



May 2016

North Harbour 2 Watermain and
Northern Interceptor in Shared Corridor

VOLUME TWO
TECHNICAL ASSESSMENT REPORTS

North Harbour 2 Watermain and Northern Interceptor in Shared Corridor

VOLUME TWO TECHNICAL REPORTS

May 2016

- Amendments to Volume 2 Technical Reports – Letters from Technical Specialists for Option 2 at Albany Reservoir
- Technical Reports
 - Technical Report A – Earthworks, Erosion and Sediment Generation Assessment
 - Technical Report B – Soil and Groundwater Contamination Assessment
 - Technical Report C – Groundwater Assessment
 - Technical Report D – Ecological Assessment
 - Technical Report E – Traffic Assessment
 - Technical Report F – Construction Noise and Vibration Assessment
 - Technical Report G - Landscape and Visual Assessment
 - Technical Report H – Arboriculture Assessment
 - Technical Report I – Archaeological Assessment

**North Harbour 2 Watermain and
Northern Interceptor in Shared Corridor**

VOLUME TWO

**AMENDMENTS TO VOLUME 2 TECHNICAL REPORTS -
LETTERS FROM TECHNICAL SPECIALISTS FOR
OPTION 2 AT ALBANY RESERVOIR**

May 2016



24 May 2016

Caroline Secretin
Senior Environmental Scientist
AECOM
PO Box 4241
Shortland Street
Auckland 1140

Dear Caroline

North Harbour 2 Watermain - Earthworks, Erosion and Sediment Generation for Albany Reservoir Option 2

The North Harbour 2 Watermain (NH2) will cross Albany Expressway by way of trenchless technology (e.g. tunnelling) and continue to Albany Reservoir via open trench. However two route options are proposed for connecting the watermain through to Albany Reservoir (reference Drawing 2010373.532).

- Option 1 – follows Albany Expressway to Data Way then follows Corinthian Drive (approximately 1000m)
- Option 2 – traverses road side reserve to Corinthian Drive and then through Spencer Ridge Reserve (approximately 720m)

Option 1 was assessed in the submitted Technical Report A – Earthworks, Erosion and Sediment Control. We have assessed route Option 2 which will require specific erosion and sediment control measures that are consistent with the following sections of Technical Report A:

- Section 5 General Erosion and Sediment Control Approach
- Section 6.1 General Open Trenching

Section 8, 9, 10 and 11 are also applicable to the mitigation of route Option 2. Option 2 will not cross any overland flow paths or streams, or flood plains (as shown in the Auckland Council GIS Catchments and Hydrology layer). There will be no additional effects or mitigation required for this section of open trench.

Therefore with correct design and construction of ESCMs it is anticipated that the effects on the environment will be less than minor.

Yours faithfully



Kristina Healy
Senior Environmental Scientist
kristina.healy@aecom.com

Direct Dial: +64 9 967 9333
Direct Fax: +64 9 967 9201



Justine Bennett
Principal Environmental Scientist
justine.bennett@aecom.com

Mobile: +64 21 421 969
Direct Dial: +64 9 967 9200
Direct Fax: +64 9 967 9201

24 May 2016

Project Name: North Harbour 2 Watermain
Project Number: AE04521

Subject: Soil and Groundwater Contamination Assessment of Option 2 at Albany Reservoir (DWG 2010673.532)

Dear Sir/Madam,

This letter confirms that I have assessed the designation boundary around Option 2 (light blue) and that I have nothing to add to my Technical Report B – Soil and Groundwater Contamination Assessment- Final, dated 18 April 2016. The reasons for this are as follows:

- The historical aerial photograph review (see Section 4.5 of Technical Report B) does not suggest that former site activities or industries that are considered likely to cause land contamination resulting from hazardous substance use, storage or disposal, i.e. sites identified on the Hazardous Activities and Industries List (HAIL), were present at or near the designation boundary for Option 2.
- The Auckland Council Site Contamination Enquiry (see Section 4.6 of Technical Report B) does not identify an activity or industry listed on the Hazardous Activities and Industries List (HAIL) located near the designation boundary for Option 2.
- A conservative approach to manage unforeseen / unknown ground contamination is to use protocols that are designed to avoid, mitigate and remedy the potential for adverse effects on the environment, for example, the Project erosion and sediment control plan (ESCP) and the Contaminated Land Management Plan (CLMP).
- It is therefore considered that potential adverse effects on the environment arising from unforeseen/unknown ground contamination at the designation boundary for Option 2 can be avoided, mitigated and remedied provided that the contractor adheres to the protocols listed in the ESCP and the CLMP.

Yours sincerely



Walter Starke

Senior Environmental Engineer, Environment, Planning & Spatial

T +64 9 928 5840 C +64 21 378 391.

Walter.Starke@jacobs.com

23 May 2016

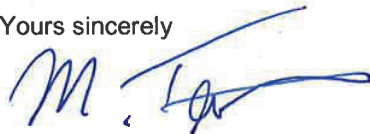
Project Name: North Harbour 2 Watermain
Project Number: AE04521

Subject: AEE of Option 2 (DWG 2010673.532)

Dear Sir/Madam,

This letter highlights the AEE related to groundwater for Option 2, at the Albany reservoir, within the park (DWG 2010673.532). Using Option 2 for this trenched section will not result in any changes to the potential effects assessed for Option 1. This is because the two options occur within the same hydrogeological area for the purposes of this assessment. Consequently, potential drawdown due to open trench excavation is expected to be minimal away from the excavation face (e.g. <1m at 30m from the trench and tapering off to zero beyond this distance).

Yours sincerely



Mauricio Taulis
Senior Hydrogeologist
99255803
Mauricio.Taulis@jacobs.com

DDI : (09) 367-5286
Mobile : 022 034 3208
Email : markdelaney@bioresearches.co.nz

MEMORANDUM

TO	:	AECOM
ATTENTION	:	Caroline Secretin
FROM	:	Mark Delaney, Ecologist
SUBJECT	:	NH2 & NI Shared Corridor: Option 2, Albany Reservoir.
DATE	:	23 May 2016
BGL REF	:	WD\15170

Bioresearches Group Limited was commissioned by Watercare Services Limited (Watercare) to assess the potential ecological effects related to the construction, operation and maintenance of Watercare's proposed North Harbour 2 Watermain (NH2) and the Northern Interceptor (NI) shared corridor.

An additional ecological assessment was required for 'Option 2' at Albany Reservoir (refer updated Drawing No 2010673.532). 'Option 2' uses open trench installation and runs from the Mercari Way and Albany Expressway intersection, via Corinthian Drive and Spencer Ridge Reserve, to the end of NOR2.

From a desktop assessment, it was determined that 'Option 2' runs through a few small patches of young native restoration plantings within Spencer Ridge Reserve. The ecological value associated with 'Option 2' are low. The ecological effects for 'Option 2' are expected to be minor with the potential loss of a small amount of young native vegetation.

Where practicable, construction activity should be adjusted to avoid or minimise disturbance to native vegetation. Where native vegetation loss does occur, at a minimum, this vegetation should be re-instated post construction using the same diversity of plants that were originally there.

With adequate mitigation, the expected effects will reduce to less than minor.



Mark Delaney MSc.

Ecologist | **Bioresearches Group Ltd**

A subsidiary of Babbage Consulting Limited

Level 4, 68 Beach Road, Auckland 1010 | PO Box 2828, Auckland 1140
T +64 9 379 9417 | DDI +64 367 5286 | M +64 22 034 3208

www.bioresearches.co.nz

26 May 2016

Caroline Secretin
Senior Environmental Scientist

NOR2: Option 2 at Albany Reservoir

Dear Caroline,

Technical Report E – Traffic Assessment Report did not describe or refer to Option 2 through the Albany Reservoir at the end of NOR2 as it was assumed that the alignment would follow Albany Expressway, Data Way and Corinthian Drive. With this alignment, the traffic assessment report noted that Data Way may need to be closed during construction which would require the use of an alternate vehicle route via Mercari Way and Don Mckinnon to enable vehicles to travel between Albany Expressway and Corinthian Drive.

The Option 2 alignment as shown in light blue on Drawing No 2010673.532 avoids Data Way entirely so there would be no need to close Data Way. A considerable percentage of the Option 2 alignment is in the reserve so it is expected that there would be less overall impact upon general traffic during construction. However, there would be traffic impacts along Corinthian Drive during the construction period in the vicinity of 5-9 Corinthian Way. This section of Corinthian Drive near the driveway to 9 Corinthian Drive is narrower than other sections of the road as there is no shoulder or on-street parking. Through appropriate traffic management, it is expected that Corinthian Drive could be kept open. The driveway in 9 Corinthian Drive will only be affected for 2 to 3 days and timing of the work will be done in consultation with the property owner and tenants immediately prior to construction to minimise disruption.

It should be noted that the section of road near 9 Corinthian Drive would likely be restricted to only 1 lane of traffic during construction. The current alignment of Option 2 would block the driveway to 9 Corinthian Drive during construction. To mitigate this effect, one of the following measures is recommended:

1. Option 2 alignment could be moved to the north side of the road as the current alignment would block the driveway during construction (see attached sketch).
2. Complete the construction work in the vicinity of 9 Corinthian Drive during off peak periods (i.e., nights, weekends or holidays) to minimise the impact

This letter confirms that we have considered Option 2 of the NOR2 through the Albany Reservoir and consider it to be a workable solution from a traffic perspective as the traffic impacts are considered to be less than minor provided that appropriate mitigation is implemented per the above guidance.

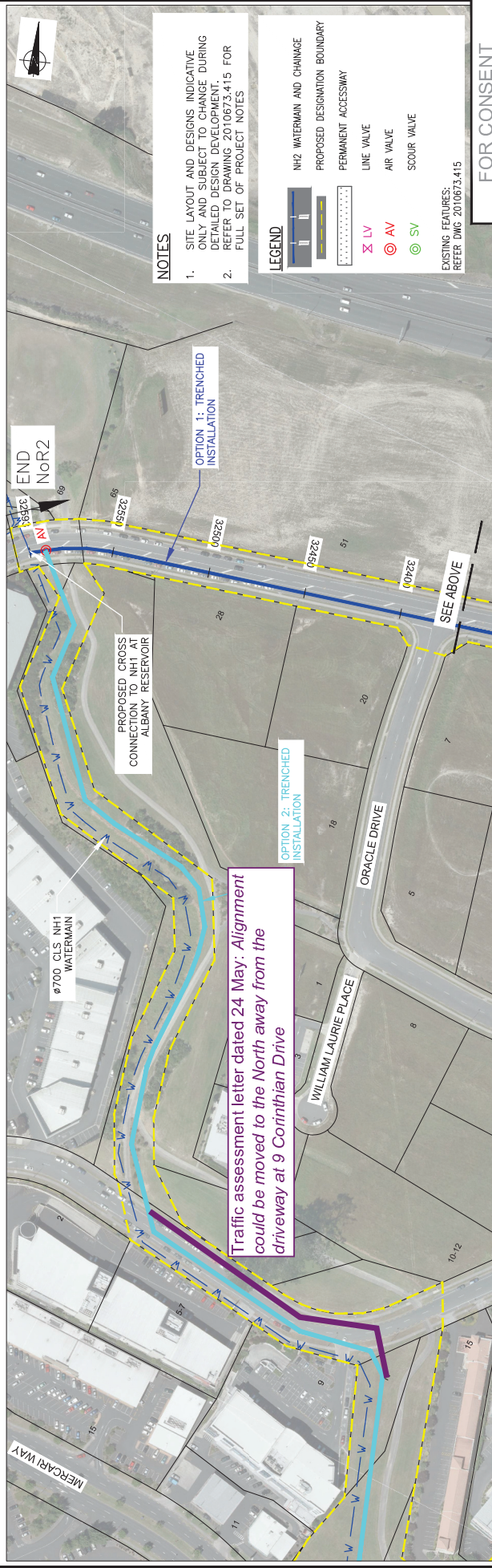
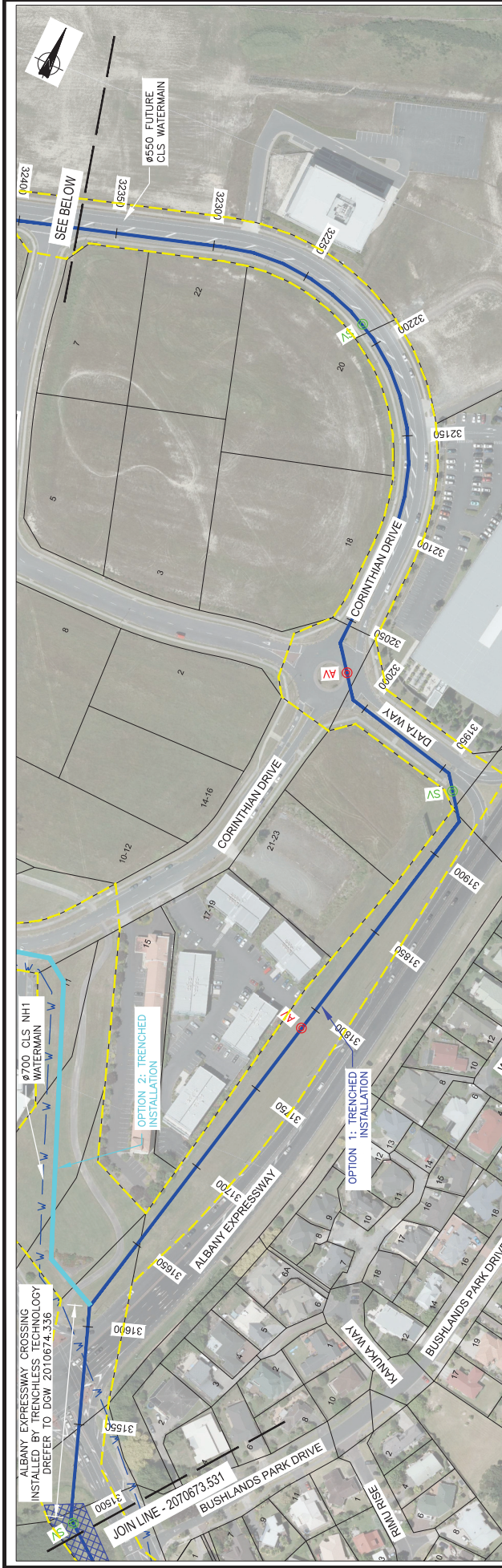
Please let me know if you have any questions regarding this matter.

Yours sincerely



Samuel Corbett
Section Leader - Transport Planning

Attachment to the Traffic Assessment Letter dated 24 May 2016 - NOR2 Option 2 at Albany Reservoir: Marked up Drawing



NOTES

- SITE LAYOUT AND DESIGNS INDICATIVE ONLY AND SUBJECT TO CHANGE DURING DETAILED DESIGN DEVELOPMENT. REFER TO DRAWING 2010673.415 FOR FULL SET OF PROJECT NOTES

LEGEND

- NH2 WATERMAIN AND CHANGE
- PROPOSED DESIGNATION BOUNDARY
- PERMANENT ACCESSWAY
- LINE VALVE
- AIR VALVE
- SCOUR VALVE

EXISTING FEATURES:
REFER DWG 2010673.415

FOR CONSENT

CAD FILE	2010673.529-532	DATE	23.05.16
ORIGINAL SCALE	A3	CONTRACT No.	5663
	1:2,000		
REF No.	WMNH2-91-G-532	ISSUE	-
DWG No.	2010673.532		3

NORTH HARBOUR No.2 WATERMAIN
GENERAL
ROUTE PLAN



ISSUE	DATE	AMENDMENT	BY	APPD.	DESIGNED	N.H.	12.15	12.15	12.15	12.15	OPERATIONS	INFRASTRUCTURE
3	23.05.16	ISSUED FOR CONSENT - UPDATED AS PER WSL REQUEST	A.T.		DES. CHECKED	M.A.E.						
2	22.02.16	ISSUED FOR CONSENT - UPDATED WITH WSL COMMENTS	W.O.		DWG. CHECKED	N.H.						
1	03.12.15	ISSUED FOR CONSENT	W.O.		PROJECT LEADER	M.A.E.						
					INFRASTR APP'D							

23 May 2016

Caroline Secretin
AECOM
AECOM House, 8 Mahuhu Crescent, Auckland 1010
PO Box 4241 Shortland St, Auckland 1140

Dear Caroline

**NH2 - Option 2 at Albany reservoir
Construction noise and vibration**

Watercare has requested that Construction Option 2 at Albany reservoir (trenched installation) within the park is included within the scope of the application recently submitted to Auckland Council.

This option is included in the updated Drawing No 2010673.532.

We have considered the potential construction noise and vibration effects of this option, and note the following:

- This option is in a generally commercial area, with setbacks of at least 40 m between works and receivers.
- The management processes documented in section 3 of our Technical Report F dated 29 April 2016 that was included with the application, remain appropriate.
- The effects would be consistent with "typical works" as detailed in section 8.2 of Technical Report F.

On this basis, there are no additional effects or mitigation that would require our technical report to be updated.

Yours faithfully



Michael Smith
Senior Acoustics Engineer
michael.j.smith@aecom.com



Darran Humpheson
Associate Director – Acoustics
darran.humpheson@aecom.com

MEMORANDUM

TO: Caroline Secretin (Aecom)

FROM: Dave Compton-Moen (Kamommarsh)

SUBJECT: NH2 and NI Shared Corridor – Assessment of Option 2 Through the open space in Albany

Project No. n/a

Date 23 May 2016

Dear Caroline

The following memorandum is to confirm if there are any effects resulting from Option 2 shown on drawing 2010673.532/3, dated 23.5.2016. It is my understanding that Option 2 proposes a trenched installation of the watermain through an open space corridor. The proposed alignment in the open space corridor, approximately 355m long, roughly follows a shared pathway which connects two sections of Corinthian Drive, Albany.

The open space is generally open grass land, moderately undulating with amenity plantings scattered in informal clusters along the existing path. The planting is a mix of native and exotic species, being a mix of grasses, shrubs and trees. The majority of specimens are 2-3m in height and estimated to be no more than 10 years old. There are some taller exotic species present but these are of a relatively young scale also.

It is considered that the option to go through the open space will not increase any of the adverse landscape and visual effects outlined in my assessment report. There may be some removal of vegetation required but the specimens are of a scale and age which can be readily replaced. There are no above ground structures proposed with the option so there will be no residual adverse visual effects. There will be some temporary visual effects during construction but these are considered less than minor.



Dave Compton-Moen

Urban Designer / Landscape Architect



GREENSCENENZ LIMITED
PO Box 56 551, Dominion Road, Auckland
P 09 623 3514
F 09 623 3515
E info@greenscenenz.com

24 May 2016

Additional information relating to NH2 and NI Shared Corridor - Options 1 & 2 at Albany Reservoir, Spencer Ridge Reserve and Corinthian Drive

Following submission of the AEE for NH2 and NI to Council, it has been noticed that the construction of Option 2 at Albany reservoir (refer updated Drawing No 2010673.532) at the end of NOR2 was not described in the AEE.

This aspect of the proposed alignment was assessed in the GreensceneNZ Limited arborist report dated 29 April 2016.

Upon review of the report and plans it has been identified that the report has erroneously referenced the two proposed options, in relation to trees numbered 134, 135 and 136. The report should read that Option 1 is the preferred option from an arboricultural perspective and Option 2 would require replanting of the Spencer Ridge Reserve to replace trees that may need removal for the open trenching in that corridor (if chosen).

Please call me on (09) 623-3514 if you have any queries relating to the above matters.

Kind regards

Craig Webb
GreensceneNZ Limited



24 May 2016

Caroline Secretin

AECOM
AECOM House
8 Mahuhu Crescent
Auckland 1140

Dear Caroline,

Re: NH2 Option 2 Albany Reservoir – updated drawing no. 2010673.532

Thank you for sending through the updated drawing for the Albany Reservoir section of proposed works (as attached). I have reviewed the changes to the plan which comprise the addition of the designation boundary around the proposed Option 2 alignment at Albany Reservoir and can confirm that this alteration does not affect the existing assessment of this area. No further assessment is required.

Yours sincerely

Charlotte Judge MA Hons (Auckland)
Senior Archaeologist

**North Harbour 2 Watermain and
Northern Interceptor in Shared Corridor**

**VOLUME TWO
TECHNICAL REPORT A
EARTHWORKS, EROSION AND SEDIMENT GENERATION
ASSESSMENT**

May 2016

Earthworks, Erosion and Sediment Generation

Technical Report A

Earthworks, Erosion and Sediment Generation

Technical Report A

Client: Watercare Services Limited

Co No.: N/A

Prepared by

AECOM Consulting Services (NZ) Ltd

8 Mahuhu Crescent, Auckland 1010, PO Box 4241 Shortland St, Auckland 1140, New Zealand
T +64 9 967 9200 F +64 9 967 9201 www.aecom.com

20-Apr-2016

Job No.: 60435364/ 42073300

AECOM in Australia and New Zealand is certified to the latest version of ISO9001, ISO14001, AS/NZS4801 and OHSAS18001.

© AECOM Consulting Services (NZ) Ltd (AECOM). All rights reserved.

AECOM has prepared this document and it may only be used for its intended purpose. AECOM undertakes no duty, nor accepts any responsibility, to any third party who may rely upon or use this document, other than for its intended purpose. This document has been prepared based on the Client's description of its requirements and AECOM's experience, having regard to assumptions that AECOM can reasonably be expected to make in accordance with sound professional principles. AECOM may also have relied upon information provided by the Client and other third parties to prepare this document, some of which may not have been verified. Subject to the above conditions, this document may be transmitted, reproduced or disseminated only in its entirety.

Quality Information

Document Earthworks, Erosion and Sediment Generation
60435364/ 42073300

Ref \\nzakl1fp005\aki-jobs\42073300\5 works\planning\aeel\technical reports\nh2_ni shared corridor\1a-earthworks erosion and sediment generation\final report april 2016\nh2-technical report a-april 2016-eesc-ver7 reve.docx

Date 20-Apr-2016

Prepared by Kristina Healy

Reviewed by Justine Bennett

Revision History

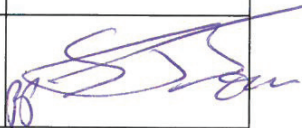
Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
A	08-Nov-2015	Draft for internal review	Justine Bennett Associate Director, Environment	
B	17-Dec-2015	Final draft for Watercare review	Justine Bennett Associate Director, Environment	
C	11-Feb-2016	Final draft for Watercare review	Justine Bennett Associate Director, Environment	
D	1-Mar-2016	Final for AEE submission	Martin Evans Senior Principal – National Water Marketing Manager	
E	20-Apr-2016	Final for AEE submission	Martin Evans Senior Principal – National Water Marketing Manager	

Table of Contents

Executive Summary	i
1.0 Introduction	1
2.0 NH2 Proposed Works	4
2.1 North Harbour 2 – Project Description	4
2.2 Construction Methodology and Sequence	4
2.2.1 Open Trenching	5
2.2.2 Trenchless Technologies	6
2.2.3 Laydown Areas	6
2.2.4 Access Ways	6
2.2.5 Construction Sequence	7
3.0 Statutory Framework	8
3.1 Auckland Council Regional Plan (Sediment Control)	8
3.2 Proposed Auckland Unitary Plan	8
4.0 Site Descriptions and Environmental Baseline	9
4.1 Geology	9
4.2 Titirangi to Westgate	10
4.3 Westgate to western start of GBWD and Causeway Project	10
4.4 Eastern Side of Greenhithe Bridge to Albany Reservoir	10
5.0 General Erosion and Sediment Control Approach	10
5.1 Key Principles	10
5.2 ESCM Design Philosophy	10
5.3 Erosion and Sediment Source Control	11
5.4 General Erosion and Sediment Control Measures	12
6.0 Specific Erosion and Sediment Control for Representative Construction Areas	13
6.1 General Open Trenching	13
6.2 Open Trenching along SH18	14
6.3 Trenchless Technologies	17
6.4 Stream Crossing Pipe Bridges	18
7.0 Universal Soil Loss Equation	19
8.0 Monitoring During Construction	20
9.0 Heavy Rainfall Response and Contingency Measures	20
9.1 Support Column Construction for Pipe Bridge Crossings	21
9.2 Emergency Spill Response	21
10.0 Site Reinstatement	22
11.0 Final ESCP	22
11.1 ESCP Information Requirements	23
11.2 Changes to the ESCP	23
12.0 Conclusions and Recommendations	23
Appendix A	
ESCP Drawings	A
Appendix B	
ESCP Calculations	B

Executive Summary

This earthworks, erosion and sediment generation technical assessment has been completed for the construction of the North Harbour 2 Watermain (NH2) from Titirangi, West Auckland to Albany Reservoir, North Shore. The earthworks, erosion and sediment generation effects are not required to be assessed in relation to the designation of that part of the Northern Interceptor (NI) Project between Westgate and Hobsonville, where a shared corridor is proposed for wastewater infrastructure.

The construction of the NH2 watermain will predominantly be by open trenching with sections using trenchless technologies, and pipe bridges over permanent streams. The assessment of erosion and sediment generating activities has been based on the preliminary design and likely construction methodology as presented in the North Harbour 2 Watermain and Northern Interceptor in the Shared Corridor Assessment of Effects on the Environment (the AEE report). Site conditions, detailed design and construction methodologies have potential to change between submission of this earthworks, erosion and sediment generation technical assessment and construction of NH2. Changes are to be captured in the Contractors Erosion and Sediment Control Plan (ESCP).

The construction activities associated with NH2 have potential to have an adverse impact on the environment, especially streams and the Upper Waitemata Harbour through the release of sediment laden runoff into the water ways. Sediment will adversely affect water quality by increasing turbidity and total suspended solids, this in turn will adversely affect the ecology and biota of the receiving water bodies. Auckland Council's Technical Publication 90 "*Erosion and sediment control guidelines for land disturbing activities in the Auckland Region*" (TP90) sets out the key principles and measures suitable for reducing impacts on the environment as a result of earthworks and construction activities. All mitigation measures prescribed in this technical report are to be designed and implemented in accordance with TP90 guidelines. The key principles for managing erosion and sediment from earthworks and construction activities are as follows:

- Stage construction to limit the time and area that soil is exposed and prone to erosion;
- Protect steep slopes by using diversion bunds, or maintaining existing vegetation;
- Stabilise exposed areas rapidly with vegetation;
- Install perimeter controls above the site to keep clean runoff out of the worked area; and
- Install perimeter controls below the site to detain sediment and prevent contamination of the existing receiving environment.

The earthworks associated with NH2 have been assessed as a restricted discretionary activity under the Auckland Council Regional Plan (Sediment Control). Consent will also be required under the Proposed Auckland Unitary Plan for general earthworks (discretionary activity), earthworks within the 100 year flood plain and Significant Ecological Area overlays, and for groundwater and stormwater diversions and discharges associated with dewatering and construction of access roads.

Representative sections of the NH2 route have been identified within this technical assessment to describe in more detail the layout of required erosion and sediment control measures (ESCMs). Once detailed designs are complete and the Contractor has confirmed the construction methodologies, their ESCP should be developed to detail implementation of the ESCMs identified in this technical assessment. With correct design and construction of ESCMs it is anticipated that the effects on the environment will be less than minor.

1.0 Introduction

AECOM Consulting Services (NZ) Ltd (AECOM) has been commissioned by Watercare Services Limited (Watercare) to assess the potential earthworks, erosion and sedimentation effects related to the construction, operation and maintenance of Watercare's proposed North Harbour 2 Watermain (NH2) project between Titirangi and Albany.

The NH2 will convey potable water from storage reservoirs in Titirangi, via west Auckland and North Shore to storage reservoirs in Albany (a length of approximately 33km). Its purpose will be to increase capacity and resilience of the water supply network to western and northern Auckland.

The NH2 project incorporates:

- Pipeline installation, operation and maintenance of a new watermain of 1,200 mm (west of Greenhithe Bridge) and 900mm (east of Greenhithe Bridge) nominal diameters;
- Pipeline length of approximately 33 km mostly within public road reserve; and
- Other features including valve chambers, scour valves, air valves, line valves, bulk supply points, pipe bridges, and associated works.

Most of the watermain will be constructed by open trenching, micro tunnelling or bored tunnel (the latter two referred to as "trenchless technology" or tunnelling within this report) within a typical construction corridor of approximately 12 – 22 metres width with additional areas required for erosion and sediment control devices, traffic management, construction yards and storage areas at intervals along the route for construction purposes.

The Northern Interceptor (NI) project comprises of a new wastewater pipeline and associated activities to convey flows from north-west Auckland to the Hobsonville Pump Station, and then to the Rosedale Wastewater Treatment Plant (WWTP).

The proposed NI project in the shared corridor begins in the vicinity of Hobsonville Road (West Harbour), near the intersection of the Upper Harbour and North Western Motorways (SH18 and SH16). From this location, the alignment follows the southern side of the SH18, continuing northeast to the Hobsonville Pump Station. Future phases of the NI project will also include new pipelines between the Hobsonville Pump Station and the SH18 causeway.

The part of the NI project falling within the shared corridor with NH2 incorporates the following:

- A new 5km wastewater pipeline of 2100mm DN;
- 16 pits / shafts for trenchless technology construction purposes. Five of these will be permanent manholes (MT Pits 2, 7, 11, 13 & 17) while the others (MT Pits 3, 4, 5, 6, 8, 9, 10, 12, 14, 15 and 16) will be temporary only until construction / testing is completed;
- MT Pit 7 will be a drop structure with permanent access, to allow for a future wastewater pipeline connection across SH18;
- A new 50m long wastewater pipeline and manholes connecting the 2100mm ND pipeline to the existing pump station;
- A new 1750 l/s Pump Station with future capacity across the site of 3,500l/s;
- Wastewater storage (within pipeline);
- Two 800m 1500mm DN rising mains (length to the causeway); and
- A 2100mm DN pipe installed by trenchless technology at SH18.

The proposed alignment of NH2 and the location of the NI project are shown in Figure 1 below.

A full description of the proposed works and construction methodology is included in in the North Harbour 2 Watermain and Northern Interceptor Shared Corridor Assessment of Effects on the Environment (the AEE report) prepared by AECOM Consulting Services (NZ) Ltd (AECOM) and Jacobs New Zealand Limited (Jacobs).

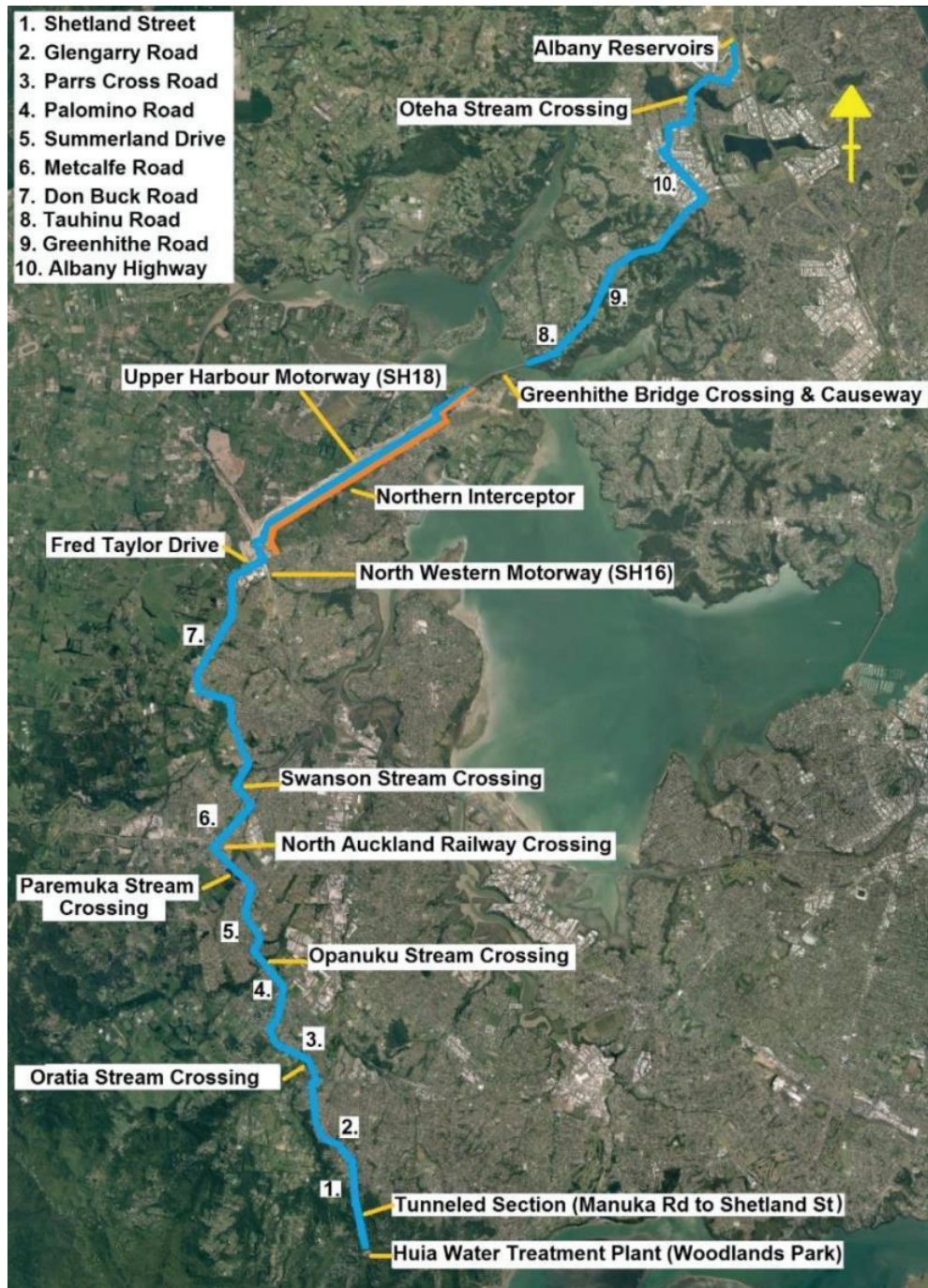


Figure 1 Alignment of NH2 (blue) and relevant section of Northern Interceptor (orange)

Watercare is proposing to designate land for the NH2 project between Titirangi and Albany and the NI project in the shared corridor between Westgate and Hobsonville, and will also be seeking various resource consents for NH2 under the Resource Management Act 1991 (RMA). Resource consents for NI in the shared corridor are not part of this assessment. This technical report provides specialist input for the AEE which supports the resource consent application for NH2 only. The earthworks, erosion and sediment generation effects are not required to be assessed in relation to the designation of that part of the Northern Interceptor (NI) Project between Westgate and Hobsonville, where a shared corridor is proposed for wastewater infrastructure. Resource consents required for works associated with the NI project will be sought by Watercare at a later date, nearer to the proposed date of construction. The alignment drawings referred to in this report are contained within Volume 3 of the AEE.

This report provides the following in relation to NH2:

- A description of the environmental baseline for the particular receiving environment(s) potentially affected by the NH2 project;
- Description of specific aspects of the NH2 project in relation to the subject area being investigated;
- Description of the investigations undertaken to assess earthworks, erosion and sediment generation;
- An assessment of the actual or potential effects on the environment (construction, operation and maintenance). This includes the identification of activities that could result in potential adverse effects and, in turn, identifying design refinements or construction methodologies that could avoid, remedy or mitigate potential adverse effects; and
- Conclusions.

2.0 NH2 Proposed Works

2.1 North Harbour 2 – Project Description

The NH2 project involves constructing a 1,200 mm nominal diameter (DN) watermain to supplement the existing North Harbour No. 1 Watermain (NH1). The NH2 will convey potable water from storage reservoirs in Titirangi, via West Auckland and North Shore to storage reservoirs in Albany (a length of approximately 33 km). Its purpose will be to increase capacity and resilience of the water supply network to western and northern Auckland.

The NH2 works assessed in this report include the construction, operation and maintenance of the proposed NH2 watermain (open trenching, trenchless technology and up to five pipe bridges), including the associated NH2 ancillary components – valve chambers, scour valves, air valves, line valves, weld-down manholes, bulk supply points, inline flow meters and three cathodic protection measures.

The recently consented Greenhithe Bridge Watermain Duplication (GBWD) and Causeway widening project will be integrated into the NH2 project.

2.2 Construction Methodology and Sequence

The full construction methodology is presented in the AEE report, Section 2. The information presented in this section is particularly relevant to the development of this earthworks, erosion and sediment generation technical assessment report. The Contractor with agreement from Watercare will be responsible for determining the final construction methodology however it is anticipated that the watermain pipeline will be constructed with a combination of open trenching methods following the land topography within the road corridors (approximately 30 km in total); and trenchless techniques where access is limited or above ground conditions restrict open trenching (approximately 2.8 km in total, locations listed in Table 1). There are five pipe bridges where NH2 crosses water bodies. All pipe bridges have been designed to accommodate estimated flood levels for their respective locations and with the support columns located as close as possible to the top of the valley sides to reduce the extent of access works for construction and avoid any works within the watercourse. These pipe bridges are listed in Table 2 below.

Table 1 Location of trenchless technology use on NH2 alignment

Trenchless Technology Location	Approximate Tunnel Length (m)
Woodlands Park (Waitakere Ranges Regional Park)	900
North Auckland Railway Line, Metcalf Road – <i>Option 2</i>	62
State Highway (SH) 16/ SH18 Interchange Crossing	140
SH18 (Sinton road)	40
Tauhinu Road Crossing – <i>Option 1</i>	210
SH18 (Wicklam Lane) – <i>Option 1</i>	310
Albany Highway Crossing	520
Greenhithe Road Crossing	150
Oteha Stream and Bush Road – <i>Option 2</i>	400
Albany Expressway Crossing	120

Table 2 Location of pipe bridges on NH2 alignment

Pipe Bridge Location	Approximate Pipe Bridge Length (m)	Number of Support Columns (Monopole)
Oratia Stream (Parrs Cross Road)	20.5	2 x 0.9 m diameter
Opanuku Stream (Border Road/ Palomino Drive)	43.5	4 x 0.9 m diameter
Paramuka Stream (Summerland Drive)	38.5	3 x 0.9 m diameter

Pipe Bridge Location	Approximate Pipe Bridge Length (m)	Number of Support Columns (Monopole)
Swanson Stream (Don Buck Corner Reserve)	19	2 x 0.9 m diameter
Oteha Valley Stream (Bush Road) – <i>Option 1</i>	81	4 x 0.9 m diameter

2.2.1 Open Trenching

All construction will occur within the designation corridor. If the Contractors require a main site yard outside the designation separate arrangements (e.g. lease and resource consents as required) will need to be made and are the responsibility of the Contractor(s). The construction corridor will be approximately 12-22 m in width. To achieve at least 1.5 m of cover over the watermain pipe, trenching will be approximately 2-3 m wide and generally 3 to 4 m deep. The length of open trench at any one time will generally be 20-30 m, laying one to two pipe lengths per day. This rate of progress will equate to earthworks volumes between 120-360 m³ at any one time for the open trenching. Figure 2 depicts a typical open trenching construction footprint which can be expected on this project.

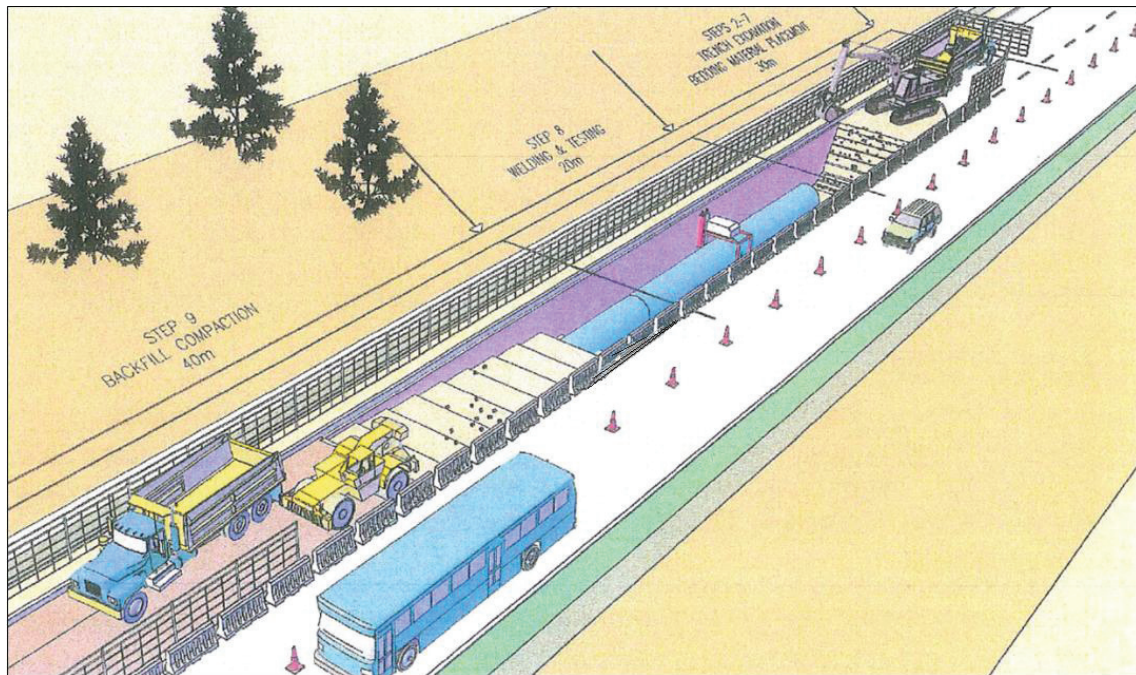


Figure 2 Typical open trenching construction footprint

The following outlines the typical sequence for open trenching construction illustrated in Figure 2 above:

- 1) Site safety, traffic control and ESC device set up as required;
- 2) Cut into ground surface, with road surface and sub-base removed for disposal;
- 3) Trench support where required with the type and extent determined by the geotechnical conditions;
- 4) Excavation of trench to approximately 150-300 mm below the pipe invert level with surplus excavated material loaded onto a truck for immediate removal from site or re-use;
- 5) Dewatering as required, depending on groundwater table level;
- 6) Placement of granular pipe bedding material;
- 7) Pipes lowered into the trench using a large excavator or crane;
- 8) Where required, installation of shoring boxes for safe welding and wrapping of pipe joints;

- 9) Internal and external welding of pipe joints carried out and tested; internal concrete lining repair and application of external wrapping;
- 10) Backfilling of trench and compaction up to ground level. Compaction usually required in layers every 200-300 mm of fill depth;
- 11) Reinstatement of the road surface with pavement material to match the adjacent pavement in compliance with the Code of Practice for Temporary Traffic Management (COPTTM); and
- 12) Removal of site safety, traffic controls and ESC devices.

2.2.2 Trenchless Technologies

The sections of trenchless technologies (as listed in Table 1) will require excavation of shafts at the beginning of the trenchless section (jacking station), and at the end of the trenchless section (reception shaft). These vertical shafts can be secured with sheet piles to the required depth that the jacking station operates from. The proposed boring machine has a closed loop slurry system where spoil from the recycling slurry water is 'separated and pumped to a waiting truck/ tank for removal from site.

The trenchless technology shafts will vary in depth depending on location and site requirements. The jacking stations will generally measure approximately 4 m by 16 m and the reception shaft will measure 4 m by 4 m. These shafts may be slightly smaller on confined sites such as Metcalf Road. In total, approximately 17 access shafts will be required for the trenchless sections of the NH2 route.

It is assumed that the reservoirs and associated hard stand areas at Woodlands Park Road will have been constructed prior to NH2. Therefore access to the Woodlands Park Road jacking station for tunnelling will be via the reservoir compound which is yet to be built. The reservoir construction is not included in the scope of this technical assessment.

2.2.3 Laydown Areas

A laydown area is used to provide secure storage for materials, machinery, staff and visitor parking, fuelling facilities, and office accommodation (including toilets). Laydown areas will be surrounded by temporary fencing for safety and security purposes; they will consist of hard stand and bunded areas for storage of hazardous materials (e.g. fuel) and stockpiles. Laydown areas will be located in practical and convenient places along the NH2 route. It is possible that the main laydown areas, site yards and pipe storage areas may be located away from the NH2 route. The number and location of laydown areas will be determined by the Contractor and will depend on available land at the time of construction. It is anticipated that each laydown area will be occupied for several months. The Contractor's ESCP will specify laydown areas and required ESCMs within the site.

2.2.4 Access Ways

Access ways are required along sections of SH18 for construction and maintenance purposes (and possibly provision of a cycleway by Auckland Transport). It is anticipated that access ways will be gravelled. The location of the access ways are presented in Table 3 and depicted in the drawings provided in Volume 3 of the AEE report.

Table 3 Access way locations and areas

Location	Area (m ²)
Titirangi to Westgate SH18 Corridor	
Hobsonville Road to SH18 (NI Shaft 2)	2,000
SH18 – NI Shaft 3	740
SH18 / 175 Brigham Creek Road (between NI Shafts 9 to 13)	5,000
SH18 / Brigham Creek Road (between NI Shafts 13 to 15)	2,500
Sinton Road (NI Shaft 15) to Squadron Drive	5,000
Greenhithe Bridge to Albany	
Albany Highway	3,000
Greenhithe Road	4,000