



NPS Assessment Geospatial Analysis Study Area New Lynn

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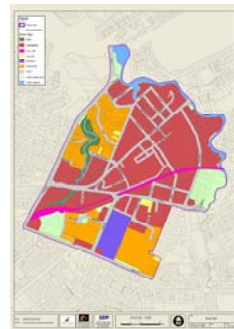
Helen Chin

Content

- **Introduction**
- **Background**
- **Scope**
- **Methodology**
- **Conclusion**

Introduction

- **Non Point Sources of Pollution (NPS) assessment**
- **Approach using the spatial analysis model and applied to**
- **The New Lynn catchment**



- **Nonpoint source pollution (NPS)**
- **ARC 'Sources and loads of metals in urban stormwater' Study 2005**
- **ARC Contaminant load model (CLM) spreadsheet**
- **Spatial Analysis**

- To develop the Spatial Analysis Method for CLM and prepare, analyse, compute and present information using ArcGIS.

**Preparation
Analysis
Outputs
Discussion
Conclusions**



- **Data preparation and database development**
 - **Contaminant yields for various source types based on current and future land coverage**
 - **Reductions efficiencies values for various treatment options applied on different source types**
 - **Input and output datasets**
- **Development of spatial tools to calculate initial contaminant loads**
- **Development of spatial tools to calculate reduced loads**

Data Description and Database Development

- Non-spatial Data
- Spatial Data
- Data Preparation

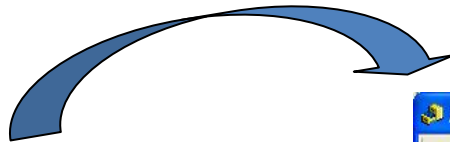
Microsoft Excel - roadlist_traffic_count.xls

File Edit View Insert Format Tools Data Window Help

Sheet1

	Start	End	Start Name	End Name	Urbanity	Length M	Width	Adt Est	Adt Count	Reason Arg
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120	246	247	MAJOR RD	MAJOR RD	Urban	246	10.6			

Contaminant yield values and treatment efficiencies

An Excel spreadsheet with multiple worksheets. The visible worksheets are labeled 'CONTAMINANT YIELD VALUES', 'TREATMENT EFFICIENCIES', and 'TREATMENT EFFICIENCIES'. Each worksheet contains a table with columns for various categories and numerical values.

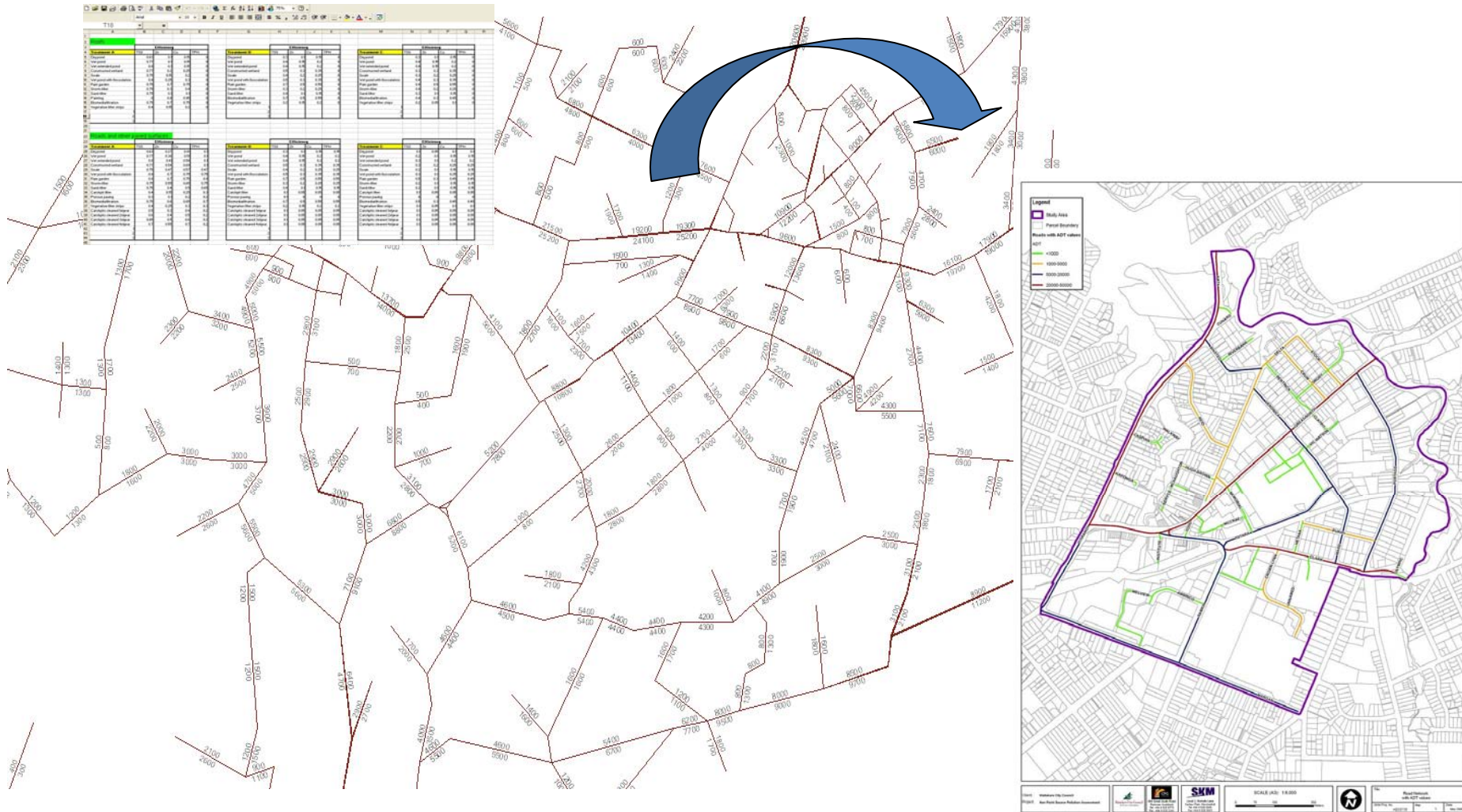
Excel spreadsheet

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Contents Preview Metadata
Yields_Efficiencies.mdb
Con_otherLUs_reduction_efficienc
Construction 12m
Construction 2m
Construction 6m
Exotic production forest
Farmed Pasture
Horticulture
PavedS
Retired Pasture
Road_reduction_efficiencies
Roads
Roof_reduction_efficiencies
Roof_surveyed
Roofs
Stable Bush
Stream_reduction_efficiencies
UGL_reduction_efficiencies
Urban Grass land
remap.dbf
remap1.dbf
Record: 1 Show: All Selected cords
Preview: Table

Roof_Type	Sediment	Zinc	Copper
Clay	5	0.02	0.0008
Colorsteel/colorcote	5	0.04	0.0008
Concrete	10	0.02	0.0013
Copper	5	0	3
Decramastic	5	0.2	0.0017
Galvanised steel poor paint	5	1.6	0.0008
Galvanised unpainted	5	2.2	0.0008
Galvanised well painted	5	0.15	0.0008
Other materials	5	0.02	0.0008
Slate	5	0.02	0.0008
Unknown (no galvanised steel	7	0.2	0.0008
Zinc/aluminium unpainted	5	0.3	0.0008

Geodatabase

Average Daily Traffic (ADT) counts



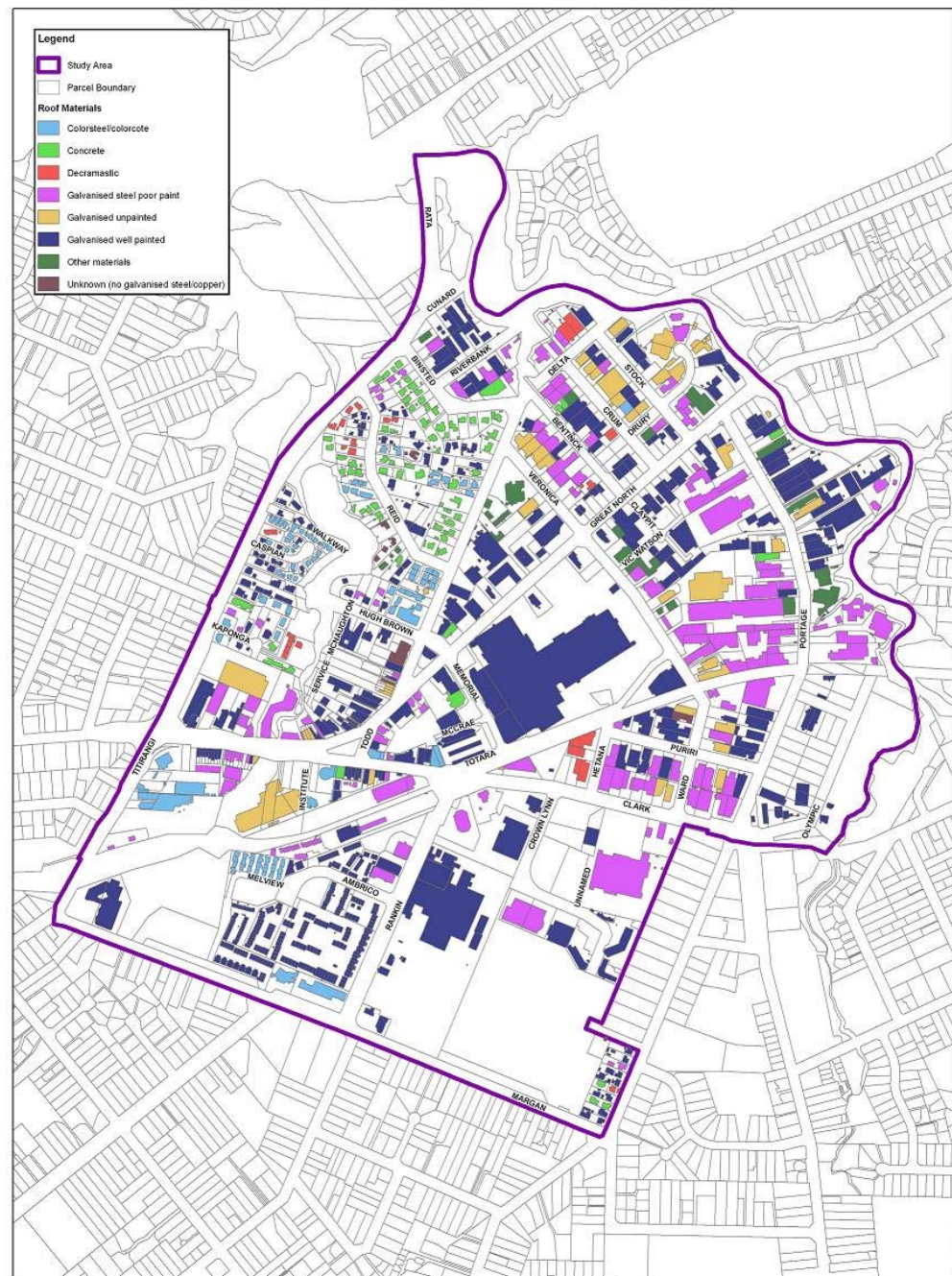
Spatial Data

Spatial data feature	Comment
Contour	The slope analysis is based on the Lidar data contours.
Impervious Area	The impervious area within the catchment is provided in various layers as roads, footpaths driveways.
Stormwater Line	Stormwater lines data set contains valuable attributes that are used to aid the data preparation.
Stormwater Point	Stormwater point's data set contains valuable attributes that were used to aid the data preparation.
Parcel Boundary	Parcel boundaries with their attributes are provided from Council's Spatial database.
District Plan Zone	District plan zone layer is sourced from the Council's spatial database. This data has been reclassified to suit land cover classes suitable for NPS analysis.
Road Network	Road network layer is used to describe ADT
Stream/River	Stream River layer are sourced from Council's Spatial database. The land cover (source type) is determined by calculating a typical width of the stream at critical locations.
Building Footprints	Building footprints source from the Council's Spatial database. This dataset was updated with roof material values.
Stormwater Treatment Devices	Locations for the existing stormwater treatment devices were provided. The catchments were determined by observation of the stormwater networks, their discharge points and land contours.
Construction Sites	Railway corridor and the site at the Corner of Astley Ave / Margan Rd were identified as construction site.
Aerial Images	Used for helping determining the land cover (source type).

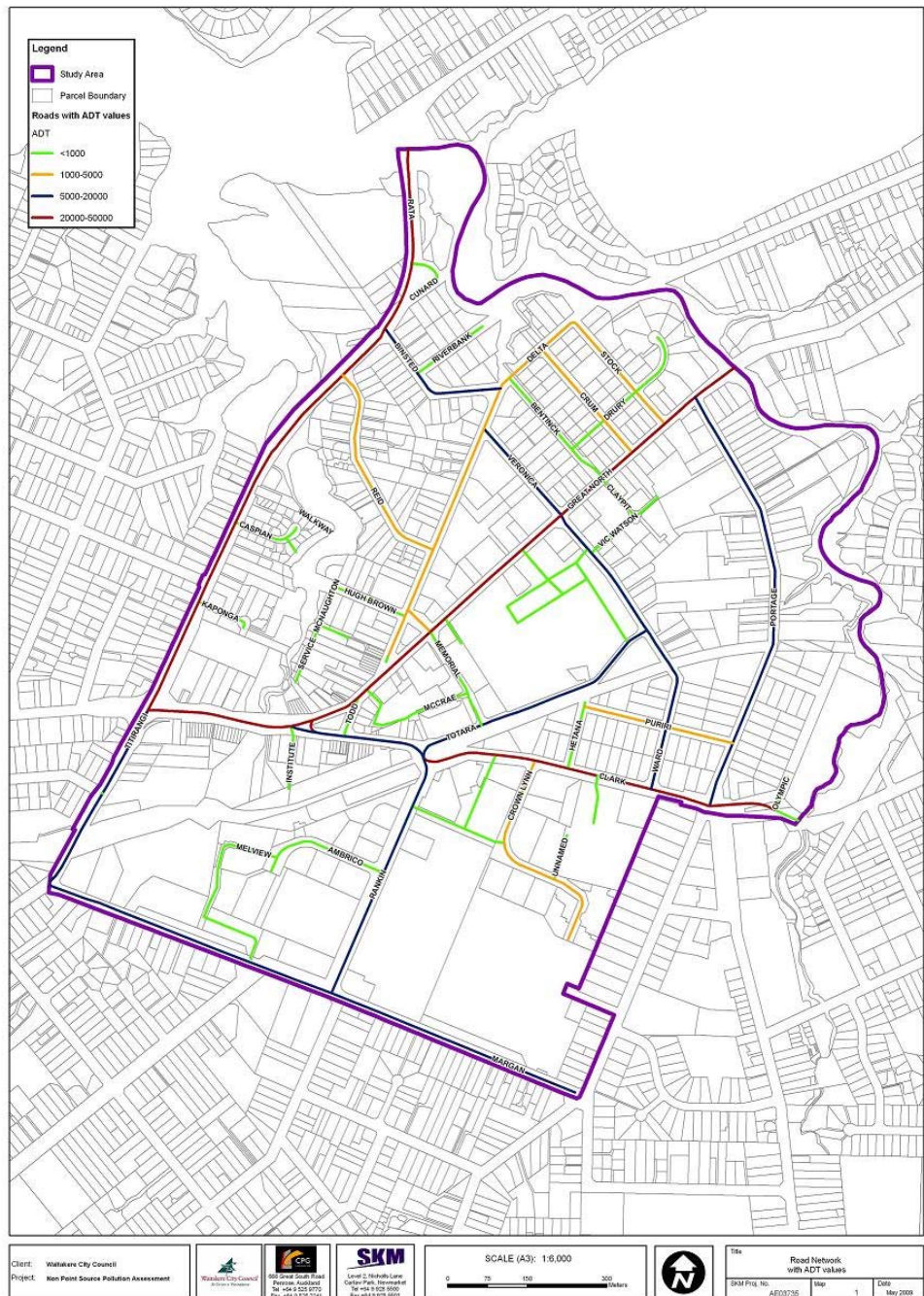
Data sets created and/or refined to be valid model inputs

Created Spatial data	Description
Roof	Building Footprints file updated with roof material type attributes
Road	Road network file updated with traffic counts attributes. The layer comprises a number of polylines from which the areas are calculated based on length and code area as per ARC guidelines.
Paved Surfaces other than roads	Impervious Area file updated by erasing roads areas and intersected with District Plan file to assign residential, commercial and industrial LU values
Source Type dataset/codes: Urban Grass Lands Stable Bush Urban Stream Road Residential Industrial Commercial Construction site – 6 months Construction site – 12 months	District Plan Zone file updated with Source Type Codes
Stormwater Treatment Catchments	Newly created file representing stormwater treatment catchment areas
DEM	Digital elevation model Developed from LIDAR contour data
Slope	Surface slope file derived from digital elevation model and reclassified (i.e. <10; 10-20; 20< degrees)

Roofs

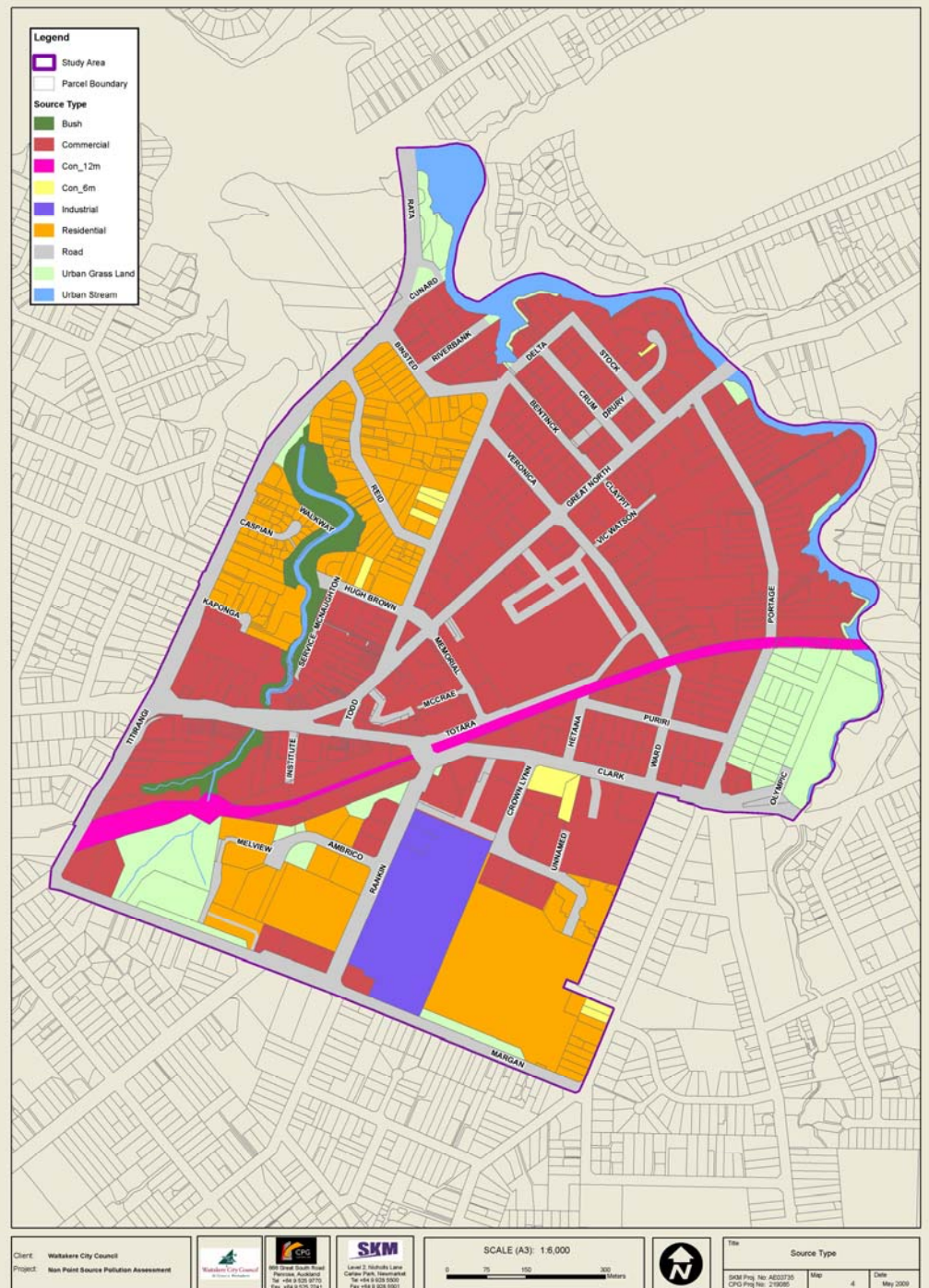


Roads



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Source Types



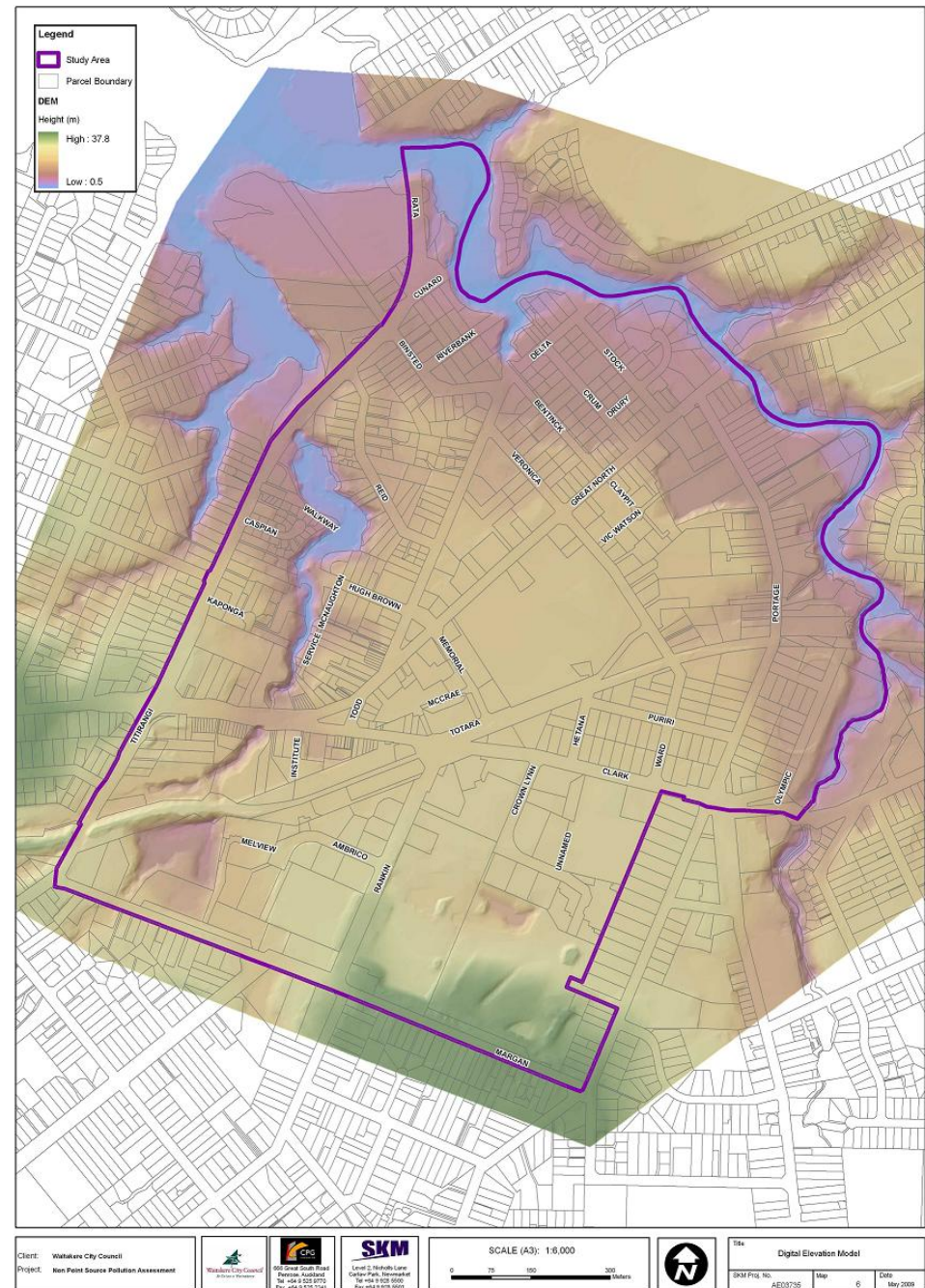
Legend

- Study Area
- Parcel Boundary
- SW Treatment Devices**
 - SANDFIL
 - WETLND
 - WETPND
- Treatment Catchments**
 - Wetland
 - Sand-filter
 - Wet pond

Map Labels:

- Area: 3.44 ha
- Area: 3.53 ha
- Area: 18.04 ha
- Area: 7.21 ha
- Area: 1.47 ha
- STREET NAMES: LAGO, QUARRO, RIVERBANK, BELLA, STOCK, CRUISE DRIVE, BENTRICE, VERONICA, GREAT NORTH, CLARITY, MC WATSON, PORTUGUE, PURRI, CLARK, MARGAN, UNNAMED, GOSWAM LYN, TODD, MCCRAE, MARGORIN, HUGH BROWN, SERVICE MCHALGHTON, WALKWAY, RED, CASPIAN, KAPONGA, INSTITUTE, MELVIEW, AMORICO, BARKIN, MARGAN.

DEM

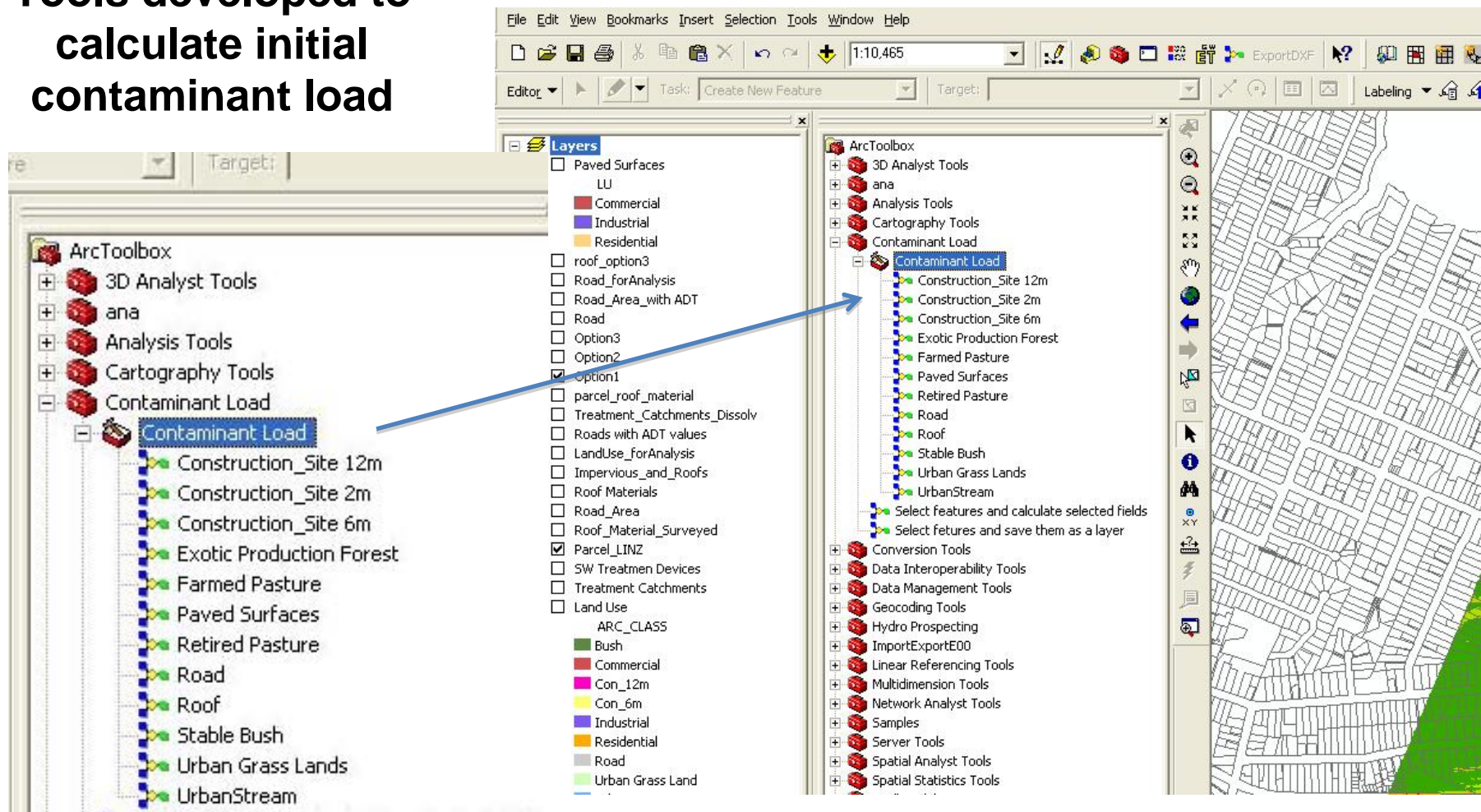


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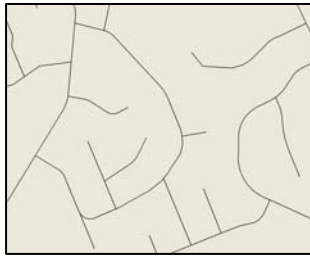
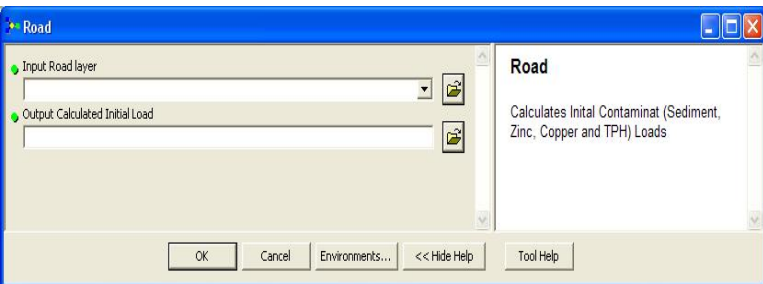
- **Calculation of initial contaminant load**

Initial Load = Source Area x Source Contaminant Yield

**Tools developed to
calculate initial
contaminant load**



Initial Contaminant Load - Roads



Rd_ADT	TSS	Zinc	Copper	TPH
<1000	4	0.0214705882	0.0069779412	0.1073529412
1000-5000	30.058823529	0.1073529412	0.0348897059	0.5367647059
5000-20000	150.29411765	0.5367647059	0.1744485294	2.6838235294
20000-50000	299.12195122	1.0682926829	0.347195122	5.3414634146
50000-100000	300	2.28125	0.74140625	11.40625
>100000	300	3.5322580645	1.147983871	17.661290323

Join

Calculate Length

Calculate Area
(Road Length x A)

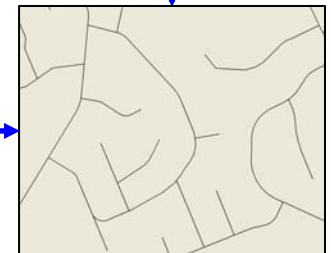
Add CL Fields

Calculate CL Fields
(Road Area x
Contaminant Yield)

Intersect with SW
Treatment Catchment
Layer

Calculate fraction of
Road area draining to
management option
train

Calculate initial load



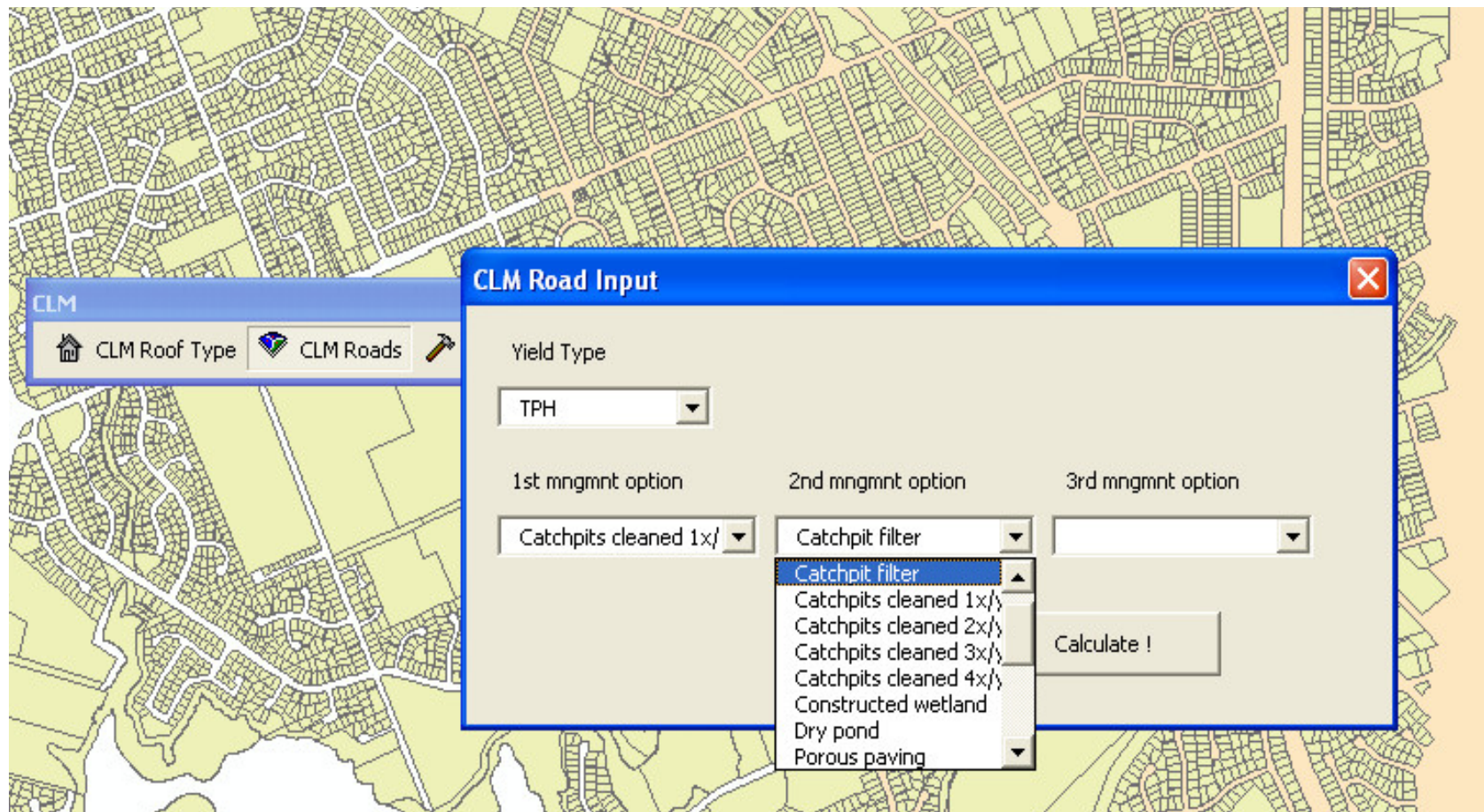
Reduced Contaminant Load

Reduced Load =

Initial Load – (Initial Load x Fraction of Area draining to a BPO x Load Reduction Efficiency)

Load Reduction Efficiency (RE) =

RE BPO 1 + (1-RE BPO1) x RE BPO2 + (1-RE BPO2) x RE BPO3



- **Option 1**

Contaminant loads calculated for the current NPS source types

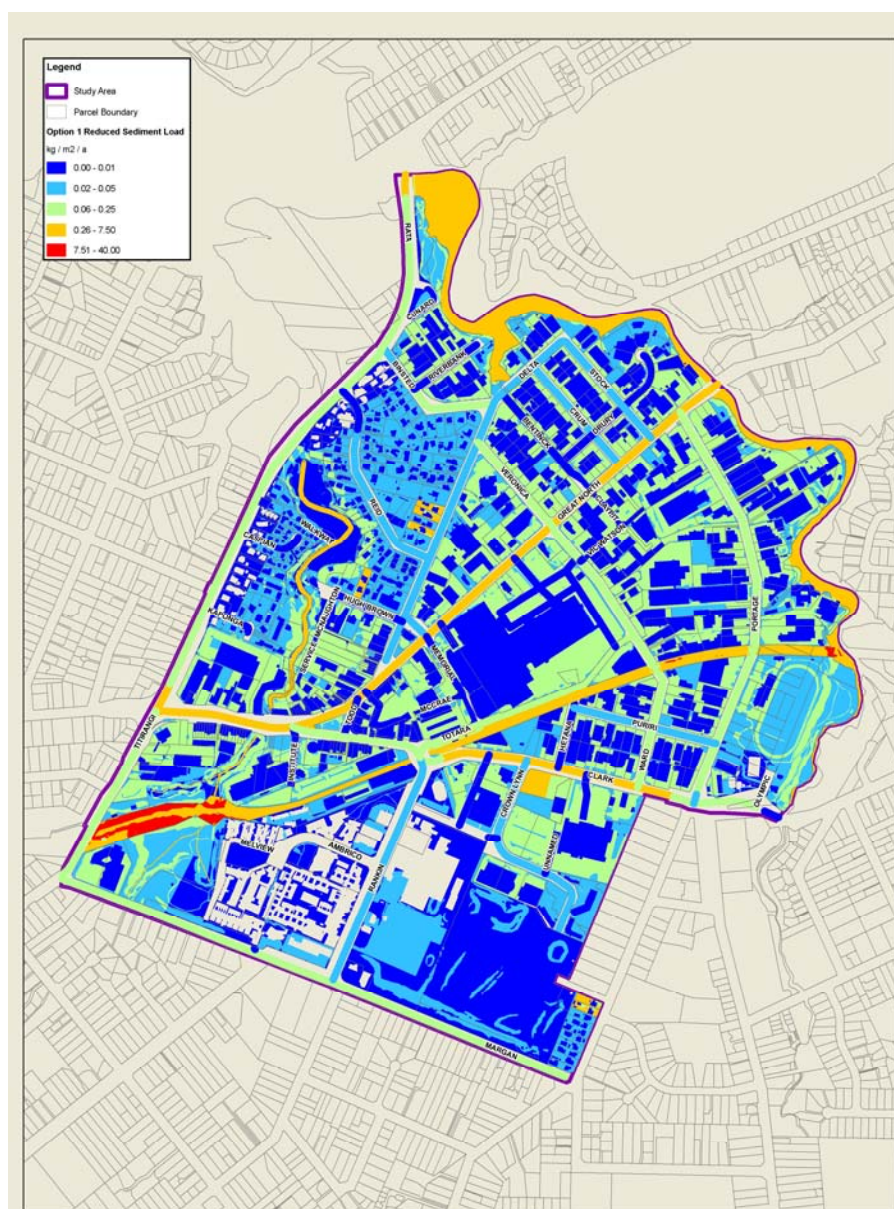
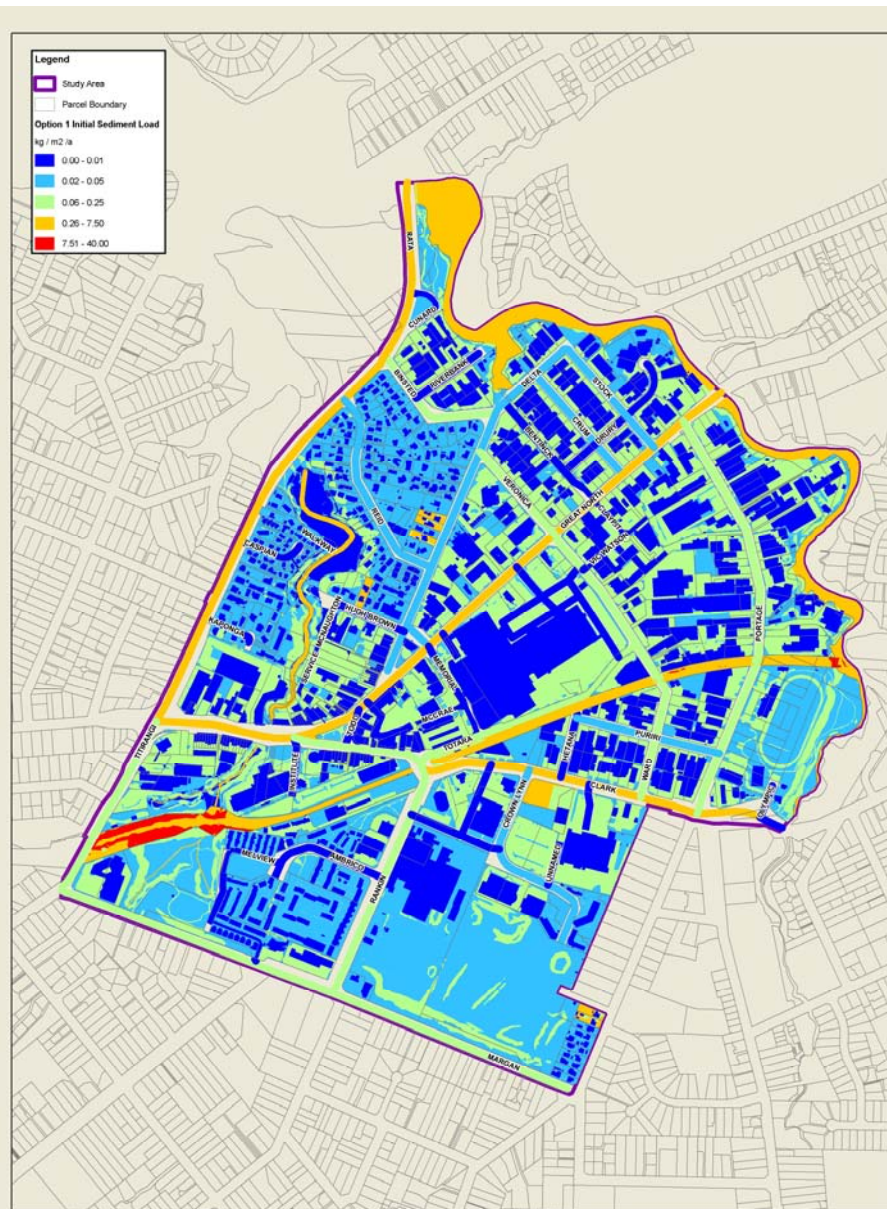
- **Option 2**

Contaminant loads calculated changing NPS source type for the site at the Corner of Astley Ave / Margan Rd to a construction site open for 12 months

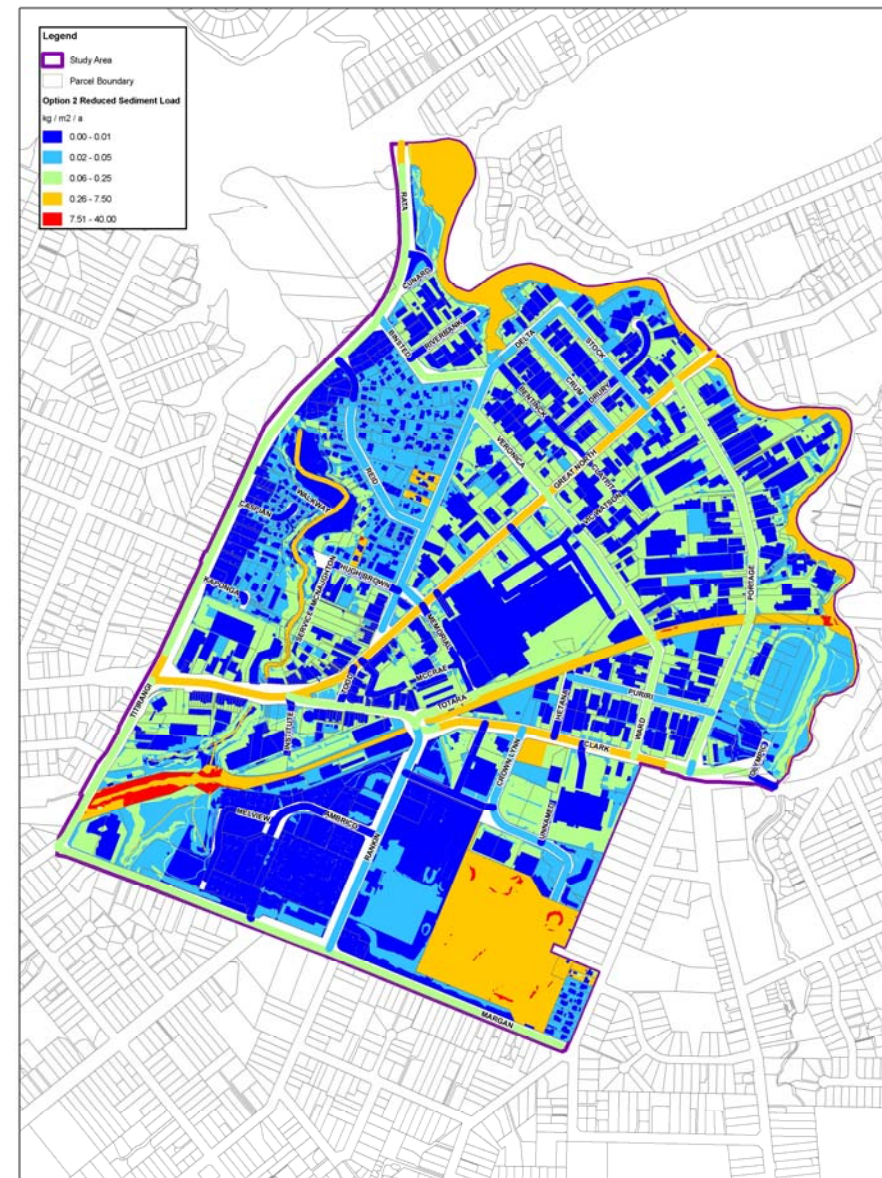
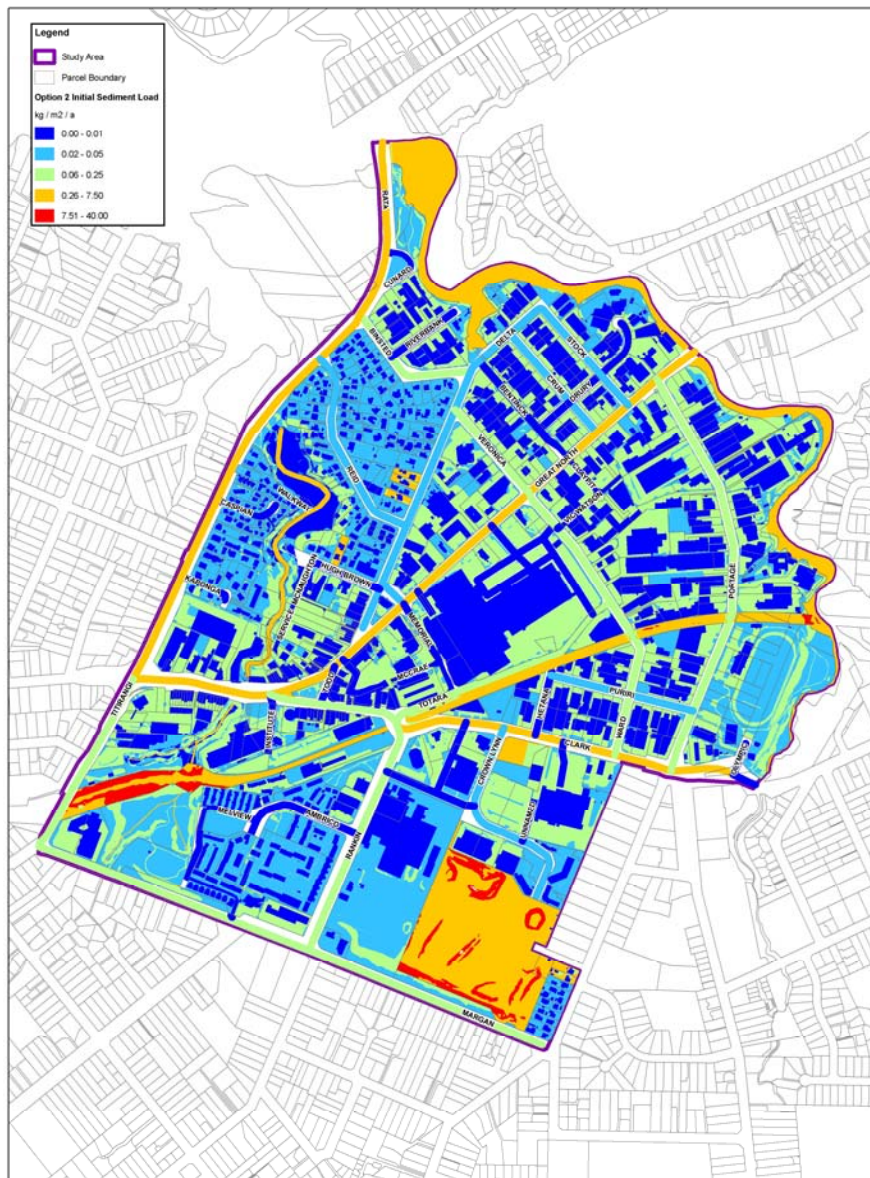
- **Option 3**

Contaminant loads calculated assuming the site at the Corner of Astley Ave / Margan Rd is a fully developed residential site (with assumed 65 % imperviousness – 50 % building and 15 % paved surfaces)

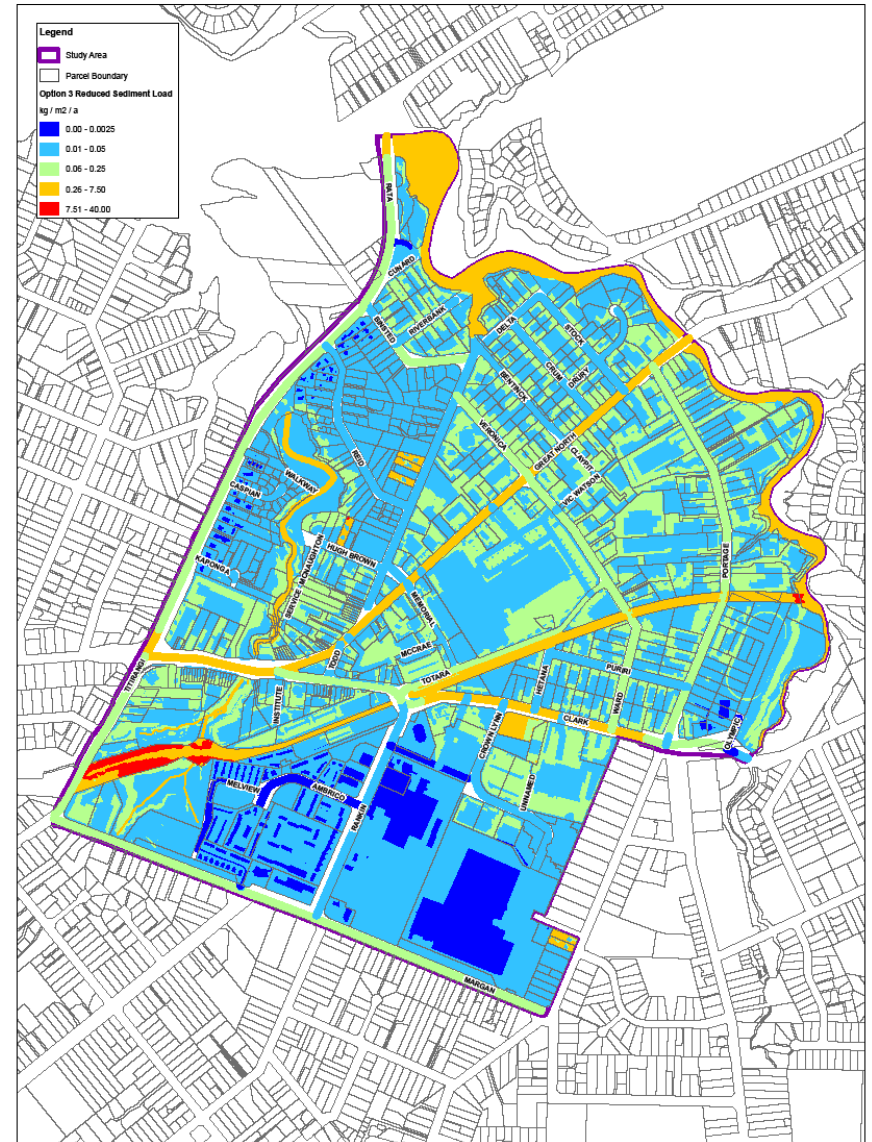
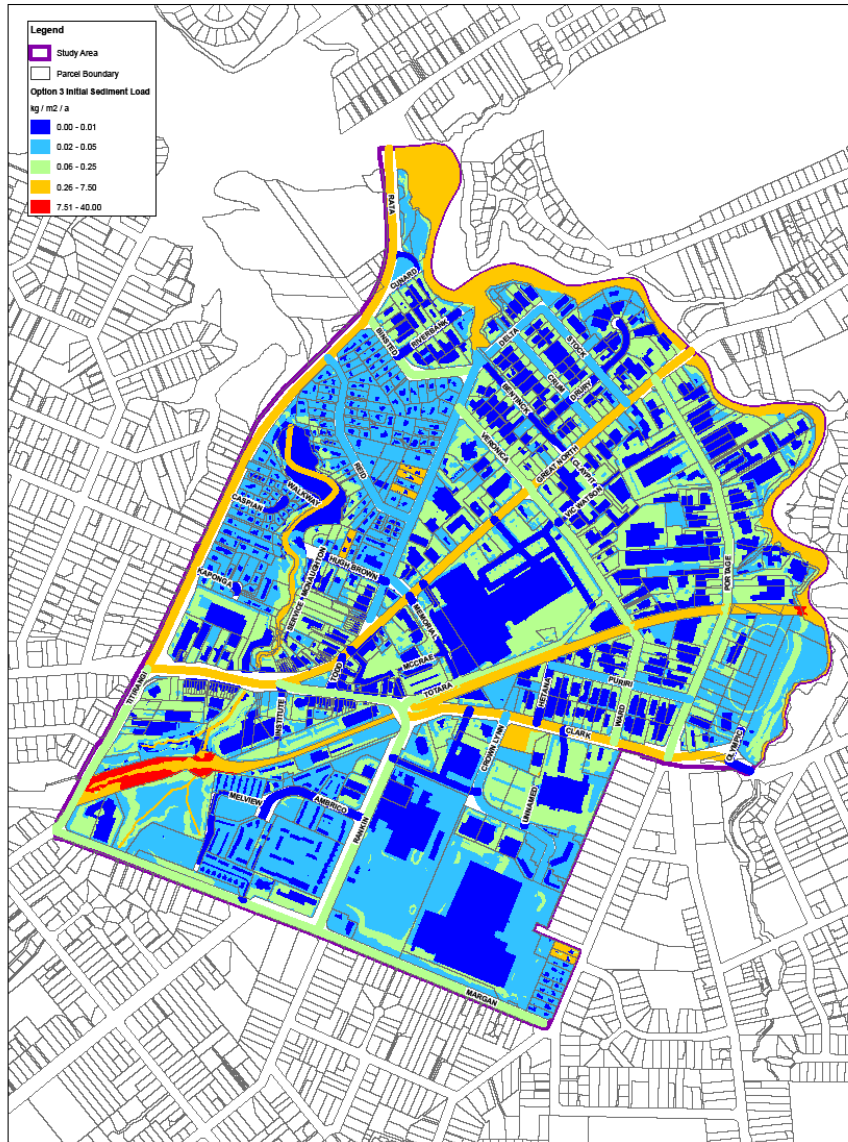
Option 1



Option 2



Option 3



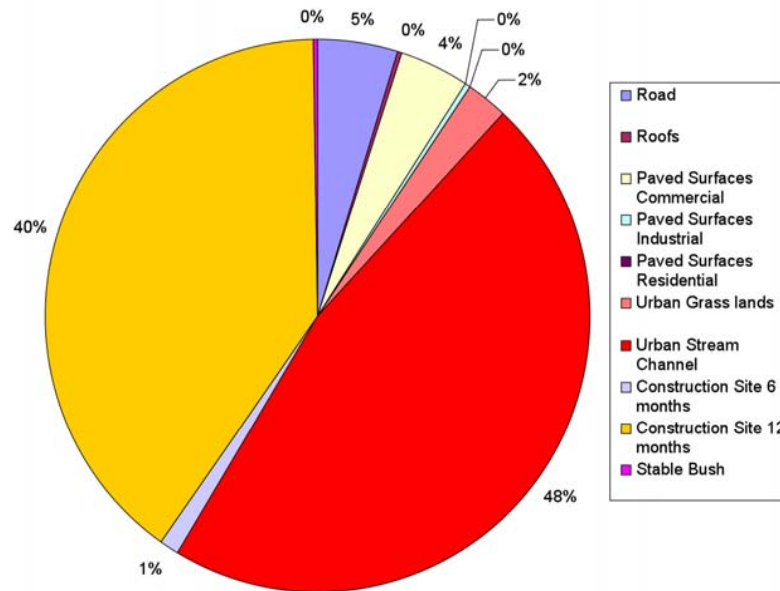
Summary of the NPS loadings Options 1 to 3

Option 1 - Current Status														
		Area Variance Vs Option 1												
Source Type	Area		Sediment Initial	Sediment Reduced	Sediment Variance	Zinc Initial	Zinc Reduced	Zinc Variance	Copper Initial	Copper Reduced	Copper Variance	TPH Initial	TPH Reduced	TPH Variance
	m2	m3	kg/annum	kg/annum	kg/annum	kg/annum	kg/annum	kg/annum	kg/annum	kg/annum	kg/annum	kg/annum	kg/annum	kg/annum
Road	263,677	-	33,360	26,094	7,266	120	104	16	39	32	7	598	531	68
Roofs	364,303	-	1,890	1,701	189	241	238	2	0	0	0	-	-	-
Paved Surfaces Commercial	290,208	-	29,021	27,871	1,150	15	14	0	15	14	0	-	-	-
Paved Surfaces Industrial	16,876	-	844	194	650	2	0.8	1	2	1	2	-	-	-
Paved Surfaces Residential	39,290	-	788	508	280	3	2.1	1	0	0	0	-	-	-
Urban Grass lands	378,234	-	16,270	11,321	4,949	-	-	-	-	-	-	-	-	-
Urban Stream Channel	54,116	-	324,698	324,698	-	-	-	-	-	-	-	-	-	-
Construction Site 6 months	6,025	-	8,122	8,122	-	-	-	-	-	-	-	-	-	-
Construction Site 12 months	32,343	-	278,181	271,099	7,083	-	-	-	-	-	-	-	-	-
Stable Bush	29,838	-	1,114	1,114	-	-	-	-	-	-	-	-	-	-
SUM	1,472,907	-	694,285	672,718	21,567	379	359	20	56	48	9	598	531	68

Option 2 - Future 1															
		Area Variance Vs Option 1	Sediment Initial	Sediment Reduced	Sediment Variance	Zinc Initial	Zinc Reduced	Zinc Variance	Copper Initial	Copper Reduced	Copper Variance	TPH Initial	TPH Reduced	TPH Variance	
Source Type	Area m2	m3	kg/annum	kg/annum	kg/annum	kg/annum	kg/annum	kg/annum	kg/annum	kg/annum	kg/annum	kg/annum	kg/annum	kg/annum	
Road	263,677	-	33,360	26,094	7,266	120	104	16	39	32	7	598	531	68	
Roofs	364,303	-	1,890	1,701	189	241	238	2	0	0	0	-	-	-	
Paved Surfaces Commercial	290,208	-	29,021	27,871	1,150	15	14	0	15	14	0	-	-	-	
Paved Surfaces Industrial	16,876	-	844	194	650	2	1	1	2	1	2	-	-	-	
Paved Surfaces Residential	39,290	-	788	508	280	3	2	1	0	0	0	-	-	-	
Urban Grass lands	309,344	- 66,890	13,335	10,634	2,701	-	-	-	-	-	-	-	-	-	
Urban Stream Channel	54,116	-	324,698	324,698	-	-	-	-	-	-	-	-	-	-	
Construction Site 6 months	6,025	-	8,122	8,122	-	-	-	-	-	-	-	-	-	-	
Construction Site 12 months	99,233	- 66,890	614,040	349,190	264,850	-	-	-	-	-	-	-	-	-	
Stable Bush	29,838	-	1,114	1,114	-	-	-	-	-	-	-	-	-	-	
SUM	1,472,907	-	1,027,209	750,123	277,086	379	359	20	56	48	9	598	531	68	
Variance Option 1 (O2-O1)	-	-	- 332,924	- 77,405	- 255,519	-	-	-	-	-	-	-	-	-	

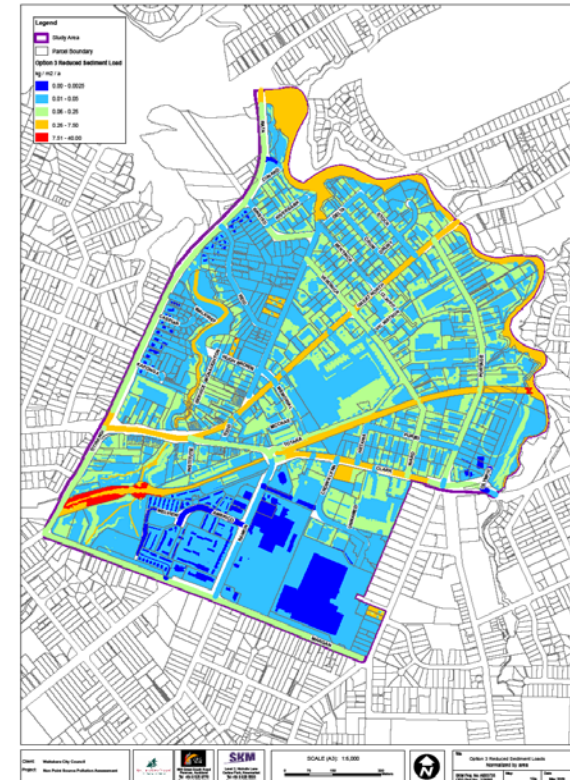
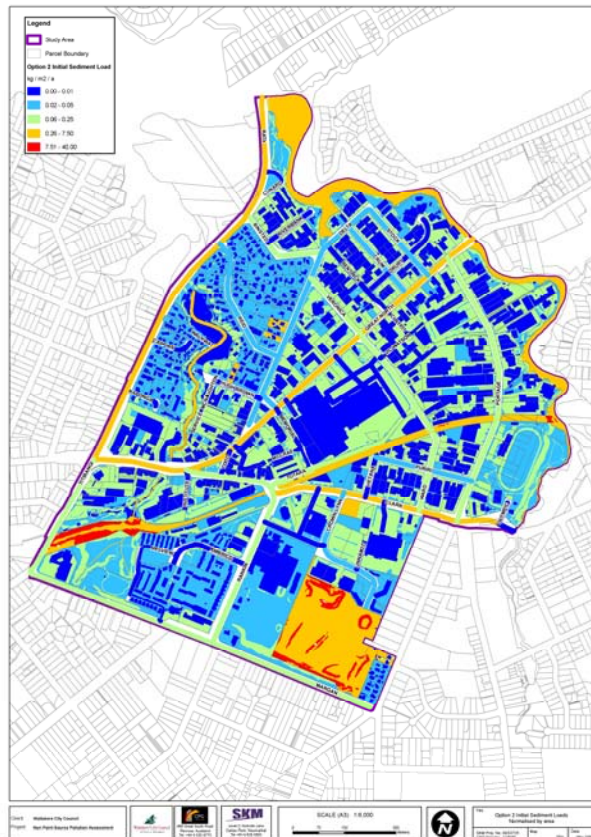
Option 3 - Future 2															
		Area Variance Vs Option 1	Sediment Initial	Sediment Reduced	Sediment Variance	Zinc Initial	Zinc Reduced	Zinc Variance	Copper Initial	Copper Reduced	Copper Variance	TPH Initial	TPH Reduced	TPH Variance	
Source Type	Area														
	m2	m3	kg/annum	kg/annum	kg/annum	kg/annum	kg/annum	kg/annum	kg/annum	kg/annum	kg/annum	kg/annum	kg/annum	kg/annum	
Road	263,677	-	33,360	26,094	7,266	120	104	16	39	32	7	598	531	68	
Roofs	397,793	33,490	2,058	1,701	357	246	243	3	0	0	0	-	-	-	
Paved Surfaces Commercial	290,208	-	29,021	27,871	1,150	15	14	0	15	14	0	-	-	-	
Paved Surfaces Industrial	16,878	-	844	194	650	2	1	1	2	1	2	-	-	-	
Paved Surfaces Residential	49,352	10,063	987	552	435	3	3	1	0	0	0	-	-	-	
Urban Grass lands	332,681	- 43,563	14,395	10,890	3,506	-	-	-	-	-	-	-	-	-	
Urban Stream Channel	54,116	-	324,698	324,698	-	-	-	-	-	-	-	-	-	-	
Construction Site 6 months	6,025	-	8,122	8,122	-	-	-	-	-	-	-	-	-	-	
Construction Site 12 months	32,343	-	278,181	271,099	7,083	-	-	-	-	-	-	-	-	-	
Stable Bush	29,838	-	1,114	1,114	-	-	-	-	-	-	-	-	-	-	
SUM	1,472,907	-	692,779	672,333	20,446	385	364	21	56	48	9	598	531	68	
Variance Option 1 (O3-O1)	-	-	- 1,506	- 385	- 1,121	6	5	1	-	-	-	-	-	-	

- Area = 147 ha
- TSS O1 694 t
- USC (48 %) 333 t
- Construction sites (41 %) 285 t
- Urban area (12%) 76 t

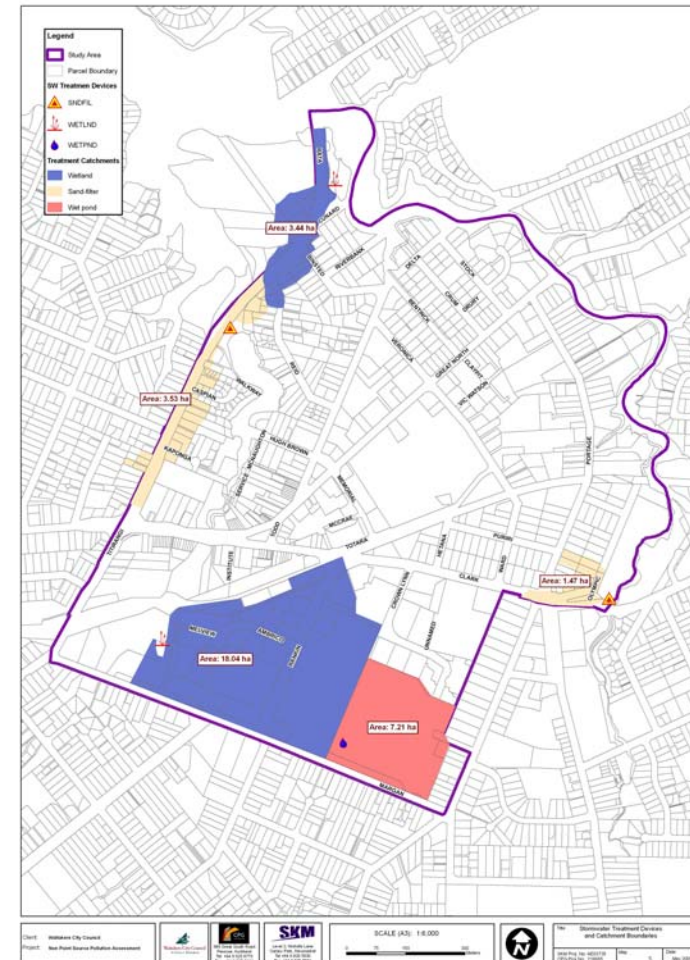


Outputs

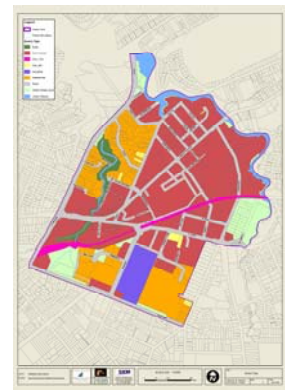
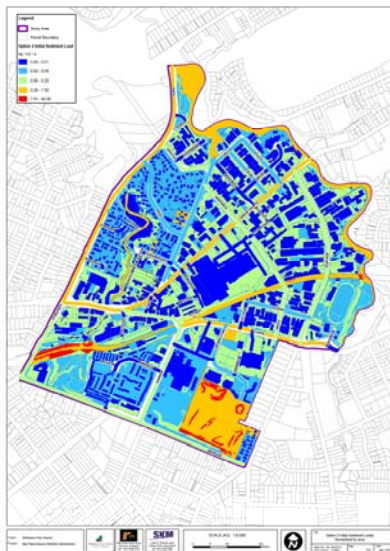
- **Sensitivity**
- **Source type inputs (land use changes) tested through option 1 to 3**
- **Sensitive to TSS changes – difference in CLM loadings is significant**
- **Minimal changes noted with heavy metals**



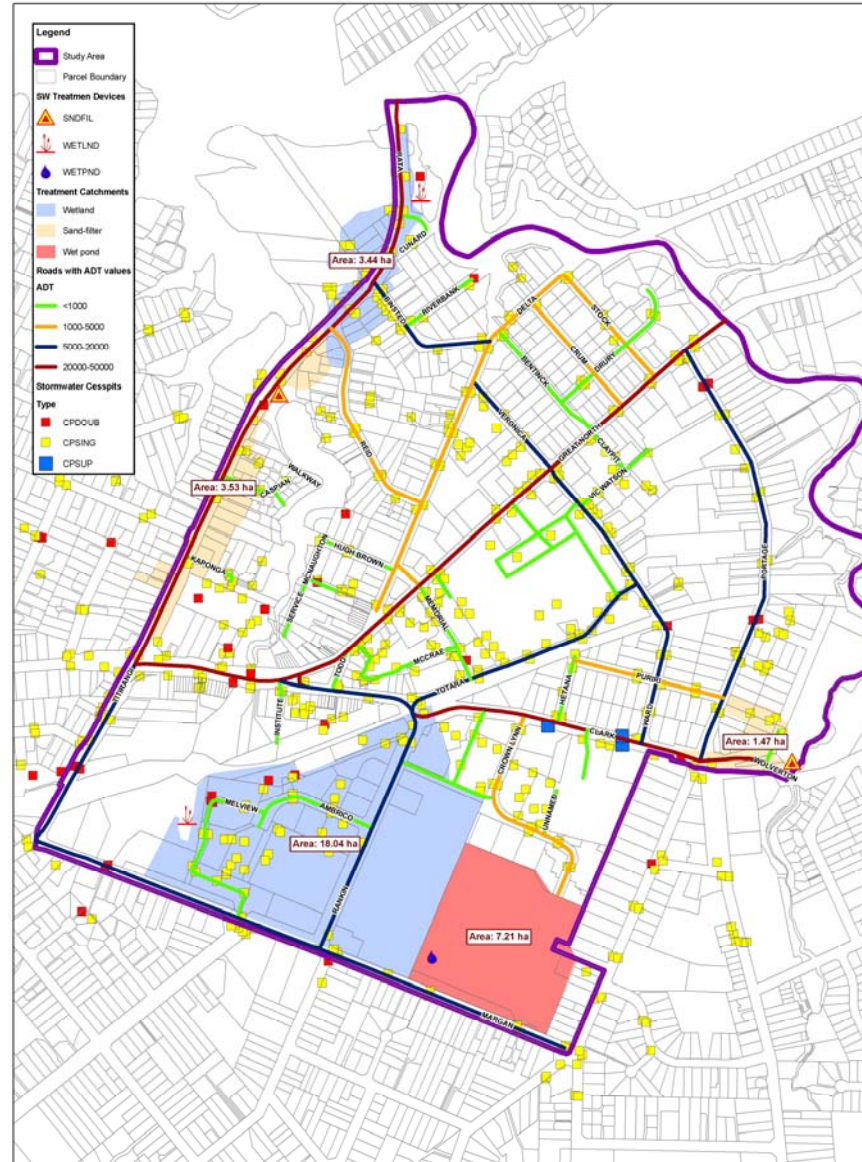
- Total study area 147 ha
- Bush, stream, urban grass area of 46 ha.
- Total SD area 101 ha
- Currently treated area 34 ha.
- Remaining area to be treated 67 ha
- $\$ 70,535 / \text{ha} \times 67 \text{ ha} = \$ 4.7 \text{ mil}$
- $\$ 70,535 / \text{ha} \times 34 \text{ ha} = \$ 2.4 \text{ mil}$
- Implementation Costs 82,088 \$/t

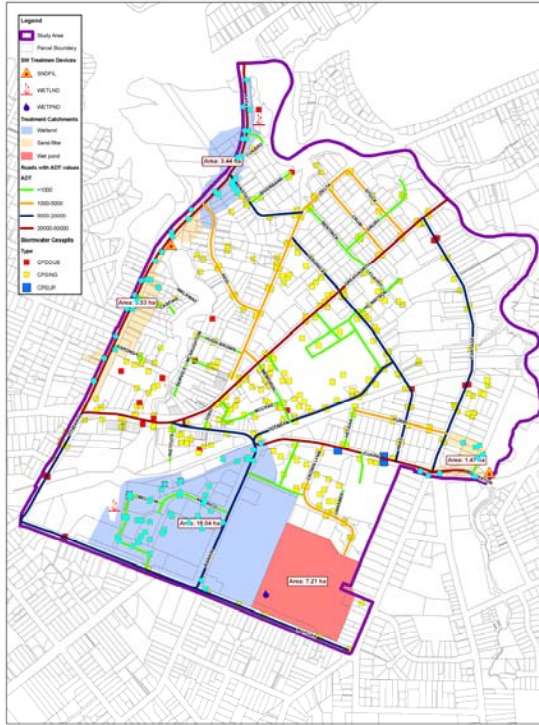


- **Spatial database with inputs/results of NPS analysis for various scenarios.**
- **Database can be used interactively for further analysis e.g sw treatment options, costs, interactions.**
- **Maps visualising CLM results per each NPS type area**
- **Normalised loads for each source expressed in kg/area/annum**
- **Kml/kmz (GoogleEarth file format) files representing CLM results**



Cost Analysis





Cost Analysis

	Total Service Cth Area	Currently Treated Cth Area	Future Treated Cth Impervious Area	Implementation Costs/ Area	Implementation Costs	Annual Maintenance Cost	Annual Depreciation	SWQID Life Cycle (Yrs)	Asset Disposal Cost	Total Life Cycle Costs (LCC)	Total Annual LCC	Annual LCC per Area	Annual LCC per Tonne
Option 1	ha	ha	ha	\$/ha	\$	20%	1%	100	10%	\$	\$/yr	\$/yr/ha	\$/yr/t
Wetland Only	101	34	67	140,000	9,380,000	938,000	93,800	100	0	10,411,800	104,118	1,554	1,827
				Costs/ha	140,000	14,000	1,400		0	155,400	1,554		

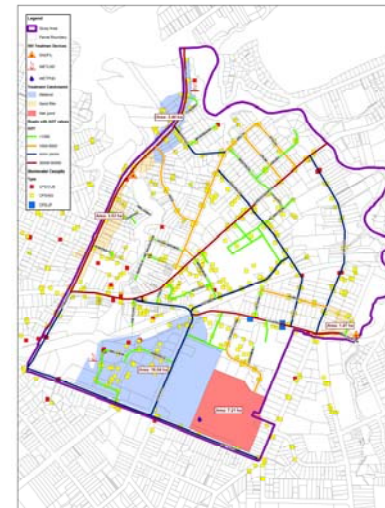
Option 2	ha	ha	ha	\$/ha	\$	0	0	50	0			\$/yr/ha	\$/yr/t
SWQID (Small Wetland, Bioretention, Prop Device, Swi) excl CPFB	101	34	67	70,000	4,690,000	938,000	93,800	50	469,000	6,190,800	123,816	1,848	2,172
				Costs/ha	70,000	14,000	1,400		7,000	92,400	1,848		

Option 3 A	No	No of CP within Treated Cth Paved Area	No of CP Future Treated Cth Paved Area	Implementation Costs/ CP	Implementation Costs	Annual Maintenance Cost	Annual Depreciation	FB Life Cycle (Yrs)	Asset Disposal Cost	Total Life Cycle Costs (LCC)	Total Annual LCC	Annual LCC per area	Annual LCC per Tonne
CP FB	no	no	no	\$/CP	\$	0	0	Yrs	0	\$	\$/yr	\$/yr/ha	\$/yr/t
CPSing	424	83	341	1,300	443,300	44,330	88,660	5	44,330	620,620	124,124		
CPDoub	27	7	20	2,600	52,000	5,200	10,400	5	5,200	72,800	14,560		
CPSup	3	0	3	3,900	11,700	1,170	2,340	5	1,170	16,380	3,276		
Total CP	454	90	364		507,000	50,700	101,400	5	50,700	709,800	141,960	4,895	5,754
cp/ha	7	3	13	Costs/ha	17,483	1,748	3,497		1,748	24,478	4,895		
Serviced Area	63	34	29										

Option 3 B													
Balance Area Treated by SWQID			38	70,000	2,660,000	938,000	93,800	50	519,700	4,211,500	84,230	2,217	2,605
				Costs/ha	70,000	24,684	2,468		7,757	110,829	2,217		

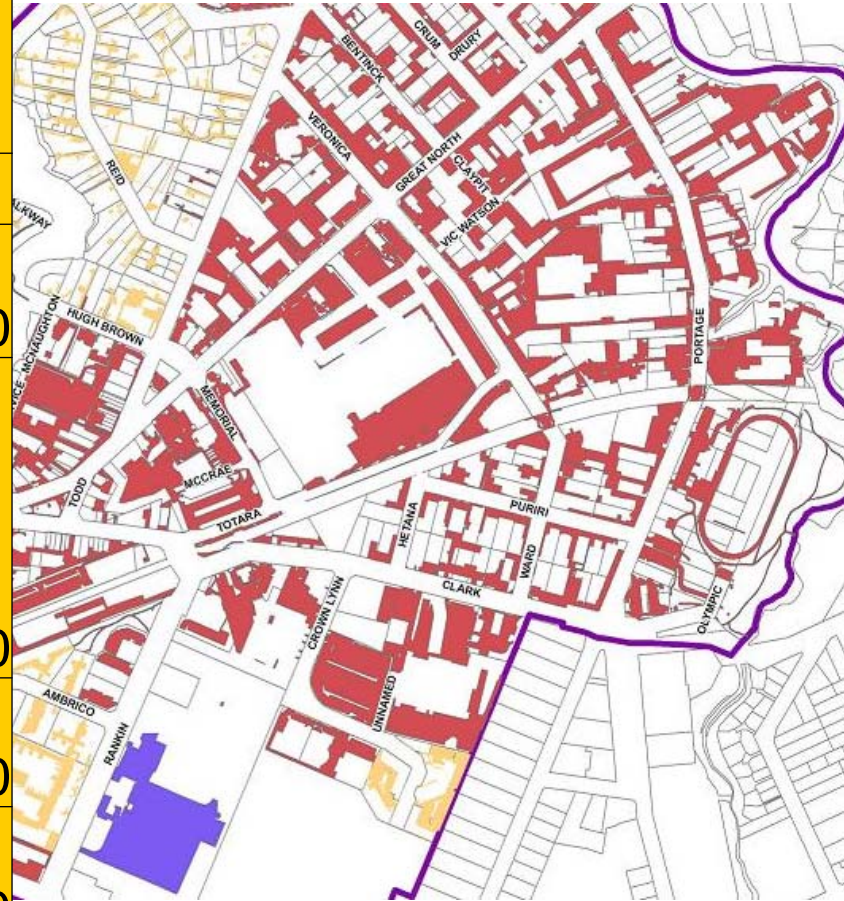
Option 4			67		3,167,000	988,700	195,200		570,400	4,921,300	226,190	3,376	2,976
CP FB + SWQID				Costs/ha	47,269	14,757	2,913		8,513	73,452	3,376		

Roads	28
Paved	35
Subtotal area serviced by CP	63
Roof	38
Total Service Cth Area	101



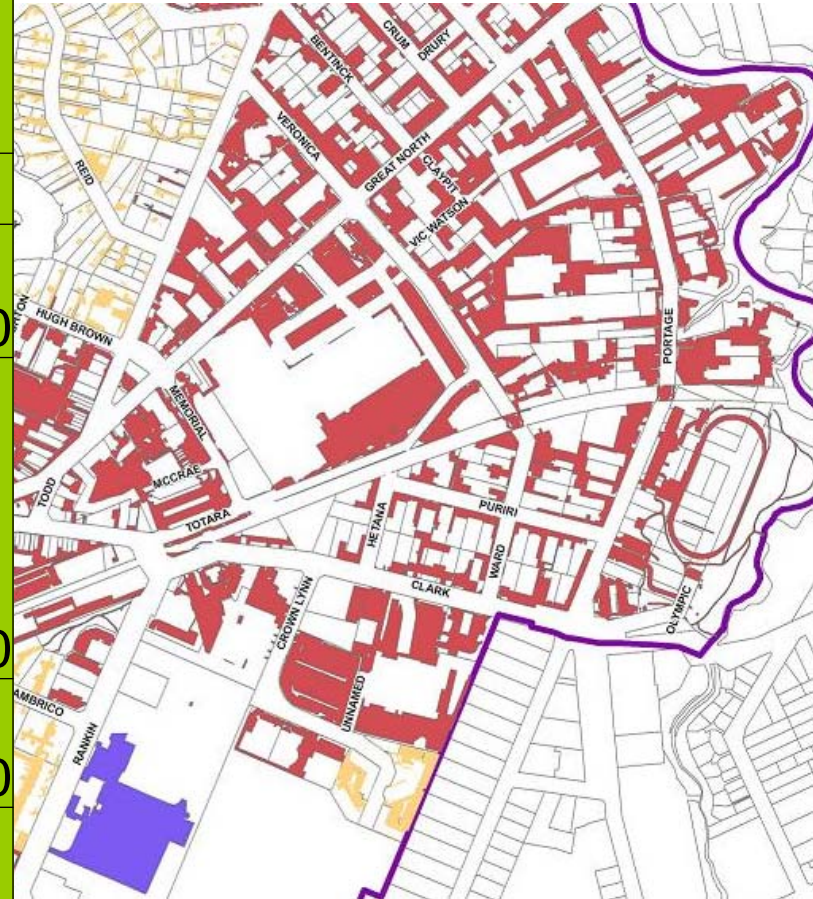
Cost Analysis

	Implementation Costs
	\$
Wetland Only	9,380,000
SWQID (Small Wetland, Bioretetion, Prop Device,Swl) excl CPFB	4,690,000
CP FB	507,000
Balance Area Treated by SWQID	2,660,000
CP FB + Balance SWQID	3,167,000

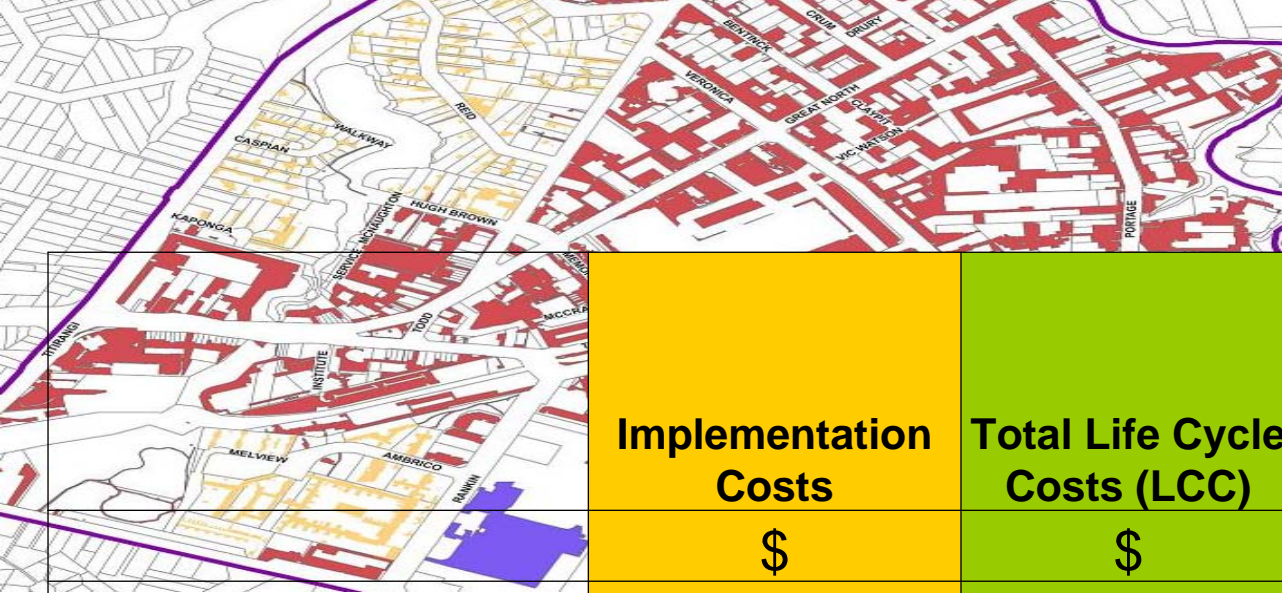


Cost Analysis

	Implementation Costs	Total Life Cycle Costs (LCC)
	\$	\$
Wetland Only	9,380,000	10,411,800
SWQID (Small Wetland, Bioretetion, Prop Device,Swl) excl CPFB	4,690,000	6,190,800
CP FB	507,000	709,800
Balance Area Treated by SWQID	2,660,000	4,211,500
CP FB + Balance SWQID	3,167,000	4,921,300

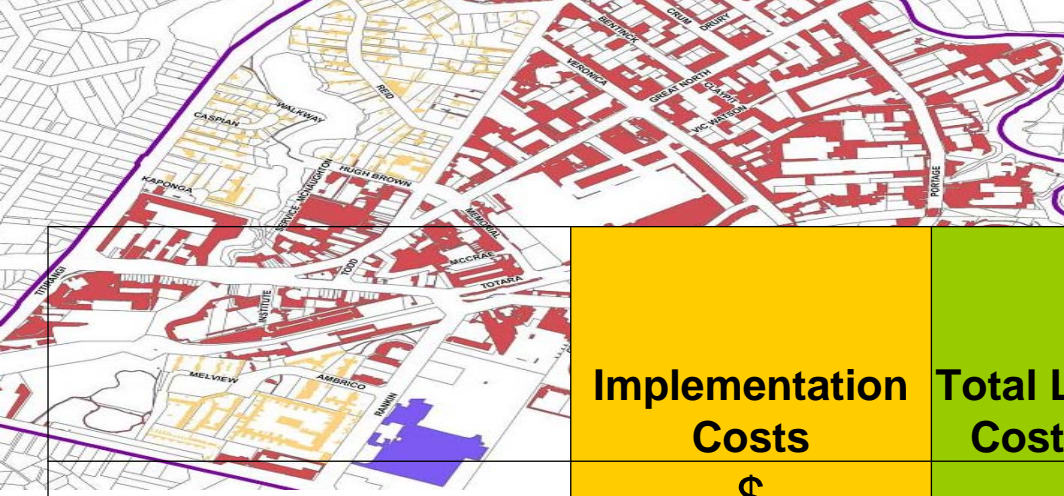


Cost Analysis



	Implementation Costs	Total Life Cycle Costs (LCC)	Total Annual LCC
	\$	\$	\$/yr
Wetland Only	9,380,000	10,411,800	104,118
SWQID (Small Wetland, Bioretetion, Prop Device,Swl) excl CPFB	4,690,000	6,190,800	123,816
CP FB	507,000	709,800	141,960
Balance Area Treated by SWQID	2,660,000	4,211,500	84,230
CP FB + Balance SWQID	3,167,000	4,921,300	226,190

Cost Analysis



	Implementation Costs	Total Life Cycle Costs (LCC)	Total Annual LCC	Annual LCC per Area
	\$	\$	\$/yr	\$/yr/ha
Wetland Only	9,380,000	10,411,800	104,118	1,554
SWQID (Small Wetland, Bioretetion, Prop Device,Swl) excl CPFB	4,690,000	6,190,800	123,816	1,848
CP FB	507,000	709,800	141,960	4,895
Balance Area Treated by SWQID	2,660,000	4,211,500	84,230	2,217
CP FB + Balance SWQID	3,167,000	4,921,300	226,190	3,376

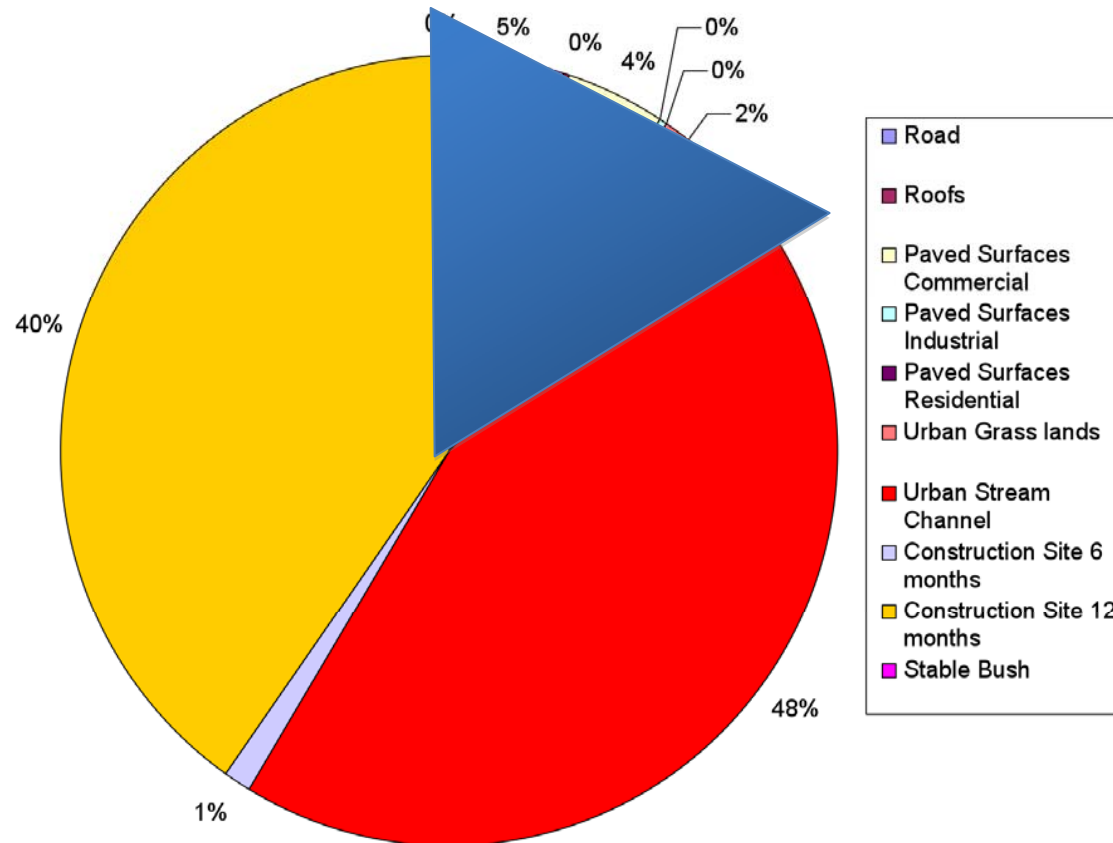
Cost Analysis

	Implementation Costs	Total Life Cycle Costs (LCC)	Total Annual LCC	Annual LCC per Area	Annual LCC per Tone
	\$	\$	\$/yr	\$/yr/ha	\$/yr/t
Wetland Only	9,380,000	10,411,800	104,118	1,554	1,827
SWQID (Small Wetland, Bioretetion, Prop Device,Swl) excl CPFB	4,690,000	6,190,800	123,816	1,848	2,172
CP FB	507,000	709,800	141,960	4,895	5,754
Balance Area Treated by SWQID	2,660,000	4,211,500	84,230	2,217	2,605
CP FB + Balance SWQID	3,167,000	4,921,300	226,190	3,376	2,976

Cost Analysis

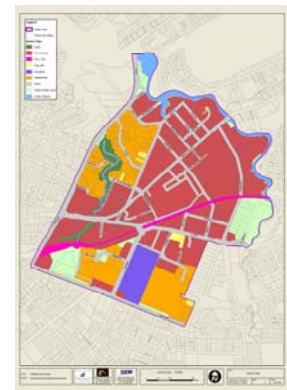
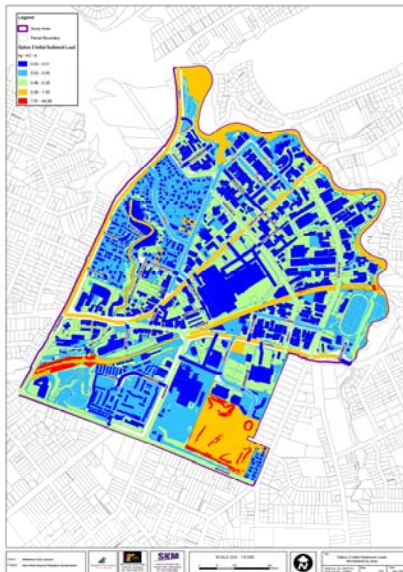
	Implementation Costs	Total Life Cycle Costs (LCC)	Total Annual LCC	Annual LCC per Area	Annual LCC per Tone
	\$	\$	\$/yr	\$/yr/ha	\$/yr/t
Wetland Only	9,380,000	10,411,800	104,118	1,554	1,827
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- Urban area (12%)
76 t



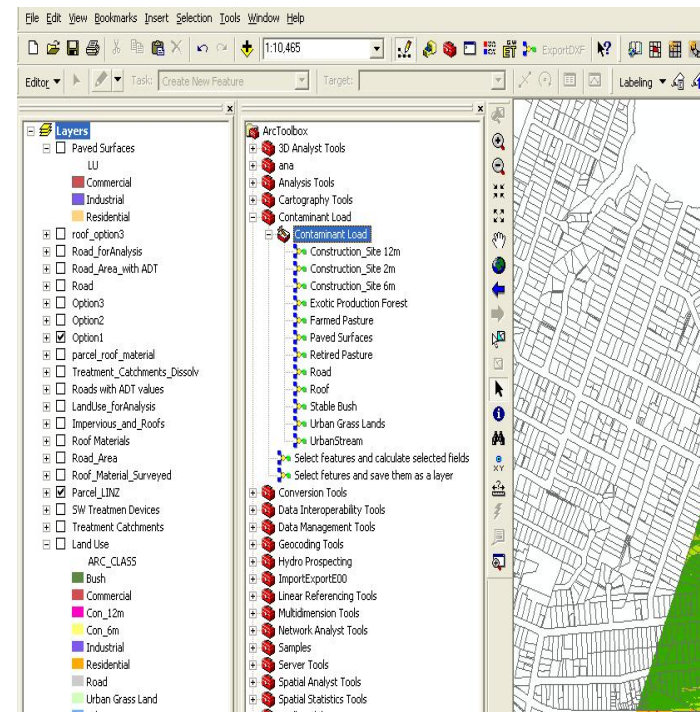
Key Aspects

- **Helps in decisions and responses**
- **Utilisation of systems and procedures that exist in various activity areas of Council**
- **Existing Data utilisation for NPS + other analysis**
- **Helps in collaboration and building up organisational capabilities**
- **Providing for innovation and learning.**



Conclusion

- **GIS approach to NPS model is effective and useful tool for SW catchment management plans**
- **Stores, manipulates and displays huge volumes of data**
- **Enables integration of spatial and non-spatial datasets**
- **Analytical capabilities**
- **Customisation options**
- **Easily adaptable**
- **Opportunities for further analysis**
- **Need for good quality datasets**



The NPS spatial assessment is an emerging approach to analysis of environmental issues including impacts and effects, level of services, demand, asset management, prioritisation.

Essential tool in optimised decision making processes with capability to explore and resolve complex relationships.

