

The Surrey Headwaters Project

A Case Study In

Sustainable and Affordable Infrastructure

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Web Site: www.sustainable-communities.agsci.ubc.ca

The Headwaters Project

- Design for Community for 13,000
- A Partnership Between City of Surrey and James Taylor Chair
- Broad Range of Funding Partners
- Involved all Stakeholders in a four day Implementation Design Charrette
- Adheres to the Six Principles For Sustainable Communities

East Clayton Plan

**13,000
Residents**

550 Acres

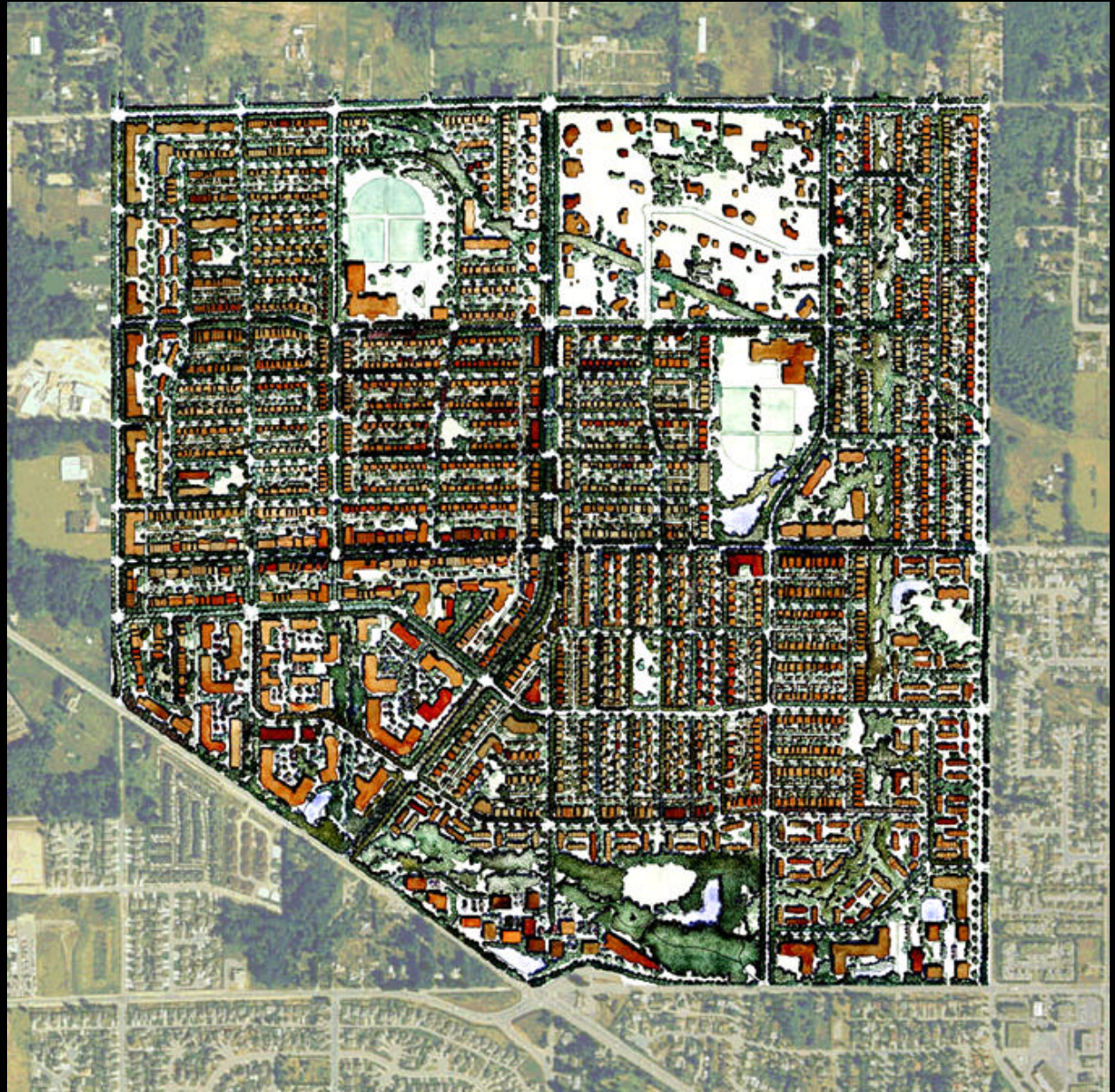
**10 Dwelling
Units per Acre**

**Interconnected
Street System**

**Complete
Community**

**40% fewer car
trips**

**90% less
downstream
impact**

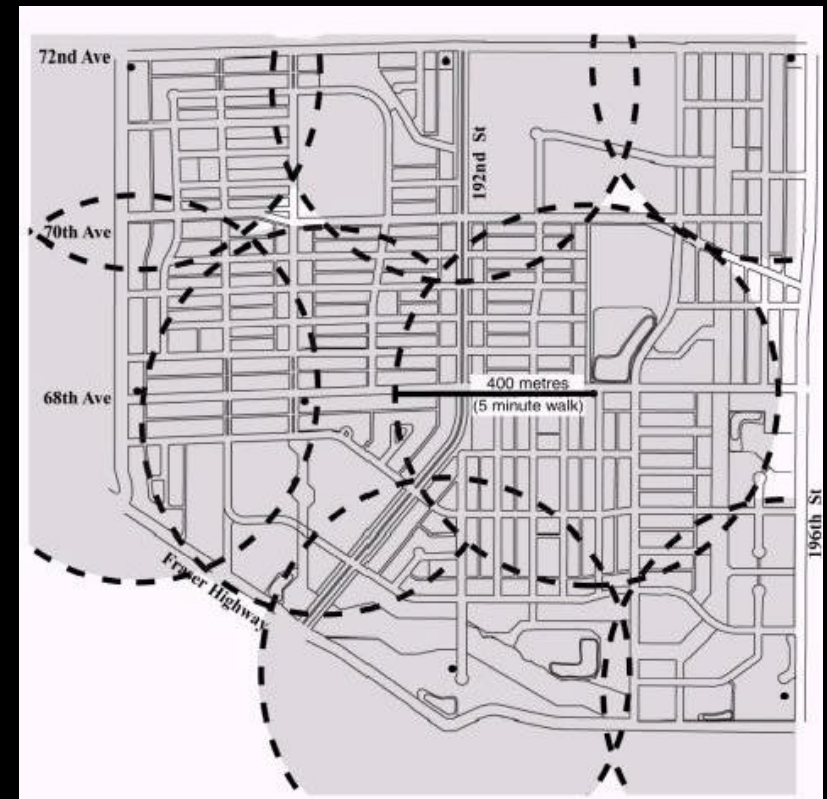
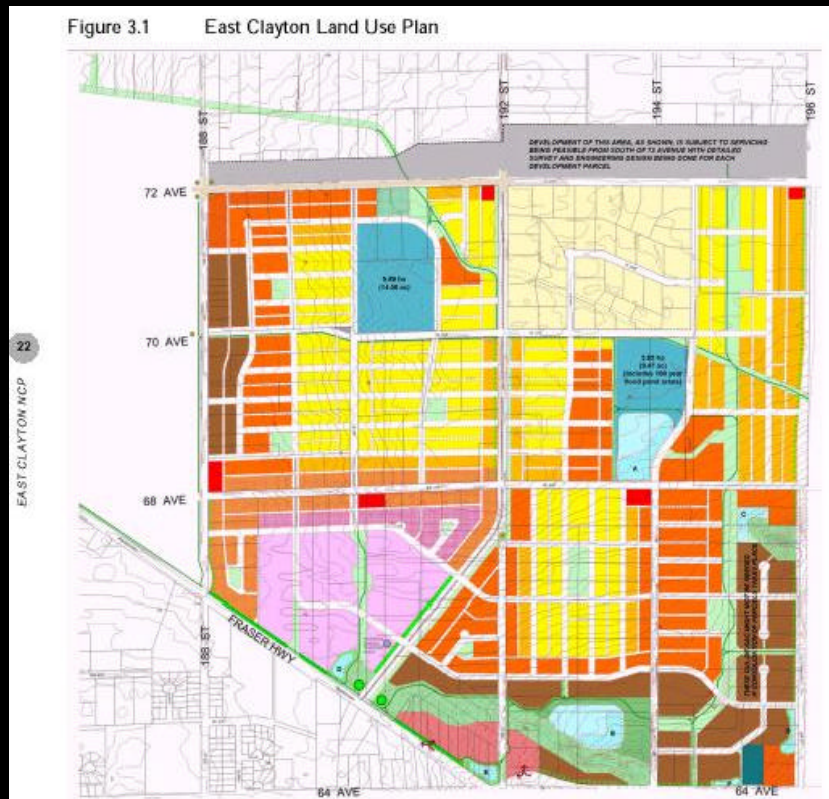


Principle 1: Different dwelling types in the same area.



Result: An unprecedented variety of
housing types in the same area.

Principle 2: Five Minute Walking Distance to Transit and Shops.



Result: Five Minute Walk to Shops.
Serviceable by Transit with Stops Five
Minute Walk from all Homes.

Principle 3: Buildings that Present a Friendly Face to the Street

The Main Street mixed use commercial/residential area is proposed at the corner of 72nd Avenue and 189th Street. Mixed-use commercial buildings have a maximum height of four storeys, and a lot coverage of up to 80 percent to ensure a near continuous street frontage. Large surface parking lots are not permitted. Short-term parking for commercial tenants and patrons will be provided in on-street angled parking areas, in underground structures, or in parking areas accessed via the rear lane.

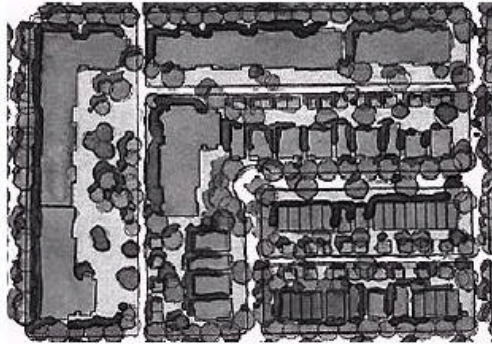
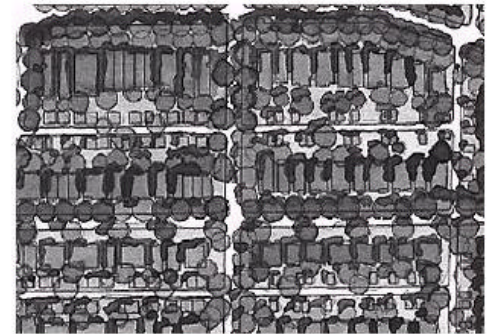


Image of a mixed-use commercial/residential street. The streetscape is comprised of similarly scaled buildings, street trees, covered sidewalks, and on-street parking.



This plan view shows a variety of lot dimensions and housing types including semi-detached single-family duplexes and fee-simple row houses. Front setbacks are between 4 and 5 metres (13 to 16.5 ft.) for single-family and semi-detached lots and 3 metres (10 ft.) for rowhouse and townhouse units. Parking is provided via lane-accessed garages and on the street.

38
EAST CLAYTON NCP



Row houses are designed to reinforce the character of single-family areas and contribute to a unified streetscape.

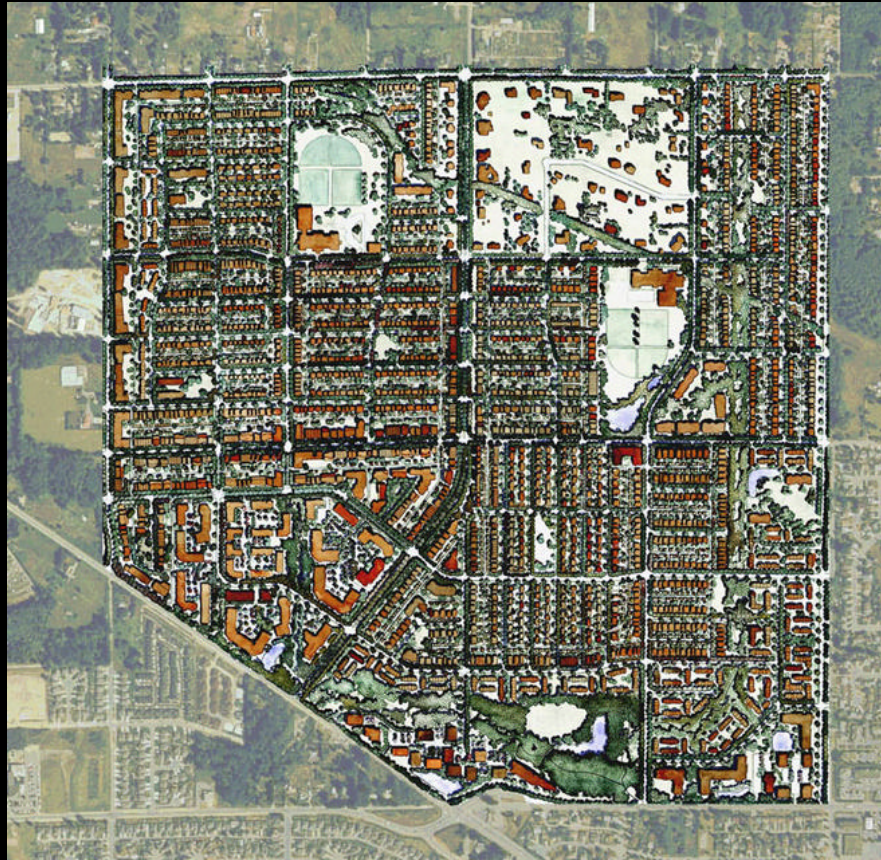
Dominant characteristics:

- ground-oriented units;
- clearly identified front entry and yard that relates to the street;
- extended porches and recessed entries;
- massing and detailing that relates to the surrounding single-family context;
- massing based on simple, regular shapes with strong, gabled roof forms; and
- garages are not a part of streetscape but, rather are accessed via rear lanes.



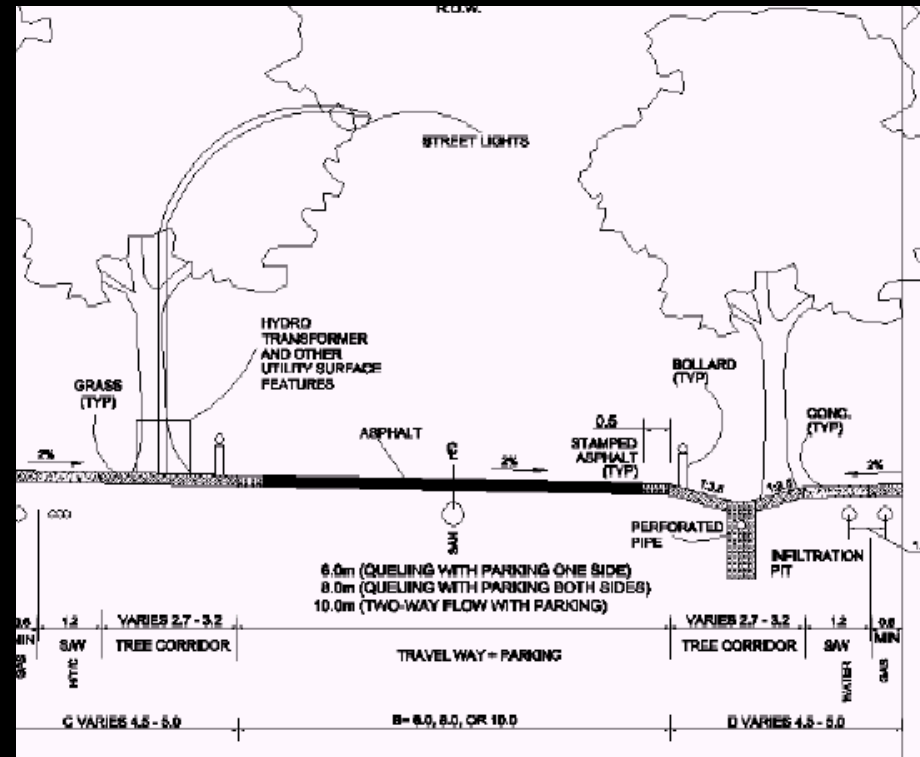
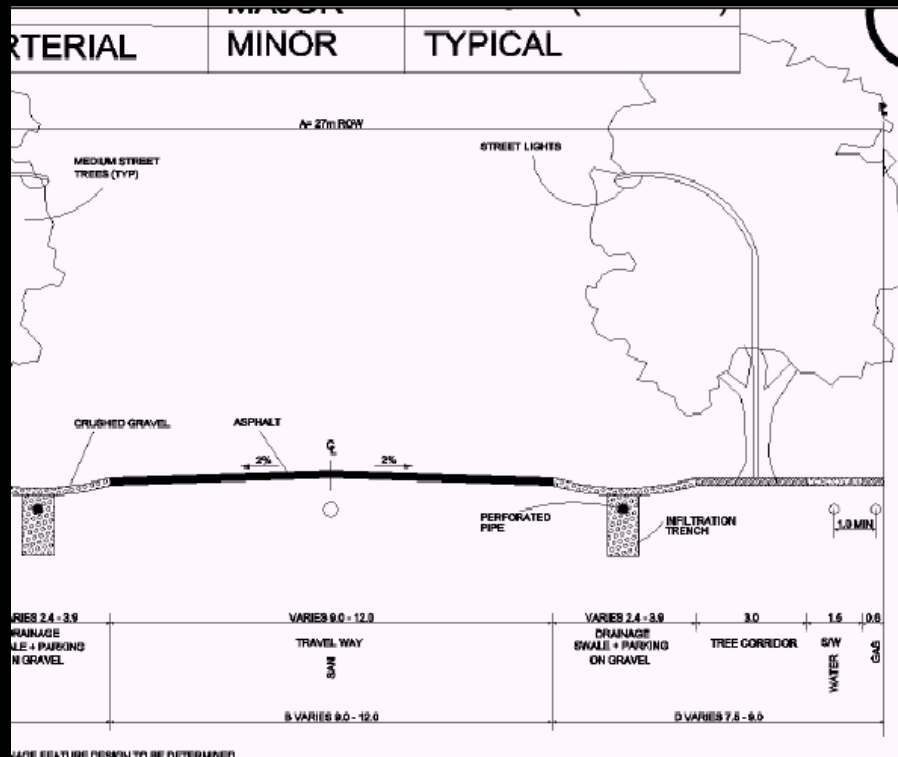
Result: Commercial and residential buildings oriented to people, not cars.

Principle 4: An Interconnected Street System



Result: Reduction in Car
Dependence of up to 40%

Principle 5: Lighter Greener Cheaper Smarter Infrastructure



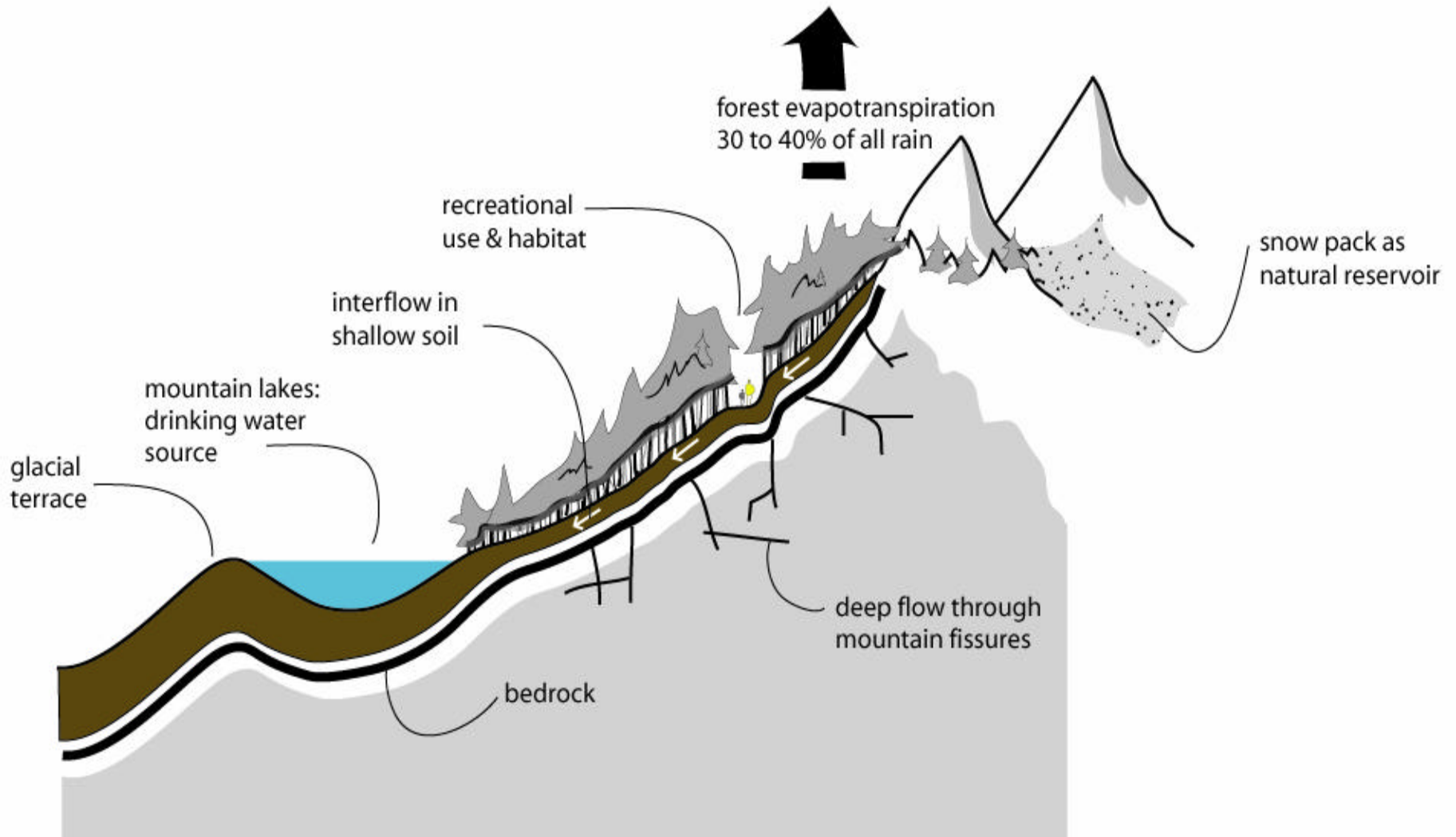
Result: Reductions in Per Dwelling Unit Infrastructure Costs of \$12,000

Principle 6: Natural Drainage Systems Where Surface Runoff Infiltrates Naturally Back to the Stream.



Result: 90% Reduction in Impact to
Receiving Streams

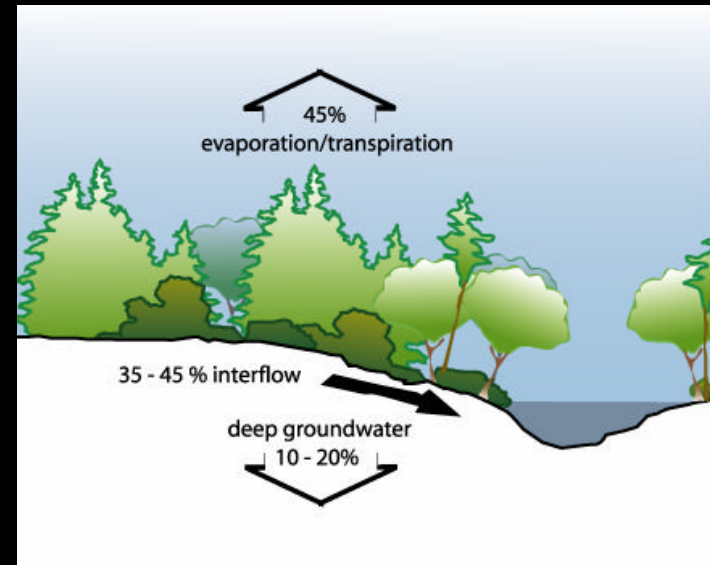
The way water works in our landscape



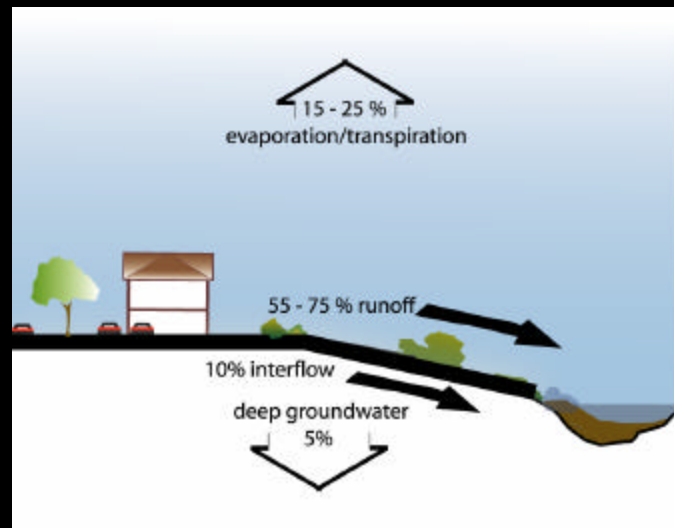
**Urbanization radically
alters the way the
watershed works**

**The problem is not
quality**

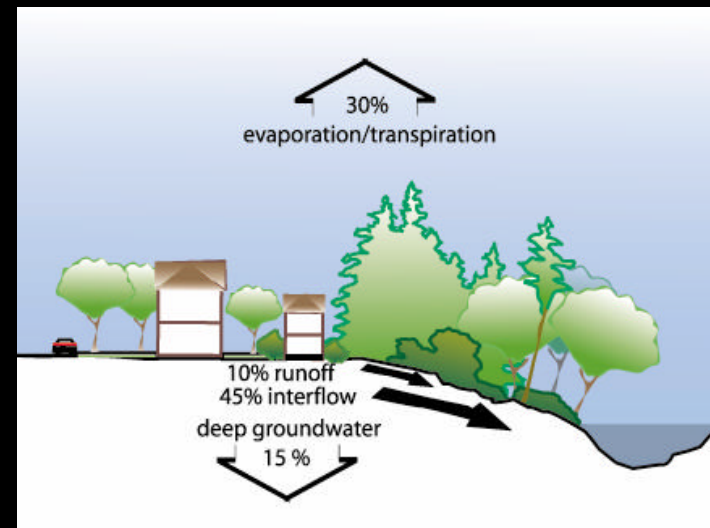
The problem is quantity



The natural condition

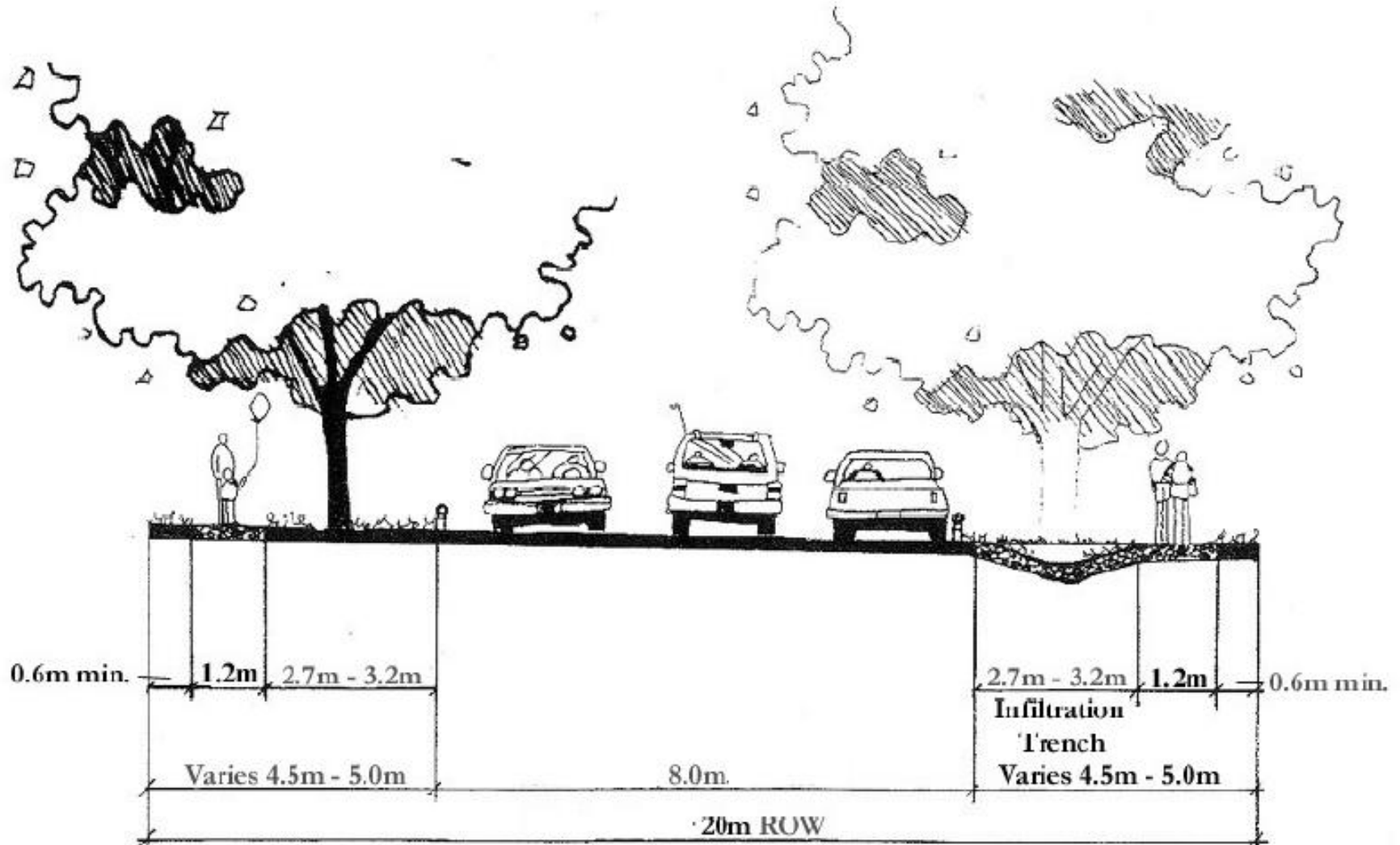


The gray infrastructure condition

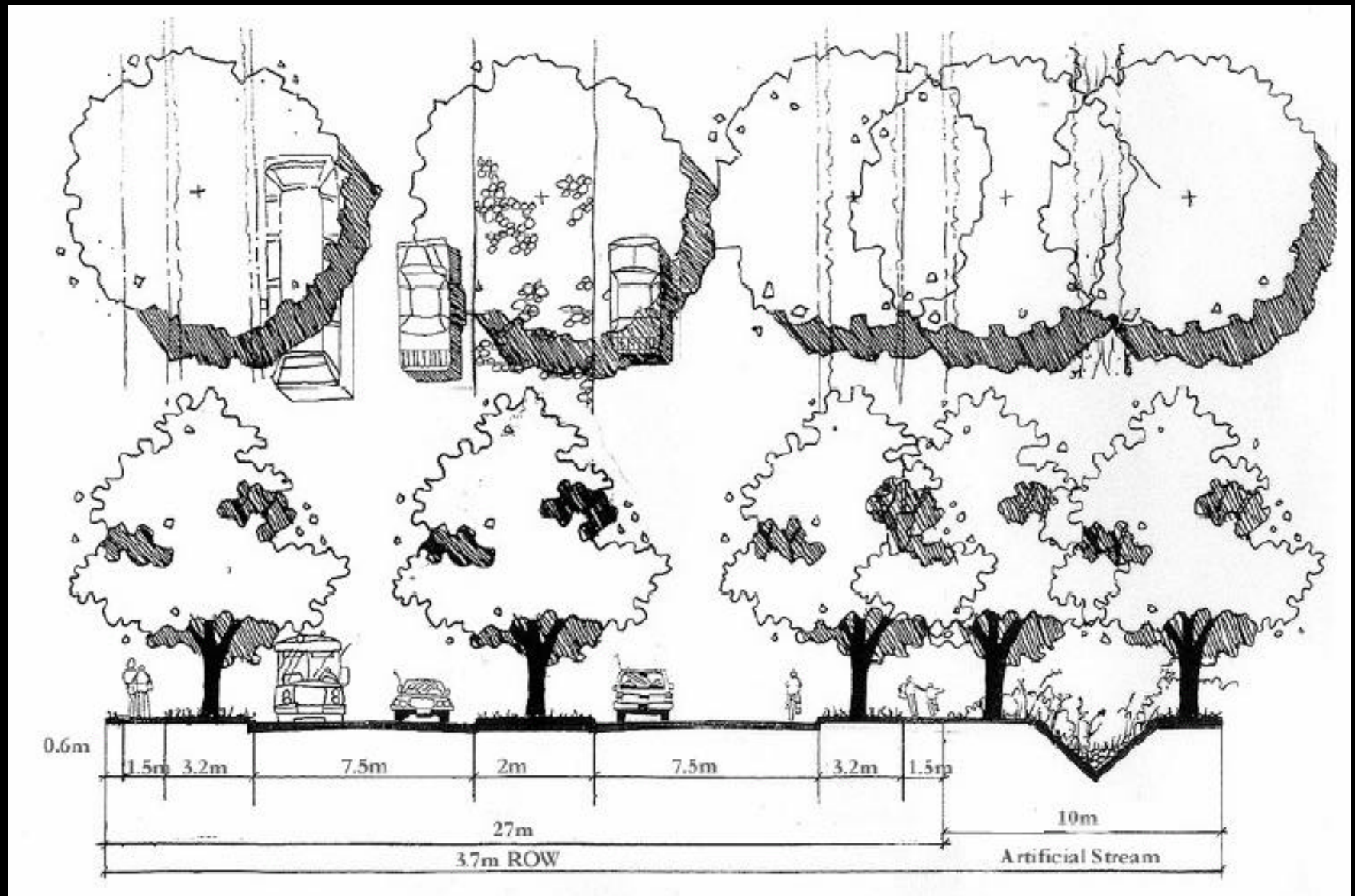


The green infrastructure condition

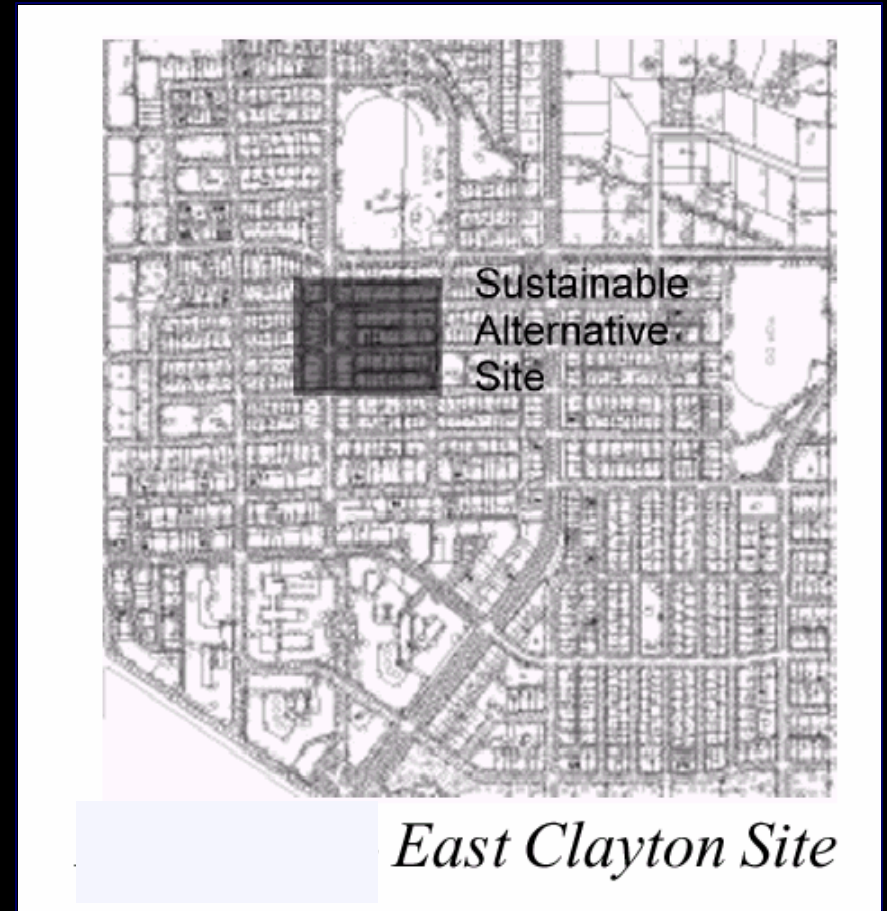
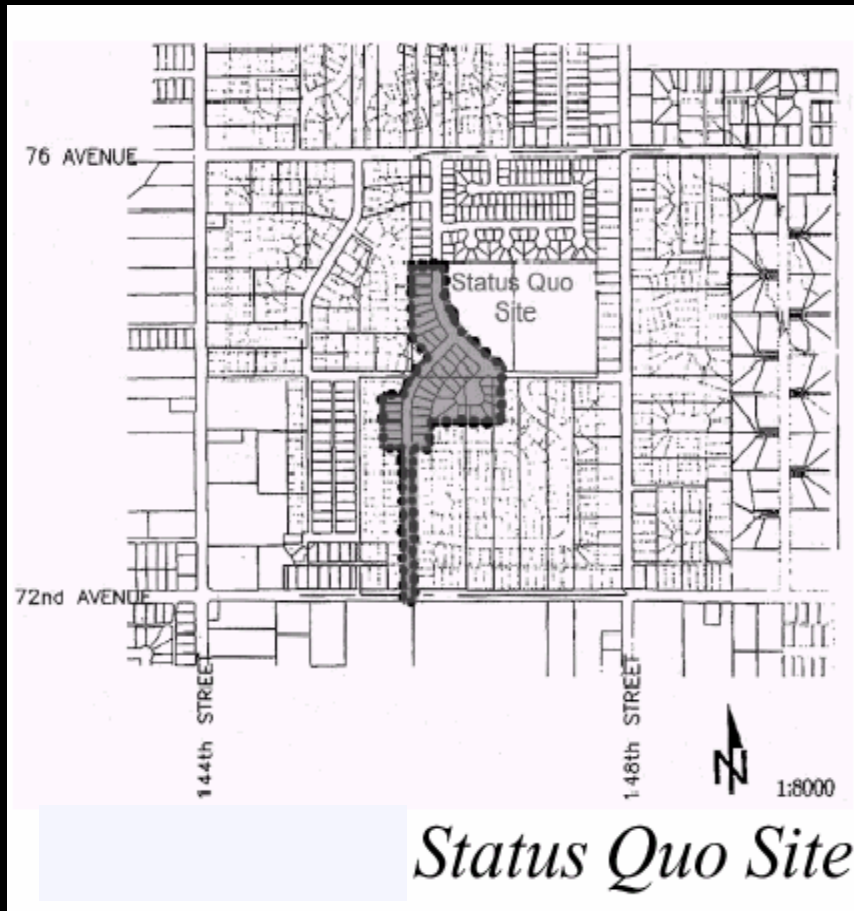
Typical Local Street Section



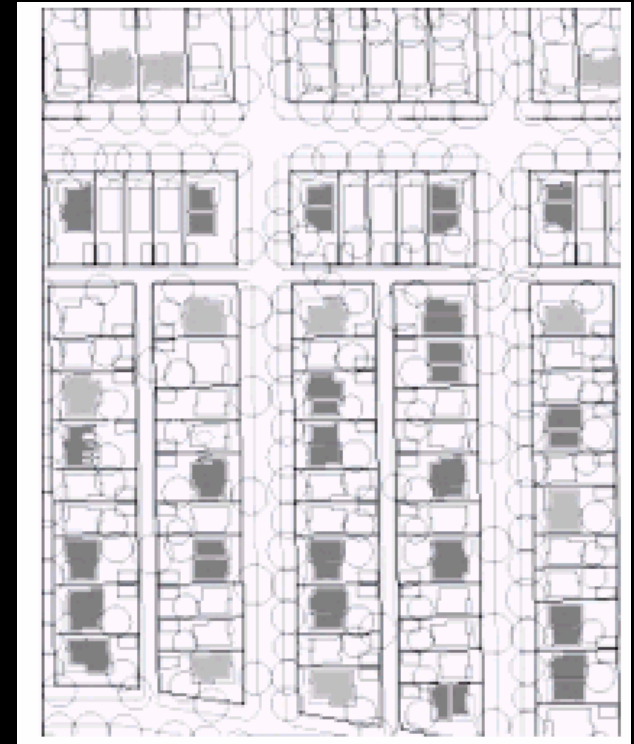
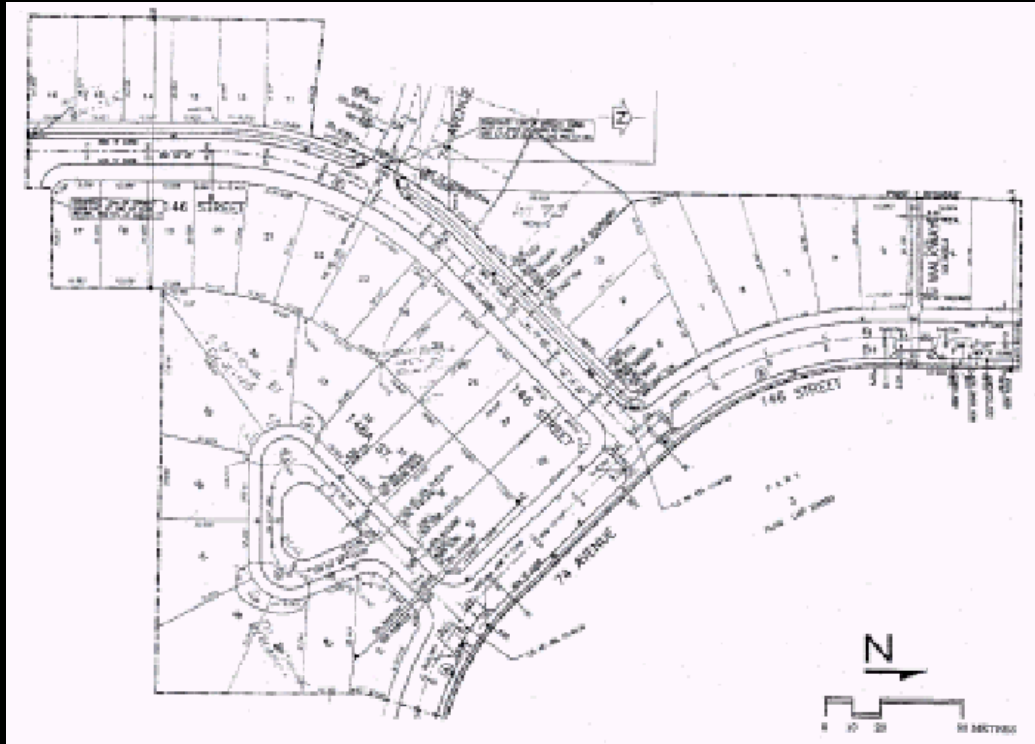
Typical Riparian Parkway Street Section



Comparing two Surrey sites, both 10 acres.
Average Home size (interior sq.ft.) equal



How many homes?



Status Quo

41 Single Family Homes

Sustainable Option

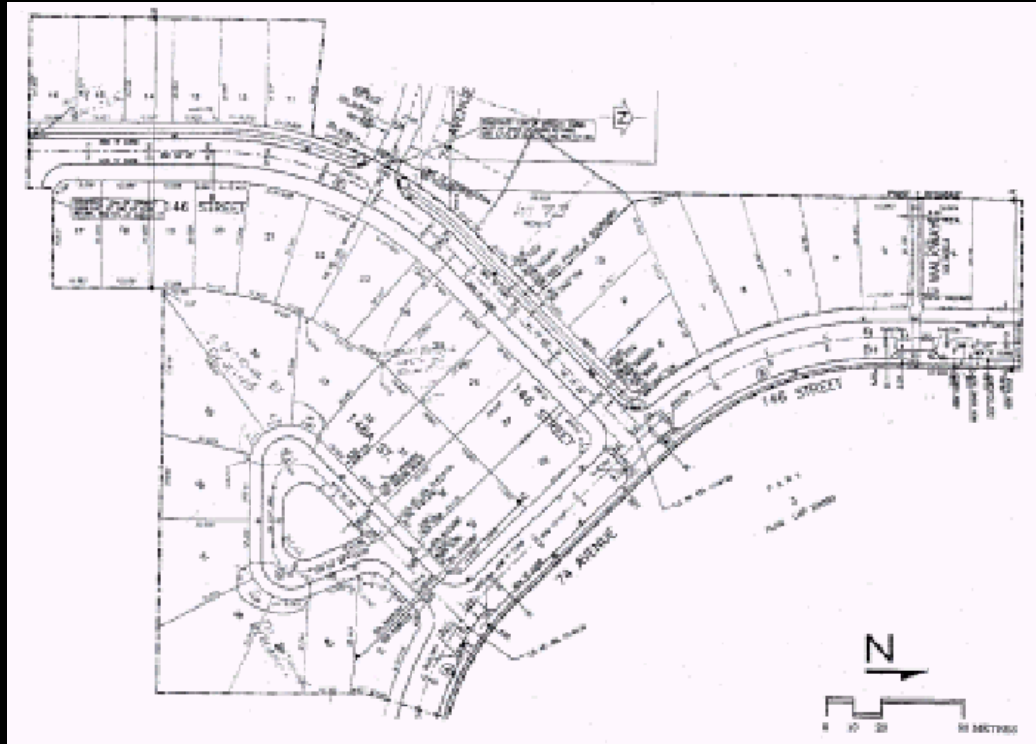
Single Family 37

Duplex Units 54

S. F. with Suite 10

Total Units 111

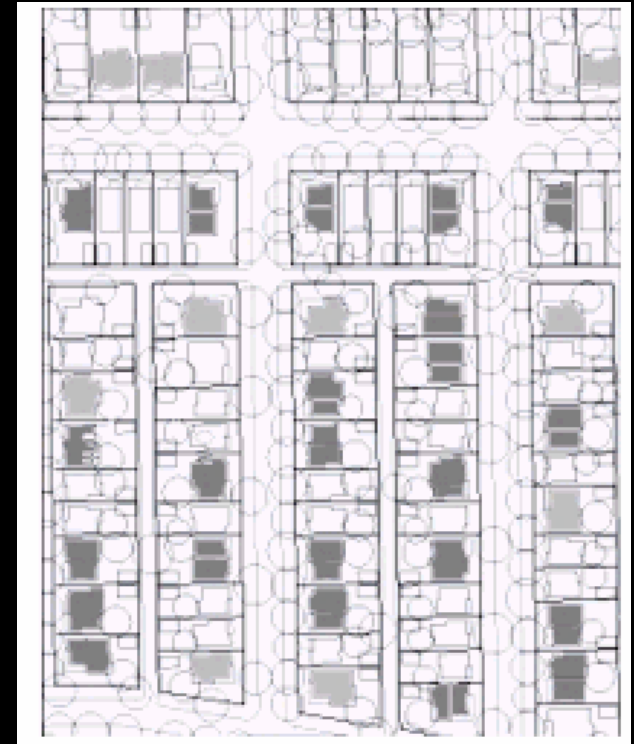
How much impervious surface?



Status Quo

TIA 50%

EIA 50%



Sustainable Option

TIA 50.3%

EIA 10%

How do they compare?

		CONVENTIONAL SUBURBAN SITE	EAST CLAYTON SITE
Site Area	hectares	4.27	4.23
	acres	10.50	10.45
Total Parcels		41	74
Total Dwelling Units ¹		41	111
Parking	stalls per unit	-	-
	total stalls	82	222
Gross Density	d.u./ha.	9.60	26.24
	d.u./acre	3.90	10.62
Lot Coverage	net (lots only)	0.40	0.45
Floor Area Ratio ²	net (lots only)	0.30	0.55
	gross (lots & ROWs)	0.20	0.28
Average Unit Size ³	sq.m.	214.00	155.00
	s.f.	2300.00	1661.00
Average Utility Run	m/d.u.	13.80	8.50
	f./d.u.	45.30	27.88
Pavement	sq.m/d.u.	229.00	83.45
	s.f./d.u.	2468.78	907.88
Site Permeability (%) ⁴		50.00	49.65

How do they compare?

INFRASTRUCTURE COST			
Roadworks		\$218,894	\$256,853
	Asphalt Paving	\$24,553	\$38,247
Storm Sewer		\$205,820	n/a
Surface Drainage	Swale Pipe ⁹	n/a	\$80,000
Boulevard Landscaping		\$30,000	\$36,070
Water Mains		\$113,705	\$169,107
Water Tie-ins and Connections *		\$18,177	\$49,211
Sanitary Sewers		\$135,255	\$229,780
Sanitary Tie-ins and Connections *		\$5,000	\$13,536
Street Lighting		\$44,000	\$64,500
Lot Grading and/or Swales		\$24,450	\$24,221
Hydro/ Telephone installation (buried services) *		\$54,000	\$146,196
Boulevard Tree Planting		\$20,000	\$24,052
Utilities *		\$54,000	\$89,859
Block interior pathways and emergency access		\$12,500	n/a
Block interior pathways landscaping		\$4,000	n/a
Total Infrastructure Cost	entire site	\$964,354	\$1,221,632
	per unit	\$23,521	\$11,005.69
	per parcel ¹⁰	\$23,521	\$16,509

How do they compare?

LAND COST ⁵		
per unit ⁶	\$76,829	\$28,243
per parcel ⁷	\$76,829	\$42,365
BUILDING COST ⁸		
per average sized unit (2300 sq. ft./1661 sq. ft.)	\$138,000	\$99,660
per equal sized structure 2,000 sq. ft.	\$120,000	\$120,000

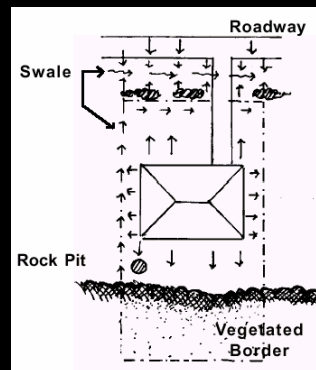
What's the Bottom Line?

TOTAL COST OF AN AVERAGE SIZED UNIT (Land+Building+Infrastructure)		
Average unit sizes (2300 sq. ft.vs. 1661 sq.ft)	\$238,350	\$138,909
Total Cost per Square Foot of interior space (Land+Building+Infrastructure)		
Average unit sizes (2300 sq. ft.vs. 1661 sq.ft)	\$104	\$84
TOTAL COST OF EQUAL SIZED STRUCTURE (Land+Building+Infrastructure)		
Equal sized structures of 2000 sq. ft.	\$220,350	\$178,873

Will Infiltration Work in our Glaciated Soils?



Amble Greene,
Surrey BC



Project Description			Amble Greene
DEVELOPMENT			
Location	South Surrey		
Development Type	residential		
No. of Units	153		
Developer	Shell Canada		
Size	9.9 Acres		
Date of Construction	1979		
ROAD			
Street Pattern	curvilinear		
Typical ROW width	20 meters		
UTILITIES			
Pattern	curvilinear		
STORMWATER			
Type of System Constructed	infiltration/ exfiltration/ storage		
Area serviced	9.9 Acres		
Level of SW	100-year storm		
Large Storm situation	3" in 24 hour		
System Length	934 meters		
Culvert	no		
Site Condition			
BIOPHYSICAL			
Settlement Patterns	Forested		
Post Development Conditions	Residential		
HYDROLOGICAL			
Average Rain Event	<1/2 inch in 24 hr (See figure 4-3)		
GEOTECHNICAL			
Soils Profile - surface	0.1- 0.5 metres		
sub soils	to 2.0 metres (gravely sandy)		
Site Grades	undulating		
Water Table Elevation	low		
Soil Infiltration Capacity	180mm/hour		
Evaluation			
PROJECT COSTS			
	1979	2000	
Stormwater Installation Costs	\$65,615	\$140,100	
cost per ha	\$18,226	\$35,025	
cost per acre	\$7,372	\$14,152	
cost per linear metre	\$70	\$150	
cost per linear foot	\$21	\$45	
MAINTENANCE COSTS			
Yearly Expenses	n/a		
SWS Expected Lifespan	10-20 years		

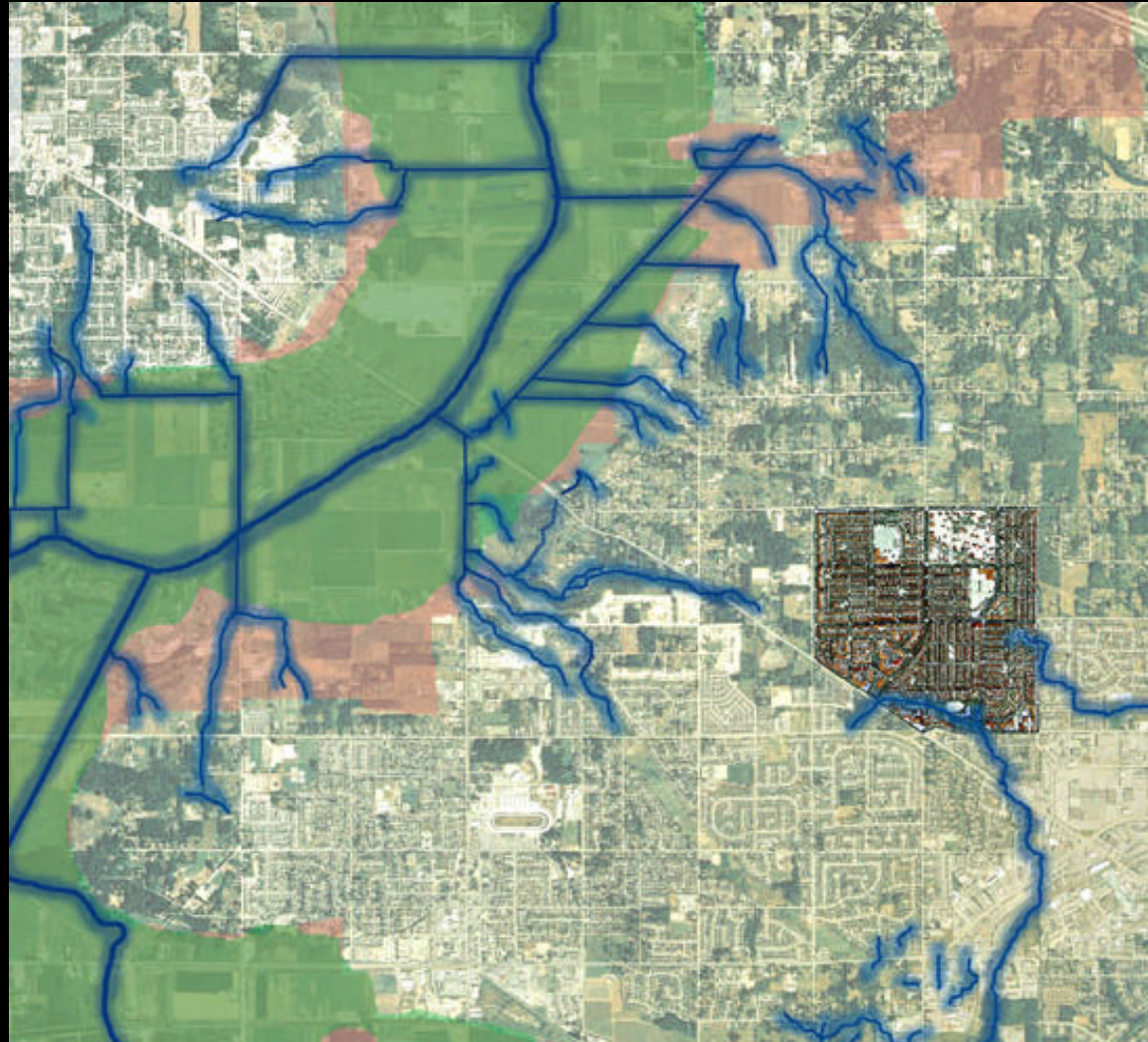
Why does that matter?

To maintain stream health and prevent flooding of agricultural lands.

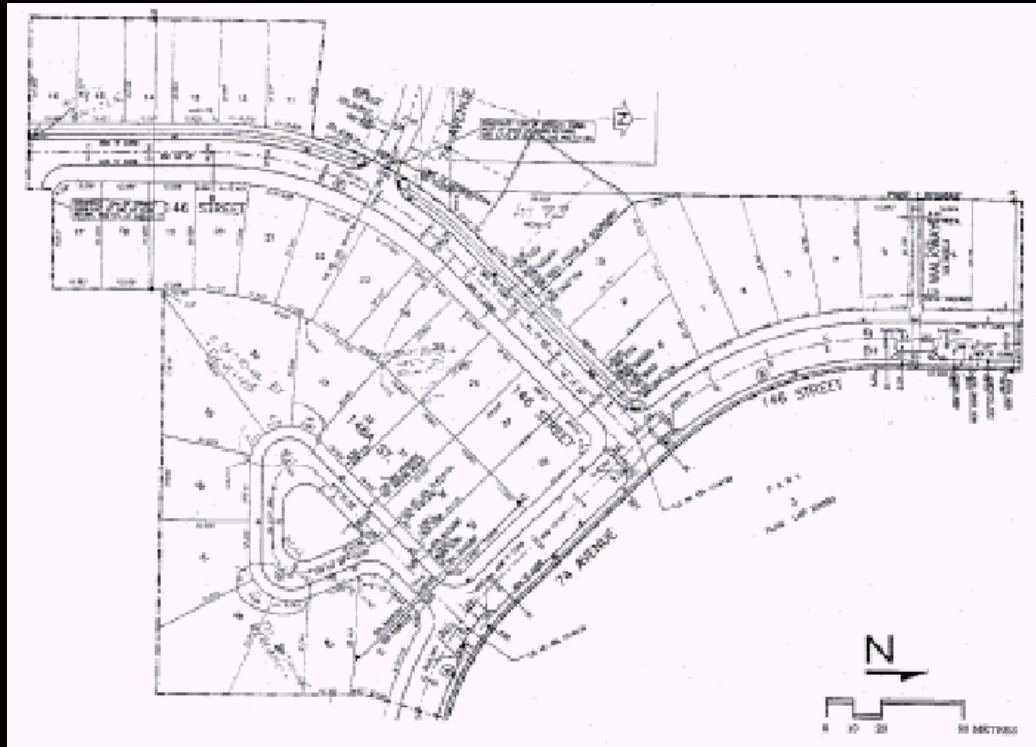
Surrey forced to pay farmers 60 million in compensation for storm water produced flooding.

Millions more for dike system.

Taxpayers and homebuyers forced to foot the bill.

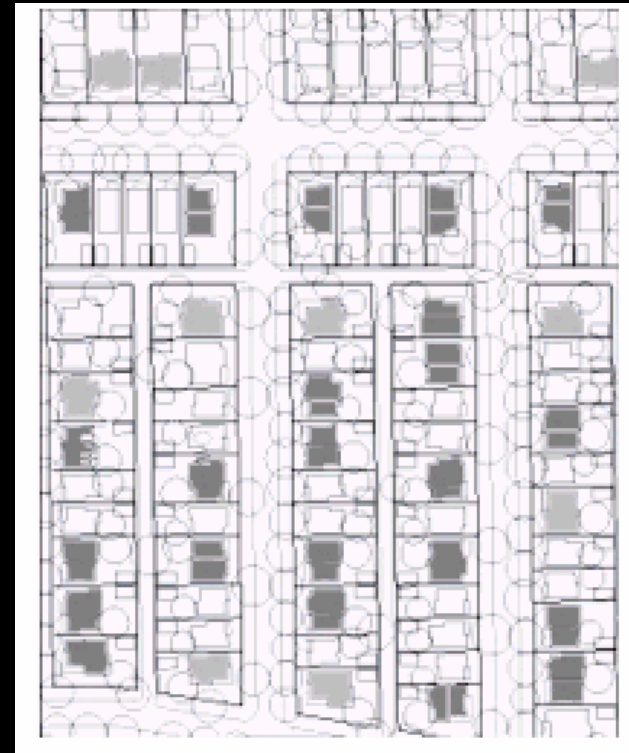


How much infrastructure to install, replace and maintain?



Status Quo

\$23,521 per dwelling unit

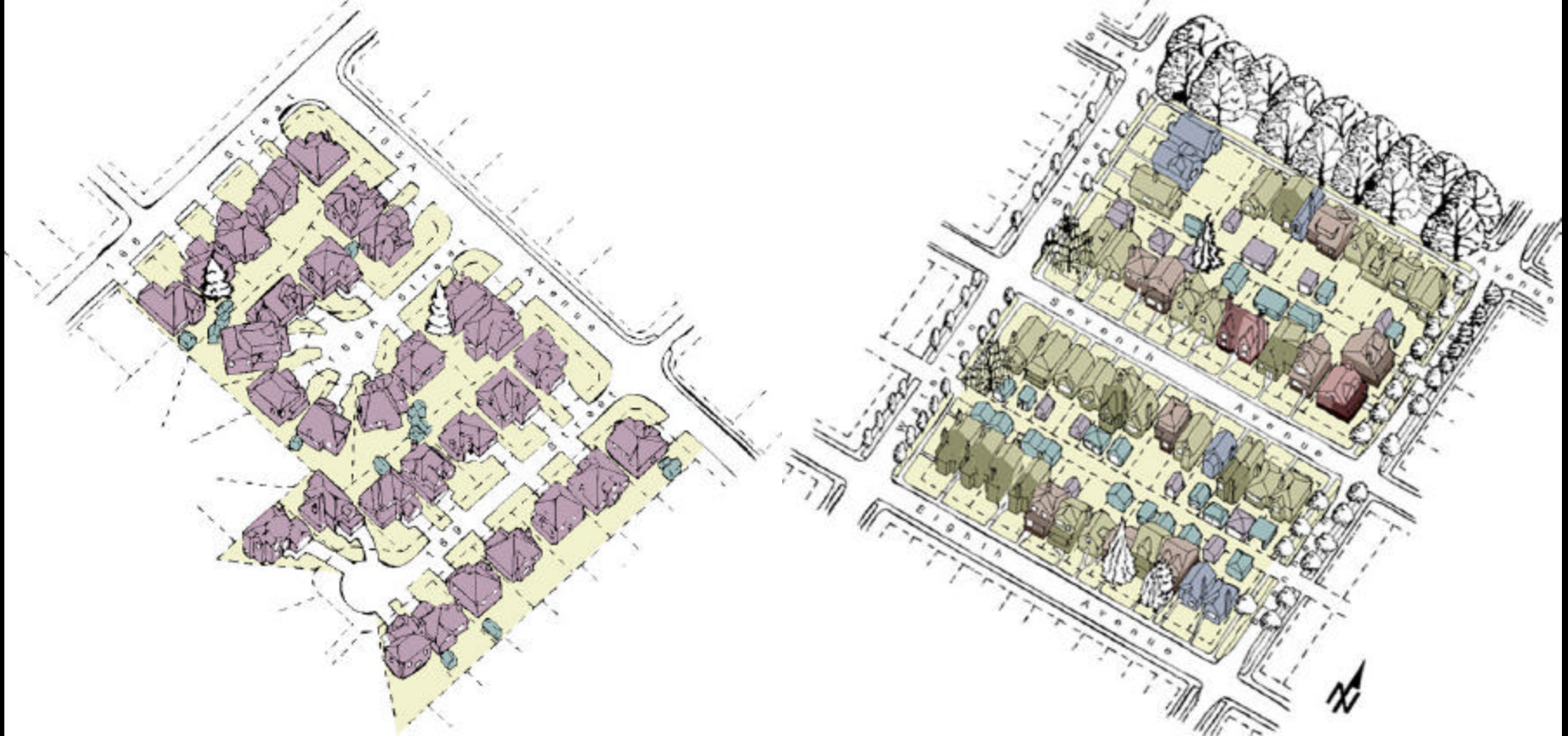


Sustainable Option

\$11,006 per dwelling unit

So how much would a home cost?

Costs included are land, construction, and on site servicing (hard) costs only. Permitting fees, DCCs, Developer profit and carrying costs not included.



\$104 / interior sq ft

\$238,300 for 2,300 sq ft average unit.

\$84 / interior sq ft.

\$138,350 for 1,660 interior sq ft average unit.

What about the tax base?

Ratio of home value to replacement cost for infrastructure



238,300 to 23,521 or 10 to 1

138,350 to 11,000 or 12 to 1

Are wide streets safer for our kids?

Denver study showed pedestrian fatalities four times more likely on wide “status quo” streets than on old fashioned narrow streets with lane access.



Regional Impacts on Infrastructure?

Using climate change gas as a measure.

JAMES TAYLOR CHAIR
IN LANDSCAPE &
LIVEABLE ENVIRONMENTS

TECHNICAL BULLETIN

No.8
January 2001

**The Headwater's Project – The East Clayton Neighbourhood Concept Plan
Environmental Benefits**

I. Introduction

The *East Clayton NCP* is guided by the following seven principles:

No. 1 *Increase density and conserve energy by designing compact walkable*

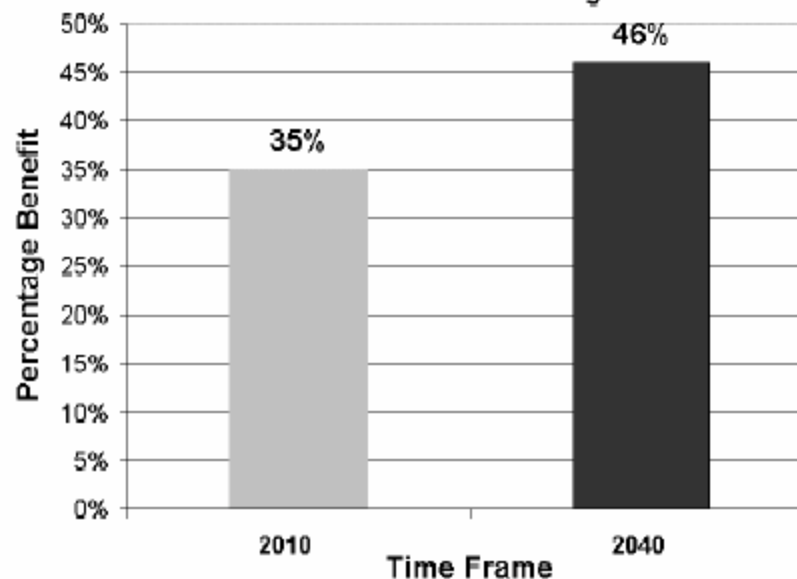
Measuring the benefits of alternative community design patterns has become an important means for understanding the influence of established land use and community design standards and practices on community and regional sustainability. In this study we provide an overview of the Headwaters Project, a demonstration of sustainable development principles and perfor-

Regional Impacts on Infrastructure?

Using climate change gas as a measure.

Long Term Benefit

Table 8-2 - The long term air quality benefit (GHG emissions) of the proposed East Clayton pattern over conventional suburban-type pattern would be at least 45% if the East Clayton pattern of development were replicated over a 30 year time frame.



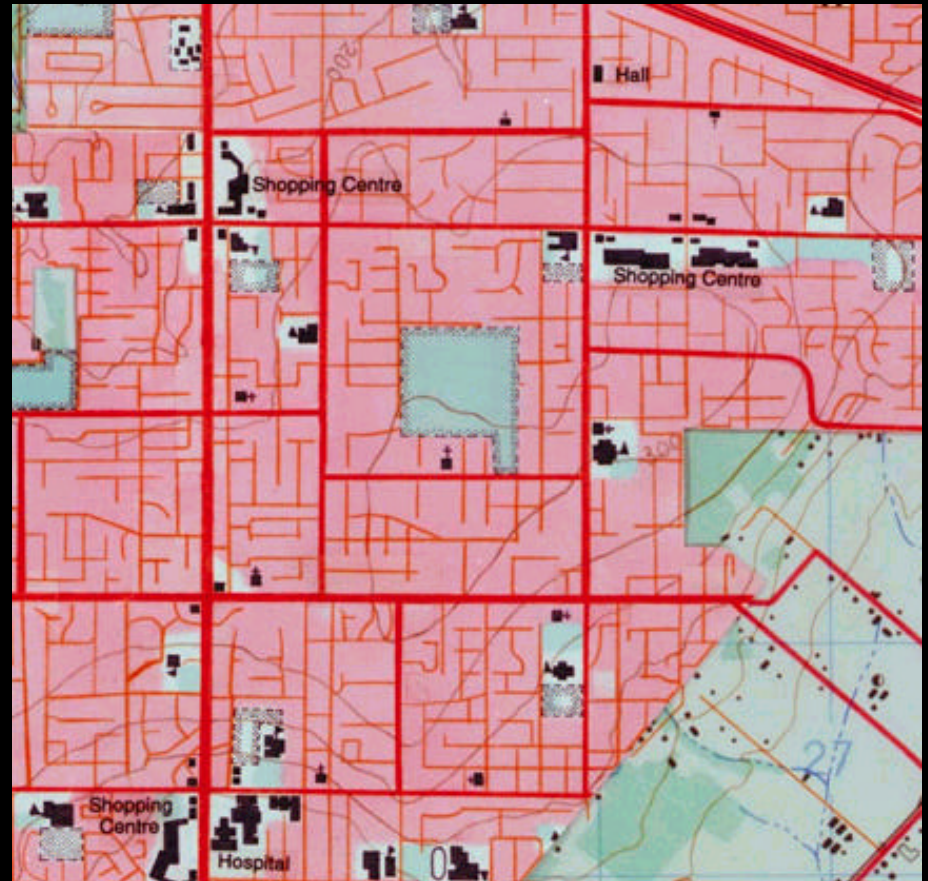
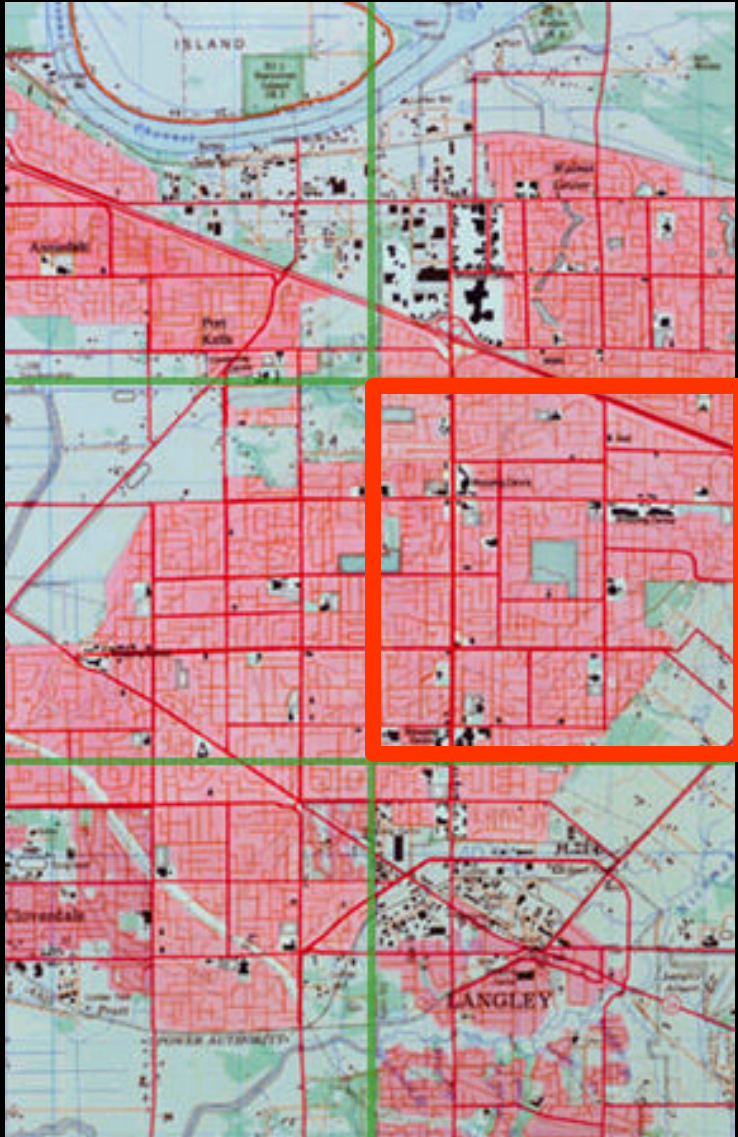
Using climate change gas as a measure.

Table 8-1

Air Quality Comparison		Scenario 1 2010		Scenario 2 2040	
Neighbourhood Attributes	East Clayton	Suburban Type ¹	East Clayton	Suburban Type ¹	
Urban Context	inner suburb ²	inner suburb ²	inner area ³	inner area ³	
Land Area	250 ha	250 ha	250 ha	250 ha	
Road Layout Type	primarily grid	random curvilinear	primarily grid	random curvilinear	
Total length of non-expressway roads	26km	20km	26km	20km	
Total number of intersections	112	60	112	60	
Total length of wide arterials (4 lane)	2.5km	5	2.5km	5	
Daily Bus Vehicle Service Hours	14.6	5	16.2	14.6	
Total Length of bike routes	7km	0	7km	0	
Socio-Demographic Data	East Clayton	Suburban-type	East Clayton	Suburban-type	
Total number of residential units	4928	2250	4928	2250	
Total Residential Density (units/ha)	20	9	20	9	
Housing Mix (1=total mix; 0=no mix)	0.74	0	0.74	0	
Number of grocery stores (1-km radius)	8	0	8	0	
Number of jobs (1-km radius)	4464	0	4464	0	
Number of jobs (5-km radius)	40000	40000	120000	120000	
Locational Characteristics	East Clayton	Suburban-type	East Clayton	Suburban-type	
Distance to CBD	12km	12km	3km	3km	
No.of Jobs (5-km radius)					
Distance to nearest rapid transit station (rapid bus)	1km	1km	1km	1km	
Distance to nearest commuter rail (SkyTrain)	8.7 km	8.7km	3km	3km	
NEIGHBOURHOOD PERFORMANCE COMPARED					
Weekday Household Travel Behaviour	East Clayton	Suburban-type	East Clayton	Suburban-type	
Average Vehicles Owned/Household	1.17	1.65	1.13	1.6	
Average VKT generated/household:	51.6	78.8	38	72.8	
Average PKT generated/household:	16.2	19.7	13	19.8	
Annual Household Vehicle Emissions	East Clayton	Suburban-type	East Clayton	Suburban-type	
Auto	5900	9000	4400	8300	
Transit	220	270	180	270	
Total Household Vehicle Emissions	6120	9270	4580	8570	

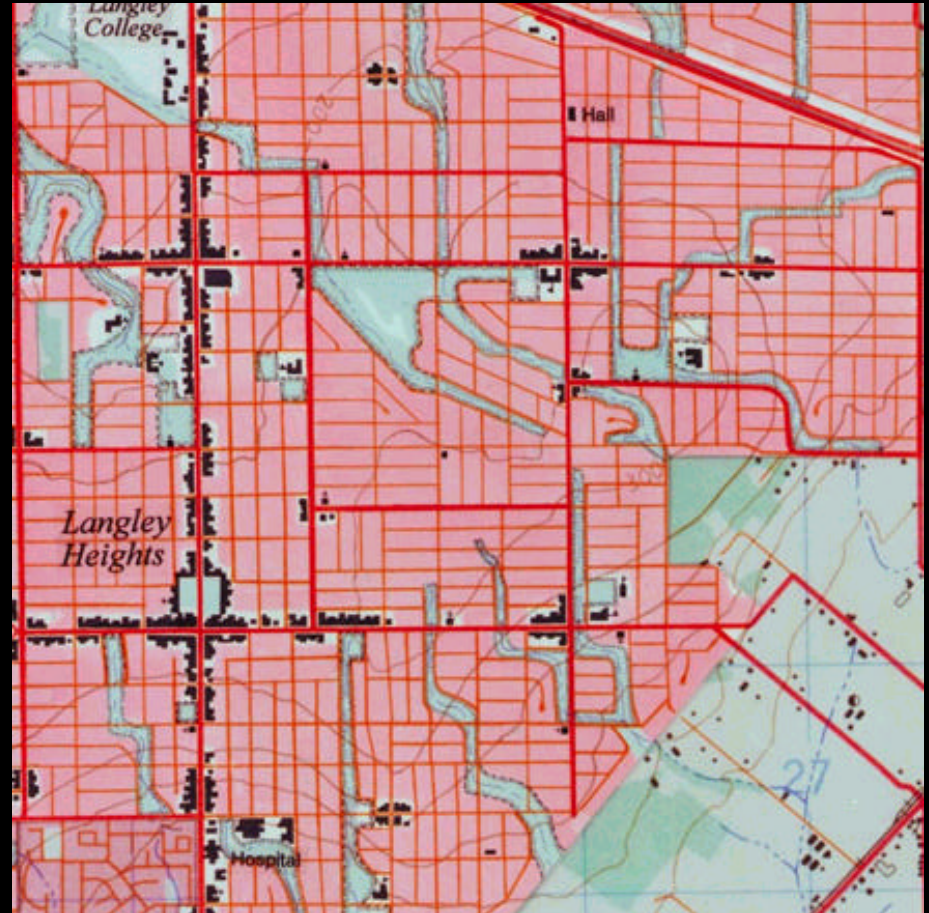
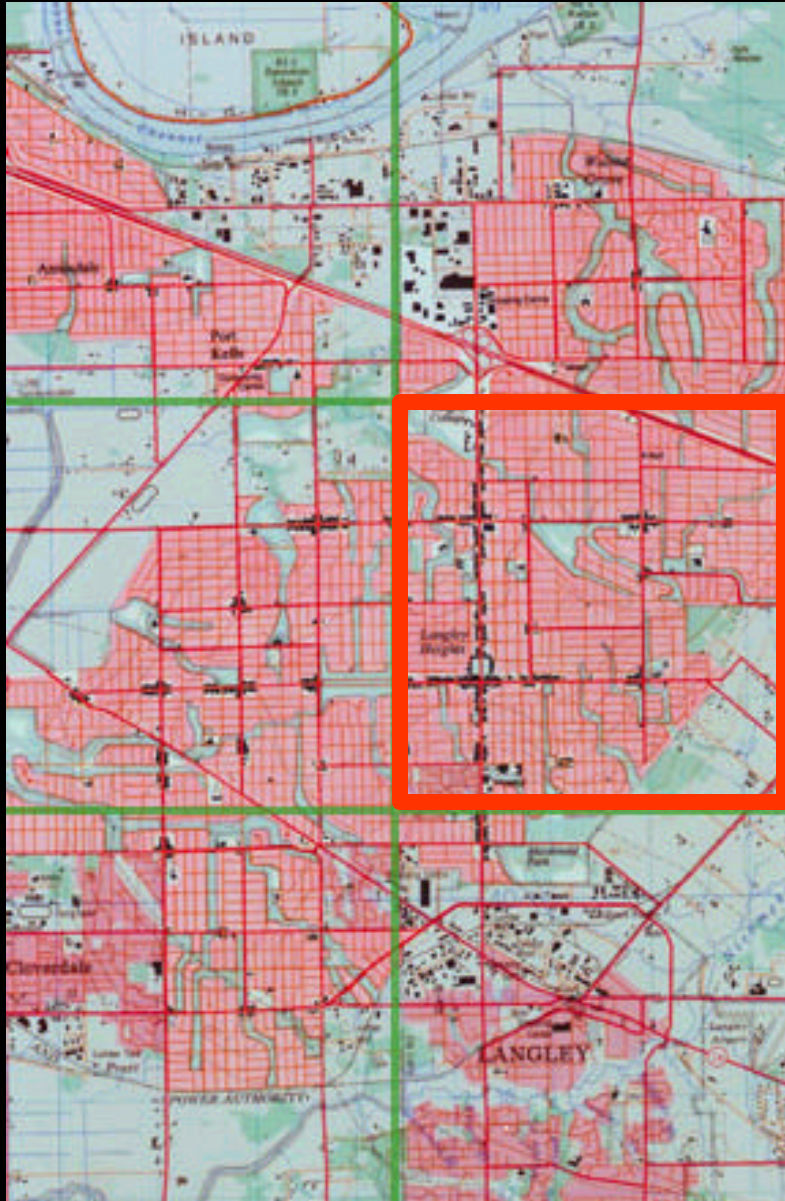
Emissions in
KG per
household

Regional Impacts



115,000 people @ 4 d.u./ acre
82,800 cars
Transit trip share 4%
9,100 KG CO²/Capita
Streams biologically dead

Regional Impacts



253,000 people @ 10 d.u./ acre
138,000 cars
Transit trip share 20% or more
6,300 KG CO²/Capita (40% less)
Stream hydrology maintained
New streams created.

*If its this easy, why isn't
everybody doing it?*

Risk !

Now let me get this straight son.

**You want me to risk my job as
chief engineer to save a few
fishies?**



Thank you!

Questions and Answers