Penlink — Summary

Road/Shared Path — New 7 km two lane road with shared path; capacity to expand to four lanes; 540 m bridge Weiti River

		Assessment period	Units	Assumptions and notes
General Project Information				
Construction Start	2022			
Construction Finish Date	2026			Opening year
Do Minimum				Existing SH1/Twin Coast Highway/Whangaparoa Road
Lane kilometres	0		km	
Infrastructure Type	Road, Busway or Shared Path			
Emissions				
Construction	0		tCO2e	
Cumulative Enabled	63,225,835	2028-2048	tCO2e	Cumulative enabled 'Do Minimum' emissions over period (see enabled worksheet
Total Emissions per Lane Kilometre			tCO2e/lane km	Not applicable for this project (project comprises bridges and on ramps)
Do Intervention				Do Minimum + New Penlink
Road Length	7		km	Length of road of which the construction emissions are estimated
Number of vehicle lanes	2			Total number of lanes in each direction
Number of shared paths	1			Shared pathway
Lane kilometres	21		km	Road length multiplied by the number of lanes
Infrastructure Type	Road, Busway or Shared Path			
Emissions				
Construction	158,189		tCO2e	Total estimated construction emissions. See Construction worksheet.
Cumulative Enabled	63,221,380	2028-2048	tCO2e	Cumulative enabled 'Do Intervention' emissions over period (see Enabled worksh
Emissions Summary				
Construction	158,189			Total estimated construction emissions. See Construction worksheet.
Enabled Emissions				
CHANGE IN EMISSIONS, in 20 years	2028-2048			See assumptions on enabled worksheet
Do Minimum Cumulative Enabled emissions	63,225,835		tCO2e	
Do Intervention Cumulative Enabled emissions	63,221,380		tCO2e	
Cumulative Change in Enabled emissions (2028-2048)	-4,455	2028-2048	tCO2e	Change in emissions as result of implementing intervention

Project Information Summary

Do minimum All traffic (including buses) using existing SH1/Twin Coast Highway/Whangaparoa Rd
Do Intervention Traffic can use existing road or Penlink (alternate, shorter, link between SH1 and Whangaparoa Rd).
Construction emissions have been calculated based on schedule of quantities from reference design used for cost estimate.
Changes in enabled emissions arise from use of shorter route with reduced congestion on existing roads.
The enabled assessment does not include any calculation of avoided emissions arising from use of the shared path.

Penlink ENABLED EMISSIONS

Road/Shared Path

Do Minimum

Calculated Emissions

Annual	2018	2028	2038	2048	Units
From vehicle journeys		3,613,362	3,361,483	2,308,839	tCO2e
From public Transport		0	0	0	tCO2e
From cycling		0	0	0	tCO2e
From walking		0	0	0	tCO2e
Total		3,613,362	3,361,483	2,308,839	tCO2e

Cumulative calculated Emissions	2028-2038	2038-2048	2044-2053	Total	
From vehicle journeys	34,874,224	28,351,610		63,225,835	tCO2e
From public Transport	0	0		0	tCO2e
From cycling	0	0		0	tCO2e
From walking	0	0		0	tCO2e
Total	34,874,224	28,351,610		63,225,835	tCO2e

Do Minimum Total Emissions	63,225,835	2028-2048

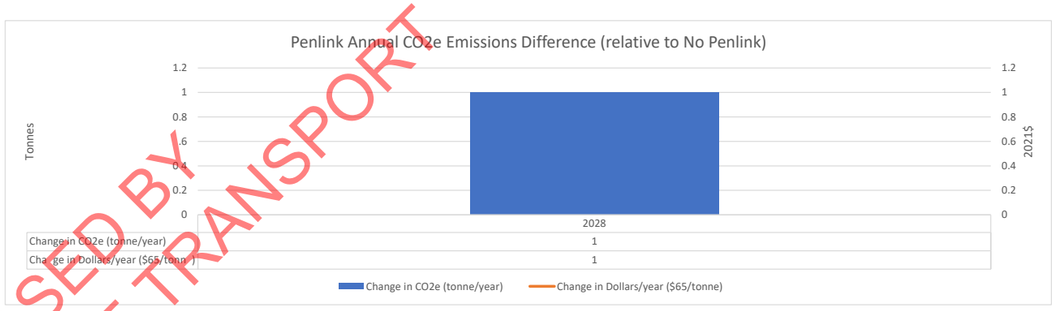
Assumptions and notes
Existing SH1/Twin Coast Highway/Whangaparoa Road

Source:

Data supplied by Beca via email 4Aug21. File VEPM 6 2 Penlink forWK.xlsm

Annual CO2-e (tonnes)

	Do_Minimum	Penlink (NoToll)	Penlink (Toll)	NoToll-DM	Toll-NoToll	Toll-DM
2028	3,613,362	3,612,650	3,605,783	- 712	- 6,868	- 7,579
2038	3,361,483	3,360,370	3,355,275	- 1,113	- 5,095	- 6,208
2048	2,308,839	2,310,885	2,308,971	2,046	- 1,915	131



Do Intervention

Do Minimum + Penlink

Calculated Emissions

Annual	2018	2028	2038	2048	
From vehicle journeys		3,612,650	3,360,370	2,310,885	tCO2e
From public Transport		0	0	0	tCO2e
From cycling		0	0	0	tCO2e
From walking		0	0	0	tCO2e
Total		3,612,650	3,360,370	2,310,885	tCO2e

Data supplied by Beca (see table above NoToll scenario).

Cumulative calculated Emissions	2028-2038	2038-2048	2044-2053	Total	
From vehicle journeys	34,865,103	28,356,277		63,221,380	tCO2e
From public Transport	0	0		0	tCO2e
From cycling	0	0		0	tCO2e
From walking	0	0		0	tCO2e
Total	34,865,103	28,356,277		63,221,380	tCO2e

Intervention Total Enabled Emissions	63,221,380	2028-2048	tCO2e

Total cumulative enabled emissions from implemening the intervention.

CHANGE in emissions				
Annual	-712	-1,113	2,046	tCO2e

Cumulative calculated enabled emissions	2028-2038	2038-2048		Total	
Do minimum vehicle journey emissions	34,874,224	28,351,610		63,225,835	tCO2e
Do intervention vehicle journey emissions	34,865,103	28,356,277		63,221,380	tCO2e
Cumulative change in vehicle journey emissions	-9,121	4,667		-4,455	tCO2e

Change in emissions as result of implementing intervention

References

Source of emissions factors for enabled emissions is the Vehicle Emission Prediction Model VEPM6 2

https://www.nzta govt.nz/roads-and-rail/highways-information-portal/technical-disciplines/air-quality-climate/planning-and-assessment/vehicle-emissions-prediction-model/

Guideline and Supporting information on methodology for transport modelling

Waka Kotahi Guidelines for transport model development
Research Report 659 Urban transport modelling in New Zealand – data, practice and resourcing

Name of Project	**NZUP Penlink**
Traffic Consultant	Beca Limited
Report (if available)	
Model Software	EMME https://www.inrosoftware.com/en/products/emme/
Model	Auckland Regional Macro Strategic Model (MSM) plus refined EMME project model for traffic Assignment and delays MSM model extent -See http://www.aucklandforecastingcentre.org.nz/
Model validation	The MSM model was satisfactorily validated to a base year of 2016, with International peer review. The local EMME traffic assignment model was validated to 2018 local conditions with peer review from Flow Transportation Ltd
Time horizons and growth assumptions	Do minimum and with Project (Toll and No toll) for 2028, 2038, 2048+, using regional Land Use forecasts Scenario I11.6. The same land use inputs were used with and without PENLINK in place
Network assumptions and interdependencies	The modelling assumed growth in the adjacent greenfield growth areas of Silverdale West, Wainui and Dairy Flat, with supporting transport networks assumed as per the SGA recommended network. Key assumptions for this analysis include SH1 widening between Albany and Silverdale in the 2048 models, along with a new rapid transit network through Dairy Flat and Silverdale West. Previous anlaysis on PENLINK has shown that wider network effects are sensitive to assumptions on widening of SH1. Other project assumptions included in later-year models include connections between Penlink and East Coast Road via Jackson Way (as per SGA network) and an expansion of the Redvale interchange to include north-facng ramps and a link west to Dairy Flat growth area.
Model Scenario Assumptions **Do Minimum**	The Do Minimum network retained the same land use and network assumptions in the wider network as the Project scenario, but excluded the Penlink project. Alternative access points for some developments off East Coast Road were required without Penlink
Model Scenario Assumptions **Do Intervention/With Project**	Option scenarios for Penl nk were tested with and without tolls. Both scenarios included bus service on Penlink between Whangaparaoa and North Shore
Induced Traffic	Induced traffic was included, via the MSM multi-modal model responses. These include mode shift, trip re-distribution and trip re-timing
Interface with Vehicle Emission Prediction Model (Where relevant)	The method used is the same as the Auckland Forecasting Centre (AFC), whereby VEPM is used to get emissions rates (g/km) for each 1km speed band between 10 and 100 kph. Those rates are then applied to each individual link in the model based on its estimated speed, and separately for cars, trucks and buses The emissions on each link are then summed across the whole network.
General assumptions/Limitations	As noted above, the results of this emissions analysis are dependent on a range of inputs and assumptions, including fleet composition (as assumed in VEPM 6.2), growth inputs (as per regional growth forecasts) and wider network assumptions (generally adopted from ATAP). This analysis only extended to the year 2048, meaning the full growth in the adjacent Dairy Flat area is not captured. Additionally, the effect of tolling depends on the tolling strategy adopted and local users response to tolls.

Transport model development guidelines (nzta.govt.nz)

https://www.nzta.govt.nz/assets/resources/research/reports/659/659-urban-transport-modelling-in-new-zealand-data-practice

Penlink — CONSTRUCTION EMISSIONS

Expected construction 2022-2026

Road/Shared Path

	Units		Emissions Factor Unit		Sources and notes
Do Intervention					
Material Quantities Estimate					
Construction Fuel Use					
Diesel	22,268,100	L	0.0027	tCO2e/L	MfE 2020
Construction Materials					
Concrete	656,980	tonnes	0.11	tCO2e/tonne	AECOM derived factor (See assumptions below)
Steel	4,410	tonnes	2.85	tCO2e/tonne	MfE 2020
Road Surface					
Crushed rock or recycled material	0	tonnes	0.0032	tCO2e/tonne	IS Calculator NZ v2.0
Gravel	671,590	tonnes	0.0182	tCO2e/tonne	IS Calculator NZ v2.0
Bitumen	0	tonnes	0.3965	tCO2e/tonne	IS Calculator NZ v2.0
Asphalt	22645	tonnes	0.0542	tCO2e/tonne	IS Calculator NZ v2.0
Project Breakdown Total	**158,189**	tonnes of CO2e			
Calculated Emissions					
Best estimate of calculated emissio	**158,189**	tonnes of CO2e			

Assumptions

Emissions for construction have been calculated from data provided by Waka Kotahi for this project. When possible assumptions have been made in a consistent manner to ensure comparability
Refer to construction schedule worksheet for indicative schedule of quantities of concrete, steel, aggregates, gravels and fuels used during construction.
Based on previous research for Waka Kotahi, only emissions from the largest emission sources from construction of infrastructure projects have been estimated (concrete, steel, aggregates, asphalt, and on-site fuel use).
Materials and works related to bridge abutments have been included where relevant.
Fuel used in the construction is assumed to be 2 litres of diesel for every m3 of earth works (AECOM derived fuel-use ratio).
The following were not included in the estimate: fuel used in quarrying activity; emissions from the transportation of construction materials to/from site.

Emission factors are sourced from MfE's 2020 Guide (see link below) where appropriate, or from the ISCA-IS Calculator v2.0.
https://environment.govt.nz/publications/measuring-emissions-detailed-guide-2020/
The ISCA-IS Calculator v2.0 is available for ISCA members at https://www.isca.org.au/Tools-and-Resources
The emission factor for concrete is based on MfE 2020 guidance and is based on a standard concrete mix.

Penlink **Construction Schedule**

Source: Penlink Project 100% Reference Design - Cost Estimate Report 7 May 2021 ((Refined Alignment) (updated earthworks quantities 4/5/2021)); as provided by WK.

Schedule of Prices

Code	Description	Unit	Quantity	Material	Unit	Material	Unit	Material	Unit	Material	Unit	Material	Unit	Assumptions/Notes
				Concrete	m3	Steel	m3	Asphalt	m3	Aggregates	m3	Fuel	kg	
1	**Environmental compliance**													
1.1	Implementation and maintenance of environmental erosion and sediment control measures (temporary sediment ponds silt fences etc)	%	5.0%											
1.2	Monitoring and implementation of temporary mitigation measures	LS	1.00											N/A
1.3	Noise and Vibration Mitigation - During Construction	LS	1.00											N/A
1.4	Dust Mitigation - During Construction (road sweeper 2 nights per week during 3 x earthworks season)	Days	186.00											N/A
1.5	Other Environmental Compliance	LS	1.00											
2	**Earthworks**													
2.1	**SITE CLEARANCE**													
2.1.1	**Private Land Accommodation Works**													
2.1.1.1	A low for all interfacing works with private properties (driveway regrades fencing etc)	No	24.00											N/A
2.1 2	**Stormwater Decommissioning**													N/A
2.1 2.1	Remove or Abandon existing stormwater network	LS	1.00											N/A
2.1 3	**Barriers**													N/A
2.1.3.1	Remove all barriers (w-section wire rope and terminal ends) along SH1	LS	1.00											N/A
2.1.4	**Signs, Lights, and Services**													N/A
2.1.4.1	Remove and dispose a l redundant signs lighting call boxes	LS	1.00											N/A
2.1.4.2	Removal of lighting columns luminaires and bases dispose or reuse	LS	1.00											N/A
2.1.4.3	Remove and dispose a l redundant utility service covers boxes chambers and lids	LS	1.00											N/A
2.1.4.4	Remove and dispose a l redundant cables and conduit as required	LS	1.00											N/A
2.1.5	**Roading**													N/A
2.1.5.1	Remove Kerb and Channel and Edge beam	LS	1.00											N/A
2.1.5.2	Remove Traffic Island at Whangaparaoa Road	LS	1.00											N/A
2.1.5.3	Remove and dispose a l edge marker posts	LS	1.00											N/A
2.1.5.4	Remove redundant Ara Weiti Road (200mx 15m x 0.3m deep)	m3	900.00									1 800.00	L	assume 2l/m3
2.1 6	**Site Clearance**													
2.1 6.1	Remove kerbs islands	days	5.00											
2.1 6.2	Clear heavy vegetation including trees stumps and roots	days	40.00											
2.1 6.3	Clear site remove surface vegetation bu ldings signs	m2	1 140 000.00									1 14 0.00	L	assume 2l/m3 and 0.5m depth
2.2	**EARTHWORKS**													
	Total Earthworks volume	m³	2 450 991.07									4 9 82.14	L	assume 2l/m3
	Total Cut	m³	1 646 565.23									3 293 130.46	L	assume 2l/m3
	Total F ll volume	m³	804 425.84									1 608 851.68	L	assume 2l/m3
	Topso l volume	m³	81 490.60									162 981.20	L	assume 2l/m3
	Cut volume less topsoil	m³	1 565 074.63									3 130 14 .26	L	assume 2l/m3
	Cut to waste	m³	1 036 203.23									2 072 406.46	L	assume 2l/m3
	Cut to f ll	m³	531 548.17									1 0 3 096.34	L	assume 2l/m3
	Imported fill	m³	272 889.97									545 79.95	L	assume 2l/m3
	Earthworks surface area	m²	271 635.34									54 32 07	L	assume 2l/m3. Assume 0.1m depth
2.2.1	**Topso l Stripping**													
2.2.1.1	Strip and remove topsoil stockpile onsite (300mm)	m²	271 635.34									162,981.20	L	assume 2l/m3 and 0.3m depth
2.2 2.2	Topso l disposal management	m³	81 490.60									162 981.20	L	assume 2l/m3
2.2 2	**Cut to Waste (%)**	%	68%											
	Cut to waste total	m3	1 036 203.23									2 072 406.46	L	assume 2l/m3
2.2 2.1	Zone 1	m³	10 039.78											Used total above
2.2 2.2	Zone 2	m³	-											Used total above
2.2 2.3	Zone 3	m³	8 684.33											Used total above
2.2 2.4	Zone 4	m³	339 211.93											Used total above
2.2 2.5	Zone 5	m³	86 530.67											Used total above
2.2 2.6	Zone 6	m³	544 082.12											Used total above
2.2 2.7	Zone 7	m³	47 654.39											Used total above
2.2 2.8	Onsite tip site management preparation	m³	200 000.00											Used total above
2.2 2.9	Tip fee to Waste Management (Redvale Landfil) - quote $5/tn	m³	836 203.23											Used total above
2.2 3	**Cut to Fill (%)**	%	32%											
	Cut to f ll total	m³	531 548.17									1 063 096.34	L	assume 2l/m3
2.2.3.1	Zone 1	m³	3 713.34											Used total above
2.2.3.2	Zone 2	m³	-											Used total above
2.2.3.3	Zone 3	m³	3 721.86											Used total above
2.2.3.4	Zone 4	m³	113 070.64											Used total above
2.2.3.5	Zone 5	m³	46 593.44											Used total above
2.2.3.6	Zone 6	m³	292 967.30											Used total above
2.2.3.7	Zone 7	m³	71 481.59											Used total above
2.2.3.8	Crusher to grade cut ECBF material	m³	292 967.30											Used total above
2.2.3.9	A low for ime stabilisation cut to fill material (20%)	m³	106 09.63											Used total above
2.2.4	**Imported Fill**	**m3**	**272,889.97**											
	Zones 1 and 2 (SH1)	**m3**	**19,056.86**											
2.2.4.1	Supply and deliver imported engineered fi l Type A (GAP65) - 25%	m³	4 4.22							8 575.59	t			Assuming density of aggregate of 1800kg/m3 (CI AE
2.2.4.2	Supply and deliver imported engineered fi l (SPR/ROP) - 60%	m³	1 434							20 581.41	t			Assuming density of aggregate of 1800kg/m3 (CI AE
2.2.4.3	Supply and deliver imported engineered fi l Type C (GAP100) for raft f ll (15%)	m³	2 858.53							5 145.35	t			Assuming density of aggregate of 1800kg/m3 (CI AE
2.2.4.4	Place and compact imported fi l	m³	19 0 6.86									38 113.72	L	assume 2l/m3
	Zone 3 (Ara Weiti Road)	**m3**	**38 3.92**											
2.2.4.5	Supply and deliver imported engineered fi l Type A (GAP65) - 25%	m³	9 575.98							17 236.77	t			Assuming density of aggregate of 1800kg/m3 (CI AE
2.2.4.6	Supply and deliver imported engineered fi l (SPR/ROP) - 60%	m³	22 982.35							41 368.24	t			Assuming density of aggregate of 1800kg/m3 (CI AE
2.2.4.7	Supply and deliver imported engineered fi l Type C (GAP100) for raft f ll (15%)	m³	5 745.59							10 342.06	t			Assuming density of aggregate of 1800kg/m3 (CI AE
2.2.4.8	Place and compact imported fi l		38 03.92									76 607.85	L	assume 2l/m3
	Zones 4, 5, 6 (Ara Weiti Road)	**m3**	**166 580.87**											
2.2.4.9	Supply and deliver imported engineered fi l Type A (GAP65) - 25%	m³	41 6 5.22							74 961.39	t			Assuming density of aggregate of 1800kg/m3 (CI AE
2.2.4.10	Supply and deliver imported engineered fi l (SPR/ROP) - 60%	m³	99 48.52							179 907.34	t			Assuming density of aggregate of 1800kg/m3 (CI AE
2.2.4.11	Supply and deliver imported engineered fi l Type C (GAP100) for raft f ll (15%)	m³	24 987.13							44 976.83	t			Assuming density of aggregate of 1800kg/m3 (CI AE
2.2.4.12	Place and compact imported fi l		166 580.87									333 161.74	L	assume 2l/m3
	Zone 7 (Whangaparaoa Road)	**m3**	**48,948.32**											
2.2.4.13	Supply and deliver imported engineered fi l Type A (G P65) - 25%	m³	12 237.08							22 026.74	t			Assuming density of aggregate of 1800kg/m3 (CI AE
2.2.4.14	Supply and deliver imported engineered fi l (SPR/ROP) - 60%	m³	29 68.99							52 864.19	t			Assuming density of aggregate of 1800kg/m3 (CI AE
2.2.4.15	Supply and deliver imported engineered fi l Type C (GAP100) for raft f ll (15%)	m³	7 342.25							13 216.05	t			Assuming density of aggregate of 1800kg/m3 (CI AE
2.2.4.16	Place and compact imported fi l	m3	48 948.32									97 896.64	L	assume 2l/m3
2.2 5	**Temporary slope stabilisation**													
2.2.5.1	Supply and place mulch or hydroseeding	m²	271 635.34											
3	**Ground improvements**													
	DSM Standard 1m dia x 25m deep 3m x 10m grid MPa - RATE ONLY	m2												
	DSM Increased Density 1m dia x 25 deep 2m m grid MPa - RATE ONLY	m2												
3.1	Supply Install and Monitor P meter and other instrumentation	LS	1.00											
3.2	**Deep Soil Mixing - Standard**													
3.2.1	ID1 - CH-14 to 50	m2	2 688.00	26 880.00										Assumed 8m depth 50% concrete ratio to soil
3.2 2	ID4 - CH1207 - 12 4	m2	3 828.00	38,280.00										Assumed 8m depth 50% concrete ratio to soil
3.2.3	ID5A - CH129 -1413	m2	3 212.00	32 120.00										Assumed 8m depth 50% concrete ratio to soil
3.2.4	ID7B - CH2 41-2286	m2	14 210.00	142 100.00										Assumed 8m depth 50% concrete ratio to soil
3.2.5	ID8 - CH-57 3861	m2	13 489.00	134 890.00										Assumed 8m depth 50% concrete ratio to soil
3.2 6	ID9 - CH3255-3	m2	6 786.00	67 860.00										Assumed 8m depth 50% concrete ratio to soil
3.2.7	ID10A - CH3438-3484	m2	4 140.00	41 400.00										Assumed 8m depth 50% concrete ratio to soil
3.2 8	ID10B - CH3615-3657	m2	2 688.00	26 880.00										Assumed 8m depth 50% concrete ratio to soil
3.3	**Deep Soil Mixing - Increased Density**													
3.3.1	ID5 - CH1293-1439	m3	2 044.00	2 555.00										50% concrete ratio to soil
3.3 2	ID6 - CH1640 - 1746	m3	2 968.00	3 710.00										50% concrete ratio to soil
3.3.3	ID7 - CH2186-2282	m3	1 440.00	1 800.00										50% concrete ratio to soil
3.3.4	ID7A - CH2196-2294	m3	1 862.00	2 327.50										50% concrete ratio to soil
3.4	**Preloading**													
3.4.1	ID2 - CH120 - 82	m3	16 120.00	20 150.00										50% concrete ratio to soil
3.4.2	ID3 - CH240 - 440	m3	11 200.00	14 000.00										50% concrete ratio to soil
3.4.3	ID10 - CH3465- 653	m3	19 176.00	23 970.00										50% concrete ratio to soil
3.5	**Undercut**													
3.5.1	ID11 - CH6220-6525 (Assume 5m deep)	m3	64 050.00											No materials just excavation backf ll covered below
3.5 2	ID11A - CH6756-6909 (Assume 5m deep)	m3	15 00.00											No materials just excavation backf ll covered below
3.5.3	Supply and deliver GAP65 hardill for undercut	m3	79 350.00							142,830.00	t	158,700.00	L	assume 2l/m3
4	**Stormwater and drainage**													
4.1	**Kerb and Channel**													
4.1.1	Supply and install NZTA semi mountable kerb	m	380.00											
4.1.2	Supply and install AT Kerb and backfill Type 1	m	4 238.80											
4.1.3	Supply and install 600mm wide dish drain	m	12 607.84											

4.1.4	Supply and install vertical kerb N b	m	3 445.00											
4.1.5	Supply and install traffic island Nib	m	2 082.14											
4.2	**Supply and install subsoil drains**													
4.2.1	Supply and install subsoil drains	m	21 042.00											
4.3	**Culvert and Headwalls**													
4.3.1	Supply and install 375dia RC pipes	m	295.00	27.66	t									Assumed width of 0.375m width and 0.1m depth. Cc
4.3.2	Supply and install 375dia wingwalls	ea	14.00	11.59	t									Standard wingwall at 300 - 675 at 0.828t per headwa
4.3.3	Supply and install 450dia RC pipes	m	395.00	44.44	t									Assumed width of 0.450m width and 0.1m depth. Cc
4.3.4	Supply and install 450dia wingwalls	ea	12.00	9.94	t									Standard wingwall at 300 - 675 at 0.828t per headwa
4.3.5	Supply and install 525dia RC pipes	m	155.00	20.34	t									Assumed width of 0.525m width and 0.1m depth. Cc
4.3.6	Supply and install 525dia wingwalls	ea	4.00	3.31	t									Standard wingwall at 300 - 675 at 0.828t per headwa
4.3.7	Supply and install 600dia RC pipes	m	345.00	51.75	t									Assumed width of 0.600m width and 0.1m depth. Cc
4.3.8	Supply and install 600dia wingwalls and safety fence	ea	0.00	8.28	t									Standard wingwall at 300 - 675 at 0.828t per headwa
4.3.9	Supply and install 750dia RC pipe	m	95.00	17.81	t									Assumed width of 0.750m width and 0.1m depth. Cc
4.3.10	Supply and install 750dia wingwalls and safety fence	ea	4.00	8.26	t									Standard wingwall at 600 - 1050 at 2.065t per headv
4.3.11	Supply and install 900dia RC pipe	m	290.00	65.25	t									Assumed width of 0.900m width and 0.1m depth. Cc
4.3.12	Supply and install 900dia wingwall and safety fence	ea	8.00	16.52	t									Standard wingwall at 600 - 1050 at 2.065t per headv
4.3.13	Supply and install 975dia RC pipe	m	0.00	6.75	t									Assumed width of 0.975m width and 0.1m depth. Cc
4.3.14	Supply and install 975dia wingwall and safety fence	ea	2.00	4.13	t									Standard wingwall at 600 - 1050 at 2.065t per headv
4.3.15	Supply and install 1050dia RC pipes	m	185.00	48.56	t									Assumed width of 1.050m width and 0.1m depth. Cc
4.3.16	Supply and install 1050dia wingwalls and safety fence	ea	6.00	12.39	t									Standard wingwall at 600 - 1050 at 2.065t per headv
4.3.17	Supply and install 1200dia RC pipes	m	45.00	13.50	t									Assumed width of 1.20m width and 0.1m depth. Con
4.3.18	Supply and install 1200dia wingwalls and safety fence	ea	2.00	12.80	t									Standard wingwall at 1200 - 1350 at 6.40t per headv
4.3.19	Supply and install 1350dia RC pipes	m	50.00	16.88	t									Assumed width of 1.350m width and 0.1m depth. Cc
4.3.20	Supply and install 1350dia wingwalls and safety fence	ea	2.00	12.80	t									Standard wingwall at 1200 - 1350 at 6.40t per headv
4.3.21	Supply and install 1600dia RC pipes	m	135.00	54.00	t									Assumed width of 1.600m width and 0.1m depth. Cc
4.3.22	Supply and install 1600dia wingwalls and safety fence	ea	4.00	32.08	t									Standard wingwall at 1600 - 1800 at 8.020t per hea
4.3.23	Supply and install 1800dia RC pipes	m	145.00	65.25	t									Assumed width of 1.800m width and 0.1m depth. Cc
4.3.24	Supply and install 1800dia wingwalls and safety fence	ea	6.00	48.12	t									Standard wingwall at 1600 - 1800 at 8.0 0t per hea
4.4	**Permanent Ponds/ Wetlands**													
4.4.1	Pond 1	m3	3 343.00											
4.4.2	Pond 2	m3	2 889.00											
4.4.3	Pond 3A	m3	1 85.00											
4.4.4	Pond 3B	m3	2 206.00											
4.4.5	Pond 4	m3	2 292.00											
4.4.6	Pond 5A	m3	907.00											
4.4.7	Pond 5B	m3	2 349.00											
4.4.8	Pond 6	m3	209.00											
4.4.9	Pond 7	m3	514.00											
4.5	**Grassed swales**													
4.5.1	Open channel/ diversion drains	m	9 670.10											
4.5.2	Grassed/ treatment swales	m	30.80											
4.6	**Pipes - up to 2m BGL**													
4.6.1	Supply and install avg 450dia RRJ Class 2	m	11 484.00	2 181.96	t	436.39	t							Calc lation provided by AECOM quantity surveyor 1
4.7	**Catchpits, Manholes, misc structures**													
4.7.1	Supply and install 1050dia catchpit MH	ea	180.00	382.50	t	6.84	t							Calculation provided by AECOM quantity surveyor 1
4.7.2	Supply and install single splay catchpit	ea	96.00	41.86	t									Assume mass of 436 kg https / www.hynds.co.nz/w
4.7.3	Supply and install1050dia scruffy dome MH at wetlands max 2 DTI	ea	9.00	19.13	t	0.34	t							Calculation provided by AECOM quantity surveyor 1
4.7.3	Supply and install 375 -600mm headwall with riprap outlet	ea	19.00	15.73	t									Standard wingwall at 300 - 675 at 0.828t per headwa
5	**Pavement and surfacing**													
5.1	**Pavement**													
5.1.1	Type 1A (Main Alignment)	m²	15 567.47					2 335.12	t					Assume 0.1m depth, 1.5t/m3
5.1 2	Type 1B (Main Alignment Interchanges and Turning Lanes)	m²	12 82.00					1 827.30	t					Assume 0.1m depth, 1.5t/m
5.1.3	Type 2A (Overlay)	m²	2 826.72					424.01	t					Assume 0.1m depth, 1.5t/m5
5.1.4	Type 2B (Widening)	m²	3 248.82					487.32	t					Assume 0.1m depth, 1.5t/m6
5.1.5	Type 2C (Overlay at interchanges and turning lanes) - on existing pavement	m²	4 198.48					629.7						Assume 0.1m depth, 1.5t/m7
5.1 6	Type 2D (Widening at interchanges and turning lanes) - new pavement	m²	2 353.74					353.06	t					Assume 0.1m depth, 1.5t/m8
5.1.7	Type 3A (SH1 Ramp)	m²	7 447.97					1 1 7.20	t					Assume 0.1m depth, 1.5t/m9
5.1 8	Type 3B (Roundabout)	m²	4 073.96					61 .09	t					Assume 0.1m depth, 1.5t/m10
5.1.9	Type 4A (Local Roads)	m²	5 471.51					820.73	t					Assume 0.1m depth, 1.5t/m11
5.1.10	Type 4B (Local Roads interchanges)	m²	7 781.84					1 67.28	t					Assume 0.1m depth, 1.5t/m12
5.1.11	Type 5A (CH3300 - 7000)	m²	29 687.19					4,453.08						Assume 0.1m depth, 1.5t/m13
5.1.12	Type 5B (Main alignment and interchange around Duck Ck Rd)	m²	7 342.91					1 101.44	t					Assume 0.1m depth, 1.5t/m1
5.1.13	Type 6 (Shared Use Path)	m²	22 843.67					3 426.55						Assume 0.1m depth, 1.5t/m15
5.1.14	Type 7 (Bridge)	m²	9 320.51					1 398.08	t					Assume 0.1m depth, 1.5t/m16
5.1.15	Type 8 (Sha low overlay)	m²	4 114.73					617.21	t					Assume 0.1m depth, 1.5t/m17
5.1.16	Type 9 (Deep overlay - Whangaparaoa Rd)	m²	5 146.50					77 .98	t					Assume 0.1m depth, 1.5t/m18
5.1.17	Type 0 (Penlink - Whangaparaoa Intersection)	m²	5 960.47					894.07	t					Assume 0.1m depth, 1.5t/m19
5.1.18	Subgrade improvement layer (33% pavement area - assume 3% lime stabilisation)	m²	31 401.95							23 551.46	t			Assumed 0.5m depth 1.5t/m3
5.2	**Pavement reinstatement/ rehabi itation**													
5.2.1	SH1 - Mill membrane relay OGPA	m²	1 400.00					210.00	t					Assumed resurfacing of 0.1m depth 1.5t/m3
5.3	Speed tables - local roads (Assume 10m W x 4m L @ $550/m2)	No	7.00											
6	**Bridges and gantries**													
6	**BRIDGES**													
	Bridge total footprint	**m2**	**1 4.00**	16 691.40	t	2 344.21	t							Allow 2500kg/m3 for concrete and 5% by volume of steel weight 7,900kg/m3 (450mm thick deck) Allow 20% factor
	On a ignment	**m2**	**11,508.00**											
	Off alignment	**m2**	**856.00**											
6.1	BR01 - Bridge 1 - CH 00 bridge over SH1	m2	447.00											
6.2	BR02 - Bridge 2 - C220 bridge over East Coast Road	m2	201.00											
6.3	BR03 - Bridge 3 - CH 1200 intersection 1 overpass	m2	384.00											
6.4	BR04 - Bridge 4 - CH2200 intersection 2 underpass	m2	472.00											
6.5	BR05 - Bridge 5 - CH 5000 Duck Creek Road overpass (Alternative ngle span)	m2	560.00											
6.6	BR06 - Bridge 6 - Weiti River Viaduct	m2	10 86 00											
7	**Retaining walls and noise wa ls**													
	RETAINING STRUCTURES													
	Note:													
	MSE assumes geogrid with precast facing panel	**m2**												
	P led wall (w/ 200mm shotcrete): 0 - 3m Heig 0.6m dia 9m ong	m2												
	P led wall (w/ 200mm shotcrete): 3 - 6m height 0 m dia 15m long 1 row anchor	m2												
	P led wall (w/ 200mm shotcrete): 6 - 9m height 1.2m dia 25m long 2 row anchors	m2												
	P led wall (w/ 200mm shotcrete): 9 - 12m height 1.2m dia 30m long 3 row anchors	m2												
	P lecap rate	m3												
7.1	**General**													
7.1.1	Subcontractor mobilisation site fac lities	LS	1.00											
7.1 2	Access tracks construction 8m wide x 1m deep	m3	7 600.00											
7.1.3	Silt control dewatering	LS	1.00											
7.1.4	Subcontractor demobi isation remove acces reinstat ment	m3	7 600.00											
7.1.5	Subcontractor P&G	LS	15%											
7.2	**MSE Walls**	**m2**	**3,819.00**	6683 25	t	527.97675	t			13,7 8. 0	t			Assumed 350 wide Conc ete facing. Assumed 2m high wall, aggrega e backf ll o full wall he ght, 2m w dth. 20% allowance for back ill beyond aggregate
7.2.1	MSE No1	m2	155.20											
7.2 2	MSE No2	m2	393.60											
7.2.3	MSE No3	m2	524.60											
7.2.4	MSE No4	m2	805.80											
7.2.5	MSE No5	m2	655.80											
7.2 6	MSE No6	m2	709.80											
7.2.7	MSE No7	m2	574.20											
	Extra over for subsoil drain below MSE	m	1 909.50							257.78	t			Allowed for 300x300 subsoil drain with drainage mat
7.3	**P led Wall**	**m2**	**5,613.00**											
7.3.1	P le No1 - 80m long 2.4m height	m2	183.00	457.50										Assume 1m wide. Assume 2.5t/m3 of concrete.
7.3 2	P le No2 - 65m long 3. m height	m2	208.00	520.00										Assume 1m wide. Assume 2.5t/m3 of concrete.
7.3.3	P le No3 - 80m long 5m height	m2	396.00	990.00										Assume 1m wide. Assume 2.5t/m3 of concrete.
7.3.4	P le No4 - 134m long 5.3m height	m2	708.00	1 770.00										Assume 1m wide. Assume 2.5t/m3 of concrete.
7.3.5	P le No5 - 110m long 6 2m height	m2	673.00	1 682.50										Assume 1m wide. Assume 2.5t/m3 of concrete.
7.3 6	P le No6 - 87m long 5.9m height	m2	512.00	1 280.00										Assume 1m wide. Assume 2.5t/m3 of concrete.
7.3.7	P le No7 - 92m long 5.5m height	m2	494.00	1 235.00										Assume 1m wide. Assume 2.5t/m3 of concrete.
7.3 8	P le No8 - 80m long 8. m height	m2	644.00	1 610.00										Assume 1m wide. Assume 2.5t/m3 of concrete.
7.3.9	P le No9 - 93m long 7. m height	m2	665.00	1 662.50										Assume 1m wide. Assume 2.5t/m3 of concrete.
7.3.10	P le No10 - 57m long 6m height	m2	337.00	842.50										Assume 1m wide. Assume 2.5t/m3 of concrete.
7.3.11	P le No11 - 140m long 5.7m height	m2	793.00	1 982.50										
7.3.12	Additional piled RW in cuts in Zones 5 and 6 (allow 200m L x 6m H)	m2	1 200.00	750.00	t	118.50	t							Assumed 250 thick retaing wall
7.3.13	P lecap - assume 1.5m wide x 1m high	m3	1 816.50	4 541.25	t	717.52	t							Assumed concreted pile caps Assume 2.5/m3 of con
7.4	**NOISE WALLS**													
7.4.1	Supply and Install 3.5m Noise Wall	m	150.00	196.88	t							157.50	L	Assume 0.15 m wide 3.5m tall https //litecretesyste
7.4 2	Supply and Install 4.0m Noise Wall	m	100.00	150.00	t							120.00	L	Assume 0.15 m wide 4.0m tall https //litecretesyste
7.4.3	Supply and Install 5.0m Noise Wall	m	460.00	862.50	t							690.00	L	Assume 0.15 m wide, 5.0m tall, https //litecretesyste
7.4.4	Supply and Install 7.0m Noise Wall	m	192.00	504.00	t							403.20	L	Assume 0.15 m wide 7.0m tall https //litecretesyste

8. TRAFFIC SERVICES (BARRIERS, ITS, LIGHTING)														
8.1	**Barriers and Transitions**													
8.1.1	Supply and install TL4 wire rope barrier (westbound carriageway edge and CL)	m	9 890.00			183.95	t							https //www.ingalcivil.co nz/products/road-safety-bar
8.1.2	Supply and install TL4 wire rope end terminals (average @500m runs)	ea	30			1.00	t							https //www.ingalcivil.co nz/products/road-safety-bar
8.1.3	Supply and install TL4 concrete barrier - northern carriageway adjacent SUP)	m	8 205.00	28 307.25										Assume height of 920 mm width of 1500 mm, https
8.1.4	Supply and install TL5 concrete barriers	m	100.00	412.50										Assume height of 1100 mm width of 1500 mm, http
8.1.5	Supply and install TL4 W-section guardrail	m	5 632.00			63.64	t							11.3kg/m (https //www.csppacific.co.nz/).
8.1.6	Supply and install TL4 W-section leading terminal	ea	20.00											
8.1.7	Supply and install TL4 W-section trailing terminal	ea	20.00											
8.1.8	Supply and install TL4 W-section guardrail transitions	ea	24.00											
8.2	**Pavement Markings and Markers**													
8.2.1	Remove existing pavement markings	LS	1.00											
8.2.2	Supply and lay new pavement markings	m	52 200.00											Exclude as likely to be immaterial based on previous
8.3	**Road Signs and Gantries**													Exclude as likely to be immaterial based on previous
	Penlink and Whangaparaoa Road													
8.3.1	Remove and dispose existing traffic signs poles footings	LS	1.00											
8.3.2	Supply and install new traffic signs	LS	1.00											
	SH1 Main Carriageway and On/Offramps													
8.3.3	Supply and install new motorway signs	LS	1.00											
8.3.4	Supply and install VMS signs and poles	LS	1.00											
8.3.5	Supply and Install New TMS Cabinets	LS	1.00											
8.3.6	Supply and Install New RMS Count site Controller Cabinet	LS	1.00											
8.3.7	Supply and Install New Roadside Controller Cabinet CCTV & VMS	LS	1.00											
8.3.8	Connection to ATOC main truck line along SH1	LS	1.00											
8.3.9	Ramp metering	LS	1.00											
	Gantries													
8.3.10	Supply and install Truss Portal foundations and piles as required (incl signs)	No	2.00	1.25	t	4.03	t							Assumed 20m width, 4m height from road to base assumed 60kg/m Assumed s
8.3.11	Supply and install Tubular Cantilever gantry foundations and piles as required	No	3.00	1.88	t	6.05	t							Assumed 20m width, 4m height from road to base assumed 60kg/m Assumed s
8.3.12	Supply and install VMS sign board	LS	1.00											
8.4	**Traffic Signals**													
8.4.1	Traffic signals - Whangaparaoa Road intersection	**LS**	1.00											
8.4.2	RMS Loops	LS	1.00											
8.4.4	RMS loops - North Bound Off Ramp	LS	1.00											
8.4.5	RMS loops - South Bound On Ramp	LS	1.00											
8.5	**Lighting at intersections, interchange, Whangaparaoa Road, and SUP**													
8.5.1	Remove and dispose existing lights	ea	12.00											
8.5.2a	Supply and install new lights footings and connection - Type V3 (50m spacing)													
	NB offramp SB onramp ECR link road	ea	6.00											
	Whangaparaoa Road	ea	19.00											
8.5.2b	Supply and install new lights footings and connection - Type V4 (50m spacing)													
	Intersection 1	ea	0.00											
	Intersection 2	ea	0.00											
	Duck Creek Road interchange	ea	11.00											
8.5.3	Supply and install new HV transformer	ea	4.00											
8.5.5	Supply and install new ducting and LV cabling	m	4 00.00											
8.5.6	Montrose Boxes	LS	5.00											
8.5.7	Power Supply and connections	LS	1.00											
8.5.8	Testing and Commissioning	LS	1.00											
8.5.9	Lighting along SUP @30m crs including cabling and conduits - Type PP3	ea	207											
8.5.10	Cabling and conduit for SUP lighting	lm	6 200.00											
9. UTILITIES														
	UTILITIES													
9.1	**Vector**													
9.1.1	2.5km of 11kV overhead cable to be undergrounded from East Coast Rd	LM	2 500.00											
9.1 2	km West of bridge to 350m East of Bridge 11kV and 33kV overhead cable to be undergrounded	LM	1 350.00											
9.1.3	A low for separated power supply for shared path and carriageway ighting	LM	6 230.00											
9.1.4	New MP4 150mm dia PE gas main along the corridor to allow for connection and future supply. Sleeved in 250mm dia PE duct through bridge and under motorway	LM	6 230.00											
9.2	**Watercare**													
9.2.1	Relocation of an existing 250 mm PE water distr bution main with associated valves runs along the southern side of Ara Weiti Rd from East Coast Road.	LM	1 800.00											
9.2 2	Whangaparoa Rd Existing services to be maintained and or relocated	Sum	1.00											
9.2.3	00mm communication duct for WSL	LM	6 230.00											
9.3	**Communications**													
9.3.1	Chorus - 2no comms duct along main corridor including cutover	LM	46 00											
9.3 2	Vodafone - 2no comms duct along main corridor (future proof)	LM	12 460.0											
9.4	**General**													
9.4.1	Shared use service trench - excavate and backfill	LM	6 2 0.00											
9.4 2	Utility locating and protection	Sum	1.00											
10. LANDSCAPING AND URBAN DESIGN														
	Notes: Open earthworks batters area = 230 000m2	m2	230 000.00											
10.1	**LANDSCAPING**													
10.1.1	Topso l treatment	m	25 000 0											
10.1.2	Respread topsoil from stockp le (250mm)	m2	250,000.0									125 000.00	l	Assume depth of 0.25 m 2l/m3
10.1.3	Mulching	m2	834 00 00											Exclude as likely to be immaterial based on previous
10.1.4	Weed control/ maintenance	m2	977 0 0.00											Exclude as likely to be immaterial based on previous
10.1.5	Revegetation planting	m2	2 0 000.00											Exclude as likely to be immaterial based on previous
10.2	**Footpath/ Shared Path/ Cycle Path**													Exclude as likely to be immaterial based on previous
10.2.1	Supply place and finish concrete footpath/ cyc pat incl SC (100mm concrete) - along Whangaparaoa Road	m2	3 337.80	1 668.90	t									Assume 0.1m depth. Concrete 2.5t/m3
10.2.2	Supply and install new pram crossing with tact le paving	Sum	1.00											
10.2.3	Supply and install green overlay for cycle path cross g	Sum	1.00											
10.3	**Fencing**													
10.3.1	Supply and install all fencing required typ adjacent SUP - pool fence	LM	6 00.00											
10.3.2	Fencing along designation boundary - 7 wire	LM	20 000.00											
11. TEMPORARY WORKS AND TRAFFIC MANAGEMENT														
11.1	**Traffic Management**													
11.1.1	Preparation of Traffic Management Plans (Design a d Ap)	LS	1.00											Exclude as likely to be immaterial based on previous
11.1.2	Implementation and maintenance of daily/ regular Te porary Traffic Management	Mo	0.00											Exclude as likely to be immaterial based on previous
11.1.3	Implementation of major road closures/ detours for cr ical activities (shifts) e.g. girder lifts asphalting tie etc	No	40.00											Exclude as likely to be immaterial based on previous
11.1.4	Temporary barriers including supply hire and emoval - 500m x 4 sides on SH1 400m x 2 on Whanga a Rd	Mo	0.00											Exclude as likely to be immaterial based on previous
11.1.5	Crash cushions	No	0.00											Exclude as likely to be immaterial based on previous
11.2	**Temporary Works**													Exclude as likely to be immaterial based on previous
11.2.1	SH1 temporary se	m2	1 600.00											Exclude as likely to be immaterial based on previous
11.2.2	Ara Weiti Road cr ssov temporary pavement and temporary tie ins (ch 1500 - 2 0) - 2 s ages to nable cut and RW construction	m2	8 000.00											Exclude as likely to be immaterial based on previous
11.2.3	Duck Cre temporary d sion earthworks and tie ins	m2	1 600.00									1 280.00	l	Assume 400mm depth
11.2.4	Whangaparaoa Road temporary widening pedestrian diversion	m2	800.00											Exclude as likely to be immaterial based on previous
11.2.5	Temporary Haul R ads	m2	60 000.00											Exclude as likely to be immaterial based on previous
12. PRELIMINARY AND GENERAL														
12	**PRELIMINARY AND GENERAL**													
12.1	Estab ishment and Demobilisation	LS	1.00											N/A
12.2	Management Plans	LS	1.00											N/A
12.3	Stakeholder communications	LS	1.00											N/A
12.4	Survey and set-out	LS	1.00											N/A
12.5	Maintenance	LS	1.00											N/A
12.6	Staffing	LS	1.00											N/A
12.7	Consent Permits and Fees	LS	1.00											N/A
12.8	Site facilities	LS	1.00											N/A
12.9	Step Change	LS	1.00											N/A
12. 0	Testing by Contractor	LS	1.00											N/A
13. EXTRAORDINARY COSTS														
13.1	Wetlands offset mitigation	ha	11.00											
13.2	Stream offset mitigation (assume 20m either side of stream bank 600m long)	m2	64 000.00											Exclude as likely to be immaterial based on previous
13.3	Ecological offsite offset mitigation	ha	92.00											
13.4	Pest control weed control maintenance (DLP)	ha	69.60											
13.5	Cattle race west of Weiti River Bridge (430m x 2.5m wide)	m2	1 075.00											Exclude as likely to be immaterial based on previous

13.6	**Toll System**													
13.6.1	Supply and install tolling system	**LS**	1.00											

Totals	656979.6	t	4410.5	t	22645.3	t	671589.6	t	22268100.4	t