Summary of Upgrade Costs to meet the Code of Practice

	Waterloo	Waikanae	Hamilton	Balclutha	Milton
Population Category	Large	Large	Large	Minor	Minor
Fluoride Chemical	SFS	SFS	FSA	NaF	NaF
Upgrade Cost	**$15,000**	**$10,000**	**$50,000**	**$25,000**	**$20,000**

The base equipment for a fluoridation system can be installed relatively inexpensively. However, in order for fluoridation to be safe for consumers, operators and the environment; proper controls must be in place regardless of system size. These additional controls add cost, which can be significant.

The cost estimates show that the infrastructure that is existing at a treatment plant has a big impact on the costs of adding fluoridation. Typically smaller plants have less infrastructure than larger ones. Some Small and Neighbourhood supplies may not even have a treatment plant.

The existing configuration of a supply can also affect the costs. The Napier supply is an example of a system that would cost significantly more to implement due to having ten wells feeding directly into the network. Whilst this type of supply is not the norm, it is not unique either. The Christchurch water supply also consists of a network of wells that separately supply the city.

When the cost estimates we have prepared are input into the CBA, it is important to appreciate that while we have given a range of capital costs, this range is not broad enough to cover the situation for all plants in a particular size category. For plants with little or no infrastructure, or supplies with multiple sources, the capital costs will be higher than the upper bound estimate.

Contents

1 Introduction

The Ministry of Health (MoH) has commissioned CH2M Beca Ltd (Beca) via Allen + Clarke to provide engineering cost inputs into the cost-benefit analysis of drinking-water fluoridation in New Zealand.

To develop a cost model that is as representative of the real world as possible, requires the development of realistic engineering estimates of what fluoridation plants actually cost. There are many variables that can influence these costs. For example:

- If the water supply is a groundwater plant from a secure water source it will typically not have a water treatment plant. It will have no chemical reception facilities, may not have a building, may not have SCADA and telemetry, and will not have other treatment plant infrastructure.
- A larger surface water treatment plant may have a good range of facilities, but may not have building space to accommodate a fluoridation plant, thereby requiring a new building with the additional costs this entails.

In this report we have undertaken a series of capital cost estimates for different sized treatment plant capacities (the four population categories of Neighbourhood, Small, Minor and Medium), as well as four case studies on large supplies. We have presented the costs as a range to account for some of the variability in existing facilities and the type of treatment process.

2 Chemical Options

2.1 Fluoridation Chemicals in New Zealand

2.1.1 Key Properties

Three fluoridation chemicals are available to fluoridate water in New Zealand. Details of each chemical including its form, supply options, the dosing system required, and indicative supply costs are presented in Table 1.

Table 1: Fluoridation Chemical Options

Detail	Unit	Fluorosilicic Acid (FSA)	Sodium Fluorosilicate (SFS)	Sodium Fluoride
Chemical Formula	-	H_2SiF_6	Na_2SiF_6	NaF
Alternative Names	-	HFA	SSF	-
Chemical Form	-	Liquid	Powder	Powder or granular
Dosing System	-	Liquid dosing	Dry feed system/liquid dosing	Saturator/liquid dosing
Supplied purity/concentration	% (w/w)	22	98-99	97-99
Solution pH (saturated)	-	1.2	3.5	7.6
Active Fluoride	%(w/w)	17 (at 22% strength)	60	45
Chemical required for dosing at 0.7mg/L	kg/ML treated water	4.4	1.2	1.6
Indicative chemical cost (excl. GST)	$/kg	Bulk: 0.48* IBC: 0.78*	25 kg Bags: 1.80*	25 kg Bags: 5.95^
Treated Water Cost (Fluoride at 0.7 mg/L)	$/ML	Bulk: 2.11 IBC: 3.43	2.16	9.52
Chemical Supply	-	Bulk tanker IBC	25 kg bag	25kg bag

* Based on indicative pricing from Ixom (formerly Orica)

^ Based on indicative pricing from DC Rosser

The costs provided in Table 1 are all indicative only. Actual transport distance, delivery quantity and frequency will affect chemical supply costs.

2.1.2 Fluoride Systems in New Zealand

In New Zealand, Councils take different approaches to water fluoridation. Of those supplies that have fluoride added:

- FSA is favoured in a number of the larger water supplies including Auckland, Hamilton, Gisborne and Hastings.
- SFS is used in the Wellington (Waterloo, Te Marua, Gear Island and Wainuiomata), Kapiti Coast (Waikanae treatment plant) and Dunedin water supplies.
- Sodium fluoride is relatively expensive in New Zealand and is not widely used. Clutha District Council uses sodium fluoride at its Balclutha, Milton, Tapanui and Kaitangata plants.

We have adopted a similar approach in developing the cost estimates, with medium-large plants based on FSA or SFS and smaller plants based on sodium fluoride.

2.2 Fluorosilicic Acid

2.2.1 Chemical Details

Fluorosilicic acid (FSA) is a pale yellow fuming corrosive acid with a pungent odour. In New Zealand FSA is currently delivered at a concentration of 22% (w/w) and has a pH of approximately 1. It is classified as a Dangerous Good[1] with a hazard class of “8 Corrosive”.

2.2.2 System Description

FSA is usually added to treated water at the supplied concentration as it may scale if it is diluted. FSA is usually pumped (with a metering pump) from a bulk tank or day tank and injected into the main treated water line. A dosing point schematic is shown in Figure 5.

The NZ Code of Practice requires that a number of “independent checks” are used to minimise the risk of overdosing of fluoride. For water supply systems that serve more than 10,000 people, at least two of the three following independent checks are required. If the water supply system serves 10,000 or fewer people, then at least one of the three independent checks is required. For FSA, the options for independent checks are:

- **Independent Check 1:** use of a day tank that can only be filled once a day and equipped with an online device to measure its contents.
- **Independent Check 2:** use of a fluoride measuring flow meter on the fluoride dosing line before the dosing point.
- **Independent Check 3:** use of a fluoride concentration analyser on the drinking-water line after the dosing point.

For further details refer to the “*Code of practice for fluoridation of drinking-water supplies in New Zealand*”.

A schematic of a generic FSA dosing process is shown in Figure 1.

[1] NZS 5433:2012 Transport of Dangerous Goods on Land

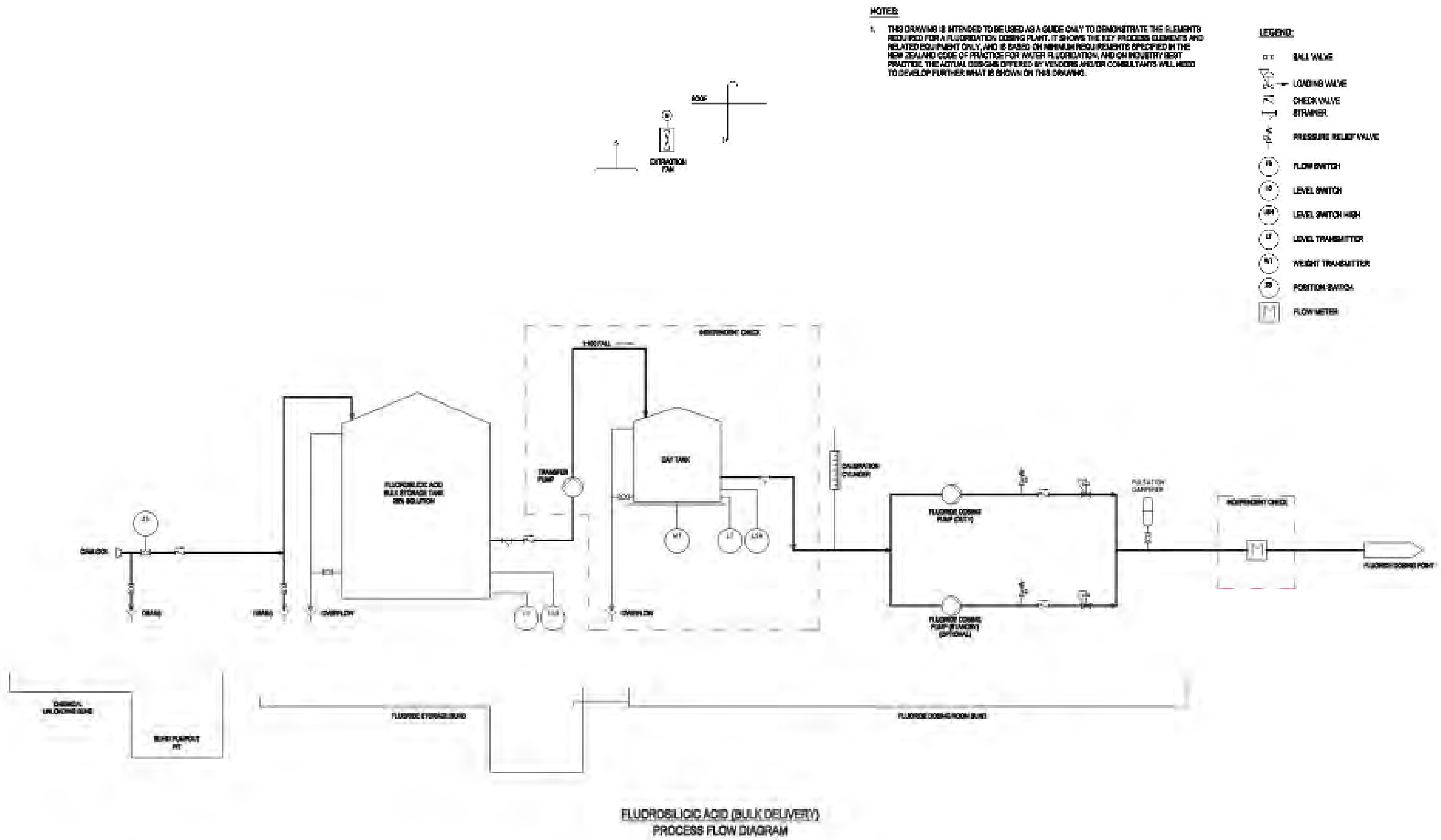

Figure 1: FSA Process Schematic

2.3 Sodium Fluorosilicate

2.3.1 Chemical Details

Sodium fluorosilicate (SFS) is supplied as a white pungent crystalline powder, comprising 60% w/w fluoride ion. It is classified as a Dangerous Good with a hazard class of “6.1 Toxic”.

SFS has a variable solubility in water (unlike NaF) hence for dose control it must be added at a controlled rate.

2.3.2 System Description

An SFS solution is prepared by transferring powder from the storage hopper to a stirred tank at a controlled rate using either a volumetric or gravimetric feeder. The amount of powder fed to the tank is generally controlled to provide flow-paced dosing of constant concentration fluoride chemical.

Industry best practice is to provide for a 10 minute minimum detention time to dissolve the SFS. If this detention time cannot be met with one tank, a separate dissolving tank may be required in addition to the dosing tank.

For a dosing plant using 25kg bags, chemical is loaded from the bags into a hopper mounted on top of the tank. Industry best practice is to use a vacuum loading system fitted with an extendable vacuum wand and dust extraction system. The chemical is drawn directly from the bag into the hopper with minimal dust generation and lifting.

The NZ Code of Practice requires that a number of “independent checks” are used to minimise the risk of overdosing of fluoride. For water supply systems that serve more than 10,000 people, at least both of the following independent checks are required. If the water supply system serves 10,000 or fewer people, then at least one of the two independent checks is required. For SFS, there are only two options for independent checks:

- **Independent Check 1:** use of a day tank that can only be filled once a day and equipped with an online device to measure its contents. In the case of SFS this could be a “day hopper” where a known weight of SFS is transferred on a daily basis. We note that this interpretation is not explicit in the Code of Practice, however as SFS has variable solubility in water, transfer of a known volume of a solution is meaningless unless the concentration is known. Similarly, for this reason a dosing line flowmeter cannot be used as an independent check for SFS.
- **Independent Check 2:** is not suitable for SFS.
- **Independent Check 3:** use of a fluoride concentration analyser on the drinking-water line after the dosing point.

For further details refer to the “*Code of practice for fluoridation of drinking-water supplies in New Zealand*”. We note that strict adherence with the Code of Practice is more difficult for SFS systems, and this is discussed in more detail in Section 5.

If the hardness of the source carrier water exceeds 75mg/L (as $CaCO_3$) then a water softener should be installed to prevent the precipitation of calcium and magnesium fluorides. The water softener will need periodic regeneration producing a strong waste brine solution which will require disposal.

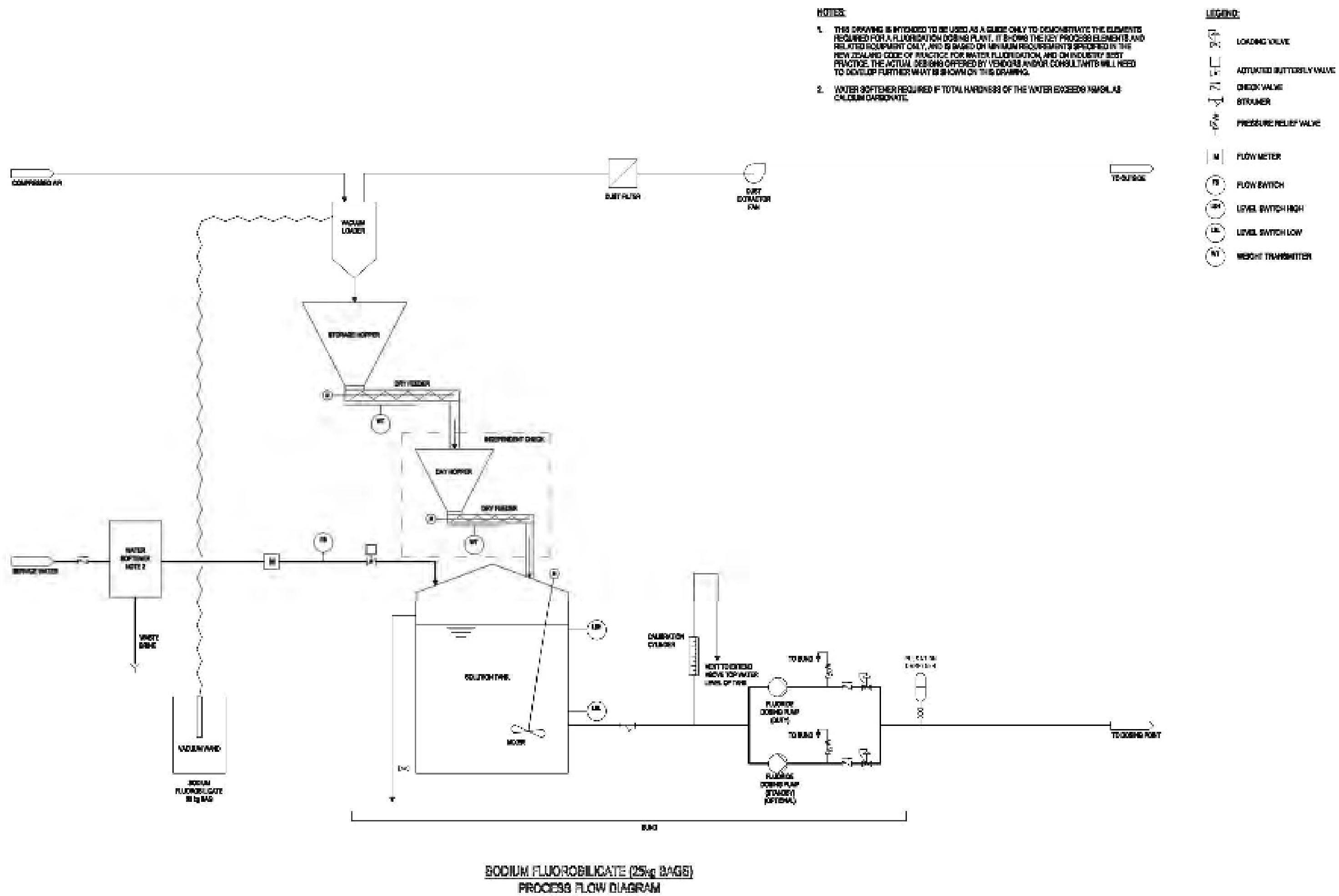

Figure 2: Sodium Fluorosilicate Process Schematic

2.4 Sodium Fluoride

2.4.1 Chemical Details

Sodium fluoride (NaF) is supplied as a white crystalline powder, comprising 45% w/w fluoride ion. It is classified as a Dangerous Good with a hazard class of "6.1 Toxic".

NaF has an almost constant solubility in water of approximately 4%, regardless of water temperature. This allows for automatic, continuous preparation of saturated solutions in a saturator tank without the need for equipment to measure chemical addition. This reduces the risk of overdosing fluoride.

2.4.2 System Description

A saturated 4% solution of NaF is prepared in a saturator tank. Chemical is loaded into the tank to form a bed. Water is then distributed up through the chemical bed in an upflow saturator, or down through the bed in a downflow saturator. Upflow saturators are typically recommended as they are less susceptible to blockages and require less maintenance.[2]

The NZ Code of Practice requires that a number of "independent checks" are used to minimise the risk of overdosing of fluoride. For water supply systems that serve more than 10,000 people, at least two of the three following independent checks are required. If the water supply system serves 10,000 or fewer people, then at least one of the three independent checks is required. For sodium fluoride, the options for independent checks are:

- **Independent Check 1:** use of a day tank that can only be filled once a day and equipped with an online device to measure its contents.
- **Independent Check 2:** use of a fluoride measuring flow meter on the fluoride dosing line before the dosing point.
- **Independent Check 3:** use of a fluoride concentration analyser on the drinking-water line after the dosing point.

For further details refer to the "*Code of practice for fluoridation of drinking-water supplies in New Zealand*".

NaF dissociates in water to give Na^+ and F^- which can form precipitates. If the hardness of the source carrier water exceeds 75mg/L (as $CaCO_3$) then a water softener should be installed to prevent the precipitation of calcium and magnesium fluorides. The water softener will need periodic regeneration producing a strong waste brine solution which will require disposal.

In Australia, NaF is available in 5kg "Fluorodose" bags which are manually loaded into the saturator tank. Operators need not open the bags as they are dissolvable, and so dust generation is eliminated. "Fluorodose" is not currently available in New Zealand.

In Australia, Prominent offer NaF in a 5kg plastic bottle with a large screw top lid. Under the lid the bottle is vacuum sealed via a plastic lid hot-glued into place. To use the chemical, the operator removes the screw cap and up-ends the bottle. The bottle screws directly into the lid of the NaF saturator (offered by Prominent). As the bottle screws into place, a small blade inside the reservoir lid cuts the plastic seal and the 5kg of

[2] Manual of Water Supply Practices M4 – Water Fluoridation Principles and Practices, 2004, American Water Works Association (AWWA)

powder falls into the saturator. The reservoir is fitted with a little spray that is then used to wash the bottle clean. Once the spray finishes, the bottle is unscrewed, the cap on the bottle and the cap on the tank lid are both replaced manually by the operator, and the empty bottle is stored for return to Prominent. Such a product is not currently available in New Zealand, but if the demand was there, Prominent may consider supplying their product to New Zealand also.

Where 25 kg bags are used, the product will be loaded from bags into a hopper mounted on top of the saturator tank. Industry best practice is to use a vacuum loading system fitted with an extendable vacuum wand and dust extraction system. The chemical is drawn directly from the bag into the hopper with minimal dust generation and lifting.

A schematic of a generic sodium fluoride dosing process for 5kg bags is shown in Figure 3 and for 25kg bags in Figure 4.

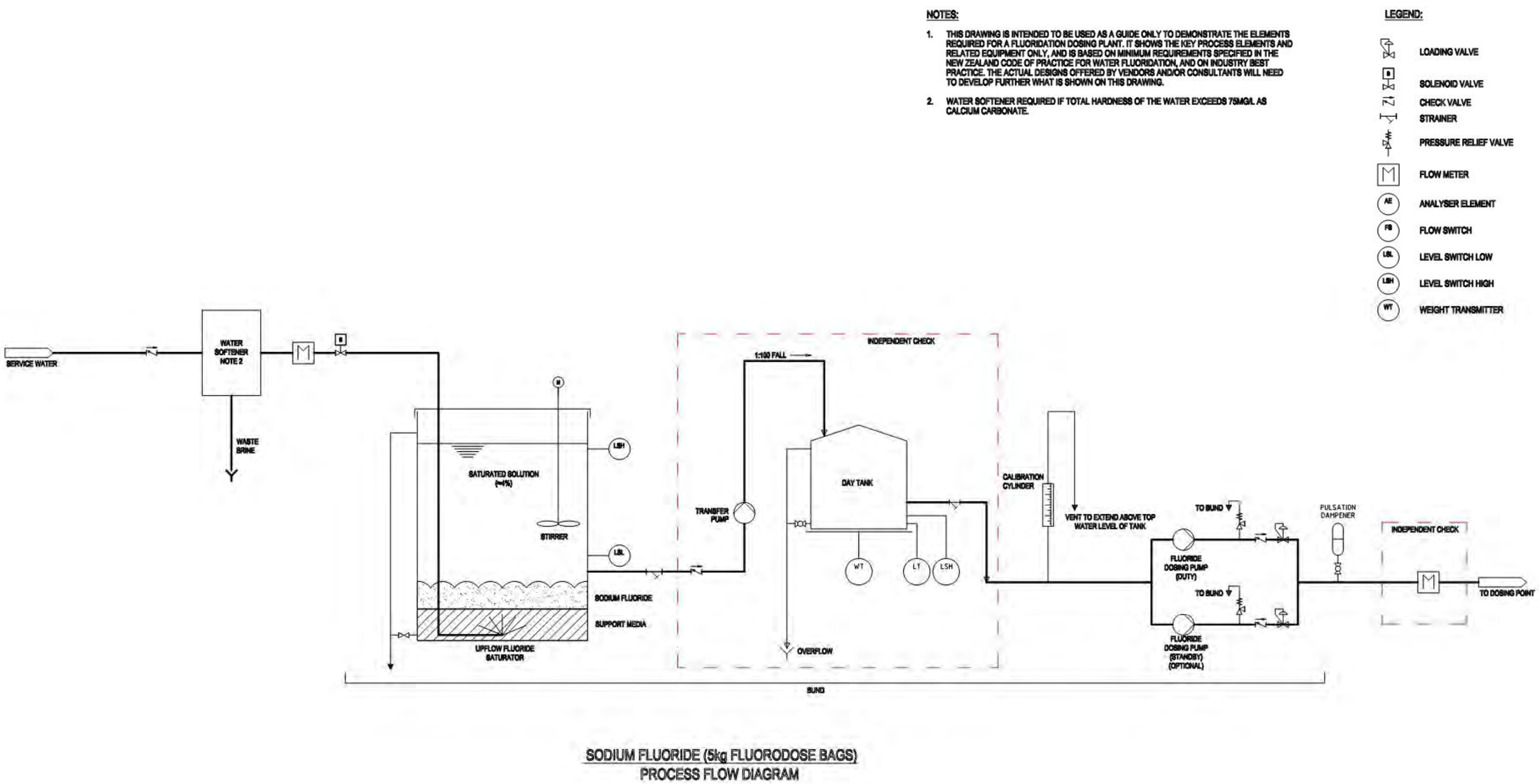

Figure 3: Sodium Fluoride Process Schematic – 5kg bags

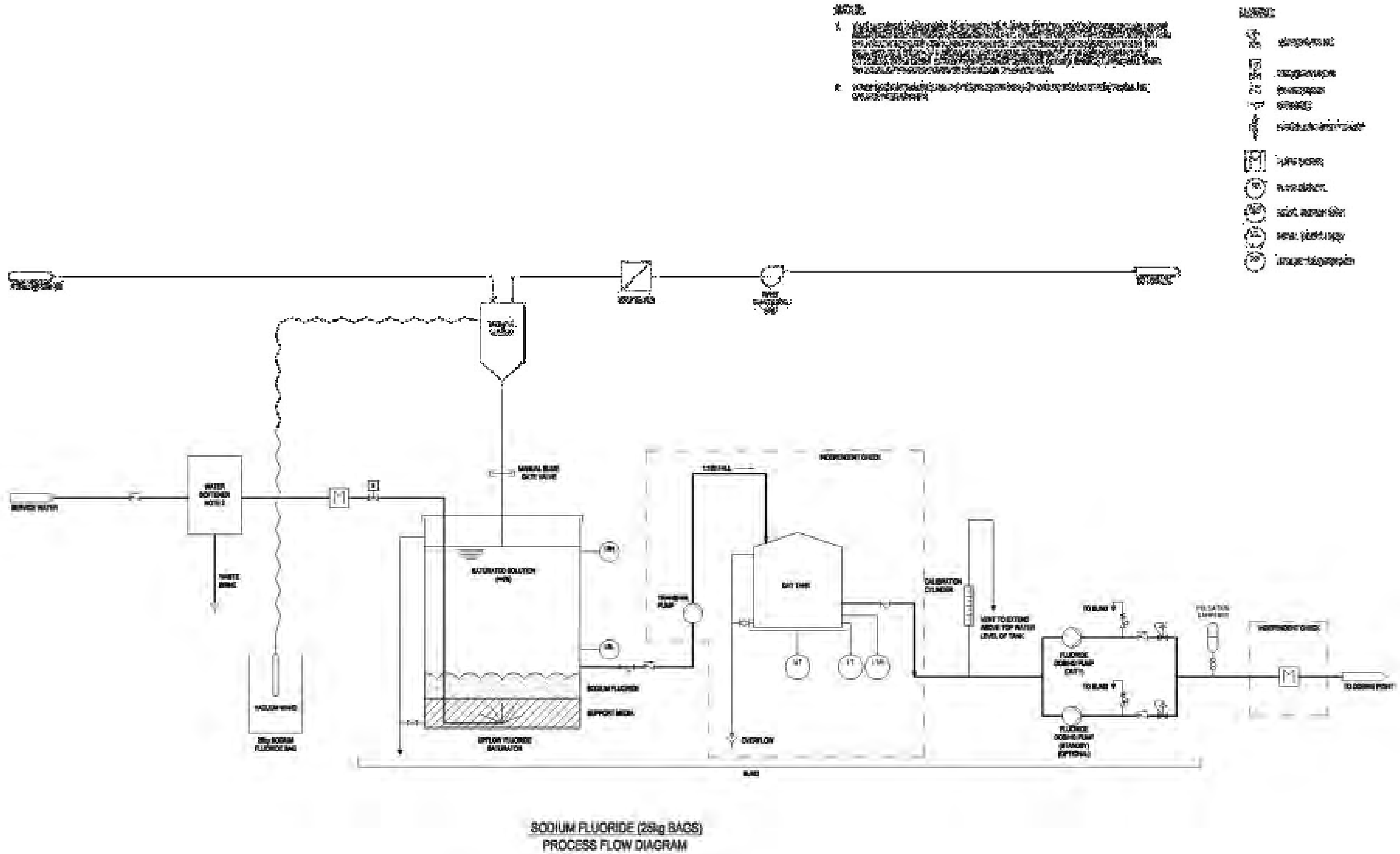

Figure 4: Sodium Fluoride Process Schematic – 25kg bags

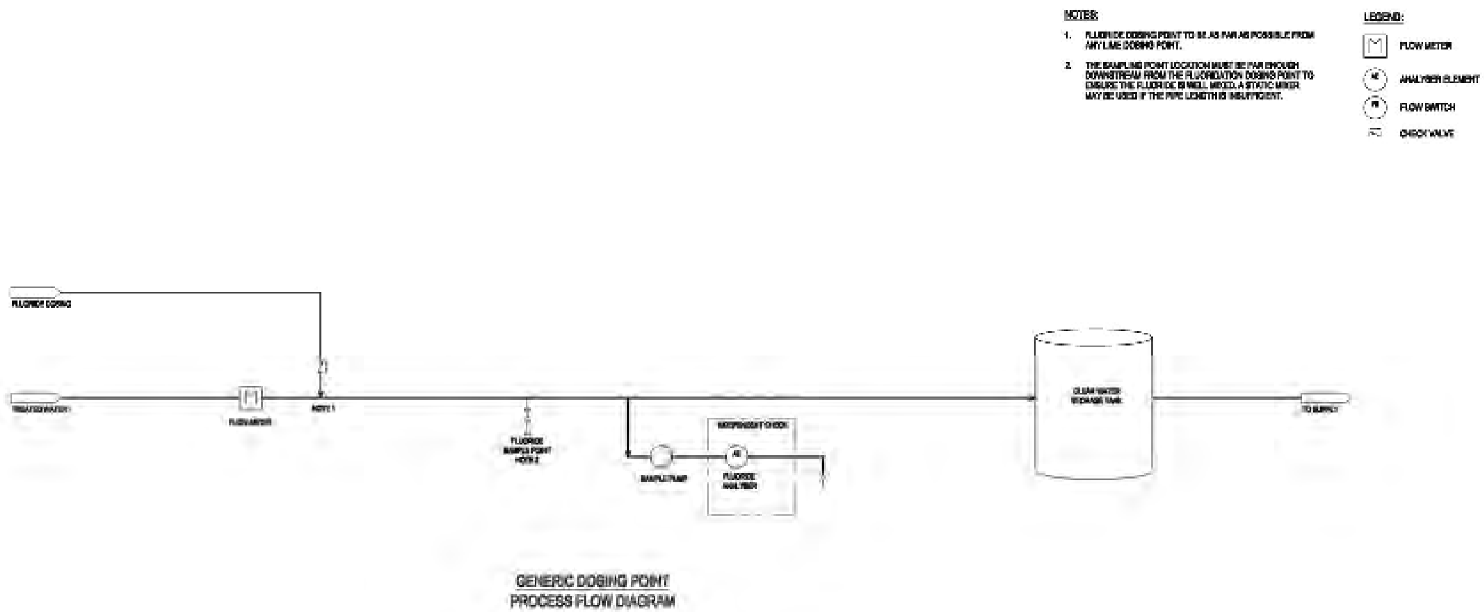

Figure 5: Fluoride Dosing Point Schematic

3 Capital Cost Estimates

3.1 Population Categories

The design flow for each population category has had the following principles applied:

- For large water supplies (population >10,000) the design flow is based on capacity advised by the water supplier. In the absence of actual design capacity, a peak figure of 700 litres/person/day and an average figure of 460 litres/person/day was used.
- For supplies serving populations <10,000 a higher peak per capita water usage rate of 1000 litres/person/day and an average usage of 500 litres/person/day was used.
- For each population category the WTP design flow was based on the per capita flow times the mean population for that category.

The population design basis for each category is shown in Table 2.

Table 2: Population Design Basis

Population category	Population band	Design population	Design Flow (m^3/d)
Large	>10,000	Varies	Varies
Medium	5001 – 10000	6900	6900
Minor	501 – 5000	2050	2050
Small	101 – 500	260	260
Neighbourhood	< 100	55	55

The population categories above are based on those used in the *"Drinking Water Standards New Zealand Cost Benefit Analysis – Engineering Input"* (2010). Rather than use the midpoint population of the population categories, which can cover a large range, the mean population has been used as the design population (based on population data received from ESR for the 2010 study). For all population categories, the mean population was below the midpoint population.

3.2 Cost Assumptions – General Approach

3.2.1 Ancillary Requirements

In addition to the fluoridation equipment detailed in Sections 2.2 to 2.4, ancillary work and equipment installation may be required to implement fluoridation at a WTP depending on the existing layout, equipment, services and operation of the WTP. In our cost estimates, where noted, we have allowed for the following ancillary equipment:

- Installation of a fluoride analyser.
- Construction of, or improvement to, the chemical delivery area.
- Construction of a new building to house equipment, or extension/refurbishment of an existing building.
- Construction of building services (ventilation/air con, lighting, power).
- Installation of a safety shower.
- Incorporation of fluoride dosing system control, monitoring and alarms into existing PLC, SCADA and/or telemetry systems.

The following ancillary work may be required at specific treatment plants, but has not been allowed for (unless otherwise stated) in the cost estimates:

- Engineering investigations (e.g. as built drawings of existing facility, geotechnical, topographical survey).
- Installation of a flow meter on the main process flow into which fluoride is to be dosed.
- Installation of a waste collection sump.
- Upgrade to drainage systems.
- Addition of a water softener (if using sodium fluoride or SFS and dilution water hardness (as $CaCO_3$) is greater than 75 mg/L). Hardness in NZ surface waters is generally less than 75 mg/L, however some groundwater sources (especially in areas with limestone) have high hardness values.
- Installation of a pit for flow meter and analyser.
- Installation of a sampling pump for fluoride analyser.
- Reconfiguration of piping and valving at the treatment plant.
- Relocation of existing services/equipment.
- Installation or upgrading of SCADA and/or telemetry systems for alarms associated with new fluoridation system.
- Installation or upgrade to the PLC system.
- Construction of amenities (possibly for a site that requires and increased level of operator attendance after installation of the fluoridation system).
- Purchase of a gantry/forklift for handling requirements.
- Installation or upgrade of security (fencing, signage and lighting).
- Construction of a laboratory complete with equipment (including bench top analyser for fluoride).
- Provision of personal protective equipment (PPE).
- Construction of or upgrade to power supply and switchboards.
- Construction of new delivery vehicle access and roads.
- Installation of a service water system.
- Land purchase may be required for a dosing building.
- GST is excluded from all cost estimates.

3.2.2 Other

Further requirements that will potentially be involved include:

- Training of operators.
- Waste disposal.
- New standard operating procedures and contingency plans.
- Increased monitoring and reporting requirements.

We have not allowed for these additional costs in our estimates.

3.3 Description and Cost Assumptions – Medium, Minor, Small and Neighbourhood Supplies

Sodium fluoride can be a good choice for smaller water supplies as the capital set up costs are generally lower than the other types of systems and the systems are relatively simple to operate. The chemical cost of sodium fluoride is relatively expensive in New Zealand compared to SFS and FSA. However, smaller supplies (neighbourhood, small, minor) only use a small quantity of fluoride on a yearly basis, so the increase in operating costs is relatively minor.

For costing purposes we have based the Neighbourhood, Small and Minor water supplies on a sodium fluoride system.

At the higher flows associated with a medium supply, the operating cost savings from using FSA are more significant and hence we have based the medium supply on a FSA system.

For each category we have provided a “low” and “high” cost estimate. The low cost estimate assumes there are already reasonable facilities onsite and the equipment installed will be a “low cost” option. Whilst a “low cost” option will be fit for purpose, it may require higher operator input, maintenance and have less robust control checks. The high cost estimate allows for a more robust system with better equipment, safety and controls.

3.3.1 Small and Neighbourhood Supplies

For small and neighbourhood supplies we have made the capital cost assumptions shown in Table 3.

Table 3: Cost Assumptions for Small and Neighbourhood Supplies

Area	Assumptions for Low Cost	Assumptions for High Cost
Equipment	■ A basic 250 L NaF upflow saturator, dosing pump, pipework and valves. Operators manually load bags in unsealed bag loader. ■ New flowmeter on treated water line to be used for control of dose rate.	■ A 250 L NaF upflow saturator, metering pump skid, patented bottle cutter unloader system to minimise dust. ■ New flowmeter on treated water line to be used for control of dose rate.
Independent Check	■ A flowmeter on NaF dosing line as the independent check.	■ Flowmeters (especially on small bore pipe) can be inaccurate and/or prone to failure. A fluoride analyser has been assumed as it is a better method for independently checking the fluoride dose.
EI&C		■ As for the low cost option. ■ A SCADA system could be implemented but is likely to incur significant cost.
Safety Shower	■ New safety shower located in the fluoride dosing room. It has been assumed that a service water system is available to connect to the safety shower.	■ As for the low cost option.
Building	■ Fluoride saturator and dosing pump located in a shipping container or proprietary shed.	■ Fluoride saturator and dosing pump located in a pre-fabricated building complete with ventilation.
Chemical Delivery	■ No chemical delivery area or specific storage facilities required. Chemical would be delivered to a larger site (with adequate handling and storage facilities) and small quantities (eg one bag) would be transported to the Neighbourhood site.	■ As for the low cost option.
Design	■ Assuming installation of a largely pre-engineered system. The allowance is for design of components for integration into the existing site.	■ As for the low cost option.

As discussed in Section 3.2, we have assumed that a WTP site will have a base level of facilities such as road access, power, security, lighting, drainage systems etc. We have not included an allowance for these items in order to keep costs to a reasonable level. Whilst this is a fair assumption for most treatment plants, some smaller plants have very limited facilities such as foot access only or no power. This needs to be carefully considered if assessing and using these capital costs in an analysis at a national level.

3.3.2 Minor Supplies

For minor supplies we have made the capital cost assumptions shown in Table 4.

Table 4: Cost Assumptions for Minor Supplies

Area	Assumptions for Low Cost	Assumptions for High Cost
Equipment	▪ A basic 500 L NaF upflow saturator, dosing pump, pipework and valves. Operators manually load bags in unsealed bag loader (dust risk). ▪ New flowmeter on treated water line to be used for control of dose rate.	▪ A proprietary 500 L NaF upflow saturator, metering pump skid, water softener, vacuum loader system complete with dust extraction to minimise dust and manual handling (refer photo on cover). ▪ New flowmeter on treated water line to be used for control of dose rate.
Independent Check	▪ A flowmeter on NaF dosing line as the independent check.	▪ Flowmeters (especially on small bore pipe) can be inaccurate and/or prone to failure. A fluoride analyser has been assumed as it is a better method for independently checking the fluoride dose.
EI&C		▪ As for the low cost option.
Safety Shower	▪ New safety shower located in the fluoride dosing room. It has been assumed that a service water system is available to connect to the safety shower.	▪ As for the low cost option.
Building	▪ Fluoride saturator, dosing pump and storage facilities can be incorporated into existing building. Some modifications may be needed for ventilation, bunding etc	▪ Fluoride saturator, dosing pump and storage facilities located in a pre-fabricated building complete with ventilation.
Chemical Delivery	▪ Assuming existing chemical delivery area is adequate.	▪ Allowance for a new bunded chemical delivery area and storage facilities.
Design	▪ Assuming installation of a largely pre-engineered system. The allowance is for design of components for integration into the existing site.	▪ As for the low cost option.

3.3.3 Medium Supplies

For medium supplies we have made the capital cost assumptions shown in Table 5.

Table 5: Capital Cost Assumptions for Medium Supplies

Area	Assumptions for Low Cost	Assumptions for High Cost
Equipment	▪ A bulk 3000 L FSA tank, dosing pump skid, pipework and valves. ▪ Existing flowmeter on treated water line used for control of dose rate.	▪ A bulk 3000 L FSA tank, dosing pump skid, pipework and valves. All equipment rated for outside installation. ▪ Existing flowmeter on treated water line used for control of dose rate.
Independent Check	▪ A flowmeter on FSA dosing line as the independent check.	▪ Flowmeters (especially on small bore pipe) can be inaccurate and/or prone to failure. A fluoride analyser has been assumed as it is a better method for independently checking the fluoride dose.
EI&C		▪ As for the low cost option.
Safety Shower	▪ New safety shower located in the fluoride dosing room. It has been assumed that a service water system is available to connect to the safety shower.	▪ As for the low cost option.
Building	▪ FSA tank and dosing pump can be incorporated into existing building. Some modifications may be needed for ventilation, bunding etc.	▪ FSA tank located outside with bunding, a roof and locked security fence. Dosing pumps located outside but within bund and under roof.
Chemical Delivery	▪ Allowance for a new bunded chemical delivery area and storage facilities.	▪ As for the low cost option.
Design	▪ Assuming installation of a largely pre-engineered system. The allowance is for design of components for integration into the existing site.	▪ As for the low cost option.

3.4 Capital Cost Summary – Medium, Minor, Small and Neighbourhood Supplies

The capital costs for the different sized water supplies are shown in Table 6. These costs are indicative only based on a generic plant of that size. More detailed information and design would be required in order to use the capital costs for capital budgeting purposes for a specific plant.

Table 6: Fluoridation Capital Cost Estimates for Different Sized Water Supplies

	Neighbourhood		Small		Minor		Medium	
Design Parameters								
Population Served	<100		101-500		501-5000		5001-10000	
Capacity (m^3/d)	55		260		2050		6900	
Fluoride Chemical	NaF		NaF		NaF		FSA	
Costs	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Equipment + Install	15,000	45,000	20,000	45,000	20,000	82,500	50,000	70,000
EI&C	15,000	15,000	15,000	15,000	15,000	20,000	20,000	20,000
Fluoride Analyser	-	15,000	-	15,000	-	15,000	-	15,000
Building	10,000	30,000	12,000	30,000	15,000	30,000	15,000	30,000
Safety Shower	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Chemical Storage and Bunding	-	-	-	-	-	-	10,000	10,000
Chemical Unload Area	-	-	-	-	-	25,000	-	25,000
Design (12%)	6,000	13,000	6,000	13,000	7,000	21,000	12,000	21,000
P&G (15%)	7,000	17,000	8,000	17,000	8,000	27,000	15,000	26,000
Contingency and rounding (nom 15-20%)	7,000	20,000	9,000	20,000	10,000	34,500	18,000	38,000
Total	**$65,000**	**$160,000**	**$75,000**	**$160,000**	**$80,000**	**$260,000**	**$145,000**	**$260,000**

A contingency allowance of 15% has been applied to the "low" cost range and a 20% contingency to the "high" cost range.

3.5 Operating Cost Summary - Medium, Minor, Small and Neighbourhood Supplies

We have estimated costs for the various sized systems as shown in Table 7.

Table 7: Operating Cost Estimates

	Neighbourhood	Small	Minor	Medium
Design Parameters				
Population Served	<100	101-500	501-5,000	5,001-10,000
Peak Capacity (m^3/d)	55	260	2,050	6,900
Average Capacity (m^3/d)	28	130	1,025	3,450
Fluoride Chemical	NaF	NaF	NaF	FSA
Costs/annum				
Chemical	100	450	3,500	4,300
Operator Input	5,200	5,200	5,200	5,200
Maintenance	1,500	1,900	3,000	3,700
Total (per annum)	**$6,800**	**$7,600**	**$11,700**	**$13,200**

The operating costs are based on the following assumptions:

- Chemical costs are based on indicative prices received from Ixom and DC Rosser.
- Operator input is based on 2 hours/week at an operator hourly rate of $50/hour. The hourly rate may be lower for some supplies.
- Maintenance costs have been estimated as 2% of capital costs of the plant.
- Monitoring and compliance costs have been excluded.
- GST is excluded.

3.6 Description and Cost Assumptions – Large Water Supplies

3.6.1 Approach

It is difficult to prepare a generic cost estimate for the “Large” plant category as these are likely to require very specific designs. There are over 20 large supplies in NZ that are not currently fluoridating. Preparing a cost estimate for each of these 20 plants is beyond the scope of this work. Hence, we have selected the following four case studies to prepare cost estimates for:

- Whangarei
- Napier
- Levin
- Blenheim

3.6.2 Whangarei

The Whangarei water supply consists of three WTPs – the Whau Valley, Poroti and Ruddles WTP. In order to fluoridate the entire Whangarei city supply a fluoridation system would be required at all three WTPs.

Whangarei District Council is currently considering replacing the existing Whau Valley WTP with a new WTP at a new site. For the purposes of this costing, we have assumed that a FSA fluoride dosing would be incorporated in the proposed new Whau Valley Water Treatment Plant and at the existing Poroti and Ruddles treatment plants. The cost for including fluoride dosing at the new Whau Valley plant would be less than if it was to be incorporated at the existing plant which is restricted in both space and capacity. For costing purposes we have made the assumptions shown in Table 8.

Table 8: Whangarei Fluoride Dosing System Assumptions

Area	Infrastructure Required	Existing Infrastructure Assumptions
Equipment	■ A bunded bulk 5000L FSA tank with level measurement and a dosing pump at each site. ■ A flowmeter on the dosing line would be used at each site as an “independent check”.	■ No current dosing infrastructure that could be utilised at either site. ■ Flowmeter on treated water to be used for flow pacing dose control.
EI&C	■ Automation, monitoring and alarming would be incorporated as per the Code of Practice. ■ Fluoride dosing meter required at each WTP as an independent check of the dose rate.	■ Dosing control, alarming and monitoring could be incorporated into the existing PLC and SCADA system at each site. ■ There is space in the existing MCC for the dosing pumps motor starters at each site. ■ Existing transformer and switchboard can accommodate the extra dosing equipment at each site.
Safety Shower	■ New safety shower located in the fluoride dosing room at each site.	■ A service water system is available for connection to the safety shower at each site.
Building	■ Dosing systems would be incorporated into the new Whau Valley WTP building and Poroti existing building (with some modifications). ■ A standalone building (portable polypanel type construction) to accommodate the FSA tank and dosing pumps would be constructed at the Ruddles WTP.	■ There is space in the Poroti existing buildings for a fluoride dosing system. ■ Land is available at all sites for a dosing building.
Chemical Delivery	■ Upgrades are required for the chemical delivery areas (bunding etc) at both the Poroti and Ruddles WTPs to make it suitable for FSA bulk delivery.	■ Site access is suitable for a chemical delivery truck. ■ The new Whau Valley WTP would have suitable chemical delivery infrastructure.

3.6.3 Levin

The Levin water supply consists of a single surface water source and treatment plant. Water is abstracted from the Ohau River and treated at the Levin water treatment plant located on Gladstone Road. The existing treatment plant consists of coagulant and flocculant dosing, pH control, horizontal pressure media filters, and chlorination. Fluoride could be added to water supply with a single dosing plant located at the existing water treatment plant.

To illustrate the costs of a SFS system for a Large supply, we have assumed a SFS system for the Levin supply. Although this plant is due for upgrading over the next 5-10 years, we have assumed that an SFS plant is added to the existing plant and that there is sufficient space at the Levin site to allow for a SFS system. For costing purposes we have made the assumptions shown in Table 9.

Table 9: Levin Fluoride Dosing System Assumptions

Area	Infrastructure Required	Existing Infrastructure Assumptions
Equipment	■ A skid mounted SFS powder system complete with storage hopper, load cells, dry chemical feeder, solution tank with mixer, dosing pump and vacuum loader for 25kg bags. ■ A second "day hopper" with screw feeder and load cell would be required as a second independent check on the fluoride dose.	■ No current dosing infrastructure that could be utilised. ■ Flowmeter on treated water to be used for flow pacing dose control.
EI&C	■ Automation, monitoring and alarming would be incorporated as per the Code of Practice. ■ The dosing skid would be supplied with a local control panel. ■ Fluoride dosing meter required as an independent check of the dose rate.	■ Dosing control, alarming and monitoring could be incorporated into the existing PLC and SCADA system. ■ There is space in the existing MCC for the screw feeder and dosing pump motor starters. ■ Existing transformer and switchboard can accommodate the extra dosing equipment.
Safety Shower	■ New safety shower located in the fluoride dosing room.	■ A service water system is available for connection to the safety shower.
Building	■ A standalone building (portable polypanel type construction) to accommodate the fluoride make-up skid and storage of 25kg bags of SFS would be constructed.	■ There is no space in the existing building for a fluoride dosing system. ■ Land is available onsite for a dosing building.
Chemical Delivery	■ A bunded chemical delivery area would be constructed.	■ Site access is suitable for a chemical delivery truck.

3.6.4 Napier

The Napier water supply consists of ten wells spread over the city network. The groundwater aquifer the supply draws from is considered secure and as such no treatment is required prior to distribution. There is no centralised water treatment plant for the Napier supply, so in order to reliably fluoridate the entire supply a dosing system would be required at each well source. Given the likely space constraints at the well sites and the current level of operator input, we have assumed that FSA would be the most appropriate system for the Napier supply.

The other option, of piping the water from the wells to one centralised treatment plant (or perhaps a few treatment plants), may be more economic. This option has not been costed.

For costing purposes we have made the assumptions shown in Table 10.

Table 10: Napier Fluoride Dosing System Assumptions

Area	Infrastructure Required	Existing Infrastructure Assumptions
Equipment	▪ A bunded bulk 3000L FSA tank with level measurement and a dosing pump at each of the ten bore sites. ▪ A flowmeter on the dosing line would be used at each site as an "independent check".	▪ No current dosing infrastructure that could be utilised at the existing sites. ▪ Flowmeter on treated water to be used for flow pacing dose control.
EI&C	▪ Automation, monitoring and alarming would be incorporated as per the Code of Practice. ▪ Fluoride dosing meter required at each dosing point as an independent check of the dose rate.	▪ Dosing control, alarming and monitoring could be incorporated into the existing PLC and SCADA system at each site. ▪ There is space in the existing MCC for the dosing pumps motor starters at each site. ▪ Existing transformer and switchboard can accommodate the extra dosing equipment at each site.
Safety Shower	▪ New safety shower located in the fluoride dosing room at all sites.	▪ A service water system is available for connection to the safety shower at all sites.
Building	▪ A standalone building (portable polypanel type construction) to accommodate the FSA tank and dosing pumps would be constructed at all sites.	▪ There is no space in the existing buildings for a fluoride dosing system. ▪ Land is available at each site for a dosing building.
Chemical Delivery	▪ A bunded chemical delivery area would be constructed at each site.	▪ Site access is suitable for a chemical delivery truck.

3.6.5 Blenheim

The Blenheim water supply consists of a number of bores located in the town and two treatment plants (Central and Middle Renwick Road). The Central WTP draws from five bores and is the primary water supply for Blenheim. The Middle Renwick Road WTP draws from three bores and is used to supplement the primary supply, especially during peak demand. Water treatment consists of pH correction and UV treatment.

We have assumed that a fluoride dosing plant would be required at both WTPs in order to fluoridate the entire supply. Given the likely space constraints at the Central WTP, we have assumed that FSA would be the most appropriate system for the Blenheim supply. For costing purposes we have made the assumptions shown in Table 11.

Table 11: Blenheim Fluoride Dosing System Assumptions

Area	Infrastructure Required	Existing Infrastructure Assumptions
Equipment	▪ A bunded bulk 5000L FSA tank with level measurement and a dosing pump at each site. ▪ A flowmeter on the dosing line would be used at each site as an "independent check".	▪ No current dosing infrastructure that could be utilised at either site. ▪ Flowmeter on treated water to be used for flow pacing dose control.

Area	Infrastructure Required	Existing Infrastructure Assumptions
EI&C	■ Automation, monitoring and alarming would be incorporated as per the Code of Practice. ■ Fluoride dosing meter required at each WTP as an independent check of the dose rate.	■ Dosing control, alarming and monitoring could be incorporated into the existing PLC and SCADA system at each site. ■ There is space in the existing MCC for the dosing pumps motor starters at each site. ■ Existing transformer and switchboard can accommodate the extra dosing equipment at each site.
Safety Shower	■ New safety shower located in the fluoride dosing room at each site.	■ A service water system is available for connection to the safety shower at both sites.
Building	■ A standalone building (portable polypanel type construction) to accommodate the FSA tank and dosing pumps would be constructed at both sites.	■ There is no space in either of the existing buildings for a fluoride dosing system. ■ Land is available at both sites for a dosing building.
Chemical Delivery	■ Upgrades are required for the chemical delivery areas (bunding etc) at both WTPs to make it suitable for FSA bulk delivery.	■ Site access is suitable for a chemical delivery truck.

3.7 Capital Cost Summary – Large Water Supplies

The capital costs for the four case study large supplies are shown in Table 12. These costs are indicative only based on preliminary information for each plant. More detailed information and design would be required in order to use the capital costs for capital budgeting purposes.

Table 12: Summary of Capital Costs to provide Fluoridation to Large Water Supplies

	Whangarei	Levin	Napier	Blenheim
Design Parameters				
Population Served[3]	48,000	20,000	49,910	24,000
Peak Capacity (m^3/d)	36,000	13,000	50,000	34,000
Average Capacity (m^3/d)	23,000	8,500	29,000	13,000
Fluoride Chemical	FSA	SFS	FSA	FSA
Treatment Plants	Whau Valley Poroti Ruddles	Levin WTP	Ten wells	Central WTP Middle Renwick Road WTP
Costs				
Equipment	120,000	125,000	350,000	100,000
Mechanical Installation	50,000	30,000	150,000	40,000
EI&C	60,000	20,000	200,000	40,000
Fluoride Analyser	45,000	15,000	150,000	30,000
Building	130,000	55,000	450,000	110,000
Safety Shower	15,000	5,000	50,000	10,000
Chemical Storage and Bunding	30,000	-	100,000	20,000
Chemical Unload Area	50,000	25,000	100,000	50,000
Design (10%)	50,000	28,000	155,000	40,000
P&G (15%)	75,000	42,000	232,000	60,000
Contingency (20%)	100,000	55,000	310,000	80,000
Total	**$725,000**	**$400,000**	**$2,250,000**	**$580,000**

[3] From WINZ database.

4 Implications for Existing Fluoridation Plants

4.1 Case Studies

We have undertaken five case studies on a range of plants that have existing fluoridation systems to estimate the cost required for each plant to meet the Fluoridation Code of Practice (CoP). Existing plants must comply with the code by 2020. These cost estimates are indicative only based on limited information gathered from the relevant water suppliers. A more detailed assessment of each plant would be required in order to more accurately assess and cost the upgrades required to meet the CoP.

4.1.1 Waterloo Water Treatment Plant

The Waterloo WTP has a SFS dosing system consisting of a powder hopper (complete with weigh cell and dust extraction) with screw feeder, dilution tank, day tank and dosing pumps. The system is located in a separate room. The Waterloo fluoridation dosing system is generally in a satisfactory condition and meets most aspects of the CoP. The Waterloo WTP is classified as a large supply and hence requires two independent checks of the fluoride dose in order to be compliant with the CoP. There is a fluoride analyser that monitors fluoride in the treated water and is used to alarm and shut down the system on high readings. Whilst there is a day tank, it may not strictly adhere to the COP (as discussed in Section 2.3.2). Some changes to the automation and alarming may be required in order for it to meet the CoP. We estimate that these upgrades would cost approximately $15,000.

4.1.2 Waikanae Water Treatment Plant

The Waikanae WTP has a SFS dosing system consisting of a powder hopper with conveyor, day hopper and screw feeder (complete with weigh cell and dust extraction) and a dilution tank. The system is located in a separate room. The Waikanae fluoridation dosing system is generally in a satisfactory condition and meets most aspects of the CoP. The Waikanae WTP is classified as a large supply and hence requires two independent checks of the fluoride dose in order to be compliant with the CoP. There is a fluoride analyser that monitors fluoride in the treated water and is used to alarm and shut down the system on high readings. The day hopper could be used as the second independent check, but some automation and operational changes would be required. We estimate that these upgrades would cost approximately $10,000.

4.1.3 Hamilton Water Treatment Plant

The Hamilton WTP has a FSA dosing system consisting of a bulk tank, day tank and dosing pumps. The bulk tank is bunded and located outside under a cover with a security fence. The Hamilton WTP is classified as a large supply and hence requires two independent checks of the fluoride dose in order to be compliant with the CoP. There is a fluoride analyser that monitors fluoride in the treated water and is used to alarm and shut down the system on high readings. The day tank could be used as the second independent check, but some automation and operational changes may be required. There are some modifications to the pipework and chemical delivery area that may also be required to improve the health and safety aspects of the system. We estimate that these upgrades would cost approximately $50,000.

4.1.4 Balclutha Water Treatment Plant

The Balcutha WTP has a NaF dosing system consisting of an upflow saturator and dosing pump located in an isolated room. The Balclutha WTP is classified as a minor supply and hence requires one independent check of the fluoride dose in order to be compliant with the CoP. There are currently no independent checks of the fluoride dose and the dose rate is manually set rather than being flow paced with the treated water flow (although we have assumed there is a plant flow meter). The least expensive independent check would be to install a flowmeter on the dosing line. A fluoride analyser would be a more robust independent check, but it would be more expensive. There is no safety shower at the plant and dust extraction controls may need to be improved. We have not seen the condition of the chemical delivery area or the storage facilities, these may need some improvements. Assuming a dosing line flow meter is installed as an independent check, and the control/programming and dust suppression upgrades are implemented, we estimate that the upgrades would cost approximately $25,000. This figure does not allow for improvements to the chemical delivery and storage area.

4.1.5 Milton Water Treatment Plant

The Milton WTP has a NaF dosing system consisting of an upflow saturator and dosing pump located in an isolated room. The fluoride dosing system is flow paced. The Milton WTP is classified as a minor supply and hence requires one independent check of the fluoride dose in order to be compliant with the CoP. There are currently no independent checks of the fluoride dose. The least expensive independent check would be to install a flowmeter on the dosing line. A fluoride analyser would be a more robust independent check, but it would be more expensive. There is a safety shower at the plant. The dust extraction controls may need to be improved. Assuming a flowmeter is installed as an independent check and the dust suppression and extraction systems are improved, we estimate that the upgrades would cost approximately $20,000.

4.2 Cost Summary – CoP Implications

A summary of the estimated capital costs for each plant to meet the CoP is shown in Table 13.

Table 13: Summary of Upgrade Costs to meet the Code of Practice

	Waterloo	Waikanae	Hamilton	Balclutha	Milton
Population Category	Large	Large	Large	Minor	Minor
Fluoride Chemical	SFS	SFS	FSA	NaF	NaF
Upgrade Cost	$15,000	$10,000	$50,000	$25,000	$20,000

5 Concluding Remarks

The base equipment for a fluoridation system can be installed relatively inexpensively. However, in order for fluoridation to be safe for consumers, operators and the environment; proper controls must be in place regardless of system size. These additional controls add cost, which can be significant.

As the cost estimates show, the infrastructure that is existing at a treatment plant has a big impact on the costs of adding fluoridation. Typically smaller plants have less infrastructure than larger ones. Some Small and Neighbourhood supplies may not even have a treatment plant.

The existing configuration of a supply can also affect the costs. The Napier supply is an example of a system that would cost significantly more to implement due to having ten wells feeding directly into the network. Whilst this type of supply is not the norm, it is not unique either. The Christchurch water supply also consists of a network of wells that separately supply the city.

When the cost estimates we have prepared are input into the CBA, it is important to appreciate that while we have given a range of capital costs, this range is not broad enough to cover the situation for all plants in a particular size category. For plants with little or no infrastructure, or supplies with multiple sources, the capital costs will be higher than the upper bound estimate.

11 November 2021

Tēnā koe

This letter is to update you on the Health (Fluoridation of Drinking Water) Amendment Bill (the Bill) and what it means for you.

As you may be aware, on Tuesday 9 November 2021, the Bill passed its final reading and will come into force 28 days after Royal assent. The new legislation amends the Health Act 1956 to give the Director-General of Health the power to issue a direction to local authority water suppliers (including bulk water suppliers) to fluoridate a public drinking water supply. The changes do not apply to private drinking water supplies.

Key content of the new legislation

Under the new legislation, when deciding whether to issue a direction to fluoridate, the Director-General of Health will be required to consider for each individual drinking water supply:

- the scientific evidence on the effectiveness of adding fluoride to drinking water in reducing the prevalence and severity of dental decay
- whether the benefits of adding fluoride to the drinking water outweigh the financial costs, taking into account:
  - the state or likely state of the oral health of the local community or population group associated with the water supply
  - the number of people who are reasonably likely to receive drinking water from the local authority supply
  - the likely financial costs and savings of adding fluoride to the drinking water, including any additional costs of ongoing management and monitoring.

Before issuing any direction to fluoridate, the Director-General of Health must seek written comment from the local authorities on the estimated cost of introducing community water fluoridation, and the date by which the local authority could comply.

The new legislation exempts you from any requirement to consult with your communities on the decision to fluoridate.

Further information on these changes and the obligations for local authorities is in the attached fact sheet.

Implementation

The Ministry of Health (the Ministry) intends to facilitate swift transition to the new fluoridation decision-making process, and anticipates that the Director-General of Health could commence issuing directions from mid-2022 onwards. Implementation will be phased over time and there will be some funding available to support local authorities with the costs of fluoridation-related capital works.

The Ministry is working through implementation details and expects to be able to provide further information to you in the next month.

The Ministry acknowledges the significance of the Government's Three Waters Reform programme on local authorities, including the recent announcement of the creation of the new water service entities. The Ministry of Health is working closely with the Department of Internal Affairs to ensure that implementation planning aligns with the reform programme and factors in current service delivery pressures across the water services sector.

Resources for your communities

You may receive queries from your communities about community water fluoridation now that the new legislation has been passed. We encourage you to refer members of the public or interested groups to the resources below. They reflect the position of the Ministry of Health, World Health Organization, and Centres for Disease Control and Prevention that community water fluoridation is a safe, effective and affordable public health measure to improve the oral health of communities.

https://www.fluoridefacts.govt.nz/

https://www.pmcsa.ac.nz/topics/fluoridation-an-update-on-evidence/

We look forward to working with you to implement these new changes that will have an important health impact on the communities you serve. We will be in touch again shortly.

Ngā mihi

Deborah Woodley
Deputy Director-General
Population Health and Prevention

Riana Clarke
National Clinical Director, Oral Health
Ministry of Health

cc: Regional Council Chief Executives

Jon Lamonte, Chief Executive, Watercare

Colin Crampton, Chief Executive, Wellington Water

Bill Bayfield, Chief Executive, Taumata Arowai

District Health Board Chief Executives

Public Health Unit Managers

MANATŪ HAUORA
MINISTRY OF HEALTH

133 Molesworth Street
PO Box 5013
Wellington 6140
New Zealand
T+64 4 496 2000

3 November 2022

Sharon Mason
Chief Executive
Buller District Council
sharon.mason@bdc.govt.nz

Tēnā koe Ms Mason

Community water fluoridation - notification of active consideration

Thank you for your work to date with Manatū Hauora (the Ministry of Health) on matters concerning community water fluoridation.

As you will be aware, in July 2022, the Director-General of Health issued directions to 14 local authorities to fluoridate some or all of their drinking water supplies. Consistent with the Director-General's June 2022 letter to you, I am now writing to a second set of 27 local authorities advising each that I am actively considering whether to issue a direction to fluoridate some or all of its drinking water supplies. I have chosen to prioritise consideration of these 27 local authorities based on the needs and size of the populations served by their water supplies.

The Buller District Council is one of the local authorities I am now actively considering for a potential direction to fluoridate. I will consider separately each of the following drinking water supplies in your area: Westport and Reefton.

Regarding each water supply listed above, before I can decide whether to issue a direction to fluoridate, I am required under section 116G(2) of the Health Act (the Act) to invite written comment from you on:

a) the estimated financial cost of adding fluoride to the drinking water, including any additional costs of ongoing management and monitoring
b) the date by which your local authority would be able to comply with a direction to fluoridate.

Thank you for providing information earlier this year on the status of the fluoridation infrastructure in your area and the estimated costs and timeframes that would be necessary to fluoridate your drinking water supplies. That information is summarised in the attached table. Please note that the table expresses the information you provided about timeframes in terms of the number of months it would take to implement community water fluoridation if a direction were given and funding available. Please confirm or update the attached table and, where applicable, provide additional comment.

The Act requires that I give you at least 40 working days to respond to my request for written comment. To take into account the summer holiday period, I am giving you an additional 20 working days to respond. Please provide written comment to me **by 2 February 2023**. Please send your response to fluoride@health.govt.nz.

When deciding whether to issue any directions to fluoridate I will also consider the scientific evidence on the effectiveness of fluoridation and, for each drinking water supply, whether the benefits of fluoridation outweigh the financial cost, taking into account the oral health status, population size, and estimated costs of fluoridation.

I continue to be mindful of current service delivery pressures across the water services and broader local government sectors. In light of this, if I do issue directions regarding your drinking water supplies, they will have compliance dates set for after July 2024 when the new water service entities are due to be established.

An official from Manatū Hauora will contact your team during the consultation phase to discuss any questions you may have. Manatū Hauora recognises that this is a busy time for local authorities and wishes to work with you to make the process as straightforward as possible for your team.

Nāku noa, nā

Dr Diana Sarfati
Te Tumu Whakarae mō te Hauora
Director-General of Health

Information about drinking water supplies for Buller District Council

Local Authority	Reticulated drinking water supply name	Water supply pop	Estimated number of months to fluoridate if a direction is given and funding available	Estimated capital works cost to fluoridate	Estimated ongoing mgmt. & monitoring costs	Additional comments
Buller District Council	Westport	4974	24	$250,000		
	Reefton	951	24	$250,000		

From: Sharon Mason
To: BDC Councillors; Douglas Marshall; Mike Williams
Subject: Fwd: Fluoridation Update BDC
Date: Friday, 29 July 2022 9:41:17 am
Attachments: image001.png
image004.png
Fluoridation for Drinking Water Supplies - BDC Gap Analysis.pdf

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Dear Councillors ,

You will be aware that the MOH has legislative responsibility to direct the fluoridation of drinking water supplies. Buller district council has not been included in the first tranche of councils required to implement fluoridation.
I have received correspondence Dr Bloomfield’s , Director General Health he states as follows,

> Drinking water supplies controlled by your local authority are not included in the first set of potential directions to fluoridate. However, it is likely your situation will be considered in the coming months, and that a decision on whether to issue a direction to fluoridate your drinking water supplies will be made by the end of 2022. As I noted in my earlier

Therefore, no immediate action is required of BDC. However, when the new council is elected , staff will bring forward strategy options and next steps in context of broader 3W reform and the next annual plan cycle.

Fluoridation was not considered in our LTP and arises from the health (Fluoridation of Drinking Water) Amendment legislation which came into effect December 2021, with direction to fluoridate coming from Director-General of Health.

The 3 Waters team has been proactive and commissioned a gap analysis and ROC for BDC fluoridation as per attached, with estimates in range of $2M for all BDC schemes, noting however, only Westport, Reefton and possibly Inangahua have the WTP capability, and only Westport is anywhere near affordable for ratepayers.

I am sharing the report with you for your background info at this stage .

Kind regards Sharon

Sharon Mason | Chief Executive Officer
DDI 03 788 9650 | Email sharon.mason@bdc.govt.nz

Buller District Council | Phone 0800 807 239 | www.bullerdc.govt.nz
PO Box 21 | Westport 7866

Community Driven | One Team | Future Focused | Integrity | We Care

From:	Sharon Mason
To:	Mayor Jamie Cleine; Mike Williams
Subject:	Fluoridation Update BDC
Date:	Thursday, 28 July 2022 9:44:12 am
Attachments:	image001.png image004.png Fluoridation for Drinking Water Supplies - BDC Gap Analysis.pdf

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Dear Jamie,

You will be aware that the MOH has legislative responsibility to direct the fluoridation of drinking water supplies. Buller district council has not been included in the first tranche of councils required to implement fluoridation.
I have received correspondence Dr Bloomfield's , Director General Health he states as follows,

> Drinking water supplies controlled by your local authority are not included in the first set of potential directions to fluoridate. However, it is likely your situation will be considered in the coming months, and that a decision on whether to issue a direction to fluoridate your drinking water supplies will be made by the end of 2022. As I noted in my earlier

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I am sharing the report with you for your background info at this stage .

Kind regards Sharon

Sharon Mason | Chief Executive Officer
DDI 03 788 9650 | Email sharon.mason@bdc.govt.nz

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ERPRO
Assess + Optimise Performance

Franz Resl, 14/07/2022

14/07/2022

Drinking Water Fluoridation

Buller District Council

Franz Resl, 14/07/2022

Table of Contents

Attachments

Attachment 1: Water Fluoridation Engineering Costs, Prepared for Ministry of Health by CH2M Beca Ltd, 35 August 2015

Attachment 2: Fluoridation of Drinking-Water Supplies in New Zealand, Code of Practice, Water New Zealand, First Edition, December 2014

Franz Resl, 14/07/2022

1. BDC Drinking Water Fluoridation

1.1. Executive Summary

Buller District Council (**BDC**) was informed by the Ministry of Health (**MoH**) by letter dated 22/06/2022 that BDC drinking water systems might be included in a set of suppliers who will need to provide drinking water fluoridation by the end of 2022. This ERPRO Environmental Ltd (**ERPRO**) report explains some of the background work which occurred during the preparation of rough order costs (**ROC**) for drinking water. It presents findings from an industry query that ERPRO undertook and estimates of expected costs for the installation of fluoridation systems. Fluoridation systems for Westport, Reefton and Inangahua can be set up within the existing environment and for all other sites the costs for set up are economically unviable at this point as all these plants require a treatment plant rebuild which should then include fluoridation to reduce CAPEX expense.

1.2. Geographical Coverage

The townships covered in this assessment are:

- Westport
- Reefton
- Waimangaroa
- Punakaiki
- Ngakawau
- Mokihinui
- Little Wanganui
- Inangahua

1.3. Technical Requirements

Documents we have considered for drinking water fluoridation:

- Fluoridation of Drinking-Water Supplies in New Zealand, Water New Zealand Code of Practice, 2014
- Water Fluoridation Engineering Costs, Beca for the MoH, 2015
- Health (Fluoridation of Drinking water) amendment Act 2021

1.4. System Description

The dosing systems required for fluoridation of drinking water are best described in “Water Fluoridation Engineering Costs, Beca for the MoH, 2015”. This report lists all elements required for a functional and safe fluoridation dosing system.

Elements to be considered are:

- Type of chemical used
- Equipment choice including water softener requirement
- Fluoride analysis and flow meter for process media and water

- SCADA implementation
- Telemetry connection
- Safety equipment like safety shower
- Separate room or compartment for set up
- Chemical storage facility
- Site safety assessment
- Material handling
- Operator training

The systems proposed for BDC would exclusively use powder forms of fluoride, mainly due to safety reasons. Handling of fluorosilicic acid (FSA) is dangerous and not recommended for smaller plants. To keep the systems comparable and to use only one type of material across the District solid chemicals are preferred.

The Westport WTP will use material delivered in 25 kg bags and the operator would transfer this by vacuum system into a "saturator", a device which provides a saturated solution for accurate dosing. Due to small consumption all other plants would use a 5kg saturator solution.

The chemical used for fluoride addition is sodium fluoride.

2. Cost Assessment

2.1. Rough Order Cost Assessment

The ROC assessment dated April 2022 included costs for the set up of fluoridation plants. For the two biggest plants, Westport and Reefton, these costs are stand alone costs as these plants are currently not undergoing substantial changes. Inangahua, which also does not require a plant rebuild, would only need a small extension and the assumption was made this could be housed in the existing plant building. All other plants require a WTP rebuild which would include certain elements which are required for operation of a fluoride dosing system like dosing shed, chemical storage facility including loading bay, flow metering and safety shower. All these items, when not installed with a plant set up, need to be installed upfront only to allow operation of the fluoridation equipment.

We have added a separate line to our cost estimate which is named "civil + safety + site adjustment + commissioning". Commissioning would usually be part of the plant-wide commissioning activity and would require separate execution for the fluoridation plant which would further increase costs.

Consequently we do not think that currently the installation of fluoridation systems other than in Westport and Reefton would pass a cost benefit analysis for economic viability.

2.2. Industry Request Outcome

A request was sent out to a supplier for an update about the current price level and the current state of the art equipment layout for fluoridation systems. The recommendation from the supplier was to use powder chemicals rather than liquid chemicals for H&S reasons. Chemical preparation is more complex with powders than with liquids, however, since fluorosilicic acid is a dangerous good we agree that especially at remote sites, with probably only one person on the job, it is better to use safe chemicals despite the higher capital expense. The quote obtained includes water softeners as standard equipment. The requirement for that would need to be identified individually for each plant based on chemical analysis. We made no modifications to the quote in this respect and consider the potential reduction as project safety margin.

Table 1 below shows an overview of estimated expected total expenses per site as well as a split into individual components and a comparison to the ROC estimates from the previous project.

The elements civil, site adjustment, H&S and commissioning are partially taken from the supplier quote with some adjustment to the plant layout. These estimated costs need to be confirmed by detailed site investigation.

The table clearly shows that a separate set up of fluoridation units without a combined upgrade project of the water treatment plants is economically unviable.

Inangahua could be considered for fluoridation set up but would need individual on site assessment and chemical analysis for project specification and costing.

We exclude Punakaiki from the initial block of plants for set up as it makes no sense to set up a fluoridation system at the old Punakaiki WTP and relocate the system in a few years' time. The system would be incorrectly sized and the electrical layout and connection to telemetry would likely be outdated.

A project margin of approximately 15 % should be added on top of the CAPEX requirement to allow for estimate uncertainty and Council overhead costs.

Monitoring and maintenance costs have not been estimated at this stage.

Before any prices are made public to the MoH a detailed review is recommended including site visits and detail engineering.

Project Location	m^3/d max	l/s peak	M&E ROC assessment	M+E Supplier	Civil, Safety, Site Adjust., Commiss.	M&E Supplier + Site Adjustment	Design & Overhead (25%)	Total
Westport	5,500	191.0	$ 300,000.00	$ 103,000.00	$ 200,000.00	$ 303,000.00	$ 75,750.00	$ 378,750.00
Reefton	1,700	59.0	$ 180,000.00	$ 89,000.00	$ 150,000.00	$ 239,000.00	$ 59,750.00	$ 298,750.00
Waimangaroa	270	9.4	$ 48,000.00	$ 89,000.00	$ 100,000.00	$ 189,000.00	$ 47,250.00	$ 236,250.00
Punakaiki	200	6.9	$ 90,000.00	$ 89,000.00	$ 100,000.00	$ 189,000.00	$ 47,250.00	$ 236,250.00
Ngakawau	170	5.9	$ 48,000.00	$ 89,000.00	$ 100,000.00	$ 189,000.00	$ 47,250.00	$ 236,250.00
Mokihinui	40	1.4	$ 30,000.00	$ 89,000.00	$ 100,000.00	$ 189,000.00	$ 47,250.00	$ 236,250.00
Little Wanganui	60	2.1	$ 30,000.00	$ 89,000.00	$ 100,000.00	$ 189,000.00	$ 47,250.00	$ 236,250.00
Inanganhua	50	1.7	$ 30,000.00	$ 89,000.00	$ 100,000.00	$ 189,000.00	$ 47,250.00	$ 236,250.00
			$ 756,000.00	$ 726,000.00	$ 950,000.00	$ 1,676,000.00	$ 419,000.00	$ 2,095,000.00

M&E: mechanical and electrical equipment

Table 1: Project Costs Estimates for Fluoridation BDC Water Supplies

3. Appendices

3.1.Quote Chemfeed

Chemfeed QUOTATION

To:	ERPRO Environmental	Phone:	N/A
Attn:	Franz Resl	Page:	**1** of **3**
Location	Buller DC	Date:	8/7/2022
Email	franz@erpro.co.nz	Contact:	Deane Morris
Mobile No.	022 364 1037	Budget No:	301316
SUBJECT:	Budget pricing for Fluoridation systems Buller District Council		

Dear Franz,

We have pleasure in submitting our budget pricing for Fluoridation dosing systems for the site as noted in your email correspondence dated 1st July 2022 2022 and spread sheet there in.

We trust this budget meets with your approval. Should you require any further information please do not hesitate to contact this office.

Should the MOH Fluoridation requirements be enacted, Chemfeed would be available to assist you with detailed scoping and additional costings once site specific details are confirmed and available .

We refer you now to page 2 schedule below.

Kind regards,

D Morris

Deane Morris Technical Sales Mobile: 0274 988 375
Chemfeed | 6a Enterprise Drive, Henderson, Auckland 0612 | Tel: 09 837 6075
2/340 Flaxton Road, Rangiora 7400 | Tel: 03 313 8188 | www.chemfeed.co.nz

Chemfeed QUOTATION

Chemfeed Budget Pricing			
Site / flow rate		**System type**	**TOTAL PRICE $**
1. Westport	5,500 m3/d	Vacuum Saturator– sodium fluoride	$ 208,000.00
2. Reefton	1,700 m3/d	Bottle Saturator - sodium fluoride	$ 194,000.00
3. Waimangaroa	270 m3/d	Bottle Saturator - sodium fluoride	$ 194,000.00
4. Punakaiki	200 m3/d	Bottle Saturator - sodium fluoride	$ 194,000.00
5. Ngakawau	170 m3/d	Bottle Saturator - sodium fluoride	$ 194,000.00
6. Mokihinui	40 m3/d	Bottle Saturator - sodium fluoride	$ 194,000.00
7. Little Wanganui	60 m3/d	Bottle Saturator - sodium fluoride	$ 194,000.00
8. Inanganhua	50 m3/d	Bottle Saturator - sodium fluoride	$ 194,000.00
		Total GST excl	**$ 1,567,000.00**
		GST	**$ 235,050.00**
		Total GST inclusive	**$ 1,802,050.00**

Note: The following allowances are included in each site price.

- Site engineering and drawings - $ 16,000 plus GST
- Building and pad cost - $ 75,000 plus GST
- Installation and commissioning - $ 30,000 plus GST
- Fluoride Analyser (installed) - $ 15,000 plus GST

Plant	Peak Flow - m3/day	Kg/Day - Sodium Fluoride Used @ 4% Solution	Kg/Year - Sodium Fluoride Used @ 4% Solution	Budget cost of chemicals per year
Westport	5,500	10.06	3671.9	$17,625.12
Reefton	1,700	3.09	1127.85	$10,150.65
Waimangaroa	270	0.49	178.85	$1,609.65
Punakaiki	200	0.36	131.4	$1,182.60
Ngakawau	170	0.31	113.15	$1,018.35
Mokihinui	40	0.01	3.65	$32.85
Little Wanganui	60	0.11	40.15	$361.35
Inanganhua	50	0.09	32.85	$295.65
Total	7,990	14.52	5299.8	$32,276.22

3.2. Types of Fluoride Used

ProMinent® Chemfeed Chemical Dosing and Disinfection Systems

3

Fluoride – Types of Fluoride

Fluoride is available commercially in 3 different forms, 2 are powders, with the other supplied in liquid form. Each display different concentrations of available fluoride ions and solubility.

Forms:

1. **Sodium Fluoride** (NaF) – 44% by weight available fluoride ion, solubility is 4.05%.

2. **Sodium Silicofluoride** (Na_2SiF_6) – 60% by weight available fluoride ion, solubility is 0.4% with normal preparation design solution strength of 0.2%.

3. **Hydroflurosilicic Acid** (H_2SiF_6) – liquid, commonly commercial availability of 24% by weight available fluoride ion.

3.3.System for less than 3,000 m^3/d

ProMinent® Chemfeed Chemical Dosing and Disinfection Systems

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Fluoride – Sodium Fluoride Saturator 5kg

ProMinent 5kg Fluoride Saturator

- Typical Installation - < 3 ML/day
- The 5kg Bottle Loader offered on this system has been designed by ProMinent® and Patent Approved.
- Sodium Fluoride has a reliable saturation solubility of 4.05%. By keeping excess sodium fluoride powder in a dissolving tank, a constant 4.05% Sodium Fluoride (NaF) saturated solution is maintained. This is then dosed into the water supply, via a ProMinent Gamma X Metering Pump, in proportion to the mains 4-20 milliamp flow signal.
- Please note that depending upon the conditions, water quality etc. that council may be required to clean the saturator tank every 12 months as the 4.05% saturation can decline.
- Make-up water to the saturator is controlled by high levels in the solution tank. It flows to the saturator via a down pipe (with air break) and enters via laterals at the base of the tank, slowly rising through the fluoride bed to form a saturated solution, ready for dosing.
- An electric stirrer is provided on the saturator tank to allow automatic turn over of the fluoride bed, maybe once a week to ensure full saturation is maintained.
- A calibration cylinder is provided to accurately calibrate the metering pump against the dosing conditions and various milli-amp flow signals.
- A water softener is required in all circumstances to ensure the water hardness is as low as possible to assist with the longevity of the fluoride bed. Salt levels need to be checked on a weekly basis to ensure that the softening process is being adhered to. The softener is an integral component of this system.

ProMinent® Chemfeed Chemical Dosing and Disinfection Systems

5

Fluoride – Sodium Fluoride Saturator 5kg

ProMinent 5kg Fluoride Saturator - Continued

- To ensure easy and dust free loading of the 5kg containers, ProMinent® designed and patented a special loader to accept the containers, slice the seal, and allow the Sodium Fluoride granules to dump into the saturator tank.
- Prior to removing the bottle, the operator can flush the bottle via the local control panel button; which provides the controls for a 10 second flushing cycle to commence. The bottle can be easily disposed of in the normal plastic recycling.
- There is two fill solenoid valves in series and an adjustable flow restrictor/rotameter that reduces the flow into the tank to just enough to keep the tank at a controlled level with the pump dosing at its maximum rate. The mains water enters the tank through a lateral pipe system that sits under the un-dissolved sodium fluoride powder. The water passes through the fluoride ready for dosing.
- Note: The metering pump has been factory set to dose at a maximum rate of approximately 1.1mg/l when accepting the plant flow signal and with the stroke setting of 100%. For the required 1 mg/litre set the stroke of the metering pump to approx. 90%. Fine tune stroke length to achieve 1 mg/l. This pump is then **code locked** at the appropriate setting so no further adjustment can be made above the maximum 1.1 mg/l.
- On the metering pump outlet, a load valve is used to ensure that the pump has a constant back pressure to dose against, and to help prevent siphoning of the fluoride solution. Also to protect against a blocked discharge, the pump has overpressure protection built into the electronics.

3.4. System for less than 15,000 m^3/d

ProMinent® Chemfeed Chemical Dosing and Disinfection Systems

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Fluoride – Sodium Fluoride Saturator Vacuum Load

ProMinent Vacuum Load Fluoride Saturator (25kg)

- Typical Installation – 0.5 – 15 ML/day
- The ProMinent® Upflow Sodium Fluoride Saturator package described below has been specifically designed & developed for adding fluoride into town water supplies as determined by the respective Health Department. The overall Saturator Package is controlled via an Allen Bradley 1400 PLC w/ Ethernet module or equivalent.
- Sodium Fluoride has a reliable saturation solubility of 4.05%. By keeping excess sodium fluoride powder in a dissolving tank, a constant 4.05% Sodium Fluoride (NaF) saturated solution is maintained. This is then dosed into the water supply, via a ProMinent® metering pump, in proportion to the mains 4-20 milliamp flow signal.
- Please note that depending upon the conditions, water quality etc. that council may be required to clean the saturator tank every 12 months as the 4.05% saturation residual can gradually decline.
- Make-up water to the saturator is controlled by high levels in the 500 / 1000 litre solution tank. It flows to the saturator via a down pipe (with air break) and enters via laterals at the base of the tank, slowly rising up through the fluoride bed to form a saturated solution, ready for dosing.
- An electric stirrer is provided on the saturator tank to allow the operator to turn over the fluoride bed (perhaps once a week) to ensure full saturation is maintained. This stirrer will operate under a timer and will shut down the fluoride pump for approximately 1 hour whilst it is in operation.
- A calibration cylinder is provided to accurately calibrate the metering pump against the dosing conditions and various milliamp flow signals.

Fluoride – Sodium Fluoride Saturator Vacuum Load

ProMinent Vacuum Load Fluoride Saturator (25kg) Continued

- A water softener is required in all circumstances to ensure the water hardness is as low as possible to assist with the longevity of the fluoride bed. Salt levels need to be checked on a weekly basis to ensure that the softening process is being adhered to. The softener is an integral component of the system and must be maintained for Warranty and overall operational purposes.
- The ProMinent® vacuum transfer system easily allows the operator to transfer powder from the 20 / 25 kg bags to the hopper. The suction wand is inserted in the bag and the air is drawn upwards through a filter to remove any powder particles that are still airborne, before leaving the unit via the vacuum motor. As the powder enters the collection unit, the large volume inside the unit causes the air velocity to drop, allowing the powder to fall to the bottom of the unit.
- A 500 / 1000 litre UV stabilised translucent PE tank is first filled with make up water. Sodium fluoride powder is then added to the tank to create the fluoride solution. By having more powder than can readily dissolve, a saturated solution is formed ready to be dosed. You will need to draw up from your fluoridation bed for approximately 3 – 5 days to ensure a full bag of 25kg Sodium Fluoride can be vacuum transferred into the ProMinent Saturator Tank.
- Fluoride is added using ProMinent's specifically developed vacuum loader and is intended for use with fluoride supplied in 20 / 25 kg bags. It generally vacuums the entire contents of a 25kg bag under 6 minutes.
- The Vacuum bag Loader is mounted on the saturator tank and comes complete with in-built dust extractor, suction wand and a flexible hose allowing the operator to easily load the contents of the bag. The Vacuum Loader includes a 100 litre Exhaust Trap with float valve, overflow and drain

Fluoride – Sodium Fluoride Saturator Vacuum Load

ProMinent Vacuum Load Fluoride Saturator (25kg) Continued

- The ProMinent Vacuum Loader is fitted with positively actuated valves on vacuum hose inlet and dump valve positions rather than the more typical flap valve systems of alternate suppliers. These positively closing valves eliminate the chance of inadvertent:

  * Backflow of suction line

  * Blowing dust out of saturator tank if inspection opening is open during loading

  * Pressurisation of saturator tank

- Note: The metering pump has been factory set to dose at a maximum rate of approximately 1.1mg/l when accepting the plant flow signal and with the stroke setting of 100%. For the required 1mg/litre set the stroke of the metering pump to approx. 90%. Fine tune stroke length to achieve 1.0 mg/l. This pump is then **code locked** at the appropriate setting so no further adjustment can be made above the maximum 1.1mg/l.

- On the metering pump outlet, a load valve is used to ensure that the pump has a constant back pressure to dose against, and to help prevent siphoning of the fluoride solution. Also to protect against a blocked discharge, the pump has overpressure protection built into the electronics.

Report

Water Fluoridation Engineering Costs -

Prepared for Ministry of Health

Prepared by CH2M Beca Ltd

25 August 2015

Revision History

Revision Nº	Prepared By	Description	Date
1	**Jessica Daly and Philip La Roche**	Draft for Client review	23/07/2015
2	Jessica Daly	Final	25/08/2015
3			
4			
5			

Document Acceptance

Action	Name	Signed	Date
Prepared by	**Jessica Daly and Philip La Roche**		25/08/2015
Reviewed by	**Andrew Watson**		25/08/2015
Approved by	**Andrew Watson**		25/08/2015
on behalf of	CH2M Beca Ltd		

Executive Summary -

The Ministry of Health (MoH) has commissioned CH2M Beca Ltd (Beca) via Allen + Clarke to provide engineering cost inputs into the cost-benefit analysis for water fluoridation in New Zealand.

In this report we have undertaken a series of capital cost estimates for different sized treatment plant capacities (the four population categories of Neighbourhood, Small, Minor and Medium), as well as four case studies on large supplies. We have presented the costs as a range (shown in the table below) to account for some of the variability in existing facilities and type of treatment process.

Capital Cost Summary for Fluoridation of Different Population Categories

Design Parameters	Neighbourhood	Small	Minor	Medium
Population Served	<100	101-500	501-5000	5001-10000
Capacity (m^3/d)	55	260	2050	6900
Fluoride Chemical	Sodium Fluoride	Sodium Fluoride	Sodium Fluoride	Fluorosilicic Acid
Cost Range	**$65,000 -$160,000**	**$75,000 - $160,000**	**$80,000 - $260,000**	**$145,000 - $260,000**

Capital Cost Summary for Fluoridation of Large Plants (Case Studies)

	Whangarei	Levin	Napier	Blenheim
Design Parameters				
Population Served	48,000	20,000	49,910	24,000
Peak Capacity (m^3/d)	36,000	13,000	50,000	34,000
Average Capacity (m^3/d)	23,000	8,500	29,000	13,000
Fluoride Chemical	FSA	SFS	FSA	FSA
Treatment Plants	Whau Valley Poroti Ruddles	Levin WTP	Ten wells	Central WTP Middle Renwick Road WTP
Total	**$725,000**	**$400,000**	**$2,250,000**	**$580,000**

We have undertaken five case studies on a range of plants that have existing fluoridation systems to estimate the cost required for each plant to meet the Fluoridation Code of Practice (CoP). These cost estimates (shown in the table below) are indicative only based on information gathered from the relevant water suppliers. A more detailed assessment of each plant would be required in order to more accurately assess and cost the upgrades required to meet the CoP.

Summary of Upgrade Costs to meet the Code of Practice

	Waterloo	Waikanae	Hamilton	Balclutha	Milton
Population Category	Large	Large	Large	Minor	Minor
Fluoride Chemical	SFS	SFS	FSA	NaF	NaF
Upgrade Cost	**$15,000**	**$10,000**	**$50,000**	**$25,000**	**$20,000**

The base equipment for a fluoridation system can be installed relatively inexpensively. However, in order for fluoridation to be safe for consumers, operators and the environment; proper controls must be in place regardless of system size. These additional controls add cost, which can be significant.

The cost estimates show that the infrastructure that is existing at a treatment plant has a big impact on the costs of adding fluoridation. Typically smaller plants have less infrastructure than larger ones. Some Small and Neighbourhood supplies may not even have a treatment plant.

The existing configuration of a supply can also affect the costs. The Napier supply is an example of a system that would cost significantly more to implement due to having ten wells feeding directly into the network. Whilst this type of supply is not the norm, it is not unique either. The Christchurch water supply also consists of a network of wells that separately supply the city.

When the cost estimates we have prepared are input into the CBA, it is important to appreciate that while we have given a range of capital costs, this range is not broad enough to cover the situation for all plants in a particular size category. For plants with little or no infrastructure, or supplies with multiple sources, the capital costs will be higher than the upper bound estimate.

Contents

1 Introduction

The Ministry of Health (MoH) has commissioned CH2M Beca Ltd (Beca) via Allen + Clarke to provide engineering cost inputs into the cost-benefit analysis of drinking-water fluoridation in New Zealand.

To develop a cost model that is as representative of the real world as possible, requires the development of realistic engineering estimates of what fluoridation plants actually cost. There are many variables that can influence these costs. For example:

- If the water supply is a groundwater plant from a secure water source it will typically not have a water treatment plant. It will have no chemical reception facilities, may not have a building, may not have SCADA and telemetry, and will not have other treatment plant infrastructure.
- A larger surface water treatment plant may have a good range of facilities, but may not have building space to accommodate a fluoridation plant, thereby requiring a new building with the additional costs this entails.

In this report we have undertaken a series of capital cost estimates for different sized treatment plant capacities (the four population categories of Neighbourhood, Small, Minor and Medium), as well as four case studies on large supplies. We have presented the costs as a range to account for some of the variability in existing facilities and the type of treatment process.

2 Chemical Options

2.1 Fluoridation Chemicals in New Zealand

2.1.1 Key Properties

Three fluoridation chemicals are available to fluoridate water in New Zealand. Details of each chemical including its form, supply options, the dosing system required, and indicative supply costs are presented in Table 1.

Table 1: Fluoridation Chemical Options

Detail	Unit	Fluorosilicic Acid (FSA)	Sodium Fluorosilicate (SFS)	Sodium Fluoride
Chemical Formula	-	H_2SiF_6	Na_2SiF_6	NaF
Alternative Names	-	HFA	SSF	-
Chemical Form	-	Liquid	Powder	Powder or granular
Dosing System	-	Liquid dosing	Dry feed system/liquid dosing	Saturator/liquid dosing
Supplied purity/concentration	% (w/w)	22	98-99	97-99
Solution pH (saturated)	-	1.2	3.5	7.6
Active Fluoride	%(w/w)	17 (at 22% strength)	60	45
Chemical required for dosing at 0.7mg/L	kg/ML treated water	4.4	1.2	1.6
Indicative chemical cost (excl. GST)	$/kg	Bulk: 0.48* IBC: 0.78*	25 kg Bags: 1.80*	25 kg Bags: 5.95^
Treated Water Cost (Fluoride at 0.7 mg/L)	$/ML	Bulk: 2.11 IBC: 3.43	2.16	9.52
Chemical Supply	-	Bulk tanker IBC	25 kg bag	25kg bag

* Based on indicative pricing from Ixom (formerly Orica)

^ Based on indicative pricing from DC Rosser

The costs provided in Table 1 are all indicative only. Actual transport distance, delivery quantity and frequency will affect chemical supply costs.

2.1.2 Fluoride Systems in New Zealand

In New Zealand, Councils take different approaches to water fluoridation. Of those supplies that have fluoride added:

- FSA is favoured in a number of the larger water supplies including Auckland, Hamilton, Gisborne and Hastings.
- SFS is used in the Wellington (Waterloo, Te Marua, Gear Island and Wainuiomata), Kapiti Coast (Waikanae treatment plant) and Dunedin water supplies.
- Sodium fluoride is relatively expensive in New Zealand and is not widely used. Clutha District Council uses sodium fluoride at its Balclutha, Milton, Tapanui and Kaitangata plants.

We have adopted a similar approach in developing the cost estimates, with medium-large plants based on FSA or SFS and smaller plants based on sodium fluoride.

2.2 Fluorosilicic Acid

2.2.1 Chemical Details

Fluorosilicic acid (FSA) is a pale yellow fuming corrosive acid with a pungent odour. In New Zealand FSA is currently delivered at a concentration of 22% (w/w) and has a pH of approximately 1. It is classified as a Dangerous Good[1] with a hazard class of "8 Corrosive".

2.2.2 System Description

FSA is usually added to treated water at the supplied concentration as it may scale if it is diluted. FSA is usually pumped (with a metering pump) from a bulk tank or day tank and injected into the main treated water line. A dosing point schematic is shown in Figure 5.

The NZ Code of Practice requires that a number of "independent checks" are used to minimise the risk of overdosing of fluoride. For water supply systems that serve more than 10,000 people, at least two of the three following independent checks are required. If the water supply system serves 10,000 or fewer people, then at least one of the three independent checks is required. For FSA, the options for independent checks are:

- **Independent Check 1:** use of a day tank that can only be filled once a day and equipped with an online device to measure its contents.
- **Independent Check 2:** use of a fluoride measuring flow meter on the fluoride dosing line before the dosing point.
- **Independent Check 3:** use of a fluoride concentration analyser on the drinking-water line after the dosing point.

For further details refer to the "*Code of practice for fluoridation of drinking-water supplies in New Zealand*".

A schematic of a generic FSA dosing process is shown in Figure 1.

[1] NZS 5433:2012 Transport of Dangerous Goods on Land

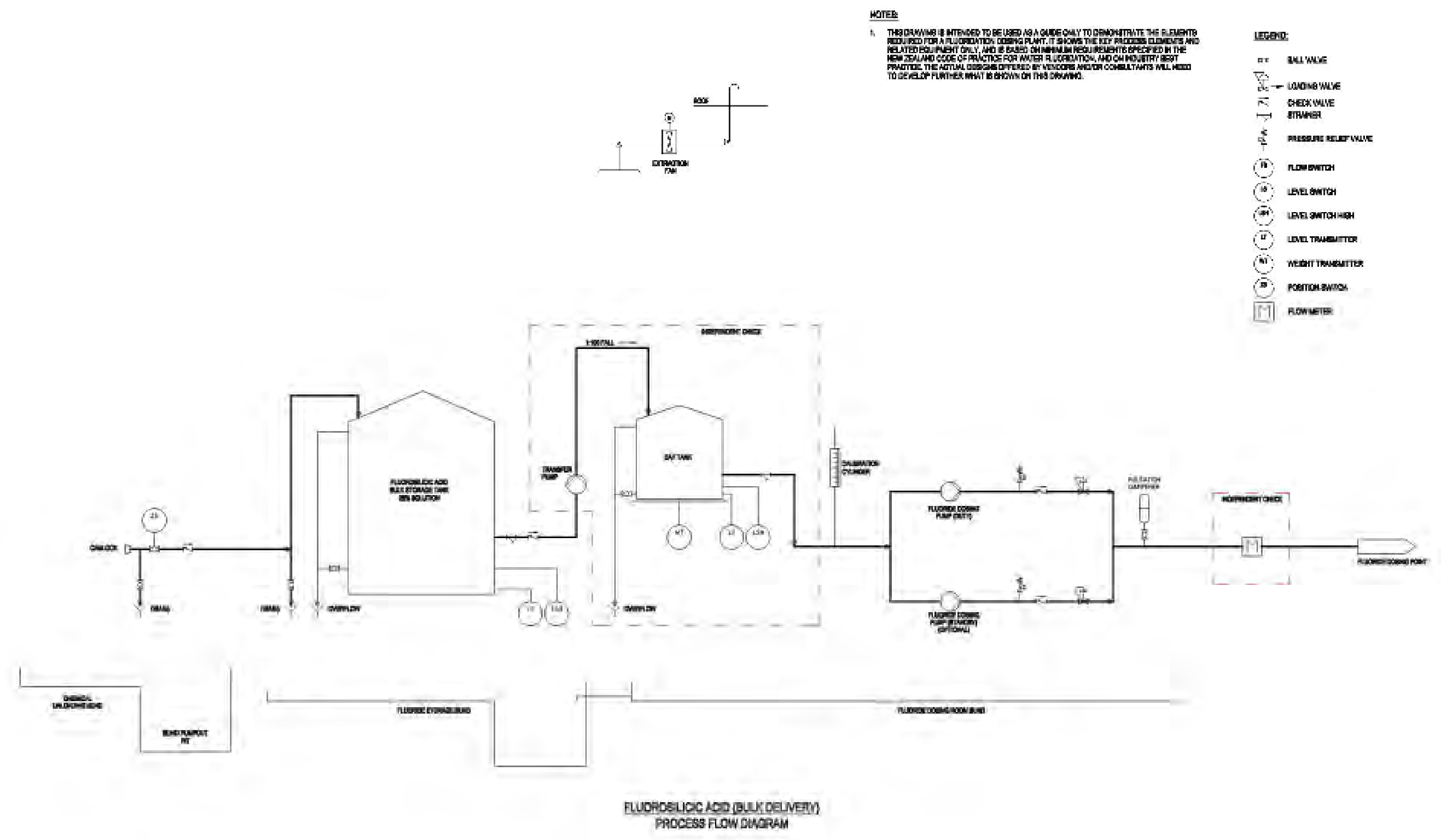

Figure 1: FSA Process Schematic

2.3 Sodium Fluorosilicate

2.3.1 Chemical Details

Sodium fluorosilicate (SFS) is supplied as a white pungent crystalline powder, comprising 60% w/w fluoride ion. It is classified as a Dangerous Good with a hazard class of “6.1 Toxic”.

SFS has a variable solubility in water (unlike NaF) hence for dose control it must be added at a controlled rate.

2.3.2 System Description

An SFS solution is prepared by transferring powder from the storage hopper to a stirred tank at a controlled rate using either a volumetric or gravimetric feeder. The amount of powder fed to the tank is generally controlled to provide flow-paced dosing of constant concentration fluoride chemical.

Industry best practice is to provide for a 10 minute minimum detention time to dissolve the SFS. If this detention time cannot be met with one tank, a separate dissolving tank may be required in addition to the dosing tank.

For a dosing plant using 25kg bags, chemical is loaded from the bags into a hopper mounted on top of the tank. Industry best practice is to use a vacuum loading system fitted with an extendable vacuum wand and dust extraction system. The chemical is drawn directly from the bag into the hopper with minimal dust generation and lifting.

The NZ Code of Practice requires that a number of “independent checks” are used to minimise the risk of overdosing of fluoride. For water supply systems that serve more than 10,000 people, at least both of the following independent checks are required. If the water supply system serves 10,000 or fewer people, then at least one of the two independent checks is required. For SFS, there are only two options for independent checks:

- **Independent Check 1:** use of a day tank that can only be filled once a day and equipped with an online device to measure its contents. In the case of SFS this could be a “day hopper” where a known weight of SFS is transferred on a daily basis. We note that this interpretation is not explicit in the Code of Practice, however as SFS has variable solubility in water, transfer of a known volume of a solution is meaningless unless the concentration is known. Similarly, for this reason a dosing line flowmeter cannot be used as an independent check for SFS.
- **Independent Check 2:** is not suitable for SFS.
- **Independent Check 3:** use of a fluoride concentration analyser on the drinking-water line after the dosing point.

For further details refer to the “*Code of practice for fluoridation of drinking-water supplies in New Zealand*”. We note that strict adherence with the Code of Practice is more difficult for SFS systems, and this is discussed in more detail in Section 5.

If the hardness of the source carrier water exceeds 75mg/L (as $CaCO_3$) then a water softener should be installed to prevent the precipitation of calcium and magnesium fluorides. The water softener will need periodic regeneration producing a strong waste brine solution which will require disposal.

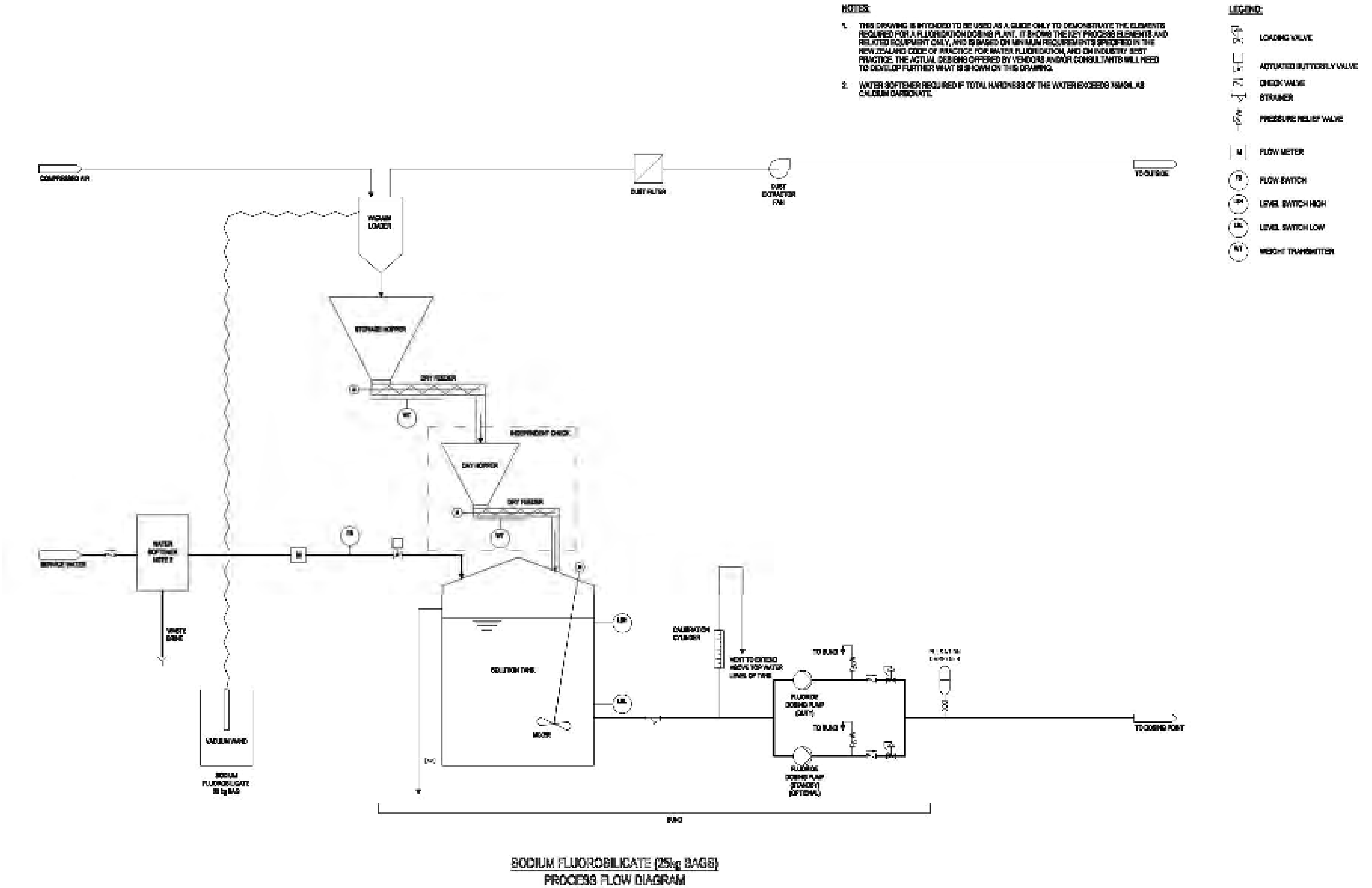

Figure 2: Sodium Fluorosilicate Process Schematic

2.4 Sodium Fluoride

2.4.1 Chemical Details

Sodium fluoride (NaF) is supplied as a white crystalline powder, comprising 45% w/w fluoride ion. It is classified as a Dangerous Good with a hazard class of “6.1 Toxic”.

NaF has an almost constant solubility in water of approximately 4%, regardless of water temperature. This allows for automatic, continuous preparation of saturated solutions in a saturator tank without the need for equipment to measure chemical addition. This reduces the risk of overdosing fluoride.

2.4.2 System Description

A saturated 4% solution of NaF is prepared in a saturator tank. Chemical is loaded into the tank to form a bed. Water is then distributed up through the chemical bed in an upflow saturator, or down through the bed in a downflow saturator. Upflow saturators are typically recommended as they are less susceptible to blockages and require less maintenance.[2]

The NZ Code of Practice requires that a number of “independent checks” are used to minimise the risk of overdosing of fluoride. For water supply systems that serve more than 10,000 people, at least two of the three following independent checks are required. If the water supply system serves 10,000 or fewer people, then at least one of the three independent checks is required. For sodium fluoride, the options for independent checks are:

- **Independent Check 1:** use of a day tank that can only be filled once a day and equipped with an online device to measure its contents.
- **Independent Check 2:** use of a fluoride measuring flow meter on the fluoride dosing line before the dosing point.
- **Independent Check 3:** use of a fluoride concentration analyser on the drinking-water line after the dosing point.

For further details refer to the “*Code of practice for fluoridation of drinking-water supplies in New Zealand*”.

NaF dissociates in water to give Na^+ and F^- which can form precipitates. If the hardness of the source carrier water exceeds 75mg/L (as $CaCO_3$) then a water softener should be installed to prevent the precipitation of calcium and magnesium fluorides. The water softener will need periodic regeneration producing a strong waste brine solution which will require disposal.

In Australia, NaF is available in 5kg “Fluorodose” bags which are manually loaded into the saturator tank. Operators need not open the bags as they are dissolvable, and so dust generation is eliminated. “Fluorodose” is not currently available in New Zealand.

In Australia, Prominent offer NaF in a 5kg plastic bottle with a large screw top lid. Under the lid the bottle is vacuum sealed via a plastic lid hot-glued into place. To use the chemical, the operator removes the screw cap and up-ends the bottle. The bottle screws directly into the lid of the NaF saturator (offered by Prominent). As the bottle screws into place, a small blade inside the reservoir lid cuts the plastic seal and the 5kg of

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[2] Manual of Water Supply Practices M4 – Water Fluoridation Principles and Practices, 2004, American Water Works Association (AWWA)

powder falls into the saturator. The reservoir is fitted with a little spray that is then used to wash the bottle clean. Once the spray finishes, the bottle is unscrewed, the cap on the bottle and the cap on the tank lid are both replaced manually by the operator, and the empty bottle is stored for return to Prominent. Such a product is not currently available in New Zealand, but if the demand was there, Prominent may consider supplying their product to New Zealand also.

Where 25 kg bags are used, the product will be loaded from bags into a hopper mounted on top of the saturator tank. Industry best practice is to use a vacuum loading system fitted with an extendable vacuum wand and dust extraction system. The chemical is drawn directly from the bag into the hopper with minimal dust generation and lifting.

A schematic of a generic sodium fluoride dosing process for 5kg bags is shown in Figure 3 and for 25kg bags in Figure 4.

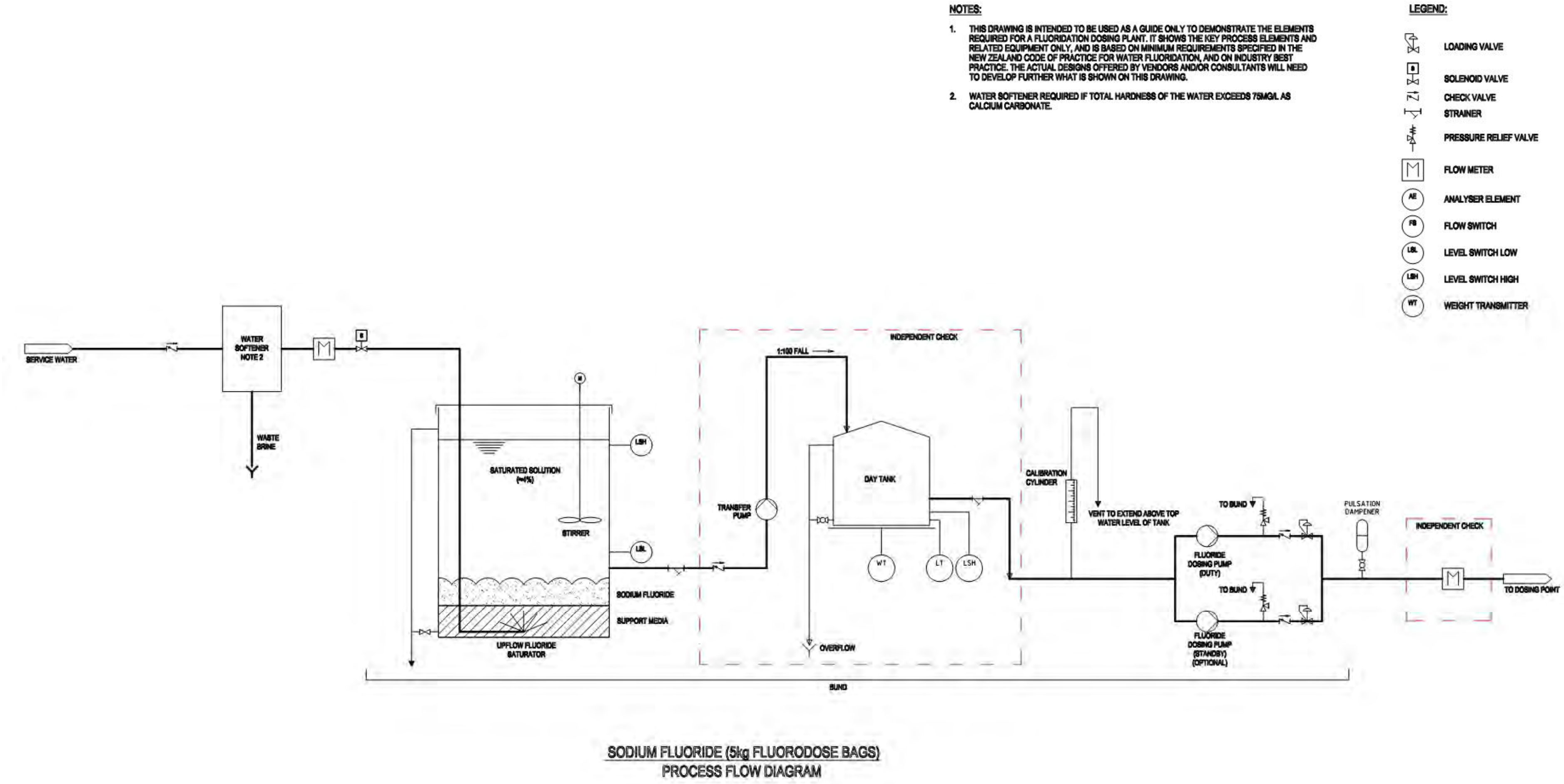


Figure 3: Sodium Fluoride Process Schematic – 5kg bags

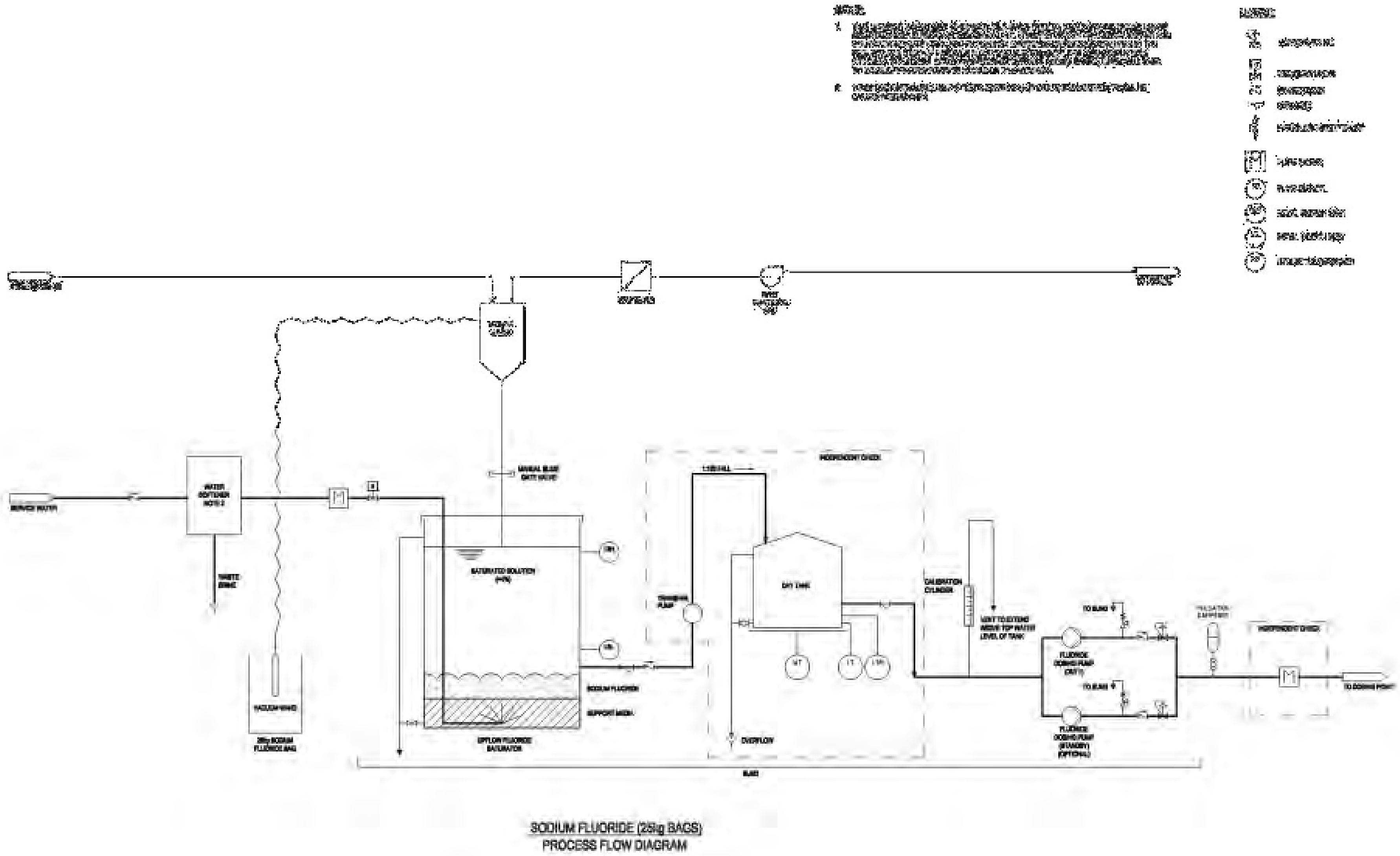


Figure 4: Sodium Fluoride Process Schematic – 25kg bags

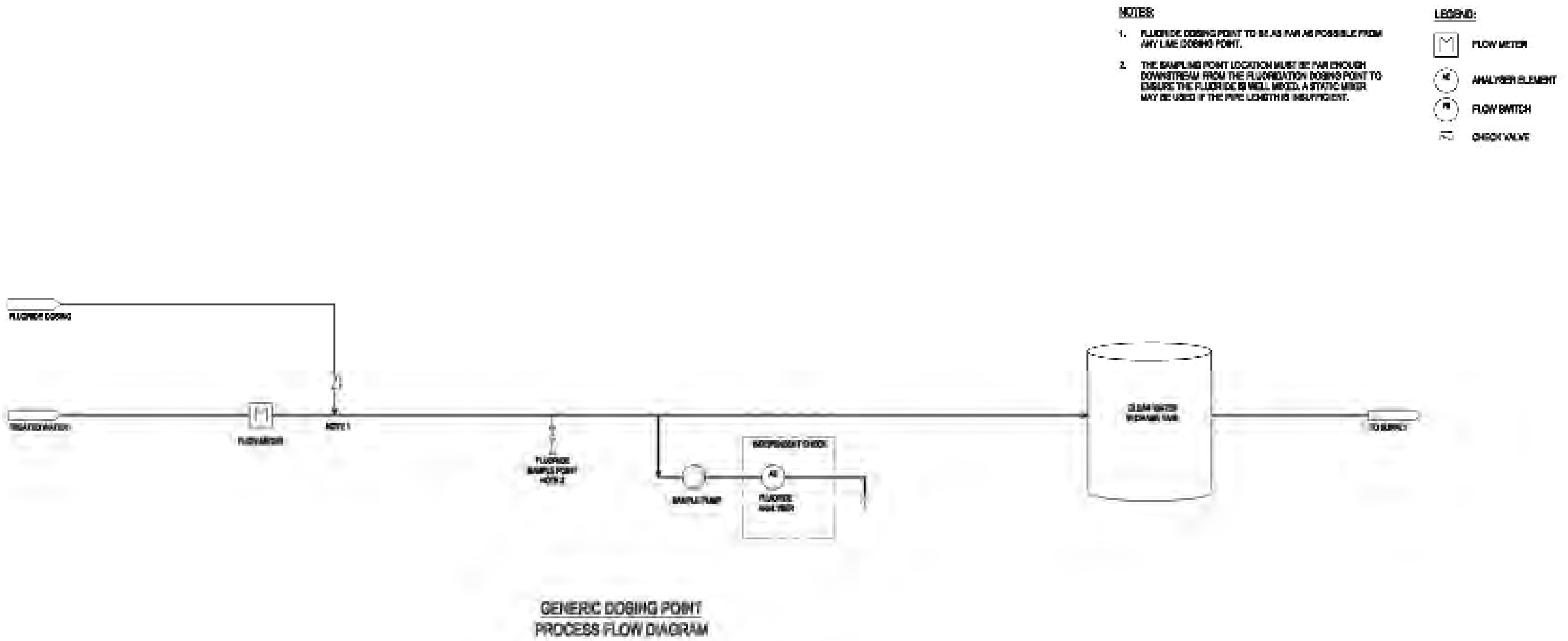


Figure 5: Fluoride Dosing Point Schematic

3 Capital Cost Estimates

3.1 Population Categories

The design flow for each population category has had the following principles applied:

- For large water supplies (population >10,000) the design flow is based on capacity advised by the water supplier. In the absence of actual design capacity, a peak figure of 700 litres/person/day and an average figure of 460 litres/person/day was used.
- For supplies serving populations <10,000 a higher peak per capita water usage rate of 1000 litres/person/day and an average usage of 500 litres/person/day was used.
- For each population category the WTP design flow was based on the per capita flow times the mean population for that category.

The population design basis for each category is shown in Table 2.

Table 2: Population Design Basis

Population category	Population band	Design population	Design Flow (m^3/d)
Large	>10,000	Varies	Varies
Medium	5001 – 10000	6900	6900
Minor	501 – 5000	2050	2050
Small	101 – 500	260	260
Neighbourhood	< 100	55	55

The population categories above are based on those used in the *"Drinking Water Standards New Zealand Cost Benefit Analysis – Engineering Input"* (2010). Rather than use the midpoint population of the population categories, which can cover a large range, the mean population has been used as the design population (based on population data received from ESR for the 2010 study). For all population categories, the mean population was below the midpoint population.

3.2 Cost Assumptions – General Approach

3.2.1 Ancillary Requirements

In addition to the fluoridation equipment detailed in Sections 2.2 to 2.4, ancillary work and equipment installation may be required to implement fluoridation at a WTP depending on the existing layout, equipment, services and operation of the WTP. In our cost estimates, where noted, we have allowed for the following ancillary equipment:

- Installation of a fluoride analyser.
- Construction of, or improvement to, the chemical delivery area.
- Construction of a new building to house equipment, or extension/refurbishment of an existing building.
- Construction of building services (ventilation/air con, lighting, power).
- Installation of a safety shower.
- Incorporation of fluoride dosing system control, monitoring and alarms into existing PLC, SCADA and/or telemetry systems.

The following ancillary work may be required at specific treatment plants, but has not been allowed for (unless otherwise stated) in the cost estimates:

- Engineering investigations (e.g. as built drawings of existing facility, geotechnical, topographical survey).
- Installation of a flow meter on the main process flow into which fluoride is to be dosed.
- Installation of a waste collection sump.
- Upgrade to drainage systems.
- Addition of a water softener (if using sodium fluoride or SFS and dilution water hardness (as $CaCO_3$) is greater than 75 mg/L). Hardness in NZ surface waters is generally less than 75 mg/L, however some groundwater sources (especially in areas with limestone) have high hardness values.
- Installation of a pit for flow meter and analyser.
- Installation of a sampling pump for fluoride analyser.
- Reconfiguration of piping and valving at the treatment plant.
- Relocation of existing services/equipment.
- Installation or upgrading of SCADA and/or telemetry systems for alarms associated with new fluoridation system.
- Installation or upgrade to the PLC system.
- Construction of amenities (possibly for a site that requires and increased level of operator attendance after installation of the fluoridation system).
- Purchase of a gantry/forklift for handling requirements.
- Installation or upgrade of security (fencing, signage and lighting).
- Construction of a laboratory complete with equipment (including bench top analyser for fluoride).
- Provision of personal protective equipment (PPE).
- Construction of or upgrade to power supply and switchboards.
- Construction of new delivery vehicle access and roads.
- Installation of a service water system.
- Land purchase may be required for a dosing building.
- GST is excluded from all cost estimates.

3.2.2 Other

Further requirements that will potentially be involved include:

- Training of operators.
- Waste disposal.
- New standard operating procedures and contingency plans.
- Increased monitoring and reporting requirements.

We have not allowed for these additional costs in our estimates.

3.3 Description and Cost Assumptions – Medium, Minor, Small and Neighbourhood Supplies

Sodium fluoride can be a good choice for smaller water supplies as the capital set up costs are generally lower than the other types of systems and the systems are relatively simple to operate. The chemical cost of sodium fluoride is relatively expensive in New Zealand compared to SFS and FSA. However, smaller supplies (neighbourhood, small, minor) only use a small quantity of fluoride on a yearly basis, so the increase in operating costs is relatively minor.

For costing purposes we have based the Neighbourhood, Small and Minor water supplies on a sodium fluoride system.

At the higher flows associated with a medium supply, the operating cost savings from using FSA are more significant and hence we have based the medium supply on a FSA system.

For each category we have provided a “low” and “high” cost estimate. The low cost estimate assumes there are already reasonable facilities onsite and the equipment installed will be a “low cost” option. Whilst a “low cost” option will be fit for purpose, it may require higher operator input, maintenance and have less robust control checks. The high cost estimate allows for a more robust system with better equipment, safety and controls.

3.3.1 Small and Neighbourhood Supplies

For small and neighbourhood supplies we have made the capital cost assumptions shown in Table 3.

Table 3: Cost Assumptions for Small and Neighbourhood Supplies

Area	Assumptions for Low Cost	Assumptions for High Cost
Equipment	▪ A basic 250 L NaF upflow saturator, dosing pump, pipework and valves. Operators manually load bags in unsealed bag loader. ▪ New flowmeter on treated water line to be used for control of dose rate.	▪ A 250 L NaF upflow saturator, metering pump skid, patented bottle cutter unloader system to minimise dust. ▪ New flowmeter on treated water line to be used for control of dose rate.
Independent Check	▪ A flowmeter on NaF dosing line as the independent check.	▪ Flowmeters (especially on small bore pipe) can be inaccurate and/or prone to failure. A fluoride analyser has been assumed as it is a better method for independently checking the fluoride dose.
EI&C		▪ As for the low cost option. ▪ A SCADA system could be implemented but is likely to incur significant cost.
Safety Shower	▪ New safety shower located in the fluoride dosing room. It has been assumed that a service water system is available to connect to the safety shower.	▪ As for the low cost option.
Building	▪ Fluoride saturator and dosing pump located in a shipping container or proprietary shed.	▪ Fluoride saturator and dosing pump located in a pre-fabricated building complete with ventilation.
Chemical Delivery	▪ No chemical delivery area or specific storage facilities required. Chemical would be delivered to a larger site (with adequate handling and storage facilities) and small quantities (eg one bag) would be transported to the Neighbourhood site.	▪ As for the low cost option.
Design	▪ Assuming installation of a largely pre-engineered system. The allowance is for design of components for integration into the existing site.	▪ As for the low cost option.

As discussed in Section 3.2, we have assumed that a WTP site will have a base level of facilities such as road access, power, security, lighting, drainage systems etc. We have not included an allowance for these items in order to keep costs to a reasonable level. Whilst this is a fair assumption for most treatment plants, some smaller plants have very limited facilities such as foot access only or no power. This needs to be carefully considered if assessing and using these capital costs in an analysis at a national level.

3.3.2 Minor Supplies

For minor supplies we have made the capital cost assumptions shown in Table 4.

Table 4: Cost Assumptions for Minor Supplies

Area	Assumptions for Low Cost	Assumptions for High Cost
Equipment	▪ A basic 500 L NaF upflow saturator, dosing pump, pipework and valves. Operators manually load bags in unsealed bag loader (dust risk). ▪ New flowmeter on treated water line to be used for control of dose rate.	▪ A proprietary 500 L NaF upflow saturator, metering pump skid, water softener, vacuum loader system complete with dust extraction to minimise dust and manual handling (refer photo on cover). ▪ New flowmeter on treated water line to be used for control of dose rate.
Independent Check	▪ A flowmeter on NaF dosing line as the independent check.	▪ Flowmeters (especially on small bore pipe) can be inaccurate and/or prone to failure. A fluoride analyser has been assumed as it is a better method for independently checking the fluoride dose.
EI&C		▪ As for the low cost option.
Safety Shower	▪ New safety shower located in the fluoride dosing room. It has been assumed that a service water system is available to connect to the safety shower.	▪ As for the low cost option.
Building	▪ Fluoride saturator, dosing pump and storage facilities can be incorporated into existing building. Some modifications may be needed for ventilation, bunding etc	▪ Fluoride saturator, dosing pump and storage facilities located in a pre-fabricated building complete with ventilation.
Chemical Delivery	▪ Assuming existing chemical delivery area is adequate.	▪ Allowance for a new bunded chemical delivery area and storage facilities.
Design	▪ Assuming installation of a largely pre-engineered system. The allowance is for design of components for integration into the existing site.	▪ As for the low cost option.

3.3.3 Medium Supplies

For medium supplies we have made the capital cost assumptions shown in Table 5.

Table 5: Capital Cost Assumptions for Medium Supplies

Area	Assumptions for Low Cost	Assumptions for High Cost
Equipment	■ A bulk 3000 L FSA tank, dosing pump skid, pipework and valves. ■ Existing flowmeter on treated water line used for control of dose rate.	■ A bulk 3000 L FSA tank, dosing pump skid, pipework and valves. All equipment rated for outside installation. ■ Existing flowmeter on treated water line used for control of dose rate.
Independent Check	■ A flowmeter on FSA dosing line as the independent check.	■ Flowmeters (especially on small bore pipe) can be inaccurate and/or prone to failure. A fluoride analyser has been assumed as it is a better method for independently checking the fluoride dose.
EI&C		■ As for the low cost option.
Safety Shower	■ New safety shower located in the fluoride dosing room. It has been assumed that a service water system is available to connect to the safety shower.	■ As for the low cost option.
Building	■ FSA tank and dosing pump can be incorporated into existing building. Some modifications may be needed for ventilation, bunding etc.	■ FSA tank located outside with bunding, a roof and locked security fence. Dosing pumps located outside but within bund and under roof.
Chemical Delivery	■ Allowance for a new bunded chemical delivery area and storage facilities.	■ As for the low cost option.
Design	■ Assuming installation of a largely pre-engineered system. The allowance is for design of components for integration into the existing site.	■ As for the low cost option.

3.4 Capital Cost Summary – Medium, Minor, Small and Neighbourhood Supplies

The capital costs for the different sized water supplies are shown in Table 6. These costs are indicative only based on a generic plant of that size. More detailed information and design would be required in order to use the capital costs for capital budgeting purposes for a specific plant.

Table 6: Fluoridation Capital Cost Estimates for Different Sized Water Supplies

	Neighbourhood		Small		Minor		Medium	
Design Parameters								
Population Served	<100		101-500		501-5000		5001-10000	
Capacity (m^3/d)	55		260		2050		6900	
Fluoride Chemical	NaF		NaF		NaF		FSA	
Costs	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Equipment + Install	15,000	45,000	20,000	45,000	20,000	82,500	50,000	70,000
EI&C	15,000	15,000	15,000	15,000	15,000	20,000	20,000	20,000
Fluoride Analyser	-	15,000	-	15,000	-	15,000	-	15,000
Building	10,000	30,000	12,000	30,000	15,000	30,000	15,000	30,000
Safety Shower	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Chemical Storage and Bunding	-	-	-	-	-	-	10,000	10,000
Chemical Unload Area	-	-	-	-	-	25,000	-	25,000
Design (12%)	6,000	13,000	6,000	13,000	7,000	21,000	12,000	21,000
P&G (15%)	7,000	17,000	8,000	17,000	8,000	27,000	15,000	26,000
Contingency and rounding (nom 15-20%)	7,000	20,000	9,000	20,000	10,000	34,500	18,000	38,000
Total	**$65,000**	**$160,000**	**$75,000**	**$160,000**	**$80,000**	**$260,000**	**$145,000**	**$260,000**

A contingency allowance of 15% has been applied to the “low” cost range and a 20% contingency to the “high” cost range.

3.5 Operating Cost Summary - Medium, Minor, Small and Neighbourhood Supplies

We have estimated costs for the various sized systems as shown in Table 7.

Table 7: Operating Cost Estimates

	Neighbourhood	Small	Minor	Medium
Design Parameters				
Population Served	<100	101-500	501-5,000	5,001-10,000
Peak Capacity (m^3/d)	55	260	2,050	6,900
Average Capacity (m^3/d)	28	130	1,025	3,450
Fluoride Chemical	NaF	NaF	NaF	FSA
Costs/annum				
Chemical	100	450	3,500	4,300
Operator Input	5,200	5,200	5,200	5,200
Maintenance	1,500	1,900	3,000	3,700
Total (per annum)	**$6,800**	**$7,600**	**$11,700**	**$13,200**

The operating costs are based on the following assumptions:

- Chemical costs are based on indicative prices received from Ixom and DC Rosser.
- Operator input is based on 2 hours/week at an operator hourly rate of $50/hour. The hourly rate may be lower for some supplies.
- Maintenance costs have been estimated as 2% of capital costs of the plant.
- Monitoring and compliance costs have been excluded.
- GST is excluded.

3.6 Description and Cost Assumptions – Large Water Supplies

3.6.1 Approach

It is difficult to prepare a generic cost estimate for the “Large” plant category as these are likely to require very specific designs. There are over 20 large supplies in NZ that are not currently fluoridating. Preparing a cost estimate for each of these 20 plants is beyond the scope of this work. Hence, we have selected the following four case studies to prepare cost estimates for:

- Whangarei
- Napier
- Levin
- Blenheim

3.6.2 Whangarei

The Whangarei water supply consists of three WTPs – the Whau Valley, Poroti and Ruddles WTP. In order to fluoridate the entire Whangarei city supply a fluoridation system would be required at all three WTPs.

Whangarei District Council is currently considering replacing the existing Whau Valley WTP with a new WTP at a new site. For the purposes of this costing, we have assumed that a FSA fluoride dosing would be incorporated in the proposed new Whau Valley Water Treatment Plant and at the existing Poroti and Ruddles treatment plants. The cost for including fluoride dosing at the new Whau Valley plant would be less than if it was to be incorporated at the existing plant which is restricted in both space and capacity. For costing purposes we have made the assumptions shown in Table 8.

Table 8: Whangarei Fluoride Dosing System Assumptions

Area	Infrastructure Required	Existing Infrastructure Assumptions
Equipment	▪ A bunded bulk 5000L FSA tank with level measurement and a dosing pump at each site. ▪ A flowmeter on the dosing line would be used at each site as an "independent check".	▪ No current dosing infrastructure that could be utilised at either site. ▪ Flowmeter on treated water to be used for flow pacing dose control.
EI&C	▪ Automation, monitoring and alarming would be incorporated as per the Code of Practice. ▪ Fluoride dosing meter required at each WTP as an independent check of the dose rate.	▪ Dosing control, alarming and monitoring could be incorporated into the existing PLC and SCADA system at each site. ▪ There is space in the existing MCC for the dosing pumps motor starters at each site. ▪ Existing transformer and switchboard can accommodate the extra dosing equipment at each site.
Safety Shower	▪ New safety shower located in the fluoride dosing room at each site.	▪ A service water system is available for connection to the safety shower at each site.
Building	▪ Dosing systems would be incorporated into the new Whau Valley WTP building and Poroti existing building (with some modifications). ▪ A standalone building (portable polypanel type construction) to accommodate the FSA tank and dosing pumps would be constructed at the Ruddles WTP.	▪ There is space in the Poroti existing buildings for a fluoride dosing system. ▪ Land is available at all sites for a dosing building.
Chemical Delivery	▪ Upgrades are required for the chemical delivery areas (bunding etc) at both the Poroti and Ruddles WTPs to make it suitable for FSA bulk delivery.	▪ Site access is suitable for a chemical delivery truck. ▪ The new Whau Valley WTP would have suitable chemical delivery infrastructure.

3.6.3 Levin

The Levin water supply consists of a single surface water source and treatment plant. Water is abstracted from the Ohau River and treated at the Levin water treatment plant located on Gladstone Road. The existing treatment plant consists of coagulant and flocculant dosing, pH control, horizontal pressure media filters, and chlorination. Fluoride could be added to water supply with a single dosing plant located at the existing water treatment plant.

To illustrate the costs of a SFS system for a Large supply, we have assumed a SFS system for the Levin supply. Although this plant is due for upgrading over the next 5-10 years, we have assumed that an SFS plant is added to the existing plant and that there is sufficient space at the Levin site to allow for a SFS system. For costing purposes we have made the assumptions shown in Table 9.

Table 9: Levin Fluoride Dosing System Assumptions

Area	Infrastructure Required	Existing Infrastructure Assumptions
Equipment	▪ A skid mounted SFS powder system complete with storage hopper, load cells, dry chemical feeder, solution tank with mixer, dosing pump and vacuum loader for 25kg bags. ▪ A second "day hopper" with screw feeder and load cell would be required as a second independent check on the fluoride dose.	▪ No current dosing infrastructure that could be utilised. ▪ Flowmeter on treated water to be used for flow pacing dose control.
EI&C	▪ Automation, monitoring and alarming would be incorporated as per the Code of Practice. ▪ The dosing skid would be supplied with a local control panel. ▪ Fluoride dosing meter required as an independent check of the dose rate.	▪ Dosing control, alarming and monitoring could be incorporated into the existing PLC and SCADA system. ▪ There is space in the existing MCC for the screw feeder and dosing pump motor starters. ▪ Existing transformer and switchboard can accommodate the extra dosing equipment.
Safety Shower	▪ New safety shower located in the fluoride dosing room.	▪ A service water system is available for connection to the safety shower.
Building	▪ A standalone building (portable polypanel type construction) to accommodate the fluoride make-up skid and storage of 25kg bags of SFS would be constructed.	▪ There is no space in the existing building for a fluoride dosing system. ▪ Land is available onsite for a dosing building.
Chemical Delivery	▪ A bunded chemical delivery area would be constructed.	▪ Site access is suitable for a chemical delivery truck.

3.6.4 Napier

The Napier water supply consists of ten wells spread over the city network. The groundwater aquifer the supply draws from is considered secure and as such no treatment is required prior to distribution. There is no centralised water treatment plant for the Napier supply, so in order to reliably fluoridate the entire supply a dosing system would be required at each well source. Given the likely space constraints at the well sites and the current level of operator input, we have assumed that FSA would be the most appropriate system for the Napier supply.

The other option, of piping the water from the wells to one centralised treatment plant (or perhaps a few treatment plants), may be more economic. This option has not been costed.

For costing purposes we have made the assumptions shown in Table 10.

Table 10: Napier Fluoride Dosing System Assumptions

Area	Infrastructure Required	Existing Infrastructure Assumptions
Equipment	■ A bunded bulk 3000L FSA tank with level measurement and a dosing pump at each of the ten bore sites. ■ A flowmeter on the dosing line would be used at each site as an “independent check”.	■ No current dosing infrastructure that could be utilised at the existing sites. ■ Flowmeter on treated water to be used for flow pacing dose control.
EI&C	■ Automation, monitoring and alarming would be incorporated as per the Code of Practice. ■ Fluoride dosing meter required at each dosing point as an independent check of the dose rate.	■ Dosing control, alarming and monitoring could be incorporated into the existing PLC and SCADA system at each site. ■ There is space in the existing MCC for the dosing pumps motor starters at each site. ■ Existing transformer and switchboard can accommodate the extra dosing equipment at each site.
Safety Shower	■ New safety shower located in the fluoride dosing room at all sites.	■ A service water system is available for connection to the safety shower at all sites.
Building	■ A standalone building (portable polypanel type construction) to accommodate the FSA tank and dosing pumps would be constructed at all sites.	■ There is no space in the existing buildings for a fluoride dosing system. ■ Land is available at each site for a dosing building.
Chemical Delivery	■ A bunded chemical delivery area would be constructed at each site.	■ Site access is suitable for a chemical delivery truck.

3.6.5 Blenheim

The Blenheim water supply consists of a number of bores located in the town and two treatment plants (Central and Middle Renwick Road). The Central WTP draws from five bores and is the primary water supply for Blenheim. The Middle Renwick Road WTP draws from three bores and is used to supplement the primary supply, especially during peak demand. Water treatment consists of pH correction and UV treatment.

We have assumed that a fluoride dosing plant would be required at both WTPs in order to fluoridate the entire supply. Given the likely space constraints at the Central WTP, we have assumed that FSA would be the most appropriate system for the Blenheim supply. For costing purposes we have made the assumptions shown in Table 11.

Table 11: Blenheim Fluoride Dosing System Assumptions

Area	Infrastructure Required	Existing Infrastructure Assumptions
Equipment	■ A bunded bulk 5000L FSA tank with level measurement and a dosing pump at each site. ■ A flowmeter on the dosing line would be used at each site as an “independent check”.	■ No current dosing infrastructure that could be utilised at either site. ■ Flowmeter on treated water to be used for flow pacing dose control.

Area	Infrastructure Required	Existing Infrastructure Assumptions
EI&C	▪ Automation, monitoring and alarming would be incorporated as per the Code of Practice. ▪ Fluoride dosing meter required at each WTP as an independent check of the dose rate.	▪ Dosing control, alarming and monitoring could be incorporated into the existing PLC and SCADA system at each site. ▪ There is space in the existing MCC for the dosing pumps motor starters at each site. ▪ Existing transformer and switchboard can accommodate the extra dosing equipment at each site.
Safety Shower	▪ New safety shower located in the fluoride dosing room at each site.	▪ A service water system is available for connection to the safety shower at both sites.
Building	▪ A standalone building (portable polypanel type construction) to accommodate the FSA tank and dosing pumps would be constructed at both sites.	▪ There is no space in either of the existing buildings for a fluoride dosing system. ▪ Land is available at both sites for a dosing building.
Chemical Delivery	▪ Upgrades are required for the chemical delivery areas (bunding etc) at both WTPs to make it suitable for FSA bulk delivery.	▪ Site access is suitable for a chemical delivery truck.

3.7 Capital Cost Summary – Large Water Supplies

The capital costs for the four case study large supplies are shown in Table 12. These costs are indicative only based on preliminary information for each plant. More detailed information and design would be required in order to use the capital costs for capital budgeting purposes.

Table 12: Summary of Capital Costs to provide Fluoridation to Large Water Supplies

	Whangarei	Levin	Napier	Blenheim
Design Parameters				
Population Served[3]	48,000	20,000	49,910	24,000
Peak Capacity (m^3/d)	36,000	13,000	50,000	34,000
Average Capacity (m^3/d)	23,000	8,500	29,000	13,000
Fluoride Chemical	FSA	SFS	FSA	FSA
Treatment Plants	Whau Valley Poroti Ruddles	Levin WTP	Ten wells	Central WTP Middle Renwick Road WTP
Costs				
Equipment	120,000	125,000	350,000	100,000
Mechanical Installation	50,000	30,000	150,000	40,000
EI&C	60,000	20,000	200,000	40,000
Fluoride Analyser	45,000	15,000	150,000	30,000
Building	130,000	55,000	450,000	110,000
Safety Shower	15,000	5,000	50,000	10,000
Chemical Storage and Bunding	30,000	-	100,000	20,000
Chemical Unload Area	50,000	25,000	100,000	50,000
Design (10%)	50,000	28,000	155,000	40,000
P&G (15%)	75,000	42,000	232,000	60,000
Contingency (20%)	100,000	55,000	310,000	80,000
Total	**$725,000**	**$400,000**	**$2,250,000**	**$580,000**

[3] From WINZ database.

4 Implications for Existing Fluoridation Plants

4.1 Case Studies

We have undertaken five case studies on a range of plants that have existing fluoridation systems to estimate the cost required for each plant to meet the Fluoridation Code of Practice (CoP). Existing plants must comply with the code by 2020. These cost estimates are indicative only based on limited information gathered from the relevant water suppliers. A more detailed assessment of each plant would be required in order to more accurately assess and cost the upgrades required to meet the CoP.

4.1.1 Waterloo Water Treatment Plant

The Waterloo WTP has a SFS dosing system consisting of a powder hopper (complete with weigh cell and dust extraction) with screw feeder, dilution tank, day tank and dosing pumps. The system is located in a separate room. The Waterloo fluoridation dosing system is generally in a satisfactory condition and meets most aspects of the CoP. The Waterloo WTP is classified as a large supply and hence requires two independent checks of the fluoride dose in order to be compliant with the CoP. There is a fluoride analyser that monitors fluoride in the treated water and is used to alarm and shut down the system on high readings. Whilst there is a day tank, it may not strictly adhere to the COP (as discussed in Section 2.3.2). Some changes to the automation and alarming may be required in order for it to meet the CoP. We estimate that these upgrades would cost approximately $15,000.

4.1.2 Waikanae Water Treatment Plant

The Waikanae WTP has a SFS dosing system consisting of a powder hopper with conveyor, day hopper and screw feeder (complete with weigh cell and dust extraction) and a dilution tank. The system is located in a separate room. The Waikanae fluoridation dosing system is generally in a satisfactory condition and meets most aspects of the CoP. The Waikanae WTP is classified as a large supply and hence requires two independent checks of the fluoride dose in order to be compliant with the CoP. There is a fluoride analyser that monitors fluoride in the treated water and is used to alarm and shut down the system on high readings. The day hopper could be used as the second independent check, but some automation and operational changes would be required. We estimate that these upgrades would cost approximately $10,000.

4.1.3 Hamilton Water Treatment Plant

The Hamilton WTP has a FSA dosing system consisting of a bulk tank, day tank and dosing pumps. The bulk tank is bunded and located outside under a cover with a security fence. The Hamilton WTP is classified as a large supply and hence requires two independent checks of the fluoride dose in order to be compliant with the CoP. There is a fluoride analyser that monitors fluoride in the treated water and is used to alarm and shut down the system on high readings. The day tank could be used as the second independent check, but some automation and operational changes may be required. There are some modifications to the pipework and chemical delivery area that may also be required to improve the health and safety aspects of the system. We estimate that these upgrades would cost approximately $50,000.

4.1.4 Balclutha Water Treatment Plant

The Balcutha WTP has a NaF dosing system consisting of an upflow saturator and dosing pump located in an isolated room. The Balclutha WTP is classified as a minor supply and hence requires one independent check of the fluoride dose in order to be compliant with the CoP. There are currently no independent checks of the fluoride dose and the dose rate is manually set rather than being flow paced with the treated water flow (although we have assumed there is a plant flow meter). The least expensive independent check would be to install a flowmeter on the dosing line. A fluoride analyser would be a more robust independent check, but it would be more expensive. There is no safety shower at the plant and dust extraction controls may need to be improved. We have not seen the condition of the chemical delivery area or the storage facilities, these may need some improvements. Assuming a dosing line flow meter is installed as an independent check, and the control/programming and dust suppression upgrades are implemented, we estimate that the upgrades would cost approximately $25,000. This figure does not allow for improvements to the chemical delivery and storage area.

4.1.5 Milton Water Treatment Plant

The Milton WTP has a NaF dosing system consisting of an upflow saturator and dosing pump located in an isolated room. The fluoride dosing system is flow paced. The Milton WTP is classified as a minor supply and hence requires one independent check of the fluoride dose in order to be compliant with the CoP. There are currently no independent checks of the fluoride dose. The least expensive independent check would be to install a flowmeter on the dosing line. A fluoride analyser would be a more robust independent check, but it would be more expensive. There is a safety shower at the plant. The dust extraction controls may need to be improved. Assuming a flowmeter is installed as an independent check and the dust suppression and extraction systems are improved, we estimate that the upgrades would cost approximately $20,000.

4.2 Cost Summary – CoP Implications

A summary of the estimated capital costs for each plant to meet the CoP is shown in Table 13.

Table 13: Summary of Upgrade Costs to meet the Code of Practice

	Waterloo	Waikanae	Hamilton	Balclutha	Milton
Population Category	Large	Large	Large	Minor	Minor
Fluoride Chemical	SFS	SFS	FSA	NaF	NaF
Upgrade Cost	$15,000	$10,000	$50,000	$25,000	$20,000

5 Concluding Remarks

The base equipment for a fluoridation system can be installed relatively inexpensively. However, in order for fluoridation to be safe for consumers, operators and the environment; proper controls must be in place regardless of system size. These additional controls add cost, which can be significant.

As the cost estimates show, the infrastructure that is existing at a treatment plant has a big impact on the costs of adding fluoridation. Typically smaller plants have less infrastructure than larger ones. Some Small and Neighbourhood supplies may not even have a treatment plant.

The existing configuration of a supply can also affect the costs. The Napier supply is an example of a system that would cost significantly more to implement due to having ten wells feeding directly into the network. Whilst this type of supply is not the norm, it is not unique either. The Christchurch water supply also consists of a network of wells that separately supply the city.

When the cost estimates we have prepared are input into the CBA, it is important to appreciate that while we have given a range of capital costs, this range is not broad enough to cover the situation for all plants in a particular size category. For plants with little or no infrastructure, or supplies with multiple sources, the capital costs will be higher than the upper bound estimate.

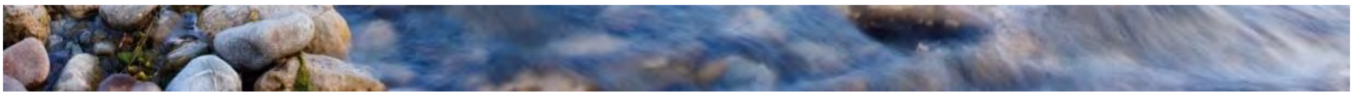
water NEW ZEALAND

The New Zealand Water & Wastes Association Waiora Aotearoa

Water New Zealand Code of Practice

Fluoridation of Drinking-Water Supplies in New Zealand

First Edition December 2014



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Foreword

Water fluoridation is the adjustment of the natural content of fluoride in drinking-water to a level that helps protect teeth against dental decay. Tooth decay is a largely preventable disease that affects both children and adults. It can cause considerable pain and suffering as well as a significant cost, which is unaffordable for some low income earners. Fluoride in drinking-water acts like a constant repair kit that neutralises the effect of acids that cause decay and helps to repair damage before it becomes permanent. Water fluoridation is the most effective and socially equitable way to give everybody access to the caries-preventive effects of fluoride regardless of age, income or education level.

In New Zealand, the decision to adjust the level of fluoride in water supplies is held by drinking-water suppliers (Local Authorities and other owners).

The *Code of practice for fluoridation of drinking-water supplies in New Zealand* (this Code) specifies good practice for the design and operation of water fluoridation plants to ensure the safe and effective addition of fluoride to drinking-water supplies. Although compliance with this Code is not a legal requirement, water suppliers are encouraged to comply with the Code to ensure the safety of their consumers. Compliance with the Code is also a way to provide increased public confidence.

The Ministry of Health and Water New Zealand would like to acknowledge the assistance of the Victorian Department of Health, as well as the important contributions from a wide range of water suppliers and industry stakeholders who assisted in this process. Both the Ministry of Health and Water New Zealand are committed to working with the water industry to ensure the safe and effective addition of fluoride to drinking-water supplies.

This Code is endorsed by the Ministry of Health as representing good practice for the addition of fluoride to drinking-water for the promotion of dental health. Suppliers that are designing new fluoridation plants are encouraged to comply. Suppliers with existing plants should consider the Code and plan to upgrade so that compliance is reached in the future.

Dr Don Mackie
Chief Medical Officer
Ministry of Health

1 Introduction

There is no legislation in New Zealand that requires the addition of fluoride to a water supply. Fluoridation is undertaken by drinking-water suppliers at their discretion. In the Drinking Water Standards for New Zealand 2005 (revised 2008) the Ministry of Health recommends that the fluoride content in New Zealand drinking water should be in the range of 0.7 to 1.0 mg/L for oral health reasons. The Code of practice for fluoridation of drinking-water supplies in New Zealand (this Code) specifies good practice for the safe design and effective operation of a fluoridation plant.

Safe and effective fluoridation of drinking-water supplies requires the adoption of a preventive risk management approach in the design and operation of fluoridation plants. Preventive risk management systems are the most effective way to assure the safe and effective addition of fluoride into a drinking-water supply. These systems underpin the approach taken in Water Safety Plans.

1.1 Objective

The overall objective of this Code is to provide guidelines for safe and effective addition of fluoride into a drinking-water supply.

This objective is achieved by specifying:

- Optimum fluoride levels for drinking-water supplies as defined by the Ministry of Health and the design control limits for fluoridation plants.
- Minimum requirements for the safe and effective addition of fluoride chemicals to drinking-water supplies, covering the design and operation of a fluoridation plant.
- Monitoring and reporting requirements for fluoridation.

1.2 Scope

This Code should apply to all new and upgraded water fluoridation plants after 1 January 2015. After 1 January 2020 the Code will also apply to existing fluoridation plants that have not been upgraded.

The Code describes:

- The regulatory framework (Section 2).
- Safety in design (Section 3).
- Requirements for the design and control of fluoridation facilities (Section 4).
- Requirements for plant operation including monitoring, training of personnel, occupational health and safety, security and environmental protection (Section 5).

1.3 Terminology

1.3.1	*Code of practice for fluoridation of drinking-water supplies in New Zealand:*	This code
1.3.2	*Drinking-water Assessor (DWA):*	A person appointed under the Health Act 1956 (the Act) to assess drinking-water supplies.
1.3.3	*Drinking-water Supplier:*	The Act defines a drinking-water supplier as a person who supplies drinking water to people in New Zealand or overseas from a drinking water supply, and: a) Includes that person's employees, agents, lessees, and subcontractors while carrying out duties in respect of that drinking water supply; and b) Includes (without limitation) i. A networked supplier; and ii. A water carrier; and iii. Every person who operates a designated port or airport; and iv. A bulk supplier; and v. Any person or class of person declared by regulations made under section 69ZZY to be a drinking water supplier for the purposes of this Part (a prescribed supplier); but c) Does not include vi. A temporary drinking water supplier; or vii. A self-supplier; or viii. Any person or class of person declared by regulations made under section 69ZZY not to be a drinking water supplier for the purposes of this Part.
1.3.4	*Drinking-water Standards for New Zealand 2005 (revised 2008):*	The DWSNZ
1.3.5	*Fluoride concentration:*	The fluoride concentration refers to the total amount of fluoride present regardless of its form and is expressed in milligrams per litre (mg/L) (Note: 1 mg/L = 1 g/m^3 = 1 ppm).
1.3.6	*Fluoridation plant:*	The building and equipment required for fluoridation of drinking-water, including chemical storage and unloading areas, dosing and control equipment, safety equipment and other fixtures used for, or associated with, the purpose of fluoridation.
1.3.7	*Guidelines for Drinking-water Quality Management for New Zealand:*	Guidelines to help water suppliers to comply with the DWSNZ.
1.3.8	*Hazardous Substances and New Organisms Act 1996:*	HSNO
1.3.9	*Health Act 1956:*	The Act that aims to protect public health by improving the quality of drinking-water provided to communities.
1.3.10	*Independent Checks:*	A control system that is entirely independent of another that is used to prevent the overdosing of fluoride.
1.3.11	*Maximum Acceptable Value:*	'MAV' as defined by the DWSNZ.
1.3.12	*'Must' and 'should':*	The word **'must'** identifies a mandatory requirement for compliance with this Code. The word **'should'** refers to practices that are advised or recommended but are not mandatory for compliance with this Code.

2 Regulatory Framework

2.1 Legislation

2.1.1 Acts

The requirements for the supply of drinking-water are set out in the Local Government Act 2002 (for Local Authorities) and the Health Act 1956. Specifically, under Section 23 of the Health Act, territorial authorities have a duty to improve, promote and protect public health; and under Section 25, to provide sanitary works including drinking-water supplies when directed by the Minister.

The Health Act 1956 was amended by the Health (Drinking Water) Amendment Act in October 2007 and aims to protect public health by improving the quality of drinking-water provided to communities. The Act requires drinking-water suppliers to:

- Take all practicable steps to ensure they provide an adequate supply of drinking-water that complies with the Drinking-water Standards for New Zealand
- Prepare and implement Water Safety Plans (see Section 2.1.3)

2.1.2 Drinking-water Standards for New Zealand

The Drinking-water Standards for New Zealand 2005 (revised 2008) (DWSNZ) specify water quality standards and compliance criteria for microbiological, chemical and radiological contaminants (determinands) in drinking-water.

The DWSNZ set a Maximum Acceptable Value (MAV) of 1.5 mg/L for fluoride. The MAV of a chemical is the concentration of that chemical which does not result in any significant risk to the health of a 70 kg person over a lifetime of consumption of two litres of the water a day. The 1.5 mg/L MAV for fluoride is based on the latest World Health Organisation (WHO) Guidelines.

Fluoride is classified as a Priority 2a determinand in the DWSNZ. As such fluoridated drinking-water supplies must be sampled at least weekly to monitor fluoride levels in the water leaving the treatment plant.

2.1.3 Water Safety Plans

A Water Safety Plan requires a drinking-water supplier to consider the potential risks to the water supply and identify ways to manage these risks, and is therefore prepared for any problems that may arise. Large (more than 10,000 people), medium (5001 to 10,000 people) and minor (501 to 5,000 people) drinking-water suppliers are required under the Act to prepare and implement approved Water Safety Plans. Small drinking-water suppliers need to implement a Water Safety Plan at the request of a Medical Officer of Health or to demonstrate they are taking all practicable steps to comply with the DWSNZ.

Drinking-water suppliers are required to start implementing their Water Safety Plans within one month of approval.

2.1.4 This Code

This Code describes good practice for drinking-water fluoridation. There is no legislation in New Zealand that requires the addition of fluoride to a water supply. Fluoridation is undertaken at the discretion of a drinking-water supplier. While there is no legal requirement to comply with this Code, it consolidates good practice from the New Zealand water industry. It therefore represents an industry-endorsed Code and, if complied with, a means of documenting in the Water Safety Plan that the risks associated with fluoridation in the supplier's water supply plant have been satisfactorily mitigated.

The Code has been written to assist water-suppliers in designing a new drinking-water fluoridation system, or upgrading an existing system to ensure the safety of its consumers. This Code describes information that is suggested for inclusion in a drinking-water supplier's Water Safety Plan, but inclusion is not required for Water Safety Plan approval by the DWA.

2.1.5 Other Legislation

Other legislative requirements of relevance to the management of a water fluoridation scheme include:

- *Hazardous Substances and New Organisms (HSNO) Act 1996*
- *Health and Safety at Work Act 2014*[1]
- *Building Act 2004*
- *NZ Building Code*
- *Land Transport Act 1998*
- *Land Transport Rule* (Dangerous Goods 2005) *45001*
- *Resource Management Act 1991*

2.2 Roles and Responsibilities

2.2.1 Ministry of Health

The function of the Ministry of Health is improving, promoting, and protecting public health. Its role is to encourage drinking-water suppliers to consider the use of fluoride for improvement of consumers' teeth, as well as to ensure that fluoride is added to drinking-water in a safe and effective way. The Ministry of Health's position is that the addition of fluoride to drinking-water is a safe, effective and affordable way to prevent and reduce tooth decay across the whole population. If subsidy for capital works to install fluoridation is available from the Ministry of Health, compliance with this Code among other factors would be assessed.

2.2.2 Drinking-water Supplier

For new and upgraded fluoridation plants, the drinking-water supplier should design, construct and operate the fluoridation plant in accordance with this Code.

Prior to the construction of a fluoridation plant, the drinking-water supplier should have the design peer-reviewed against this Code. Evidence of the peer review of the design should be provided to the DWA to demonstrate that the plant will operate in a safe and effective manner.

[1] As at 31 October 2014 it is the Government's intention that the Health and Safety Reform Bill will be passed in 2014, with the new Act coming into force from 1 April 2015. It will replace the Health and Safety in Employment Act (1992).

When a drinking-water supplier is implementing a new or upgraded fluoridation plant, the DWA needs to be advised at the design phase, the construction phase, and immediately prior to introducing fluoride to the supply.

The drinking-water supplier is responsible for ensuring that the design, installation and operation of the fluoridation plant, and the storage and handling of chemicals, are in accordance with all the relevant legislative requirements. Specifically, the drinking-water supplier must ensure that the water fluoridation plant is incorporated into the Water Safety Plan for a drinking-water supply. Future intent to add fluoride should also be indicated in the Water Safety Plan. In relation to transport of chemicals, the drinking-water supplier is responsible for engaging contractors who comply with relevant legislative requirements. Shipping of the chemicals, unloading and storage should be in accordance with the Water New Zealand, Good Practice Guide: *Supply of Fluoride for Use in Water Treatment*.

3 Safety in Design

3.1 Approach

The Safety in Design process involves the application of a risk management framework early in the design process to eliminate or minimise the risk to public health and the environment and to ensure occupational health and safety throughout the life of the fluoridation plant. It encompasses all phases of the plant design including facilities, hardware, systems, equipment, products, tooling, materials, energy controls, layout and configuration. From April 2015, a new Health and Safety at Work Act will be introduced and it will include Safety in Design requirements[2].

In the context of water fluoridation, Safety in Design encompasses:

- Drinking-water safety for consumers
- Occupational health and safety
- Environmental safety
- Asset safety

A safe design basis, together with a formal safety management system and safety practices, procedures, and training, is critical for providing the level of confidence required.

3.2 Risk Assessment

Drinking water suppliers that are fluoridating or are planning on installing new plant to fluoridate must carry out and document a site-specific risk assessment covering all aspects of safety and environmental risk associated with the design and operation of the fluoridation plant. Where risks are identified, appropriate control measures (based on the hierarchy of controls) must be implemented. The preventive risk management system must include the development of considered and controlled responses to incidents or emergencies that can compromise the safety of fluoridating a drinking-water supply, worker safety or the environment.

Based on the hierarchy of controls, hazards should be eliminated wherever practicable, followed by minimising the remaining hazards through use of engineering controls.

The risk assessment for the fluoridation plant and the effectiveness of actual control measures should be reviewed on a regular basis. Initial design risk control measures should not be degraded through subsequent modifications of the fluoridation plant and/or the water supply system. This is consistent with the approach taken in Water Safety Plans.

3.2.1 Risk-based systems

Risk-based systems include ISO 9001, ISO 14001, HACCP and local standards such as the Australian and New Zealand *Risk management – principles and*

[2] Refer section 2.1.5.

guidelines (AS/NZS ISO 31000). A risk-based system must be used to systematically address and manage risks associated with the fluoridation plant prior to commissioning.

3.2.2 Hazard and operability (HAZOP) studies

The drinking-water supplier should also conduct a Hazard and Operability (HAZOP) study as one part of the Safety in Design assessment. The HAZOP should involve the application of a formal systematic critical examination of the process and engineering intentions of the fluoridation plant to assess the hazard potential of inappropriate operation or malfunction of individual items of equipment and their consequential effects on the water treatment plant as a whole.

Any actions arising from the HAZOP study should be incorporated into the design and/or operation of the fluoridation plant.

3.3 Drinking-Water Safety

The performance objective is to ensure the design, construction, installation, operation and maintenance of the fluoridation plant protects public health by:

- Maintaining the optimum fluoridation concentration in the drinking-water supply
- Preventing overdosing of fluoride
- Implementation of quality assurance processes to guarantee the chemical purity of the fluoridating agent

Controls for managing risks to drinking-water safety, as identified through the site-specific risk assessment, must be incorporated in the drinking-water supplier's Water Safety Plan.

3.4 Occupational Health and Safety

The design and operation of the fluoridation plant must ensure worker safety. The drinking-water supplier must conduct and document a site-specific safety hazard risk assessment covering all aspects associated with the design and operation of the fluoridation plant.

The drinking-water supplier must ensure risks are assessed and managed in accordance with the relevant occupational health and safety requirements. The *Health and Safety at Work Act 2014* provides information and advice on eliminating hazards and controlling risks at the design, construction and operational stage to those involved in the design or modification of products, and processes used for work. Health monitoring of staff must be carried out to ensure that the hazard risk controls employed are functioning as intended. This is an employer responsibility required under the *Workplace Exposure Standards and Biological Exposure Indices*.

3.5 Environmental Safety

The design and operation of the fluoridation plant must not cause environmental harm. HSNO provides further details of the requirements that must be implemented to avoid this. The drinking-water supplier must conduct and document a site-specific environmental risk assessment covering all aspects associated with the design and operation of the fluoridation plant, including the delivery, storage and handling of the fluoridating agent. Consideration of all aspects of environmental safety to do with the fluoridation chemical and plant should be evident.

4 Design of Fluoridation Plant

4.1 Design Criteria

4.1.1 Legislation, regulations, guidelines, standards and codes

The drinking-water supplier must ensure the design, construction and operation of the fluoridation plant complies with the relevant legislative requirements, guidelines and standards. These include, but are not limited to:

- Legislation - refer to Section 2
- NZS/AS 1319 *Safety signs for the occupational environment*
- AS 1345 *Identification of the contents of pipes, conduits and ducts*
- AS/NZS 1715 *Selection, use and maintenance of respiratory protective devices*
- AS 3780 *The storage and handling of corrosive substances*
- AS/NZS 4020 *Testing of products for use in contact with drinking water*
- AS/NZS ISO 31000 *Risk management – Principles and guidelines*
- AS/NZS 4452 *The storage and handling of toxic substances*
- AS/NZS 4801 *Occupational health and safety management systems— Specification with guidance for use*
- *NZS 5433.1&2: 2012, Transport of Dangerous Goods on Land*
- NZS 5807 *Code of practice for industrial identification by colour, wording or other coding*
- *Code of Practice for Manual Handling,* Published jointly by the Occupational Safety and Health Service of the Department of Labour and the Accident Compensation Corporation. June 2001
- Trade Waste Bylaws (if disposing of fluoride wastes to Council wastewater systems)
- Workplace Exposure Standards and Biological Exposure Indices

4.1.2 Chemical selection

The three chemicals used for the fluoridation of drinking-water in New Zealand are listed in Table 1.

The drinking-water supplier is responsible for selecting the most suitable fluoridating agent for the drinking-water supply. The selection process should consider chemical availability and security of supply, whether a quality management system is in place to ensure chemical purity, site constraints and how the drinking-water supplier will comply with the DWSNZ. Evidence of the selection process (including a risk assessment) should be recorded.

Water New Zealand's Good Practice Guide *Supply of Fluoride for Use in Water Treatment 2014* should be used for specifying the supply of the chemical. The Good Practice Guide includes requirements for meeting the appropriate specification limits for contaminants using the Maximum Acceptable Value (MAV) approach as described in Chapter 1.5 of the DWSNZ.

The drinking-water supplier must undertake a risk assessment to ensure that any material used in the dosing of fluoride, such as soluble bags, do not present a risk to public health. The risk assessment must also ensure that the addition of contaminants in the fluoridation chemical to the concentrations of these contaminants already present as Priority 2 determinands in the supply, do not result in any contaminant exceeding its MAV.

Table 1: Fluoridating agents

Common name	Formula	CAS No.*	Alternative name(s)	UN Class	Hazard Classification**
Fluorosilicic acid	H_2SiF_6	16961-83-4	Hydrofluorosilicic acid (HFA), hexafluorosilicic acid	8, PG II	8.2C, 8.3A
Sodium fluoride	NaF	7681-49-4	Sodium monofluoride	6.1; PG III	6.1C, 6.3A, 6.4A, 6.6B, 6.8B, 6.9A, 9.1D, 9.3B
Sodium fluorosilicate	Na_2SiF_6	16893-85-9	Sodium silicofluoride, sodium hexafluorosilicate	6.1; PG III	6.1C, 6.4A, 9.3B

* CAS Numbers are as per the Chemical Classification and Information Database (CCID) on www.epa.govt.nz. Note that there are other CAS numbers in use for these chemicals.

** Classification as per the CCID on www.epa.govt.nz (chemicals in the CCID are classified in accordance with the Hazardous Substances and New Organisms (HSNO) regulations)

4.1.3 Concentration of fluoride in water

The purpose of fluoridation is to adjust the natural fluoride content of drinking-water to the optimum level to provide a dental health benefit. The target concentration of fluoride in treated water is between 0.7 and 1.0 mg/L.

The selected dosing concentration and the basis for the selection (including allowance for the fluoride concentration in the raw water) should be included in the Water Safety Plan. The drinking-water supplier should maintain a historical record of the fluoride concentration in the raw water to ensure an appropriate allowance is made for the fluoride concentration in determining the dosing concentration. The fluoride concentration in the raw water should be analysed at an appropriate frequency for the expected variability.

4.1.4 Design control limits

The design of the fluoridation plant must:

- Use a fluoride dosing concentration as determined using Section 4.1.3, and be controlled to the limits specified in Table 2.
- At no time allow the fluoride concentration in the drinking-water supply to exceed 1.5 mg/L (as specified by the MAV in the DWSNZ).

Real-time monitoring of the fluoride concentration after the dosing point (either direct or indirect), linked to an appropriate alarm monitoring system and automatic shut-down, is required - refer section 4.1.6. The fluoride plant control limits in Table 2 apply specifically to the instruments used for real-time fluoride monitoring, namely those instruments used for calculating instantaneous water flow and fluoride dose rates, and analyser/s for monitoring the fluoride concentration, if fitted.

Any delay time associated with the process limits in Table 2 (to account for instantaneous spikes) should be kept to a minimum, justified and documented.

Table 2: Fluoride plant control limits and alarms

Parameter	**Total fluoride concentration (mg/L)**	**Response to process limits**
Operating target	As determined by section 4.1.3.	–
Operating range (≥95% of the time that the fluoridation plant is In operation)	Within ± 0.15 of operating target.	–
Lower action process limit	0.6*	Dosing corrected. No shut down required.
Upper action process limit	1.2^	Immediate fluoride plant shut down. (Online monitoring system must be interlocked with the dosing system.)
Emergency process limit	1.5†	Immediate fluoride plant shut down. (Online monitoring system must be interlocked with the dosing system.) Notify the DWA Immediately, investigate the cause of the exceedance and take appropriate action. See DWSNZ for more information.

* NHMRC 2007, *A systematic review of the efficacy and safety of fluoridation*

^ This action level is a slightly lower dose than the maximum level of fluoride permitted in the DWSNZ, and has been established to ensure that the MAV is never exceeded.

† Based on the Maximum Acceptable Value set in DWSNZ.

4.1.5 Functionality of the fluoridation plant

To comply with this Code the fluoridation plant must be designed to meet the following requirements as well as the Independent Check requirements specified in Section 4.1.6:

a) The design of the fluoridation plant must ensure that provision is made for operational staff to monitor and control the fluoridation process reliably, accurately and in a timely manner.

b) The fluoride concentration in the water supplied for drinking must comply with the requirements set out in Section 4.1.3 and 4.1.4.

c) The plant must be configured so that the functionality requirements set out in 4.1.5, 4.1.6 and 4.1.7 are fully automated, and operated by a control system that is based at the treatment plant.

d) Plant design must ensure dependable automatic operation with reliable stopping and starting of the system during plant shut-down and start-up.

e) The plant must have alarms (including after hours to duty operator) and automatic shut-downs for key process elements.

f) If a day tank is used (see Section 4.1.6 for information about when day tanks are required as one of the Independent Checks):

   a. fluoride transfer from the bulk tank to the day tank must occur nominally once in a 24-hour period. Refer to Section 4.1. 6.

   b. it must be equipped with either an online weight measurement device or an online level instrument that enables measurement of the quantity of fluoride used during each 24 hour period.

g) If a bulk tank is used it must be equipped with an online level indicator or instrument and an easily readable graduated volume scale to reduce the risk of overfilling. When fluorosilicic acid is used the tank level must be displayed at the delivery connection point for the bulk tanker supplier.

h) Fluoride dosing must be flow-paced based on the measured water flow into which the fluoride is being dosed. Typically dosing will be achieved through use of a suitable flow meter and variable speed metering pumps. A secondary flow-based control device (for example, a flow meter or flow sensing device such as a flow switch) should be provided as backup to the main flow meter (i.e. in series).

i) The maximum physical dosing capacity of the fluoridation chemical feeding equipment must be limited by design to a maximum value that is as close as practicable to the operating target dose rate at the maximum water flow rate. This maximum value should not exceed 110 per cent of the operating target dose rate at the maximum plant capacity. For metering pumps which have a manual stroke adjustment, the component of the dosing flow that is able to be changed by manual adjustment of the stroke is excluded from this requirement, as long as the stroke adjustment is locked in position and its maximum operating position is clearly marked.

j) The drinking-water supplier must ensure that upon failure of the control system, treated water exceeding the emergency process limit in Table 2 does not enter the drinking-water supply system. This fail safe system would include metering pumps stopping and supply valves closing.

k) Metering pumps should be in a duty/standby arrangement. A duty/assist arrangement is acceptable, however the additional risk of control malfunctions should be considered.

This is not an all-inclusive list and further functionality requirements may be identified in the HAZOP and/or the safety-in-design phases. Alternatives to any of the requirements above may be used, as long as an equivalent level of safety, control and risk minimisation can be demonstrated as part of the peer review of the design.

4.1.6 Dose monitoring

To minimise the risk of overdosing of fluoride, a number of Independent Checks are required. For water supply systems that serve more than 10,000 people, at least two of the three following Independent Checks must be used. If the water supply system serves 10,000 or fewer people, then at least one of the three Independent Checks is required.

The checks are listed below:

Independent Check 1: Use of a day tank that can only be filled once a day and is equipped with an online device to measure its contents

Day tanks are commonly used with fluorosilicic acid fluoridation plants and can be used for sodium fluoride or sodium fluorosilicate. A day tank acts as a physical barrier that minimises the risk of large quantities of chemicals from the bulk storage tank (or if using powders, from the saturator or mixing tank) being added into the water supply in error.

To meet the requirements of Independent Check 1, the day tank must be fitted with an online device to measure its contents. This measurement device can be either a load cell or a level sensor:

- Level sensors measure and display the liquid level in the tank and generate alarms where operating parameters are exceeded. The accuracy of the sensors must be within ±1 per cent over the full range of the operational capability.
- Load cells measure and display the loss of mass in the tank and generate alarms where operating parameters are exceeded. The accuracy of the load cells must be within ± 1 per cent of the range being measured. Load cells are recommended (but not required) for measuring mass loss in the day tank as they are more reliable than level sensors.

Both level sensors and load cells can be used together to provide a higher degree of assurance but this is not a requirement.

Daily changes in the volume/mass of fluoride chemical consumed in the process must be recorded and used as an additional check.

Arrangements for the transfer of the fluoridation chemical from the bulk tank (or saturator or mixing tank) to the day tank must meet the following basic principles:

a) Transfer should occur through controlled pumping. Gravity transfer should be prevented by appropriate design (for example, an anti-siphon loop).
b) All equipment, pumps and day storage facilities should be located within a bunded area and chemical spillage must be captured in a safe manner. The bund volume must be in accordance with the *Code of Practice HSNOCOP 47 Secondary Containment Systems*.

c) The day tank must be sized for a maximum of 110% of the volume required for the maximum capacity and target dose rate. The day tank must not be filled more than once in any 24-hour period.

If using fluorosilicic acid, the day tank must be vented to the outside atmosphere and all connections sealed to prevent corrosion of the equipment in the room, or ‘clouding’ of any windows and damage to any electrical panels. A water trap should be provided on the tank overflow. The building should also include appropriate levels of ventilation.

Independent Check 2: Use of a fluoride measuring flow meter on the fluoride dosing line before the dosing point (only for (a) fluorosilicic acid, or (b) sodium fluoride from a saturator)

A flow meter before the dosing point is used to measure the amount of fluoride being added to the drinking-water. This flow meter must be linked to an appropriate alarm monitoring system and an automatic fluoridation plant shut down. These measurements must be compared with the operational target as an independent check of the quantity of fluoride dosed.

The dose flow meter must not be used as part of a feedback control to alter the dose rate. The flow meter's purpose is for alarming only and deviations from the expected dose flow should alert the operator so that they can determine the appropriate action.

The flow meter should measure the rate of flow and the SCADA must record the rate and total volume of flow. An electromagnetic flow meter should be used to achieve an accuracy of ±1-2%.

Independent Check 3: Fluoride concentration analyser on the drinking-water line after dosing point

A fluoride ion analyser is used after the dosing point to measure the concentration of fluoride in the final treated water. The sample point supplying the analyser must be located such that the measurement reflects the real-time dosing performance of the fluoridation plant. To achieve this requirement:

- The sampling point must be located such that adequate mixing has taken place before the sampling point
- The time taken for the sample to travel from the sampling point to the instrument should be kept to a minimum
- The sampling point must be before the first draw off for a consumer, and should be located upstream of the clear (or treated) water storage or, if downstream, at such a location that the measurement reflects the real-time dosing performance of the fluoridation plant.

The fluoride ion analyser should use the ion-selective electrode (ISE) analysis method or an alternative method that has been proven to be just as accurate. Accuracy to at least ± 0.15 mg/L should be achieved by a properly calibrated and well-maintained instrument in a production environment.

Interferences in the measurement using ion selective electrodes should be considered. Interferences are typically not an issue if the water has:

- Consistently low aluminium and iron levels (i.e. consistently below the aesthetic guidelines values in DWSNZ – 0.1 mg/L for aluminium and 0.2 mg/L for iron), and

- A relatively stable pH that is between 5.5 and 8.5.

If the water to be sampled falls outside this range a Total Ionic Strength Adjustment Buffer (TISAB) should be used, with the instrument able to alarm on exhaustion of the buffer.

All ISE analyses, including online ISE analyses, should be performed at a constant temperature, or results corrected for temperature, as ISE measurements are water temperature dependent.

Grab samples should be analysed at least weekly to check the calibration of the on-line analyser and the procedures in DWSNZ Appendix A2 (section A2.1) followed as if the testing is required for compliance. The samples should be analysed using a bench-top analyser (the ISE method, SPADNS method[3], the ion chromatography method, or other validated test method can be used for this purpose) and the results compared with those from the online analyser to ensure the accuracy of the online analyser.

In terms of DWSNZ, the drinking-water supplier must ensure the fluoride level in the treated water leaving the plant is analysed once a week (refer 5.1.3), by a laboratory recognised by the Ministry of Health.

Those undertaking fluoride analysis must be certified as competent analysts as if the analysis is required for compliance (refer section 3.1.1 of DWSNZ).

The analytical method used for both on-line and bench-top analysers must conform to (or be validated against) the reference methods in DWSNZ or the latest edition of *Standard Methods for the Examination of Water and Wastewater*.

4.1.7 Other design considerations

a) *Water service off-takes*

No drinking-water service within the plant or to consumers must be taken directly off the water line to which fluoride is dosed. This will provide additional

[3] The SPADNS (Sodium 2-(parasulfophenylazo)1,8-dihydroxy-3,6-naphthalene disulfonate) method is a colourimetric method for determining fluoride concentration in water. Fluoride ions react with the zirconium-SPADNS dye lake resulting in a loss of colour. The residual colour of the dye is then measured at 570 nm in a spectrophotometer. The concentration of the fluoride ion is inversely proportional to the intensity of the colour. This method is suitable for fluoride ion analysis in on-site laboratories.

time and volume for a high concentration of fluoride to be diluted if it has been increased above the upper action process limit.

b) *Anti-siphonage, back-flow protection and pressure relief*

The dosing system must be fitted with anti-siphon and pressure-relief valves (refer 4.4.3).

Any water supply used for dissolving the fluoridating agent or as carry water must have a backflow prevention device fitted upstream of where the fluoridating agent is dissolved or diluted (such as mixing tanks), or injected (such as metering pumps). In some situations backflow prevention may be achieved simply through using an air gap. Any backflow device must comply with the current New Zealand standards and with the Boundary Backflow Prevention for Drinking Water Supplies Code of Practice, June 2013.

c) *Control equipment*

It must be physically impossible for any component of the fluoridation feeding or control equipment to be manually plugged into standard electrical outlets for continuous operation if isolation of the power supply is used for the stop/start control of the dosing equipment. Any manual mode (or 'test') switch for the fluoridation chemical feeding equipment should not permit permanent selection (such as spring-loaded switches) and should return to the off position when released to prevent unattended manual operation.

All key components of the fluoride dosing control system must be interlocked to ensure total fluoride dosing system shutdown in the event of failure of any individual equipment item and to ensure that the dosing system cannot operate unless water is flowing. These key components should include, but are not limited to:

- Stop/start/pacing signals;
- Feeders;
- Metering pumps;
- Solution transfer pumps;
- Solution tank levels or weight;
- Dilution water pumps; and
- An online monitoring system.

Refer to Section 4.1.6 for the key overdosing controls.

An assessment of the possible causes of overdosing must be conducted during plant design and, where appropriate, interlocks and alarms designed into the system to prevent overdosing of fluoride.

d) *Corrosion and dust suppression*

Corrosion prevention measures should be implemented for all fluoridation plants.

Dust control measures should be implemented where sodium fluoride and sodium fluorosilicate are the agents used.

These measures will help protect the equipment, the operational staff and the neighbours surrounding the plant.

4.2 Equipment

All equipment used for adding fluoride to a drinking-water supply is required to operate in a safe, reliable and precise manner.

The drinking-water supplier must ensure that the equipment and associated controls have safety measures against over dosing and under dosing of chemical through human or operational malfunctions and that the equipment is safe to operate and maintain.

4.3 Chemical Delivery, Handling and Storage

The delivery, handling and storage of chemicals must be in accordance with occupational health and safety and environment protection requirements (including HSNO) to ensure the safety of staff, the community, the environment and the drinking-water supply.

4.3.1 Chemical delivery and quality assurance

Fluoride supply should be in accordance with the Water New Zealand, Good Practice Guide: *Supply of Fluoride for Use in Water Treatment 2014*.

The drinking-water supplier should ensure that the chemical supplier has a quality assurance system for the supply and delivery of the fluoridating agent to ensure its chemical purity, safe delivery and use. The quality assurance system should be implemented to manage all the factors associated with the specification, contract management, supply (including transportation), purity, storage, use and handling of fluoride compounds that could adversely impact upon the health and safety of staff, contractors and consumers. This quality assurance system should be included as part of the Water Safety Plan.

4.3.2 Bulk chemical storage

The drinking-water supplier should ensure that there is sufficient chemical available and readily accessible to ensure continuity of water fluoridation. The drinking-water supplier should document its assessment of storage requirements (taking into consideration availability of the fluoridating agent, transport, procurement strategies and itinerant populations).

Design of the bulk chemical storage should take into consideration:

a) Material selection (fit for purpose)
b) Safety in design for access, operation and maintenance ensuring compliance with relevant codes, guidelines and regulations
c) Separate chemical storage where required by the *Code of Practice HSNOCOP 47 Secondary Containment Systems*
d) Chemical storage bunding requirements as per the *Code of Practice HSNOCOP 47 Secondary Containment Systems*
e) Handling equipment for dry fluoride must be suited to the form and unit size of the delivered chemical
f) Spill removal and clean-up procedures
g) Ventilation and dust extraction as appropriate for the selected chemical
h) Measures to prevent corrosion (such as sealing all connections, water traps and ventilation)

i) Weather protection as appropriate
j) Controls and instrumentation including alarms, and visual display of tank contents
k) Security from unauthorised personnel (access control methods should be addressed as part of the HAZOP)
l) Safety and compliance of the chemical delivery area

4.3.3 Bag loaders/Vacuum Loading Systems

Where a dry fluoridating agent is used, the design of the plant should minimise airborne dust and the need for manual handling. Where manual handling is necessary, it should be in accordance with the *Code of Practice for Manual Handling* and the *Health and Safety at Work 2014*[4].

4.4 Chemical Mixing and Dosing

4.4.1 Mixers

Fluoride solutions should be homogeneous, irrespective of preparation method. Mechanical mixers should be used for the preparation of sodium fluorosilicate solutions.

4.4.2 Softeners

If using sodium fluoride, the fluoridation plant should include a water softener where the total hardness[5] of the water used for dissolving sodium fluoride chemical exceeds 75 mg/L as calcium carbonate. This requirement applies only to the water used to make up the fluoride solution in the mixing tanks and not to the main water supply being treated.

4.4.3 Metering pumps

Metering pumps must be able to accurately deliver the required flow rate, and be sized to operate at maximum output during the maximum flow that the treatment plant is designed to operate at. A safe method for calibrating dose rates must be available and maintained to ensure that the metering pumps are providing an accurate flow rate.

Any risk of gravity flow or siphoning of the fluoride chemical through the metering pump must be prevented. Siphoning can be prevented through use of an anti-siphonage trap, air gap or similar. A loading valve (or alternative such as an air break) on the delivery side of the pump shall be provided if gravity flow from the metering pump is possible.

Pressure relief on the delivery side of the pump or built into the metering pump must be provided. The pressure relieved at this point must be directed safely (e.g. back to the tank or bund).

When located within any bunded area, the transfer pump and metering pumps should be positioned above the maximum spillage level of the storage tank.

[4] Expected to replace the Health and Safety in Employment Act (1992).

[5] If water harder than 75 mg/L as $CaCO_3$ is used for dissolving the sodium fluoride in a saturator (i.e. producing a 4% w/w concentration fluoride solution), this will lead to excessive precipitation of calcium fluoride and magnesium fluoride from the fluoride solution.

4.4.4 Dry feeder systems

Dry feeder systems must meet the following requirements:

- Ensure accurate delivery of the required volume or weight of fluoridation chemical for the quantity of water being treated and must be sized for the maximum flow of the treatment plant
- The dry feeder, tank solution level, mixer, and metering pump must be controlled to meet the functionality requirements of Section 4.1.5
- Include a dust extraction system as specified in Section 4.3.3

4.4.5 Injection point

The location and detailing of the chemical injection point must:

a) Provide homogenous mixing (minimum coefficient of variance of 0.95) of the chemical in the treated water (where necessary mixing devices should be used) before the first take off or sampling point
b) Minimise loss of fluoride by precipitation with other chemicals (such as those containing calcium, aluminium and magnesium) or treatment processes (such as coagulation, filtration and pH correction), by dosing the fluoride following filtration and as far away as practicable after final pH correction if using lime
c) Minimise the possibility of siphonage and overfeeding
d) Include provision of a sampling point following mixing
e) Be located upstream of buffer storage of treated water
f) Not allow any bypass or secondary pipework (or channel) into which the fluoride chemical will not be dosed (except for fire-fighting purposes or other non-potable water).
g) Consider the impact of any recycle flow streams to avoid "double dosing".

4.5 Process Control and Instrumentation

Dosing fluoride into drinking-water is a continuous process with the objective of providing a lifetime exposure to fluoride for most consumers. It is therefore essential that the drinking-water supplier has a validated and verified system of accurately controlling fluoride dosing in place at all times.

As described in Section 4.1.6, two Independent Checks are required for plants that supply more than 10,000 people, and one Independent check is required when 10,000 people or fewer will be served. This is a minimum requirement for drinking-water suppliers for compliance with this Code. Those suppliers serving 10,000 people or fewer should consider the use of two Independent Checks.

In addition to the one or two Independent Checks, the following instrumentation must be provided:

a) Flow meter on the process stream into which fluoride is being dosed
b) Level, pressure or weight indicators on bulk tank
c) Alarm system to notify dosing abnormalities, particularly during unsupervised and after-hours periods

The following instrumentation is not a requirement for compliance with this Code but may be used to improve control of the system:

a) Reference bench-top fluoride analyser to verify the performance of the online unit required by Independent Check 3

b) Both a load cell and level sensor on the day tank (only one is required for Independent Check 1).

All online instruments must be calibrated in accordance the manufacturer’s recommendations as to method and frequency.

4.5.1 Flow measurement

A flow meter must be provided to measure and communicate the water flow, and to pace the fluoride dosing equipment over the full water flow rate range. The metered flow must be truly representative of the flow into which the fluoride is dosed.

The flow rate signal must be fed back from the meter to the fluoride dosing system to enable automatic adjustment of the fluoride dose rate. Use of electromagnetic flow meter or similar with an accuracy of ± 1 per cent over the complete range of flow is recommended. The accuracy must not exceed ± 3 per cent. The flow meter must be installed in accordance with the manufacturer's recommendations (particularly in relation to the length of straight pipe upstream and downstream of the meter).

4.5.2 Control and alarms

The fluoridation plant must generate alarms and respond to the fluoride action limits as specified in Table 2.

All dosing systems must be configured so as to be ‘fail safe’, that is, failure of a critical component automatically leads to the cessation of dosing and generation of an alarm. If it is not possible for the unit to fail safe, the PLC must be configured to ensure that fluoride will not be added to the water supply if a failure occurs. Loss of water to the online fluoride analyser must also generate an alarm.

All alarms, including fluoride concentration alarms, where online instrumentation is installed must inform a resource capable of immediate response even after hours. Where dosing is stopped during automatic operation that is outside of the normal operating parameters of the plant (either manually or by shutdown alarms), dosing must not restart automatically without manual on-site intervention.

Where automatic shutdown systems can be manually overridden (such as for maintenance purposes) any override events must be logged and the override facility configured such that the operator is aware that an override is activated (such as by the activation of a local or telemetry alarm).

The operation of shutdown systems must be fully tested at least annually and the outcome of these tests recorded. The testing procedure must be developed as part of the risk management planning as described in Section 3.2.

The fluoridation plant must generate alarms and respond to the fluoride action limits as specified in Table 2.

4.6 Plant Security

The drinking-water supplier must control access to the fluoridation plant to prevent unauthorised access which will minimise the risk of anyone being injured. Appropriate signage must be provided to indicate the presence of the fluoridating agent, any electrical or OHS hazard, and any required personal protective clothing or equipment, and that authorised entry only is permitted.

Access to the fluoridation plant should be restricted to authorised personnel through provision of a security locking system.

5 Operation and Maintenance

All plant and equipment used for adding fluoride to a drinking-water supply must operate in a safe, reliable and precise manner. The drinking-water supplier must ensure that the plant and equipment is well maintained.

5.1 Operational Monitoring and Verification Monitoring

5.1.1 **Monitoring of fluoride concentration in the raw water**

The fluoride concentration in the raw water should be analysed at least annually, but preferably biannually in summer and in winter. Prior to design, more frequent monitoring is suggested. The sample must be analysed for fluoride at a Ministry of Health recognised laboratory (which will be IANZ accredited). The analysis must be done using the same method as described in Section 4.1.6 for testing the fluoride concentration in drinking-water for Independent Check 3. The raw water fluoride concentration must be taken into account when designing and operating the fluoridation plant.

5.1.2 **Quantity of fluoride dosed**

Every 24 hours the mass of fluoride consumed by the plant (determined from the gross quantity of chemical used) must be calculated and divided by the volume of water that has passed the fluoride dosing point. This is another check of the average concentration dosed over each 24-hour period. Any inconsistencies must be investigated and remedial actions taken to bring the actual dose within the operating dose range (refer to Section 4.1.4).

5.1.3 **Monitoring of the treated water**

DWSNZ requires that the drinking-water leaving the treatment plant is tested for fluoride with a weekly sampling frequency at minimum. DWSNZ specifies that there cannot be more than 13 days between samples. Alternatively, fluoride sampling may be carried out in the distribution zone.

The sampling programme must be integrated into the Water Safety Plan under the DWSNZ for the drinking-water supplier and for any downstream water supplier receiving fluoridated water from the drinking-water supplier.

The drinking-water supplier must have a procedure to investigate and rectify 0.15 mg/L or more discrepancies between the monitoring results and the fluoride concentration as determined from the quantity of fluoride dosed and the Independent Checks.

5.2 Quality Assurance

The quality assurance system must ensure the fluoridation process is adequately monitored and maintained such that any discrepancy, equipment reliability issue or unacceptable variability in the final fluoride concentration is readily identified and effectively rectified.

The drinking-water supplier must also include the details of the quality assurance (QA) and quality control (QC) framework that will be implemented to verify the accuracy of the fluoride testing results, and the corrective actions and process by which operators will be informed in the event the fluoride dosing system is either under dosing or over dosing.

The QC framework must comprise activities (checks) designed to ensure:

- data integrity (consistency and accuracy)
- use of standardised procedures for sampling, analysis and data interpretation
- identification of errors or omissions, and estimation of uncertainties
- calibration of equipment
- credible results that relate to the data and analysis.

The drinking-water supplier must ensure that the Operations & Maintenance Manual (described in Section 6.3) is a controlled document with defined procedures/processes for amendment.

5.3 Maintenance and Calibration

The drinking-water supplier should carry out monthly plant inspections at a minimum and record in writing the outcome of the inspections and any resultant actions. In some instances, the HAZOP may determine that a more rigorous plant inspection regime is required. Plant inspections will help ensure effective process control, determine whether equipment is operating normally and identify the need for maintenance.

All equipment and instruments considered vital for process control must be maintained and calibrated regularly according to maintenance and calibration schedules documented or referenced to in the Operation & Maintenance Manual (see Section 6.3). Performance of metering pumps should be calibrated at least monthly by measuring the volume of solution pumped during a measured time interval.

Upon request, the drinking-water supplier must provide the DWA with evidence of maintenance and calibration of all plant items and equipment.

5.4 Operational Personnel

The drinking-water supplier must ensure that operational personnel (employees or contractors) are appropriately skilled and trained in the management and operation of the fluoridation plant, and that these competencies are maintained (and that this is documented in the Water Safety Plan). Operational personnel must have an adequate knowledge of the principles of fluoridation (including the risks), the type of plant or equipment and its operation and maintenance.

A National Certificate in Water Treatment (Site Operator) - Level 4 (or equivalent), or preferably a National Diploma in Drinking Water - Water Treatment (Site Technician) - Level 5 (or equivalent) is recommended as a minimum qualification for operators of fluoridation plants.

Operational personnel must have a sound knowledge base from which to make effective operational decisions. This requires training in the methods and skills required to perform tasks efficiently and competently. Operational personnel should be aware of the potential consequences of system failures, and how decisions made can affect the safety of the scheme.

5.5 Occupational Health and Safety

In the area of safety, and the handling and storage of dangerous goods, the *Health and Safety at Work Act 2014,* Hazardous Substance and New Organisms Act 1996 and associated regulations have precedence over this Code. If clarification is required in these areas then WorkSafe New Zealand will provide the defining interpretation.

The health and safety measures discussed below provide a basis for a drinking-water supplier to assess the control measures it should employ to manage occupational and safety risks associated with fluoridation systems. The control measures listed are not exhaustive and the use of these control measures (set out below) in no way ensures that compliance with the above mentioned Acts and Regulations is achieved.

Health and safety measures for consideration in the design and operation of a fluoridation plant include:

a) Safety in Design to ensure a safe working environment and facilitate safe working practices
b) Effective control measures are applied to mitigate risks as identified by the risk assessment
c) Adequate training for plant operators about the specific hazards associated with the fluoridating agent
d) Accessibility of the Material Safety Data Sheet (MSDS) for the fluoride chemical by maintaining the current MSDS in the Operation & Maintenance Manual, and providing a copy close to where the substance is used to enable reference to it by operators who handle the substance
e) Pipework and tanks used for storage and distribution of fluoride chemicals comply with the relevant standards and are appropriately distinguishable (for example, colour coded and labelled) from other plant pipework
f) The installation and arrangement of the equipment to ensure that the handling and operation of the equipment meet workplace health and safety requirements
g) Fluoridation equipment should be kept in a room or building separate from other water treatment plant equipment.
h) Electrical control panels for the fluoridation plant are protected and should be located outside the fluoridation room
i) The atmosphere of any areas where fluoridating agents are stored or used is safe for workers, and ventilation and dust extraction as appropriate is provided for the selected chemical
j) Appropriate personal protective equipment and hand washing facilities are

supplied and maintained by the drinking-water supplier at the fluoridation plant for mandatory operator use

k) Emergency eyewash/showers are available where fluoridating agents are stored and handled

l) Emergency skin treatment such as calcium gluconate gel or similar

5.6 Environmental Safety

The drinking-water supplier should ensure that the design and operation of the fluoridation plant does not result in environmental harm.
In its management of the fluoridation plant and ancillary equipment and activities, the drinking-water supplier must consider the Resource Management Act 1991 and relevant regional or unitary plans.

5.6.1 Spills and leaks

The drinking-water supplier must ensure the fluoridation plant and equipment is designed and operated to minimise the risk of fluoridating agent spills or leaks. Any spills or leaks must be contained and must not come into contact with or be stored with incompatible chemicals.

Where fluorosilicic acid is used then appropriately sized bunding with chemical resistant lining and other measures (such as drip trays) must be provided to contain any spillage. The design of bunding must facilitate the safe removal of any spillage, and be consistent with the Code of Practice HSNOCOP 47 Secondary Containment Systems and other relevant New Zealand standards. In designing the fluoridation plant, the inclusion of all components containing fluorosilicic acid (including the chemical feeding equipment) in the storage bund area should be considered as an effective way of reducing environmental risks.

Operating procedures must include measures for managing spills and leaks of the fluoridating agent, including in-built detection devices, surveillance, corrective actions and remedial works, and notification and reporting to the appropriate authorities. Fluoride piping should be visible so that it can be easily inspected for integrity. Where pipes are not visible, leak detection measures should be in place.

5.6.2 Release to the atmosphere

Where dry fluoridating agents are used, measures must be implemented to control dust. This includes designing the plant to prevent the escape of powder into the fluoridation room and atmospheric discharges.

Dry sweeping of dry fluoride chemical should not occur. If powder is spilt then it should be cleaned by vacuuming that is fitted with a HEPA filter to prevent dust. Operators must use personal protective equipment and this should be dictated in the Operation and Maintenance Manual.

5.6.3 Waste disposal

The management or the disposal of waste containing fluoride must be in accordance with the Hazardous Substance and New Organisms (HSNO) Act 1996. Wastes include fluoride chemical and plant and equipment that have been in direct contact with fluoride chemical.

The drinking-water supplier must document and implement an environmental waste disposal plan for fluoridating agent spills and leaks, contaminated fluoridating agent and fluoridating agent containers.

6 Documentation

6.1 Design Report

Water suppliers should document the design of new and upgrading of existing fluoridation facilities in a Design Report, which should include:

- The name of the drinking-water supply proposed to be supplied, including the WINZ identification numbers
- Plans and specifications including:
    - General description of facility and process including an outline of the overall treatment process, description of fluoridation facility, and the design capacity of the plant, expected minimum and maximum flows in normal operations and the expected growth of flows with time
    - A process and instrumentation diagram showing all key items by appropriate symbol
    - A location map, a site plan, and a 'general arrangement' showing the fluoridation facility in the context of the overall treatment plant
    - Evidence of the chemical selection process, natural fluoride content, optimum fluoride level and the dosage concentration
    - Fluoride design control limits, maximum pumping rate, feed rate and dosage calculations
    - Functionality of the fluoridation plant including details of intended process control, process and instrumentation (including process and instrumentation design), control philosophy for the proposed facility and integration into overall treatment process
    - Risk assessment as per Sections 3, 4.1.2, and 4.3.1, including the fluoridating agent selection process, quality assurance processes, supply and delivery risks, storage risks and the prevention or control of dosing risks associated with human error, plant malfunction and plant performance
    - Supplier of the selected fluoridating agent and that supply is in accordance with the Water New Zealand, Good Practice Guide: Supply of Fluoride for Use in Water Treatment.
    - Plans showing the spatial relationship (including levels) between the storage and metering facility and the dosing point, the relationship between the dosing points for fluoride and for any other chemicals added 'post treatment', and the pipeline layout from the dosing point downstream to the next component in the plant such as the clear water storage
    - Measurement of fluoride ion concentration in the treated water, monitoring programme and quality assurance
- A gap analysis against this Code providing justification for any deviations from the requirements of this Code and demonstrating an equivalent or greater level of safety
- Project plan including timelines
- Commissioning plan

Documentation of the fluoridation plant design should be incorporated in the drinking-water supplier's quality management system. Plant operational staff must be sufficiently trained so that they have knowledge of the location of these documents and are familiar with their content before commissioning. Operators that were absent from this training must be trained once the plant has been commissioned.

6.2 Completion of Work

Upon completion of plant construction and commissioning, the drinking-water supplier should maintain the following documentation:

- Operation & Maintenance Manual (refer section 6.3.)
- Emergency Management Plan (refer section 6.4)
- Commissioning records verifying that the fluoridation plant installation is in accordance with the plans and specifications and its operation is safe and reliable

6.3 Operation and Maintenance Manual

The Operation & Maintenance Manual must contain sufficient information to facilitate the operation and maintenance of the fluoridation plant by the operational staff. At minimum it must include:

- Standard operating procedures for the plant
- Maintenance and calibration schedules for items of equipment and instrumentation
- As-constructed drawings, equipment manuals, and functional description

The Operation & Maintenance Manual should be a controlled document which must be integrated into the drinking-water supplier's quality management system.

6.4 Emergency Management Plan

The drinking-water supplier must develop and implement an Emergency Management Plan to manage incidents and emergencies, including fluoride overdosing, spills entering the environment and operator exposure.

The Emergency Management Plan must address how the system will be managed to prevent any duration of fluoride concentrations over 1.5 mg/L (the MAV) reaching consumers.

An Emergency Management Plan must address:

- Procedures for shutting down the equipment in the event of overdosing
- The actions required to identify and rectify the problem
- Action required to advise and protect the public in the event of a significant overdosing event
- Reporting protocols including a clear chain of command and designated responsibility.

The Emergency Management Plan must be integrated into the Water Safety Plan or reference within it.

6.5 Record Keeping

The drinking-water supplier should keep records verifying that the fluoride plant is managed and operated in accordance with this Code, and with DWSNZ and section 69ZD of the Health Act. The records must be maintained and made available for inspection upon request by the DWA. Records include:

- Regular chemical analysis of fluoridating agent delivered
- Regular analysis of concentration of fluoride in raw water
- Plant and equipment calibration certifications and maintenance data
- Routine testing of critical alarms and corrective actions and outcomes of the system shutdown tests
- Surveillance monitoring and audits records
- Staff training records

The drinking-water supplier must, at a minimum, also record the following parameters at the frequencies indicated:

a) Continuously (minimum 5 minute interval records) as required by DWSNZ
   - Water flow
   - Online fluoride concentration (if Independent Check 3 is used)
   - Fluoride solution flow

b) Daily
   - The volume of water treated
   - The quantity of fluoride added to the water
   - The level or weight of the day tank prior to and after refilling or the volume of fluoride solution used (if a level sensor or load cell is fitted to the day tank for Independent Check 1)
   - The stock of fluoride on hand
   - The results of fluoride analysis of the samples of water taken from the treated water at the intervals required
   - Average fluoride concentration each day on the basis of the online analyser records (if Independent Check 3 is used)
   - Average fluoride concentration each day on the basis of the loss of mass or volume in the day tank (if using Independent Check 1)
   - A reconciliation of each of the Independent Checks

c) Weekly
   - Results from weekly sampling for fluoride content in the treated water

7 Reporting and Auditing

7.1 Annual Reporting

Water suppliers should provide the DWA with a report each year of their fluoridation systems. The annual report should include information required to demonstrate that the fluoride P2 compliance criteria within the DWSNZ has been achieved for the July - June period, and:

- The annual average, minimum and maximum fluoride concentration at each fluoridation plant
- The annual average, minimum and maximum fluoride concentration from the weekly samples in the water sampling localities, including a summary of any missed samples
- A summary of incidents and emergencies that were reported during the year
- A summary of the fluoridation process and chemicals used at each fluoridation plant (including any fluoridation plants operated by others that feed into that water supply being reported on)

7.2 Notification Requirements

The DWA must be notified of emergency and exceptional situations as described in Table 3. If the fluoride concentration in the drinking-water is less than the lower action process limit for a continuous period of >72 hours, it is not mandatory that the DWA be notified but it is encouraged.

7.3 Auditing

The drinking-water supplier's water fluoridation activities should be integrated into the Water Safety Plan.

Table 3: Emergency and exceptional notifications

Emergency and exceptional situation	**Method of notification**
Fluoride concentration in drinking-water supplied in a water sampling locality exceeds or may exceed 1.5 mg/L.	Notify the DWA Immediately, investigate the cause of the exceedance and take appropriate action. See DWSNZ for more information.
Fluoride concentration measured at the fluoridation plant exceeds 1.5 mg/L, however, does not enter the drinking-water supply.	This does not require a mandatory notification but the DWA should be notified. In addition, an internal investigation into the cause of the incident should be carried out and action should be undertaken and documented.
Fluoride concentration in drinking-water supplied is less than the lower action process limit for a continuous period of >72 hours.	This does not require a mandatory notification but the DWA should be notified.
If the rolling annual average fluoride concentration of drinking-water in a water supply has exceeded, or is expected to exceed, 1.0 mg/L in each quarterly compliance period.	The DWA should be notified.

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- http://www.health.qld.gov.au/ph/documents/ehu/fluoride_codepractice.pdf
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9 Further Information

To find out what New Zealand Health professionals think about fluoridation see:

- www.fluoridefacts.govt.nz
- For free download of the Water New Zealand guides see:
- www.waternz.org.nz and click on *publications*.
- See the website of your local District Health Board, or visit:
- Ministry of Health www.health.govt.nz and click on *Our Work* and then *Preventative Health/Wellness*
- Your local District Health Board's website
- New Zealand Dental Association www.nzda.org.nz
- New Zealand Medical Association www.nzma.org.nz
- National Fluoridation Information Service www.rph.org.nz

MINISTRY OF HEALTH
MANATŪ HAUORA

133 Molesworth Street
PO Box 5013
Wellington 6140
New Zealand
T+64 4 496 2000

22 June 2022

Sharon Mason
Chief Executive
Buller District Council
sharon.mason@bdc.govt.nz

Tēnā koe Ms Mason

Community water fluoridation next steps

Thank you for your response to my letter of 15 December 2021, providing information on the status of the fluoridation infrastructure in your area and the estimated costs and timeframes that would be necessary to fluoridate your drinking water supplies. This information has informed my decisions about which local authorities to consider first, in my decision-making about whether to issue directions to fluoridate.

I have now advised fourteen local authorities that I will soon decide whether to issue directions in relation to some of their drinking water supplies. In deciding which local authorities and water supplies to consider first, I took into account factors including local authority ability to implement fluoridation swiftly, and size and needs of populations served by the relevant water supplies.

Drinking water supplies controlled by your local authority are not included in the first set of potential directions to fluoridate. However, it is likely your situation will be considered in the coming months, and that a decision on whether to issue a direction to fluoridate your drinking water supplies will be made by the end of 2022. As I noted in my earlier letter, I am also mindful of current service delivery pressures across the water services and broader local government sector. In light of this, if I do issue directions for your water supplies, some of these may have compliance dates set for after July 2024 when the new water service entities are established as part of the Three Waters reforms.

When considering whether to issue any direction to fluoride, and as required under the new legislation, I will seek written comment from you on the estimated costs of fluoridation (including costs of ongoing monitoring and maintenance), and the date by which you could comply with a direction. I will also consider the scientific evidence on the effectiveness of fluoridation, and the oral health status, population size and estimated costs of fluoridation for the area served by each water supply.

Please note too that you do not need to wait for a potential direction from me to start fluoridating water supplies in your area. Community water fluoridation is widely recognised by national and international expert bodies to improve public health by substantially reducing rates of preventable tooth decay. Here in Aotearoa New Zealand we still have high rates of preventable tooth decay, particularly amongst Māori and Pacific people, and people living in deprived communities. Evidence shows that community water fluoridation both improves the oral health of everyone and also has a proportionately larger benefit for these groups.

Thank you for your co-operation as we work together to improve the oral health of the communities we each serve.

Nāku noa, nā

Dr Ashley Bloomfield
Te Tumu Whakarae mō te Hauora
Director-General of Health

11 November 2021

Tēnā koe

This letter is to update you on the Health (Fluoridation of Drinking Water) Amendment Bill (the Bill) and what it means for you.

As you may be aware, on Tuesday 9 November 2021, the Bill passed its final reading and will come into force 28 days after Royal assent. The new legislation amends the Health Act 1956 to give the Director-General of Health the power to issue a direction to local authority water suppliers (including bulk water suppliers) to fluoridate a public drinking water supply. The changes do not apply to private drinking water supplies.

Key content of the new legislation

Under the new legislation, when deciding whether to issue a direction to fluoridate, the Director-General of Health will be required to consider for each individual drinking water supply:

- the scientific evidence on the effectiveness of adding fluoride to drinking water in reducing the prevalence and severity of dental decay
- whether the benefits of adding fluoride to the drinking water outweigh the financial costs, taking into account:
  - the state or likely state of the oral health of the local community or population group associated with the water supply
  - the number of people who are reasonably likely to receive drinking water from the local authority supply
  - the likely financial costs and savings of adding fluoride to the drinking water, including any additional costs of ongoing management and monitoring.

Before issuing any direction to fluoridate, the Director-General of Health must seek written comment from the local authorities on the estimated cost of introducing community water fluoridation, and the date by which the local authority could comply.

The new legislation exempts you from any requirement to consult with your communities on the decision to fluoridate.

Further information on these changes and the obligations for local authorities is in the attached fact sheet.

Implementation

The Ministry of Health (the Ministry) intends to facilitate swift transition to the new fluoridation decision-making process, and anticipates that the Director-General of Health could commence issuing directions from mid-2022 onwards. Implementation will be phased over time and there will be some funding available to support local authorities with the costs of fluoridation-related capital works.

The Ministry is working through implementation details and expects to be able to provide further information to you in the next month.

The Ministry acknowledges the significance of the Government's Three Waters Reform programme on local authorities, including the recent announcement of the creation of the new water service entities. The Ministry of Health is working closely with the Department of Internal Affairs to ensure that implementation planning aligns with the reform programme and factors in current service delivery pressures across the water services sector.

Resources for your communities

You may receive queries from your communities about community water fluoridation now that the new legislation has been passed. We encourage you to refer members of the public or interested groups to the resources below. They reflect the position of the Ministry of Health, World Health Organization, and Centres for Disease Control and Prevention that community water fluoridation is a safe, effective and affordable public health measure to improve the oral health of communities.

https://www.fluoridefacts.govt.nz/

https://www.pmcsa.ac.nz/topics/fluoridation-an-update-on-evidence/

We look forward to working with you to implement these new changes that will have an important health impact on the communities you serve. We will be in touch again shortly.

Ngā mihi

Deborah Woodley
Deputy Director-General
Population Health and Prevention

Riana Clarke
National Clinical Director, Oral Health
Ministry of Health

cc: Regional Council Chief Executives

Jon Lamonte, Chief Executive, Watercare

Colin Crampton, Chief Executive, Wellington Water

Bill Bayfield, Chief Executive, Taumata Arowai

District Health Board Chief Executives

Public Health Unit Managers

Community water fluoridation

Only around half of all New Zealanders receive fluoridated drinking water. Until now, it's been up to local authorities (councils) to make decisions around fluoridating their water supplies. The Director-General of Health now has the authority to decide if community drinking water supplies should be fluoridated.

What is water fluoridation?

Fluoride already exists in water. Water fluoridation is when the natural level of fluoride in the water supply is topped up to between 0.7 ppm and 1.0 ppm. This is the ideal amount for giving protection against tooth decay. This is recommended by many national and international health bodies, including the World Health Organization.

The Ministry of Health recommends water fluoridation as a safe and effective way to prevent and reduce tooth decay for everyone. The levels of fluoride in water are carefully monitored.

Is it safe?

The role of fluoride in water has been examined around the world – including in New Zealand – over the last 60 years. There is strong evidence that there are no adverse effects of any significance from fluoridation at the levels used in New Zealand, and that it is beneficial to New Zealanders of all ages. This is especially true for our most vulnerable communities

Is it effective?

Fluoride in water like a constant repair kit. It neutralises the effect of acids that cause decay and helps to repair damage before it becomes permanent.

The most recent New Zealand Oral Health Survey (2009) shows that children and adolescents have 40 percent less tooth decay over their lifetime if they live in areas with fluoridated water.

The government estimates that introducing community water fluoridation to all public drinking water supplies would result in net savings of more than $600 million over 20 years - mostly to consumers, and some to government?

How will decisions about community water fluoridation be made?

The new legislation allows the Director-General to make decisions about fluoridating public water supplies only. They cannot direct the fluoridation of privately-owned water supplies.

Before issuing a direction to fluoridate a water supply, the Director-General must invite the affected local authority to give information in writing on the estimated cost and timing for introducing fluoridation.

The new legislation requires the Director-General of Health to consider the scientific evidence of the effectiveness of fluoridation in reducing dental decay, and whether the benefits outweigh the financial costs. They must consider the oral health status (or likely oral health status) of the local community, the size of the water supply and how much it's likely to cost to introduce fluoridation.

The Director-General of Health is required under the new legislation to seek advice from the Director of Public Health before issuing a direction. They may also consider other factors or views. The new legislation does not require local authorities to consult with their communities on decisions around fluoridating their water supplies.

Local authorities that are currently fluoridating drinking water supplies must continue to do so.

When will the Director-General of Health start issuing directions?

We expect the Director-General of Health could start issuing directions regarding some community water supplies from mid-2022. It is expected that implementation will be phased over time. The Ministry will be engaging further with local authorities about implementation in late 2021 and early 2022.

The Director-General of Health will ensure when providing a date by which the local authority must comply with a direction, that it is reasonably practical. In instances of non-compliance, the Director-General of Health may take action to hold local authorities to account. See sections 116I and 116J of the new legislation for more information.

Do local authorities need to wait for a direction to start fluoridating?

No. Local authorities may wish to consider whether to fluoridate water supplies in the absence of the Director-General of Health issuing directions.

Who will pay for fluoridation?

Some funding will be available to support local authorities with the capital costs of fluoridation. The operational costs of fluoridation will remain with local authorities.

Who will ensure my water is safe to drink?

Local authorities and water suppliers will still be responsible for providing safe drinking water to their communities and need to meet water safety regulations. Water suppliers are required to meet the Drinking water standards for New Zealand, which set maximum acceptable values for a range of substances and organisms, including for fluoride.

How does the new legislation support equity?

Some communities and population groups in Aotearoa have worse oral health outcomes than others. New Zealand still has high rates of preventable tooth decay, particularly among Māori and Pacific children and adults, and those in vulnerable communities.

The benefits of community water fluoridation are broadly spread, but are greater for Māori, Pacific and those living in deprived communities.

Extending community water fluoridation aligns with the Treaty of Waitangi principles of equity and active protection. Te Ao Mārama (the Māori Dental Association) and the Pasifika Dental Association support community water fluoridation.

Find out more

www.fluoridefacts.govt.nz | www.health.govt.nz/water-fluoridation

BULLER DISTRICT COUNCIL
Te Kaunihera O Kawatiri

WEST COAST NEW ZEALAND
UNTAMED NATURAL WILDERNESS

From:	BDC_Lgoima
To:	BDC_Lgoima
Subject:	FW: Meeting 30/11/22
Date:	Tuesday, 27 June 2023 11:45:19 am

From: Councillor Toni O'Keefe <Toni.O'Keefe@bdc.govt.nz>
Sent: Tuesday, November 29, 2022 10:05 AM
To: Mayor Jamie Cleine <jamie.cleine@bdc.govt.nz>
Subject: Re: Meeting 30/11/22

Thanks Jamie

Get Outlook for Android

From: Mayor Jamie Cleine <jamie.cleine@bdc.govt.nz>
Sent: Tuesday, November 29, 2022 10:00:23 AM
To: Councillor Toni O'Keefe <Toni.O'Keefe@bdc.govt.nz>
Subject: Re: Meeting 30/11/22

Hi Toni,

The figure represents capital cost for whatever equipment is needed to be added to existing plant. This is likely similar regardless of population it serves, just the larger unit would be dialled up a bit more (kind of).

Population may have an effect on the running costs, as presumably the chemical additives used will be proportionately higher in a larger water scheme.

Hope that answers your question.

Regards
Jamie

Jamie Cleine| Mayor
Mobile027 423 2629| Emailjamie.cleine@bdc.govt.nz

Buller District Council|Phone0800 807 239|www.bullerdc.govt.nz
PO Box 21 | Westport 7866

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On 29/11/2022, at 09:51, Councillor Toni O'Keefe <Toni.O'Keefe@bdc.govt.nz> wrote:

Hi Jamie, just a question on fluoride treatment cost for Westport & Reefton
Different population, but same exspence $250,000
See attached, cheers Toni

Toni O’Keefe | BDC Councillor Seddon Ward
Email : Toni.O’Keefe@bdc.govt.nz
Phone: 0273 671 315

Buller District Council | Phone 0800 807 239 | www.bullerdc.govt.nz
PO Box 21 | Westport 7866

MANATU HAUORA

Information about drinking water supplies for Buller District Council

Local Authority	Reticulated drinking water supply name	Water supply pop	Estimated number of months to fluoridate if a direction is given and funding available	Estimated capital works cost to fluoridate	Estimated ongoing mgmt. & monitoring costs	Additional comments
Buller District Council	Westport	4974	24	$250,000		
	[illegible]	[illegible]	24	[illegible]		

From:	Mayor Jamie Cleine
To:	Councillor Linda Webb
Subject:	Re: Meetings this week
Date:	Sunday, 11 December 2022 4:02:51 pm

Yes it is public.

Jamie Cleine| Mayor
Mobile027 423 2629| Emailjamie.cleine@bdc.govt.nz

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On 11/12/2022, at 15:58, Councillor Linda Webb <Linda.Webb@bdc.govt.nz> wrote:

Thanks Jamie,

Just a question, is the fluoridation workshop open to the public? I see there is a lot of public interest around this.

Ngā mihi nui,

Linda Webb | Councillor
Email Linda.Webb@bdc.govt.nz

Buller District Council | Phone 0800 807 239 | www.bullerdc.govt.nz
PO Box 21 | Westport 7866

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From: Mayor Jamie Cleine <jamie.cleine@bdc.govt.nz>
Sent: Sunday, December 11, 2022 2:14:49 PM

To: BDC Councillors <Councillors@bdc.govt.nz>
Cc: Rachel Townrow <Rachel.Townrow@bdc.govt.nz>
Subject: Meetings this week

Hi Councillors,

Just a quick reminder we have a big day on Wednesday with three meetings in your calendars. First is 9.00am Regulatory and Hearings Committee to hear verbal submissions on the Keeping of Animals Bylaw. This is followed by a workshop on the fluoridation requirements of BDC, the RAC meeting and finishes with Full Council.

I acknowledge this is a lot of reading at a busy time of year but please do your best to be prepared for Wednesday. As per usual, please ensure any questions or issues with the papers that require follow up prior to Wednesday are forwarded by COB Monday.
For the Regulatory and hearings agenda, these should should be via Chairperson Cr Graeme Neylon. For the other meetings these should be via Mayor.

Best Regards
Jamie

Jamie Cleine| Mayor
Mobile027 423 2629| Emailjamie.cleine@bdc.govt.nz

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PO Box 21 | Westport 7866

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From:	Georgia Wilkinson
To:	BDC Councillors+ICB
Subject:	Media releases x2
Date:	Monday, 12 December 2022 12:56:02 pm
Attachments:	image003.png 221212 - Media Release - Updates for Reeftons library service.pdf 221212 - Media Release - Fluoridation workshop.pdf

Kia ora koutou

Please find attached 2x media releases from today, for your information. The Reefton Library media release has been printed in this week's Clarion newsletter.

Cheers,

Georgia Wilkinson | Communications & Community Services Officer
Mobile 027 315 7021 | Email Georgia.Wilkinson@bdc.govt.nz

Buller District Council | Phone 0800 807 239 | www.bullerdc.govt.nz
PO Box 21 | Westport 7866

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BULLER DISTRICT COUNCIL

Media Release

12 December 2022

Council to hold a water fluoridation workshop

Councillors will come together on Wednesday to discuss potential fluoridation of the town water supplies in both Reefton and Westport.

Manatū Hauora (the Ministry of Health) wrote to Council in November 2022 asking for a comment on the estimated financial cost of adding fluoride to the drinking water, as well as the date by which Council would be able to comply with a direction to fluoridate.

Buller Mayor Jamie Cleine says: “Council will meet to have a thorough discussion around this health directive. We are aware adding fluoride to the water supply can be a controversial issue, however the decision-making on fluoridation has been taken out of Council’s hands and sits with the health authorities.

After the workshop, Council will formulate a reply for the Ministry of Health, which needs to be completed by early February.”

The public is welcome to attend the workshop on Wednesday 14 December starting 12.30pm at the Clocktower Chambers.

Background

In July this year, the Ministry of Health directed 14 local authorities around New Zealand to add fluoride to some or all of their water supplies. It is expected that local authorities who are directed to fluoridate will be invited to apply for funding for capital projects associated with this work. The letter to Buller District Council was part of a second wave of requests to 27 further local authorities in regard to this topic.

Around half of all New Zealanders currently are connected to water supplies that have fluoridated water.

The Health (Fluoridation of Drinking Water) Amendment Act 2021 shifted decision-making on fluoridation from local authorities to the Director-General of Health on the basis that it is a health-based decision.

-ENDS-

For more information contact:
Buller District Mayor
Jamie Cleine
jamie.cleine@bdc.govt.nz

From: [redacted]
To: Mayor Jamie Cleine
Cc: BDC Councillors; Rachel Townrow
Subject: Re: Fluoridation of Reefton.
Date: Monday, 12 December 2022 11:22:40 pm

Thank you for your response. *I will be up in the bush - no reception! I hope The session is recorded.*

On Mon, 12 Dec 2022 at 22:43, Mayor Jamie Cleine <jamie.cleine@bdc.govt.nz> wrote:

> Hi [redacted]
>
> Thanks for your email. These are all questions that can be discussed at BDC workshop on Wednesday. It is a public workshop and may be live-streamed or recorded. This is Councils response to the letter from Director General of Health that seeks a response from Council. The workshop is to aid understanding of the request and implications for Council and provide direction on Councils formal response to the DG of Health.
> I will share your email with elected members.
>
> Best Regards
> Jamie
>
> **Jamie Cleine**| Mayor
> Mobile027 423 2629| Emailjamie.cleine@bdc.govt.nz
>
> **Buller District Council**|Phone0800 807 239|www.bullerdc.govt.nz
> PO Box 21 | Westport 7866
>
> **Community Driven | One Team | Future Focused | Integrity | We Care**
>
>
>
> > On 12/12/2022, at 22:28, [redacted] wrote:
> >
> > Dear your honour,
> > As you might guess, I am equally sceptical about fluoridation of our water supply in Reefton, as I am about chlorine.
> >
> > 1. I saw something about fluoridation costing $200,000 or more per water supply, (which must be exaggerated, surely)?
> > 2. For that you could employ a lot of health educators

teaching children how to brush their teeth (as they successfully did in Scotland apparently - they got their perfect smiles at a fraction of the cost). And buy them all electric toothbrushes - only $35 each - as well.

3. How many kids do we have in Reefton - maybe 300 in the wider area?
4. Do we have to bankrupt our councils at the whim of some technocrat with a bee in their bonnet?
5. I understand the original studies were poorly carried out, a long time ago.
6. Are there any **recent quality studies** to support this draconian move? There should be.
7. You can duck behind the excuse that it is mandated, and you have no power to stop it. But you have a lot more power than we individuals (who voted for you), and enough questions from mayors could stimulate some questioning of this policy higher up.
8. I can't attend the meeting in Westport, but could we have access to the minutes?

Regards,
Dr [redacted] BVSc

From:	Mayor Jamie Cleine
To:	Lee Scanlon
Subject:	Friday Forum
Date:	Friday, 16 December 2022 10:10:44 am
Attachments:	Mayors Friday Forum 16 December 2022.docx

Hi Lee,

Attached is FF copy for you.

Have a great weekend.

Jamie Cleine| Mayor
Mobile027 423 2629| Emailjamie.cleine@bdc.govt.nz

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Mayors Friday Forum 16 December 2022

Monday I attended via zoom a quarterly catch-up with Mayors Taskforce for Jobs (MTFJ) head office, Ministry of Social Development Officials and a group of other Mayors to discuss the MTFJ Buller programme so far. This was an opportunity for Julie Moore and Ruby Erickson from our local team, to share ideas and feedback to the wider scheme members.
Tuesday I travelled through to Reefton to share a Xmas morning tea with our hard working staff. The team there have been busy merging the Library, Service Centre and I-site into one building. I travelled out to Ngakawau to meet community members to discuss reserve sub committees and understand concerns around management of the reserve.
Wednesday started early with my regular catch up on Coast Fm before starting a day of meetings at the Clock tower. Cr Neylon chaired the Regulatory Committee to hear submissions on the Keeping of Animals bylaw, deliberations have started and will resume in the New Year. Next we held an information workshop to bring Councillors up to date on the issue of Fluoride, which is now controlled by the Director General of Health. It is possible the DG of Health will require Council to fluoridate water in the future as has recently been required in other Districts. I chaired the Risk and Audit Committee with a focus on monitoring Risk this month as Council discussed and approved various updates to the Strategic Risk register. Final meeting of the day was Full Council where Councillors considered applications for the independent chairperson of Risk and Audit Committee. The appointment of local accountant Sharon Roche will ensure council continues to move towards best practice in line with advice of the Auditor General to have independent oversight of audit and risk.
Yesterday I attended the first Te tai Poutini Plan committee meeting for the triennium in Greymouth. I also had the pleasure of joining Westport Rotary as a guest speaker for their Christmas Dinner at Club Buller. I provided an update on the myriad of projects and funding currently in hand at BDC and thanked the members for the support they provide as volunteers in the community.
This morning I helped cook a Xmas breakfast for Council staff in the Brougham House garage. It was also brilliant to attend a blessing of the Buller Health Trust new build site and turn the first sod before SouthPeak homes begin site works on the new health centre next week.
Have a wonderful weekend…….Whew!

From:	Mira Schwill
To:	BDC Councillors+ICB
Subject:	Media Statement
Date:	Tuesday, 7 February 2023 11:18:28 am
Attachments:	image007.png image009.png Fluoridation BDC reply to Ministry of Health.pdf

Media Statement

7 February 2023

Council responses to Manatū Hauora (Ministry of Health) consideration to fluoridate water supplies in Buller

Buller District Council (BDC) has sent a letter to Manatū Hauora in response to a letter received in November last year, that Manatū Hauora is actively considering issuing a direction to fluoridate our water supplies for both Westport and Reefton.

Buller Mayor Jamie Cleine says: "We wanted to highlight some key issues like the increased overall cost of implementation, monitoring and management, and the fact that fluoridation is not included in our Long-Term Plan which raises the question how it will be funded.

"Also, we wanted to emphasise that the community has not been consulted on this issue and there are differing views within our communities regarding fluoridation, both for and against."

Council estimates an increase in overall costs of 23% to the figures provided in June last year including ongoing expenses for management and monitoring.

Council's response highlights the current pressure on the water service delivery and the government sectors. Council suggests considering a standardised approach to the fluoridation system across Entity D to manage this. Entity D will encompass the entire South Island as one of the new water services regions under the Three Waters Reform.

Buller Mayor Jamie Cleine says: "We are aware adding fluoride to the water supply can be a controversial issue. With this letter we wanted to bring in our local voice and knowledge into the discussion.

"However, the decision-making on fluoridation has been taken out of Council's hands and sits with the health authorities."

Background

In July this year, the Ministry of Health directed 14 local authorities around New Zealand to add fluoride to some or all of their water supplies. It is expected that local authorities who are directed to fluoridate will be invited to apply for funding for capital projects associated with this work. Buller District Council was part of a second wave of requests to 27 further local authorities in regard to this topic.

Manatū Hauora (the Ministry of Health) wrote to Council in November 2022 asking for a comment on the estimated financial cost of adding fluoride to the drinking water, as well as the date by which Council would be able to comply with a direction to fluoridate.

Councillors came together in December 2022 to discuss potential fluoridation of the town water supplies in both Reefton and Westport.

Around half of all New Zealanders currently are connected to water supplies that have fluoridated water.

The Health (Fluoridation of Drinking Water) Amendment Act 2021 shifted decision-making on fluoridation from local authorities to the Director-General of Health on the basis that it is a health-based decision.

ENDS-

For more information please contact:
Mayor Jamie Cleine
Jamie.cleine@bdc.govt.nz
Mira Schwill | Communications & Community Services Officer
DDI 03 788 9683 | Mobile 027 403 6609 | Email mira.schwill@bdc.govt.nz

Buller District Council | Phone 0800 807 239 | www.bullerdc.govt.nz
PO Box 21 | Westport 7866

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From: Krissy Trigg
To: Mayor Jamie Cleine
Subject: FW: Reefton Chlorination
Date: Tuesday, 4 April 2023 6:43:29 am
Attachments: image003.png
reefton-chlorination-faqs-3-april-2023.pdf
Additional Reefton FAQs for media responses.docx
ReeftonWaterDiagram (2).pdf
Reefton water chlorination community update letter FINAL.pdf

Good morning Jamie

As requested yesterday, please find the FAQs and additional information for your trip to Reefton today.

We also have them on our website https://bullerdc.govt.nz/your-council/key-projects/reefton-water-supply-upgrade/

Additional FAQs for media responses - back pocket (reactive rather than proactive)

The water diagram and the letter that was sent out.

Note copies of everything (other than the back pockets FAQs) have been given to the Service centre staff. You can refer people there if they want copies, or take copies of these with you to hand out if anyone wants them.

The letter drop is happening this week, the media releases have been timed for the last few days and everything has been timed back from when the live chlorination date is.

Sing out if you need anything further.
Amanda is working on the talking points for the meeting next week and I will send them through once finalised.

Thanks
Krissy

Krissy Trigg | Group Manager Community Services
DDI 037889679 | Mobile 0272133022 | Email krissy.trigg@bdc.govt.nz

Buller District Council | Phone 0800 807 239 | www.bullerdc.govt.nz
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Update #1 April 2023

BULLER DISTRICT COUNCIL
Te Kaunihera O Kawatiri

Community Update

Chlorination of Reefton's water supply

Kia ora koutou,

This update is to inform you that Buller District Council's project team is about to commence work on preparing the water supply system for the introduction of chlorine.

Dear resident,

We have put together this update to help the community understand the project steps and how you can communicate with council as we go along.

The Reefton Water Upgrade Project Team

What is happening?

The Reefton water supply is being prepared to be fully chlorinated by mid May to early June 2023.

This will involve about 6-8 weeks of preliminary work, starting in April 2023, which includes installing additional equipment at the water treatment plant. Water chlorination will affect all customers on the Reefton water supply. We will keep the community updated as we move through the different steps. Any changes to timeframes will be communicated to the Reefton community.

Why?

Under the Water Services Act 2021, passed in November 2021, all councils must provide residual disinfection (chlorine) for public drinking water supplies.

Chlorination has been used safely and effectively all over the world for around 120 years as a preventative treatment to avoid contamination of water supplies. It keeps millions of people all round the world safe from waterborne disease, including the majority of New Zealanders.

We want to make sure the water is always safe to drink for everyone in our community and avoid the need for boil water notices.

When is this happening?

Council is planning for chlorination to be in place by early June 2023. Preparing the Reefton water supply for chlorination will occur in four phases:

- **Flushing** – pushing water through the pipes to clear them of build-up of slime and any metal deposits that may exist. This happens regularly now but will increase prior to implementation.
- **Installation and commissioning** – installing and testing new equipment at the existing Water Treatment Plant.
- **Operations** – trialling the equipment for short periods of time to gauge its effectiveness and identify any issues.
- **Go live** – permanent chlorination of the Reefton water supply.

Reefton township
Photo by Buller District Council

What's happened previously?

You may remember that in 2020 we found bacteria in the water supply, and this resulted in a boil water notice. We investigated and found some issues at our reservoirs.

Buller District Council's Draft Annual Plan 2020/21 budgeted for the following improvements:

- the realignment and replacement of the rising and falling main (complete)
- securing the integrity of the treated water reservoir (complete).
- **the provision of residual disinfection (chlorination) (scheduled for May/June2023) .**

How can you find out more?

Community meeting 12 April 2023, 5.30pm

There will be a community meeting on Wednesday the 12 April 2023 at 5.30-7pm at the Reefton Cinema to discuss what this means for the community.

Members of the project team will be there to explain the process and the reasons for chlorinating Reefton's water supply.

It's important to note that chlorination is a legal requirement and no further consultation regarding whether or not to chlorinate will be undertaken.

Newsletter

A regular newsletter will be distributed via email, and for collection at the Reefton Visitor and Service Centre.

You can subscribe for the newsletter by signing up to Buller District Council's email list online by selecting Reefton.

Scan the QR code or go to **bullerdc.govt.nz/do-it-online/water-supply-update-sign-up/.**

Facebook

Updates on progress, timeframes and any other relevant information on the project will be posted on the Reefton Water Supply Upgrade Facebook page, with major updates on Buller District Council's Facebook page, and website **bullerdc.govt.nz**

Emails

If you want to contact the project team, please email **info@bdc.govt.nz** with the subject **Reefton chlorination**.

FAQ

Get started to find out more about what is happening by reading our frequently asked questions (FAQ).

How will Council chlorinate the Reefton water supply?

A new, automatic dosing system is being installed at the Reefton water treatment plant. The dosing system will provide a constant, low dose of chlorine into the water system that supplies Reefton with drinking water.

From the reservoir the chlorinated water flows through a network of pipes prior to reaching your tap. This provides plenty of time for the chlorine to kill any bacteria which may be in the water.

How will chlorination levels be monitored?

Reefton will have two chlorine monitors post-reservoir and one monitor at the treatment plant to optimise the chlorine dose and ensure the water is safe. This dosage may vary at specific times if it is needed to keep your drinking water safe.

How much chlorine is being added to my water?

The Drinking Water Rules require a minimum dose of 0.2 mg/L of chlorine in the water at the point of supply (toby). This ratio can vary based on the location within Reefton's water supply network.

Comprehensive FAQs are available on Buller District Council's website.

Go to bullerdc.govt.nz/your-council/key-projects/reefton-water-supply-upgrade/ or scan the QR code.

Reefton Visitor and Service Centre

Staff at the Reefton Visitor and Service centre will have copies of this letter, Frequently Asked Questions and newsletters as they are published.

Please remember they are there to help you access information.

Whatever your feelings about this project, please respect our staff when you interact with them.

FOR MORE INFORMATION

If you have further questions, please email **info@bdc.govt.nz** with the subject **Reefton chlorination**. If you like to be added to the distribution list for updates **please subsribe at bullerdc.govt.nz/do-it-online/water-supply-update-sign-up** selecting Reefton.

bullerdc.govt.nz

Issue #1 April 2023

BULLER
DISTRICT COUNCIL
Te Kaunihera O Kawatiri

Frequently asked Questions

Chlorination of Reefton's water supply

FAQ

Get started to find out more about what is happening by reading our frequently asked questions (FAQ).

When is chlorination happening?

Council is planning for the chlorination to be in place by mid May to early June . This will occur in four phases:

- Flushing – pushing water through the pipes to clear them of build-up. This happens regularly now but will increase prior to implementation.
- Installation and Commissioning – installing and testing new equipment at the existing Water Treatment Plant (gas dosing system, pH probes, sensors, alarms and emergency shut-off systems on cylinders).
- Operations – trialling the equipment for short periods of time to gauge its effectiveness and identify any issues. This may involve dosing the system on a limited basis to test the reticulation system.
- Go live – permanent chlorination of the Reefton water supply.

What's happened previously?

In 2020, Council found bacteria in the Reefton water supply, and this resulted in a boil water notice. Further investigation found some issues at the reservoirs.

The problems identified in 2020 were investigated and budgets were assigned in Buller District Council's Draft Annual Plan 2020/21. These improvements included:

the realignment and replacement of the rising and falling main (complete) securing the integrity of the treated water reservoir (complete) the provision of residual disinfection (chlorination) (scheduled for 2023).

Why chlorinate?

Under the Water Services Act 2021, passed in November 2021, all councils must provide residual disinfection (chlorine) for public drinking water supplies.

Chlorination has been used safely and effectively all over the world for around 120 years as a preventative treatment to avoid contamination of water supplies. It keeps millions of people all round the world safe from waterborne disease, including the majority of New Zealanders

We want to make sure the water is always safe to drink to everyone in our community and to avoid the need for boil water notices.

Currently the water leaving the Reefton water treatment is compliant with drinking water standards, however chlorine provides an additional barrier to any contamination which occurs post-treatment at the plant.

How will Council chlorinate Reefton water?

A new, automatic dosing system is being installed at the Reefton water treatment plant. The dosing system will provide a constant, low dose of chlorine into the water system that supplies Reefton with drinking water.

From the reservoir the chlorinated water flows through a network of pipes prior to reaching your tap. This provides plenty of time for the chlorine to inactivate (stop from growing) any bacteria which may be in the water.

There will be chlorine monitors in both the treatment plant and reticulation (pipe network) which will inform the dosage rate. WestReef staff will also have a portable chlorine monitor to read levels throughout the reticulation.

Are other places in Buller chlorinated?

Westport is chlorinated and following Reefton, Punakaiki will also be chlorinated.

What are the timeframes for testing? Will we be warned if temporary chlorination that is going to happen as part of the testing process?

Notification will be given when the system is being tested and if this involves brief periods of chlorination, and when the township is being permanently chlorinated.

Frequently Asked Questions

What should you expect once the water is chlorinated?

In the first one or two weeks of the water being chlorination, a change in the taste and smell of the water are to be expected. Chlorine acts on the organic build up in the pipes. A change in taste/smell means it is doing its job. This will settle down.

If you think there is something wrong with the water (tastes very strong, has an unusual odour or is not colourless) we will want to hear from you, please email info@bdc.govt.nz with the subject Reefton chlorination. This might result in more flushing and testing in the network.

How much chlorine is being added to my water?

The Drinking Water Rules require a minimum dose of 0.2 mg/l of chlorine in the water at the point of supply on your property (toby). Normally the dose at the water treatment plant is about 1mg/l as some chlorine is lost once the water is running through the pipes.

How will it be monitored?

Reefton will have two chlorine monitors post-reservoir and one monitor at the treatment plant to optimise the chlorine dose and ensure the water is safe. This dosage may vary at specific times if it is needed to keep your drinking water safe.

If I can taste chlorine, how do I remove it?

There are many ways of reducing the taste of chlorine in your water. A simple method is to let the water sit out on a bench as the chlorine level will naturally reduce over time or chill the water in a bottle in the fridge. This will not reduce the chlorine level, but many people find it tastes much nicer.

You can also filter the water though a carbon filter. The cheapest option is to buy a small filter jug which sits in your fridge. You pour the water into the top and it filters through a small cartridge into the bottle of the jug. These are designed to fit in your fridge to also chill the water. A more expensive option would be to install an under-sink filter which is attached to a cold tap.

If you don't want to shower or wash your clothes in chlorinated water, you can buy at your own cost a filter that attaches to your water supply where it enters your property. It will remove all the chlorine from the water to your home. This is the most expensive option.

These filters remove chlorine by adsorption to a granulated activated carbon (GAC) filling which is safe for drinking water use. These are available from hardware supplies stores and water filter companies. Your local plumber may also be able to install one. After a while the filter will become 'used up' and needs replacing.

Is chlorine safe?

Chlorine has been used safely all over the world for around 120 years. It keeps millions of people all round the world safe from waterborne disease.

The majority of New Zealand's drinking water is chlorinated. Westport is already permanently chlorinated, providing effective treatment to keep the water safe for the town.

The amount of chlorine added to the water supply is carefully managed and monitored to ensure levels of chlorine in the water people drink are absolutely minimised.

What if I have a skin condition or sensitivity to chlorine?

Chlorine can be an irritant for existing skin conditions such as asthma or eczema. If you feel your skin getting dry or itchy, use moisturiser after having a shower or bath. If you notice increased skin irritation, asthma symptoms or other symptoms, seek medical advice from your GP.

If you have severe reaction or a reaction that seems unusual for you, we want to hear from you and we will log the incident and investigate.

What about my pets?

If you have fish in outside ponds you will need to either turn down in-coming water to an absolute trickle (this dilutes the chlorine level to a safe amount for your fish) or fill up containers of water and let them sit for at least 24 hours before using (the UV of the sun evaporates chlorine). You could also collect rainwater and use that instead.

For smaller fish tanks or bowls inside, fill up a container of water and let it sit for at least 24 hours and then only replace a third of the water at a time. If you're still worried, you can buy de-chlorinating kits (sodium thiosulfate) at pet supplies stores.

How does council communicate with people in Reefton during this process?

There will be a community meeting on 12 April at the Reefton Cinema, where the project team will explain the process of chlorinating the Reefton water supply and answer questions.

A regular newsletter will be distributed via email, and for collection at the Reefton Visitor and Service Centre. You can subscribe for the newsletter by signing up to Buller District Council's email list online by selecting Reefton.

Go to bullerdc.govt.nz/do-it-online/ water-supply-update-sign-up/

Updates on progress, timeframes and any other relevant information on the project will be posted on the Reefton Water Facebook page, with major updates on Buller District Council's Facebook page, and website - bullerdc.govt.nz

The project team can be contacted by emailing info@bdc.govt.nz with the subject Reefton chlorination.

Copies of newsletters and Frequently Asked Questions will be available at Reefton Visitor and Service Centre.

Reporting issues

We expect that at the start of the chlorination process, as any remaining debris in the pipes is chlorinated, there will be a short period where the water will taste stronger. This will dissipate over time.

If you think there is something wrong with the water, we will want to hear from you. Please either email info@bdc.govt.nz with Reefton chlorination as the subject or lodge a service request with Council.

Reefton Visitor and Service Centre

Staff at the Reefton Visitor and Service centre will have copies of Frequently Asked Questions and Newsletters as they are published. Please remember they are there to help you access information.

Why does drinking water need to be treated?

International experts are in agreement that drinking water should always be disinfected even if the source of the water is protected from influences from the surface (such as deep groundwater). This is because contamination can occur in the pipes or reservoirs the water flows through (such as repairs, backflow, and deterioration with age).

A well operated water treatment system reduces the risk of water supplies becoming contaminated.

What happens when drinking water becomes contaminated?

Contaminated water can result in disease spreading quickly through a population. About 5,500 of the 14,000 residents in Havelock North were estimated to have become ill with campylobacteriosis in 2016. Around 45 were subsequently hospitalised. This outbreak may have contributed to three deaths, and an unknown number of residents continue to suffer health complications. This resulted in changes to regulations around drinking water.

What is FAC?

When chlorine is introduced to untreated water it gets 'spent' or used up when it reacts

with organic matter and micro-organisms. Water treatment plant operators need to ensure that the amount of chlorine left in the water after it has been spent is sufficient to continue to safeguard the water from any possible recontamination throughout the reticulation. This leftover chlorine is called free available chlorine (FAC).

How can the water in the pipe network (reticulation) get recontaminated?

Contaminated water can enter a water supply through cracks in pipework, or through any backflow in the reticulation. Backflow is one of the biggest risks to water supplies and happens when water flows backward from a customer's property into the network. This can happen when pressure drops in the network and causes water (and potentially contaminants) to be sucked or pushed back into the public water supply.

We already treat the water with UV. Why do we have to chlorinate the water as well?

Both chlorine and UV provide excellent disinfection of water.

Ultraviolet (UV) light works by inactivating micro-organisms, making them unable to reproduce in the human gut. This treatment allows them to pass right through the body without causing any illness. UV light is a highly effective disinfectant at the point of treatment, but doesn't offer any protection from possible recontamination of the water within the reticulation once it has left the treatment plant. Chlorine is a highly efficient disinfectant that will kill most micro-organisms in the water. Once introduced into a water supply, chlorine will continue to kill any pathogens that it comes into contact with as it passes through the reticulation. This is called a residual disinfectant, and this is the major difference between UV and chlorine treatment.

Additional FAQs on Reefton water chlorination (for use in response to enquiries)

As at 20 March 2023

What is the cost of chlorinating Reefton's water supply?
A total budget of $440,000 was associated with the project.

Is there a long term plan for the old pipes (reticulation system)?

There is a mains renewals budget every financial year. Currently we are replacing Cast Iron pipes in the North-Eastern area in the town which have significant issues identified.

Will you pay for our water cylinders if they are damaged by chlorine, and/or the leaks that may occur?

There have been some instances of hot water cylinders failing in other parts of the country after chlorination. Many factors can be involved in this including the age of the cylinder and chemical composition of the water supply. Council doesn't anticipate any issues but also can't compensate if an issue occurs.

Why didn't everyone get a letter?

We tried to reach as many people as possible sending out a letter to homes, businesses and P.O Boxes in and around Reefton. In addition, we put out a media release, have posted on social media and have advertised the Community Meeting. We apologise if we missed any individual properties but we attempted to reach as many people as possible.

Does chlorine cause cancer?

The International Agency for Cancer Research (IARC) do not believe chlorinated water is either a probable or even possible cause of cancer. Any theoretical risk of chlorination can be mitigated by the removal of organic matter in water pipes and by closely monitoring levels of disinfection by products.

What might delay the project?

We are waiting for some pieces of equipment that were ordered at the end of last year. Our suppliers inform us they will arrive in time, but there have been delays due to factors out of their control.

Without these parts we can't commence installation and testing but we have made plenty of allowance for that in the timings provided to the public.

Fluoridation – will you use this process to slip fluoride into the system without our knowing?

No, this would never happen.

Is the system you're installing set up for fluoridation if/when that does happen?

No, a different delivery system is required for fluoride delivery and monitoring. This is generally funded by the Ministry of Health, not ratepayers.

REEFTON WATER SUPPLY CHLORINATION

Reefton water's journey

From treatment plant to tap

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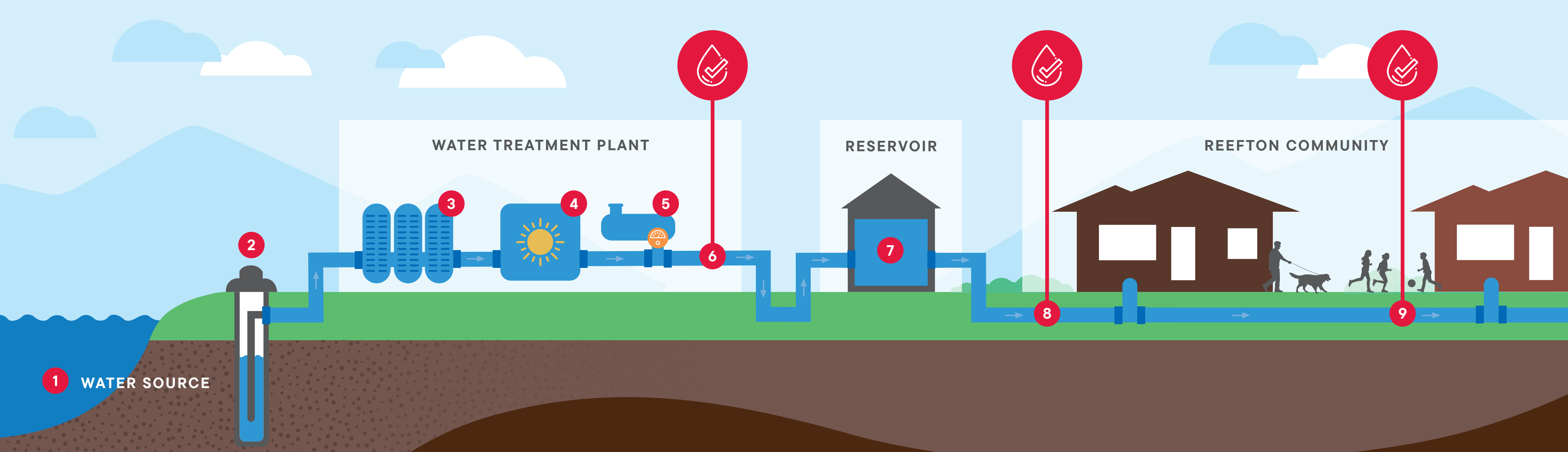
Te Kaunihera O Kawatiri



KEY

1	**Water source**	Inangahua River is our water source
2	**Well**	Water is pumped from the well to the water treatment plant
3	**Filtration**	Water is pushed through a series of macrolite filters
4	**UV**	Water is treated by ultraviolet (UV) irradiation
5	**Chlorine**	Chlorine is delivered via an automated system
6	**Monitoring**	Chlorine and pH levels are monitored at the water treatment plant
7	**Reservoir**	The reservoir is located in the hills to the south-east of the town
8 9	**Monitoring**	Chlorine levels are monitored in two places in the community

For more information please visit:
https://bullerdc.govt.nz/your-council/key-projects/reefton-water-supply-upgrade/

Scan to visit our website and find out more

From: Fluoride Free New Zealand
To: Mayor Jamie Cleine
Subject: Rebuttal of Stuff"s The Whole Truth - Water Fluoridation
Date: Wednesday, 5 April 2023 2:31:57 pm

Dear Mayor and Councillors,

We are aware the Director General of Health has ordered your council to fluoridate all water supplies that provide 500 people or more.
However, please be reminded that you are voted to represent your community first and foremost. Please also be reminded that New Zealanders believe we live in a democracy not a technocracy.

Last month the US Government's National Toxicology Program (NTP) released its second draft of review of fluoride and neurotoxicity. They could not find a safe level of fluoride and that high quality studies have found fluoride affecting children's IQ at levels we are exposed to.

In response to the NTP Report, Stuff published an article called “The Whole Truth: Water Fluoridation - at recommended levels - is safe and beneficial”.

Please see below our rebuttal of the claims made by Stuff.

Rebuttal of Stuff’s “The Whole Truth: Water fluoridation - at recommended levels - is safe

and beneficial"

On the 28th of March 2023, New Zealand mainstream media outlet Stuff, published an article titled "The Whole Truth: Water fluoridation - at recommended levels - is safe and beneficial."

Stuff's article was in response to the release of the US Government's National Toxicology Program's Monograph titled "NTP Monograph on the State of the Science Concerning Fluoride Exposure and Neurodevelopmental and Cognitive Health Effects: A Systematic Review".

This post rebuts all the points made in Stuff's article. Text from Stuff's article has grey background, our rebuttals have white background.

Stuff

This reporting is part of Stuff's fact-checking project, The Whole Truth – at recommended levels - is safe and beneficial
What's the issue? Misinformation about fluoride isn't new. Community water fluoridation isn't new, either. Since the 1960s, about half of Aotearoa New Zealand's population has had access to it. Fluoride is known for its role in helping protect our teeth by making them stronger and by reducing tooth decay.

Rebuttal

There is no strong evidence that fluoridation reduces tooth decay. The Cochrane Review, considered the gold standard in providing factual evidence on health topics, published a review in 2015. They said:

- Studies on dental decay and fluoridation were of low quality.
- The only studies worthy at all of review were published at least 40 years ago i.e. pre 1970.
- An estimate that 40% of people will have dental fluorosis when water is fluoridated at 0.7ppm
- An estimate that 12% of people will have dental fluorosis that could cause concern over appearance when water is fluoridated at 0.7ppm
- No evidence that cessation of fluoridation led to an increase in dental decay rates

- No evidence that fluoridation reduced inequalities between rich and poor
- No evidence that fluoridation benefited adults
- 97% of the studies they examined were biased

Stuff

The mineral is actually present in all water sources but usually at levels too low to have beneficial effects on dental health. Water fluoridation is the process of increasing levels to between 0.7 parts per million and 1.0 ppm – in line with World Health Organisation recommendations and kept in check by national standards.

Rebuttal

Fluoride is not like calcium or magnesium, it's like lead or arsenic. There is no requirement for fluoride in the body, so it can never be too low for anything.

We have one of the highest levels for fluoridation. The NZ MoH recommend a range of 0.7ppm to 1.00ppm with a target of 0.85ppm. The US has lowered their recommended maximum level to 0.7ppm.

Stuff

But concerns about links between childhood fluoride exposure and reduced IQ have reemerged in the backlash against compulsory fluoridation orders for local authorities in New Zealand, using controversial data published by the National Toxicology Program (NTP) in the United States.

Rebuttal

The NTP report does not provide data but provides scientific reviews of studies. This information has not been anything to do with a backlash against the NZ Government decision to mandate fluoridation, but as a result of the NTP report of 2016 where it found fluoride may be causing neurotoxic effects on animals but there was not enough information to determine what effect it was having on humans.

The Monograph and Meta analysis are not controversial according to all National Academies of Sciences, Engineering, and Medicine (NASEM) reviewers who praised the NTP for its high quality.

Stuff

What we found The misinformation we've seen suggests current exposure to fluoride via drinking water prenatally and during childhood results in measurable IQ loss. This simply isn't true. So why's it doing the rounds?

Rebuttal

Two of the highest quality studies, Green and Till, found measurable IQ loss in children exposed either prenatally or via bottle feeding respectively, in areas of Canada that are fluoridated. In Canada they fluoridate at a lower level than New Zealand – 0.7ppm compared to the MoH target of 0.85ppm.

Stuff

The National Toxicology Program in the United States has been reviewing studies on fluoride exposure and potential neurodevelopmental and cognitive health effects. On March 15, the site published a draft report of its systematic review from September, 2022, saying there is "a large body of evidence on IQ effects in children" and more limited evidence suggesting "other neurodevelopmental and cognitive effects in children".

But the report also highlights issues with the quality of the literature and notes the strongest associations between fluoride and cognitive effects were seen at levels in excess of the current recommendations.

Rebuttal

This is patently not true. "The results from 18 of the 19 high-quality studies that evaluated IQ in children provide consistent evidence that higher fluoride exposure is associated with lower IQ."

The Green and Till studies are two that were done in fluoridated Canada. The Bashash study is from Mexico where actual fluoride exposure to each of the study participants was measured and found to be comparable with fluoridated areas. Referring to these three studies, the NTP state "together the three studies provided consistent evidence that increasing maternal fluoride levels were associated with lower IQ scores in the children.”

NTP - “We have no basis on which to state that our findings are not relevant to some children or pregnant people in the United States.”

NTP - “Several of the highest quality studies showing lower IQs in children were done in optimally fluoridated (0.7 mg/L) areas…many urinary fluoride measurements exceed those that would be expected from consuming water that contains fluoride at 1.5 mg/L.” (page 346 of the NTP Meta analysis).

New Zealand fluoridates at 0.85 mg/L (range between 0.7 – 1 mg/L).

Stuff

A Ministry of Health spokesperson told Stuff: “Much of the evidence presented in the NTP report comes from studies that involve relatively high fluoride concentrations and is not applicable to the fluoridation of water in municipal water sources.”

Rebuttal

In response to a similar comment from a peer reviewer, the NTP said “We do not agree with this comment…our assessment considers fluoride exposures from all sources, not just water…because fluoride is also found in certain foods, dental products, some pharmaceuticals, and other sources… Even in the optimally fluoridated cities…individual exposure levels…suggest widely varying total exposures from water combined with fluoride from other sources.”
NTP found that the Green and Till studies from Canada, with lower fluoride levels than NZ, were of high quality.

New Zealand has a high tea drinking population. Tea contains high levels of fluoride. A study published in 2017 provides data on how much fluoride many New Zealanders are being exposed to through their tea consumption.

Stuff

Misinformation about fluoride isn’t new. Community water fluoridation isn’t new, either.
Some people have incorrectly claimed the report had been suppressed. It’s online. It just has not been formally published because it’s under review. Peer

review – where fellow scientists look for errors – is an important part of the scientific process.

Rebuttal

The Report was withheld from the public even though it had been peer reviewed twice. Normally NTP reviews only go through one peer review process, In May 2022, the US Associate Secretary Health, prevented the Report from being released claiming the review needed even more peer review. However, because of the current court case in the US the judge ordered the Report had to be released. The judge ordered that the NTP had to also release all the reviewer comments and the NTP responses so the court was provided with a full understanding of everything that had been considered.

Stuff

"Research on fluoride can influence exposure guidelines or regulations, so it is important for it to be able to withstand scientific scrutiny," the ministry spokesperson said. It's known excessive consumption of fluoride can present health risks, the most common being dental fluorosis – a tooth enamel defect resulting in white marks on the teeth. Progressively higher levels can increase risks of bone disease, skeletal fluorosis.

Rebuttal

According to the last research done in NZ (2009) to ascertain levels of dental fluorosis, Kanagarathnam et al found 30% of children have some form of dental fluorosis. The study also found children who lived continuously in fluoridated areas were over four times more likely to have dental fluorosis than children who lived continuously in non-fluoridated areas.

The Cochrane Review (Gold standard in research) found that 40% of adolescents had dental fluorosis and 12% was of cosmetic concern in areas that fluoridated. It's known excessive consumption of fluoride can present health risks, the most common being dental fluorosis – a tooth enamel defect resulting in white marks on the teeth. Progressively higher levels can increase risks of bone disease, skeletal fluorosis.

Dental fluorosis is the first outward sign of overexposure to fluoride i.e. fluoride poisoning.

Stuff

While there’s some research to suggest very high levels and chronic exposure can potentially have negative neurodevelopmental and cognitive impacts, experts say this isn’t a concern at the levels we’re exposed to in New Zealand.

Rebuttal

Quotes from unnamed "experts" are meaningless. They should be named and the studies on which they base their view need to be cited to have any credibility.

The NTP Report states “We have no basis on which to state that our findings are not relevant to some children or pregnant people in the United States.” “Several of the highest quality studies showing lower IQs in children were done in optimally fluoridated (0.7 mg/L) areas…. Many urinary fluoride measurements exceed those that would be consuming water than contains fluoride at 1.5 mg/L.”

Stuff

Using data from the Dunedin Multidisciplinary Health and Development Study, researchers have studied the relationship between community water fluoridation and lower IQ in childhood and adulthood. The study, published in 2015, concluded: “These findings do not support the assertion that fluoride in the context of [community water fluoridation] programs is neurotoxic.”

Rebuttal

The study using data from the Dunedin Multidisciplinary study was carried out by dentist, Jonathan Broadbent. That study was excluded from the NTP Report as it was considered of low quality and at risk of bias. Providing their reasoning for excluding the Broadbent study, the NTP said “In one case, multiple sources of fluoride exposure were assessed separately without properly controlling for the other sources of exposure, which could bias the results (Broadbent et al. 2015). Broadbent et al. (2015) assessed fluoride exposure in three ways: use of community water in a fluoridated area versus a non-fluoridated area, use of fluoride toothpaste (never, sometimes, always), or use of fluoride tablets prior to age 5 (ever, never). The same children were used for each analysis without accounting for fluoride exposure through other sources.

For example, there were 99 children included in the non-fluoridated area for the community water evaluation, but there is no indication that these 99 children were not some of the 139 children that had ever used supplemental fluoride tablets or the 634 children that had always used fluoride toothpaste. Therefore, comparing fluoridated areas to non-fluoridated areas without accounting for other sources of exposure that might occur in these non-fluoridated areas would bias the results toward the null”. (page 722 of the meta- analysis).

For comparison, it was found the the exposure to lead through paint and car fumes amounted to a reduction in four IQ points. This was enough to cause serious widespread concern throughout the world and lead was removed from these products. See study on Lead by the [Dunedin Multidisciplinary Health and Development Study] published in JAMA in 2017.

Stuff

In 2014 review by the Royal Society of New Zealand and the office of the Prime Minister’s chief science adviser of scientific evidence for and against the safety of fluoridation of public water supplies found “on the available evidence there is is no appreciable effect on cognition arising from [community water fluoridation]”.

Rebuttal

The [2014 NZ Report] on fluoridation is completely outdated. The NTP say half of the high-quality studies have been carried out since 2015. The NZ Report originally stated in its summary findings on IQ “Further, the claimed shift of less than one IQ point suggests that this is likely to be a measurement or statistical artefact of no functional significance”. The authors of the NZ Report were made to change this as they had mistakenly said “less than one IQ point” when in fact it was “less than one standard deviation”. The Report was amended to say standard deviation but the conclusion that it “is likely to be a measurement or statistical artefact of no functional significance“, was not changed, even though one standard deviation is 15 IQ points and drop being discussed was 7 IQ points.

The NTP review highlights that a loss of 5 IQ points across a society is serious. “Although the estimated decreases in IQ may seem small, research on other neurotoxicants has shown that subtle shifts in IQ at the population level can have a profound impact on the number of people who fall within the high and low ranges of the population’s IQ distribution. For example, a 5-point decrease in a population’s IQ would nearly double the number of people classified as intellectually disabled.” (page 476 of the meta-analysis).

Stuff

The authors said: “[We] conclude that the efficacy and safety of fluoridation of public water supplies, within the range of concentrations currently recommended by the Ministry of Health, is assured.” Fluoridation remains the safest and most appropriate approach for promoting dental public health, they said.

Rebuttal

In non-fluoridated Scotland they have a [Childsmile programme]() that involved school and nursery school tooth brushing. This has been hugely successful reducing dental decay rates in children significantly and halved the number of children needed general anaesthetics.

Stuff

In 2021, the office examined new evidence on water fluoridation and found the conclusions of the 2014 report “remain appropriate”. Jonathan Broadbent, a professor at Otago University’s Department of Oral Sciences and the lead author of the 2015 paper, told Stuff, “there are measurable benefits to oral health” with community water fluoridation.

Rebuttal

Studies by New Zealand researchers Schluter, Kanagaratham and others have found no major difference in decay rates between fluoridated and non-fluoridated areas.

The NZ School Dental Statistics that provides data for all 5 year old children and all Year 8 children, who attend the school dental service (most children), finds virtually no difference in dental decay rates when comparing the combined average in nonfluoridated areas and fluoridated areas. In some years, and always in some areas, children in nonfluoridated areas do better than children in the fluoridated areas. As mentioned above, Cochrane, the Gold Standard in medical science review found there was no modern evidence that fluoridation is effective in reducing dental decay.

Stuff

He added “there is a need for ongoing research” on potential risks, particularly in understudied areas such as this.

Rebuttal

If there is a need for ongoing research, it means promoters do not actually know that fluoridation is not causing harm. Therefore, fluoridation needs to be stopped immediately. The Government does not have a right to carry out medical experiments on the population without informed consent.

Stuff

New Zealand dentist and Dental Association spokesperson Dr Rob Beaglehole also emphasised the need for ongoing research. However, the levels of fluoride added to drinking water are “almost homoeopathic”. To reach an acute toxic dose, an adult would need to drink between 1200 and 1500 glasses of water a day.

Rebuttal

If levels added to drinking water are "almost homeopathic" then there can only be an "almost homeopathic" dental benefit. Yet, New Zealand children are suffering from fluoride toxicity: almost 30% of children in New Zealand have some form of dental fluorosis and children in fluoridated areas are four times more likely to be adversely affected by dental fluorosis. (See Kanagarathnam et at)

In 1999 the US Government’s Centers for Disease Control advised that the primary benefit from fluoride is topical rather than systemic i.e. it works on the outside of the teeth, not from swallowing.

In 2013 at the Hamilton City Council Tribunal, Dr Robin Whyman (former Principal Dental Officer for the MoH) gave testimony to the Council explaining how fluoridation is supposed to prevent dental decay. He stated that when fluoride is swallowed, it is stored in the bones and soft tissue. Around 50% of It is then released during the day into the blood stream and eventually secreted by the salivary glands, providing a topical benefit to the tooth surface. But simple math shows this new theory does not hold water any more than the older dis-proven theory because the amount of fluoride required for topical benefit is much higher than what is secreted from the salivary glands. The Ministry of Health advises that children should brush their teeth with adult strength toothpaste containing fluoride of 1,000 parts per million (ppm) rather than the child strength toothpaste, which only has 400ppm. They say that 400ppm is not strong enough to provide a benefit. Yet fluoridated water only contains 0.85ppm and the amount secreted into the salivary glands is only 0.016ppm.

This doesn't add up. If 400ppm child strength is not strong enough to provide a benefit, how can the 0.016ppm that is secreted from the salivary glands provide a benefit? 0.016ppm is approximately 62,500 times less fluoride than 1,000ppm in adult strength toothpaste.

Stuff

Numerous studies have shown children and adults living in areas with community water fluoridation have significantly less tooth decay. (In children, up to 40% less decay.) And tooth decay is one of the leading causes of preventable hospitalisations for children in New Zealand. Beaglehole says fluoride isn't the only answer: "The number one reason we get decay is dietary sugar".

Rebuttal

We assume Dr Beaglehole is referring to the 2009 Oral Health survey which states in its own report should not be used as a fluoridation study. As stated above, the Cochrane review found that there were no modern (post 1970) studies on tooth decay that could be relied on.

The MoH and fluoridation promoters such as Drs Broadbent and Beaglehole are ignoring the highly successful Scotland Childsmile Programme that has seen outstanding results such as a halving of the number of general anaesthetic operations needed for severe tooth decay.

Stuff

In summary Numerous studies have shown the oral health benefits of community water fluoridation. Namely, the prevention of tooth decay among children. The levels of fluoride in fluoridated water in Aotearoa New Zealand are in line with those recommended by key public health agencies around the world including the World Health Organisation. There has been no serious suggestion current levels pose any neurodevelopmental or cognitive risks to children (or adults).

Rebuttal

In the closing discussion in the US Government's National Toxicology Program's Monograph they state:

"This review finds, with moderate confidence, that fluoride exposure is associated with lower IQ in children. The association between higher fluoride exposure and lower IQ in children was consistent across different study populations, study locations, study quality/risk-of-bias determinations, study designs, exposure measures, and types of exposure data (group-level and individual-level). There were 19 low risk-of-bias studies that were conducted in 15 study populations, across 5 countries, and evaluating more than 7,000 children. Of these 19 studies, 18 reported an association between higher fluoride exposure [e.g., represented by populations whose total fluoride exposure approximated or exceeded the WHO Guidelines for Drinking-water Quality of 1.5 mg/L of fluoride (WHO 2017)] and lower IQ." (page 82 of the Monograph)

Note: WHO guidelines assume 1.5 mg/L constitutes total exposure of 1.5 mg per day.

The NTP also comment:
"We have no basis on which to state that our findings are not relevant to some children or pregnant people in the United States." "Several of the highest quality studies showing lower IQs in children were done in optimally fluoridated (0.7 mg/L) areas…many urinary fluoride measurements exceed those that would be expected from consuming water that contains fluoride at 1.5 mg/L." (page 352 of the Meta Analysis)

New Zealand fluoridates at a higher level than the US so this comment is even more pertinent to NZ. It is not truthful for Stuff's "Whole Truth" to say "There has been no serious suggestion current levels pose any neurodevelopmental or cognitive risks to children (or adults)."

Stuff

Reporting disclosure statement: This post was written with expert advice from Jonathan Broadbent, a professor of dental public health, Dr Rob Beaglehole, New Zealand Dental Association spokesperson, and the Ministry of Health.

Rebuttal

The "Whole Truth" did not seek comment from opponents of fluoridation and can therefore not be considered "the whole truth" as it is only providing one side of a very contentious debate. The current court case in the US provides affidavits from world renown scientists who are far more qualified to speak to this issue than two New Zealand dentists or anyone in the New Zealand Ministry of Health.

From:	Amanda South
To:	Mayor Jamie Cleine
Cc:	Eric de Boer; Krissy Trigg
Subject:	Updated comms for Reefton meeting
Date:	Tuesday, 11 April 2023 5:03:34 pm
Attachments:	Upd Talking points Reefton chlorination meeting.docx Updated additional FAQs Reefton chlorination for review.docx

Hi Jamie,

I hope all is well. I am attaching the talking points for tomorrow (along with some updated back pocket FQAs). They are largely as they were, but I have tidied them up a bit. Let me know if anything isn't clear.

We are working on the PowerPoint presentation and will get that to you asap. It is likely to be tomorrow morning. You and Eric will largely be working off your notes which I suggest you print out (or we can arrange for copies to be there). Rory will work from the PowerPoint.

The team will be at the Reefton Cinema by about 4.30 tomorrow afternoon to get familiar with the mics and layout. The doors open at 5 and we start at 5.30pm.

Thank you for your work on this.

Cheers

Amanda

Talking points - Reefton Chlorination community meeting 12 April

Eric – MC [5.40-5.50pm]

[Overall, Eric's role is to control the pace, set expectations and moderate the atmosphere of the meeting where possible.]

Housekeeping, introductions, quick background

Hi – I am Eric de Boer, Manager Infrastructure Delivery for Buller District Council.
Joining me tonight is Mayor Jamie Cleine and Rory Weston, Acting Coordinator Drinking Water, other members of the project team, along with Mira Schwill, our communications manager.

This meeting is about informing residents about what council is doing to prepare to chlorinate the Reefton water supply. We will talk you through the process, why this is happening and how you can find out more.

I won't keep you long as Rory who is leading the project can fill you in on the details and before him the Mayor will speak briefly.

In terms of housekeeping there are three main things I want to make clear:

Information

This meeting is about sharing information about the project and is an opportunity for the community to talk to us about anything that isn't clear or any concerns. There is and will be no further consultation is whether chlorination is actually happening. It is happening, it is necessary under the law and there's no going back. It won't be the best use of anyone's time for the discussion to focus on anything but how is this happening, how it might affect you, why and when. There we can help you.

Livestreaming

You will notice cameras in the room. This is so we can livestream the event to council's Youtube channel. We are aware there are some key people including some of your local community board representatives who couldn't make it tonight so this makes it possible for people to participate without needing to be here in person.

You will only be shown on camera if you approach the front of the room/stage. If you don't want to be filmed please let us know.

Questions
That brings me to my next point, at the end of the technical presentation, you will be invited to ask questions. Please hold onto your questions until then as we may have already answered them in the presentation. If you are happy to be on camera, Mira will ask you to

come to the front so that everyone can see and hear clearly. Otherwise Mira will bring the mic to you.

Those watching on YouTube can post questions in the comments sectional and Mira will pass them on.

Other housekeeping – fire exits etc.

Finally, before I hand over to the Mayor, a quick background on how we got here.

Buller District Council's project team is about to commence work on preparing the Reefton water supply system for the introduction of chlorine.

Chlorination of Reefton's water supply is expected to be fully in place by early June.

As a large water supply, Reefton is required to meet drinking water legislative requirements. This requires the supply to have residual disinfection (chlorine) unless an exemption is granted by Taumata Arowai – the water services regulator for Aotearoa.

Due to the aged pipes and high leakage rates within the Reefton reticulation (pipe network), it is extremely unlikely that Reefton would be granted an exemption. We won't be seeking one.

We are aware that this is a topic of interest for people who are affected by this change, and for some it might be an unwelcome development.

We know the history of how this has been received by members of this community in the past and we appreciate that there will be mixed feelings now.

It is important to note our priority is to provide safe drinking water to the community. The law dictates how we do that.

In short, chlorination is necessary to ensure the safety of Reefton's water supply and we will try to explain why that is and what the plan is.

All we ask is that you hear us out, let us help you gain a better understanding of what is happening and save your questions to the end so that we can help clarify any facts and listen to what you have to say.

Thank you – Now a few words from Mayor Jamie Cleine.

Reefton chlorination meeting (12 April) Mayor Jamie Cleine talking points.

5.50 – 6pm.

[Jamie to speak about community support, touch on history but looking ahead to overall benefits to community, and councillors absence.]

Kia ora koutou

Welcome and thank you for coming. As Eric has indicated, we are aware this is a potentially contentious issue for some in the community and in a perfect world we wouldn't need to chlorinate. But we do. Our water supply in Reefton has had issues in the past and there's no way (without a magic wand) to 100% guarantee they won't happen again.

Even with a magic wand, chlorination is mandated by law in reticulated (delivered by pipes) systems and we as a council have to implement it. This applies to all councils in New Zealand where water is piped to homes.

That is why we have made it clear there can and will be no further consultation on this. That may be difficult to hear and may prompt an emotional response for some people and that is all understandable. Council has no choice but to chlorinate Reefton as we have already in Westport and as we will in the future in Punakaiki.

Chlorination is used in water supplies all over the world and most of New Zealand. It keeps drinking water safe. Once this is in place, the precautionary boil water notice can be removed from Reefton, which is a positive for the town and visitors here who may be confused by the notice.

The risk of outbreaks like the one that happened in Havelock North is removed. The new equipment required to chlorinate means the quality and safety of the supply can be maintained. This is the third of three key improvements to Reefton's water supply over the past couple of years to secure the safety of the water.

[https://bullerdc.govt.nz/your-council/key-projects/reefton-water-supply-upgrade/]

You will note that your local councillors aren't in attendance tonight. They make their apologies. Unfortunately, the dates didn't work for them but the Project team felt it was important to press ahead with the programme of work in order to deliver the project on time and work through any potential issues with plenty of time in hand. We have arranged for the Youtube feed so that the councillors and anyone else who couldn't make it in person tonight can still receive the update and feedback with any questions.

It is important for me that you know council is doing everything it can to make this transition has seamless and as well-informed as we can.

We are focussing very much on communication. We will be sending out regular newsletters and Facebook updates to keep you posted. You can sign up for the newsletters on our website, or Mira has a form here that you can fill in to be added to the list. Newsletters, Frequently Asked Questions and other material will also be available at the Reefton Visitor and Service centre upon request, and we have copies of material here that you can take away with you afterwards.

We have also contacted key Reefton partners and stakeholders such as local businesses and health providers to make sure they are aware of what is happening.

Once chlorination is in place, the project team will also be asking you to provide them with feedback and keep you informed via council service requests. This will be very important at the start so any issues can be addressed as quickly as possible.

Now with more information around the technical side of things I am now going to hand over to Rory Weston who is leading this project for BDC.

Rory talking points

Rory to present a power point on what the project involves.
Science and legislation behind chlorination.
Monitoring and testing.
How might this affect people.
How do they communicate with the project team if they come across issues.

Background

Issues with the safety of Reefton's water supply were identified a number of years ago, resulting in a programme of work to improve the safety and reliability of the system. Reefton water is currently under a precautionary boil water notice.

The Reefton Water Supply Improvements were one of the key projects in Buller District Council's Draft Annual Plan 2020/21. These improvements include:

- the realignment and replacement of the rising and falling main (complete)
- the provision of residual disinfection (chlorination) (scheduled for 2023)
- securing the integrity of the treated water reservoir (complete).

Why chlorinate?

As a large water supply, Reefton is required to meet the Taumata Arowai Quality Assurance Rules for Drinking Water and the Water Services Act 2021. This requires the supply to have residual disinfection (chlorine) unless an exemption is granted by Taumata Arowai. Due to the aged pipes and high leakage rates within the Reefton reticulation, it is extremely unlikely that Reefton would be granted an exemption.

Once Reefton is chlorinated, the precautionary Boil Water Notice (BWN) which was required by Te Whatu Ora – Waitaha (formerly Canterbury District Health Board (CDHB)) can be removed.

How will Council chlorinate the Reefton water supply?

A new, automatic gas dosing system is being installed at the Reefton Water Treatment Plant. The dosing system will provide a constant, low dose of chlorine into the system.

There will be chlorine monitors in both the treatment plant and reticulation which will inform the dosage rate. WestReef personnel will also have a portable chlorine monitor to read levels throughout the reticulation.

When will this happen

Council is planning for the system to be activated by mid May to early June 2023. This willoccur in four phases:

- **Flushing** – pushing water through the pipes to clear them of build-up. This happens regularly now but will increase prior to implementation.
- **Commissioning** – installing the new equipment (gas dosing system, pH probes and emergency shut-off systems on cylinders).
- **Testing –** testing the system to ensure all equipment, sensors and alarms are working as required.
- **Go live –** permanent chlorination of the Reefton water supply.

Technical stuff

State of the system (age and leaking)
Dosage (monitoring and testing)
What the reticulation system looks like
What it might cost to entirely revamp the reticulation system
How chlorination might affect you

Communication: How to report issues and find out more

Key messages

- Residents are encouraged to communicate with the Council about the project (changes in water colour/taste, water pressure).

- Council will make sure its planning and commissioning phases are methodical and well-informed in the lead up to activation.

- After activation, Council will operate the system to best practice standards which means minimum free available chlorine (FAC) levels that still meet compliance.

- Council is working hard to ensure any issues with going live are worked through in the testing phase.

- Chlorine dosing in Reefton will be fully in place by the mid May to early June 2023.

- In the first one or two weeks of chlorination, a change in the taste and smell of the water are to be expected. Chlorine acts on the organic build up in the pipes. A change in taste/smell means it is doing its job. This settles down.

- Activated carbon filters can remove a lot of the chlorine and are cost effective for household use. They can either be plumbed in (under the kitchen sink) or handheld carbon filter jugs can be purchased. Some people may also prefer bottled water.

- Chlorination is widely and safely used in New Zealand and around the world to ensure protection against contamination.

- There is no risk to public safety through chlorination, although dialysis patients in the community can be affected. Council is working with local health authorities to identify at-risk properties. At this point, there are no known dialysis patients in the area.

[7pm Eric to close and start taking questions]

Set a window of 15 minutes but can go over that as required.

Additional FAQs on Reefton water chlorination (for use in response to enquiries)

As at 20 March 2023

What is the cost of chlorinating Reefton's water supply?
A budget of more than $400,000 has been set aside for the project, although final costs won't be known until the project is complete.

Is there a long term plan for the old pipes (reticulation system)?

There is a mains renewals budget every financial year. Currently we are replacing Cast Iron pipes in the North-Eastern area in the town which have significant issues identified.

The cost of overhauling the network would be considerable and unaffordable for council.

Will you pay for our water cylinders if they are damaged by chlorine, and/or the leaks that may occur?

There have been some instances of hot water cylinders failing in other parts of the country after chlorination. Many factors can be involved in this including the age of the cylinder and chemical composition of the water supply. Council doesn't anticipate any issues but also can't compensate if an issue occurs.

Why didn't everyone get a letter?

We tried to reach as many people as possible sending out a letter to homes, businesses and P.O Boxes in and around Reefton. In addition, we put out a media release, have posted on social media and have advertised the Community Meeting. We apologise if we missed any individual properties, but we attempted to reach as many people as possible.

Does chlorine cause cancer?

The International Agency for Cancer Research (IARC) do not believe chlorinated water is either a probable or even possible cause of cancer. Any theoretical risk of chlorination can be mitigated by the removal of organic matter in water pipes and by closely monitoring levels of disinfection by products.

What might delay the project?

We are waiting for some pieces of equipment that were ordered at the end of last year. Our suppliers inform us they will arrive in time, but there have been delays due to factors out of their control.

These parts won't delay the installation of the Chlorination equipment but will be required as part of the commissioning and monitoring. We have made plenty of allowance for that in the timings provided to the public.

We have been told there will be no further consultation on this – isn't that undemocratic?

The Buller District Council agreed to chlorinate the Reefton water supply in November 2020 once the then planned upgrade project was complete (it now is). There was consultation at the time.

With an even vote for and against chlorinating the water, Buller District Mayor Jamie Cleine was required to make the deciding vote.

At the time the Mayor stated that he had to weigh up public health, council's legal responsibility to comply with the Health Act 1956 and the Drinking-water Standards of New Zealand 2005/18, alongside some peoples' desire for their water to remain chlorine free.

That legislation has since been strengthened and Council is required to meet the Taumata Arowai Quality Assurance Rules that came into effect on the 14 November 2021.

Taumata Arowai is the water services regulator for Aotearoa New Zealand

Fluoridation – will you use this process to slip fluoride into the system without our knowing?

No, this would never happen.

Is the system you're installing set up for fluoridation if/when that does happen?

No, a different delivery system is required for fluoride delivery and monitoring. This is generally funded by the Ministry of Health, not ratepayers.

Relevant documents:

Link to a Canadian video that might be helpful (more than 7 minutes long) (https://www.youtube.com/watch?v=ag9U9MWYzzo

https://www.stuff.co.nz/the-press/news/123558281/tribunal-rules-christchurch-council-not-liable-for-damaged-hot-water-cylinder

https://www.pressreader.com/new-zealand/the-press/20181106/281603831477154

https://www.stuff.co.nz/national/politics/local-democracy-reporting/119059991/reefton-e-coli-outbreak-raises-questions-about-towns-water-infrastructure