EAST CLAYTON NEIGHBOURHOOD CONCEPT PLAN (NCP)

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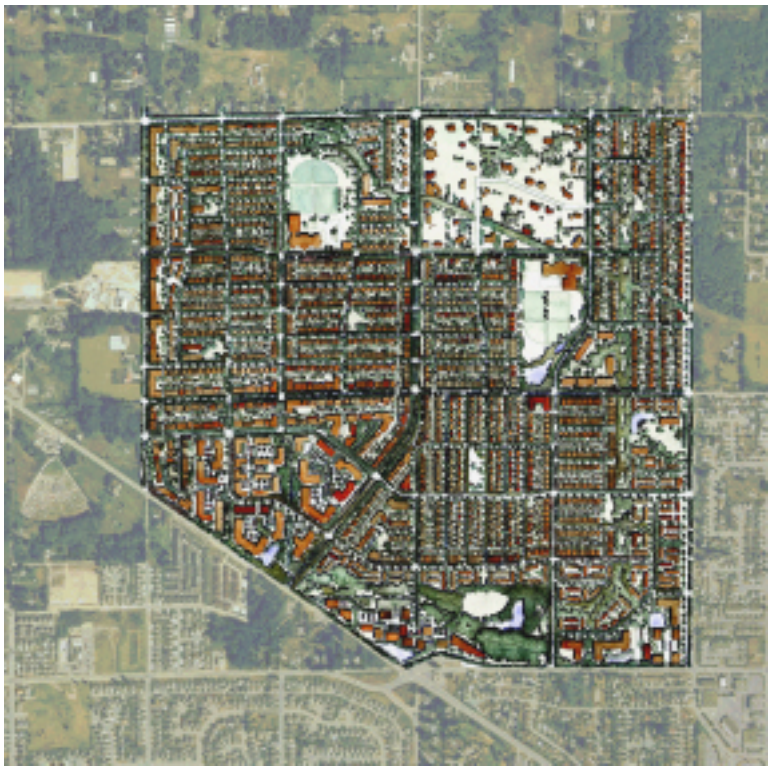

This Neighbourhood Concept Plan was prepared by the following organizations:

City of Surrey
UBC James Taylor Chair in Landscape and Liveable Environments
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Real Estate Foundation of British Columbia

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1.0 INTRODUCTION

1.1 Purpose of Report

The East Clayton Neighbourhood Concept Plan (NCP) is the result of an integrated planning process involving several constituencies of interest. Based on principles of sustainability and complete communities, the plan includes the application of innovative servicing, stormwater management, road standard, and neighbourhood planning ideas.

The East Clayton NCP will be used as a policy framework to guide the future development of this sustainable community. The report includes a detailed description of the process, land-use designations and densities, and development standards and guidelines. It also includes a discussion of development phasing and cost-sharing arrangements for municipal servicing, infrastructure, and neighbourhood amenities.

1.2 The Planning Context

This section provides a brief summary of provincial planning legislation and concurrent design initiatives that influenced the development of the East Clayton NCP.

1.2.1 Planning Legislation

The majority of growth currently occurring in the Lower Mainland region is urban.[1] It is the objective of the City of Surrey to manage its share of growth effectively. The Clayton district, and specifically East Clayton, needs to plan for its future within the context of legislation that establishes the authority to plan for urban growth. The *Livable Region Strategic Plan*, the Greater Vancouver Regional District's (GVRD) vision of land- use and transportation, sets out four broad strategies for achieving urban growth in the Lower Mainland region. These include: protecting the green zone, building complete communities, achieving a compact metropolitan region, and increasing transportation choice.[2]

The "Green Zone" establishes a long-term boundary for urban growth and is intended to protect the region's natural assets (i.e., parks and watersheds). Building more complete communities requires a balanced distribution of jobs, housing, public services, and transportation services. Within its vision for a compact metropolitan region, North Surrey is designated to accommodate residential growth to an estimated population capacity of 472,000 persons, or 191,100 households.[3]

Within the broad legislative context of the Growth Strategies Statute Amendment Act – The Municipal Act, the City of Surrey, in a Memorandum of Agreement with the GVRD, recognized the need to "achieve not only the development of Surrey Centre and an increase in population but more complete communities in other parts of the municipality." More specifically, it recognized that additional growth capacity might be necessary in the Cloverdale district.[4] This agreement gave the city some flexibility in accommodating urban growth and established the context for the development of a complete community in Clayton, including East Clayton.

[1] Province of British Columbia, *Growth Strategies Statutes Ammendment Act: Explanatory Notes* (Victoria, British Columbia: Province of British Columbia, Ministry of Municipal Affairs, 1995).
[2] Greater Vancouver Regional District, *Livable Region Strategic Plan* (Vancouver, BC: Greater Vancouver Regional District April, 1996).
[3] Ibid.
[4] *Memorandum of Understanding* between the City of Surrey and the Greater Vancouver Regional District regarding resolution of objections to the Livable Region Strategic Plan (Vancouver, BC: October 3, 1995).

1.2.2 City of Surrey OCP and a Vision for Complete Communities

The Official Community Plan for Surrey (October 8, 1996) (OCP) designates some "suburban" areas as those having long-term development potential subject to land-use planning with local residents.[5] Within this framework the Clayton area was identified as a "suburban", and East Clayton as a new "urban" neighbourhood. The first step in planning for East Clayton's future was the formulation of a Neighbourhood Concept Plan for East Clayton area.

The Surrey OCP "promotes planned community development – bringing together residents, business and city resources to guide the location and form of growth toward long term city and regional goals for complete and sustainable communities."[6] Complete and sustainable communities are those that offer a wide range of housing choices, services, and employment opportunities at high enough densities to support convenient access to services and transit, all within a pedestrian-friendly neighbourhood fabric. At the same time, complete communities also protect the quality and integrity of ecosystems by maintaining environmentally sensitive areas (i.e., natural flow-receiving watercourses), and by managing the quantity and quality of storm-water runoff.

1.2.3 South Newton Charrette

In 1995, an international team of urban designers was assembled to help provide a vision for more livable and sustainable communities within the region. The South Newton area of Surrey was the chosen site for the first Sustainable Urban Landscapes Design Charrette.[7] Emerging from the charrette were principles promoting natural drainage systems, walkable neighbourhoods, interconnected street systems, lighter and greener infrastructure, mixed dwelling types, and affordable, detached housing.

1.2.4 Alternative Development Standards Workshop

In the Spring of 1998, the UBC James Taylor Chair in Landscape and Livable Environments undertook researched the costs and benefits of the alternative development standards emerging from the South Newton Charrette. Findings were presented to a workshop that involved planners; engineers; real estate agents; developers; and federal provincial, and municipal government officials. Participants in that workshop strongly recommended a demonstration project that would put the alternative development standards into practice. The East Clayton neighbourhood was eventually selected. The existence of several special constraints contributed to its selection. Of these constraints, drainage constraints, both on the site and on receiving lowlands were most significant.

In addition, a general land-use plan for the entire Clayton area had recently been completed, local resident groups and the City were mobilized, and most stakeholders were prepared to participate.

1.3 The Clayton General Land-Use Plan

The preparation of a General Land-Use Plan for the Clayton Area commenced in June 1996 and involved two stages. The first stage created a "vision" for the community that would lead to the development of land-use concepts, a servicing and phasing strategy, a master drainage plan, and a list of environmental objectives.

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[5] City of Surrey Planning and Development Services, *Official Community Plan* (Surrey, British Columbia: City of Surrey, 1996).
[6] Ibid.
[7] Patrick Condon, ed., *Sustainable Urban Landscapes: The Surrey Design Charrette,* (University of British Columbia The James Taylor Chair in Landscapes and Livable Environments 1996).

The public consultation component of the process included a formal questionnaire and public meeting, held in June 1996. Internal and external stakeholder meetings were held in November 1996, culminating in a public visioning workshop, held November 13, 1996 (see sidebar). Public involvement was enhanced through the involvement of the 15-member Clayton Citizen Advisory Committee (CAC), who brought local knowledge to the planning process and who represented property owners and residents during the preparation of land-use alternatives. The final public information meeting for the General Land-Use Plan was held by City Council in December 1998.

The second stage would involve the preparation of more detailed NCPs for the individual neighbourhoods of Clayton.

Workshop participant responses included:

- a range in views from maintaining suburban densities and the rural character of the area to low to medium housing densities;
- opportunities for local work;
- commercial uses at a neighborhood scale with some higher-order commercial uses along Fraser Highway;
- the preservation of natural areas;
- a variety of park sizes with pathways and bicycle routes;
- the preservation of Clayton's heritage resources and the provision of adequate libraries and recreation facilities;
- roadway improvements with sidewalks and appropriate lighting; and
- the resolution of groundwater problems.

1.3.1 General Land-Use Plan and Seven Principles of Sustainable Development

On December 7, 1998, a corporate report [8] from Planning and Development recommended that City Council:

1. approve the General Land-Use Plan;
2. instruct staff to commence the preparation of the NCP for East Clayton (lands currently designated "urban" in Surrey's Official Community Plan) and to ensure that it includes the type, size, location and densities of the specific land uses, road hierarchy, and alignments based on the General Land Use Plan;
3. instruct staff to explore the application of sustainable development principles, standards, and practices during the detailed NCP process for East Clayton;
4. instruct staff to prepare a comprehensive servicing, phasing and financial strategy for East Clayton that will demonstrate adequate funding for specific amenities, infrastructure, and utilities; and
5. instruct staff to address issues left outstanding after the completion of the process.

In July, 1998, City Council held a shirtsleeve session to raise discussion and obtain feedback on issues related to sustainable growth, efficient development and livable communities for Surrey. At this session the following seven principles of sustainable development were presented:

Principle No. 1
Conserve land and energy by designing compact walkable neighbourhoods. This will encourage pedestrian activities where basic services (e.g., schools, parks, transit, shops, etc.) are within a five- to six-minute walk of their homes.

[8] City of Surrey Planning and Development, *Corporate Report: Clayton Neighbourhood Concept Plan General Land Use Concept,* (Surrey, BC: City of Surrey, 1998). See ***Appendix 1.***

Principle No. 2
Provide different dwelling types (a mix of housing types, including a broad range of densities from single-family homes to apartment buildings) in the same neighbourhood and even on the same street.

Principle No. 3
Communities are designed for people; therefore, all dwellings should present a friendly face to the street in order to promote social interaction.

Principle No. 4
Ensure that car storage and services are handled at the rear of dwellings.

Principle No. 5
Provide an interconnected street network, in a grid or modified grid pattern, to ensure a variety of itineraries and to disperse traffic congestion; and provide public transit to connect East Clayton with the surrounding region.

Principle No. 6
Provide narrow streets shaded by rows of trees in order to save costs and to provide a greener, friendlier environment.

Principle No. 7
Preserve the natural environment and promote natural drainage systems (in which storm water is held on the surface and permitted to seep naturally into the ground).

On January 25, 1999, Council approved the General Land-Use Plan for Clayton and authorized planning staff to explore the application of the seven principles in the East Clayton NCP planning process.

1.4 The East Clayton Integrated Planning Process

Planning for a more sustainable East Clayton community required the integration of resources and an integrated planning method. It called for the application of a multi-party approach to building policy and developing acceptable standards of commitment among diverse constituencies. It involved raising awareness, providing time for reflection, and accepting alternative ways of developing a community – all within a relatively short time period.

1.4.1 A Planning Partnership

In 1998, the Headwaters Project was conceived. It is a partnership between the City of Surrey Planning and Engineering Departments, the UBC James Taylor Chair in Landscape and Livable Environments, and the Pacific Resources Centre, and its purpose was to apply sustainability principles within the East Clayton planning area.[9]

The James Taylor Chair provided leadership and technical expertise regarding principles of sustainable urban design and the use of the design charrette method. The Pacific Resources Centre assisted in the design and facilitation of an integrated planning process. The Planning Department carried out its mandate to implement Council's directives by ensuring that the planning process maintained a standard that was consistent with, or higher than, those of other planning processes; that the East Clayton NCP was compat-

ible with the OCP and the Clayton Area General Land-Use Plan; and that the plan was completed within an acceptable timeframe. The City's Engineering Department also ensured compliance with the objectives of the Clayton Master Drainage Plan, the Surrey Transportation Plan, and other engineering servicing mandates.

1.4.2 East Clayton Citizen Advisory Committee (ECCAC)

On January 26, 1999, a meeting was held to confirm the involvement of the East Clayton Citizen Advisory Committee (ECCAC) and to introduce the idea of incorporating sustainable development principles and standards into a detailed plan for East Clayton.

ECCAC involvement ensured that:

1) a core group of local people developed an understanding and appreciation for the underlying principles of the plan, its features, and how they are linked to form a complete community system;
2) an effective two-way communication system conveyed information to constituency members, the design table, and City staff as the plan evolved;
3) the outstanding issues stayed on the table until resolved or advanced to its satisfaction;
4) local landowner interests were represented;
5) planning concepts were practical, achievable, and financially responsible from the perspectives of both landowners and the public;
6) despite major concerns over certain proposals for the future of East Clayton (i.e., the arterial designations and realignment), the momentum of the plan and its credibility was maintained; and
7) self-interest was placed within the context of the community and City-wide interests.

1.4.3 East Clayton NCP Process Structure

The process started with the following premise: that "everyone has their job to do and everyone does their job *well, but seperately.*"[10] At the core of this premise was the recognition that there was a need to bring people together as often as possible, not only so that they could become aware of the concepts but also to give them the opportunity to reflect carefully.

Figure 1.1 illustrates the structure of the NCP process. Its components include: the identification of constituencies of interest, a series of workshops, the formation of a planning design team, charrette events, and public consultation sessions.

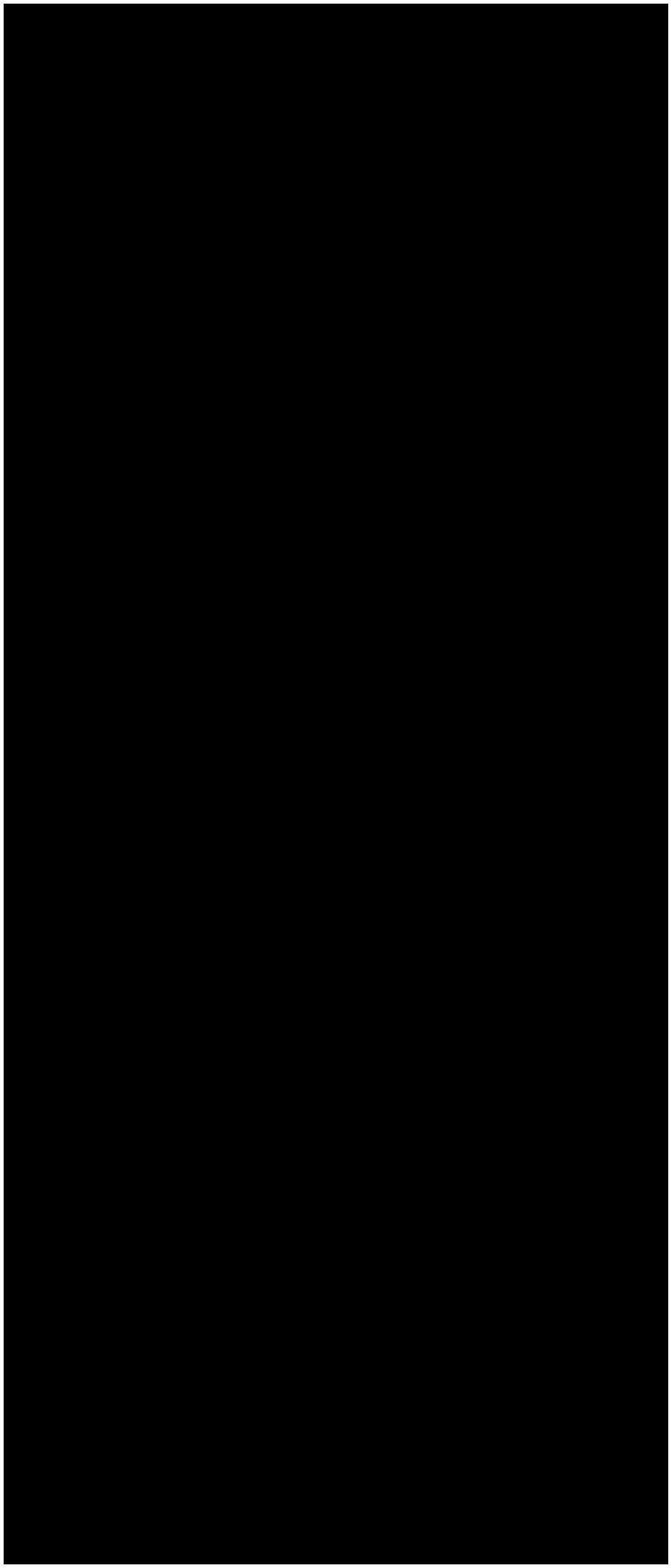
Constituencies of Interest

Constituencies of interest, taken together, form a community of interests. Interests, such as a landowner's concern over land values, a developer's hopes for a fair return on a residential development, environmentalist's desire for quality streams and a city's fear concerning its inability to cost-effectively maintain what is built, can affect plan policy and its implementation. These interests were identified and grouped under constituencies so as to represent various

[9] The intent of the Headwaters Project is to demonstrate: (a) sustainable urban development "on the ground" and (b) an integrated planning method that uses the charrette to bring together all involved and to expedite approval processes and implementation. Supporting this initiative is a diverse advisory committee and generous support from the Real Estate Foundation of BC, Environment Canada, the BC Ministry of Municipal Affairs, BC Ministry of Agriculture, Investment Agriculture Foundation, Canadian Mortgage and Housing Corporation, Affordability and Choice Today ACT, the Greater Vancouver Regional District, and the Department of Fisheries and Oceans.

[10] Quote from a charrette design team member.

Figure 1.1 NCP Process



aspects of the community (see ***Appendix 2.1*** for a list of constituency representatives).

Workshops

Constituency workshops brought together members of each of the constituencies in order to raise awareness of sustainable development principles and to table the issues each believed essential to applying principles to the future East Clayton community. The workshops also served as an opportunity to identify a spokesperson who would participate directly in the planning process.

Design Brief

Using objectives, principles, performance criteria and specific standards that were consistent with the Clayton general land-use concept, the design brief formed the basis for the development of an integrated land-use plan. (For the complete design brief, see ***Appendix 3.***)

Charrette Process

The charrette process involved a design team made up of constituency spokespeople who were to focus on building a physical plan for the East Clayton neighbourhood within a concentrated time period. ***Figure 1.2*** illustrates the structure of the design table. The charrette process involved two separate charrettes: the first aimed at identifying alternatives and systems, and the second aimed at developing specific subdivision patterns and standards (see ***Figure 1.3***).

The discussion and joint resolution of both policy matters and acceptable standards was facilitated by an appointed convenor. In addition, constituency "report-back" sessions provided members with the opportunity to critique and to develop negotiable positions for their representatives to take back to the design table. To make the process more manageable, subtables evolved out of the charrette to deal with matters that required action external to the design team. See ***Table 1.2*** for a list of the external issues.

Public Consultation

The East Clayton NCP process incorporated public consultation at three levels: through the ECCAC, through the design team, and through general public sessions. ***Table 1.1*** indicates the public consultation components while ***Table 1.2*** and Appendix 2 provides a list of constituents and issues raised during design table sessions.

Figure 1.2 Design Table Structure

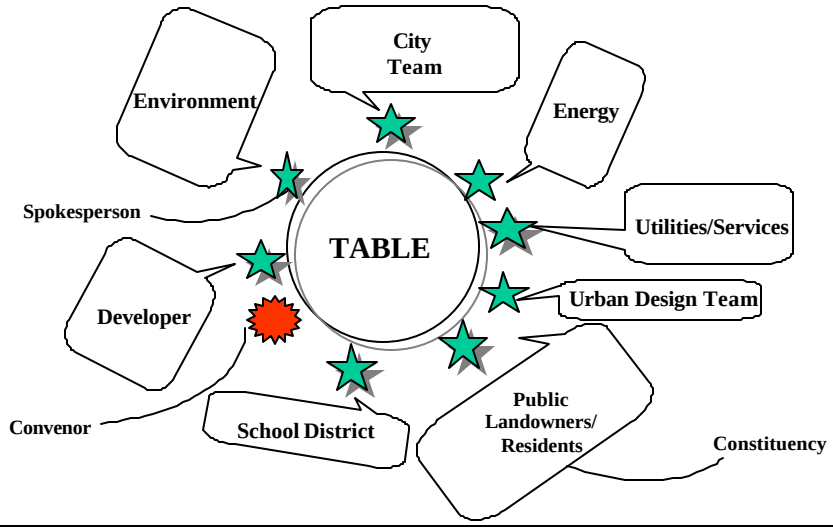
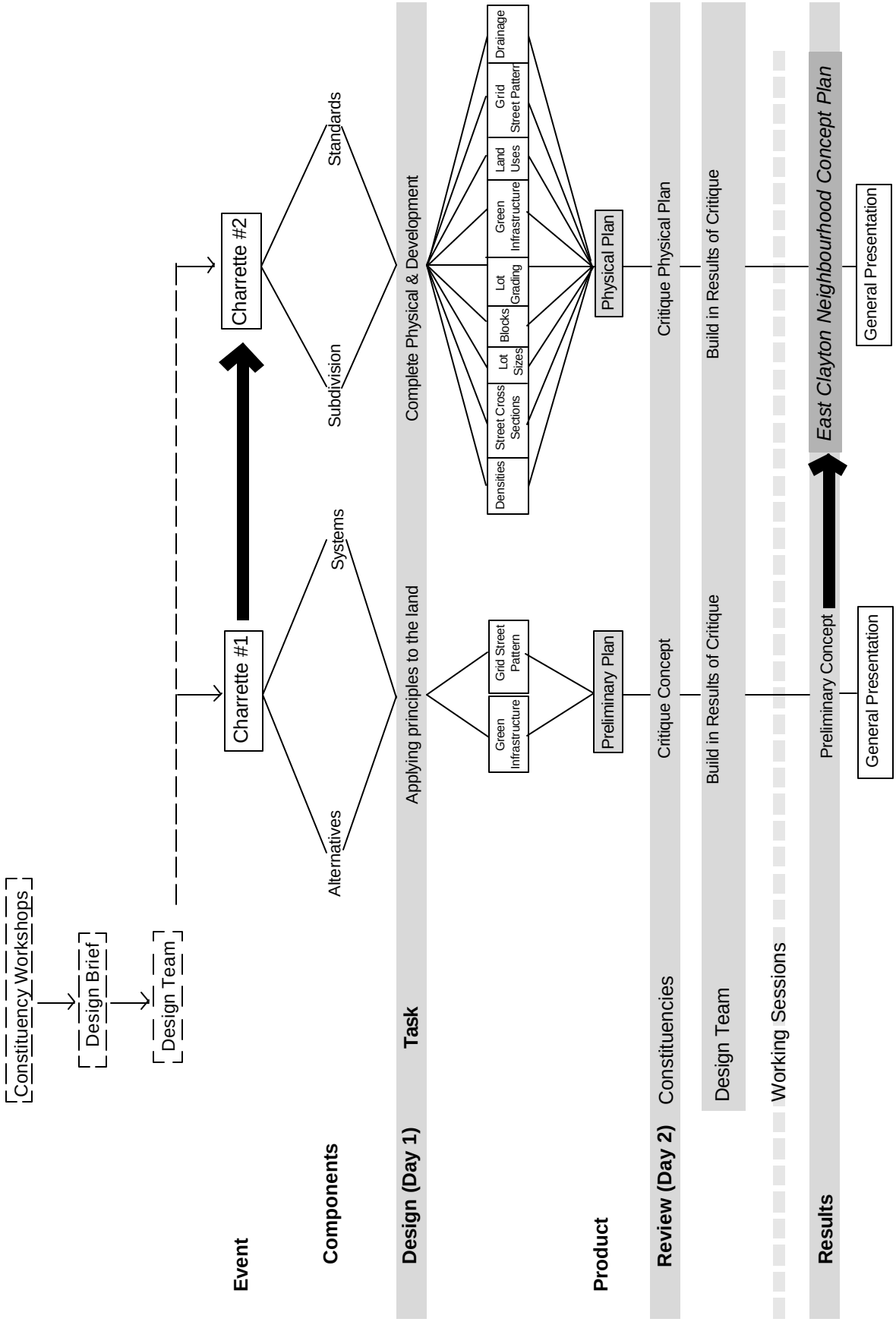


Figure 1.3 Charrette Process



1.5 Process Objectives

The NCP charrette process was guided by the following objectives:

Table 1.1 Public Consultation

Pre-charrette Workshops	Public Meetings	East Clayton Advisory Committee Meetings	Public Open House	Media
Charrette Design Team Representation and Participation	March 30	Feb. 9 April 13 April 28 May 19 June 29 July 15 Sept. 21 Oct. 4 Oct. 19 Nov. 9	July 5 Nov. 25	"A Pipeless Dream" *The Surrey Leader* "Beware of Killer Pavement" *The Vancouver Sun* Clayton News - NCP updates, every issue Display at City Hall

Build capacity for integration through shared awareness and determination to act jointly.
As previously mentioned, the NCP process components are linked in order to ensure ongoing participation. The linkages were made to build the capacity for integration and to maintain a positive climate within which to plan. Throughout the NCP process, the ECCAC, City staff and all other constituencies provided a high level of commitment to acting jointly, as was evidenced by attendance, participation, and joint agreements attained during the charrette event and sub-table work. Continual challenges to the plan concepts demonstrated a commitment to jointly and positively resolve unsatisfied interests.

Involve early on (preferably at the beginning) those people, agencies, and organizations that can influence plan policy and development standards (including their implementation).
The NCP process was designed to be flexible so as to expand involvement. The objective was to broaden the opportunities for the constituencies of interest to reach acceptable solutions and to influence the outcome of the plan. The broader the support for the concepts, the greater the likelihood of their implementation. Opportunity for open dialogue revealed constituency interests, including personal interests, which helped to sensitize participants to each other's concerns. Early involvement allowed time to jointly reach solutions, as it provided participants with the knowledge that they would otherwise not have had.

Share information equally.
Proper information and mutual trust in that information is essential if diverse interests and mandates are to result in acceptable solutions. The rules of engagement set by the Design Team at the outset and maintained throughout ensured that everyone was operating with the same information. Agreement was reached that all proposals external to the planning process or new information would be tabled with the Design Team and the CAC.

Share resources and cross mandates for mutual gain.
Participants involved in creating plans brought to the NCP process a variety of valued resources. These resources included technical skills, policy and regulatory skills, financial skills, negotiating skills, interests, ideas, and common sense. The process was designed to bring together these resources and, thus, to produce a joint outcome. Similarly, success in reaching workable solutions called for negotiation and a joint sharing of resources. Crossing the mandates of city drainage engineering, city parks, the school district, and federal fisheries produced a negotiated concept for an integrated green infrastructure system that resulted in mutual gain for all parties. (For a description of the system see Section 5.0.)

Build confidence in the process, in planning policies, and in alternative development standards.
The NCP process was deliberately designed to promote awareness of the principles and concepts of a more sustainable urban community, to reinforce acceptable solutions at each stage, and to generate an acceptable Neighbourhood Concept Plan by June 1999. In May, the design team agreed that the concept plan was ready for presentation at a public open house. It was an opportunity to view an innovative plan for a complete community and to measure the level of public buy-in. Completed comment sheets indicated that the level of buy-in was sufficient to move forward to the final approval stages.

Far left: **Design Table session**
Near left: **Public Open House presentation**

Direct involvement of municipal staff.
Direct municipal staff involvement is essential, and it involves having a municipal champion and an active and committed staff. In the case of the NCP process, engineering and city planning staff recognized an opportunity to explore ways to apply sustainable development principles. They provided the leadership necessary to promote staff participation and buy-in.

Essential to the adoption of any new standard is its acceptance and application by city staff. Engineering, planning, operations, parks and recreation, public safety officials, and the school district all had significant influence on policy and standards. They brought to the planning process essential technical expertise and resources. City staff maintained a high level of commitment to, and involvement in, the NCP process. This afforded an opportunity for increased awareness of new concepts and the dissemination agree-upon principles and standards to those staff not directly involved. Workshops and the charrette involved approximately 20 staff members, with eight working on the design team. A firm foundation was established for the adoption of the NCP at the municipal level.

Access necessary technical expertise.
Urban design experts complemented the participation of city staff and consultants in the design team (see ***Table 1.2***). Under the leadership of the James Taylor Chair in Landscape and Livable Environments, four urban designers provided the design team with the expertise necessary to assist in the development of concepts, to negotiate resolutions, and to translate them into drawings. The drawings and visual presentations formed the conceptual plan.

Deal with issues efficiently.
Efficiently dealing with planning issues means that none are left on the table or unresolved. In this case they were resolved to the point at which all constituencies agreed that the concept plan can be advanced to the presentation and approval stages. ***Appendix 2.2*** indicates that some 40 complex (and in some cases) controversial planning issues and 20 implementation matters were raised at various stages. Although many could only be resolved in phases, this table illustrates that all were dealt with either by the design table or a subtable. Some were external to the process and required special consideration (e.g., the designation of 196th Street as an arterial road). Others could only be dealt with at a later stage. For example, concerns over lot landscaping practices and meeting construction standards can only be resolved at the construction stage, when alternative standards are established.

1.6 Supplementary Follow-up Projects

In order for the successful implementation of the NCP to take place, the following are some of the programs that we must consider during the various stages of its evolution:

- stream monitoring;
- monitoring pedestrian and automobile use patterns;
- education and awareness;
- building form;
- energy and district heating systems; and
- ensuring safe and convenient access to transit.

Table 1.2 Design Table

Constituency	Spokesperson	Opportunities and Challenges
City team	Planning Manager, Area Planning Senior Planner, Planner, Urban Designer Engineering Storm Water Management General Manager Operations Parks. Recreation and Culture Urban Forestry	• Aim to achieve critical mass in terms of the objects of the sustainable development principles knowing that they may not be fully realized. A critical mass of ecological systems is essential. • Create the Complete Community and organize the physical space as a total community. • Maintain public safety while using alternative approaches: i.e. fire and police protection.
School District #36	Planning	• Maintain environmental values through sustainable measures that accommodate urban growth and protect fish.
Developer	Progressive Construction Ltd.	
Utilities/Services	BC Hydro Translink	• Given the soils characteristics of Clayton what can be done to increase or improve ground infiltration.
Environment	Fisheries and Oceans	• Use what is between single family dwellings and high density to achieve mixed densities that can free up open spaces and focus on mixed uses.
Public/Landowners/Residents	Norm Alexander (Charrette 1&2) Elsa Watt (Charrette 2) Amar Bains (Charrette 2) Mike MacLennan (Follow up)	• Achieve a level of acceptable flexibility to alleviate fears of uncertainty with the type of neighborhood that will actually be created.
Urban Design	The James Taylor Chair Moriarty/Condon Ltd. Ramsay Worden Architects Tera Planning Ltd.	• Maintain the involvement of City operations since the legacy the NCP will leave will be theirs to maintain.
Consultants	Reid Crowther Dunster & Associates Piteau & Associates Pacific Resources Centre	• Integrate transportation planning and land use with emphasis on people movement with their neighborhood as part of the community fabric.

2.0 BACKGROUND

2.1 Historic Settlement Pattern of Surrey

The pattern of modern settlement in Surrey was governed in large part by the existing landscape structure, organic development, and the agricultural grid. The landscape structure is distinguished by the low-lying floodplains of the Serpentine and Nicomekl River systems, which are contained on three sides by a ridge/hill/upland terrain. This structure influenced the placement of a trail system, which was built diagonally along the ridges and through the valley floor, thereby connecting New Westminster and Vancouver eastwards to the BC Interior and southwards to Washington State. The Semiahmoo Trail (1872), Yale Road (1875), and McLellan Road (1874-5) (later King George Highway, Fraser Highway, and No. 10 Highway, respectively), connected the uplands to the lowlands and stimulated early organic development along the ridges and dryer portions of the lowlands.[1] Early district lot subdivision created a loose gridiron framework based on 160-acre parcel units (see ***Figure 2.1***).

2.2 Clayton's Cultural History

Formerly called Serpentine Flats, or Serpentine Valley, Clayton was named in 1889 by the postmaster, John George, for his native Clayton, Ohio. Begun in 1871, Yale Road (now Fraser Highway), was for many years the lifeline to New Westminster and Vancouver. The construction of the Fraser River Bridge in 1904, and the gravelling and extension of the Clover Valley Road (renamed the Pacific Highway) as far as the US border by 1913, established Clayton's role as a major Surrey transportation hub. This role was further enhanced in 1923 by the paving of the Pacific Highway (176th Street as of 1957). The first Crown land grant was granted to John Wesley Pickard in 1883. By 1891, with a population of about 300, Clayton had two churches, at least one paid school teacher, and a train service to New Westminster.

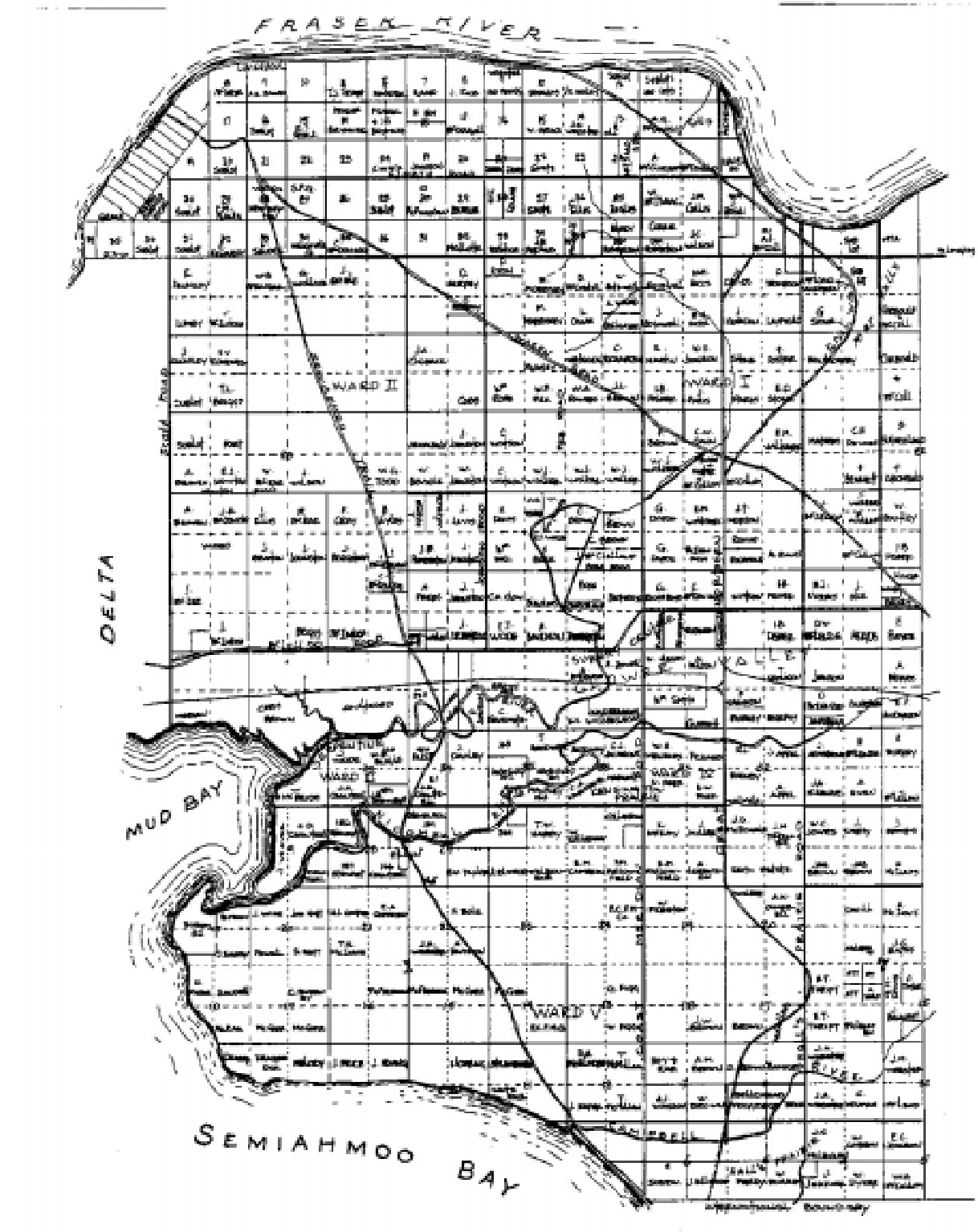
Topographically, Clayton Centre lies on the high ground known as Clayton Hill (above the flats of the Serpentine River to the south and west, and the Nicomekl River to the south and east). Its main industry was farming. Before the end of the First World War, most farming in Surrey was carried out on the Serpentine flood plain; however, returning soldiers could only purchase on higher ground. These new residents practised poultry farming, as it required less capital investment and land than did other types of farming. Dairy farmers and the growers of feed crops prospered on the "flats" below.

2.3 Site Location/Context

The East Clayton district is an approximately 250-hectare (617-acre) area located on the southeastern edge of the larger Clayton district, an approximately 909-hectare (2,250-acre) area on the Surrey/Langely border. Located within one of the Lower Mainland's fastest growing municipalities and in close proximity to several ecologically important areas, Clayton is a diverse planning area with a number of opportunities and constraints. It is bordered by the Agricultural Land Reserve on its north and west sides, by Fraser Highway on its south side, and by the Langley border (196th Street) on its east side. The East Clayton district lies east of 188th Street, and south of 72nd Avenue to Fraser Highway (see ***Figure 2.2***). Its low net densities, narrow curbless roads, and expansive views to the surrounding agricultural lowlands give Clayton its distinctive rural character.

[1] G. Fern Treleaven, *The Surrey Story* (Surrey, BC: Surrey Museum and Historical Society. 1969).

Figure 2.1 Historic Settlement Pattern of Surrey



Source: G. Fern Treleaven, *The Surrey Story* (Surrey, BC: Surrey Museum and Historical Society. 1969).

Figure 2.2 East Clayton Context

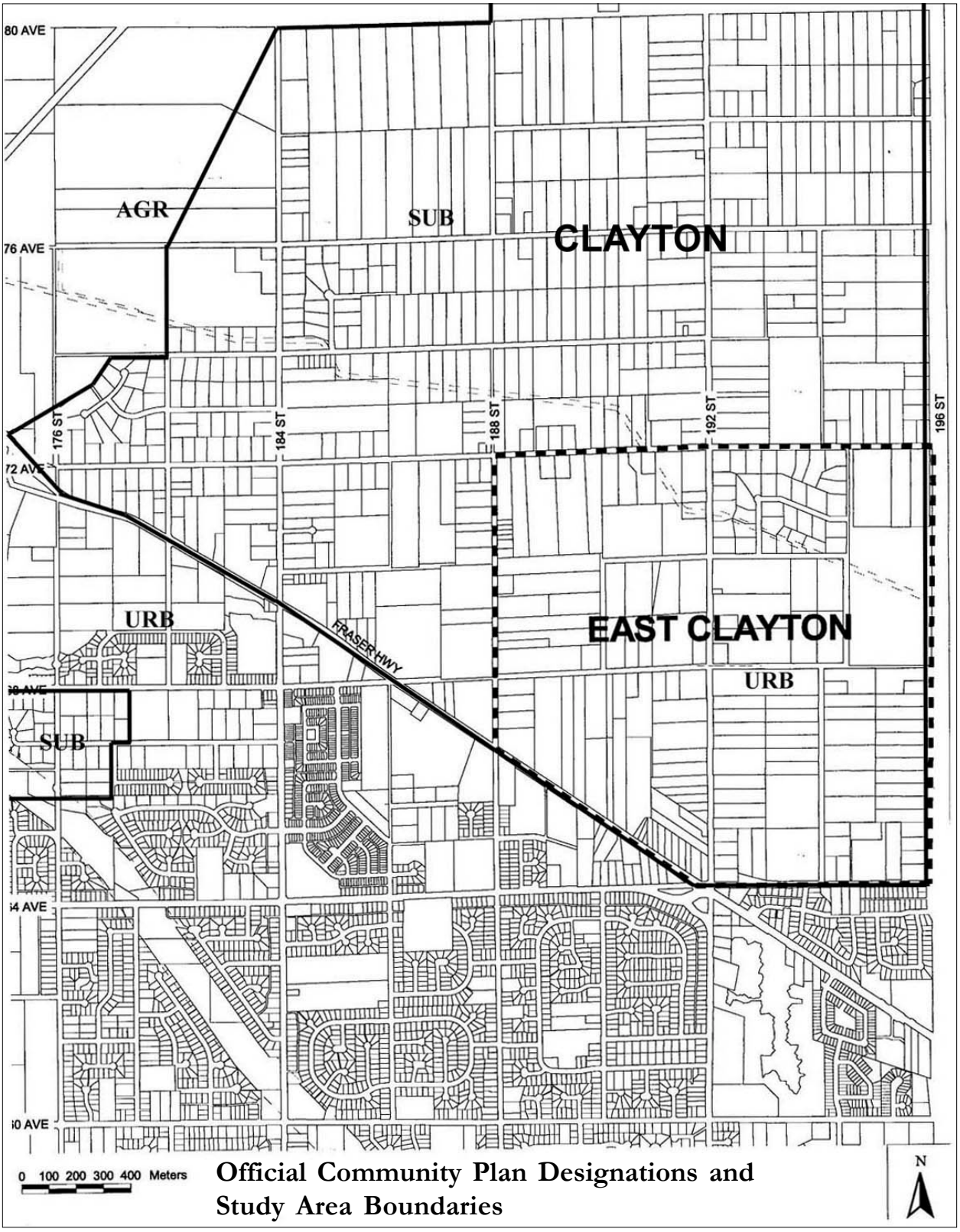
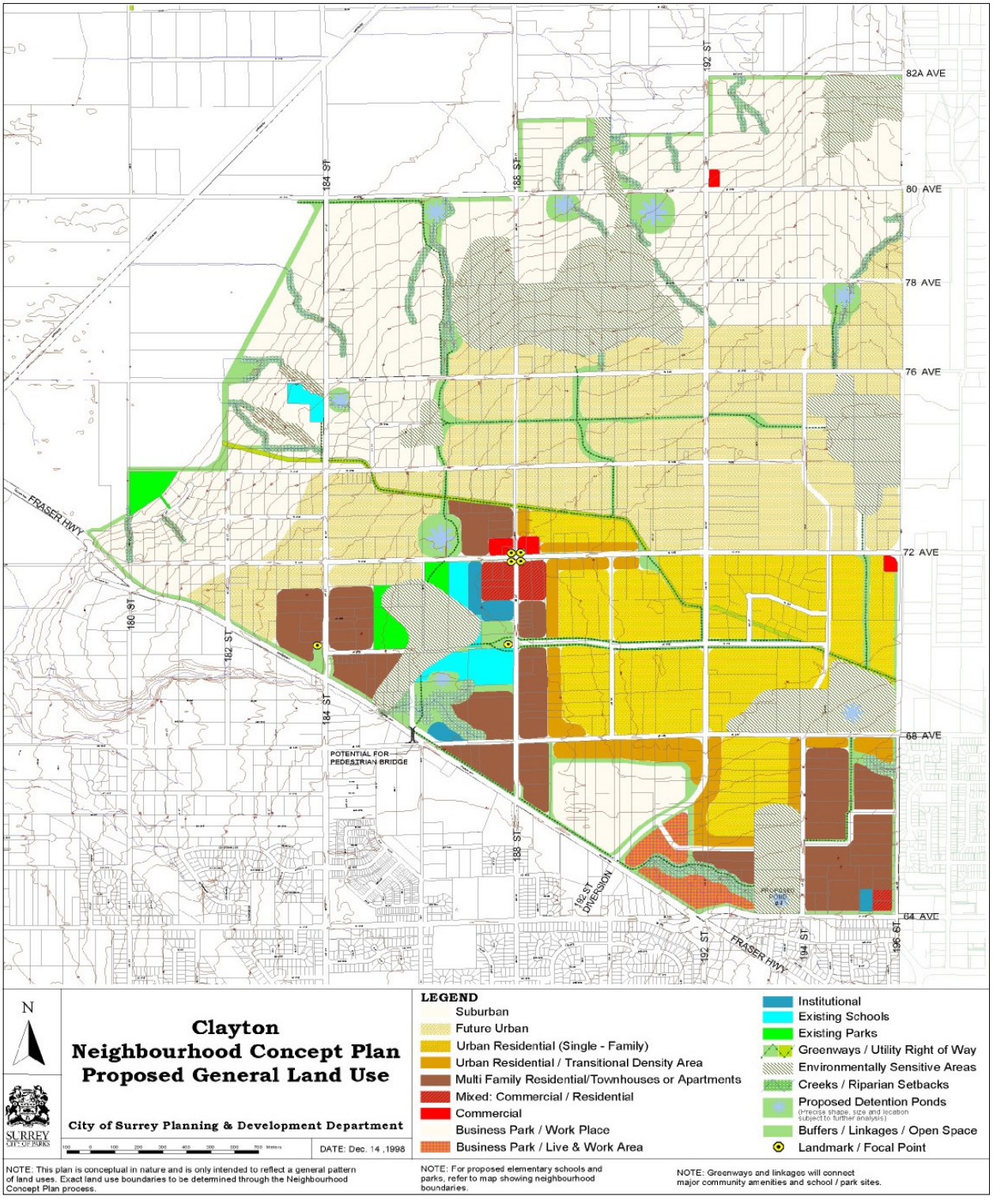


Figure 2.3 Clayton General Land Use Plan



2.4 Existing Land Uses

As part of its urban growth concept, the *Official Community Plan* for Surrey identifies East Clayton as "urban," meaning that it may be provided with the urban infrastructure (i.e., water, sewer, roads) necessary to support urban densities (of at least 6 dwelling units per acre).[2] The remainder of Clayton is identified as "suburban," meaning it is considered to have-long term development potential subject to land-use planning with local residents. ***Figure 2.3*** shows the general land use patterns for Clayton as proposed in the Clayton General Land Use Plan.

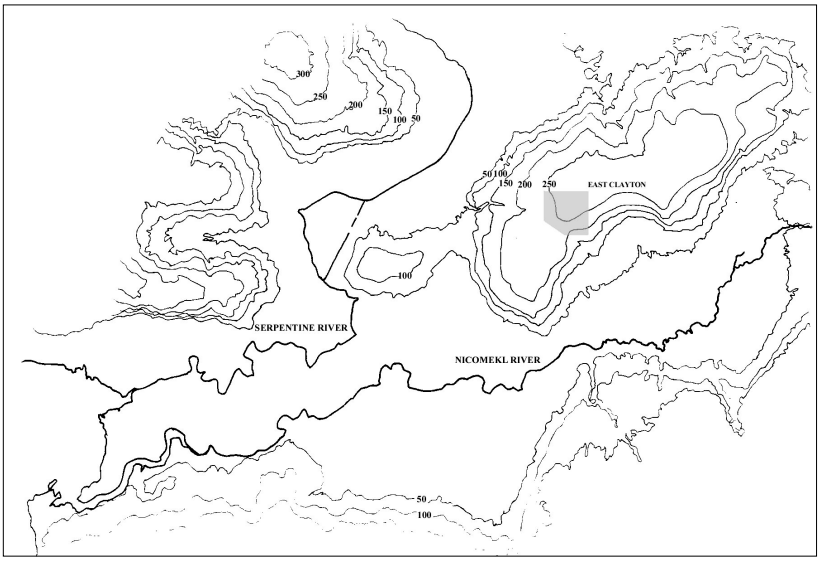
The primary existing land-use in the area covered by the East Clayton NCP is residential and contains 191 individual parcels. Most land is privately owned, and approximately 460 people currently live in the area. The area consists of parcels averaging three-quarters of an acre to 10 acres, with some parcels as large as 60 acres. Subdivision generally conforms to the historical agricultural grid, with the exception of Aloha Estates, a suburban subdivision of one-acre parcels built in the 1980s and located near the southeast corner of 72nd Avenue and 192nd Street.

Other new development that has occurred over the past 10 to 15 years has been centred around 192nd Street and Fraser Highway. Near the study area is a small service station/corner store located at 80th Avenue and 192nd Street, and a small commercial node at 184th Street and the Fraser Highway. There are a number of agricultural activities taking place in Clayton, including rangeland, hay, dairy, and poultry operations. Most of these operations are occurring within the agriculturally zoned land (ALR) to the north and west of Clayton; however some are dispersed within the site.

2.5 Topography

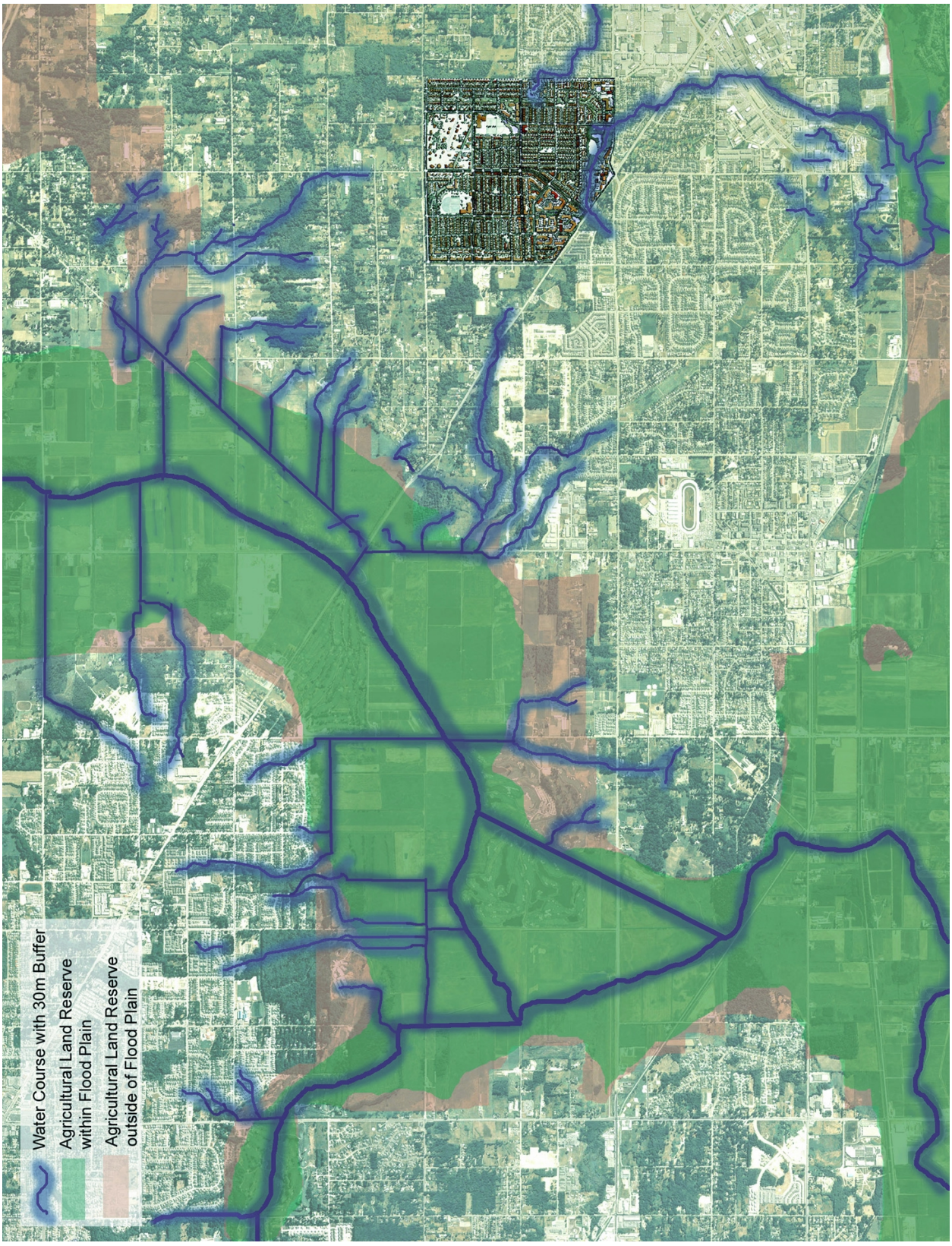
East Clayton is located on a gently sloping upland region at Surrey's far eastern edge. The area is defined primarily by two distinct ridgelines, the first of which runs approximately parallel to 192nd Street, and the second of which crosses the northern portion of the site diagonally. Following these ridge lines, the site drains, generally, in southerly direction to the Nicomekl River on the southeast, and in a westerly direction to the Serpentine River on the site's west (see ***Figure 2.4***). Significant slopes on the site range from 6 percent to 9 percent, with flat hilltop areas ranging from 0 percent to 2 percent. An uncharacteristically steep area, with slopes in excess of 10 percent, exists along a small portion of the eastern edge of the site (at the Horner Creek headwaters). Micro-topographical elements include roadside swales and ditches as well as natural drainage channels and ravines (occurring through wooded areas). With the exception of the less than 10 percent slopes ant the southeastern portion of the site, and individual channel and stream banks, no slopes present particularly difficult construction challenges.

Figure 2.4 Topography and Landform



[2] City of Surrey, *Official Community Plan* (Surrey, BC: Surrey Planning Department, 1996).

Figure 2.5 East Clayton in Relation to ALR and Flood Plain

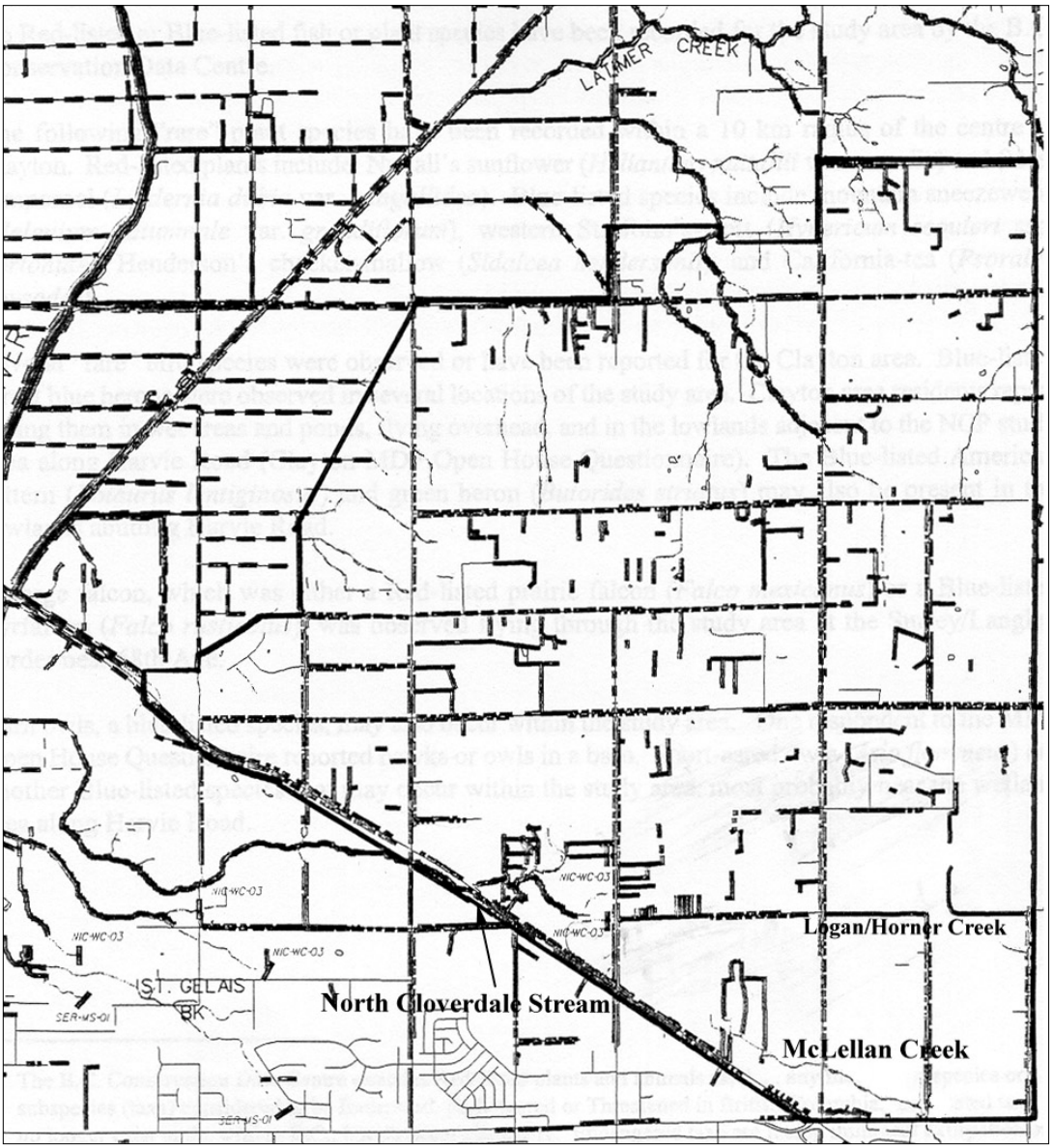


2.6 Vegetation

Clayton is primarily a mixture of fields and relatively young stands of mixed forest. Historically, vegetation conformed to that found in the Coastal Western Hemlock (CWH) biogeoclimatic zone, which covers much of the Lower Mainland region and consists of Western helmock, Douglas fir, and western red cedar. However, logging activity between 1912 and 1930, together with more recent clearing and suburban development, has resulted in the formation of younger forest blocks dominated by red alder, paper birch, black cottonwood, and big-leaf maple, with conifers occurring as individuals or in small clusters.

The report entitled *Clayton Area Neighbourhood Concept Plan: Environmental Report* (from this point referred to as the Dillon Report), completed by Dillon Consulting Limited and Strix Environmental Consulting, provides a detailed bio-inventory and assessment of the sensitivity and significance of Clayton's

Figure 2.6 Stream Classification Map for Clayton



[6] Dillon and Strix, *Clayton Area Neighbourhood Concept Plan*, 30.

[7] Ibid, 33.

terrestrial habitat, using forest blocks and watercourses as the primary study units.[3] In general, most large and small forest blocks are in a relatively early stage of development and are located in the least disturbed portions of the East Clayton area. They are distinguished by their high level of species diversity and large proportions of introduced species as compared with the largest and most established forest blocks located to the north and west of the study area. The Dillon Report located a number of "highest valued natural areas", designated as requiring priority for protection based on several criteria. These criteria include, but are not limited to: supporting or potentially supporting significant wildlife, plant or fish species; providing nesting, roosting and/or foraging habitats for various raptors; and facilitating groundwater recharge and discharge important or potentially important to downstream aquatic systems. ***Figure 2.3***, the Clayton Land Use Plan, shows areas of environmental sensitivity within the larger Clayton district.

The area to the north of 68th Avenue is described as a large forest block and field, and consists of a combination of habitats suitable for nesting and hunting by raptors. Evidence of several species has been observed in this area including Great horned owl, Red-tailed hawk, and Douglas' squirrel.
The area to the north of Fraser Highway is characterized by mixed vegetation including bigleaf maple, Sitka spruce, Douglas-fir, western hemlock, and several large black cottonwoods. Wildlife species observed include Red-tailed hawk and eastern cottontail.

2.7 Soils

The subsurface geology in the uplands of east Surrey consists largely of Capilano sediment, which is composed of deposits ranging from moderately coarse-textured glacial till to moderately fine-textured glaciomarine sediments. The primary soil unit is Bose, a soil typically found on the upland areas of the Sunshine Coast, Delta, and Surrey municipalities.[4] Bose is characterized by a sandy loam or gravelly, loamy sand surface texture. This surface texture may be up to 10 centimetres (3.9 inches) thick and is underlain with a deeper, coarser gravelly sand or sandy subsurface. Immediately below this is a more impervious layer, approximately 50 centimetres (19.6 inches) thick, of glacial till or glaciomarine deposits, which is composed of either red cemented sand or silty clay loam. Undisturbed and uncompacted, the heavy soils of the substrata can normally absorb approximately 1.0 millimetre (.039 inches) of water per hour during winter conditions and approximately 1.0 millimetres to 2.0 millimetres (.039 inches to .8 inches) per hour during summer conditions.

With a low water-holding capacity, extensive agricultural and forestry use are limited. However, with depths of up to 1.5 metres (5 feet) , the soil-bearing capacity is able to support moderate urban development, although low subsoil permeability and high water tables limit septic tank use.

2.8 Streams and Hydrology

Positioned on a high point within the larger Fraser River Basin, the uplands of Clayton are separated by the Serpentine Basin to the west, and the Nicomekl Basin to the southeast, each of which drains directly into Boundary Bay to the south. Once covered by forests, peat bogs, and marsh lands, this upper area functioned as a sponge, absorbing a large percentage of runoff and controlling discharge to sensitive aquatic systems. More recent suburbanization and forest clearing along the ridges and high areas has altered the integrity of these systems, resulting in ever lower base flows in upland watercourses, and

[3] Dillon Consulting Limited and Strix Environmental Consulting, *Clayton Area Neighbourhood Concept Plan: Environmental Report* (Surrey, British Columbia: City of Surrey. 1997).
[4] H.A. Luttmerding, *Soils of the Langley – Vancouver Map Area* (Kelowna, British Columbia: Province of British Columbia Ministry of Environment, Lands and Parks, Assessment and Planning Division. 1984).
[5] Susan Abs, Catherine Berris, Alan Ferguson, Sarah Groves, *Finding the Balance: Environmnetally Sensitive Areas in Surrey* (Surrey, British Columbia. District of Surrey Planning and Development Services. February, 1990):6.

flooding, erosion, and land wasting along the slopes and in the lower floodplain areas.[5] Within the Serpentine lowlands and the Langley Township, increased flooding, protracted periods of springtime soil saturation caused by storm flow from upland urban areas, and poor water quality are issues of rising public concern.

The hydrological regime for the East Clayton district consists primarily of ditched and piped channels running along roadways and property lines. The sources of natural channel flows in the Clayton area vary from groundwater discharge in forested areas to storm sewers in more developed areas. There are several natural stream channels occurring within this area, many of which have had their source of flow altered due to increased development and conventional stormwater systems. Often, alterations to sources of flows lead to changes in stream hydrology and morphology, resulting in loss of aquatic life, increases in peak flows, and reductions in base flows.

The Dillon Report utilizes Surrey's existing stream classification system in order to identify and rank aquatic habitats according to their sensitivity to physical disturbance. It found that the site's existing drainage network provides the best opportunity for habitat connectivity through the restoration of natural riparian habitat, and identifies three watercourses within the East Clayton area that warrant special consideration. The first is North Cloverdale Creek, which is located on the southern boundary of the study area which drains into the Serpentine Basin. This stream is primarily a channelized, low-gradient ditch of between 0.75 metres (2.5 feet) and 2.0 metres (6.5 feet) in width, and between 1.0 metres (3.3 feet) and 2.0 metres (6.5 feet) in depth and it provides important overwintering habitat for juvenile salmonids.[6] Horner Creek (located to the east of the site above 68th Avenue and also referred to as Logan Creek), and McLellan Creek (located just north of Fraser Highway), are of a lower classification and do not currently support young fish, although they do supply significant food/nutrient value to downstream fish populations. Figure 2.6 show the location of these three water courses in addition to the ditch network.

In addition, the network of roadside ditches and swales running adjacent to roadways and property lines provides, during periods of intermittent flow, for the conveyance of nutrients to more valuable fish habitats downstream as well as habitat areas for terrestrial and avian wildlife. These ditches are also valued for their capacity to enhance the infiltration of runoff into the ground during periods of low flow.[7]

The riparian zones associated with these watercourses are essential components of a healthy aquatic environment, providing food, cover, shade, bank stability, and erosion control. Many of these areas, due to their relatively mature and diverse vegetation and their proximity to water, are also important habitat areas for wildlife . The Ministry of Environment, Lands and Parks (MELP) Land Development Guidelines require preservation zones (setbacks) of at least 15 horizontal metres from the top-of-bank of all waterways that support fish habitat. Accordingly, all streams and their riparian setbacks must be permanently protected either through registration of a restrictive covenant, through dedication as park land, or through purchase by the municipality, which shall itself agree to restrict the use of these setbacks to maintain ecological function therein.

Reflecting the recommendations of the Dillon Report for the protection and enhancement of areas of high natural value, the East Clayton NCP recommends that development proceed in ways that balance multiple objectives while ensuring that impacts to existing and expected species are mitigated.

3.0 DESCRIPTION OF THE EAST CLAYTON LAND USE PLAN

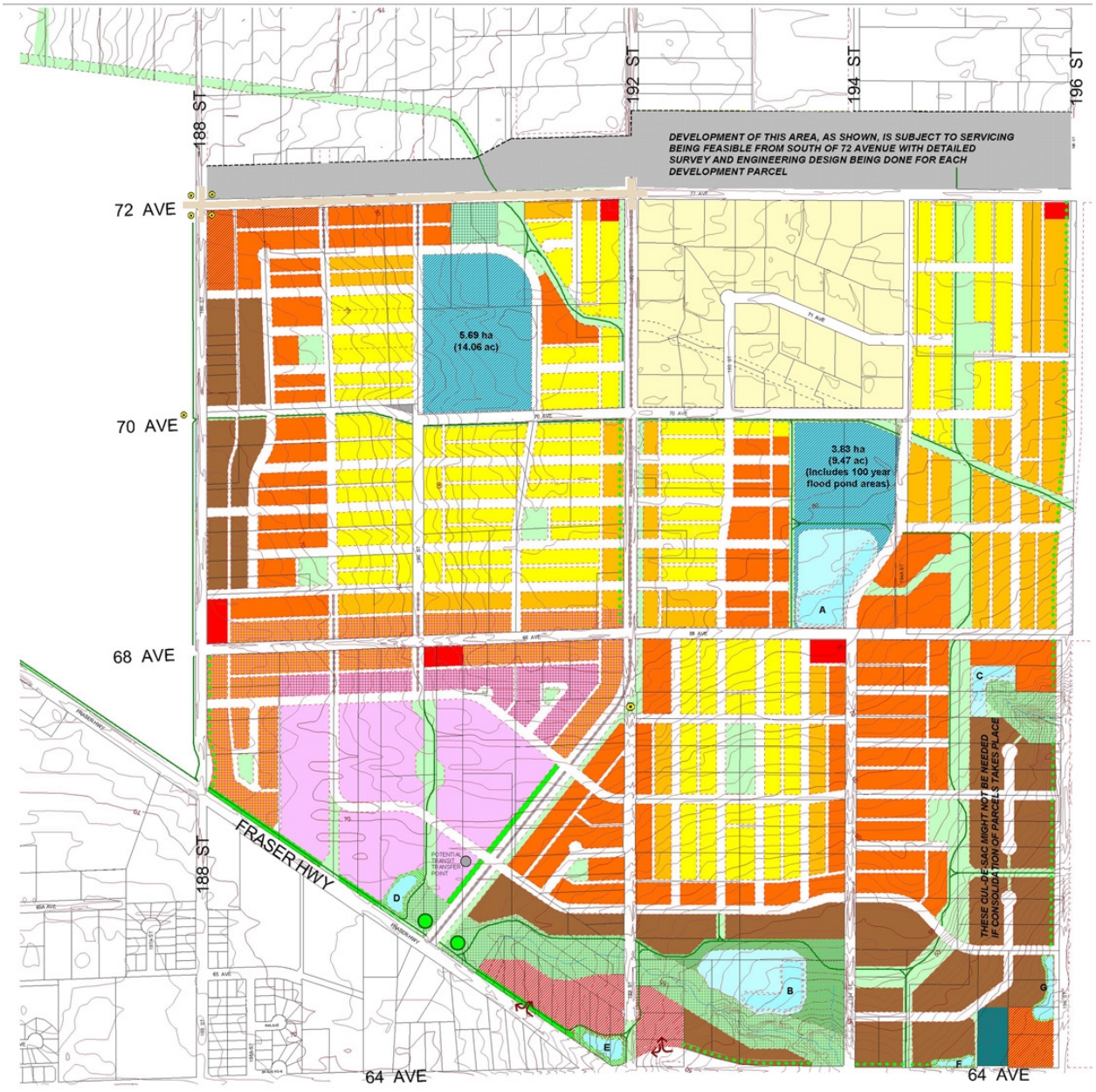
Section 3 provides a description of the various land uses proposed in the East Clayton Development Concept (***Figure 3.1***). The land uses are based upon the approved General Land Use Plan for Clayton and conform to the seven principles for sustainable development in East Clayton, as endorsed by Surrey City Council in December 1998 [1] and outlined in section 1.3.1.

Sections 4 through 7 provide detailed standards and design guidelines pertaining to four interrelated areas of the NCP: Land Use; Building Development; Ecological Infrastructure; and Engineering and Servicing. It is important to note that these standards and guidelines are mutually supportive. For example, the proposed infiltration drainage system for East Clayton is dependant upon (among other things) the fine-grained grid pattern, (which facilitates the dispersal and infiltration of groundwater), as well as ensuring that surface infiltration throughout the site is maximized. Similarly, issues of density, land use integration and street connectivity are expected to influence potential reductions in automobile dependency, while having a positive influence on neighbourhood walkability.

It is anticipated that the standards contained herein will require more detailed refinement as development applications progress through the approval process. However, the following performance standards for the land use, building footprint, ecological infrastructure, road engineering, and servicing plans must be achieved. It is expected that this will require increased efforts on the part of the City and developers to coordinate, engineer, and implement the design standards as future development takes place.

[1] City of Surrey Planning and Development Services, "Corporate Report" (Surrey, British Columbia: City of Surrey, Dec. 7, 1998).

Figure 3.1 East Clayton Land Use Plan



EAST CLAYTON NCP

City of Surrey Planning & Development Department

APPROVED BY COUNCIL ON NOVEMBER 22,1999

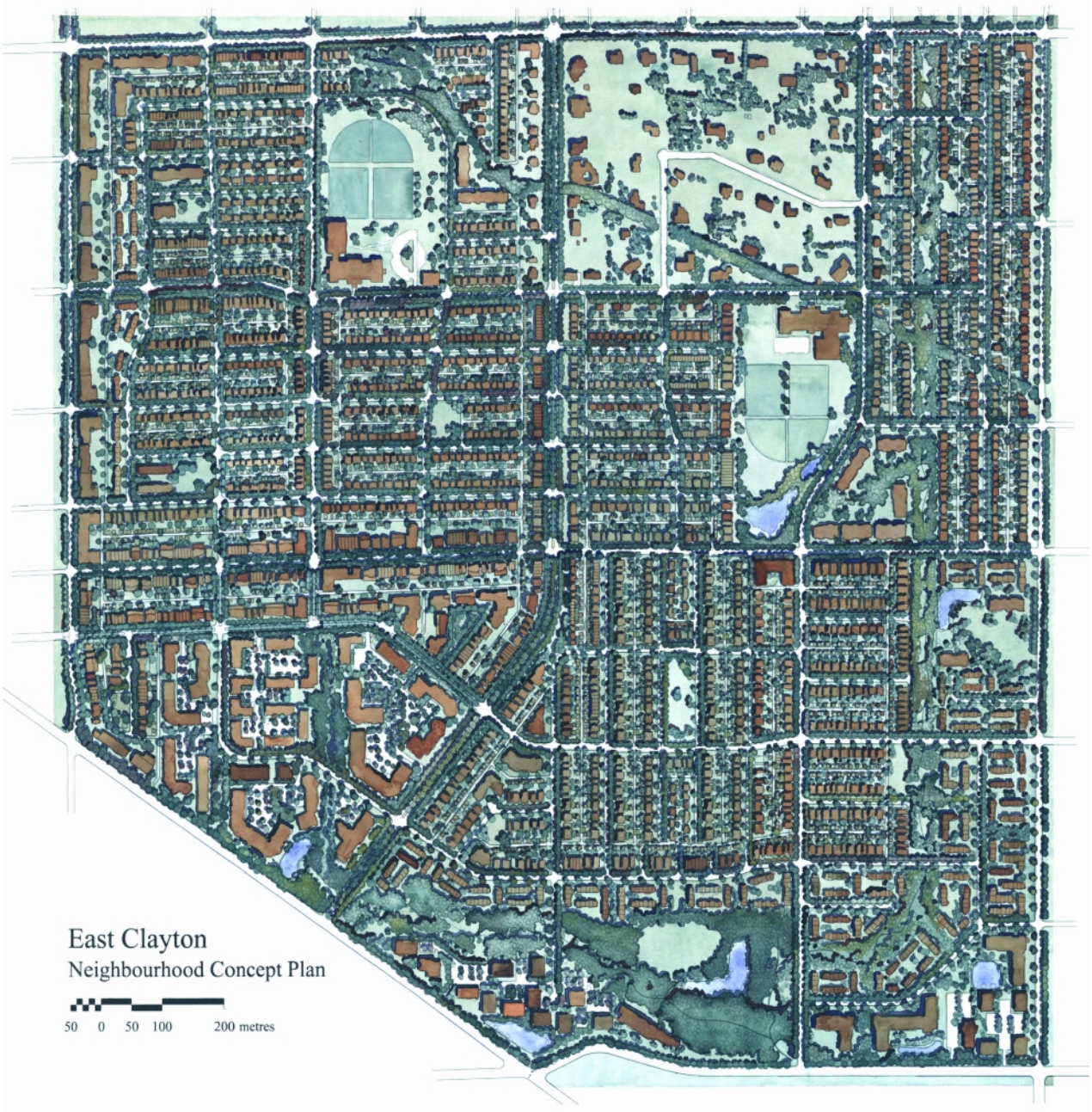
100 0 100 200 300 400 500 Meters

NOTE:
This plan is conceptual in nature and is intended to reflect a general land use pattern.

Half Acre Residential	16.74 ha	(41.36 ac)
6-10 u.p.a.	36.31 ha	(89.72 ac)
10-15 u.p.a.	16.42 ha	(40.58 ac)
15-25 u.p.a.	27.80 ha	(68.68 ac)
25-45 u.p.a.	19.28 ha	(47.65 ac)
Techno / Business Park	11.97 ha	(29.58 ac) (Incl. buffer & pond.)
Work / Live (15-25 u.p.a.)	2.86 ha	(7.06 ac)
Live / Work (15-25 u.p.a.)	7.79 ha	(19.26 ac)
Neighbourhood Commercial	1.58 ha	(3.91 ac)
Commercial / Residential	2.79ha	(6.90 ac)
Specialty Community - Oriented Commercial	3.34 ha	(8.27 ac)
Utility - Open Space	0.64 ha	(1.58 ac)
Proposed Roads		
Special Treatment of Street, Traffic Calming		

Institutional (church, schools, civic buildings, seniors housing, etc.)	0.6 ha	(1.48ac)
Storm Water Ponds (100 year flood event)	A - 2.14 ha 5.28 ac B - 1.94 ha 4.79 ac C - 0.40 ha 0.98 ac	Total 4.48 ha (11.05 ac)
Storm Water Pond on Private Property (amenity)	D = 0.32 ha (0.79 ac) E = 0.38 ha (0.93 ac) F = 0.14 ha (0.34 ac) G = 0.30 ha (0.74 ac)	Total 1.14 ha (2.81ac)
School & Park	9.53 ha	(23.54 ac) (Incl. 100 yr. flood overflow area of pond)
Riparian Protection Area	6.70 ha	(16.55 ac)
Natural Area	1.84 ha	(4.54 ac)
Open Space / Park	14.45 ha	(35.71 ac) Utility (Gas R.O.W.) 1.19 ha (2.94 ac)
Buffers (landscaped area on private property)	0.86 ha	(2.12 ac) (These areas have been incl. in the respective land use totals)
Urban Landmark / Reference Point		
Neighbourhood Gateway Feature		
Special Set Back & Landscaping		
Neighbourhood Multi-use Pathway Network		

Figure 3.2 East Clayton Illustrative Community Plan



3.1 Sustainable Planning Principles

This section presents the seven principles and describes generally how each is represented in the Land Use Plan. The plan supports enough of a variety of land uses and residential/community types to maximize affordability, sociability, and availability of commercial services within easy walking distance for the proposed population of approximately 13,000 persons. Envisioned as a complete, mixed-use community, East Clayton is designed to promote social cohesion, local economic opportunities, and environmental stewardship while providing equitable access to housing and jobs and reducing dependence on the automobile.

Principle No. 1

Conserve land and energy by designing compact walkable neighbourhoods. This will encourage pedestrian activities where basic services (e.g., schools, parks, transit, shops, etc.) are within a five- to six- minute walk of their homes.

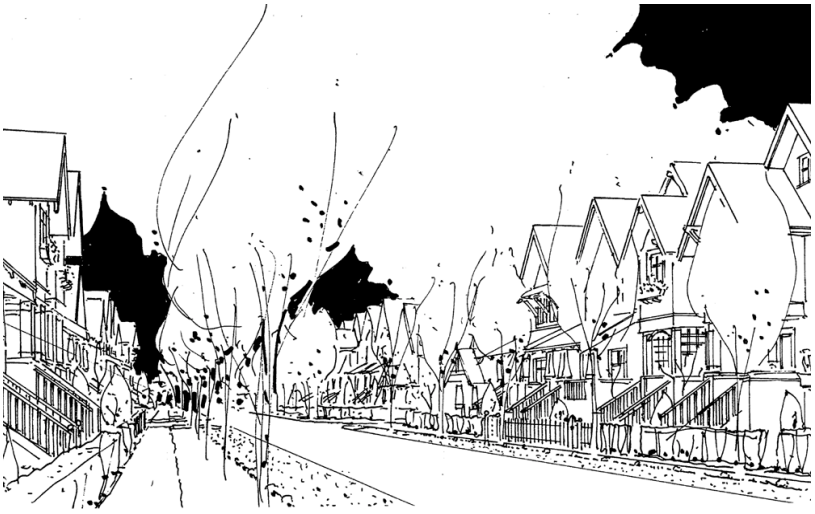
Achieving a pedestrian-oriented neighbourhood requires that homes be within a walkable distance of shops and services and that streets be interconnected to provide the widest possible choices for reaching nearby destinations. Accordingly, residential neighbourhoods are to be structured around a fine-grained modified grid of streets and lanes, with block dimensions averaging 160 metres (525 feet) by 80 metres (250 feet). They are to be considered both public corridors and neighbourhood amenities and are to accommodate automobile, pedestrian, and bicycle traffic while ensuring easy access to local destinations.

Two schools/major parks are to be located centrally within the community and among residential uses, and each smaller residential area is to be organized around a central neighbourhood green. Building design and orientation are to reflect the size, location, and configuration of individual parcels.

The "Main Street" Commercial Area, located at 188th Street and 72nd Avenue, is the most important commercial destination for residents of East Clayton. This district will also serve the additional 15,000 new residents expected to reside in the surrounding Clayton community within the following 30 years.

Additionally, each individual neighbourhood is to have a neighbourhood commercial area that provides a working and shopping place for people within walking distance of their residence. Urban landmarks and neighbourhood gateway features will announce entries into different neighbourhoods, create a civic focal point, and enhance wayfinding throughout the community.

A mixed-use commercial core. A mix of uses (i.e., commercial-residential; live/work and work/live; ground-oriented town homes), street-oriented buildings, and human-scaled detailing will contribute to the creation of pedestrian-friendly and economically vibrant community nodes.



This perspective sketch shows a diversity of dwelling types and sizes on the same street, a diversity that is masked by the similarity in massing, height, and quality of detail of all the structures. Common touches (such as covered porches, deep overhangs, front-yard fences and hedges, and the amount of window space on the front of buildings), contribute to a powerful sense of unity – a unity that includes a diversity of people within a cohesive community.

Principle No. 2

Provide different dwelling types (a mix of housing types, including a broad range of densities from single-family homes to apartment buildings) in the same neighbourhood and even on the same street.

The plan accommodates a wide variety of household types and tenures. A diverse and socially cohesive neighbourhood for the community population of approximately 13,000 persons is the intended result. The plan promotes integration and symbiosis between different family types and ages as a way of strengthening the larger community. Creative and economic housing options will be encouraged, such as single-family homes with a second dwelling unit available to provide a "mortgage-aid" to young families, while also serving those individuals and families in need of affordable housing.

The types of housing offered by this plan include multiple-unit residential in the form of apartments and fee-simple ground-oriented townhouses, single-family homes on small- to medium-sized lots, live/work, and mixed-use commercial/residential housing. The diversity of housing tenures and types that the plan proposes ensures that a proportion of units are affordable rental suites capable of adequately serving Surrey citizens, whose earned income places them in the bottom one-third of earners regionwide.

Small front setbacks ensure more "eyes on the street" and create a larger back-yard area for private outdoor space. Low front-yard fences clearly distinguish between private and public space. Street trees, boulevard infiltration strips and on-street parking create a pleasant envelope for pedestrians and buffer the effects of passing traffic.

Principle No. 3

Communities are designed for people; therefore, all dwellings should present a friendly face to the street in order to promote social interaction.

Blocks are to be proportioned to create a fine-grained, interconnected network of streets; to reduce congestion; and to allow as many homes as possible to front directly onto public streets. The image below (on the right) shows how dwellings are situated closer to streets, thereby ensuring more "eyes on the street" and creating a larger backyard area for private outdoor space. Front yards will have buffers that ensure privacy and clearly distinguish between private and public space. Street trees, boulevard infiltration devices, and on-street parking will create a pleasant envelope for pedestrians and provide a buffer from passing traffic.

The image at the near right depicts a residential street dominated by garage doors.

The image at the far right shows a streetscape of similar-sized lots but with garages located off rear lanes, thereby allowing homes to directly address the street.

Principle No. 4

Ensure that car storage and services are handled at the rear of dwellings.

The existing site conditions (i.e., topography, vegetation, road network, and parcel configuration) determined the proposed community structure and lot sizes for East Clayton. Narrow lots demand lanes so as to prevent building fronts from being consumed by garages, front yards from being consumed by concrete, and residents from being closed off from contact with activities on the street by the barrier of the garage (as shown in the image above left). Lanes allow cars to gain access to units from behind, resulting in a reduction of the required frontyard setback and an increase in useable backyard space. A small portion of the plan includes shallower blocks that have wider lots with no lanes. However, on these wider parcels, the lot dimension allows garages to be placed beside and behind the principal façade rather than in front of the dwelling, thereby maintaining direct front-door access to the street and reducing the negative effect of garages on streets.

Principle No. 5

Provide an interconnected street network, in a grid or modified grid pattern, to ensure a variety of itineraries and to disperse traffic congestion; and provide public transit to connect East Clayton with the surrounding region.

The organization of roads, blocks, parks, parkways and riparian areas responds to the site's topography and the location of its sub-watersheds, which are found in the southern portion of the site around Cloverdale Creek, McLellan Creek, and Horner Creek (see ***Figure 2.2***). The street network is organized around a four-part hierarchy of streets, which includes arterials, collectors, local streets, and lanes. This is unlike conventional developments, wherein traffic is routed along an exclusive and dendritic (i.e., branching like a tree) hierarchy of roads — from an arterial, to a collector, to a local, and finally to a cul de sac. The plan's integrated system proposes that traffic be dispersed across the interconnected and modified grid, thereby reducing the need for arterials and large intersections. Major and local through-traffic is accom-

modated on a system of major and minor arterials, which is to be furnished according to specific requirements for servicing, utilities, drainage, pedestrian amenities, and urban forestry. Through-traffic occurs on the north-south routes of 188th, 192nd, and 196th Streets, and along 68th, 70th, and 72nd Avenues, with the Main Street mixed-use commercial street occurring along 72nd Avenue. This system, in concert with sufficient provision of mixed-use services and access to transit, can produce major reductions in auto dependence. Areas similar to East Clayton show up to 40 percent reduction in trip generation per capita. The plan assumes a 25 percent reduction as the basis for designing the transportation network that will serve the wider area.

Principle No. 6
Provide narrow streets shaded by rows of trees in order to save costs and to provide a greener, friendlier environment.

Paved street widths for local and collector streets range from 6 metres to 11.3 metres. Rights-of-way for these streets range from between 17 metres (56 feet) and 22 metres (72 feet), depending on the specific infrastructure and servicing and amenity requirements (i.e., drainage, traffic volume, and urban forestry) of each individual corridor. The image below shows a narrow, curbless residential street. Its curbless profile allows water to infiltrate directly into the infiltration zone, and street trees are closely spaced to provide ample shade for pedestrians.

Narrow, curbless streets save money, cause fewer ecological impacts and are more easily shaded by street trees.

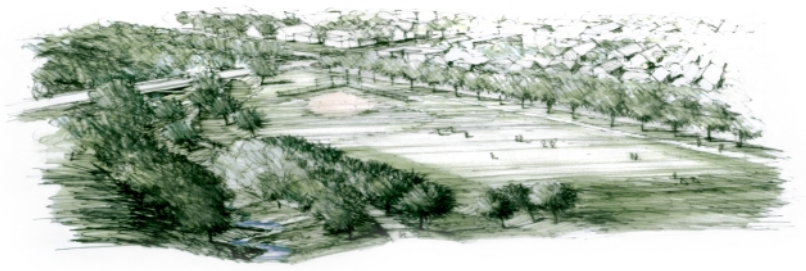
Principle No. 7
Preserve the natural environment and promote natural drainage systems (in which storm water is held on the surface and permitted to seep naturally into the ground).

The backbone of the plan's ecological infrastructure is its linked system of streets and open spaces, which includes local streets, major and minor parks, schools, riparian protection areas, tree preservation areas, neighbourhood parks, and buffers. This system will have many beneficial functions. It will simultaneously satisfy social, recreational, and educational demands while meeting important ecological goals (such as stream protection, stormwater management, and habitat preservation). As a result of the increased permeability of road and yard surfaces, it is anticipated that at least 80 percent of all annual rainfall will be absorbed by the soil in yards and roadway boulevards.

3.1.1 Performance Objectives

The plan includes two major park/school sites, which are to function as retention ponds/artificial wetlands during unusually heavy rains and as useable green areas for the surrounding residents and school facilities during normal periods (image below). In addition, a series of shallow ponds are to serve as detention/

Large parks and school grounds are integral components of the site's ecological infrastrucutre. They provide on-site bioremediation and infilatration for large storms, and they become shallow retention basins during 20 to 100 year storm events.



infiltration areas for more frequent major rains, holding it until it too can seep naturally back into the soil; be transpirated by aquatic plants; or be released gradually into the stream. Designed as natural components of two of the three major parks, these ponds are to provide a permanent habitat for avian and aquatic species while also making a positive contribution to the aesthetic quality of the landscape.

The above seven principles provide the general parameters for sustainable planning and design in East Clayton. The following are feasible targets for performance in the areas of ecology, economy, and equity. These performance targets informed the design brief for the charrette (see Appendix 3) and are derived from key local, regional and provincial policies relating to sustainable development over the past decade.[2]

ECOLOGY

To improve air quality by reducing auto use:

- Ensure that commercial and transit services are to be within a 400-metre walkable radius of all residents.
- Ensure a 25 percent reduction in travel-related CO^2 emissions generated per capita and corresponding increase in air quality.

To maintain stream health and to enhance habitat:

- Maintain or enhance ecological performance of native aquatic habitats.
- Ensure that 60 percent of parks, riparian areas, and greenways have significant habitat value.
- Maintain existing base flow level in all on-site and off-site stream channels.
- Maintain stream temperature.
- Eliminate storm surge.
- Eliminate water pollution.

EQUITY

- Provide one job per 2.8 community residents.
- Provide a wide variety of unit types appropriate to citizens of all ages and family types.

[1] British Columbia Energy Council, *Planning Today for Tomorrow's Energy* (Vancouver, British Columbia: British Columbia Energy Council, 1994); BC Hydro, *Bringing Electricity to the Liveable Region* (Vancouver, British Columbia: BC Hydro Corporation, 1994); BC Transit, *Transit and Long Range Planning* (Surrey, British Columbia: BC Transit Long Range Planning, 1994); CORE, F*inding Common Ground: A Shared Vision for Land-use in British Columbia* (Vancouver, British Columbia: Commission of Resources and Environment, 1994); City of Surrey Planning and Development Services, "Suburban Lands Review Study" (Surrey, British Columbia: City of Surrey,1992); City of Surrey Planning and Development Services, *Official Community Plan* (Surrey, British Columbia: City of Surrey, 1996); City of Surrey Planning and Development Services, "Corporate Report" (Surrey, British Columbia: City of Surrey, Dec. 7, 1998). City of Surrey Planning and Development Services, "Official Community Plan Background Report: Existing Policies" (Surrey, British Columbia: City of Surrey, 1994); City of Vancouver Planning Department, *Clouds of Change: Final Report of the City of Vancouver Task Force on Atmospheric Change* (Vancouver, British Columbia: City of Vancouver, 1990); Greater Vancouver Regional District, *Livable Region Strategy: Proposals* (Burnaby, British Columbia: Greater Vancouver Regional District, 1993); Greater Vancouver Regional District, *Livable Region Strategic Plan:* (Burnaby, British Columbia: Greater Vancouver Regional District, 1995); Province of British Columbia Legislative Assembly and Minister of Municipal Affairs, *Bill 11 – 1995, Growth Strategies Statues Amendment Act* (Victoria, British Columbia: Province of British Columbia Ministry of Municipal Affairs, 1995).

- Provide at least 20 percent of affordable rental housing relative to income distribution and family size of the surrounding communities – with an emphasis on affordable family housing – throughout the community.

ECONOMY

- Orient all residential units so that they maximize passive solar heating.
- Reduce cost of infrastructure by 20 percent.
- Increase efficiency of land by 30 percent.
- Incorporate imaginative financing devices (i.e., mortgage helpers in the form of secondary suites and live/work).
- Reduce base cost of housing by 25 percent per square foot.

3.2 Land-Use Types

The following section provides a brief description of each land-use type and its designated land allocation. ***Table 3.1*** identifies proposed building and population densities for each of the land-use types and shows low, average, and high density targets for each land-use.

3.2.1 Residential Areas

Including the existing one-acre lot subdivision at Aloha Estates, approximately 119.3 hectares (294.9 acres) of East Clayton's land area is proposed for future residential use. The proposed residential land uses offer a wide variety of forms and tenures within walkable neighbourhoods, as per the sustainable planning principles including:

Aloha Estates Future Half-acre Residential
Single-family homes with and without ancillary and/or coach house units on half-acre lots up to a maximum density of 4 units per acre. (Rezoning and subdivision of existing one-acre lots will require a high level of cooperation from residents and hinge upon the timing of road infrastructure and servicing.)

Low Density
Single-family homes (with and without ancillary and/or coach house units) and duplexes on lots of an approximate area of 372 m^2 to 414m^2 (4,000 to 4,500 sq. ft.) up to a maximum of 557.4 m^2 (6,000 sq. ft.) with and without lanes at densities between 6 and 10 units per acre.

Medium Density
Single-family homes (with and without ancillary and/or coach house units) on narrow lots of an approximate area of 270m^2 to 360m^2 (3,000 to 4,000 sq. ft.) with lanes at densities between 10 and 15 units per acre.

Medium-High Density
Row houses, duplexes, stacked townhouses, or single-family houses with a coach house at densities between 15 and 25 units per acre.

High Density
Fee-simple row houses on lots between 185.8m^2 360m^2 (2,000 and 3,000 sq. ft.), stacked

townhomes and apartments at densities between 25 and 45 units per acre.

Mixed-Use/"Main Street" Residential
Residential units above ground floor commercial uses (see also *Mixed-Use Commercial*)

3.2.2 Commercial Areas

A total of 7.61 hectares (19.08 acres) of the site area is designated for three types of commercial use.

Mixed-Use /"Main Street" Commercial
The Main Street commercial centre is located at the corner of 72nd Avenue and 188th Street. Located at a key entry point to the neighbourhood, the Main Street commercial centre is to serve as the heart of the community and will connect East Clayton to the wider Clayton area. This area is to be pedestrian-oriented in terms of street design as well as building massing and orientation, and is to have a "village-centre" character. A smaller mixed-use commercial/residential area is to be located at the opposite end of the neighbourhood at the corner of 196th Street and Fraser Highway. (see also *Mixed-Use/"Main Street" Residential*)

Neighbourhood Commercial
Smaller-scale commercial areas are proposed at five additional locations, which are situated so that every residential unit is within a five-minute walk of at least one commercial location. These smaller commercial areas may also incorporate residential use above the street-oriented commercial units.

Specialty Commercial
A specialty community-oriented commercial area, geared towards both local residents as well as those from the wider community, is proposed along Fraser Highway. It is imagined that this area could be similar to the commercial area at Panorama Village (No.10 Highway and 152nd Street) and would be a particularly good location for restaurants and shops.

Development within the three commercial areas will conform to the relevant commercial zones contained in the Surrey Zoning By-law. However, where allowable uses and regulatory standards contained in the related By-laws are inconsistent with the performance objectives outlined in the NCP (i.e., parking, building coverage, and setbacks), these alternative standards will be incorporated in the Zoning By-law by way of consequential By-law amendments.

3.2.3 Live/Work, Work/Live Areas

Adjacent to the business park, along 68th Avenue between 188th and 192nd Streets, 26.32 acres are proposed for Live/Work, Work/Live uses. At densities between 15 dwelling units per acre and 25 dwelling units per acre these forms of mixed-use accommodation allow for home-based work and for certain types of craft, office, retail, and selected wholesale uses as well as consultant businesses. The distinction between Work/Live and Live/Work use resides in the proportion of the building area given over to office- or work-related use versus residential use. In addition, the live/work area differs from the mixed-use commercial areas in that the residential component of the building is tied in tenure to the business component. The intent is for the Work/Live area to provide a transition from

the Techno-business park area to the Live/Work area. The Live/Work area will provide a transition to residential uses north of 68th Avenue. A type of housing unique to Surrey, this type of land-use fulfils a need for affordable housing and provides home-based work opportunities within a complete community.

The City of Surrey Zoning By-law does not currently include work/live, live/work zones. It is anticipated that further refinement to this concept is required before development of the live/work area proceeds. This notwithstanding, the development guidelines presented in Section 4.3 provide direction with regard to lot coverage, possible uses, building integration, and architectural character for these areas.

3.2.4 Techno-Business Park

In keeping with the Clayton Land-Use Plan, the East Clayton NCP designates approximately 11.9 hectares (33 acres) of the south-central portion of the site (between 192nd Street and 188th Street) a business park area. Uses within this area will be oriented towards industry of a high-tech and/or light manufacturing and service nature. The development of the Techno-business park zone will generally conform with the existing IB "Business Park" Zone of the Zoning By-law.

3.2.5 Public and Natural Areas

A total of 37.67 hectares (93.1 acres) of the site is allocated for an integrated system of public and natural areas consisting of but not limited to: two school/park sites, a system of neighbourhood, and riparian parks, greenways, and landscaped buffers. These components are considered part of the green infrastructure system, and thus will perform multiple functions, including recreation, habitat, and surface drainage. See Section 5 "Green Infrastructure..." and Section 6 "Engineering Servicing" for more detailed performance requirements related to natural drainage, environmental enhancement, and circulation.

3.2.5.1 School/Park Sites

The size and location of the two school/park sites conforms to the policy "Site Layout and Design Guidelines for the Planning of School/Neighbourhood Park Sites Jointly Operated by the City of Surrey and School District No. 36." This policy indicates that school/park sites should have an area of between 13 and 20 net acres and be located to serve a minimum of 750 and maximum of 1,500 family-oriented housing units. The two sites are centrally located within walking distance of the surrounding residential communities and are both aligned with the 70th Avenue collector street (also designated as a greenway). Section 5.0 of this report provides general performance objectives for the school/park sites within the context of the green infrastructure system. However, in order to achieve compatibility with related City and Provincial policies, in addition to meeting the performance objectives of the NCP, specifically with respect to drainage and urban forestry, more detailed standards and design guidelines will be required as development proceeds.

Table 3.1 East Clayton Land Use Statistics

LAND-USE	Area in hectares/acres		FAR	Average No. of Units per Ha./Acre		Total No.Units (low range)	Total No.Units (mid range)	Total No.Units (high range)	% of Total Net Area	Estimated Population (average of 2.8 people per unit)	
Residential											
Future half-acre residential (4 upa max.)	16.74	41.36	0.50	5	2	41	84	165	9%		234
Low density (6 - 10 upa)	36.31	89.72	0.55	20	8	538	717	897	19%		2,009
Medium Density (10 - 15 upa)	16.42	40.58	0.60	31	12.5	406	507	609	16%		1,420
Medium-High Density (15 - 25 upa)	27.80	68.68	0.90	49	20	1,030	1,373	1,717	15%		3,845
High Density (25 - 45 upa)	19.28	47.65	0.90	86	35	1,191	1,667	2,144	10%		4,667
Mixed-Use (25 - 45 upa)	2.79	6.90	2.50	86	35	172.5	241	311	1.5%		675
Total Residential	**119.3**	**294.9**				**3,379**	**4,589**	**5,843**	**70%**		**12,616**
Live /Work Work / Live										**Est. # Jobs Created**	**Population (average 2 people per unit)**
Live / Work	7.79	19.26	.9-1.5	50	20	289	392	481.50	4%	392	785
Work /Live	2.86	7.06	.9-1.5	50	20	106	141	176.50	2%	282	282
Total Live /Work Work / Live	**10.65**	**26.32**				**395**	**534**	**658.00**	**6%**	**675**	**1067**
Commercial								**Total m2 (Square ft.)**			
Mixed-Use Commercial	2.79	6.90	1.80					4,079 (43,889)	1.5%	41	
Neighbourhood Commercial	1.58	3.91	0.4 (commercial only)					12,643.7 (13,6047)	0.8%	129	
Specialty Community-Oriented Commercial	3.24	8.27	0.80					33,360 (358,959)	2%	1,074	
Total Commercial	**7.61**	**19.08**						**50,082.7 (538,895)**	**4%**	**1,244**	
Total Business Park	**11.97**	**29.58**	**0.75**					**95,891 (1,031,789)**	**0.6%**	**3,093**	
Total Institutional	**0.60**	**1.48**		**existing church**				**approx. 3,015.7 (32,450)**	**0.3%**		
Schools, Parks, Greenways and Riparian Areas											
School/Park Sites	9.53	23.54							**5%**		
Storm Water Pond (Public property)	4.48	11.05							**2%**		
Storm Water Pond (Private property)	1.14	2.81							**1%**		
Riparian Protection Area	6.70	16.55							**4%**		
Parks and Linear Open Space	14.45	35.71							**3%**		
Buffers (landscaped private property along arterials)	0.86	2.12							**0.5%**		
Natural Area (adjacent to Riparian Greenway)	1.84	4.54							**0.7%**		
Utility Open Space	0.64	1.58							**0.3%**		
Total Schools, Parks, Greenways and Riparian Areas	**39.64**	**97.90**							**16%**		
Total net area (hectares/acres)	**190**	**469**									

4.0 LAND-USE AND DEVELOPMENT PERFORMANCE STANDARDS AND DESIGN GUIDELINES

These guidelines, along with Surrey's Official Community Plan, the Clayton General Land-Use Plan and the Surrey Zoning By-law, will be used to guide development in East Clayton. The primary intent of these guidelines is to facilitate the co-ordinated development of an identifiable, mixed-use, and pedestrian-oriented community that is consistent with the seven principles for sustainable communities and development objectives outlined in Section 1.3.1 of this report. The development performance standards and guidelines are organized by the following four land use types proposed by the plan, including:

1. **Residential areas**
2. **Commercial areas**
3. **Live/work, Work/Live areas**
4. **Techno-Business Park area**

4.1 Residential Areas

The intent of the residential areas design guidelines is to encourage the development of a variety of housing types, densities, and forms that will provide a varitey of housing options while still ensuring a strong and unified residential character for East Clayton. These guidelines support the sustainable planning principles outlined in Section 1.3.1 of this report, with a special emphasis on the following:

Principle No. 1

Conserve land and energy by designing compact walkable neighbourhoods. This will encourage pedestrian activities where basic services (e.g., schools, parks, transit, shops, etc.) are within a five- to six- minute walk of their homes.

Principle No. 2

Provide different dwelling types (a mix of housing types, including a broad range of densities from single-family homes to apartment buildings) in the same neighbourhood and even on the same street.

Principle No. 3

Communities are designed for people; therefore, all dwellings should present a friendly face to the street in order to promote social interaction.

Principle No. 4

Ensure that car storage and services are handled at the rear of dwellings.

Objectives

- to provide a diversity of housing types (i.e., detached, semi-detached, fee-simple row housing, townhouses, and apartments) and tenures so as to accommodate a wide range of individuals (i.e., single parents, couples, families with children, seniors, people with special needs, and others);
- to increase housing options for people at a variety of income levels and family types;
- to allow as many dwellings as possible to address the street;
- to encourage walking and cycling to local destinations and thereby reduce dependence on cars;
- to include on-street parking, street trees, swales/boulevards, and sidewalks;
- to establish front-yard setbacks that will ensure a clear definition between private and public space and that will enhance crime prevention by increasing the number of “eyes on the street”;
- to encourage a design that respects the regional heritage, climate, and landscape while maximizing opportunities for views, natural ventilation, and solar access;
- to enhance public safety through the application of crime prevention through environmental design (CPTED) principles; and
- to reduce the cost of new homes.

1. Half-acre Residential (Aloha Estates)

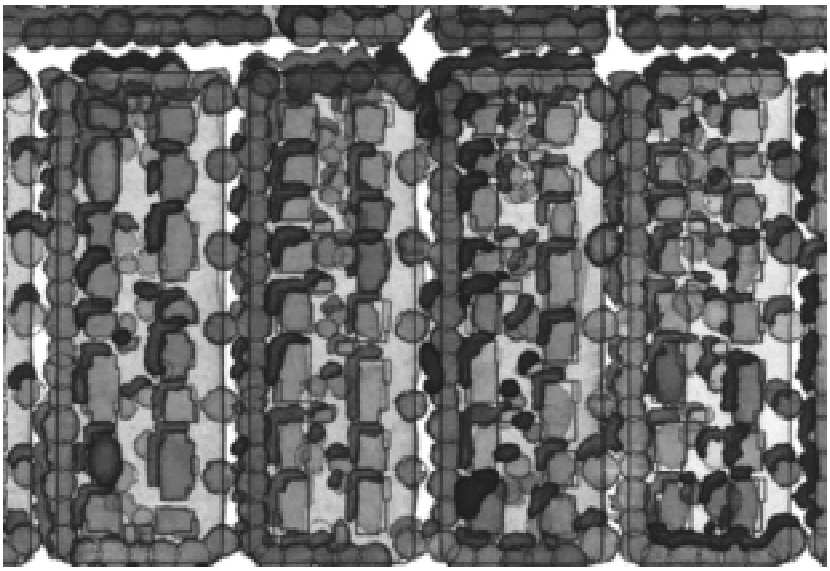
Single-family homes with and without ancillary and/or coach house units on half-acre lots up to a maximum density of 4 units per acre. Development standards/regulations should generally be in accordance with the RH Zones contained in Surrey's Zoning By-law.

In keeping with the objective of providing a variety of housing types and sizes, the Aloha Estates area south-west of 72nd Avenue (currently one-acre lots) may eventually be redeveloped into half-acre lots (with or without coach houses). The subdivision potential and timing will be dependant upon road infrastructure and servicing and will require a high level of cooperation among property owners. The design of coach houses is to reflect the existing "estate" character of the Aloha Estates area.

2. Low Density Residential

Single-family homes (with and without ancillary and/or coach house units) and duplexes on lots of approximately 371.6m^2 to 414m^2 (4,000 to 4,500 sq. ft.) up to a maximum of 557.4 m^2 (6,000 sq. ft.) with and without lanes at densities between 6 and 10 units per acre, with a desirable density of 8 units per acre or above.

This plan view of a low-density area shows single-family homes on a variety of lot sizes on blocks without lanes. Small front setbacks allow more room for private backyard space. All corner lots are to have coach house units to increase diversity, to provide unity to the streetscape, and to increase "eyes on the street." Garages are accessed via front driveways (or on blocks with lanes, via the lane). On-street parking is provided where possible.



This single-family streetscape illustrates the character of larger lots within the low density area.

Dominant characteristics:

- entries that retain a human scale (i.e., no higher than one storey) and that relate to the street;
- front porches with overhangs;
- small front-yard setback and clear delineation of public and private space;
- façades articulated with window details and projections;
- steep sloped gable roofs;
- high quality materials and finishes (i.e., wood, masonry); and
- garages are accessed via the rear lane or (on blocks without rear lanes) are recessed behind the front façade.

3. Medium Density Residential

Primarily single-family residential homes in more compact neighbourhoods are permitted while allowing for additional accommodation in the form of two-family dwellings (i.e., duplexes), on narrow 270m^2 to 360 m^2 (3,000 to 4,000 sq. ft.) lots with lanes at densities between 10 and 15 units per acre, with a desirable density of 12.5 units per acre or above.

This plan view of a medium-density area exhibits a range of housing types – single-family homes, single family homes with secondary units, and duplex units – all within the same block and all maintaining a single-family character. Front setbacks of between 4 and 5 metres (13 and 16.5 ft.) reinforce the human scale of the street and allow more room for backyard space. Lots range from between approxmiately 270m^2 (3,000 sq. ft.) and 360 m^2 (4,000 sq. ft.). Garages and ancillary dwelling units are accessed via the rear lane or, in the case of corner unts, via the side street. Parking is allowed on both sides of the street wherever possible.

Medium-density areas retain single-family character while providing a range of housing types.

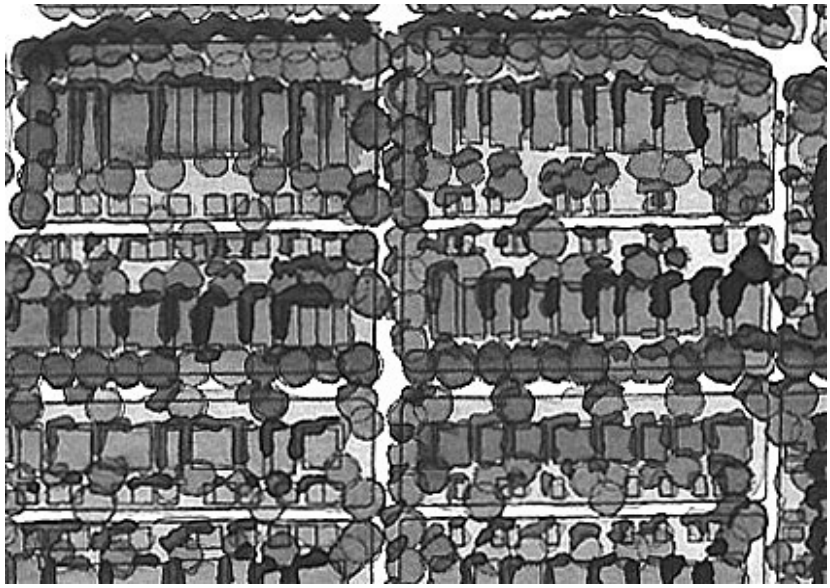
Dominant characteristics:

- strongly defined front entry that relates to the street;
- front porches with overhangs;
- small front-yard setback with clear delineation of public and semi private space;
- façades articulated with appropriately proportioned windows and roof projections;
- strong roof forms to provide interest and rhythm to the streetscape;
- use of materials that reflect regional context (i.e., wood, cedar shingles, stone) and careful detailing; and
- garage and ancillary units are accessed via rear lanes;
- no garages front onto the street.

4. Medium-High Density

Medium-high density development, comprising semi-detached single-family duplexes and fee-simple row houses, and at the higher density range, integrated townhouse developments, are permitted between the ranges of 15 and 25 units per acre, with a desirable average density of 20 units per acre. Emphasis is on recognizing the neighbourhood character of East Clayton, ensuring a compatibility of design with other residential areas, and promoting a high number of ground-oriented units.

This plan veiw 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.



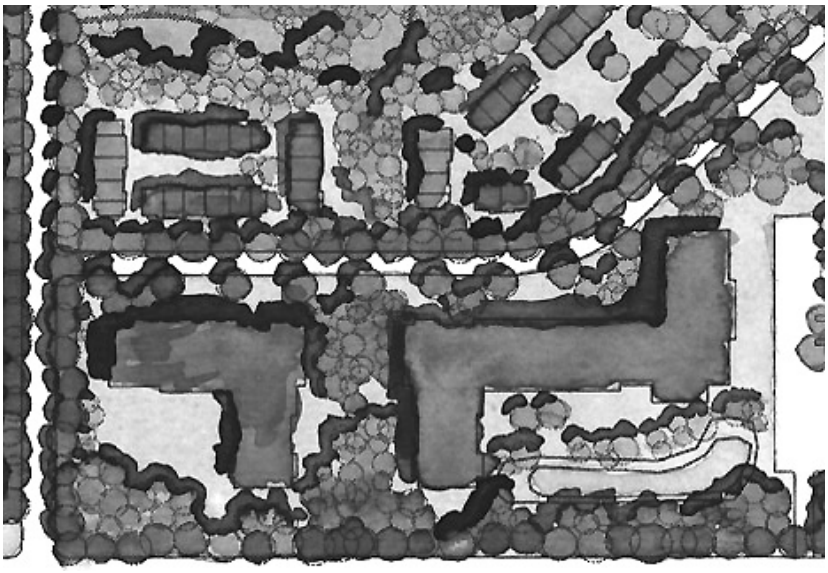
Row houses are designed to reinforce the character of single-family areas and contribute to a unified streetscape.

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.

5. High Density

High-density residential development between the ranges of 25 and 45 units per acre is permitted with a desirable average density of 35 units per acre. Emphasis is on recognizing the neighbourhood character of East Clayton, ensuring a compatibility of design with other residential areas, and promoting the highest possible number of ground-oriented units with a direct connection to the street.



High-density areas are comprised of stacked townhouses, row houses, and/or garden apartments at densities between 25 and 45 units per acre. This plan view shows high-density row houses across the street from apartments. Front setbacks are minimized in order to create a strong street-orientation. Parking is provided in individual garages at the rear, in rear parking areas, or underground.

High-density apartments have ground-oriented access with a strong orientation to the street.

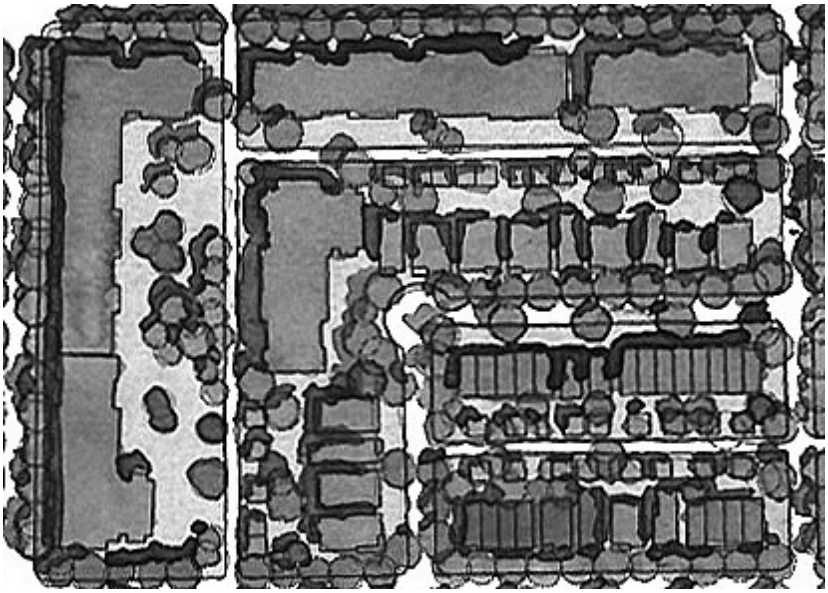
Dominant characteristics:

- a maxium number of individual entries front onto the street;
- clear deliniation between private and public space;
- recessed front entries or porches to articulate façade and reinforce unified residential character;
- upper-floor units have private roofdecks or balconies;
- massing and proportions contribute to human scale of the street; and
- high-quality materials and detailing that is compatible with adjacent single-family residential areas.

6. Mixed-Use Main Street Residential

High-density residential units of densities between 25 and 45 units per acre are permitted within the context of a mixed-use neighbourhood and with desriable average densities of 35 units per acre. The Main Street district serves as the "heart," or central locale first for the East Clayton community and ultimately, for the Clayton district as a whole. In the Main Street residential area residential units are designed to visually and functionally integrate with commercial uses. The external design of buildings is oriented to the pedestrian realm, with a direct and close connection to the public sidewalk. All parking is to be provided via rear lanes, underground, or on the street.

The Main Street residential area is envisioned as a high-density mixed-use area that accommodates apartments or townhouses above ground-floor commercial uses. The residential density of this area ranges between 25 and 45 units per acre. Front setbacks of between zero and 2 metres (6.5 feet). Building heights should not exceed 4 storeys. Parking is provided at the back with access from the lane.
(see also Mixed-Use Commercial, Section 4.2.1)



The Main Street residential area features commercial uses along the ground floor with residential units above. Lot coverage is up to 80% to ensure street frontage continuity. Residences are accessed via a separate entrance that is integrated into the façade of the building. Awnings, canopies, and/or arcades provide pedestrian weather protection and articulate ground-floor retail uses.

4.1.1 Housing Density and Diversity

4.1.1.1 Net Density

Assuming that the average density for each residential zone is reached, the total net residential density (total site area excluding rights-of-ways and other undevelopable area) is 27.28 units per hectare/11 units per acre.

4.1.1.2 Block Diversity

To reach the overall residential density target in East Clayton and to ensure effective and efficient operation of the services, infrastructure, and the integrated community structure, a mix and variety of residential types along with the target densities must be achieved.

- The target densities are those at the average to higher range identified in the NCP (see ***Table 3.1***)
- Target land use mixes comprise a wide array of different dwelling types in the same neighbourhood and on the same block arranged in compatible building forms.
- Residential development projects will be required to provide a variety of dwelling types and densities according to the criteria identified in section 7.0 “Implementation.”

4.1.2 Relation of Buildings to Streets - Building Footprint Standards

The relationship between density, land use integration, and street connectivity is important in reaching the various objectives of the plan. With this in mind, the interconnected system of streets and lanes shall be maintained as per the Land Use Plan.

4.1.2.1 Building Coverage

Achieving the various performance objectives related to green infrastructure and drainage requires minimizing the amount of impervious surface area consequent to buildings and other surfaces on each lot.

- The total lot coverage of low and medium density lots (including coach houses) shall be no greater than 45 percent. In medium-high density areas, site coverage shall be no greater than 45 percent for single family lots with coach houses and 55 percent for semi-detached duplex and row house lots. In high density areas, building coverage should not exceed 55 percent. Mixed-use developments may have a lot coverage of up to 80 percent, while still meeting infiltration performance standards.

4.1.2.2 Building Height

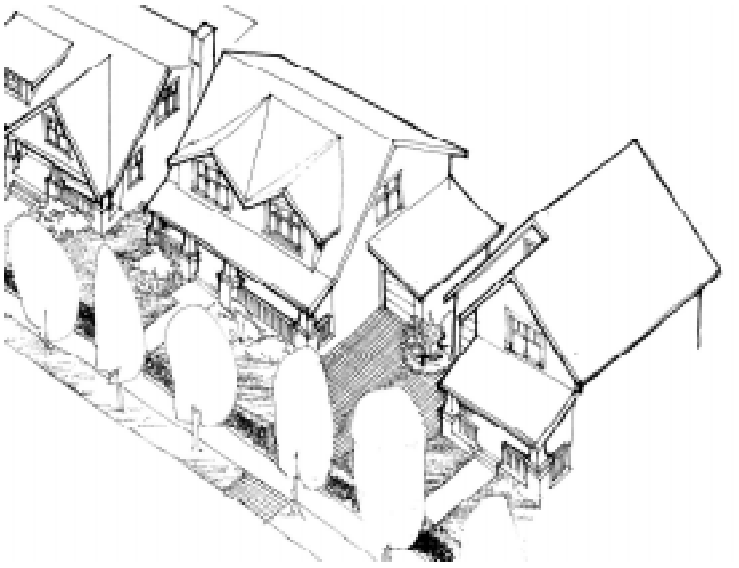
- The height of principal single-family dwellings on low, medium and medium-high density lots should not exceed 2 and a half storeys plus basement. (Note: where applicable, the floor above the second floor [i.e., space within the roof gable] is considered habitable space.) The height of coach houses in these areas shall not exceed 2 and a half storeys.
- The height of row houses and townhomes in medium-high and high-density areas shall not exceed 3 storeys plus full basement.
- High-density and mixed-use apartments shall not exceed 4 storeys.

4.1.2.3 Parking and Garages

For low, medium, medium-high, and portions of high density areas (i.e., row house/ townhouse developments), a minimum of 2 parking spaces per unit is required. One of these spaces must be on the site. The second space may be provided on the site or on the street, provided that a parking count confirms that the parking requirements for all dwelling units on the block/street plus 20 percent (for visitors and cueing space) can be accommodated.

- Lanes must be provided if on-street parking is counted as part of the required parking.
- Parking in the lane ROW is not allowed.
- Access to parking is to be provided off of the lanes; on those exceptional blocks where this is not feasible, parking is to be provided from the street (from shared drives) and incorporated in such a way as to enhance the streetscape of the neighbourhood.
- Garages for single-family dwellings are to have a maximum of one garage door with a maximum width of 3 metres (10 feet). On blocks without lanes garages should be set back from the façade of the house a minimum of 2 metres (6.6 feet).
- On blocks without lanes, entry drives are to be a maximum of 3.5 metres (12 feet) in width. Driveways may flare slightly on private property to provide a parking court or storage next to the garage.
- On blocks without lanes, entry drives and curb cuts are to be minimized by combining two drives for entry off the street.
- On blocks without lanes, the massing of garages is to be secondary to the primary form of the home. The design and detailing of the garage should be consistent with the architectural style of the home.
- Permeable materials (i.e., individual pavers, permeable asphalt, “grass-crete”, gravel, ribbon-strip treatments) are required for driveways, parking pads, and parking courts.
- All garage doors visible from a public street or open space are to have the same quality of detail and craft as does the primary building.
- In low-, medium- and medium-high density areas, attached garages and garage doors are to be integrated into the building mass. In high-density areas, placement of the

On blocks without lanes, recessed garages with minimum dimensions are integrated into the home. Shared curb cuts, “ribbon strips” (median planted area), and individual pavers increase the permeable surface area of the driveway.

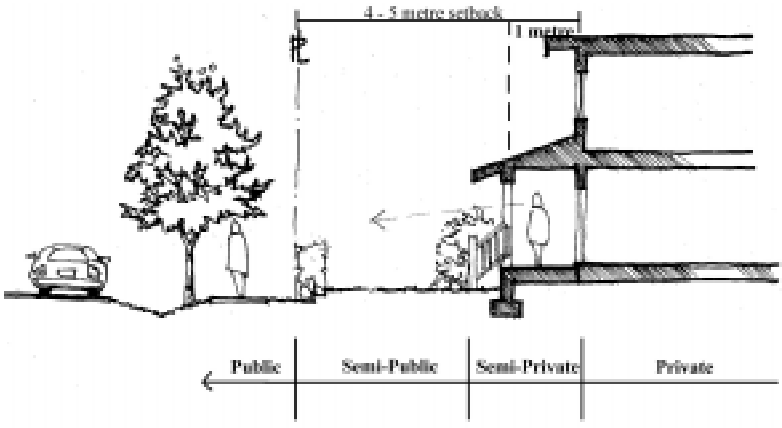


parking entrance shall be integrated with, but secondary to, the rest of the building façade. The parking entrance shall be accessed via the side street or lane.

- Lane-accessed garages and coach houses should be set back a minimum of 1 metre from the lane right-of-way.

4.1.2.4 Front Setbacks

- Front setbacks should reinforce the human scale of the street and neighbourhood (i.e., in low, medium, and medium-high density areas, front setbacks for primary dwelling units on single family lots should be a minimum of 4 metres [13 feet] and a maximum of 5 metres [15 feet]).
- Special front setbacks of 7.5 metres (25 feet) are required for lots facing portions of 188th, 192nd, and 196th Streets, and portions of 64th Avenue (see Land-Use Plan).
- Front porches may project up to 1 metre (3.3 feet) into the front yard setback.
- Coach houses on a flanking street should have a front setback that is compatible to the sideyard setback of the primary dwelling unit (i.e., 3 metres/10 feet).
- Front setbacks for row houses and townhouses in medium-high and high-density areas should be a minimum of 3 metres (10 feet) from the front property line. Where town/row houses abut single-family lots, the front setback should be the same as the single-family dwelling.
- Mixed-use residential/commercial dwellings should have a front setback of between zero and 2 metres (6.6 ft.).



An approrpriate relationship between private single-family residence and public street. The front porch is allowed to extend a maximum of 1 metre (3.3 feet) into the front setback. Low shrubs along the property line make a clear distinction between the private front yard and the public street.

4.1.2.5 Building Orientation

- All residential buildings are to have their primary façades facing public streets, parks, and greenways. In cases where buildings are fronting two streets, they should address both.

A small home facing two streets. Note the porch addresses both streets, provides a generous amount of outdoor space and incorporates the front entry door.

4.1.2.6 Entries, Porches, and Front Yards

- Where appropriate, fencing and hedging should be provided in order to help delineate public and semi-private space. Hedging or fences should be kept low, and the latter should be designed to be in keeping with the architectural character of the dwelling. The maximum recommended height of any front-yard fencing is 1 metre (3.3 feet).
- Wood or stone fencing, or a combination of the two, is acceptable while chainlink metal fencing is not. Picket, lattice, or other similar wood fencing is acceptable while solid fence panels are not.
- Gates and/or arbours should be consistent with the style of the fence.
- Front doors, or individual entries, on ground-oriented units are to be emphasized through the use of entry porches (or recessed front doors).

On this row house street, all units access the street from a recessed front entry and a small front porch. Low fences (1metre/3.3 feet) and landscaping distinguish public from private space and contribute to a neighbourly character.

- The addition of large porches facing the street is encouraged. These promote neighbourhood interaction and provide semi-private outdoor space. They should have a clear depth of 1.8 metres (6 feet) and may project a maximum of 1 metre (3.3 feet) into the front-yard setback. Porches are to be raised a minimum of 0.5 metre (18 inches) above the ground.
- In High-density residential areas, as many units as possible are to be provided with individual access to the street.
- "Gated Communities" are not consistent with the planning principles and are therefore not permitted.

This corner duplex also incorporates a small coach house in the rear yard. Note the 3 metre (10 feet) side yard setback on the primary unit is consistent with the front yard setback of the coach house. Massing, roof forms and porch elements are complementary to the primary dwelling and contribute to a unified streetscape.

4.1.2.7 Coach Houses

- Coach houses are required on all corner lots in low- and medium-density areas.
- The principal entry for all corner coach-house units is to face the flanking street.
- The design of coach houses is to be compatible in scale and character with that of the primary residence.
- On lots other than corner lots, entries to coach houses must connect to streets via side yards.
- As of April, 2000, policy and regulatory development is underway with respect to coach houses and other ancillary dwelling units. Contact the Department of Planning and Development for the status of policies and regulations.

4.1.3 Built Form and Materials

Consideration is to be given to massing and materials of all buildings in order to create a rich overall neighbourhood character with rhythm and variety, while keeping within a cohesive design framework.

4.1.3.1 Built Form Diversity

- In addition to the diversity of building forms between the different residential density areas, diversity of building forms is encouraged within the same area and on the same street.
- A variety of unit types (i.e., single-family, duplex and row houses) are encouraged within each block in order to provide a variety of tenures and add variation to the streetscape.
- Variation in individual housing types results in different "models." Each model may have the same lot size and basic floor plan but must be differentiated by varied exterior treatments and materials.
- No street block should have more than two consecutive single-family homes with the identical house model; the same models should have variations on its expression toward the street. Variations in the expression of the building towards the street, through the location of porches, roof form, façade articulation and front elevation design details (i.e., window proportions, trim, and materials) is encouraged.

4.1.3.2 Building Massing

- The massing of individual houses or buildings should express a strong and clear hierarchy of forms.
- Building massing should reflect the character of homes found in traditional West Coast urban neighbourhoods (especially in the low-, medium- and medium-/high-density areas). This massing should incorporate strong, pitched roof forms, porches and/or recessed entries.
- The scale of adjacent buildings should minimize overlook and shadowing between buildings.

4.1.3.3 Roof Forms

- Buildings in low-, medium- and medium/high-density areas should have strong primary roof forms, with secondary roofs gables, sheds, or integrated skirt roofs being incorporated to express a clear formal heirarchy and to visually support the primary roof form.

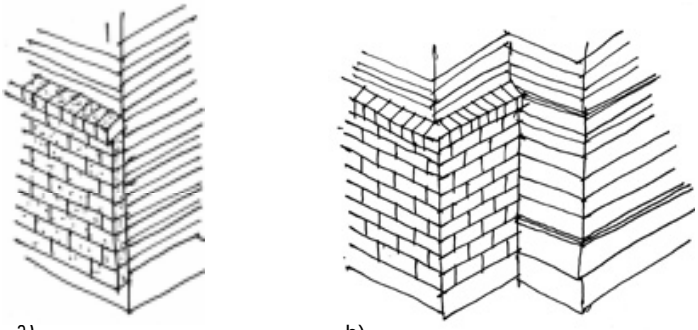
Examples of appropriate roof forms.

- The incorporation of living spaces within the roof form is encouraged.
- Roof slopes of a minimum of 8 in 12 are encouraged, with steeper roofs preferred on dominant and primary roofs.
- Garage roofs are to complement the roof form of the house.
- Consideration should be given to the roofing materials so as to achieve an appropriate fit with the building's structural massing, articulation, and roof forms.

4.1.3.4 Building Finishes

- Building and roofing materials are to reflect the regional heritage and climate as well as to express a high level of craft.
- Recommended exterior finishes include wood and vinyl siding, shingle siding, brick, stone, and stucco. A maximum of two material finishes is encouraged on any elevation, with a third material being permitted above the upper storey on gable ends or dormers. On three- or four-storey buildings there should be a layering of cladding materials in order to create a base, middle, and top wherever appropriate.
- Siding treatments should continue around corners in order to avoid a "pasted on" appearance.
- Flashings and gutters should be integrated into the design through colour or other methods.

Recommended treatment for changes in cladding. Image a) shows an abrubt change from brick to wood cladding that is unacceptable. Image b) shows the change occuring an acceptable distance around the corner of the principle elevation and at an appropriate junction.



a) b)

4.1.3.5 Windows

- Windows are to be visually prominent and are to be articulated with colour and/or trim. The largest group of windows, or those belonging to the primary living spaces within the building, should be of a scale that is compatible with the massing and roof forms of the building and be clearly visible from the street.
- Windows are to be of a simple configuration, carefully composed to support the massing of the buildings. Groupings in bays are encouraged. Large horizontal picture windows are discouraged.
- Vertical or square windows (individual or in groups) are preferred.

The image at left shows an appropriate treatment for windows. Windows are of a rectangular shape, with wide trim. Wood trim is used around windows and doors in a manner consistent throughout building elevations.

4.1.4 Environmental Design Considerations

4.1.4.1 Climatic Response

- All residences are to be oriented so that a maximum amount of primary living space receives direct sunlight. They are also to incorporate overhangs, awnings, or trellises that will allow the low winter sun, but not the high summer sun, to penetrate the unit. Wherever possible, principal rooms are to have windows on two walls in order to provide balanced daylighting and to facilitate natural cooling and ventilation.

4.1.4.2 Views

- Views from the larger Clayton district, featuring the agricultural lowlands, Mount Baker, and other visually significant amenities are to be preserved wherever possible. Residential development within East Clayton is to ensure that existing views are not unduly compromised by insensitive siting, massing or orientation and that potential views are protected.

4.1.4.3 Topography

- Planning and building designs should be responsive to the contours and natural features of the site. Specific slope conditions are to be considered in building layout, and designs should ensure that the functional and visual integrity of the site's grade, as well as its relationship to adjoining sites, is maintained.

4.1.4.4 Useable Outdoor Space

- Provide a generous amount of usable private ground-orientated outdoor space for each residential unit. Upper-storey terraces, patios, and/or rooftop gardens for upper-storey units in high-density residential areas would be an acceptable alternative to ground-oriented outdoor space only when it is impossible to provide direct ground access.

4.1.4.5 Crime Prevention Through Environmental Design

- Developers and designers are to consider appropriate safety and natural surveillance measures (such as lighting design, visual access/surveillance) as per CPTED principles.
    - The maximum number of units are to face onto greenways and neighbourhood parks.
    - Homes are to be designed so that primary living areas have a clear view of the street, park, and/or greenway.
    - Garages are to be oriented so that they do not block the view of the street or lane.
    - All blocks with lanes will have coach house units at the lane entry.
    - The largest group of windows, or those belonging to primary living areas (e.g., kitchens, family rooms, or master bedrooms) are to directly overlook rear yards and lanes.
    - Adequate lighting is to be provided on streets and in lanes.
    - In order to increase surveillance onto the lane, where possible, coach houses should include at least one room on the ground floor or have windows facing the lane.
    - Functional porches are to be provided on the street-facing elevation of residences.
    - On principal residences, the first-floor elevation is to be set high enough to provide a commanding view of the street.

4.2 Commercial Areas

The intent of the commercial area guidelines is to encourage street-oriented commercial, and mixed-use commercial development of appropriate densities and forms so as to meet the needs of the residents of East Clayton and surrounding communities. In the case of specialty commercial, due to its location and subdivision pattern, street-oriented development is not possible. However, the guidelines provide direction for the development of specialty commercial buildings that convey a village-like character and that support pedestrian activity. The guidelines conform to the seven sustainable planning principles outlined in Section 1.3.1 of this report, with a special emphasis on the following two principles.

Principle No. 1

Conserve land and energy by designing compact walkable neighbourhoods. This will encourage pedestrian activities where basic services (e.g., schools, parks, transit, shops, etc.) are within a five- to six- minute walk of their homes.

Principle No. 2

Provide different dwelling types (a mix of housing types, including a broad range of densities from single-family homes to apartment buildings) in the same neighbourhood and even on the same street.

Objectives

- to encourage development that is compatible with and serves adjacent residential uses;
- to increase housing options for a variety of income levels and family types by providing residential units over main floor commercial areas;
- to use lanes to provide access to parking and to create a continuous building frontage;
- to encourage walking and cycling to local destinations and, thereby, reduce dependence on the automobile;
- to include on-street parking, street trees, infiltration devices, and sidewalks;
- to encourage building design that emphasizes the pedestrian realm through the use of compressed front setbacks, pedestrian weather protection, and human-scale detailing;
- to accommodate economic development and to increase the number of local jobs for people who live in East Clayton;
- to provide basic commercial services within walking distance of all homes; and
- to enhance public safety through the application of crime prevention through environmental design (CPTED) principles.

1. Main Street Mixed-Use Commercial / Residential

The intent of this area is to encourage the development of street-oriented commercial uses that are compatible with upper-storey residential units. Mixed-use commercial areas are intended to accentuate nodes of activity where high levels of pedestrian traffic are expected to occur and where the most intense development is expected to take place. At-grade retail/commercial uses with residential units on upper storeys are to be designed to create an appealing, pedestrian-friendly streetscape that is compatible with surrounding residential uses. The primary mixed-use commercial area (Main Street) is proposed at the intersection of 188th Street and 72nd Avenue and serves as a central commercial locale for the entire Clayton community. A second mixed-use area is proposed at the corner of 196th Street and Fraser Highway.

The Main Street mixed-use commercial/ residential area is proposed at the corner of 72nd Avenue and 188th 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 tennants and patrons will be provided in on-street angled parking areas, in underground structures, or in parking areas accessed via the rear lane.

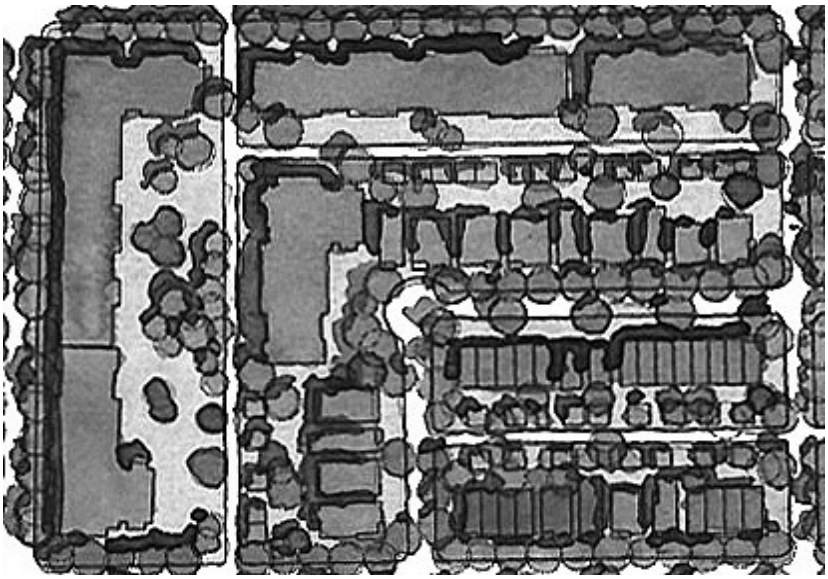
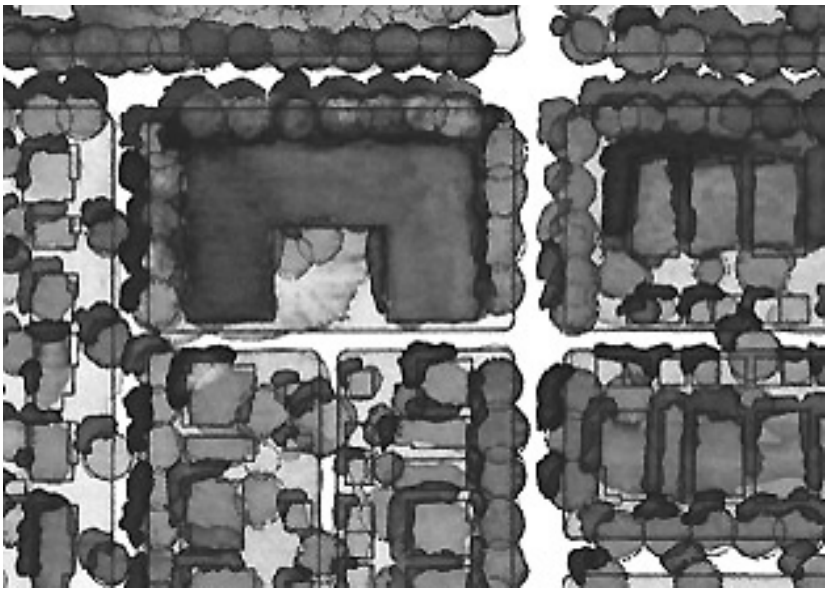


Image of a mixed-use commercial/ residential street. The streetscape is comprised of similarly scaled buildings, street trees, covered sidewalks, and on-street parking.

2. Neighbourhood Commercial

The intent of this area is to provide for retail and service development that features small-scale commercial enterprises and services (such as neighbourhood grocery or convenience stores) that cater to the everyday needs of local residents. Proposed at five locations throughout the community, neighbourhood commercial areas are to be situated so that residents of East Clayton are within at least a 400-metre (5-minute) walking distance from one of them.



A total of 1 hectare (2.49 acres) of neighbourhood commercial is proposed in five locations throughout East Clayton. Front setbacks are between zero and 2 metres (6.6 feet) in order to ensure a strong pedestrian orientation. Parking lots along building fronts are not permitted; rather, parking will be accommodated on the street, in underground structures, or in parking areas accessed via the rear lane or side street.

Neighbourhood commercial nodes accomodate small-scale, street-oriented commercial uses (e.g., a local grocery store, cafe, or office) that respond to residents' daily needs. The massing and form of these buildings incorporates elements of the surrounding residential character.

3. Specialty Commercial

This use will accommodate a range of goods and services, commercial activities, and personal services (such as restaurants, specialty shops and services, bistros and cafes) that require a centralized location. Unlike other commercial zones that support residential uses, the specialty commercial area is envisioned as a centre of commercial activity for the larger neighbourhood and surrounding communities. The nature of its location and parcel structure precludes direct street orientation, as is seen in neighbourhood commercial and mixed-use Main Street commercial uses; however, small-scale building footprints, human-scale detailing, and parcelized parking areas ensures a pedestrian-oriented environment that is compatible with surrounding residential uses and that is easy to access from the residential areas by bike or on foot.

A total of 3.24 hectares (8.27 acres) along the north side of Fraser Highway is allocated for specialty commercial use. The area will serve both the local and surrounding communities with a mix of commercial uses. The built form will reflect the scale and character of surrounding residential buildings. Large parking surfaces will not be permitted; instead, smaller parcels of parking will be divided among each building. A 15-metre (50 feet) landscaped buffer is required along Fraser Highway.

Image of a specialty commercial area. Arcaded buildings provide weather protection for pedstrians and create a "village-centre" atmosphere. Small parking areas are grouped between buildings and are planted generously with trees.

4.2.1 Relation of Buildings to Streets – Building Footprint Standards

4.2.1.1 Building Coverage

Achieving the various performance objectives related to green infrastructure and drainage requires minimizing the amount of impervious surface area consequent to buildings and other built surfaces on each lot. At the same time, creating pedestrian-friendly streets (in the case of Neighbourhood Commercial and Mixed-use Commercial areas) requires minimizing front setbacks and maximizing the street frontage of buildings.

- The total maximum building coverage permitted for Main Street mixed-use commercial lots is 80 percent.
- The total maximum permitted building coverage for Neighbourhood Commercial is 50 percent.
- The total maximum building coverage permitted for the Specialty Commercial area is 50 percent.

4.2.1.2 Building Height

- Buildings in Main Street mixed-use commercial areas shall not exceed a height of 4 storeys.
- Buildings in Neighbourhood Commercial areas shall not exceed a height of 3 storeys.
- Buildings in the Specialty Commercial area shall not exceed a height of 3 storeys.

4.2.2.3 Parking and Garages

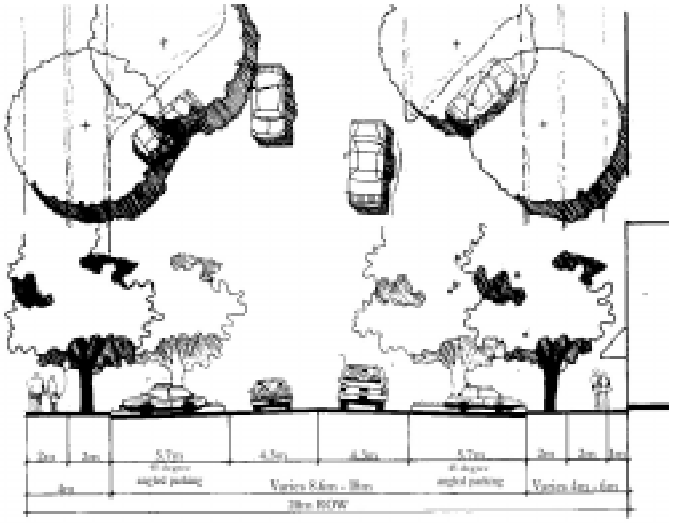
- On-street parking is a convenience for people visiting commercial establishments for a short time. It can also improve the pedestrian realm at the street edge by providing a buffer to moving traffic. In Neighbourhood Commercial and Mixed-use Commercial areas, the amount of adjacent on-street parking shall be maximized and may be counted towards the parking requirement. Diagonal parking will be allowed in these areas.
- Off-street parking in large open parking lots can detract from the flow of pedestrian activity and can jeopardize the level of architectural continuity along a mixed-use commercial street. This being the case, other than street parking, all surface parking

Landscaped medians, planters, street trees, and awnings create a pleasant envelope for the pedestrian. Parking is provided on the street and/or in lane-accessed parking areas.

in Neighbourhood Commercial and Mixed-use areas is to be accessed from rear lanes or side streets and be designed in such a way as to avoid potential conflict with pedestrian activity.

- The visual impact of service areas and vehicular parking ramps is to be minimised through proper treatment (such as enclosure, screening, high quality finishes, sensitive lighting, and landscaping).
- Where it can be demonstrated that a mix of uses creates staggered peak periods of parking demand, parking areas can be shared among adjacent uses.
- In the Specialty Commercial area, surface parking areas are to be separated from pedestrian walkways and sidewalks by landscaped medians and be planted with shade trees at an approximate ratio of one tree per five spaces. (Tree species with a canopy large enough to cover, at tree maturity, a minimum of 50 percent of each parking surface shall be chosen by the Parks Department.)
- Trees should be set into permeable areas and protected by bollards or tree guards.
- The use of permeable surfaces, or other equally effective means of treating stormwater on all parking areas is required in order to reduce surface runoff.

Cross section and plan view of the proposed 72nd Avenue Main Street. The cross section features a two-way travel lane angled on-street parking, street trees, wide sidewalks and pedestrian weather protection. Rear and underground parking areas, service areas, and vehicular parking ramps are accessed via lanes on all blocks.



4.2.2.4 Front Setbacks and Building Orientation

- With the exception of specialty commercial buildings, all mixed-use commercial buildings shall have front setbacks between zero and 2 metres (6.6 feet) and should incorporate sufficient retail continuity to maintain a viable pedestrian-oriented commercial street.
- With the exception of specialty commercial buildings, all commercial buildings are to have their primary façades address public streets. Shop windows, awnings, canopies, and signage are to enliven the public realm and create an engaging walking environment.
- Commercial buildings on corner lots should include architectural detailing that addresses both streets.
- Outdoor extensions of cafes and restaurants are encouraged where the context is appropriate.

4.2.2.5 Primary Entries

- The entrances of all commercial buildings are to be visible and immediately accessible from the public street. Pedestrian entries should be clearly expressed and be recessed or framed by a sheltering element such as an awning, arcade or portico. In order to provide a continuous walking path and to be high enough to ensure light penetration, arcades should be a minimum of 1.8 metres (6 feet) in width. They should also be well lit at night.
- Commercial building entries should be recessed no more than 2 metres (6 feet) into the principal façade.
- Individual commercial unit entries should be located on the street (and not in a common vestibule).
- Internal public circulation systems, such as shopping malls, are discouraged.
- Residential entries and lobbies are to be separate from commercial entries. The former should have a residential character that distinguishes them from the latter.
- Residential lobbies are to be visible from the street, and their main entries should front onto the street.

Note the separate entry court and stairways to residential units on upper floor units.

4.2.2.6 Pedestrian Access and Bicycle Circulation

- The orientation of the Main Street commercial mixed-use area is distinct from that of other commercial areas. Elements such as angled on-street parking, wide sidewalks, and landscaped boulevards featuring infiltration devices, will contribute to a pedestrian-oriented, village-centre character that favours pedestrian and bicycle movement. For standards and guidelines specific to the bikeways, refer to Section 5.3 of this report.
- Adequate bicycle parking facilities should be provided and are to be accessible from the sidewalk.

4.2.3 Built Form and Materials

4.2.3.1 Massing and Roof Form

- Mixed-use commercial buildings are to be compatible in form and scale with surrounding lower-density residential buildings, especially on lots adjacent to residential areas.
- Changes in massing should relate to the building's structural systems and reflect its interior arrangement of spaces.
- Building configuration and massing are to maximize sun access by terracing the upper levels on the south side.

4.2.3.2 Building Finishes

- Building materials are to reflect the regional heritage, climate, and landscape, and their construction should display a high level of craft. Cladding, particularly on the lower levels, is to be sturdy and appropriate to commercial establishments.

4.2.3.3 Massing and Roof Form

- On upper-storey residential portions in mixed-use and neighbourhood commercial areas, the largest group of windows (or those belonging to the primary living spaces within the building) should be of appropriate residential scale.
- The relationship between the street and ground-floor commercial uses is to be emphasized with display windows, awnings, and/or canopies.

4.2.3.4 Canopies and Signage

- Street-level commercial, office, and retail activities should feature pedestrian weather protection (in the form of awnings or architectural overhangs extending a minimum width of 1.8 metres [6 feet]).
- All weather protection elements are to be designed to facilitate a continuous, architecturally integrated building frontage.
- It is recommended that canopies have a minimum slope of 30 degrees (35 to 45 degree is preferred).
- Fascia signs and window signs are encouraged.
- Sign size, location and information thereon is to be designed and oriented to pedestrians and is to relate to the scale and character of the commercial area.

Angled awnings provide weather protection and identify individual storefronts. Signage should be consistent with a "village centre" character. The image on the far left shows signage incorporated under the awning. The image on the near left shows wooden fascia signs above each commercial entry.

- Materials used for signs should reflect the surrounding character and be compatible to materials used in adjacent buildings.

4.2.4 Environmental Design

4.2.4.1 Noise

- Noise disturbance to residential units as a result of mixed-use commercial components (such as parking, loading exhaust fans, and restaurant entertainment) is to be minimized. Methods to help reduce the level of noise disturbance include: orienting bedrooms away from noise sources, allowing windows to be closed by choice, enclos ing balconies, and using sound deadening construction materials and techniques.

4.2.4.2 Crime Prevention Through Environmental Design

- A high level of safety and a sense of security are important aspects of liveability. Commercial development should provide appropriate safety and natural surveillance measures (such as proper lighting, visual access and security), as per CPTED principles.
  - Residential units above commercial ground-floor units are to instill a feeling of security by providing “eyes on the street.”
  - Public, private, and semi-private areas are to be clearly defined. Public and semi-private spaces are to be designed so as to maximize surveillance.
  - Buildings are to provide maximum opportunity for surveillance of sidewalks, entries, circulation routes, semi-private areas, children’s play areas and parking entrances.
  - Any recessed entries and/or blind corners are to be avoided. It should be possible to see stairwells and halls. Servicing, amenity, and storage rooms are to be grouped together in a visible locale for easy surveillance.
  - Residential lighting in mixed-use commercial areas is to ensure the clear visibility (day and night) of access routes and landscaped areas without excessive lighting levels or glare.
  - Adequate, pedestrian-oriented lighting is to be provided on all streets and in lanes.

4.3 Live / Work – Work / Live Areas

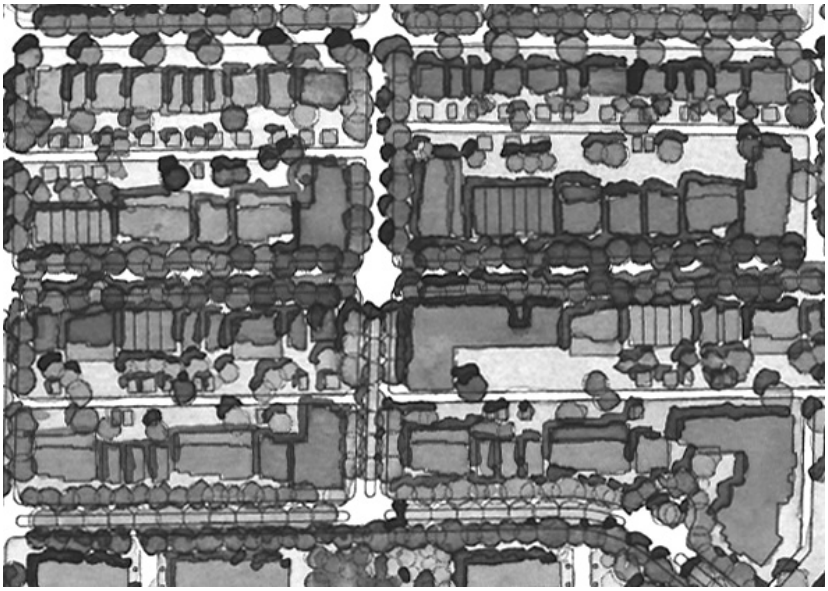
The intent of the Live/Work and Work/Live areas is to provide a transition from the Business Park area into residential areas. This designation permits and encourages the development of a medium-density neighbourhood alongside a wide array of compatible business, wholesale, limited retail, production. The following objectives support the development of a functional, liveable, and safe live/work and work/live environments.

Objectives

- to provide a diversity of housing types and tenures in order to accommodate a wide range of households and family types;
- to provide housing/business accommodation in order to foster the development of small businesses and artisans in Surrey;
- to provide more job opportunities in Surrey, thus reducing work trips to Vancouver and reducing automobile usage;
- to provide an innovative form of affordable housing by allowing home owners to live and work at home;
- to provide the opportunity for home owners to increase their quality of life by eliminating commuting times and, possibly, child care costs;
- to facilitate a transition between residential land-uses and predominantly business/office uses;
- to encourage walking and cycling to local destinations and, thereby, reduce dependence on the car;
- to include on-street parking, street trees, infiltration devices, and sidewalks; and
- to encourage building design that emphasizes the pedestrian realm through compressed front setbacks, pedestrian weather protection, and human-scale detailing.

1. Live/Work Area [1]

The intent of the Live/Work area is to provide a place for people to both live and work at densities between 15 and 25 units per acre. The Live/Work area will provide a transition between the residential areas north of 68th Avenue and the predominantly business/office uses to the south. Flexibility of use will be encouraged at the ground level which will accommodate either residential or business uses associated with a residence.The area is structured around a fine-grained modified grid of streets and lanes, ensuring easy access to local destinations, rear-unit access and storage, street parking, and maximum street frontage of buildings. A vibrant business atmosphere is envisioned along 68th Avenue, with residential uses occupying upper storeys. The difference between live/work use and mixed-use commercial/residential uses is that in the live/work area, the residential use is tied in tenure to the business use.



An average density of 20 units per acre is proposed for the live/work area, shown in this plan view. Buildings accommodate up to 70 percent residential use with up to 30 percent accommodating opportunities for home-based businesses and ground floor office/studio/retail use. Residences associated with ground-floor retail/commercial uses are provided either behind the residential unit or in upper storeys. Sixty-Eighth Avenue is envisioned as pedestrian-oriented street with parking pockets for on-street parking, street trees, and business on the ground-floor.

Image of a live/work streetscape. Limited retail and offices occupy ground-floor units with associated residential units above or behind these spaces. The massing, roof forms, and window proportions reflect a residential character. At the ground level, recessed entries, generous glazing, awnings, and signage animate the streetscape and identify ground-floor uses. On-street parking is used for commerical/office use while street trees and wide sidewalks enhance the pedestrian scale of the street.

[1] Policies and regulatory standards for live/work and work/live area are currently under review.

2. Work/Live Area [2]

The intent of the Work/Live area is to provide a transition to the Business Park area into a mixed-use work/live community. It will encourage the development of a high-density mixed use neighbourhood combining some residential uses with compatible light industrial/office uses at densities between 15 and 25 units per acre. A variety of small-scale services will be encouraged with limited larger offices and commercial uses being permitted in ground-level units, but tied in tenure with the residential component of the unit. The area is structured around a fine-grained modified grid of streets and lanes, ensuring easy access to local destinations, rear unit access and storage and maximum continuous street frontage for buildings.

An average density of 20 units per acre is proposed for the Work/Live area. Up to 70 percent of floor area can be used for office/commercial/light industrial (i.e., high-tech) or other compatible uses. Residences associated with these ground-floor uses are provided either behind the business unit or in upper storeys.

Work/live buildings are to accommodate ground-level retail/commercial/office spaces with residences above. Façades are articulated with a high proportion of windows, both to allow maximum light into each unit and to provide visual access into street level shops and businesses. Materials and massing are to be complementary with the adjacent Business Park while also being compatible in scale and character with the adjoining live/work area.

[2] Policies and regulatory standards for the work/live area are currently under review.

4.3.1 Density and Diversity

The Live/Work and Work/Live areas will accommodate between 15 and 25 units per acre. Live/work and work/live developments will be comprehensively designed. Developers/ builders will be required to achieve at least the average densities in each area.

The distinction between Live/Work and Work/Live is in the amount of the total building given over to either work-related or residential uses. In the Live/Work area, approximately 30 percent of the floor area will be permitted for work-related uses. Examples of allowable work-related uses include independent professional offices; artist/craft studios; and street oriented uses such as grocery, cafe, restaurant, small-scale printing, and desktop publishing. The remaining 70 percent of floor space will be permitted for residential use. Conversely, in the Work/Live area, approximately 70 percent of the floor space will be permitted for work-related uses similar to the Live/Work area although with a greater emphasis on uses that also are compatible with the adjoining Techno-business Park, such as light manufacturing, assembling and finishing, and small-scale wholesale uses.

4.3.1.1 Land-Use Compatibility

The compatibility of live/work and work/live units is of concern when adjacent uses generate noise, vibrations, or odours that could affect liveability in the residential portions of units. All new development within and abutting the live/work and work/live areas may be asked to demonstrate, through a report from a qualified acoustical and/or environmental engineer, either that there are no negative impacts on residential liveability or that they can be mitigated through appropriate design. All projects must be designed comprehensively and the permitted uses must be defined to avoid conflict and to promote symbiotic lane use compatibility.

4.3.2 Relation of Buildings to Streets – Building Footprint Standards

4.3.2.1 Building Coverage

Buildings in Live/Work and Work/Live areas should not cover more than 65 percent of the lot and should achieve as continuous a street frontage as possible (especially in Live/Work development that fronts onto 68th Avenue).

4.3.2.2 Building Height

Buildings in both areas shall be a minimum height of 2 and a half storeys and should not exceed a height of 3 storeys.

4.3.2.3 Orientation

- The massing, setbacks, and orientation of buildings are to reinforce the pedestrian street.
- It is anticipated that residential units will only be provided above the main floor; however, if properly designed to mitigate conflicts concerning liveability and privacy, ground-floor or partial ground-floor units would be considered.
- Physical connection between working and living units is mandatory.

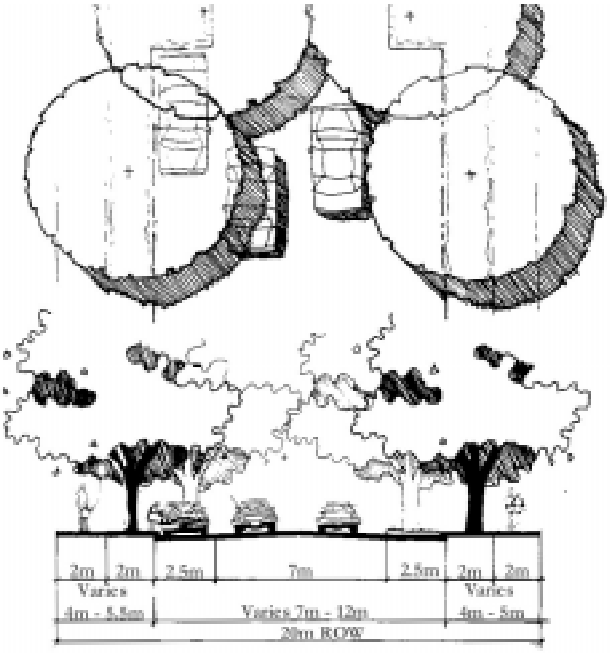
4.3.2.4 Entries and Private Outdoor Space

- Each residential unit should provide some useable outdoor space, in the form of a garden patio or deck, of at least 10m^2 (108 sq. ft.) and with a minimum depth of 1.8 metres (6 feet).
- There is to be direct pedestrian access at the fronting street at or near grade level to each individual business occupancy and/or (in the case of live/work units) a residential unit that abuts the fronting street of the development.
- Upper-floor units can be accessed through a central entry off the public street or through individual entries.

Live/work units are to be accessed from individual entries or through central entries or courtyards off the street as shown in the image at the near right. Parking is accessed via the rear lane, either underground or attached to each unit, as shown in the image at the far right.

4.3.2.4 Parking and Storage

- Parking access to units is to be provided in individual garages at the rears of units, underground, or on the street. Access to garages and underground parking is to be via lanes or side streets.
- On-street parking is a convenience and can improve the pedestrian realm at the street edge by providing a buffer to moving traffic. The amount of adjacent on-street parking should be maximized (especially along 68th Avenue).
- Garbage container storage areas, heating and mechanical equipment, and off-street parking andloading facilities are to be enclosed or screened so as not to be visible from the street.



Conceptual plan and section of the proposed live/work collector along 68th Avenue. Elements include two travel lanes, on-street parking in parking pockets, street trees, and 2 metre (6.6 feet) wide sidewalks.

4.3.3 Built Form and Materials

4.3.3.1 Massing

- Changes in massing should relate to the building's structural systems and to reflect the interior arrangement of space.
- A strong residential character for live/work units is recommended in order to achieve a transition to residential uses to the north.

4.3.3.2 Roof Forms

- Roof forms of live/work buildings should reinforce the overall residential character of the area.
- For sloping roof forms, slopes of a minimum of 8 in 12 are encouraged, with steeper

These live/work units incorporate massing and roof elements characteristic of residential architecture. Ground levels are used for offices, studios and shops with associated living spaces either recessed behind or on upper floors.

roofs preferred on dominant and primary roofs.

- Work/live buildings should incorporate roof forms that are compatible with the primarily commercial/office character of the area.
- Consideration should be given to the roofing materials so as to achieve an appropriate fit with the building's structural massing and roof forms.

4.3.3.3 Weather Protection and Signage

- Street frontages should include canopies or awnings approximately 3 metres (10 feet) above grade and protruding a minimum of 1.5 metres (5 feet) from the building face.
- It is recommended that canopies have a minimum slope of 30 degrees (35 to 45 degree is preferred).
- Fascia signs and window signs are encouraged.
- Sign size, location and information thereon is to be designed and oriented to pedestrians and is to relate to the scale and character of the live/work or work/live area.
- Signage should be integrated into the detailing of the building (and not applied as an afterthought).

4.3.3.4 Windows

- Windows on all ground street-facing façades should cover at least 60 percent of the façade area. Glazing, with high transparency, should be used to encourage visual connections between street/open spaces and building users.
- The treatment of windows should be consistent with the architectural style of the building. On live/work buildings, the scale, placement and trim of windows should reinforce a residential character while allowing visibility and light into street front business and office spaces. Similarly, work/live buildings should have high amounts of glazing, especially at the ground level so as to allow maximum light and visibility into street front offices and commercial spaces.

4.3.3.5 Building Finishes

- Building material should reflect the regional climate and landscape and be compatible with surrounding land uses. For live/work units, buildings should use materials that are compatible with the surrounding residential character. Appropriate materials include wood and vinyl siding, brick masonry, concrete, and stucco. Work/live units should use materials that reflect the surrounding office/light industrial/commercial character while also being sensitive to the adjacent live/work area. Appropriate materials include brick/masonry, stucco, concrete, metal cladding. Where ground floor uses include commercial/business uses, cladding on the lower level should be sturdy and appropriate to the commercial/business establishment.

4.3.4 Environmental Design

4.3.4.1 Climatic response

- All units are to be oriented so that most of the primary living space receives direct sunlight, and they should incorporate terracing, overhangs, and awnings or trellises that allow the low winter sun, but not the high summer sun, to penetrate the unit.

4.3.4.2 Light and Ventilation

- Adequate lighting and ventilation is required for all live/work and work/live units.
- Solar shading and light shelves are recommended, especially on south facing façades, as part of an energy-efficient design that also animates façades.

4.3.4.3 Crime Prevention Through Environmental Design

- A high level of safety and a sense of security are important aspects of liveability. Live/work developments are required to consider the following CPTED principles:
  - Live/work units are to be designed so that areas of the highest daily use address the public street.
  - Adequate lighting is to be provided on streets and in lanes.
  - Functional upper-storey terraces and balconies are to be provided on both the street and lane-facing elevation of dwellings in order to increase safety and "eyes on the street."
  - Public, private, and semi-private areas are to be clearly defined. Public and semi-private spaces are to be designed to maximize surveillance.
  - Buildings are to provide maximum opportunity for surveillance of sidewalks, entries, circulation routes, semi-private areas and parking entrances.
  - Any recessed entries in the rear of buildings and/or blind corners are to be avoided. It should be possible to see into stairwells and halls. Servicing, amenity, and storage rooms are to be grouped together in a visible locale for easy surveillance.

4.3.4.4 Policy and Regulation Review

The City of Surrey Department of Planning and Development, in consultation with the development and design industries, is in the process (as of April, 2000) of preparing policies and guidelines for live/work developments. This policy review is focused upon issues such as design, building code requirements, permitted uses, etc. Information on the status of this review and any new policy development can be obtained from the City of Surrey Department of Planning and Development.

4.4 Techno-Business Park Area

The techno-business park performance standards encourage the development of light industrial, office, consultant, and research uses that are generally compatible with one another and with adjoining residential and/or commercial areas. The standards for the Techno-Business Park area conform to those found in the IB Zone of the Surrey Zoning By-law.

Objectives

- to encourage the creation of a complete, mixed-use community through the integration of industry and commercial business in the business park with other land uses in East Clayton;
- to encourage healthy, safe, and clean business and industry while addressing area character and environmental concerns; and
- to accommodate on-site infiltration of the "six-month storm", through the incorporation of detention and infiltration systems (see Section 5.0 for detailed performance stand ards regarding on-site infiltration/detention measures).

4.4.1 Land-Use Compatibility

- To ensure compatibility between the business park and the adjacent work/live area, all new development may be asked to demonstrate, through a report from a qualified acoustical and/or environmental engineer, either that there are no negative impacts on residential liveability or that they can be mitigated through appropriate design.

4.4.2 Relationship of Buildings to Streets

4.4.2.1 Building Orientation

- The massing, setback, and orientation of the building are to create a positive relationship between industrial buildings and the streets onto which they face, both in order to reinforce the character of the surrounding work/live area, and to enliven the surrounding streets. Ways of achieving this include:
  - facing ground-floor offices and commercial services toward the street and sidewalk with maximum areas of clear glass;
  - achieving a maximum front setback of 9 metres (30 feet);
  - orienting corner buildings so that the façades address both streets with some architectural expression at the corner being appropriate;
  - maintaining a near-continuous street frontage; and
  - screening any large parking areas from the street.

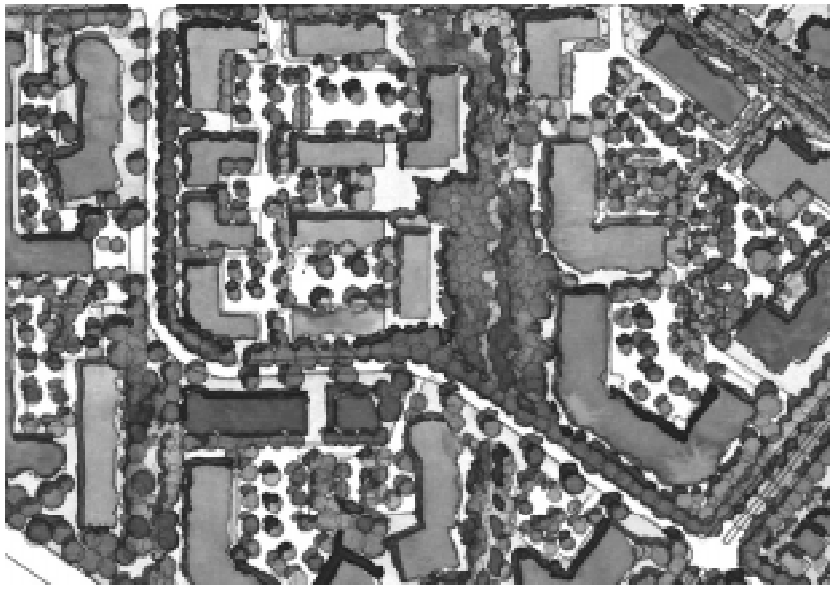
4.4.2.2 Entries and Courtyards

- These are to provide direct pedestrian access, at the fronting street, to the building or ground-level individual rental or strata units. Upper-floor units are to be entered through a central entry lobby off the public street or through individual suite doors provided at grade.

Techno-Business Park

The plan designates approximately 11.97 hectares (29.58 acres) of the south-central portion of the site (between 192nd Street and 188th Street) as a Techno-Business Park area. This designation will provide for advanced technology, research and development industries, and compatible commercial uses that complement these light industrial activities.

Plan view of Techno-business Park area in the southwest quadrant of the site. Front building setbacks of 9 metres (30 feet) provide a landscape buffer area for infiltration and maintain a positive relationship between the building and the street. Rear parking lots are divided into parcels big enough to serve each individual building and to allow adjacent buildings to share space. Each parking area features pervious surface treatment (i.e., porous pavement, pavers) and is generously planted with trees.



This high-tech building features generous glazing, massing that relates to its interior functions, and human-scaled detailing – elements that contribute to a strong street presence. Parking is provided to the side and is shielded from the sidewalk.

4.4.2.3 Parking, Loading, and Storage

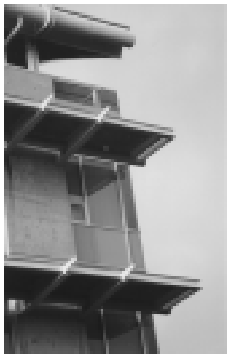
- Parking entries off public streets should be a maximum of 8 metres (26 feet) wide in order to reduce visual impact. The entries to the parking and loading areas are also to be located so as to reduce the visual impact on the street.
- The use of large, impermeable parking surfaces is to be avoided. Surface parking lots are to be planted with shade trees at an approximate ratio of one tree for every five spaces. (Tree species with a canopy large enough to cover, at tree maturity, a minimum of 50 percent of each parking surface shall be chosen in consultation with the Parks Department.)
- Trees planted in parking areas should be protected by bollards or other barriers.
- In surface parking areas, the use of permeable paving is required in order to reduce surface runoff.
- Garbage container storage areas as well as heating and mechanical equipment are to be enclosed, located, or screened so as not to be visible.

4.4.3 Built Form and Materials

4.4.3.1 Massing and Articulation

- A single dominant building mass is to be avoided. Variations in massing are to include changes in height and horizontal plane. Changes in massing are to relate to the building's structural systems and to reflect the interior arrangement of space.
- Glazing is encouraged on all street-facing façades so as to create visual connections between street/open spaces and building users.
- All sidewalks adjacent to retail and office uses are to be provided with rain protection.

Near right: Landscaped setbacks and unit pavers maximize infiltration and define the building entry. The glass awning provides weather protection and allows light into the foyer.
Far right: Light shelves provide shade to south facing offices and animate the facade.



4.4.3.2 Exterior finishes

- Building material is to reflect the regional climate and landscape and to express an urban industrial aesthetic while being compatible with the character of the surrounding residential neighbourhoods.
- Recommended exterior finishes include masonry, concrete, stucco, glass, and steel.

4.4.4 Environmental Design

4.4.4.1 Rain Protection and Signage

- Building entries should include canopies or rain protection that are approximately 3 metres (10 feet) above grade and that protrude no more than 2.5 metres (8.2 feet) from the building.
- Building entrances should be articulated with recesses, awnings and/or canopies, and signs that are appropriate to the architectural language and material expression of the building. Clear glass and metal are considered appropriate materials.
- Entries of buildings should be highly visible, clear glazed, and easily recognized from the street.

4.4.4.2 Climatic Response, Light and Ventilation

- As much as possible, all offices are to be oriented so that a maximum amount of workspace receives direct sunlight, and they are to incorporate terracing, overhangs, awnings or trellises that allow the low winter sun, but not the high summer sun, to penetrate the space.
- Landscaped courtyards are encouraged in order to provide sufficient light and ventilation into large floor plates. All courtyards should include trees and have unit pavers to ensure infiltration on all hard surfaces.
- Solar shading and light shelves are recommended, especially on south facing facades, as part of an energy-efficient design and as a means of animating façades.

4.4.4.3 Crime Prevention Through Environmental Design

- Consider appropriate safety and natural surveillance measures (such as lighting design and visual access/surveillance) as per CPTED principles.
  - Sidewalks/walkways with the appropriate lighting and low landscaping are to be provided between parking areas and building entries.
  - Any recessed entries and/or blind corners are to be avoided. It should be possible to see into stairwells and halls.
  - Servicing, amenity, and storage rooms are to be grouped together in a visible locale for easy surveillance.
  - Buildings should maximize opportunities for surveillance of sidewalks, entries, circulation routes, and parking areas.

5.0 ECOLOGICAL INFRASTRUCTURE PERFORMANCE STANDARDS AND GUIDELINES

The green infrastructure performance standards and guidelines suggest the necessary minimum levels of performance for maintaining and potentially enhancing natural drainage systems in East Clayton. This section describes how the principles of infiltration best management practices (BMPs), urban forestry, and soil preservation should be applied to building sites, streets, and public green spaces.

Objectives

- to reduce immediate as well as life cycle costs of the storm drainage system;
- to protect and enhance the environment;
- to increase access to, and variety of, recreational opportunities;
- to protect habitat, especially fish habitat;
- to maintain stream hydrology and stream water quality;
- to eliminate the need for removing any soil from the site; and
- to enhance community value, quality, and appeal.

5.1 Building Sites – Performance Objectives

- All lots are to be constructed so as to minimize impervious surfaces.
- For areas with gross residential densities of equal to or less than 20 dwelling units per acre, no more than 45 percent of the site is to be covered with impermeable surfaces (roofs and impermeable pavement). Remaining permeable areas are to accept roof runoff, patio runoff, and so on; they are to be equipped with infiltration devices (or infiltration grading) capable of enhancing the infiltration capacity of the site, which is to function as though it had no impermeable surfaces and as though it were vegetated and uncompacted.
- The Business Park area, Specialty Commercial area, and the 196th Street Mixed-use Commercial area are to accommodate the rainfall from the 6 month storm through the incorporation of detention and infiltration systems. (See ***Figure 5.1.3*** and Section 5.3.1.1 in addition to Section 6.0 for details).
- All surface parking areas (e.g., Specialty Commercial and Techno-business Park), shall be planted with trees at a minimum of one tree per every 5 spaces. Tree species with a canopy large enough to cover, at tree maturity, a minimum of 50 percent of each parking surface shall be chosen by the Parks Department.
- Performance thresholds for sites are, therefore, 24 millimetres (0.9 inches) per day, on average, during winter conditions, times the total area of the parcel.

5.1.1. Infiltration Best Management Practices for Building Sites

- Infiltration enhancements can be accomplished via infiltration pits of various designs and configuration.
- In most cases infiltration pits should be located at front, rear, or side property lines and as far from building foundations as is practical so that there is at least one metre (3 feet) of undisturbed parent material between infiltration pits and foundation excavation. Infiltration pits should be filled with three-quarter-inch crushed rock or prefabricated infiltrators.

- Grass filter strips and elevated yard drain inlets are to be used to prevent siltation. Observation pipes must be installed in each pit/trench. Roof drains are to discharge into lawn or planted areas rather than directly into infiltration devices to allow silts and organic matter emanating from the roof to be absorbed by surface vegetation.
- In general, infiltration devices are to be designed to ensure at least 30 years of trouble-free operation under normal use. Siltation is the most common reason for infiltration device failure; consequently extreme care is to be exercised in designing and installing systems.The Engineering Department will inspect and approve all construction specifications for infiltration devices and will observe their installation. In certain instances infiltration objectives may be met not by installing infiltration pits, but by careful yard grading and installating of deeply mulched planting areas. Plants should be chosen for their water tolerance.

5.1.2. Urban Forestry on Building Sites

- Residential yards are an important element in the urban forestry strategy for East Clayton. In the permeable areas of the lot, locations should be found for shade trees so that, when mature, their canopy will cover at least 40 percent of the lot. Trees will generally be of the "medium-sized" variety, capable of achieving approximately 12 metres (40 feet) in height, and a comparable breadth, at maturity. A list of suggested native species is available from the Surrey Parks, Recreation and Culture Department.
- Trees are to be located at least 3 metres (10 feet) from the outside edge of infiltration devices. Trees should be at least 3 inches (7.62 centimetres) diamtere at breast height (d.b.h.) when installed, and they should be thriving one year after planting.

5.1.3 Soil Preservation on Building Sites

- Site topsoil is to be carefully stockpiled for later redistribution on the site. In no cases should topsoil be removed from the site. Stockpiled topsoil is to be examined by the Engineering Department to ensure that there is no loss or removal of this resource. In general, on sites developed for residential use at densities at or lower than 25 units per acre, the area available for re-spreading this topsoil will be approximately 50 percent of the area of the site prior to development. Consequently, topsoil depths in the finished site will be up to twice what they were originally.
- Topsoil depth in East Clayton is generally thin, often less than 0.5 metre (1.6 feet). Where topsoil depth is greater than 0.5 metre, at least the first 0.5 metre of topsoil should be stockpiled for later distribution over the areas intended for permeable surfaces. This requirement ensures that the thin soils of the Clayton area are re-used to their maximum advantage and that topsoil will not be permanently removed from the site. In short, yards and boulevards must absorb more water and provide a better medium for tree growth when development projects are completed than they do at present.
- Care must be exercised in grading the site and setting finished floor elevations.This site development method will make it difficult (and in many cases impossible) to retain existing trees. In these cases the need to ensure the adequate hydrological and urban forestry performance of the site after development will take priority.
- Proper aeration of returned topsoil is crucial. Topsoil areas are to be checked for depth and aeration prior to the granting of an occupancy permit by the Surrey Engineering Building Departments. Soil amendments may also be required. Pre-existing vegetation may need to be ground up and added to the soil to improve its aeration and humus

content. If this process leaves soil that is still too thin for healthy tree growth and water infiltration, then additional soil amendments will be called for.

- In keeping with its regulations, the Surrey Parks Department will review and approve soil tests and any proposed amendment strategy. It will also inspect construction sites to ensure compliance.

5.1.4 Foundation Drains

- Foundations can be drained in three basic ways. Acceptable devices include electric sump pumps that can be run from municipal water pressure in the event of electric power failure (these pumps should discharge into yards in the same manner as downspouts); drain pipes that discharge into street-side infiltration devices, street-side swales, or lanes; and a street "storm-drain" system that connects into the district system of infiltration wells or retention ponds.
- A foundation drain strategy can be chosen, as cost and site constraints dictate, by the developer (with the approval of the City Engineer).

5.2 Streets – Performance Objectives

- All residential lots are to be constructed to maximize the retention of permeable surfaces.
- Generally, street rights-of-ways are to be no more than 50 percent impermeable surfaces. Remaining permeable areas are to accept runoff from paved areas and are to be equipped with infiltration devices capable of enhancing the infiltration capacity, so that, under average precipitation conditions, the site will perform as though it had no impermeable surfaces and as though it were vegetated and uncompacted.
- Infiltration performance threshold for streets would, therefore, be 24 millimetres (0.9 inches) per day, on average, during winter conditions, times the total area of the right of-way.

5.2.1 Infiltration Best Management Practices (BMPs) for Streets

- In most cases infiltration devices will be located on one side of local streets. In certain cases, infiltration devices will be located on both sides of collector streets and arterials. Refer to Section 8.0 for more detailed street design information. Grass filter strips and elevated drain inlets, or other similar devices approved by the Surrey Engineering Department, must be used to prevent siltation. Observation pipes must be installed in each device.
- In general, infiltration devices are to be designed to insure at least 30 years of trouble free operation under normal use. Siltation is the most common reason for infiltration device failure; consequently, extreme care should be exercised in designing these systems. Approved filter fabric must be used to line rock-filled trenches. The Surrey Engineering Department will inspect and approve all construction specifications for infiltration devices and will observe their installation. In certain instances infiltration objectives may be met in part or in whole by using permeable pavement with an infiltration capacity equal to or exceeding 24 millimetres (0.9 inches) per day during winter conditions.
- Certain portions of East Clayton are suitable for deep well infiltration thereby allowing for aquifer recharge. These systems are capable of handling a five-year storm. Details of these areas and design parameters for deep well infiltrators can be found in Section

6.0 of this report. Specific system design is to be managed on a development-by development basis under the direction of the Surrey Engineering Department.

- Subsurface conveyance systems are required to deliver water in excess of 24 millimetres (0.9 inches) per day during winter conditions up to the five-year storm amount. A typical device is a shallow perforated pipe located near the top of street-side infiltration devices. Such pipes connect all infiltration devices on the street and deliver water to secondary retention and treatment ponds/artificial wetlands that, in most cases, are located on public lands. Storms in excess of the five-year event are conveyed over the surface, via the right-of-way to the aforementioned treatment ponds/artificial wetlands.
- Curbs that prevent the free flow of water from paved surfaces to grass boulevards are not allowed. On curbless streets, the spaces between pavement edge and turf boulevard must allow for the free flow of water. Soil level at pavement edge must be between two and three inches below pavement level in order to prevent water damming by the turf.
- Bollards, or other devices for discouraging parking on turf, are required. Suggested devices include concrete or natural stone "bollards" or occasional barriers located approximately every 3 metres (10 feet). These devices are not to impede pedestrian movement from sidewalk to street, nor are they to interfere with car doors.
- Modified rolled curb edges with water inlets located at no more than 1.5 metres (5 feet) intervals may also be allowed.

5.2.3 Urban Forestry on Street Rights-of-ways

- Streets are an important element in the urban forestry strategy for East Clayton. Locations are to be found in the permeable areas of the right of way for shade trees. When mature, the canopy of these trees will cover at least 60 percent of the street. Trees will generally be of the "medium-sized" variety, capable of achieving a height of approximately 12 metres (40 feet), and a comparable breadth, at maturity. (A list of suggested species is available from the City of Surrey Parks, Recreation and Culture Department.
- The Surrey Parks, Recreation and Culture Department should be consulted with regard to tree spacing and species variety. Trees are to be located such that the infiltration device does not cause detrimental impact to the tree roots. Paved sidewalks within 3 metres (10 feet) of a tree trunk should be underlain with structural soil to avoid sidewalk heaving. Trees should be at least 7.6 centimetres (3 inches) diameter at breast height when installed and should be thriving one year after planting (see ***Figures 5.2.3.1– 5.2.3.4***).

5.2.4 Soil Preservation on Street Rights-of-Ways

- Site topsoil must be carefully stockpiled for later redistribution on the right-of-way. In no cases should topsoil be removed from the site. The Surrey engineering department will examine stockpiled topsoil to ensure there is no loss of this resource. Generally, the area available in street rights-of-way for re-spreading this topsoil will be approximately 50 percent of the area of the right of way prior to development. Consequently, topsoil depths in the finished site will be up to twice what they were originally.
- Topsoil depth in East Clayton is generally thin, often less than 0.5 metre (1.6 feet). Topsoil excavated for replacement by structural gravel is to be stockpiled on the site for

Figure 5.2.3.1 Local Residential Road

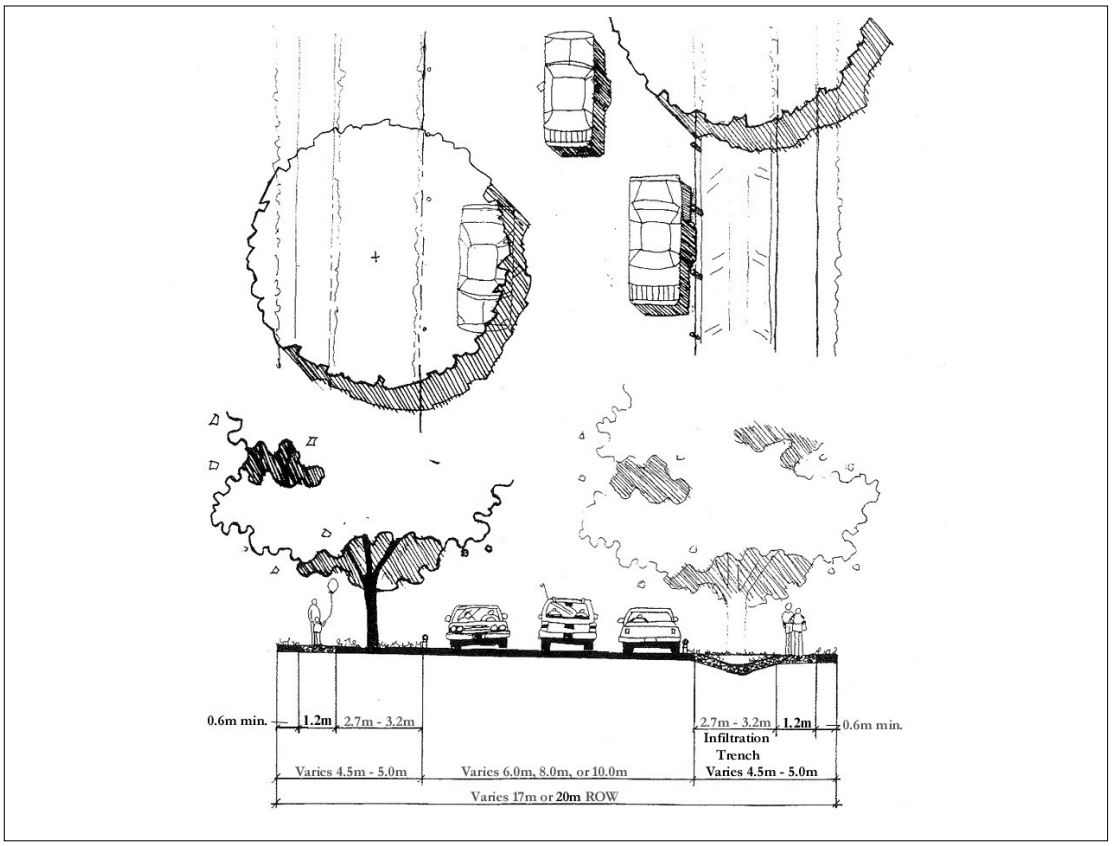


Figure 5.2.3.2 Residential Collector

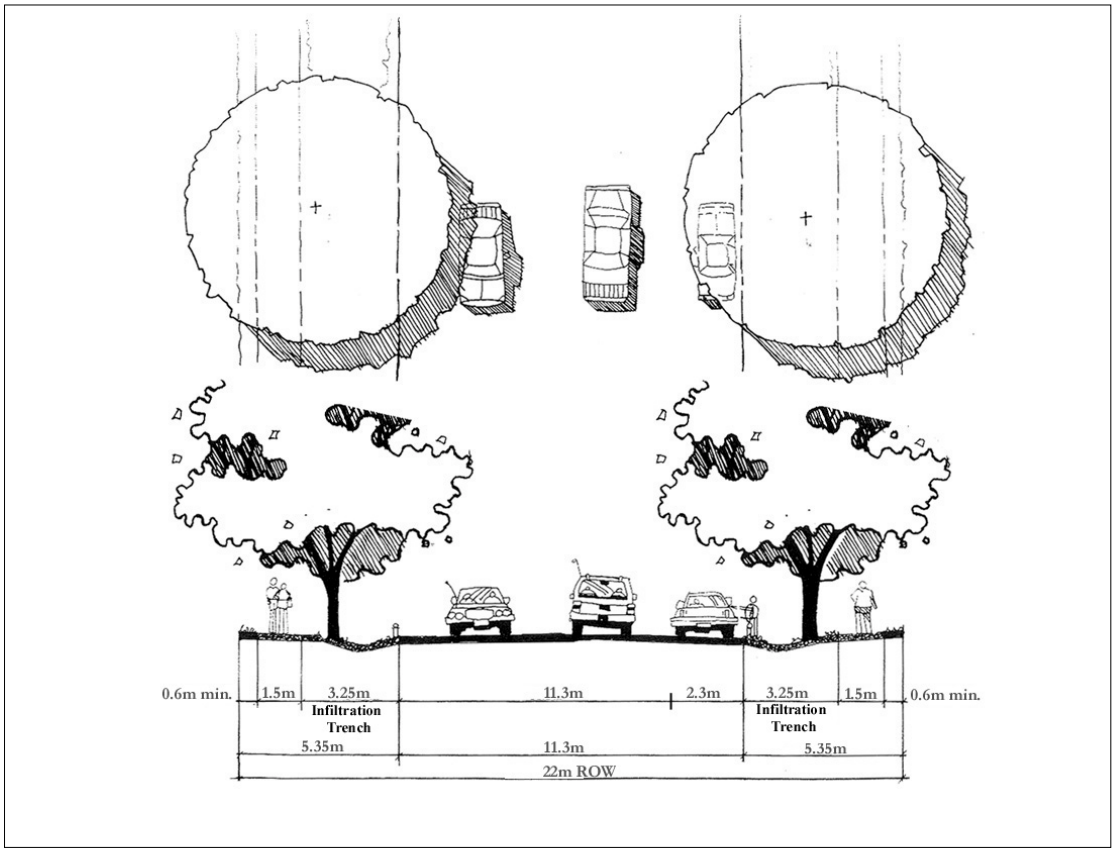


Figure 5.2.3.3 Green Arterial

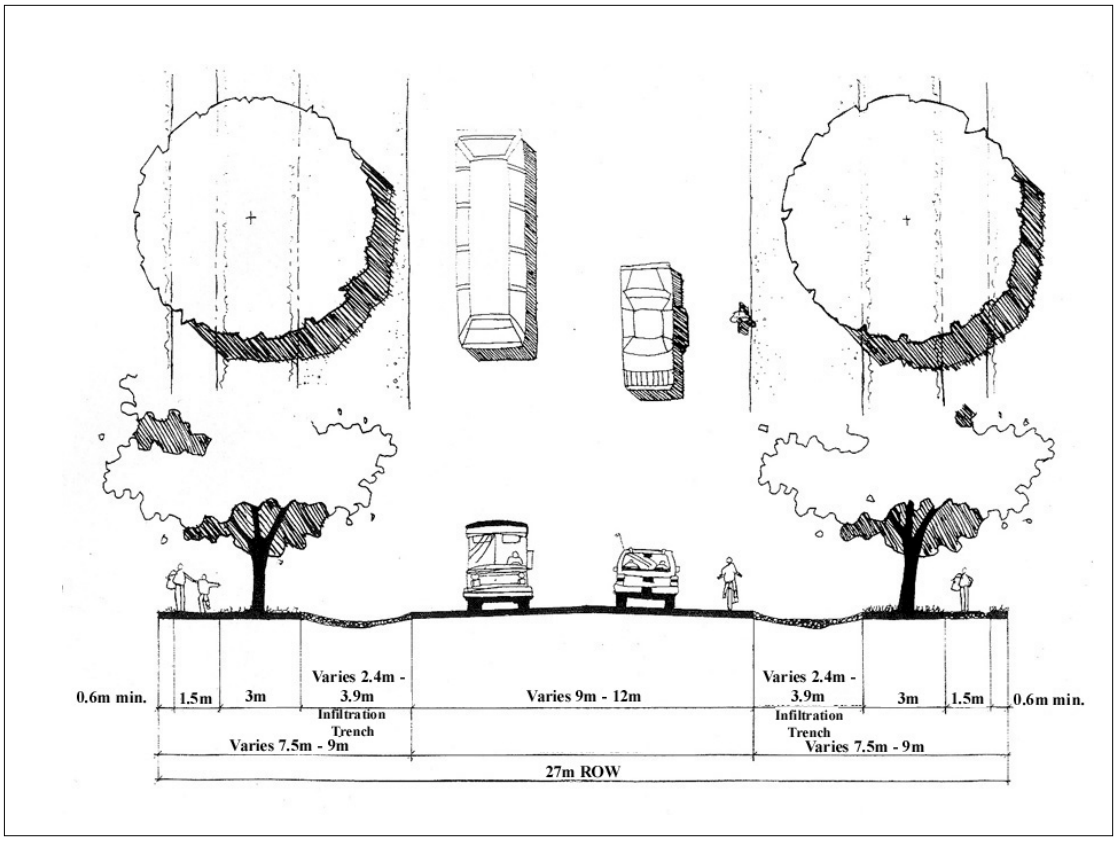
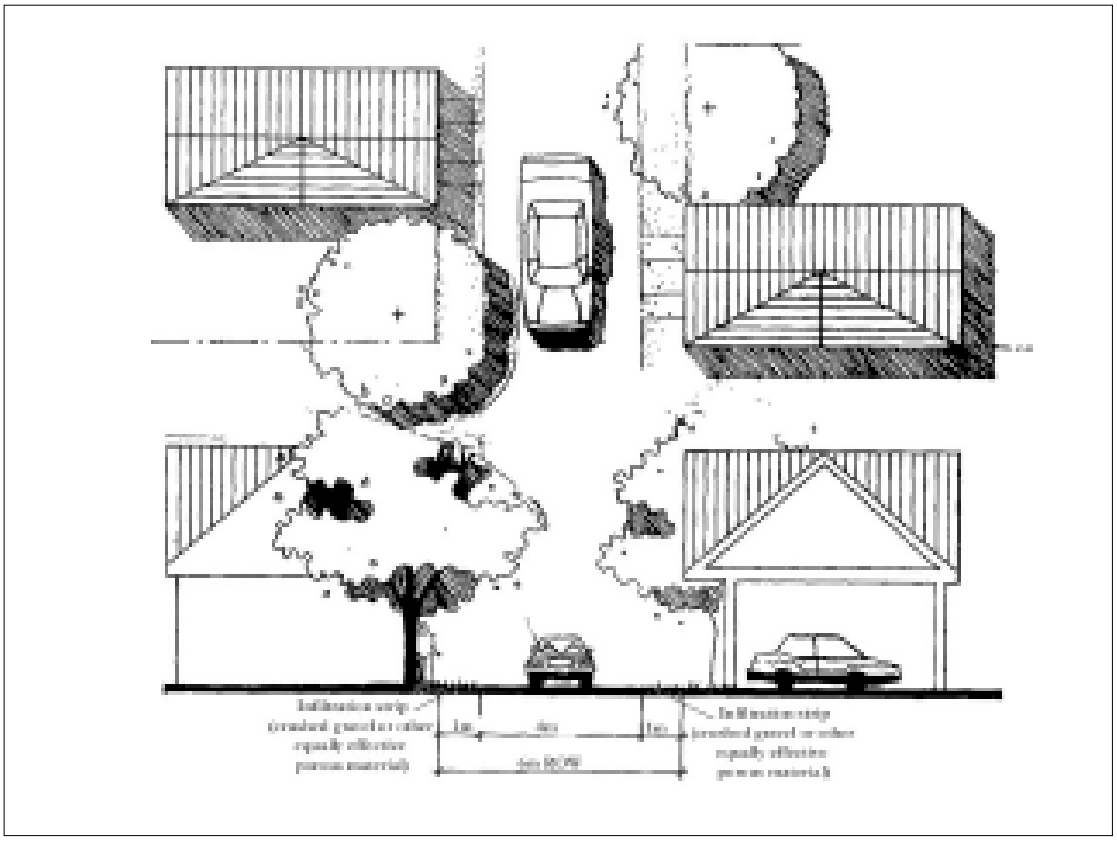


Figure 5.2.3.4 Residential Lane



later distribution over the areas of the right-of-way intended for permeable surfaces (i.e., boulevards).

- Care must be exercised in grading the site and setting final street grades to ensure that this happens. This site development method will make it difficult (and in many cases impossible) to retain existing trees. In these cases the need to ensure that adequate hydrological and urban forestry performance of the site after development will take priority.
- Proper aeration of returned topsoil is crucial. Topsoil areas will be checked for depth and aeration prior to the granting of an occupancy permit by Surrey Engineering/Building Department. Pre-existing vegetation on the site may need to be ground up and added to the soil to improve aeration and humus content. If this process still leaves soil unsuitable, then additional soil amendments will be called for.The Surrey Parks Department will review soil tests and proposed amendment strategy.

5.3 Public and Natural Areas

These guidelines are applicable to the various components of the public green space network that extends throughout East Clayton. ***Table 5.3.1*** indicates the areas allocated, and ***Figure 5.3.1*** shows the location of various components of the network. The network serves both ecological and social purposes by supporting the surface drainage system, providing sufficient avian and aquatic habitat, maintaining base flows in streams, and providing areas for both passive and active recreation.

Table 5.3. 1 Public and Natural Areas

Public and Natural Areas	Ha.	Acres
School/Park Sites	9.53	23.54
Storm Water Pond (Public property)	4.48	11.05
Storm Water Pond (Private property)	1.14	2.81
Riparian Protection Area	6.70	16.55
Parks and Linear Open Space	14.45	35.71
Private lawns along arterials (buffers)	0.86	2.12
Natural Area (adjacent to Riparian Greenway)	1.84	4.54
Utility Open Space	0.64	1.58
Total	**39.64**	**97.9**

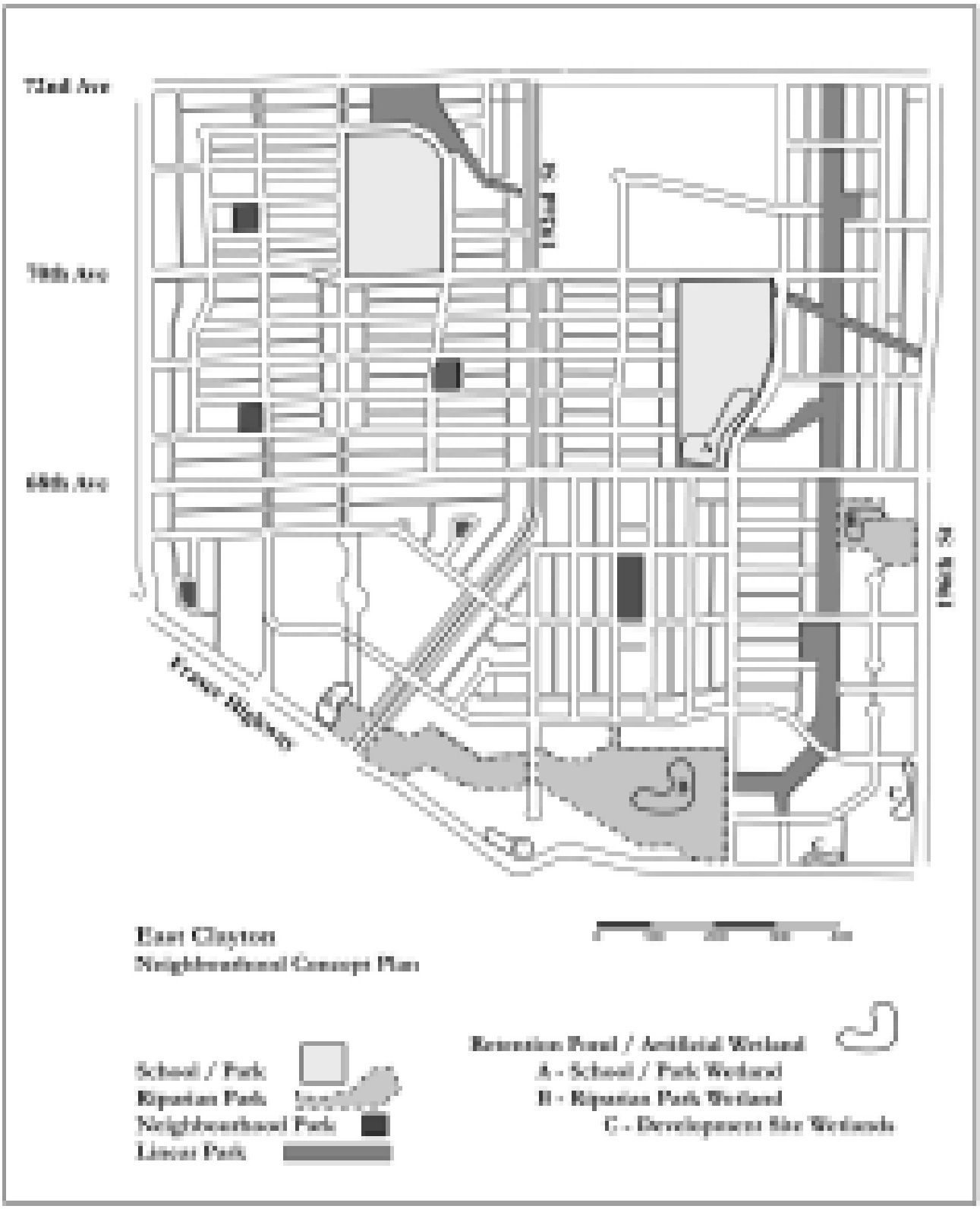
5.3.1 School/Park Sites

The plan proposes 9.53 hectares (23.54 acres) of combined park and school sites. Each of the sites is to serve the recreation and educational needs of the community. Areas of forest cover, combined with a naturalized wetland/retention pond on the eastern school/park site, are to provide infiltration for surface water and bird habitat. The Surrey Parks Department will manage and oversee construction and maintenance of the school/park sites.

5.3.1.1 Infiltration Best Management Practices (BMPs) and Wetlands

- All impervious surfaces (i.e., multi-use paths, streets, parking lots) are to drain into permeable areas and/or on-site infiltration devices.
- All permeable surfaces on park/school sites are required to infiltrate at rates not less than 36 millimteres (1.4 inches) per day during winter conditions.
- Where required, infiltration BMPs and soil preservation measures (as per sections 5.2.1 and 5.2.3) are to be applied in order to achieve prescribed infiltration rates.

Figure 5.3.1 Parks



The wetland proposed for the schoolground in the northeastern quadrant of the site is intended as a retention and biofiltration area for surface water. The wetland is to incorporate a naturalized edge with native wetland plants and to provide small islands and protected areas for bird habitat.

- The centre depth is to be no greater than 1 metre (3.3 feet) with peripheral areas accepting the five-year storm and remaining marginally wet. The 100-year storm will flood adjacent sports fields up to a maximum depth of 1 metre (3.3 feet).
- All such work is to comply with existing Surrey Parks, Recreation, and Culture Department construction and maintenance standards and guidelines and be inspected by the Surrey Engineering Department and Ministry of Environment, Lands and Parks staff. All detained water is to be discharged into streams only as per Department of Fisheries and Oceans and Ministry of Environment, Lands and Parks regulations.

5.3.1.2 Urban Forestry

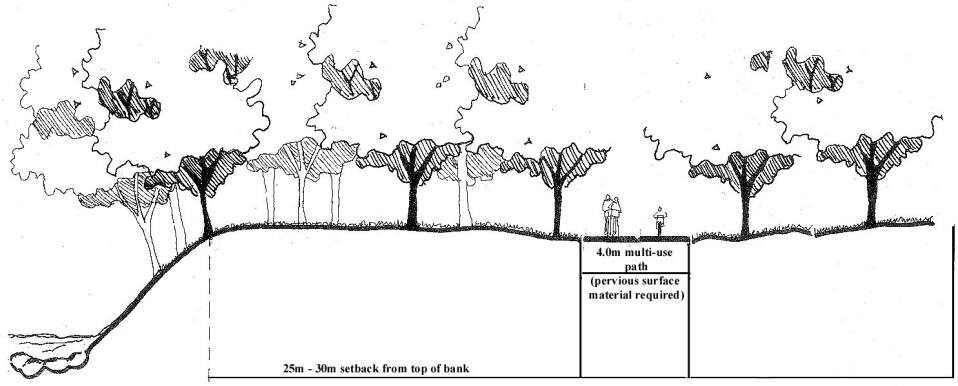
- At least 40 percent of school/park sites are to be covered by canopy at tree maturity.
- Areas that are not required for playfields shall have up to 50 percent habitat value in order to replace habitat lost to construction. There is to be a particular emphasis on avian habitat.

5.3.2 Riparian Parks

Riparian parks have considerable ecological and recreational value. Their use is to be restricted to passive recreation and is to incorporate multi-use pathways outside the prescribed leave areas. As per Ministry of Environment Land Development Guidelines and the Provincial Fish Protection Act Streamside Protection Directive, appropriate leave areas are determined according to the presence or absense and/or condition of riparian habitat. For example, where 30 metres (100 feet) of riparian vegetation exists (or the potential for vegetation to be established exists) the streamside protection area (leave-area) is 30 metres (100 feet) wide as measured from top-of-bank. This leave area provides for a number of biophysical and geotechnical features and functions, including: providing continuous tree canopy for shade and leaf litter; preventing understory vegetation removal in order to ensure soil binding and, thus, preventing soil erosion and stream sedimentation; and maximizing smaller understory species, which provide leaf litter and insect drop/drift to the stream, which are prefered fish food. In addition, snags or dead trees within the leave area can become large organic debris in streams, thereby providing the instream complexity needed by juvenile salmon as well as critcal habitat for cavity-nesting birds and many small mammmals.

5.3.2.1 Performance Objectives

- The leave areas are “leave-alone areas,” and the objective is conservation rather than multiple-use.
- No vegetation is to be removed from leave areas. This includes understory and ground cover, which provide many important geotechnical as well as biological functions.
- Access corridors are not to be aligned within leave areas that are 30 metres (100 feet) or less in width.
- Any access corridors that would necessitate removal of vegetation or soil disturbance for trail construction in a leave area are either to be discouraged or to be limited to the outer 5 meters (16 feet) of the leave area. In a 30 metre (100 feet) leave area this would put the corridor no closer than 25 metres (82 feet) from top-of-bank.
- Access corridors in or around sensitive aquatic areas are to be designed as narrow, low-impact walkways (maximum width of 1.5 metres [5 feet]) with natural substrate or



Left: **Riparian Park Greenway. Note 25-30 m setback from top of bank.**

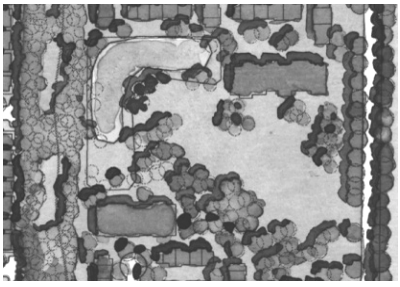
crushed gravel surfaces to encourage infiltration (asphalt, compacted clay, or bark mulch are not permitted). Access corridors within the leave areas are not to be designed to accommodate vehicles (including wheelchairs and bicycles). Hard surface multi-use paths outside the leave area can accommodate vehicles (i.e., wheelchairs and bicycles) and are to be a maximum of 4 metres (13 feet).

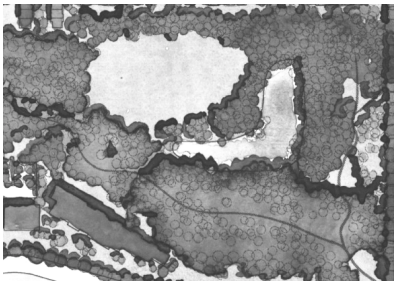
- Where it can be accommodated by meandering through existing vegetation or by removing limited vegetation and disturbing very little of the surface soils a narrow footpath (maximum width 1.2 metres [4 feet]) could be used either to connect the corridor on one side of the leave area to a particular site of interest within the leave area or to transect the leave area altogether. Such footpaths should be aligned at right angles to the stream so that it limits the length of the incursion within the leave area. So as to avoid wetted or erodible areas or areas supporting unique or sensitive vegetation the locations for these penetrating footpaths are to be developed following a thorough assessment of the area. Alternatively, these narrow access footpaths should be elevated above the forest floor (i.e., on boardwalks), with associated signage explaining the biological values of these areas.

5.3.2.2 Artificial Wetlands/Retention Ponds

The Land-Use Plan proposes situating two artificial wetlands adjacent to riparian park areas: the first is to be located near the headwaters of McClellan Creek, and the second is to be located just north of the North Cloverdale Stream riparian zone.

- Retention ponds shall be located outside the leave areas.
- The stormwater management ponds are to be designed to limit flows to the creeks to existing rates for 2-year through to the 100-year return period storms.
- Where required, infiltration BMPs and soil preservation measures, as per Sections 5.2.1 and 5.2.3, are to be applied so as to achieve prescribed infiltration rates.
- All work is to comply with existing Surrey Parks, Recreation and Culture Department





Left. **Constructed wetlands along the Dedicated and Riparian Greenways. Designed with a naturalized edge and native riparian plants, these ponds will be natural filters for runoff, provide habitat for birds, and enhance the aesthetic quality of the landscape.**

construction and maintenance standards and guidelines, and it is to be inspected by the Surrey Engineering Department and the Ministry of Environment, Lands and Parks staff.
- The centre depth of the retention pond/artificial wetland is to be no greater than 1 metre (3.3 feet) with peripheral areas accepting the five-year storm and remaining marginally wet. The 100-year storm will flood adjacent sports fields up to a maximum depth of 1 metre (3.3 feet).
- Ponds should be designed for maximum practical water retention to further improve water quality. The design must also reduce possible temperature impact.
- The wetlands are to incorporate a naturalized edge with native wetland plants and to provide small islands and protected areas for bird habitat.
- All detained water is to be discharged into streams at discharge rates and of a quality that conforms with Department of Fisheries and Oceans and Ministry of Environment, Lands an Parks regulations.

5.3.2.3 Urban Forestry

- All existing forested areas are to be maintained for infiltration (i.e., the understory and natural mulching of the forest is to be preserved).
- All riparian setbacks (up to 30 metres [100 feet]) or as much as possible given natural species composition, shall be maintained as large woody vegetation (preferably large trees that with overstory for angular canopy cover).
- Each riparian area is to accommodate open clearings for recreation outside the prescribed leave area. This area will be available for holding flood waters for the 100-year storm up to a maximum depth of 1 metre (3.3 feet.).
- The Surrey Parks Department, in co-operation with the Surrey Engineering Department, is to manage and oversee the construction and maintenance of riparian parks.

5.3.3 Neighbourhood Parks

5.3.3.1 Infiltration

- All impermeable surfaces (i.e., multi-use paths, streets) are to drain into permeable areas and/or on-site infiltration devices.
- All permeable surfaces are required to infiltrate at rates of not less than 36 millimetres (1.4 inches) per day during winter conditions.
- Where required, infiltration BMPs and soil preservation measures, as per Sections 5.2.1 and 5.2.3, are to be applied in order to achieve prescribed infiltration rates.
- Neighbourhood parks are to accept and to manage drainage from surrounding street surfaces, and, in certain instances, they are to provide locations for deep well infiltrators.
- Pathways and sidewalks around the periphery of parks are to drain into permeable areas and or into infiltration devices.

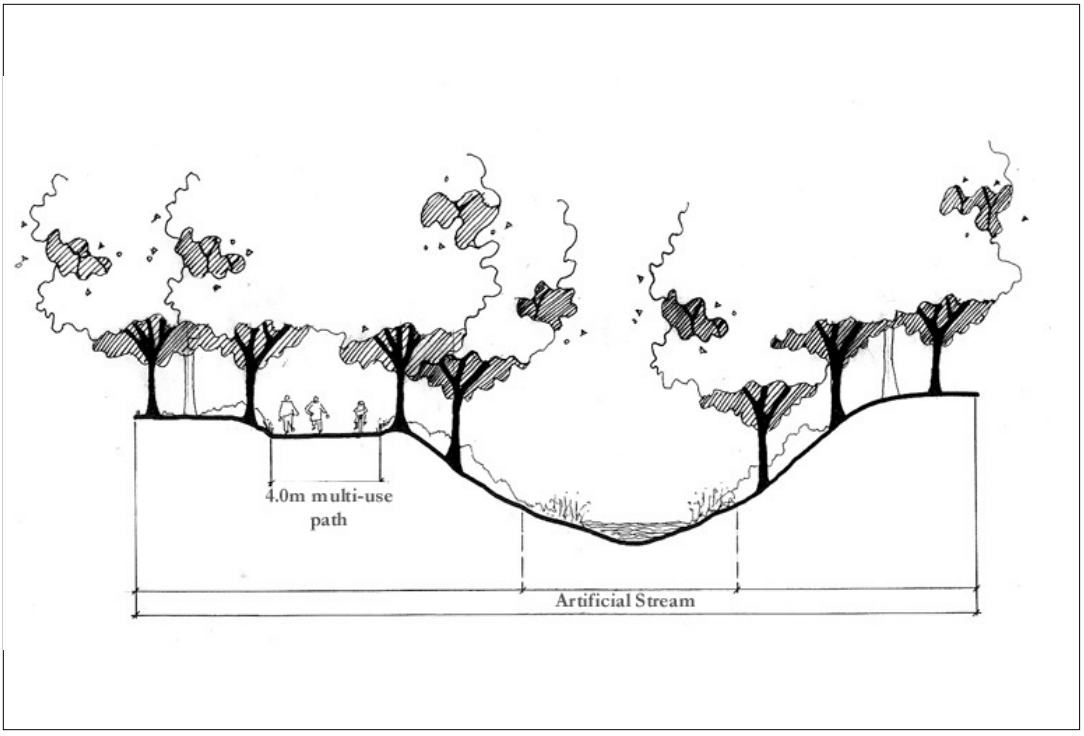
5.3.3.2 Urban Forestry

- At least 30 percent of neighbourhood parks are to be covered by canopy at tree maturity, thus ensuring that a strong vegetated edge surrounds an open interior space.
- The Surrey Parks Department is to manage and oversee the construction and maintenance of all public parks.

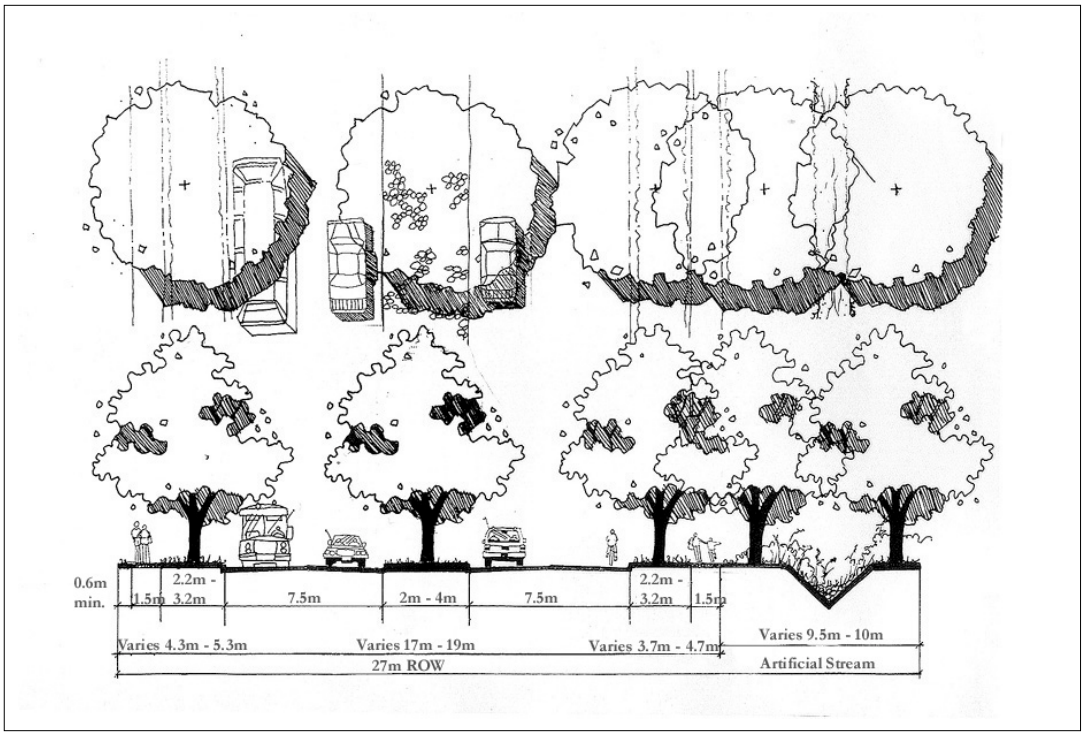
5.3.4 Greenways and Bicycle Routes

The East Clayton greenway system is a series of multi-use corridors that are to connect areas of public and

Below: **Dedicated Greenway. Note how the constructed drainage channel becomes a natural amenity.**



Below: **Riparian Parkway Greenway. An artificial stream located in boulevard, provides habitat and biofiltration of surface water.**



natural space with mixed-use and residential neighbourhoods. A key component of green infrastructure is that the proposed system is to be designed to encourage alternatives to automobile travel and to provide opportunities for passive recreational use throughout East Clayton. Ultimately, this system will link the community to the Greater Surrey greenway system. The greenway network has been classified with regard to local function and appears in ***Figure 5.3.2***.

(Note: The term "greenway" refers to a recreational and travel corridor [for pedestrians, wheelchair users, cyclists, etc.] that links natural and urban areas. "Path", or "Pathways", refers to the paved or gravel surface that is located within the greenway and that is used for walking and/or biking.)

5.3.4.1 Pedestrian and Bicycle Routes

Pedestrian and bicycle routes are to be integrated within the greenway system. This pertains to areas within the dedicated greenway (along 70th Avenue and the north-south greenway corridor), as well as within appropriate distances of riparian areas, as defined by the Ministry of Environment, Lands and Parks regulations and the Provincial Fish Protection Act Streamside Protection Directive or the Ministry of Environment Land Development Guidelines as the case may be (see Section 5.3.2.1). ***Figure 5.3.3*** shows the alignment of core and secondary bike routes as well as multi-use pathways.

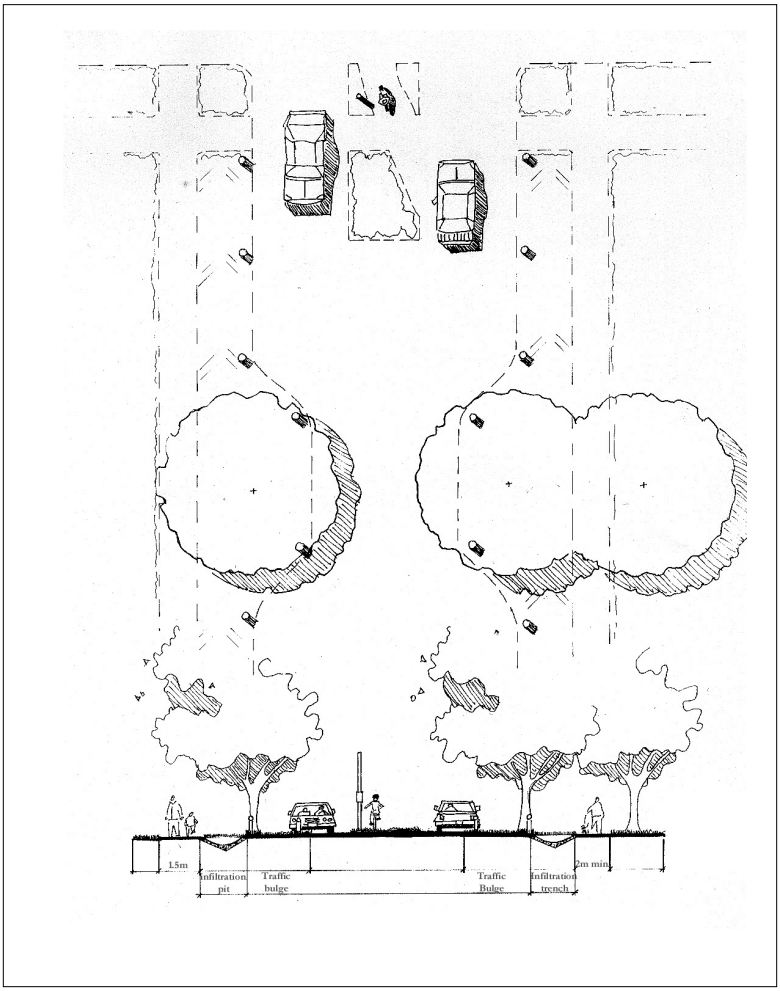
- The width of all multi-use pathways within the dedicated greenway corridor and the riparian greenway corridor is to be at least 3 metres (10 feet) and preferably 4 metres (13 feet). This width is required to accommodate various potential users (walkers, wheelchairs, cyclists, joggers), and will allow emergency and maintenance vehicle access. Multi-use pathways may meander within the total width of the multi-use corridor without compromising safety and function.
- On greenways along roadways (i.e., the 70th Avenue greenway), pedestrian-only pathways will be no less than 2.0 metres (6.6 feet) wide.
- All roadway intersections along greenways are to be designed to accommodate pedestrian and bicycle traffic and may include controlled signal lights; curb bulges to calm traffic and ensure safe crossings; trees, landscaping and pavement treatment to enhance appeal and to assist in groundwater infiltration.

5.3.4.2 Dedicated Greenway

The dedicated greenway runs in a north-south direction parallel to 194th and 196th Streets. It will have a 40 metre (130 feet) minimum design width and will be designed in a "park-like" way appropriate to its condition as the "front door" for hundreds of new dwelling units. Notwithstanding the above, 50 percent of the greenway will have habitat value and will be designed to hold, clean, oxygenate, infiltrate, and convey clean cool water , within artifical stream channels, at rates consistent with those of streams as per Provincial stream protection guidelines.

Urban Forestry

- At least 60 percent of the dedicated greenway is to be covered by canopy at tree maturity, with areas of clearing available in order to allow direct winter sunlight to penetrate and to provide year round areas of use for all residents.
- Dramatic views down and across the corridor are to be protected wherever possible and are to be a consideration when it comes to tree selection and spacing.



Typical intersection of 70th Avenue Collector Road Greenway.
Design features include bicycle turning bays, traffic calming bulges, bollards, infiltration trenches, and a double row of trees with a minimum 2.0 metre (6.6 ft.) pedestrian path on the south side of the street.

Infiltration

- All permeable surfaces within the dedicated greenway are to accept and manage drainage from surrounding impermeable surfaces at rates of not less than 36 millimetres (1.4 inches) per day during winter conditions. To meet these objectives they may require infiltration BMPs and or soil amendments (see Sections 5.2.1 and 5.2.3).
- The greenway system is to be designed principally to manage ordinary storms for the purposes cited above, but it must also be designed to safely convey the 100-year storm amounts to retention ponds (which are located within Riparian Park areas).
- In certain instances, the greenway is to provide locations for deep well infiltrators.
- Artificial, intermittent, and, possibly, semi-permanent streams are to be constructed as part of the greenway.

5.3.4.3 Riparian Parkway Greenway

Located along 192nd Street, the riparian parkway is to be designed in a "park-like" way appropriate to its condition as the "front door" for hundreds of new dwelling units. It is to accept and manage drainage from surrounding districts via a constructed stream, and, in certain instances, it is to provide locations for deep well infiltrators.

- The parkway drainage system is to be designed to hold, clean, oxygenate, infiltrate, and convey clean cool water at rates consistent to streams as per Ministry of Environment, Lands, and Parks guidelines.

- The parkway artificial stream is to accept drainage in excess of 24 millimetres (0.9 inches) per day up to the 100-year storm level, from surrounding streets (with lesser amounts being handled by streets and yards through infiltration).
- The parkway system is to be designed principally to manage storms of less than the five-year level (for the purposes cited above); it is also to be designed to safely convey the 100-year storm amounts to retention ponds.
- 100 percent of the constructed stream is to have habitat value.

5.3.4.4 Collector Road Greenway

The 70th Avenue collector greenway is to be a multi-use corridor designed for bikes, pedestrians, and automobiles. Its design is to contribute to neighbourhood character, to connect schools to neighbourhood centres, to connect the centre of the community to adjacent communities, and to provide a safe bike and walking route.

- Boulevards on both sides of the roadway are to incorporate infiltration devices and street trees so as to ensure a 60 percent canopy at their maturity. Traffic-calming measures, such as pedestrian- and bicycle-controlled signals, curb bulges, traffic circles, and planted medians, are to take into account the location of infiltration devices and street trees.

Figure 5.3.2 Greenways

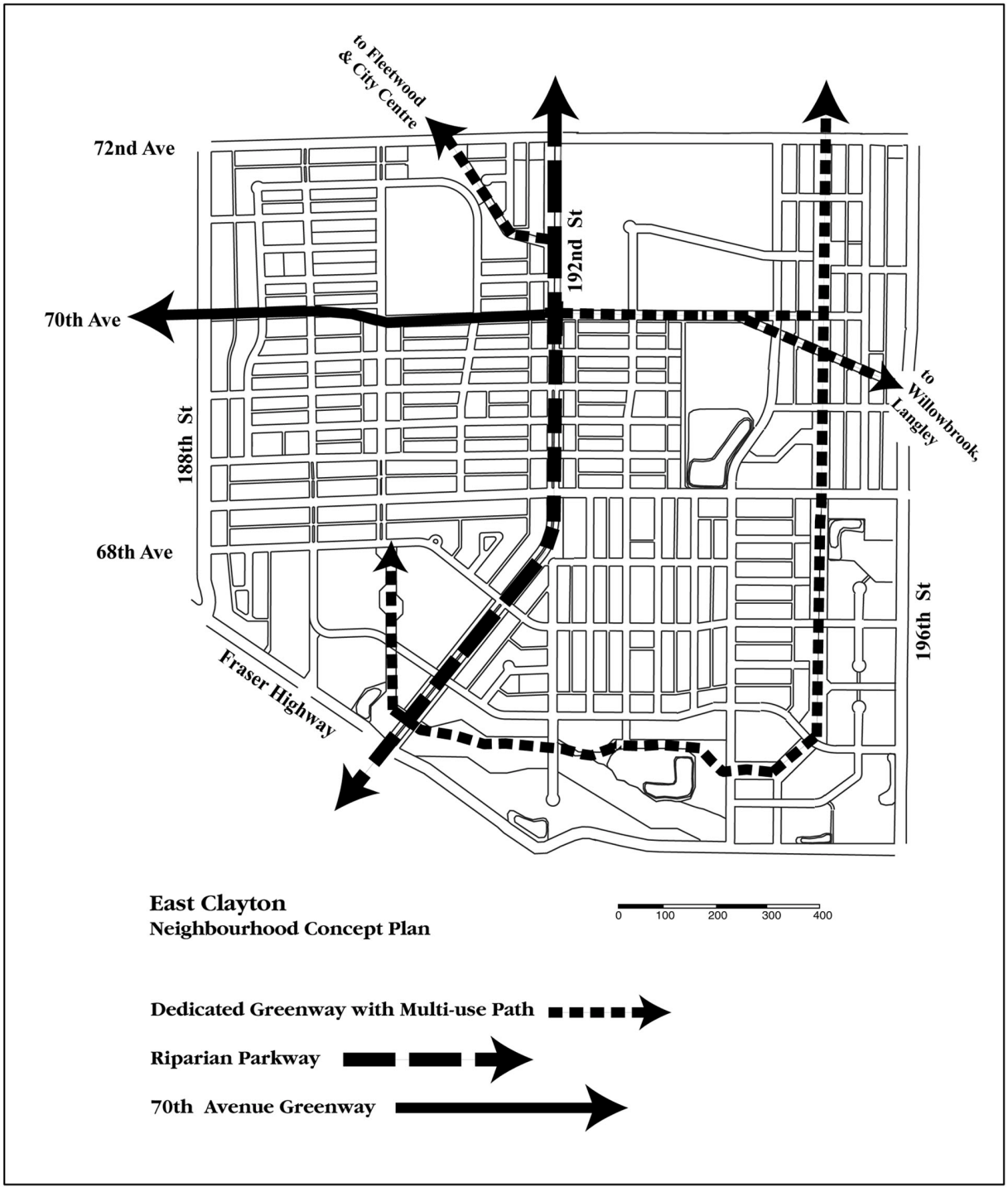


Figure 5.3.3 Bicycle Network

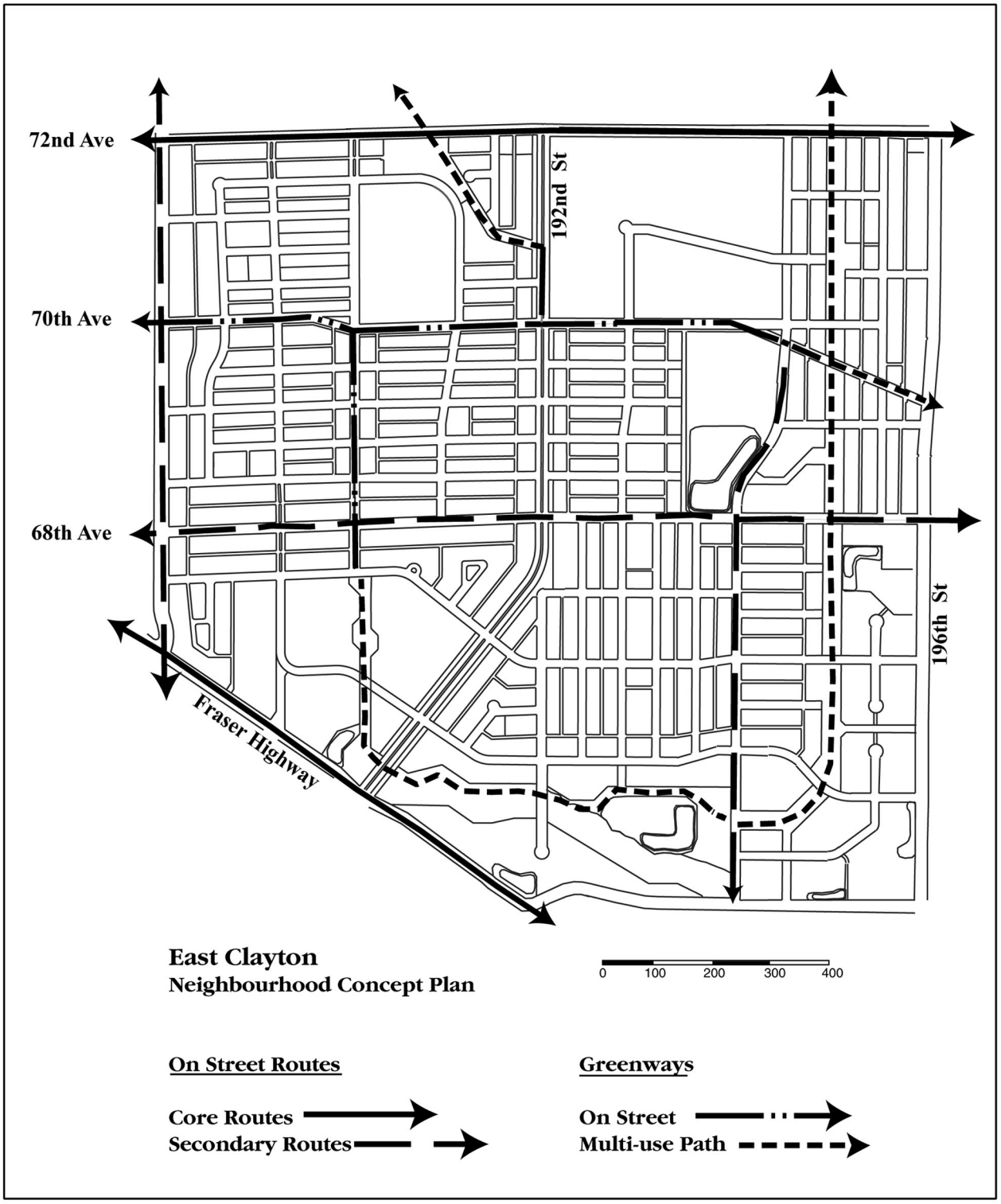


Figure 5.3.4 Walkable Radius from Mixed-use Commercial Centres

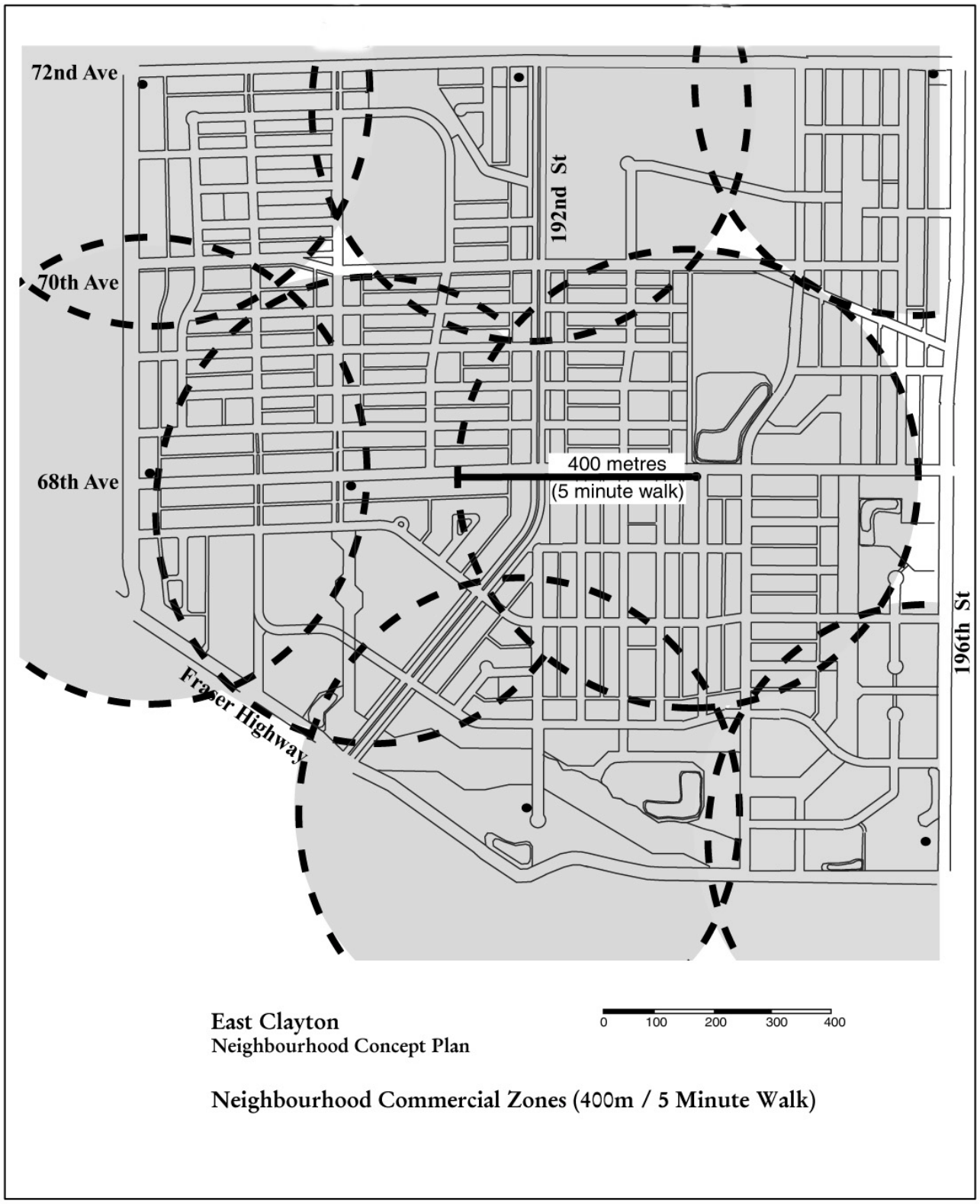
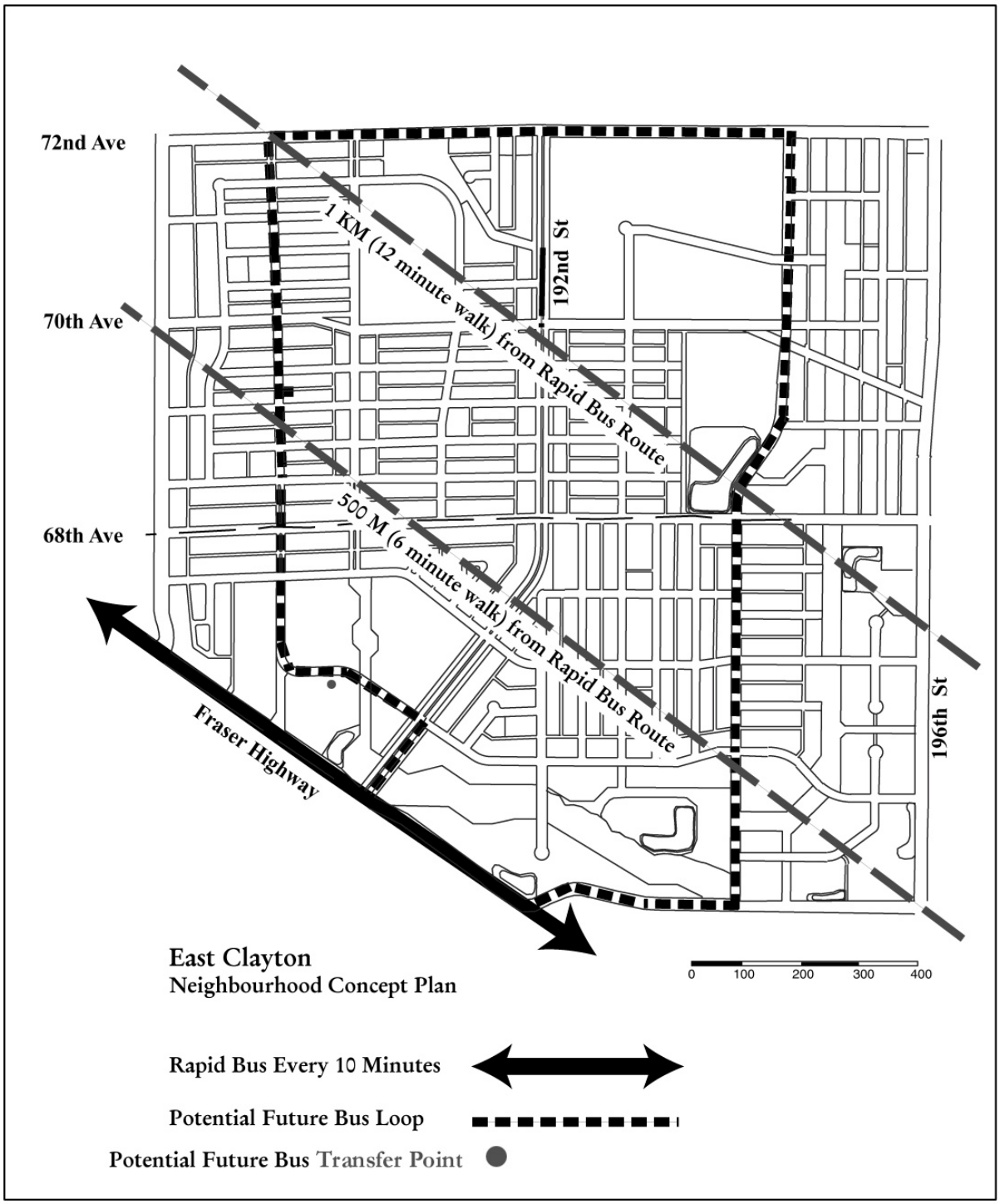


Figure 5.3.5 Bus Routes



SECTION 6.1

INTRODUCTION

The East Clayton Neighbourhood comprises the southeastern sector of the Clayton Neighbourhood and is approximately 250 ha in land coverage. The area is bounded by 196 Street to the east (the east/west boundary between the City of Surrey and Township of Langley); to the north by 72 Avenue; to the west by 188 St.; and to the south by Fraser Highway and 64 Avenue.

The East Clayton Engineering Servicing Plan has been developed to support the land use proposed in the East Clayton Neighbourhood Concept Plan (NCP). The East Clayton NCP as presented in the preceding sections describes the planned land use and design guidelines for this neighbourhood. The following section describes the engineering servicing plan.

In context, the East Clayton Servicing Plan presents a more refined servicing concept for this area and follows the Clayton Generalized Neighbourhood Concept Plan (GNCP), the Master Drainage Plan (MDP) and supporting Engineering Servicing Plan completed in 1998.

Furthermore, this servicing plan includes innovative servicing standards resulting from an extensive interactive effort to implement a more environmentally sustainable development concept in East Clayton.

The servicing concept requires detailed design and refinement of standards as the development applications progress through the approval process. The City will need to ensure that the performance standards of this development plan are achieved during the development approval and implementation process. To facilitate that, there will need to be increased effort to engineer the design standards as the initial development is being designed.

6.2.1 Background

The transportation servicing plan for East Clayton was developed between 1996 and 1999, as part of:

- the studies and public process carried out for the Clayton Generalized Neighbourhood Concept Plan (GNCP); and,
- the Charette and public meetings held as part of the East Clayton Neighbourhood Concept Plan (NCP) process.

A series of reports documenting the development of the transportation servicing plan were submitted to the City of Surrey over the above time period; these are listed in ***Appendix A.1***

6.2.2 East Clayton Road Network Plan

6.2.2.1 Context

The basis for the development of the detailed East Clayton Road Network Plan was the May, 1999 version of the GNCP Major Road Network Plan approved by City Council as part of the Stage 1 Plan for the whole Clayton area, shown on ***Figure 6.2.1***. This plan represents the "ultimate" road network plan at full build-out of Clayton as well as the Willoughby area in the Township of Langley. Similarly**,** ***Figure 6.2.2***, the recommended Clayton GNCP Bicycle Network Plan was used as the basis for the development of the East Clayton NCP Bicycle Network Plan.

6.2.2.2 Recommended East Clayton Road Hierarchy and Network Plan

In keeping with the sustainability objectives for the East Clayton area, the East Clayton Road Network Plan was developed during the multi-stakeholder Charette process and was based upon the following key principles:

- Maintaining the Arterial and Major Collector road network as defined in the Clayton GNCP, as much as possible;

- Use of a modified "grid" system of local and minor collector streets, with short blocks and rear lanes where possible, to provide multiple route choices, and a more refined pedestrian/cyclist network;

- Provision of a richer "menu" of street cross sections to respond to different land uses and functions intended for various streets;

- Respect for the continuity of green space, drainage requirements and land use/topography conflicts, as well as existing property boundaries;

- Incorporation of alternative street and boulevard drainage systems which reduce environmental impacts of urban development, by promoting in-ground disposal of stormwater using infiltration techniques and measures;

- Emphasis on street trees as a key component of the City's "urban forest" policies.

Table 6.2.1 below summarizes the recommended street hierarchy system. It shows the various right-of-way and pavement widths associated with each street type.

***Table 6.2.1*: Street Hierarchy System for East Clayton**

No.	Type				RoW Width	Paved Width (1)	Cross Section Code (2)
1	ARTERIALS	MAJOR	PARKWAY	ULTIMATE 4 LANES	27.0m(3)	17m	A
2				INTERIM 2 LANES	27.0m	17m	A
3			RIPARIAN PARKWAY	ULTIMATE 4 LANES	27.0m(3)	17m	A
4				INTERIM 2 LANES	27.0m	17m	A
5			TYPICAL	ULTIMATE 4 LANES	27.0m(6)	15m	B
6				INTERIM 2 LANES	27.0m	9m	C
7		MINOR	PARKWAY		27.0m	17m	A
8			TYPICAL		27.0m	9m	C
9			MAIN STREET		28.0m(4)	20m	D
10	COLLECTORS	MAJOR	RESIDENTIAL		22.0m	11.3m	E
12			LIVE/WORK		22.0m	12.0m	F
11		MINOR	BUSINESS PARK		22.0m	13.0m	G
13			RESIDENTIAL		22.0m(7)	11.3m	E
14	LOCALS	RESIDENTIAL	TWO-WAY		20.0m	10m	H
15			QUEUEING		17.0m	8m	H
16			ONE WAY		15.0m	6m	H
17		COMMERCIAL	BUSINESS PARK		20.0m	8.0m	I
18	LANES	RESIDENTIAL			6.0m	4m	J
19		COMMERCIAL			8.0m	5m	K

Notes:

(1) Paved width includes median width and continuous parking lanes/pockets but excludes intermittent parking pockets and left turn bays.

(2) "Cross Section Code" refers to the proposed street standard cross sections (See Figures 6.2.5 to 6.2.15).

(3) *The most desirable Parkway Ultimate standard would have a full 4.0m treed median for its entire length if 29m of right-of-way can be obtained during the development process, and the extra cost covered by Park DCCs. 27.0m only provides for a 2.0m median with low plantings between intersections, with localized widening to 4.0m in advance of intersections where left turn bays are required.*

(4) *The Mainstreet Arterial RoW is 1.0m wider that current City Arterial standards; however, this cross section provides for angle parking on both sides of the street, which results in higher on-street parking supply. It is expected that developments fronting Mainstreets would have reduced on-site parking requirements due to the provision of more on-street stalls, so this could act as an incentive to owners to provide the additional dedication width.*

(5) *Road Development Cost Charges (Road DCCs) are based upon street types No. 1-12 only. Minor Collectors, Local Roads and Lanes are not DCC eligible.*

(6) *196 Street will require 30m right-of-way throughout its length in East Clayton, 64 Avenue to 68 Avenue, due to topographical constraints.*

(7) *The 70 Avenue "Greenway" requires 1.5m additional right-of-way for a 2.5m sidewalk on one side, as well as 2.0m right-of-way for an additional row of street trees, for a total of 25.0m.*

Figure 6.2.3 illustrates the proposed road network plan for East Clayton. The "Cross Section Codes" refer to the various street cross section types, as described in the following section. Note that while the Arterial and Collector designations and alignments are relatively well defined, the Local street configurations shown on this figure are considered preferred/desirable concepts which shall be reviewed and refined as development proceeds. The Local street layouts on ***Figure 6.2.3*** reflect the sustainability principles embraced by the plan. The City during the development process may consider alternative layouts, which are proven to achieve the same transportation goals and drainage performance standards. In particular, the roadway Right of Way (ROW) and the network layout includes various drainage measures which are designed to promote in-ground disposal of stormwater through infiltration.

Figure 6.2.3 also indicates locations of existing and potential future traffic signals. The proposed traffic signal locations were based upon engineering judgement, not detailed traffic impact/signal warrant analyses. Generally, it can be expected that most Arterial/Major Collector and Arterial/Minor Collector intersections will require traffic signals by the full build-out of Clayton. Some of the Major Collector/Minor Collector intersections may also require traffic signals. Most other types of intersections could be effectively controlled through stop signs, either with 4-way stops or 2-way stops. Specific traffic control requirements will evolve over time as vehicular traffic grows due to new development.

Proposed Local road access to Arterials and Major Collectors is more frequent in the East Clayton NCP than that typically found in other neighbourhoods of Surrey with more conventional suburban development patterns. This feature of the plan is intended to support the "open" grid network concept by diffusing traffic among multiple routes. However, only selected local roads will have full movement access to Arterial roads; most will have right-in/out movements permitted only. While right-in/out traffic movements are not typically problematic on/off Arterial roads, permitting left turns can sometimes be difficult from a safety perspective. Therefore, the Local road access concepts presented on ***Figure 6.2.3*** are subject to detailed review during the development stage and/or the design stage for Arterial road upgrading.

6.2.3.3 Refinements to Recommended GNCP Major Road Network Plan

During the development of the East Clayton Road Network Plan, several refinements were made to the May, 1999 version of the GNCP Major Road Network Plan. These were:

- The proposed Major Collector on the 65/66 Avenue alignment between 192 Street and 196 Street was designated a Minor Residential Collector;

- 196 Street between 64 Avenue and 72 Avenue was designated a "2 Lane Arterial", with right-of-way protection for a future 4 lane facility (refer to Reference No. 7 in Appendix A.1). A functional design study of this section of 196 Street at 4 lanes was carried out by Reid Crowther & Partners under separate joint contract with the City of Surrey and Township of Langley. The required right-of-way for 196 Street was established at 30m; this width is greater than the City's existing standard of 27m due to the grades on 196 Street;

- 188 Street, a designated 2 lane Major Collector road, is expected to require 2 additional travel lanes between Fraser Highway and 68 Avenue due to the peak hour traffic volumes forecasted in this short section. In addition, a future traffic signal at 188 Street/68 Avenue will probably be required. These recommendations should be confirmed at the time of the development of the Business Park and Live/Work area.

Figure 6.2.4 illustrates the Refined Major Road Network Plan for the Clayton GNCP with the above noted changes.

6.2.3 Street Cross Sections

Alternative and more environmentally sustainable street designs are a critical component of the East Clayton NCP. Street designs were discussed at length during the Charette process, both with the entire Design Team, the East Clayton Citizens Advisory Committee (CAC) and during meetings with a sub-committee tasked with development of specific cross sections. At the outset, it was agreed that there were some fundamental principles for the design of the road cross sections in East Clayton, as follows:

- The performance standards for drainage will not be compromised by the new street designs;

- The street rights-of-way will be the same or less than current City standards, except where the additional width is needed for drainage and/or amenity requirements.

Appendix A2 contains figures that illustrate the proposed Arterial, Collector, Local Road and Lane cross sections for East Clayton. The letters in the upper-right hand corners of these figures represent the "Cross Section Codes" noted in ***Table 6.2.1*** and ***Figure 6.2.3***.

Other key design principles are noted below:

- East Clayton's street drainage systems must be capable of dealing with the five-year storm without flooding the travel portion of the street.

- "Open" drainage systems are to be used in as many street designs as possible, utilizing small and shallow swales/gravel infiltration pits, combined with a perforated pipe for water conveyance once the pit is saturated. Under trees, the perforations should be discontinued so that street trees do not experience saturated soil conditions.

- The maximum infiltration rate expected from the proposed shallow infiltration pit system is about 2.0mm/hr. In the winter, due to saturated conditions, this rate would be reduced to about 0.5-1.0mm/hr. It is expected, therefore, that the perforated pipe would act like a conveyance pipe several times during the winter months, conveying water to the deep injection wells and the storage/retention ponds. The infiltration function and the conveyance function of the perforated pipe system are required to avoid too frequent surface flow within the swales and to convey flows into the deep infiltration wells/stormwater ponds, respectively.

- The design flow for the swale system will not be appreciably affected by the 0.5 to 1.0mm/hr infiltration rate of the shallow infiltration systems during saturated winter conditions. Therefore, the surface of the swales will be required to convey water during most storm events. The swale system must be designed to address surface flow for the 5-year storm event with no road or boulevard flooding, and for the 100 year event with a maximum depth of 250mm permitted on the roadway surface.

- The surface flow system must be as continuous as possible; breaks caused by driveways must be minimized through the use of rear lanes (and use of shared driveways where rear lanes are not possible). When trees are located near the swale system, the area of saturated soil must not encroach to the root area; both underground and surface flows must be able to continue around the trees.

- For Arterials and Major Collectors, barrier curbs and gutters should be used due to the higher speeds and traffic volumes, to ensure pedestrian safety. However, the minor underground storm sewer systems required with the curb and gutter system would drain only the road surface, and the runoff must be directed to bio-filtration systems.

- Reduced water quality associated with use of the curb and gutter must be addressed through design (e.g., directing the runoff to other bio-filtration systems such as the proposed riparian stream).

- All new street cross sections for Arterials and Major Collectors should follow the City's current policy of integrating cyclists on the travel way, through the use of wider curb lanes or bicycle lanes. For Minor Collectors and Locals, vehicular volumes and speeds are intended to be such that separate bicycle facilities are not necessary. "Enhanced" integration routes on Minor Collectors or Locals can be considered when Greenways are located on-street rather than on a separate pathway, as proposed for the 70th Avenue Greenway.

- Business Park streets should be designed to address the higher number of larger trucks expected on this type of street. On-street parking should only be provided along the frontage of the Live/Work area.

- The design approach to Business Park streets requires property owners to address run-off quality. Bio-filtration mechanisms should be provided on-site in the Business Park (for example, through a pond/stream system), as illustrated in Cross Section G, ***Appendix A2.6***. The road drainage must be directed to a common facility, located on private property with a City right-of-way.

- There may be need to limit the number of trees on the side of Local streets, which contain the swale or where driveways are present. If tree spacing is not attractive (8-10m is desirable for small/medium trees for a continuous canopy) then other options are available:

    - Smaller trees;

    - Variable tree spacing;

    - Street trees on private properties close to front property lines.

- The infiltration requirements override the street tree requirement on the side of Local roads, which incorporates the drainage feature.

- 4m vertical clearance is required for Fire Trucks according to the BC Building Code. Street tree species for Local roads will have to be carefully selected and/or trimmed to ensure adequate vertical clearance, since several Local road cross section incorporate narrower travel ways.

- On Local roads with block lengths greater than 100m, a clear width of 6.0m is required for fire truck horizontal clearance, so parking may have to be prohibited one side of longer "queuing" streets, effectively turning them into two-way streets. On Local roads less than 100m in length, fire trucks would

set up on the closest intersecting street and carry equipment to the fire incident. Fire hydrant locations should, therefore, be carefully planned.

- The encouragement of on-street parking is an important concept for East Clayton streets; it narrows the effective width of street pavements and contributes to the traffic calming effect. On-street parking should only be prohibited on "Ultimate Arterial" streets where 4 travel lanes are provided.

- Rear lanes are important for achieving the sustainability principles of East Clayton. They permit narrow lots, which are not dominated by front garages, garbage collection in the rear, additional on-street parking supply and a "finer" pedestrian/cyclist network. In addition, driveways will not interrupt the swale drainage system proposed for East Clayton.

- There may be some locations where rear lanes are not feasible due to topography or other reasons; in these cases, driveways must be used. In order to reduce the impact of driveways on the overall "sustainability" concept, they should be shared between adjacent properties and their widths kept to a minimum (3.5m) at the boulevard/sidewalk/roadway interface. Driveways could flare slightly on private property to provide on-site vehicle storage, in addition to garage storage. Driveway surface materials must be specified to support the sustainability principles for East Clayton (for example, porous pavement, gravel or gravel/grass). Driveway crossings of the infiltration pit/swale system must be carefully designed to ensure continuity of surface water flow during saturated conditions yet still allow safe access for residents.

- Garage rear setbacks (1.0m minimum) in lanes are required to accommodate turning movements.

- Parking in commercial lanes can be permitted between driveways and hydro poles in signed/marked locations.

Appendix A.2 contains a detailed chart of "Performance Measures" for each of the East Clayton street cross sections. ***Appendix A.3*** contains information about traffic calming measures which would be appropriate for various street types in East Clayton; note that many of these measures have been directly incorporated into the East Clayton street designs.

6.2.4 Alternative Modes

6.2.4.1 Commuter Bicycle and Pedestrian Networks

The entire bicycle network in Clayton will be comprised of both on-street and off-street routes. Typically, on-street routes are oriented towards "commuter" cyclists, while off-street routes are oriented towards "recreational" cyclists, although their purposes can overlap. The City's current policy is to integrate

cyclists on all roads as well as providing separate, recreational routes on shared, multi-use pathways. Although there will be designated/signed main bicycle routes, the City's policy is that all roads in Surrey eventually will be "bicycle-friendly". The East Clayton plan and road cross sections has been developed using this philosophy.

Figure 6.2.5 illustrates the East Clayton NCP Commuter Bicycle Network Plan, with "Core", "Secondary" and "Greenway" routes. The GNCP Commuter Bicycle Network Plan was used as the basis for ***Figure 6.2.5***. Note that there are many other recreational and/or Greenway routes planned for East Clayton, as shown on the land use plan, but these are not considered major commuter routes and are not, therefore, part of the Commuter Bicycle Network Plan. The routes shown on ***Figure 6.2.5*** would be eligible for funding through Road Development Cost Charges, while other routes proposed in the East Clayton NCP would not be eligible.

The Arterial and Major Collector road cross sections for East Clayton include space for either wide curb lanes of 4.5m, or bicycle lanes/shoulders of 1.3-1.5m. Special facilities for cyclists on Minor Collectors or Local Roads are not required, since the traffic speeds and volumes of vehicle traffic are expected to be low. Greenways which coincide with commuter routes as shown on ***Figure 6.2.5*** should have multi-use pathways incorporated within them, at least 3.0m (and preferably 4.0m) wide, constructed of porous pavement.

The pedestrian network in East Clayton will be comprised of the 1.2m-1.5m wide sidewalks provided within each of the street rights-of-way, the off-street multi-use pathway system and Greenways, as well as other off-street pedestrian links which will be defined by the City as development proceeds. The road sections for East Clayton have all been planned with sidewalks on both sides of the street, buffered from the travel way by boulevards, street trees and/or parked cars to maximize pedestrian level of service. In addition, the rear lane system shall also serve as part of the pedestrian network. Many of the street cross sections indicate that curb pinching at intersections would be appropriate to minimize pedestrian crossing distances.

While planning pedestrian linkages between streets, care should be taken to ensure convenient pedestrian access to transit stops and shopping opportunities, as well as protected pedestrian crossings of major roads. School crossing safety is of particular importance and must be part of the detailed planning and design for new schools in East Clayton.

6.2.4.2 Potential Transit Routes and Facilities

The East Clayton road network will also be utilized by transit vehicles. BC Transit's current future plans in the area include Rapid Bus on Fraser Highway and 200 Street (with 10-minute headways during the peak demand periods) but

with no specific services planned for Clayton itself. However, it is expected that with the urbanization of the Clayton area, additional internal transit services will be viable. The higher residential densities and employment opportunities in the business park embodied in the East Clayton land use plan, in particular, would support reasonably frequent transit service on its internal road network, likely with 15 to 30 minute headways in the peak periods. These services could be logical extensions of transit routes already provided for the City/Township of Langley. The proposed modified grid system is good for attractive transit service since it offers more direct and convenient pedestrian routings to bus stops and it offers more direct and flexible transit routings.

It is unknown at this time which streets within Clayton could become transit routes in the future; however, it is reasonable to assume that all Arterial roads and Major Collector Roads could be potential candidates, as well as selected Minor Collectors. The road cross sections have been developed with this assumption in mind.

While BC Transit has identified a future transit exchange/park and ride for the Willowbrook Mall area, there may be a need for a small transit exchange facility within Clayton to support the increased transit service to this area required to achieve the principles of "sustainability". It is recommended that consideration be given to planning for such a facility. Potential locations and physical requirements for this facility should be discussed with BC Transit; the proposed "village" at 188 Street/72 Avenue may be an appropriate location as it will be a key destination point within the Clayton area.

A small, local park and ride facility within East Clayton for residents only could be incorporated within the Business Park, with convenient pedestrian connections to the future Rapid Bus station on Fraser Highway. Bicycle lockers should be provided at this facility to encourage commuting by bicycle/transit.

SECTION 6.3

SANITARY SERVICING SYSTEM

6.3.1 Introduction

Section 6.3 describes the proposed sanitary servicing scheme to convey the sanitary flows generated within the East Clayton Neighbourhood. This plan presents a servicing scheme for the NCP in conformity with the City's long-term servicing strategy for the entire area. The report also identifies upgrading needs for the existing off-site systems, resulting from the projected flows from the East Clayton NCP area.

6.3.2 Design Criteria

The sanitary sewerage flows for the East Clayton NCP was estimated using the City's design criteria summarized herein-below on the basis of ultimate development scenario with population densities applied only to the designated developable areas; i.e. roadways, parks and other environmental reserves were excluded when computing the contributing population.

This design approach provides the recommended safety factor to meet the sanitary servicing needs of the future, as densities could change upwards; sewer upgrading work would be uneconomical for such incremental changes.

a) Design Population by Land Use Designation

Land Use	Maximum Units Per Acre	Assumed Number of People per Unit	Assumed Number of People Per Hectare
Work / Live	25	2.8	173.0
Live / Work	25	2.8	173.0
100' Frontage Lots	7	3.2	55.3
6-10 u.p.a.	10	3.2	79.1
10-15 u.p.a.	15	3.2	118.6
15-25 u.p.a.	25	2.8	173.0
25-45 u.p.a.	45	2	222.4
Special Community	15	2	74.1
Commercial / Residential	15	2	74.1
Neighbourhood Commercial	15	2	74.1
Techno / Business Park	18	2	89.0
Institutional	10	2	49.4

Type of School	Population (people/school)	Approximate Area (ha)	Equivalent Land Use based Population Per Hectare
Elementary	500	4.3	45
Secondary	1200	8.0	45

b) Equivalent Population Component

Daily average per capita flow = 350 litres

c) Peak Flow Rate

Sewers will be designed to carry the total peak flow rates under free flow conditions. The peak flow rate is computed as a sum of peak dry weather flow resulting from wastewater and the Infiltration/ Inflow allowance. Peak dry weather flow is the mean rate during the maximum 15 minutes for any 12-month period. Peaking factors is the ratio of peak to average flows for the contributing population. These are calculated using Harman's Peaking Factor.

Harman's Peaking Factor: $1+ 14 / (4 + (\text{population}/1000)^{0.5})$ minimum value 2.5
maximum value 3.8

d) Sanitary Sewers Design

Sanitary sewers are to be designed using open channel hydraulics with invert slopes designed to satisfy the required flow conditions.

Capacity shall be provided to accommodate peak flows, corresponding to the potential population density at saturation and land-uses fully realised in accordance with the Official Community Plan.

To avoid full-bore flow from unaccountable surges, the depth of flow under maximum design condition, has been designed so as not exceed 50% of the internal diameter of the sewer.

Hydraulic analysis was carried out assuming steady state conditions and using Manning's Formula.

For full flow conditions: $Q=1/nAR^{0.66}S^{0.5}$; n=0.013.

The minimum sewer size has been designed as follows:

For residential lands - 200mm diameter
For industrial lands - 250mm diameter

All sanitary sewers are assumed to have been designed at grades to ensure sewage flow with a minimum self-cleansing velocity of 0.6 m/s, based on flow from development upstream. Upstream sections require steeper grades to ensure self-cleansing velocity under partial flow conditions, as a result, upstream sections will require a minimum grade of 1%.

A sewer shall be installed maintaining a depth sufficient to provide appropriate service connections to all properties tributary to the sewer. The optimal cover required, as per the latest updating of Standards is 2.5 m.

6.3.3 Offsite Service and Servicing Scheme Orientation

The total Clayton NCP area is shown in ***Figure 6.3.1.*** It is bounded on the South by the Fraser Highway, on the North and the West by the lowland and Agricultural Land Reserve (ALR) boundary and on the East by the 196 Street forming the Surrey/Langley border. The total area is approximately 852.3 ha. The City has planned to eventually service this entire area by directing the flow generated within this area to the GVS & DD interceptor sewer located to the south of this area, flowing westwards from 188 Street at 52 Avenue.

As shown in ***Figure 6.3.1,*** previous long-range planning work by the City, has identified the following off-site facilities to receive flows from the Clayton area:

	Off-Site Trunk Sewer	Serviced Area from Clayton NCP	Present Status and Updating Needs
1	Langley Bypass Trunk sewer from 64 Ave/196 Street, south-westerly to GVS&DD trunk sewer gravity section, at 52 Ave./ 188 St.	Southeast sector south of 72 Ave., approximately 188 ha.	• Identified in the City's 10-year Capital Plan; • Alignment and design to be completed prior to construction. • Requires design services/update to accommodate East Clayton area Servicing needs. Planned for design in 2000.
2	68 Ave. trunk sewer, conveying flow west to the trunk sewer mentioned in 4 below.	South central sector, approximately 101 ha.	• Constructed up to 188 St.
3	70 Avenue trunk sewer, Fraser Highway to 177 St., approximately.	Southwest sectors approximately 78 ha.	• Conceptual layout identified as part of the North Cloverdale West NCP; • Requires design review and updating based on proposed East Clayton NCP servicing needs.
4	Trunk Sewer from 72 Avenue / Fraser Highway, south to 60 Ave. along approximate alignment of 177 St. [As an interim measure, the City provided facilities mentioned in 5 below, to permit development to proceed, thereby generating DCCs to pay for the ultimate system.]	Northern sector north of 72 Ave., approximately 485 ha. [Also intercepts flows from 3 & 4 above.]	• Conceptually identified, conventional trench and cover North of 68 Ave. and micro-tunnel for the deeper section South of 68 Ave. • Part of it from Fraser Highway to 68 Avenue is funded for upsizing in the 10-year Capital Plan • Requires design/implementation review/updating based on total area servicing need forecasts.

	Off-Site Trunk Sewer	Serviced Area from Clayton NCP	Present Status and Updating Needs
5	Interim 68 A Ave. Pump Station @ 176 A St., and force main/gravity main to 60 Avenue approximately	On an interim basis, areas serviced into above trunk sewer along 68 Ave., 70 Ave. and 72 Ave./Fraser Highway to 68 Avenue. (amongst other areas from the west.)	• Interim Pump Station, force main, and gravity sewer constructed in 1996/97. • Interim Pump Station has limited capacity of 100 λ/s now, final design capacity is 400 λ/s. • Requires design/implementation review/updating based on total area servicing need forecasts.

The overall servicing scheme for the entire Clayton/Cloverdale area west of 176 Street has been delineated into 9 large sub-areas: A, B1, B2, C1, C2, D1, D2, E, and F as shown in ***Figure 6.3.1*** with sewer systems shown in ***Figure 6.3.2.*** It was developed taking into consideration the following key constraints and opportunities:

Opportunity / Constraint	How the Servicing Scheme Accounts For It
• The topography of the area	• Maximize gravity servicing function of the sewer system
• The watercourses/creeks traversing the area	• Minimize the number of watercourse crossings which interfere with continuous gravity flow grades of sewer lines
• Receiving capacity of the off-site trunk system	• Maximize conformance with planned / implemented plans
• Least distances to off-site trunk system	• Within the capacity limits, orient the on-site sewer system to minimize lengths, while meeting the other constraints / opportunities.

6.3.4 East Clayton NCP Area Sanitary Sewer System

The proposed sanitary sewer system relevant internally to East Clayton NCP area is shown on ***Figure 6.3.2***. The sewer system is designed with a minimum cover of 1.5m. This assumes that any below-grade basements in the area will require the sewage to be 'lifted' to the ground floor piping system connected to the street sewer. The optimum cover for these sewers would be 2.5 m.

Based on our analysis for the ultimate development flows, the recommended sanitary trunk sewers and a layout plan of the local collector sewers are shown on ***Figure 6.3.2***. ***Table 6.3.1*** summarizes the planned population and peak sanitary flow per catchment area. Using these peak sanitary flows, the performance of the existing sanitary trunks

was evaluated. These results are summarized in ***Table 6.3.2***. Also using the peak sanitary flows per catchment area proposed sanitary trunks for the area were developed and is summarized in ***Table 6.3.2***.

Appendix B contains the detailed calculations used in developing the proposed sanitary sewer trunk system, as well as the calculations used to evaluate the existing sanitary sewer trunk system.

The following is a summary of the catchment areas and their servicing system arrangements.

6.3.4.1 Area Servicing into the Langley Bypass Trunk Sewer

Catchment A (168.3 ha) [Please note: No development can proceed within Catchment A without the completion of the first phase of the Langley By-pass sewer to relieve the current capacity constraints.]

This area drains southeast to the intersection of 64 Avenue and 196 Street. It will be serviced by three gravity sub-systems. The first sub-system will run south along 196 Street from 66 Avenue to 64 Avenue. This alignment is based on preliminary road alignments. The second sub-system will run east along 65 Avenue from 192 Street to 194 Street. The third sub-system will run south along 194 Street from 69 Ave to 64 Ave. The two sub-systems at 65 Avenue and 194 Street will then be combined into one sewer which will travel south along 194 Street to 64 Avenue, and then along 64 Avenue to 196 Street. Finally, the two sewers at 68 Avenue and 196 Street will be combined into one sewer along 196 Street from 64 Avenue and then connected to the proposed Langley Bypass Trunk Sewer. At the present time the proposed alignment along 196 Street indicates culvert will be used for the creek crossing at approximately 67 Ave. This alignment allows for the use of a gravity sewer, as the sanitary sewer will be placed above the culvert. However, if a bridge is constructed over the creek along 196 Street, a syphon that passes underneath the creek will have to be installed.

6.3.4.2 Areas Servicing into the '177 Street Trunk' Sewer

Catchment B1 (114.9 ha)

This catchment is serviced by the recently constructed gravity sewer running south along 188 Street from 71 Avenue to 68 Avenue. The flows are then conveyed along 68 Avenue from 188 Street to the 68 Avenue Trunk at 184 Street. The 68 Avenue trunk will carry the flows initially, on an interim basis, to the Clayton sanitary pump station, and later to the ultimate "deep trunk" along the 177 St. alignment on a permanent basis.

6.3.5 Impacts on Existing System

6.3.5.1 Proposed Langley Bypass Trunk Sewer

The maximum contributing flows from the East Clayton has been re-estimated at 151.3λ/s. The existing sewer system south of Hwy. 10 and east of 192 Street is running at capacity and requires a relief trunk system flowing south-westward from Hwy. 10 to the GVRD trunk sewer on 52 Avenue at 188 Street. Hence, until such time as the relief trunk is complete and functional, development within this area will need to wait.

188 Street and 68 Avenue Trunk

The newly constructed 188 Street trunk sewer appears to be marginally undersized for the maximum population density. As a result, twinning along this undersized section may be required. However, if the maximum population density in not achieved the twinning of this sewer will not occur.

6.3.6 Conclusions & Recommendations

1. The sanitary servicing scheme proposed for the NCP area can adequately service the East Clayton NCP area, based on the proposed land use and saturation population densities. It is recommended that this servicing scheme be adopted for this area as a framework for planning, design and construction.

2. The layout and orientation, as detailed in ***Figure 6.3.1***, has been developed to minimize the number of stream crossings and optimize the system in respect of planned/available off-site connecting sewers. This servicing plan, when implemented will transfer the East Clayton sanitary flows (from Catchment Area A) to the existing westerly GVS&DD trunk sewer along 52Avenue, in accordance with the City's overall long-range servicing plan.

SECTION 6.4

WATER DISTRIBUTION

6.4.1 Introduction

This section outlines the water distribution system servicing requirements to meet projected demands and fire-flow requirements for the East Clayton NCP.

6.4.2 Existing System

The water supply system in the generalized Clayton NCP study area is separated into two pressure zones along approximately the 50 m contour. The upper or 'Clayton' pressure zone currently operates at 115 m static head and covers the East Clayton NCP Plan Area. The lower or 'Cloverdale' pressure zone operates at 90-m static head. (See ***Figure 6.4.1.***) Water supply to the overall area is provided by the new Clayton Jerico Main and the GVWD's Whalley/Clayton main which feed the Existing Clayton Reservoir at 72 Avenue and 190 Street.

The majority of the existing mains within the study are smaller diameter local mains (less than 300 mm diameter). There are existing grid mains of 300mm and larger diameter in the NCP Area on 188 Street south of 72 Avenue and on 72 Avenue from 184 Street to 196 Street.

The existing distribution system as of 1996 in the Clayton Generalized NCP Study area was evaluated as part of the City's Water Supply Study which assessed its' ability to meet the existing servicing needs.

Key findings included:

1. With the construction of the Clayton/Jericho main, the Clayton reservoir will be categorized as an unlimited source of supply at zero residual pressure (89m TWL).

2. Modification of the PRV set points to retain more water in the Clayton pressure zone has allowed the City of Surrey to defer the planned upgrading of the Clayton Pump Station. The HGL of the Clayton pressure zone will remain at 115m until the projected demand exceeds the existing pumping capacity of 321 l/s (3pumps @ 107 l/s).

3. Although the HGL of the Clayton pressure zone will ultimately be increased from 115m to 125m, in the East Clayton NCP area (south of 72 Avenue and east of 188 Street) the proposed feeder main loop has been upsized to allow servicing of this area at the lower HGL on an interim basis.

6.4.3 Proposed System

The total equivalent population that was calculated and used for evaluation of the water supply requirements of the Clayton Generalized NCP is 44,950.

For residential areas water demand was calculated on the basis of an average daily per capita allowance of 500 lpcd, a maximum day allowance of 1000 lpcd and a peak hour demand of 2000 lpcd in accordance with the City's design criteria. For all other areas such as commercial, institutional, etc. Table 2.3.1.4 of the City's Design Criteria Manual was used as a guideline.

A water network model of all of the pipes in the existing distribution system was prepared using EPANET. The input data for the existing distribution system was obtained from the input data of the City's CYBERNET water model. The proposed system was analyzed for both maximum day plus fire flow; and peak hourly flows.

Detailed analysis is summarized in the appendix. The analyses confirm that the proposed grid and feeder system will meet the City's design criteria for maximum day plus fire flow, and peak hour demands.

The following recommendations are made for the ultimate water distribution system for servicing of the land use concept for the East Clayton Generalized NCP Plan.

- Design the East Clayton system for an ultimate buildout equivalent population, based on the zoning of the preferred land use concept for the East Clayton NCP.

- Increase the HGL of the Clayton pressure zone from 115 m to 125 m when demands warrant and design the new Clayton pump station to provide a peak flow of 1,400 λ/s at 40 m TDH (including the immediate downstream discharge piping).

- Provide a grid and feeder main network for the ultimate development as shown on ***Figure 6.4.1***. Although the indicated pipe sizes represent the network required for the ultimate development scenario, it is possible that individual developers, that do not have the benefit of access to the ultimate looped distribution system, may have to upsize individual pipes to service their developments even on the basis of interim fire-protection.

- As development progresses and requires upgrading of existing inadequate system, have the existing 150-mm mains replaced with minimum 200-mm mains.

- No service connections should be allowed to the Feeder mains (450ϕ or greater).

SECTION 6.5

STORMWATER DRAINAGE SERVICING

6.5.1 Introduction

Context

As natural areas are transformed into urban development, the on-site and the off –site drainage servicing facilities are designed to meet environmental and public safety performance standards. The servicing needs to meet habitat preservation objectives and municipal by-laws to minimize drainage conflicts between lots as well as to provide protection of public safety and property from potential flooding and erosion.

Exploring and recommending ways and means of managing stormwater runoff in a more environmentally sustainable manner was one of the key objectives of the East Clayton NCP. The related concepts and how they are to be applied to the East Clayton stormwater drainage servicing scheme, are presented in this Section.

Local Rainfall and Runoff Characteristics

The yearly rainfall characteristics in Surrey are typical of those in the Pacific Northwest. The yearly recurring, 5-month wet weather period from October 31 to March 30 accounts for over 65% of the total average annual rainfall. During that period, evaporation rates are very low and the proportion of rainfall accounted for by infiltration losses to the soil are reduced due to saturation.

The 24 hour design, winter rainfall in the East Clayton area for different return periods (i.e., recurrence intervals) is summarized below. These values are based on the 35 year historical records at the Surrey Kwantlen Park rain gauge station from 1962 to 1996.

Return Period	**24-Hour Design Rainfall Data**	
	Depth of Rain in mm	**Peak hourly intensity (mm/hr)**
1-year or less	Up to 54.2	up to15.4
1 year to 5 year	54.2 to 82.9	15.4 to 23.4
5 year to 100 year	82.9 to 133.0	23.4 to 36.7

In any given watershed, rainfall is transformed into three main components:

1) **Evapotranspiration** through evaporation from exposed surfaces and transpiration by plants;

2) **Infiltration** into ground through pores in the surficial ground layers; and

3) **Runoff** over the surface.

The relative distribution among these three components is very different for rural and urban land uses. In the case of urban land use, the runoff component could potentially increase to 95% of the rainfall. To effectively handle this excessive runoff, a well-designed stormwater drainage system is needed.

In East Clayton, the planned building density, paved roadway areas, paved driveways and patios, as well as the application of traditional lot grading and landscaping practices will result in impervious surfaces and generate high surface runoff. Sustainable drainage management approach provides an opportunity to counter this high runoff trend. It requires the implementation of a drainage scheme that will encourage reversal of this high runoff process back to one that emulates the rural condition, as much as possible. Thus the sustainable development's approach will include means and measures to drain impervious areas through pervious areas/infiltration facilities (i.e. not allow direct connections to a storm sewer system); maximize natural ground covered green areas and tree clusters; and provide the use of stormwater infiltration measures on a lot by lot basis.

The local soil plays a key role in this innovative approach. The objective is to maintain and improve the permeability characteristics of the soil during and after development.

Local Soil Infiltration Characteristics

As discussed above, the key performance of managing storm water drainage in a sustainable manner is to minimize the runoff volumes generated from paved and landscape surfaces. Achieving such reductions in surface runoff in East Clayton is difficult due to the proposed development density and the clayey, silty, sub-soil prevalent in the area. In this context, a Hydrogeologic Assessment of the local sub-soil and water well data completed by Piteau Associates, Consulting Engineers, has shown that:

(a) On an area-wide basis, shallow (i.e. up to 2-meter depth) infiltration rates in the order of 0.5 to 1.0 mm/hour (i.e., 120 to 240 cubic meters/hour/day) could be achieved through these relatively impermeable clay-till layers in their natural state. This level of shallow infiltration represents a significant portion of the total seasonal rainfall, will potentially reduce runoff volume, and will add to baseflows in downstream watercourses.

(b) Under urban conditions, it is feasible to promote shallow infiltration by adopting various infiltration measures at all parts of the

watersheds, and adopting different construction practices during fill material selection for landscaping of lots, etc.

(c) On an area-wide basis, there is a deep water bearing sand and gravel layer, underlying the Clayton upland area. This aquifer has the potential to act as a recharge area for stormwater runoff fed through recharge wells.

Figure 6.5.1 shows the potential recharge rates per well in different parts of the study area. These are broadly categorized into four zones of potential recharge rates as follows:

Recharge Zone	Recharge Rate per Well (l/s)	Approx. Area (ha)	General Location
Good Potential	50 l/s	77	North of 70 Ave from 188 St to 196 St.
Moderate Potential	30 l/s	56	South of 70 Ave, North of 68 Ave from 188 to 196 St.
Low Potential	20 l/s	72	South of 68 Ave, North of 67 Ave from 188 to 195 St.
Very Low Potential	10 l/s	66	South of 68 Ave to study area's South boundary.

These preliminary rates are based on a review of available historical data and requires confirmation through field tests, as part of further follow up work prior to designing well injection facilities.

(d) These initial findings confirm that using appropriate designs, a significant part of the stormwater can be transferred into the regional aquifer under the study area. ***Figure 6.5.3*** is the schematic of a typical recharge (deep infiltration) well; it can be adapted to filter and transfer surface rainwater into the deep aquifer.

Off-Site Drainage Constraints

Drainage from East Clayton currently discharge to storm sewers and natural watercourses in Langley and Surrey. The post-development flow rates have to be controlled to levels which are similar to those under existing conditions. Summarized below are the approximate peak discharge rates from East Clayton into Langley. These rates and their site specific connection points are proposed to be the basis of an agreement between the two municipalities:

Location	**Peak Discharge Rate (m3/s)**	
	5-Year	**100-Year**
Outfall along 68 Ave, East of 196 St. to Langley	0.1	0.3

Location	Peak Discharge Rate (m3/s)	
Outfall South of 68 Ave, East of 196 St. to Langley	0.5	1.4
Outfall at 65 Ave, East of 196 St. to Langley	0.3	0.6
Outfall Along 64 Ave, East of 196 St. to Langley	0.1	0.2
Total	**1.0**	**2.5**

6.5.2 Drainage Servicing Scheme

Based on the above guiding needs, constraints and opportunities, a storm drainage servicing scheme concept was developed for the area. The overall servicing scheme is shown in ***Figure 6.5.2*** and briefly described below:

Service Area

The service area comprises of a number of drainage catchment areas as shown in ***Figure 6.5.2*** and summarized in ***Table 6.5.1***. There are no external drainage areas on the upstream, which will flow through East Clayton. Based on the proposed land use, the percentage of the total impervious area (TIA) varies from 46%, to 90%. The objective of the proposed servicing scheme is to achieve a much reduced effective impervious area (EIA), in terms of the surface flows to the downstream receiving systems.

Servicing Scheme Components

The overall servicing scheme comprises of four key components:

- **On-lot measures** for in-ground disposal;
- **On-street measures** for in-ground disposal and conveyance;
- **Recharge Wells** for in-ground disposal, and
- **Community Detention facilities** for detention, infiltration and controlled discharge to receiving waters.

Each of these facilities is to provide in-ground disposal of rainwater during all meteorological events spanning from everyday rainfall events to very rare events, which statistically occur once in 100 years. These components are further described below.

6.5.2.1 On-Lot Measures

On-lot drainage areas will cover about 70% of the watershed. The paved areas comprising of the planned buildings, driveways, and patio areas will generate significantly high levels of surface runoff. In addition, traditional landscaping of grassed/treed areas does not encourage percolation of rainwater into the ground. Furthermore, during wet winter season the percolation capacity of soil is reduced due to antecedent rainfall and the evapotranspiration losses through tree leaves are also reduced due to cold temperature and reduced leaf cover.

Therefore, the adoption of innovative designs to manage on-lot drainage through in-ground infiltration is a must for this development area. For example, by reducing the total impervious surface area and by routing the drainage from these impervious areas through pervious areas/infiltration facilities (i.e. preventing direct connection to the drainage system), net stormwater runoff can be reduced significantly. Similarly, by maximizing the use of pervious soils in the grassed areas, and the use of below ground enclosed infiltration trenches, runoff can be reduced. These dispersion Best Management Practice (BMP) facilities and the shallow infiltration facilities will handle the frequent rainfall events of a recurrence interval of once every month. To achieve this level of control, these measures have to be implemented in each lot, at depths below those affected by construction related compaction of the natural sub-surface soils.

To meet the above objective of significantly higher in-ground infiltration of rainwater, the traditional land grading, landscaping and lot drainage design practices have to be modified. It is therefore recommended that practices and measures similar to the following be adopted, as part of the land development application approval process.

Design Guidelines

a. The in-ground disposal facilities should be capable of infiltrating at a rate of 12 to 24 mm/day (or about 120 to 240 cubic meters per ha. per day) over the total area, as a minimum.

b. The drainage from all paved areas such as roofs, patios, driveways should be directed into various infiltration facilities within the property and not directly connected to the street storm sewer system.

c. In all new developments, native vegetation and soil must be maintained until building permit applications are approved. All areas except those earmarked for buildings must be protected from heavy machinery related compaction to protect the natural permeability characteristics.

d. The land clearing, regrading and landscaping guidelines have to be changed from current practice. Topsoil must not be removed from the project site, but placed on the lots.

e. The on-site infiltration best-management practices (BMP) measures such as the following should be implemented:

- Surface soil displaced by construction of services/houses must be replaced on site to maximize yard coverage with porous/permeable soils;
- Soakaway pits, grassed swales and rock filled trenches along property perimeter;
- Directing all building runoff through grassed/treed areas into the below ground infiltration facilities;
- Re-use through rain barrel and underground storage collection, and,
- Promote evapotranspiration losses by growing trees and bushes in each lot.

These measures are also briefly described in Section 5, Part 1 of this report under "Green Infrastructure".

6.5.2.2 On-Street Measures

The street/lane network typically covers about 30% of the gross development area. Traditionally, over 90% of the roadways are paved and contribute high runoff volumes and flow rates. In addition, the roadway network has to function as the overland flow conveyance system to safely convey flows up to the 100-year level storms. The traditional curb / gutter, catchbasin / sewer design provides for collecting and conveying the runoff from streets. This system is traditionally designed to carry the "5-year" level flows.

The sustainable development approach provides an opportunity to direct street runoff into grassed swales on either side. For small rainfall events, these swales can be used to treat runoff and infiltrate the runoff by making the soil base pervious / porous.

The roadway swales and perforated storm sewer system will supplement infiltration capacity of the preceding components. These two components play the vital role of safe conveyance of all runoff, including those from heavy and infrequent events such as the once in 100-year events. Thus they form the backbone of a good drainage servicing scheme. By this function, they are able to convey flows to the deep infiltration wells, the community detention ponds and the receiving watercourses.

The effective stormwater run-off rate from the East Clayton catchment area will be reduced due to the implementation of various infiltration measures within each lot and along roadway swales. Therefore, the trunk conveyance system, which will convey flows to the detention ponds, has been sized to convey the 2-year design event. Trunks, which convey flows from the detention ponds, have been sized to convey the peak pond 5-year release rate. A preliminary layout of

the proposed trunk sewer system is shown in ***Figure 6.5.2*** and tabulated in ***Tables 6.5.2.*** and ***6.5.3.***

Appendix C also contains the Rational Method calculations used to size the storm trunk sewer system for the East Clayton catchment area for the both scenarios (with and without deep injection wells).

Design Guidelines

a. To effectively manage excess runoff resulting from all rainfall events (i.e., from 2 to 100-year recurrence frequency) a continuous overland flow path and a sub-surface storm sewer system are required as an integrated continuous conveyance system so as to minimize public inconvenience to an acceptable level. The preliminary layout shown in ***Figure 6.5.2*** and ***Table 6.5.2*** provides the overall guidelines.

b. The storm sewers must be placed within a continuous network of infiltration trenches to promote infiltration, and their design must ensure that they will be used to convey flow, only when the trench becomes saturated.

c. The integrated design of roadways and the on-street drainage facilities is a critical component of the follow-up design and construction process. The related key issues and needs are described in the Transportation Section of this report (under "street cross-sections"). These should be complied with on a site specific application basis.

d. As a minimum, the perforated sewer system must be designed to convey the full flows generated from the area for the 2-year level design storm, as per the City's current servicing standards. This downsizing of the design storm from the traditional 5-year level is a special provision for the East Clayton area that recognizes the value of the recommended plan to adopt in-ground disposal measures on an area-wide basis. The 2-year level flows are therefore, applicable only if all the on-lot and on street infiltration measures are fully adopted during the design and implementation of the site servicing of the developments in the area.

e. These perforated sewers must be used to promote infiltration by using soakaway pits and by perforating the sewers. This requires revising design standards on a NCP area specific basis.

6.5.2.3 Recharge (Deep Infiltration) Wells

As discussed in Section 6.5.1, the disposal of stormwater using distributed deep wells in the study area is included as a central component of the drainage servicing scheme. See ***Figure 6.5.3*** for a conceptual schematic of a typical well. As part of the preliminary servicing concept, these wells are included in those areas where the potential well flow capacity is estimated to be 30λ/s or over. The resulting flow distribution by each catchment area is tabulated in ***Tables 6.5.2*** *and* ***6.5.3***. This is a conservative approach as detailed information is currently not available. However, as recommended by the Hydrogeotechnical Consultants (Piteau Associates), additional field tests are required to maximize the potential recharge flow rate of each well and to increase the density of these wells over the total development area in East Clayton.

Design Guidelines

a. The recharge wells are to be designed as part as an integral part of the underground perforated sewer system for determining their locations, sizes and flow rate capacities and access requirements for future maintenance and operation. The case of large scale developments a similar concept must be used in conjunction with local, on-site servicing system. ***Tables 6.5.2*** and ***6.5.3*** demonstrates the design approach using the 2-year level storm which is equivalent to the traditional 5-year level design, as explained in Section 6.5.2.2.

b. The flow capacity targets for these wells are closely tied up with their location in the area and vary from 50 to 60 liters/second down to 10 liters/second. The expected reductions in peak flows resulting from various storms is their key performance measure. At this conceptual design stage, it has been set at a range of 30 to 60% of the peak runoff flow rates from each area during the 2-year storm, as shown in ***Table 6.5.2***. As these units are integral to the sizing of the storm sewer system and the community storage facilities, it is essential that, site specific field locations and their capacities be used at the next level of the servicing system design.

c. The discharge from these wells will replenish the regional groundwater aquifers. Therefore, the well design should incorporate filtration facilities as part of their design to improve the quality of the recharge water. As the watershed is a typical urban residential development and will stabilize over time, water quality is not expected to be a major impediment to their adoption as part of the servicing system components.

6.5.2.4 Community Detention Facilities

The sustainable development approach provides a practical opportunity to reduce the size/s of the detention ponds required to mitigate downstream impacts by implementing the in-ground disposal measures as discussed under lot drainage and street drainage. Appropriate storage volumes and locations to slow down the post-development flows to the above levels have been identified in the NCP and are discussed below. The detention ponds have to be designed and built in advance of developments.

The storage requirements of the stormwater storage facilities are dependent on the allowable peak flows to the downstream. The preliminary storage requirements and the peak pond outflow rates for each facility has been calculated based on the downstream constriction, the size of the contributing area and the flow reduction capacity of the upstream system's in-ground disposal measures. As part of the related computations, the inflow estimate to each stormwater storage facility has been calculated on the basis that there are deep infiltration wells in those areas classified as "Good and Moderate Potential". ***Figure 6.5.2.*** shows the approximate location of facilities and ***Table 6.5.4*** summarizes the approximate storage requirements for the 5-year, and 100-year design events for the option analyzed. ***Appendix C*** contains the stage/storage discharge curves for each of the ponds for the option that includes deep injection wells.

Table 6.5.4 summarizes the approximate pond construction, land, trunk construction, and deep well injection (if applicable) costs for both the option analyzed. As all stormwater storage facilities are 'wet' ponds, the land and construction costs associated with the dead storage have also been included. These costs are discussed in Section 7.0 of the report.

Design Guidelines

The City's current servicing standards should be followed for the location and design of these facilities. The storage values and the outflow rates should be based on site specific needs and constraints. The conceptual guidelines are, as discussed in this report, dependent on the planned drainage measures within each pond's contributing catchment. An initial estimate of these pond locations and their characteristics are presented in this report, as an overall guide to follow, during detailed designs.

6.5.3 Water Quality

The overall stormwater management plan recommended for East Clayton provides significant opportunities to protect the quality of stormwater generated in the area. Some of the related key measure which are part of the integrated Best Management Practices (BMP) approach include the following:

(a) Biofiltration measures: These are described in detail in ***Section 5*** of the report under "Green Infrastructure", and includes infiltration measures within each lot/building site; roadway swales, biofiltration facilities in developments and along roads, soil erosion control particularly during construction related surface regrading and stockpiling/moving of excavated/imported soils;

(b) Recharge (Deep Infiltration) Wells: All deep infiltration wells proposed for the area will be designed to include pretreatment of stormwater. These units will receive runoff from the watershed after being treated through the green infrastructure components such as the grassed swales, biofiltration ditches.

(c) Stormwater Detention Ponds: The stormwater ponds proposed for East Clayton are of the detention type. These facilities improve the quality of stormwater by promoting particle settlements. As well, those facilities can be designed to include additional biofiltration benefits by incorporating wetland components as part of their physical design. Furthermore, these detention facilities, at some locations in the watershed, could be used to supply improved water to the deep infiltration wells, thereby further enhancing water quality management in the area.

(d) Landscape Maintenance: There is an opportunity to promote environmentally friendly garden and landscape maintenance practices in the area, by developing appropriate guidelines for the benefit of and use by East Clayton residents. By encouraging such source control practices, contamination can be reduced.

6.5.4 Servicing Scheme Summary

The following is a summary overview of the proposed servicing scheme:

#	Component	Performance Role	Locations
1	Tree canopy • Trees/bushes in each lot boulevards, parks, etc.	Facilitate evapo-transpiration (E/T), add trees with high E/T potential in winter and summer.	All parts of the watershed.
2	On-Lot Measures • Eliminate direct connections from lots to street drainage system and • Adopt dispersion BMPs such as roof leader splash pads, vegetated flow paths, sheet flows on grassed/green areas, roadway swales.	To disperse stormwater runoff into pervious areas from paved areas and facilitate infiltration 0.5-1.0mm/day, or more where feasible.	All parts of the watershed with particular emphasis on paved area drainage redirection into vegetated and grassed areas.

#	Component	Performance Role	Locations
3	<u>On-Street Measures</u> Shallow infiltration BMPs such as Infiltration trenches, perforated pipes, buried in dispersion trenches, biofiltration swales, grassed swales along roads.	Facilitate collection of runoff generated from lots, roads, etc. and then promote infiltration as well as safe conveyance to detention facilities and receiving watercourses. • Minimum infiltration rates of 0.5 to 1.0 mm/hr. • Conveyance capacity to be at least 2-year level peak flow rates from the contributing watershed.	Along roadways, lanes and other drainage right of ways and making a continuous under ground/above ground system to convey storm runoff, eventually to the receiving watercourses.
5	<u>Recharge Wells</u> Deep infiltration wells are conceptually shown in ***Figure 6.5.3.***	To recharge the deep aquifers under Clayton area. The recharge rates will vary from 10 λ/s to 50 λ/s or more, as shown in ***Figure 6.5.1.***	Those areas marked as "Good, moderate and low potential" as shown in ***Figure 6.5.1.***
6	<u>Stormwater Ponds</u> Stormwater Detention facilities on a regional basis and within strata developments, commercial, and industrial sites.	To detain net runoff from upstream areas and then gradually release to the downstream receiving system. These facilities play a critical key role in managing flows into the existing downstream systems which may have capacity constraints. The minimum storage /area requirements for each contributing watershed are given in ***Table 6.5.4.***	Specific locations as shown in ***Figure 6.5.2***. Those locations are to be integrated with other community services such as parks, playing fields, etc., to facilitate cost reductions through joint use.

SECTION 6.6

IMPLEMENTATION

6.6.1 Implementation

The following recommendations are made to support the implementation of the East Clayton servicing plan:

6.6.1.1 Changes to GNCP Recommended Network

1. City staff should advise Council of the changes to the GNCP Road Network Plan and obtain Council's approval of the Revised GNCP Road Network Plan. The GNCP Plan should then be amended.

6.6.1.2 Further Studies and Analysis

2. The City should consider addressing the key issues and concerns expressed during the Charette process, either through further studies and analysis, or possibly through a "pilot project" in East Clayton, as follows:

6.6.1.2.1 Drainage

- Confirm required spacing and locations of trees to ensure swale drainage scheme can operate effectively. Determine if this spacing would be sufficient for aesthetics/urban forest policies.

- Develop detailed design/maintenance criteria for infiltration pits/swales, including depth, maximum/minimum grades, type of materials, sizes of pipes, swale dimensions and slopes.

- Develop design/cross section/spacing criteria for lawn drains in pits/swales connecting to perforated pipe.

- Confirm if drainage scheme in street cross sections needs to be larger or altogether different for varying densities and built forms

- Investigate drainage system configuration at driveway crossing and how to ensure continuous surface flow during major storm events while maintaining functionality of driveway. Establish design standards for driveway crossings of drainage system. Confirm if there would be significant loss of infiltration at driveway crossings, such that the drainage concept is compromised in areas with high numbers of driveways.

- Develop innovative and site specific best management measures to achieve bio-filtration within a storm sewer/detention pond system.

6.6.1.2.2 Street Trees

- Develop "performance measures" for the urban forest in East Clayton, such as percentage of canopy coverage for each street type.

- Develop a range of spacing of trees for longevity/cost/aesthetics for each street type, and listing of appropriate species for Clayton soil and drainage conditions.

- Confirm that in situations without rear lanes, where driveways, transformers, street trees and infiltration trenches are all competing for space in the boulevard, there would be sufficient area remaining for street trees. If not, re-consider allowing driveways or develop alternative cross section standards for development with driveways.

6.6.1.2.3 Utilities

- Obtain formal approval of street cross sections from all private utility companies.

- Develop alternative street lighting features, such as special decorative poles and pedestrian-scale lighting standards.

- Consider reduced street lighting levels on Minor Collector and Local roads to reduce energy consumption, with a full review of liability.

6.6.1.2.4 Parking

- Investigate alternative options to prevent drivers from parking on infiltration trenches/boulevards in Collector and Local roads; establish appropriate spacing and design criteria for such measures. Investigate liability issues of alternative options.

6.6.1.2.5 Alternative Surface Materials

- Investigate options for alternative pavements for roads and multi-use pathways (e.g., grass block, permeable pavements, gravel, etc.). Review both capital and maintenance costs.

- Determine if alternative/permeable pavements are necessary in any of the street cross sections for the proposed drainage concept to work effectively. Confirm if traditional asphalt would be acceptable.

6.6.1.2.6. Driveways

- Determine the conditions under which use of driveways should be considered appropriate.

- Develop new design standards/guidelines for shared driveways to complement the "sustainability" concept and reduce impact of additional hard surface (width, vertical grade, flaring on site, tandem parking, porous pavement/gravel, etc.).

- Investigate need for modifying Local and Collector road cross sections to account for driveways.

6.6.1.2.7 Intersection Design and Plan Elements

- Develop a series of generic functional intersection layouts, with all potential configurations represented, in order to establish intersection design guidelines, including design vehicles.

- Develop alternative design guidelines for accommodation of truck turning movements. For example, sweeping into opposing lanes/mounting curbs/sidewalks could be acceptable for large vehicles at Local and Minor Collector intersections to minimize turning radii/walking distances.

- Consult with the City's waste collection contractor, especially in regard to turning sight distance in rear lanes.

- "Prove out" the proposed street cross sections by designing a neighourhood with the new cross sections, which includes centre-line profiles, plan views and intersection layouts of various street types, with street trees, utilities, on-street parking, lanes and driveways, and **drainage schemes all incorporated**.

6.6.1.2.8 Bike Network

- Confirm the proposed on-street bicycle route system with the City of Langley City and Township of Langley.

- Review vertical grades for the proposed bicycle network routes and confirm proposed routes are acceptable.

- Identify what street cross section changes, if any, are required to incorporate the proposed on-street Greenways. Establish design guidelines for On-street Greenways.

6.6.1.3 Development Process

3. Give consideration to the development of a unique Subdivision and Control Bylaw for East Clayton (and possible the whole Clayton area, if sustainability principles are also applied beyond the boundaries of East Clayton), which address street standards and design guidelines, drainage performance measures, implementation issues, etc.

4. Prepare both developers and City staff involved in land development and transportation to support the East Clayton NCP, by training them in the application of this new bylaw, as well as the overall development concept for East Clayton and sustainability principles in general.

SECTION 7.0
DEVELOPMENT PHASING & FINANCING

7.1 Development Phasing

A general land use plan for the Clayton Neighbourhood was approved by the City of Surrey Council in February 1999, permitting the East Clayton NCP Area to proceed with the preparation of a detailed Land Use and servicing plan.

At present, the East Clayton NCP Area is substantially rural in nature, with a small subdivision of acreage properties having urban services (The Aloha Subdivision). Rural roadways, surface storm drainage systems, and a limited grid of watermains, and individual septic disposal systems presently service the area.

At full build-out condition, the proposed East Clayton NCP land use plan will result in the development of approximately 4900 residential units along with a business park of over a million square feet. It is expected that the area's population will increase by about 13,000, based on average density rates for all development categories. At the maximum density proposed, the final population could reach 20,000.

To effectively service the proposed development, the municipal infrastructure comprising the roadways, sanitary sewer, watermains and the storm drainage system have to be upgraded and extended, as per the servicing plans presented in the preceding section. The salient features of the servicing scheme are summarized below from a perspective of identifying the potential development phasing pattern and the DCC financing eligible elements of those infrastructure components.

Sanitary trunk sewers have been extended along 68 Avenue to 188 Street for a recent high school construction. This will effectively service the Cloverdale sub-basin area 'B'. Servicing of the McLellan and Langley sub-basins (sub-basin area 'A") cannot proceed until the Langley By-Pass Sewer is in place from the GVRD Trunk Sewer at 188 St. and 52 Avenue to 64 Avenue at 196 Street. It is important to note that no development can proceed within Catchment A without the completion of the first phase of the Langley By-pass sewer to relieve the current capacity constraints

The ground topography divides the NCP area into three significant drainage and sanitary sub-basin areas, as shown in ***Figure 7.1***. The two major basin areas are the West Basin B abutting 188 Street draining west to Cloverdale Creek, and the East Basin A comprising the majority of the west half of the plan draining to McClellan Creek. A smaller sub-basin consists of an area abutting 72 Avenue and 196 Street that drains to the Township of Langley. The constraints for each sanitary and storm drainage sub-basin will largely govern the ultimate development phasing.

The downstream lowland drainage and flooding condition is a significant constraint to further developemnt in the Cloverdale Creek sub-basin tributary to the Serpentine River System. The lowlands flood control program is expected to be completed by the Year 2008. In order for development to proceed, the full implementation of local infiltration systems, stormwater pond facilities, and deep infiltration wells will be required in advance of development.

A servicing limit north of 72 Avenue has been established based on the proposed conceptual plan for storm and sanitary trunk systems. Actual development of the area north of 72 Avenue, servicable from the south will be subject to confirmation of servicing feasibility through detailed survey and engineering designs.

The existing grid of trunk watermains feeding the 115m pressure zone for the plan area must be expanded as development proceeds to reliably provide projected fire flows from the existing Clayton Pumping Station and Reservoir south of 72 Avenue, west of 192 Street. The rate of development in Clayton will dictate when the existing Clayton High Pressure Pump Station will need to be upgraded.

The existing rural arterial road network, collector road and local road network will have to be upgraded as the area develops to meet both access and circulation requirements. This includes the re-alignment of 192 Street arterial at Fraser Highway, and provision of the 196 St. arterial corridor.

7.2 Infrastructure Financing

The financial analysis was based on the following approach and planning assumptions:

1. Land use Plan and Population projections (October 1999) were provided by the City of Surrey Planning Department.

2. The Full Build-Out condition was assessed for each municipal utility to confirm all required future DCC Infrastructure elements for the Plan Area.

3. Current DCC Policies and Principles require that for NCP Build-Out, based on Current (February 1999) DCC Rates, revenues balance or exceed expenditures for each of the Infrastructure elements as summarized in ***Table 7.6.***

4. On an annual basis, DCC revenues must balance expenditures or be addressed by agreement by the benefiting developers. The City will not finance interim works. However, the City will make every effort to assist fair cost recovery to developers who have up-fronted DCC eligible works that benefit a larger area than the development application. This arrangement will be necessary to finance DCC eligable stormwater elements.

Table 7.1 summarizes the projected number of units for each type of land use for the East Clayton NCP and the potential revenues for the various DCC components (storm, sanitary, water and collector roads) based on current– DCC Rates (By-law 13476) and the medium range of density. A significant portion of the single family units will be in the form of compact lots, for which the City is considering lower DCC rates. Therefore, it is anticipated that the surplus DCC revenues will be lower than that predicted in Table 7.6.

DCC Eligible Infrastructure elements for the East Clayton Plan are summarized as follows:

- **Collector Roads** – Summary of collector road elements required for build-out in ***Table 7.2*** **and** ***Figure 7.2***

- **Sanitary System** - spreadsheet and schematic of Sewer DCC elements required in the NCP Area Plan for build-out (***Table 7.3 and Figure 7.3)***

- **Water System** – spreadsheet and schematic of Water DCC elements required in the NCP Area Plan for build-out (***Table 7.4 and Figure 7.4)***

- **Storm Drainage System** – spreadsheet and schematic of Drainage DCC elements required for build-out (***Table 7.5 and Figure 7.5)***

Table 7.6: **Preliminary Summary of Projected Development Cost Charge (DCC) Revenue and Expenditures at Full Build-Out (1)**

	Projected DCC Revenue (2)	**Projected DCC Expenditures (2)**	**Balance + ve (-ve)**
Collector Roads	$6,091,000	$5,840,000	$251,000
Sanitary Sewers	$4,449,000	$4,430,000	$18,000
Water	$4,743,000	$2,470,000	$2,273,000
Storm	$7,557,000	$4,810,000	$2,747,000

Note:

(1) ***The City of Surrey collects DCC's on a community basis and*** *not on a NCP or area basis. This table is presented to show that the NCP can be self financed. The table also shows the magnitude of DCC eligible works to service the East Clayton NCP Plan area.*

(2) *Values rounded to nearest $1,000*

The Projected DCC Revenues exceed estimated costs for all DCC Infrastructure elements within the East Clayton area.

Land Use	Units	Ave.	Sanitary		Water		Storm		Arterial		Collector		Parks	
		Size	Rate	Revenue	Rate	Revenue	Rate	Revenue	Rate	Revenue	Rate	Revenue	Rate	Revenue
RA	35	n/a	950	33,250	1020	35,700	4740	165,900	5620	196,700	1370	47,950	5510	192,850
6-10 UPA	451	n/a	950	428,450	1020	460,020	2370	1,068,870	5620	2,534,620	1370	617,870	8380	3,779,380
10-15 UPA	480	n/a	950	456,000	1020	489,600	1400	672,000	5620	2,697,600	1370	657,600	8380	4,022,400
15-25 UPA	1307	n/a	950	1,241,650	1020	1,333,140	1400	1,829,800	5620	7,345,340	1370	1,790,590	8380	10,952,660
25-45 UPA	1766	1200	0.55	1,165,560	0.59	1,250,328	0.92	1,949,664	2.51	5,319,192	0.61	1,292,712	5.11	10,829,112
Comm/Res	312		600	187,200	640	199,680	590	184,080	3150	982,800	770	240,240	6670	2,081,040
Live/Work	392		950	372,400	1020	399,840	1400	548,800	5620	2,203,040	1370	537,040	8380	3,284,960
Work/Live	141		950	133,950	1020	143,820	1400	197,400	5620	792,420	1370	193,170	8380	1,181,580
Commercial (Office)	1,032,000		300	309,600	320	309,600	310	319,920	1850	1,909,200	450	464,400	0	
Commercial (Spec)	359,000		300	107,700	320	107,700	1540	552,860	2530	908,270	620	222,580	0	
Commercial (Neigh)	44,000		300	13,200	320	13,200	1540	67,760	2530	111,320	620	27,280	0	
Total				4,448,960		4,742,628		7,557,054		25,000,502		6,091,432		36,323,982

Table 7.1
East Clayton Financial Projection (DCC Revenues

8.0 COMMUNITY SERVICES AND AMENITIES

8.1 General

In accordance with City Council's policy, in order to address the amenity needs of the proposed new development in East Clayton, at the time of rezoning or building permit issuance, development proposals will be required to make a monetary contribution toward the provision of new police, fire protection and library services and toward the development of the parks, open space and pathways.

The monetary contributions toward police, fire and library materials will offset the capital costs of providing these services to the new development and are applied on a standardized basis in all of Surrey's Neighbourhood Concept Plan areas. The monetary contributions toward park, open space and pathway development are based upon an estimate of the capital costs of these improvements for this particular Neighbourhood Concept Plan area. The total cost is divided among the anticipated number of dwelling units and acreages (for non-residential) to ensure an equitable contribution arrangement.

The sustainable design of the East Clayton community has resulted in a major reduction in park and open space development costs due to the dual function of many of these areas for both recreation and stormwater management purposes. The natural features of the area (i.e., watercourses) are considered to be important components of both the natural passive recreation system and stormwater management strategy and their development for these dual purposes will therefore be paid for both by amenity contributions and through the City's Development Cost Charge program.

8.2 Parkland Development

The East Clayton community will contain two neighbourhood school/park sites (one with a storm water pond/ biofiltration amenity area), two riparian park areas, two linear parks (greenways) and a series of six neighbourhood parks.

The village and civic centre for the entire Clayton area is located immediately west of East Clayton (west of 188 Street). An elementary and secondary school are located in the village centre along with a larger community park. The village centre may also contain civic buildings and other institutional uses such as churches or senior's facilities. It is envisioned that the public spaces in the village centre will contain street furniture, light standards, walkways, urban plazas and special landscaped areas.

While the village centre is mostly located outside of East Clayton proper, the future development in East Clayton will benefit from the civic features, parks and other amenities. The specific design guidelines and precise types of amenities in the village centre will be determined when the detailed Neighbourhood Concept Plan for this area is prepared. However, it is prudent for the City to set up a development fund for the village centre in conjunction with initial development in East Clayton. A contribution of $250,000 is based upon East Clayton's share (2 neighbourhoods out of 8) of a total of $1,000,000 to assist with the development of Clayton's village centre.

Two gateway features will be constructed at the 192 Street entrance into East Clayton. The westerly one will be constructed and be integrated with the storm water detention pond as an attractive water feature. Public art, provided either through the City's capital construction program or through private sector

sponsorship should be incorporated into the gateway features, and/or at other locations in the civic centre area.

The estimated cost of developing the park-and related amenities in the future East Clayton community is $3,788,254. ***Table 8.2*** outlines the features of the parks and amenities and their associated costs. The parks and amenities are to be funded in part through amenity contributions obtained through the development process and partly through the City's Development Cost Charge (DCC) program.

8.3 Library and Library Materials

A study of library requirements in Surrey's new neighbourhoods has determined that a contribution of $115.68 (in 2000 dollars) per dwelling unit (non-residential development is exempt) would be appropriate to cover the capital costs for library materials and services. Consequently, a total of $592,629 will be contributed from this neighbourhood towards materials such as books, computers and CD's.

8.4 Fire and Police Protection

Future development in this neighbourhood will require upgrading of existing fire and police protection facilities. A study of fire protection requirements in Surrey's new neighbourhoods has determined that a contribution of $222.11 per dwelling unit and $205.64 per acre non-residential (in 2000 dollars) would be appropriate to cover the capital costs for fire protection. Similarly, a contribution of $51.42 per dwelling unit and $888.46 per acre non-residential would be appropriate to cover the capital costs for police protection. This results in a total contribution of $1,181,102 toward fire protection and $273,431 toward police protection.

8.5 Summary of Funding Arrangements

A summary of the applicable amenity contributions (per dwelling unit or hectare/acre) and the estimated revenue the City can expect to receive from the East Clayton Neighbourhood Concept Plan area is illustrated in ***Table 8.5.***

Table 8.2 Parkland Development and Amenities: Estimated Costs and Funding Sources

Park or Amenity Feature	Total Estimated Cost	Portion Funded by Amenity Contributions	Portion Funded by City (DCCs)
Westerly School/Park Site includes soccer field, baseball diamond, washrooms, benches, bike racks, log rail fencing, trails, spray park, and a playground	$780,650	$444,385	$336,265
Easterly School/Park Site includes soccer field, baseball diamond, washrooms, benches, bike racks, log rail fencing, trails, retention pond/water amenity, and playground	$774,050	$774,050	n/a
Neighbourhood/Local Parks local parks ranging in size from 0.3 to 1.7 acres one local park will have a playground includes landscaping, clearing and grubbing, log rail fence construction around perimeter of parks and construction of roads adjacent to the parks	$713,456	$713,456	n/a
Major Greenway north/south greenway is about 16 acres includes landscaping, clearing and grubbing and log rail fence construction	$1,053,668	$1,053,668	n/a
Riparian and Natural Areas includes forest management, pathways and a casual playfield	$152,550	$52,550	$100,000
Linear Paths includes about 0.898 hectares of paths @ $60,000 per ha	$53,880	$53,880	n/a
Gateway Features (2) at Community Entrance (192 Street diversion)	$10,000	$10,000	n/a
Contribution Toward Village Centre Amenities	$250,000	$250,000	n/a
Total: Amenity Contributions		$3,351,989	
Total: DCC Program			$436,265
TOTAL COST: PARK/OPEN SPACE DEVELOPMENT	**$3,788,254**		

Table 8.5 Amenity Contributions

EAST CLAYTON NEIGHBOURHOOD CONCEPT PLAN AMENITY CONTRIBUTIONS			
	Per Acre Contribution All residential *Approx. 5,123 dwelling units (mid-range)*	**Per Acre Contribution All non-residential** *Approx. 48.66 acres (19.58 ha.)*	**Anticipated Revenue**
Police Protection	$51.42 per dwelling	$205.64 per acre	$273,431
Fire Protection	$222.11 per dwelling	$888.46 per acre	$1,181,102
Park/Pathways Development	$654.30 per dwelling	n/a	$3,351,989
Library Materials	$115.68 per dwelling	n/a	$592,629
Total Contribution (per unit or acre)	**$1,043.51 per dwelling**	**$1,094.10 per acre**	
Total Anticipated Revenue			$4,806,522

9.0 IMPLEMENTATION

9.1 General

Following the approval of the East Clayton Neighbourhood Concept Plan, a number of implementation initiatives will be undertaken and are needed to ensure that development in East Clayton proceeds in accordance with the approved land use policies, guidelines and servicing strategies. The following initiatives will help determine the nature of development in East Clayton and describe some of Surrey's development application processes which may apply to individual developments.

9.2 Implementation Guidelines to Achieve Residential Density and Diversity

Each residential land use designation in the East Clayton Neighbourhood Concept Plan (NCP) contains a density range. The lower range is the maximum density allowed in the land use designation. The higher ranges are density bonuses which may only be achieved by the use of a variety of dwelling unit types and/or lot sizes in a compatible arrangement within a block and/or development site. A development site is typically defined as the area included within individual development applications. The following table describes how the higher density ranges may be obtained to achieve the density and diversity objectives, and thus to implement sustainable development principles.

9.3 Amendments to Surrey's Zoning By-law No. 12000

Bonus Densities and Amenity Contributions

Pursuant to Sections 378 and 963.1 of the Municipal Act, the current Zoning By-law No. 12000 has to be amended in order to accommodate bonus densities in exchange for contributions towards the specified amenities that have been identified in the final Neighbourhood Concept Plan (see Section 8 of this Report). An amendment by-law will be prepared and forwarded for consideration by City Council.

Zoning Regulations Unique to East Clayton and Achieving Sustainable Development

The East Clayton Neighbourhood Concept Plan identifies a number of performance standards that should be achieved in order for development to meet the sustainable principles premised in the plan. In some cases, there may be discrepancies between Surrey's current zoning regulations (e.g., prescribed setbacks or parking requirements) and the recommendations in the Neighbourhood Concept Plan pertaining to specific types of development proposed for East Clayton. In theses cases, where justified in the East Clayton context, specific regulations for East Clayton may be incorporated into Surrey's Zoning By-law. The appropriate variances would be confirmed in conjunction with the initial development applications after which the applicable Zoning By-law amendments would be prepared and forwarded for consideration by City Council.]

9.4 Initial Development Applications

The initial development applications for properties in East Clayton will be invited to participate in a collaborative design and application review process to research, design and apply the various sustainable initiatives into the proposed development. As pilot projects, the first development applications may be eligible for assistance

Residential Land Use Designation & Density Range (as per NCP)	Density Proposed [1]	Mix of Dwelling Types/Lot Sizes Required	Applicable Zones as per Zoning By-law [2]
Half-acre residential (Aloha Estates) 5-10 units per hectare (2-4 units per acre)	Base Density: 5 units per hectare (2 units per acre)	1 single family dwelling unit per lot (i.e., on a ½ acre lot)	RH, RH-G
	Bonus Density: 5-10 units per hectare (2-4 per acre)	Maximum 4 dwelling units per acre including one principal dwelling per ½ acre lot, with coach house or other ancillary dwelling unit on at least one of the ½ acre lots	Combination of: RH, RH-G; CD to allow one coach house per lot [3]
Low Density 5-25 units per hectare (6-10 units per acre)	Base Density: 15 units per hectare (6 units per acre)	1 single family dwelling unit per lot (up to 6 upa)	RF
	Bonus Density: 15-20 units per hectare (6-8 upa)	Combination of:[4]	Combination of:
		1 single family dwelling unit per lot (up to 6 upa), and	RF, RF (G)
		1 single family dwelling unit per lot with coach house or other ancillary dwelling unit (up to 8 upa)	CD to allow coach house; RF-SS
	Bonus Density: 20-25 units per hectare (8-10 upa)	Combination of: [4]	Combination of:
		1 single family dwelling unit per lot (up to 6 upa)4, and	RF, RF (G)
		1 single family dwelling unit per lot with coach house or other ancillary dwelling unit (up to 10	CD to allow coach houses, RF-SS
		1 single family dwelling unit per lot (up to 10 upa), and/or	RF-12
		Duplexes	RF-SD, RM-D
Medium Density 25-37.5 units per hectare (10-15 units per acre)	Base Density: 25 units per hectare (10 units per acre)	1 single family dwelling unit per lot (up to 10 upa)	RF-12
	Bonus Density: 25-30 units per hectare (10-12 upa)	Combination of: [4]	Combination of:
		1 single family dwelling unit per lot (up to 10 upa) 4, and,	RF-12
		1 single family dwelling unit per lot (up to 10 upa) with coach house or other ancillary unit,	CD to allow coach house
		Duplexes, and/or,	RF-SD, RM-D
		1 single family dwelling unit per lot (up to 12 upa)	RM-9
	Bonus Density: 30-37.5 units per hectare (12-15 upa)`	Combination of: [4]	Combination of:
		1 single family dwelling unit per lot (up to 12 upa) 4, and,	RF-12
		1 single family dwelling unit per lot (up to 12 upa) with coach house or other ancillary unit,	CD to allow coach house
		Duplexes, and/or,	RF-SD, RM-D
		1 single family dwelling unit per lot (up to 15upa) with coach houses or other ancillary unit	RM-10

[1] Density refers to net density which excludes existing and future roads, watercourses and other undevelopable areas. The density proposed refers to that proposed in an individual development (i.e., rezoning) application.

[2] Following the approval of the NCP, special zoning regulations will be proposed for East Clayton to allow the certain "sustainable" standards to be applied.

Residential Land Use Designation & Density Range (as per NCP)	Density Proposed [1]	Mix of Dwelling Types/Lot Sizes Required	Applicable Zones as per Zoning By-law [2]
Medium-High Density 37.5-62.5 units per hectare (15 - 25 upa)	Base Density: 37.5 units per hectare (15 upa)	1 single family dwelling unit per lot	RF-9
	Bonus Density: 37.5-50 upa	Combination of: [4]	Combination of:
		1 single family dwelling unit per lot (up to 15 upa) 4, and,	RF-9
		1 single family dwelling unit per lot with coach house or other ancillary unit, and/or,	CD to allow coach house
		Duplexes, and/or,	RF-SD, RM-D
		Detached and semi-detached units (Strata), and/or,	RM-10
		Townhouses/rowhouses up to 25 upa	RM-15, RM-19, RM-30, CD
	Bonus Density: 50-62.5 units per hectare (20-25 upa)	Combination of: [4]	Combination of:
		1 single family dwelling unit per lot (up to 15 upa) 4, and,	RF-9
		1 single family dwelling unit per lot with coach house or other ancillary unit, and/or,	CD to allow coach house
		Duplexes, and/or,	RF-SD, CD
		Detached and semi-detached units (Strata), and/or,	RM-10, CD
		Townhouses/rowhouses up to 25 upa	RM-15, RM-30, CD, RM-19
High Density 62.5-112.5 units per hectare (25-45 units per acre)	Base Density: 62.5 units per hectare (25 units per acre)	Townhouses up to 25 upa	RM-15, RM-30, CD
	Bonus Density: 62.5-87.5 units per hectare (25-35 upa)	Combination of: [4]	Combination of:
		Townhouses up to 25 upa 4, and,	RM-15, RM-30
		1 single family dwelling unit with coach house or other ancillary unit, and/or,	RF-9, CD to allow coach houses
		Duplexes, and/or,	RF-SD, CD
		Detached and semi-detached units (Strata), and/or,	RM-10, CD
		Townhouses/rowhouses up to 35 upa, and/or,	RM-15, RM-30, CD, RM-19
		Apartments up to 45 upa	RM-30, RM-45
	Bonus Density: 87.5-112.5 units per hectare (35-45 upa)	Combination of: [4]	Combination of:
		Townhouses up to 25 upa 4, and,	RM-30, RM-45
		1 single family dwelling unit with coach house or other ancillary unit, and/or,	CD to allow coach houses
		Duplexes, and/or,	RF-SD, CD
		Detached and semi-detached units (Strata), and/or,	RM-10, CD
		Townhouses/rowhouses up to 45 upa, and/or,	RM-15, RM-30, CD, RM-19
		Apartments	RM-30, RM-45

[3] As of April 1, 2000 policies and regulations pertaining to coach houses are in process. See the Planning & Development Department for status of the applicable regulations.

[4] Where more than one dwelling type/lot size is listed as candidates for land use mix, a concentration of more than 70% of an individual dwelling type/lot size should be avoided.standards

from engineering experts who will work with the developer's consultants in designing the various infrastructure systems consistent with the East Clayton Neighbourhood Concept Plan. In addition, a team consisting of City staff, agencies and consultants will be established and in consultation with the Headwater's Advisory Committee, will work with the initial applicants in designing and implementing the development projects to meet the identified sustainable development objectives.

9.5 Development Applications for Lands North of 72 Avenue

Certain lands immediately north of 72 Avenue and east of 188 Street have been identified as possibly being able to be serviced in conjunction with lands on the south side of 72 Avenue. The serviceability of these lands will depend upon site surveys and detailed engineering infrastructure design criteria at the time of application for each development parcel.

The serviceable lands on the north side of 72 Avenue will need to be redesignated from Suburban to Urban in Surrey's Official Community Plan in order to accommodate urban development. Therefore, a rezoning application will need to be accompanied by an application to amend the Official Community Plan.

9.6 City Project Team

A project team consisting of City staff from Planning, Engineering (Planning, Land Development and Operations) and Parks will be established to guide the overall implementation of the Neighbourhood Concept Plan, to educate City staff and other stakeholders, to ensure consistent practice and operation and to evaluate and monitor the various aspects of neighbourhood and infrastructure performance as development proceeds.

9.7 Design Guidelines - Neighbourhood Character Studies and Registered Building Schemes

The Neighbourhood Concept Plan contains design guidelines for land uses that are intended to provide general direction to achieve the desired neighbourhood character, preserve and enhance natural spaces, encourage pedestrian access to destination areas, facilitate social interaction, and achieve the overall development objectives defined in the final Neighbourhood Concept Plan. The design guidelines make recommendations regarding the interface between residential areas and public spaces; landscaping and lighting of boulevards and multi-use corridors as well as architectural elements appropriate for residential and commercial buildings. These guidelines will be used by City staff and the developers to co-ordinate the design among individual development applications and to ensure that the desired neighbourhood character is achieved in East Clayton.

9.8 Live/Work & Work/Live Developments

The concept of designing and building new live/work developments, particularly in the Surrey context, is yet untried, although market research suggests that there is a pent up demand for this unique and innovative housing/business accommodation. The benefits of this type of development are that it would provide more choice and affordability in the housing/business market and could serve as an incubator for small businesses in Surrey.

As of April, 2000, the City is undertaking research and is developing policies and regulations for the applicability and implementation of live/work developments in Surrey. A report and recommendations arising from this study will be forwarded to City Council for consideration, and consequent policies and zoning mechanisms will be implemented in conjunction with live/work development proposals.

9.9 Coach Houses and Other Ancillary Dwelling Units

As of April, 2000 the City of Surrey is preparing policy guidelines for the development of affordable secondary dwelling units (granny flats, garage apartments, coach houses, etc.) to encourage the efficient use of housing stock and infrastructure and to provide alternative housing options. Potential development applicants should contact the Planning & Development Department for the latest policy guidelines pertaining to secondary dwelling units.

9.10 Community Infrastructure Maintenance Plan and Community Stewardship

The unique streetscapes including the swales, infiltration wells and urban forestry profile in East Clayton will require a different maintenance program than typical curb/gutter type of developments in Surrey. Consequently, the property owners may need to take on the responsibility of maintaining the streetside swales, and ensuring that they do not become blocked. There will also need to be some community co-operation to ensure that cars do not park on the swales and to ensure that the individual lots retain the maximum porous surface materials to allow infiltration into the ground by rainwater.

APPENDICES

APPENDIX A

A.1 East Clayton Proposed Street Standards
A.2 East Clayton NCP Appropriate Application of Traffic Calming Measures

APPENDIX A.1
TRANSPORTATION BACKGROUND TECHNICAL REPORTS

1. "Clayton Generalized NCP Transportation Planning Stage 1 Report: Background Data, Issues, Objectives, Opportunities and Constraints", May 5, 1997, Reid Crowther & Partners Ltd.

2. Technical Memo entitled "Clayton Generalized Neighbourhood Concept Plan: Major Road Network Requirements", December 12, 1997, Reid Crowther & Partners Ltd.

3. Technical Memo entitled "Refinements to Clayton GNCP Road Network", May 14, 1998, Reid Crowther & Partners Ltd.

4. "Clayton Generalized NCP: Engineering Servicing Plan Report", November, 1998, Reid Crowther & Partners Ltd.

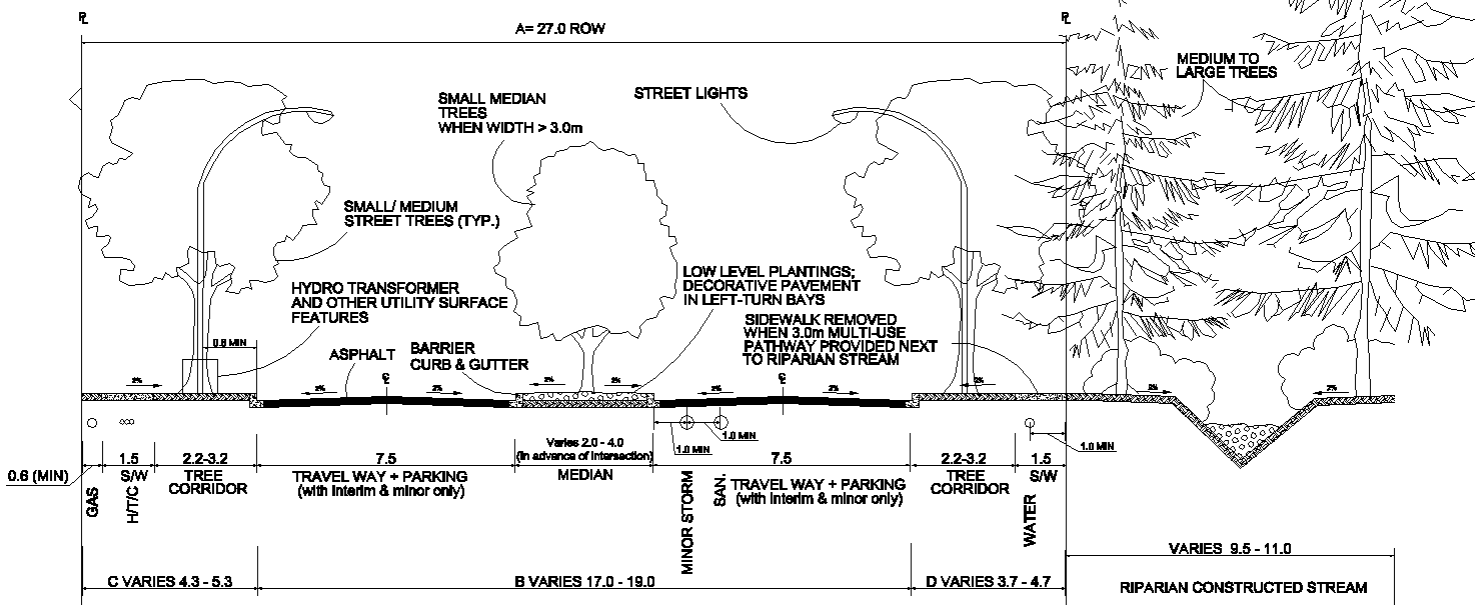
5. "East Clayton NCP Sustainable Development: Transportation, Drainage, Water Supply and Sanitary Servicing Issues and Constraints", April, 1999, Reid Crowther & Partners Ltd.

6. "East Clayton NCP Sustainable Development: Transportation and Drainage Servicing Concept Plan", July 27, 1999, Reid Crowther & Partners Ltd.

7. "Clayton Transportation Modelling", October 13, 1999, Reid Crowther & Partners Ltd.

ARTERIAL	MAJOR	PARKWAY (ULTIMATE & INTERIM)
		RIPARIAN PARKWAY (ULTIMATE & INTERIM)
	MINOR	PARKWAY

A



NOTE:

1. ULTIMATE MAJOR PARKWAY HAS 4 TRAVEL LANES, INTERIM AND MINOR PARKWAYS HAVE 2 TRAVEL LANES WITH PARKING
2. MEDIAN COULD BE WIDENED TO 4.0m TO ALLOW FOR TREES, WITH ROW = 29.0m
3. INTERIM STANDARD OF MAJOR/ MINOR PARKWAY HAS GRASS SWALE IN MEDIAN & TRAVEL WAYS 6.0m WIDE.
4. RIPARIAN ZONE WILL WIDEN BY 1.5m AND ONE SIDEWALK REPLACED BY A 3.0m MULTI-USE PATHWAY WITHIN THE RIPARIAN ZONE AS PART OF THE PROPOSED GREENWAY NORTH OF 70 AVENUE.
5. MINOR STORM SYSTEM WITH CATCH BASINS TO DRAIN ROAD SURFACE ONLY; RUNOFF TO BE DIRECTED TO WET PONDS.
6. HYDRO/TEL/CABLE MAY BE OVERHEAD ON POLES.

Reid Crowther

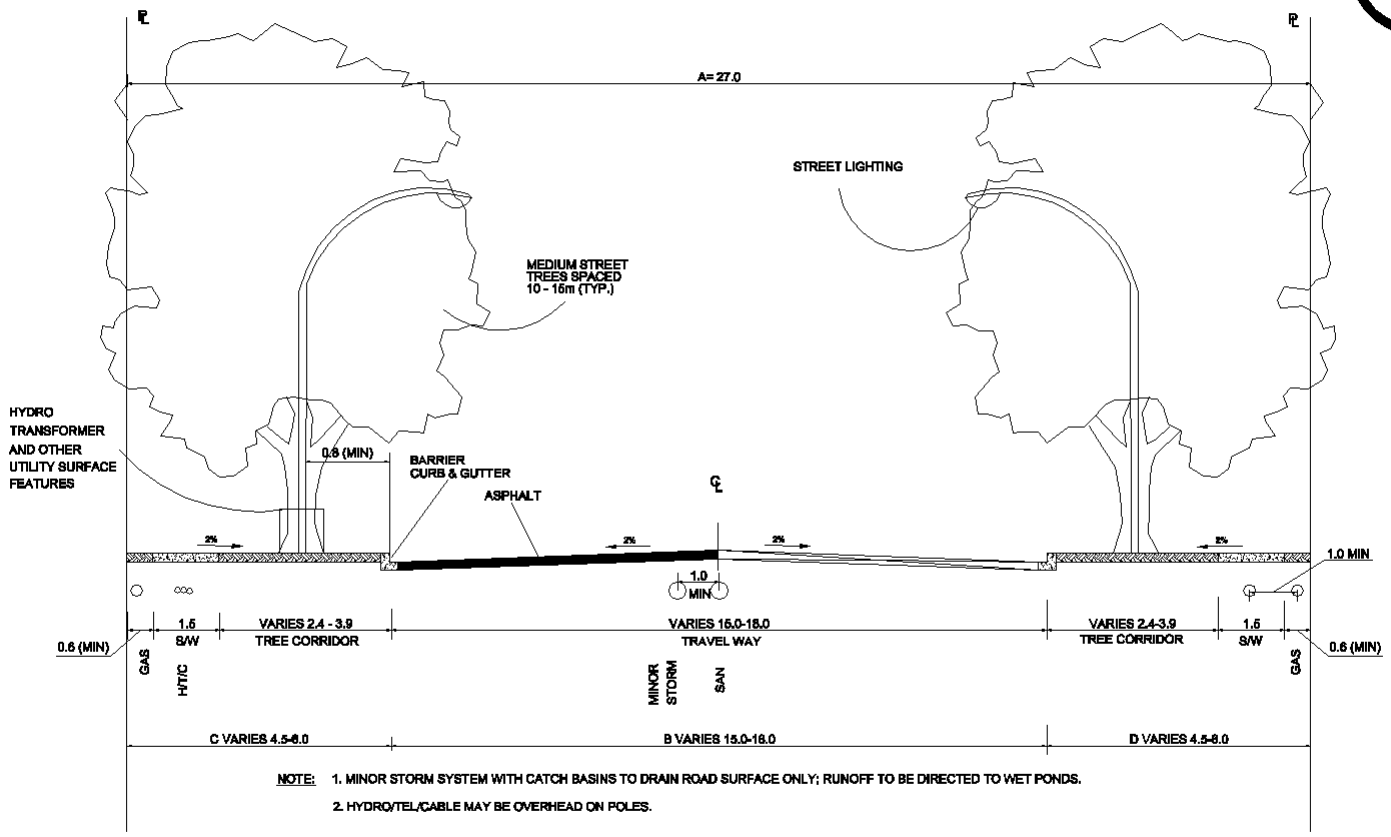
N.T.S.

EAST CLAYTON NCP
CROSS SECTIONS : ARTERIAL PARKWAYS
FIGURE A2.1

TIME : 16:56:5 DATE : 07-20-09 USER : ahow
FILE INFO : H:\PROJECTS\MMM_3852000\GDA\civil\MMM_3852000_GDA_civil_A1-section.dwg

ARTERIAL	MAJOR	TYPICAL (ULTIMATE)

B



NOTE: 1. MINOR STORM SYSTEM WITH CATCH BASINS TO DRAIN ROAD SURFACE ONLY; RUNOFF TO BE DIRECTED TO WET PONDS.

2. HYDRO/TEL/CABLE MAY BE OVERHEAD ON POLES.

Reid Crowther

N.T.S.

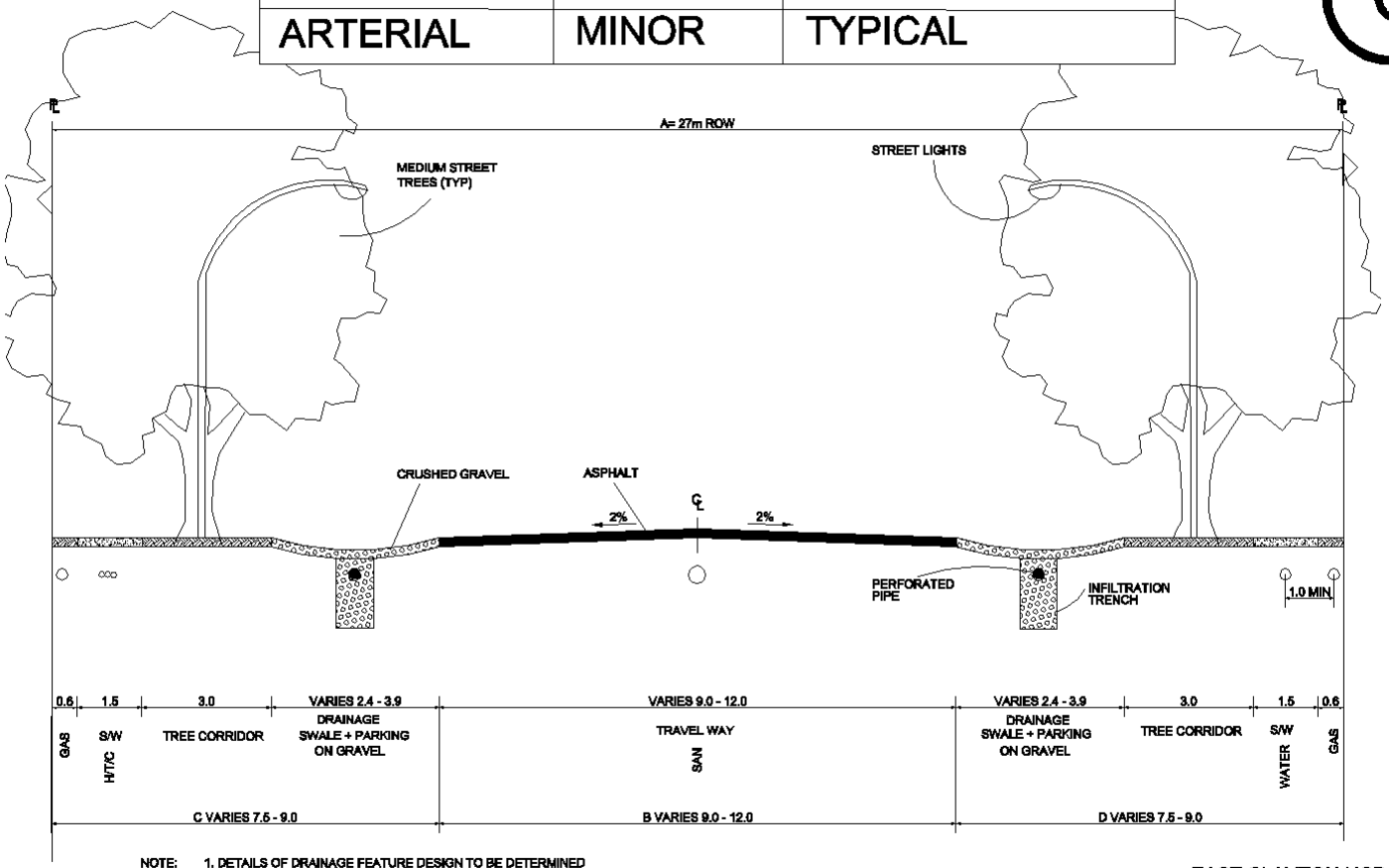
EAST CLAYTON NCP

CROSS SECTION : TYPICAL ARTERIAL

Figure A2.2

TIME : 16:55:10 DATE : 07-JUL-96 USER : stanw
FILE INFO : H:\PROJECTS\AAM\366000\GIS\Lotsville\CS01*.* - landscaping

ARTERIAL	MAJOR	TYPICAL (INTERIM)
ARTERIAL	MINOR	TYPICAL



NOTE: 1. DETAILS OF DRAINAGE FEATURE DESIGN TO BE DETERMINED
2. HYDRO/TEL/CABLE MAY BE OVERHEAD ON POLES.

Reid Crowther

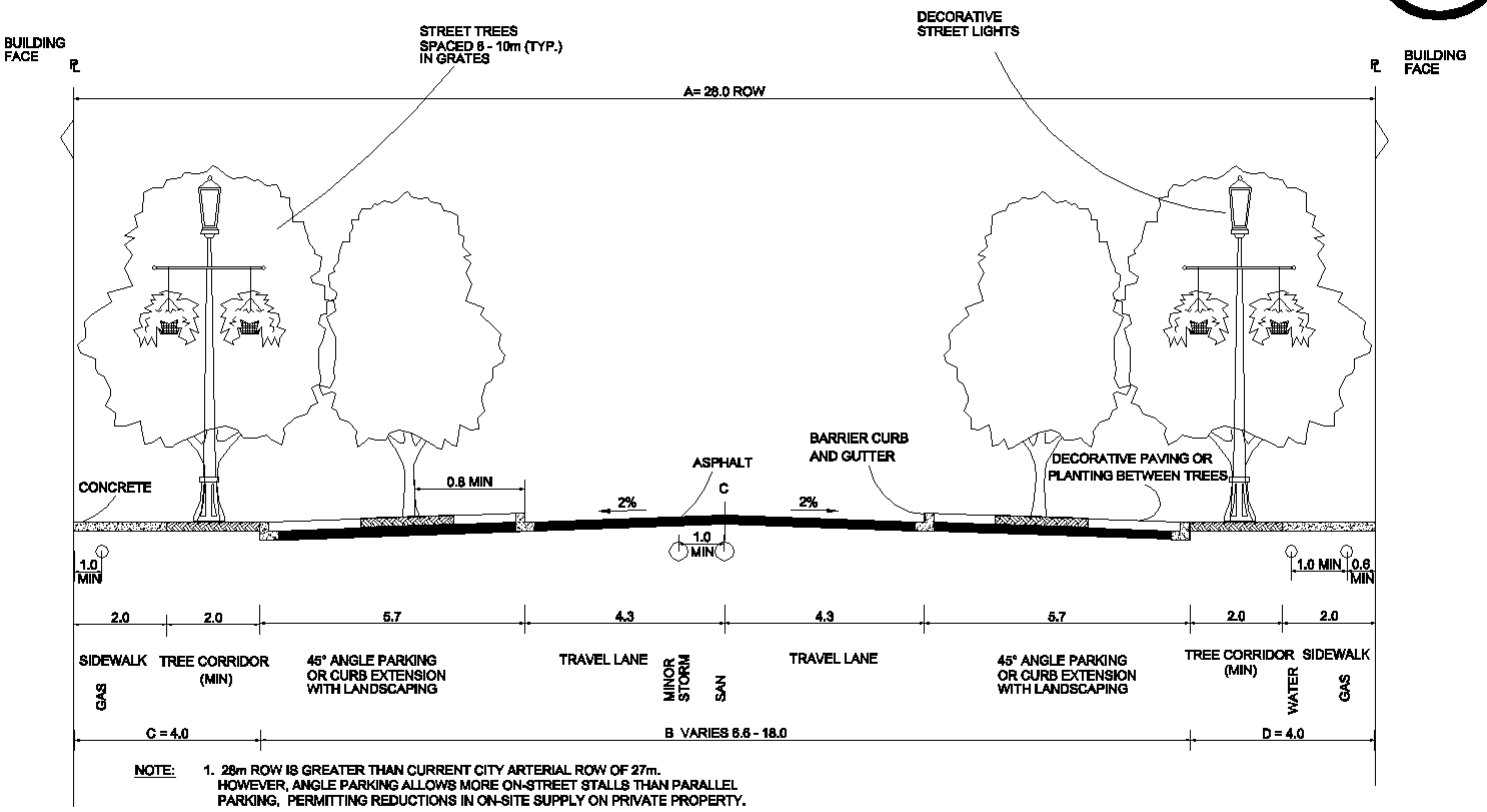
N.T.S.

EAST CLAYTON NCP
CROSS SECTIONS : TYPICAL ARTERIALS
Figure A2.3

© C

ARTERIAL	MINOR	MAINSTREET

D



NOTE:

1. 28m ROW IS GREATER THAN CURRENT CITY ARTERIAL ROW OF 27m. HOWEVER, ANGLE PARKING ALLOWS MORE ON-STREET STALLS THAN PARALLEL PARKING, PERMITTING REDUCTIONS IN ON-SITE SUPPLY ON PRIVATE PROPERTY.
2. H/T/C SHOULD GO ON POLES OVERHEAD IN REAR LANES TO AVOID LARGE SURFACE UTILITY FEATURES ON MAINSTREET ARTERIAL.
3. MINOR STORM SYSTEM WITH CATCH BASINS TO DRAIN TO ROAD ONLY; RUNOFF TO BE DIRECTED TO WET PONDS.

Reid Crowther

N.T.S.

EAST CLAYTON NCP

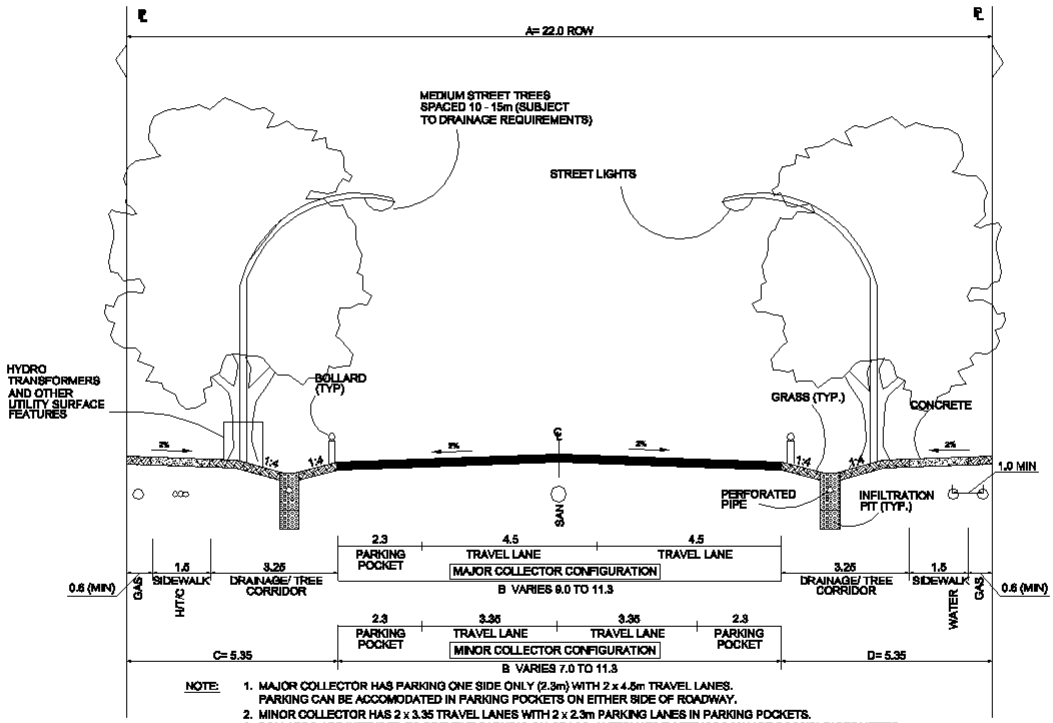
CROSS SECTION : ARTERIAL MAINSTREET

Figure A2.4

TIME - 16:56:49 DATE - 07-05-08 USER - shaw
FILE INFO - I:\PROJECTS\1481\01\DGN\schematic\3823\1_mainstreet.dgn

COLLECTOR	MAJOR	RESIDENTIAL
COLLECTOR	MINOR	RESIDENTIAL

E



NOTE:

1. MAJOR COLLECTOR HAS PARKING ONE SIDE ONLY (2.3m) WITH 2 x 4.5m TRAVEL LANES. PARKING CAN BE ACCOMODATED IN PARKING POCKETS ON EITHER SIDE OF ROADWAY.
2. MINOR COLLECTOR HAS 2 x 3.35 TRAVEL LANES WITH 2 x 2.3m PARKING LANES IN PARKING POCKETS.
3. BOLLARDS ARE INTENDED TO PREVENT PARKING ON GRASS; ALTERNATIVE METHODS MAY BE POSSIBLE/ PERMITTED
4. DESIGN OF SWALE AROUND TREES AND UTILITY SURFACE FEATURES AND AT DRIVEWAY CROSSINGS, TO BE DETERMINED
5. DETAILS OF DRAINAGE FEATURE DESIGN TO BE DETERMINED
6. PAVEMENT WIDTH AT INTERSECTIONS MAY BE NARROWED BY REMOVING PARKING TO REDUCE PEDESTRIAN CROSSING DISTANCE
7. 70th AVENUE GREENWAY WILL HAVE 2.5m SIDEWALK AND DOUBLE ROW OF STREET TREES ON THE SOUTH SIDE, REQUIRING AN ULTIMATE RIGHT-OF-WAY OF 25.0m.
8. MAJOR COLLECTORS ARE DCC ELIGIBLE; MINOR COLLECTORS ARE NOT.

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N.T.S.

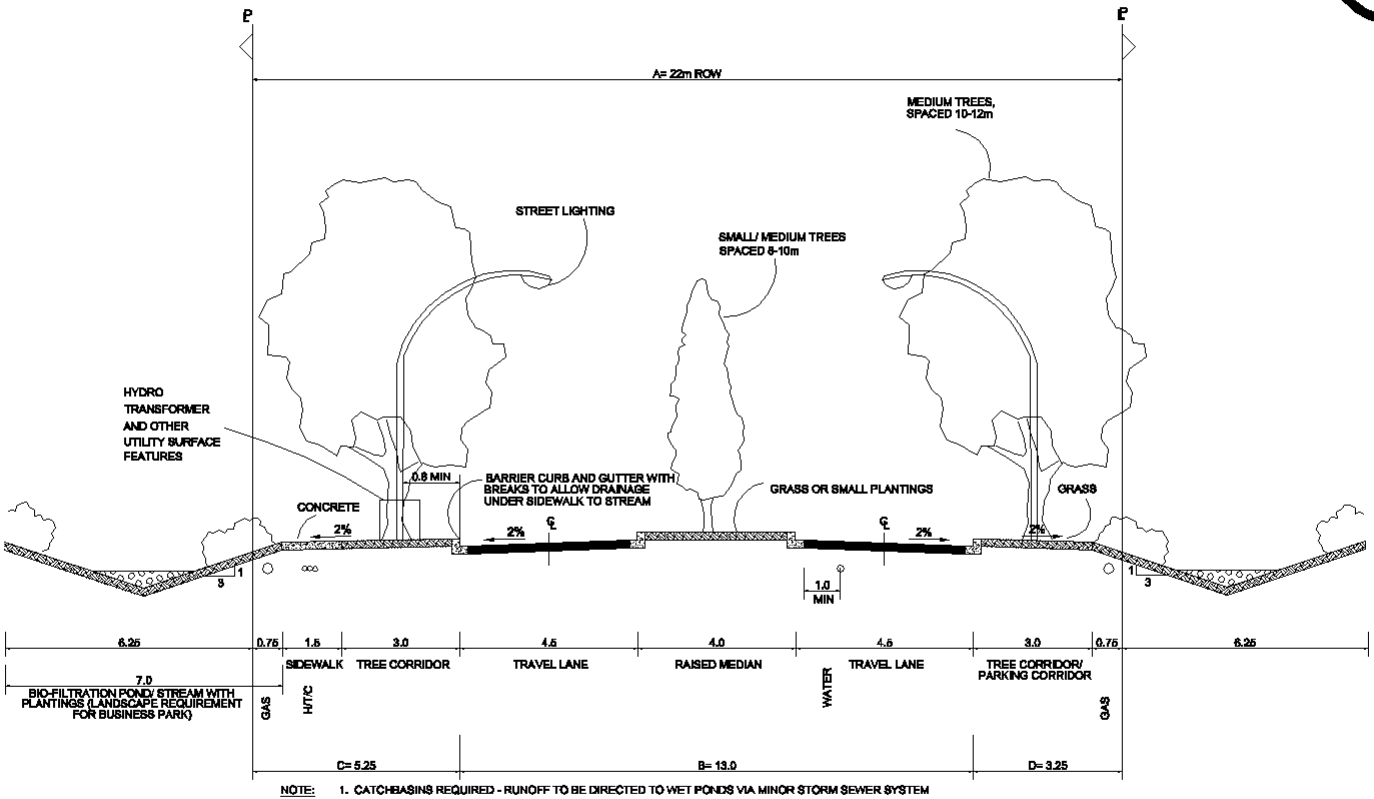
EAST CLAYTON NCP

CROSS SECTIONS : RESIDENTIAL COLLECTORS

Figure A2.5

COLLECTOR	MINOR	BUSINESS PARK

G



NOTE:
1. CATCHBASINS REQUIRED - RUNOFF TO BE DIRECTED TO WET PONDS VIA MINOR STORM SEWER SYSTEM
2. PARKING POCKETS ONLY PERMITTED ON FRONTAGE OF LIVE/ WORK AREA
3. VERTICAL CLEARANCE FOR TRUCKS MAY REQUIRE SELECTION OF COLUMNAR SHAPED TREES AND/ OR PRUNING
4. DETAILS OF DRAINAGE FEATURE DESIGN TO BE DETERMINED

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N.T.S.

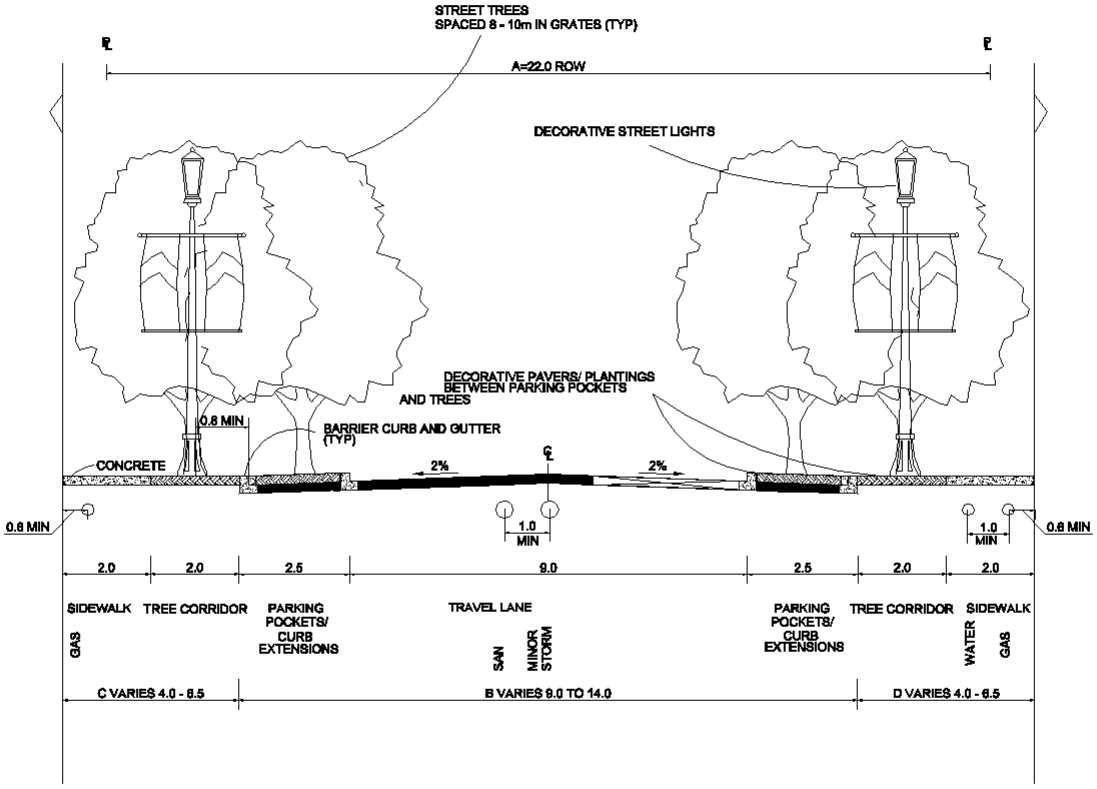
EAST CLAYTON NCP

CROSS SECTION : LIVE/ WORK AREA COLLECTOR

Figure A2.6

COLLECTOR	MAJOR	LIVE/ WORK

F



NOTE: 1. HYDRO/TELEPHONE AND CABLE SHOULD GO ON POLES OVERHEAD IN REAR LANES TO AVOID LARGE SURFACE UTILITY FEATURES
2. MINOR STORM SYSTEM WITH CATCH BASINS TO DRAIN ROAD SURFACE ONLY; RUNOFF TO BE DIRECTED TO WET PONDS.

Reid Crowther

N.T.S.

EAST CLAYTON NCP

CROSS SECTION : BUSINESS PARK COLLECTOR

Figure A2.7

TIME : 14:15:2 DATE : 07-Jul-09 USER : kfrey
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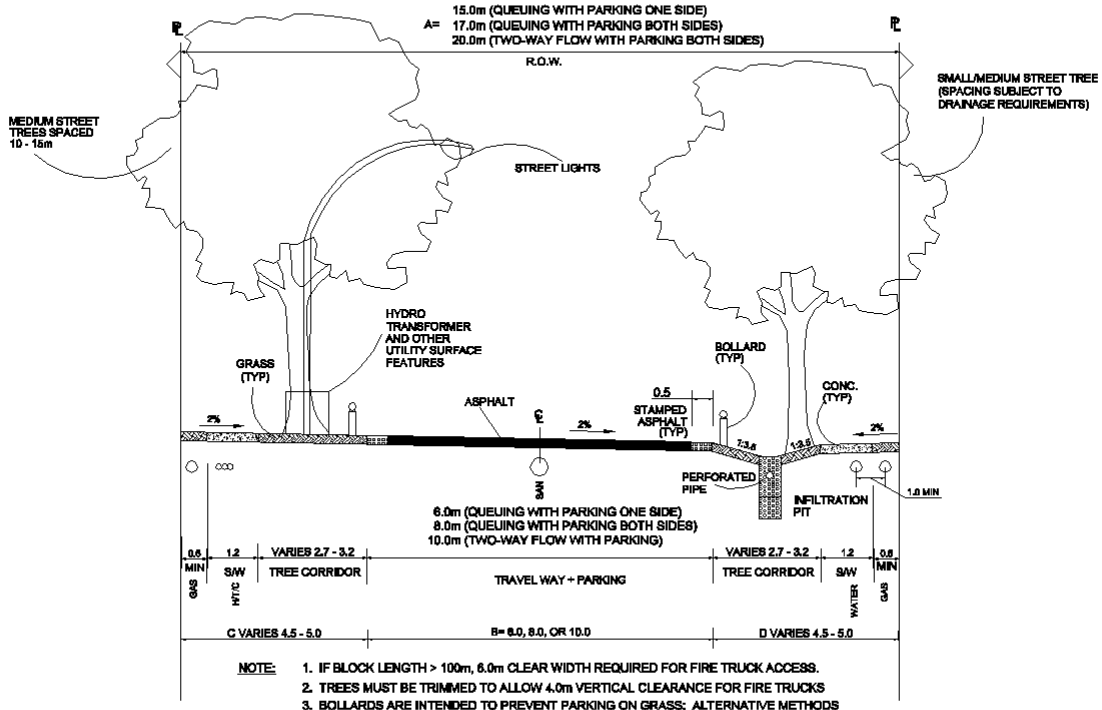
LOCAL	RESIDENTIAL	TWO WAY QUEUEING

H



NOTE:

1. IF BLOCK LENGTH > 100m, 6.0m CLEAR WIDTH REQUIRED FOR FIRE TRUCK ACCESS.
2. TREES MUST BE TRIMMED TO ALLOW 4.0m VERTICAL CLEARANCE FOR FIRE TRUCKS
3. BOLLARDS ARE INTENDED TO PREVENT PARKING ON GRASS; ALTERNATIVE METHODS MAY BE POSSIBLE/ PERMITTED.
4. DETAILS OF DRAINAGE FEATURE DESIGN TO BE DETERMINED
5. QUEUING STREET WITH PARKING ONE SIDE SUBJECT TO CITY APPROVAL

Reid Crowther

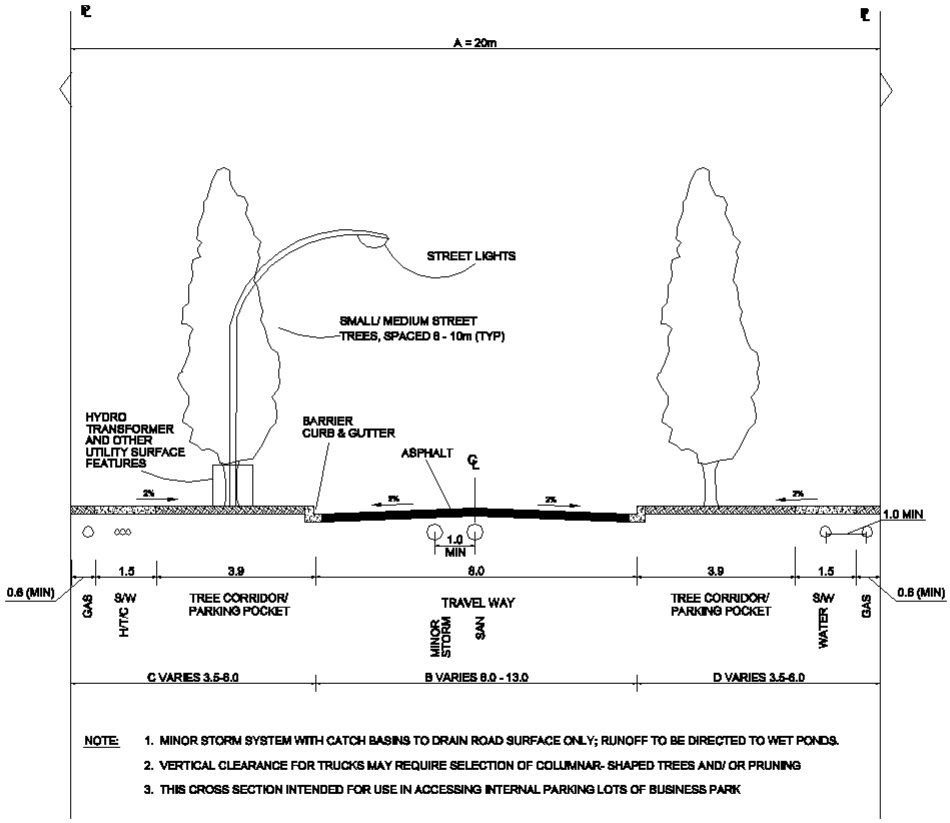
N.T.S.

EAST CLAYTON NCP
CROSS SECTIONS : RESIDENTIAL LOCALS
Figure A2.8

DATE : 07-05-09 USER : akoay
FILE INFO : H:\PROJECTS\KAR\13662001\DGN\Amended\13662TS-residential.dwg

LOCAL	COMMERCIAL	BUSINESS PARK

I



NOTE:
1. MINOR STORM SYSTEM WITH CATCH BASINS TO DRAIN ROAD SURFACE ONLY; RUNOFF TO BE DIRECTED TO WET PONDS.
2. VERTICAL CLEARANCE FOR TRUCKS MAY REQUIRE SELECTION OF COLUMNAR- SHAPED TREES AND/ OR PRUNING
3. THIS CROSS SECTION INTENDED FOR USE IN ACCESSING INTERNAL PARKING LOTS OF BUSINESS PARK

Reid Crowther

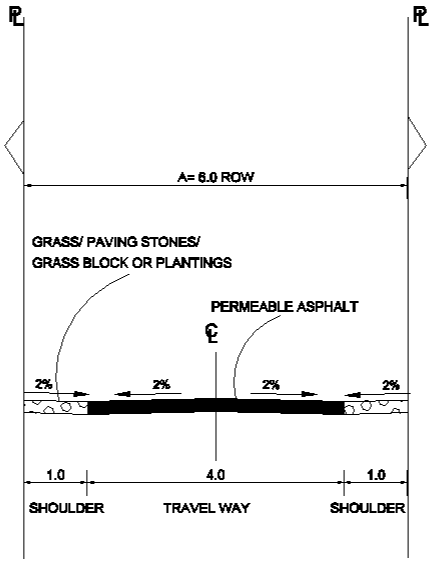
N.T.S.

EAST CLAYTON NCP
CROSS SECTION : BUSINESS PARK LOCAL
Figure A2.9

TIME : 13:50:2 DATE : 07-05-09 USER : stone
FILE INFO : H:\PROJECTS\AM\3550220\CAD\drawings\ASD\3-sections.dwg

LANE	RESIDENTIAL

J



NOTE:

1. PARKING CAN BE PERMITTED IN REAR LANES IN RESIDENTIAL AREAS.
2. A LARGE TRUCK (2.6m) CAN PASS A PARKED CAR WITHOUT THE TRUCK ENCROACHING ONTO THE SHOULDER CAR

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N.T.S.

EAST CLAYTON NCP
CROSS SECTION : RESIDENTIAL LANE
Figure A2.10

DATE : 07-05-08 USER : ahow
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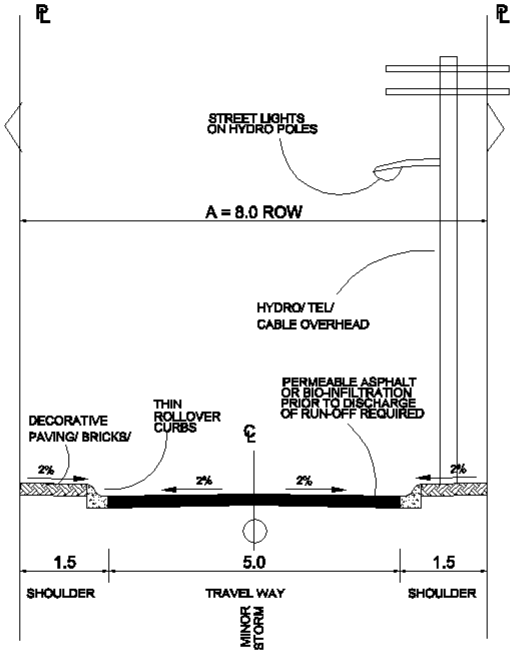
TIME : 7h30m

LANE	COMMERCIAL

K



NOTE:

1. PARKING COULD BE PERMITTED BETWEEN HYDRO POLES/ DRIVEWAYS IN DESIGNATED AREAS SO DECORATIVE PAVING SHOULD BE DESIGNED TO HANDLE WEIGHT OF PARKED CAR.
2. LARGE TRUCKS (2.6m) CAN MANOEVER AROUND PARKED CARS ON BOTH SIDES.
3. REAR PARKING LOTS NOT PERMITTED TO DRAIN TO LANE.
4. MINOR STORM SYSTEM REQUIRED IF PERMEABLE PAVEMENT NOT UTILIZED; RUNOFF TO BE DIRECTED TO WET PONDS.

Reid Crowther

N.T.S.

EAST CLAYTON NCP
CROSS SECTION : COMMERCIAL LANE
fIGURE A2.11

DATE : 07-26-06 USER : ebrown
FILE : N:\Projects\VA\VA06005\DGN\new\VA06005-Commercial Lane.dgn

APPENDIX A.2: EAST CLAYTON
STREET PERFORMANCE STANDARDS

STREET CLASS CHARACTERISTICS		ARTERIALS				
		MAJOR: PARKWAY & RIPARIAN PARKWAY	MAJOR: TYPICAL 4 LANES	MINOR: PARKWAY 2 LANES	MINOR: TYPICAL 2 LANES	MINOR: MAIN STREET
	CROSS SECTION CODE	A	B	A	C	D
A. SERVICE FUNCTIONS AND CHARACTERISTICS						
A.1	**Traffic Volume Ranges**	10,000 to 30,000 vpd; peak direction during peak hour from 1,000 to 1,600 vph	10,000 to 15,000 vpd; peak direction during peak hour from 800 to 1,200 vph	5,000 to 10,000 vpd; peak direction during peak hour from 400 to 800 vph	5,000 to 10,000 vpd; peak direction during peak hour from 400 to 800 vph	5,000 vpd-10,000 vpd; peak direction during peak hour from 400 to 800 vph
A.2	**Flow Characteristics**	uninterrupted two-way flow except at traffic signals, typically spaced no less than 200m apart. Transit stops require pull-outs.	uninterrupted two-way flow except at traffic signals and when parking manoevers occur. Transit stops do not require pull-outs, so that transit operations contribute to traffic "friction" and reduce operating speeds	uninterrupted two-way flow except at traffic signals and when parking manoevers occur. Transit stops in parking lanes; do not require separate pull-outs.	uninterrupted two-way flow except at traffic signals, stop signs and when parking manoevers occur. Transit stops in parking lanes; do not require separate pull-outs	interrupted two-way flow, at signalized/stop controlled intersections, transit stops, mid-block pedestrian crossings and when parking maneovers occur. Transit operations interrupt flow; curb extensions required at bus stops. Major pedestrian zone requires slower operating speeds
A.3	**Access/Intersection Characteristics**	mid-block access to local roads typically via right-in/out only in order to maintain continuous median and improved safety & traffic flows. Left turn bays required at most intersections, whether signalized or not. Rear lanes are preferred for property access; however, frontage roads considered in special circumstances. No direct access permitted	limited mid-block access to local roads permitted, but no left turn bays provided. Rear lanes required for property access. No left turn bays at signalized intersections unless required due to high turning volumes. Rear lanes required for property access. No direct access permitted	mid-block access to local roads permitted via right-in/out only to maintain continuous median. Rear lanes preferred for property access. No direct access permitted; frontage roads considered for special circumstances only.	local road access permitted but left turn bays only provided at major intersections. Rear lanes required for property access. Direct access may be permitted in special circumstances only.	short blocks between 60m and 100m required. No mid-block access to individual properies; rear lanes required. Parallel back access roads/lanes required for adequate circulation and access to rear parking. Left turn bays permitted at Arterial intersections only
A.4	**Design / Operating Speed**	60-70 km/h design speed; operating speed should be 50-60 km/h	60-70 km/h; operating speed should be 40-50 km/h	60-70 km/h; operating speed 40-50 km/h	60-70 km/h; operating speed 40-50 km/h	50 km/h design speed; operating speed design objective is 20-30 km/h to support "pedestrian zone"
A.5	**Frequent User Types**	all user types: passenger vehicles, small and large trucks, transit vehicles, pedestrians, cyclists	all user types: passenger vehicles, small and large trucks, transit vehicles, pedestrians, cyclists	all user types: passenger vehicles, small and large trucks, transit vehicles, pedestrians, cyclists	all user types: passenger vehicles, small and large trucks, transit vehicles, pedestrians, cyclists	major pedestrian zone, with small trucks, some larger delivery trucks, transit,passenger vehicles and pedestrians. Lower numbers of cyclists due to higher traffic volumes/high parking turnover.
A.5a	**Design Vehicle(s) at Intersections**	fire trucks, WB-15 and transit vehicle must be able to make all turns without sweeping into opposing lanes of traffic on Arterials or Collectors (on Locals, 1.0m encroachment is permitted for trucks/fire trucks). Transit vehicles and trucks must be able to make turns without encroaching more than 1.0m into lanes of same-direction flow. Fire trucks can encroach fully into lanes of same-direction flow	fire trucks, WB-15 and transit vehicle must be able to make all turns without sweeping into opposing lanes of traffic on Arterials or Collectors (on Locals, 1.0m encroachment is permitted for trucks/fire trucks). Transit vehicles and trucks must be able to make turns without encroaching more than 1.0m into lanes of same-direction flow. Fire trucks can encroach fully into lanes of same-direction flow	fire trucks, WB-15 and transit vehicle must be able to make all turns without sweeping into opposing lanes of traffic on Arterials or Collectors (on Locals, 1.0m encroachment is permitted for trucks/fire trucks). Transit vehicles and trucks must be able to make turns without encroaching more than 1.0m into lanes of same-direction flow. Fire trucks can encroach fully into lanes of same-direction flow	fire trucks, WB-15 and transit vehicle must be able to make all turns without sweeping into opposing lanes of traffic on Arterials or Collectors (on Locals, 1.0m encroachment is permitted for trucks/fire trucks). Fire trucks can encroach fully into lanes of same-direction flow. Encroachment onto gravel shoulder permitted	WB-15 trucks and transit vehicles should be able to physically negotiate turns at intersections, but only at locations where they are regularly expected to be turning . 1.0m enroachment into sidestreet and main line opposing lanes is allowable since travel lanes are wide, but not for transit vehicles. Emergency vehicles/large trucks permitted to mount curbs at intersections (large, flush curb let-downs possible).
A.5b	**Design Scenario(s) for Travel Way Width**	transit bus (2.6m) or truck (2.6m) passing a car (2.1) travelling in the same direction, and a bicycle (1.0m). Emergency vehicles expected to encroach into same-direction traffic lanes or width for cyclists	transit bus (2.6m) or truck (2.6m) passing a car (2.1) travelling in the same direction, and a bicycle (1.0m). Emergency vehicles expected to encroach into same-direction traffic lanes or width for cyclists	transit bus (2.6m) or truck (2.6m) passing a car (2.1) travelling in the same direction, and a bicycle (1.0m). Emergency vehicles expected to encroach into same-direction traffic lanes or width for cyclists	transit bus (2.6m) or truck (2.6m) passing an oncoming car (2.1) and bicycle (1.0m). Emergency vehicles expected to encroach into same-direction bike lanes/shoulders	transit bus (2.6m) passing a cyclist (1.0m) in one travel lane without encroaching into oncoming traffic. Emergency vehicles expected to encroach into extra width for cyclists. Angle parking also requires wider travel lane for safe backing manoever.
A.6	**Role in Sustainable Drainage Scheme**	1. - be part of the overland flow path (major system) to safely convey stormwater runoff and to designated discharge location such as ponds, outfalls etc.	1. - be part of the overland flow path (major system) to safely convey stormwater runoff and to designated discharge location such as ponds, outfalls etc.	1. - be part of the overland flow path (major system) to safely convey stormwater runoff and to designated discharge location such as ponds, outfalls etc.	1. - be part of the overland flow path (major system) to safely convey stormwater runoff and to designated discharge location such as ponds, outfalls etc.	1. - be part of the overland flow path (major system) to safely convey stormwater runoff and to designated discharge location such as ponds, outfalls etc.
		2. - where required by the grading plan designs of developments, effectively transfer all cross flows to drainage swales/inlets/constructed streams.	2. - where required by the grading plan designs of developments, effectively transfer all cross flows to drainage swales/inlets.	2. - where required by the grading plan designs of developments, effectively transfer all cross flows to drainage swales/inlets.	2. - where required by the grading plan designs of developments, effectively transfer all cross flows to drainage swales/inlets.	2. - where required by the grading plan designs of developments, effectively transfer all cross flows to drainage swales/inlets.
		3. - where curbs are provided, provide for catchbasins with connection to the drainage swale/pipe system to safely transfer the roadway runoff. Biofiltration to occur prior to discharge into natural stream system	3. - where curbs are provided, provide for catchbasins with connection to the drainage swale/pipe system to safely transfer the roadway runoff. Biofiltration to occur prior to discharge into natural stream system	3. - where curbs are provided, provide for catchbasins with connection to the drainage swale/pipe system to safely transfer the roadway runoff. Biofiltration to occur prior to discharge into natural stream system		3. - where curbs are provided, provide for catchbasins with connection to the drainage swale/pipe system to safely transfer the roadway runoff. Biofiltration to occur prior to discharge into natural stream system

APPENDIX A.2: EAST CLAYTON
STREET PERFORMANCE STANDARDS

STREET CLASS CHARACTERISTICS			ARTERIALS				
			MAJOR: PARKWAY & RIPARIAN PARKWAY	MAJOR: TYPICAL 4 LANES	MINOR: PARKWAY 2 LANES	MINOR: TYPICAL 2 LANES	MINOR: MAIN STREET
CROSS SECTION CODE			A	B	A	C	D
B. CROSS SECTION ELEMENTS							
B.1	**Roadway Features**						
	B.1.1.	**travel lanes**	In Ultimate configuration: two travel lanes in each direction of 3.1m, with 1.3m bike lane. At intersections, 3.0m wide left turn bays. In Interim configuration: one 6.0m paved surface for one 3.5m travel lane and one 2.5m parking lane.	two travel lanes each direction of 3.1m with two 1.3m bike lanes (or two 3.2m inside lanes with two 4.3m outside lanes to allow for cyclists). No marked left turn bays at intersections unless required due to high turning movements at signalized intersections	one travel lane in each direction of 4.5m (wide curb lane for cyclists). At intersections, 3.0m opposing left turn bays. Mid-block left turn bays not permitted	one travel lane in each direction of travel of 3.1m, with painted 1.4m shoulders for cyclists. At intersections, 3.0m opposing left turn bays. Mid-block left turn bays not permitted unless required for traffic/capacity reasons	one travel lane in each direction of 4.3m. Short left turn bays of 3.0m only at major intersections with other Arterials, developed by prohibiting parking.
	B.1.2.	**parking bays/lanes**	parking is not permitted on 4 lane Ultimate Parkways; parking may be permitted with 2 lane Interim configuration, with 2.5m parking lane as noted above.	parking is not permitted	2 continuous 2.5m parking lanes, with pinch points at intersections where no parking permitted or at mid-block crossings, to reduce pedestrian crossing distance	parking permitted on 2.4-3.9m gravel-covered swales	2 continous 45 degree angle 5.7m parking bays, with curb extension at intersections, mid-block crossings and transit stops
	B.1.3	**median width**	varies 2.0m (between intersections) to 4.0m (for 1.0m raised concrete channelization and 3.0m left turn bay at intersections). Median width could be increased to a constant 4.0m width to permit continuous trees, if compensation to property owners for additional right-of-way can be obtained.	none	varies 2.0m (between intersections) to 4.0m (for 1.0m raised concrete channelization and 3.0m left turn bay at intersections). Median width could be increased to a constant 4.0m width to permit continuous trees, if compensation to property owners for additional right-of-way can be obtained.	none	none
	B.1.4	**overland flow path/street runoff**	2% crown drainage to direct overland flow to curb/gutter and catch basins/minor storm sewers, which convey excessive stormwater runoff into designated outfalls and wet ponds. Biofiltration required before discharge into natural streams	2% crown drainage to direct overland flow to curb/gutter and catch basins/minor storm sewers, which convey excessive stormwater runoff into designated outfalls and wet ponds. Biofiltration required before discharge into natural streams	2% crown drainage to direct overland flow to curb/gutter and catch basins/minor storm sewers, which convey excessive stormwater runoff into designated outfalls and wet ponds. Biofiltration required before discharge into natural streams	2% crown drainage to gravel swale/infiltration pits in boulevards on both sides of street	2% crown drainage to direct overland flow to curb/gutter and catch basins/minor storm sewers, which convey excessive stormwater runoff into designated outfalls and wet ponds. Biofiltration required before discharge into natural streams
	B.1.5	**total paved width**	varies 17m (between intersections) to 19m (at intersections, with left turn bays)	usually 15.0m, 18.0m only if left turn bay required due to high traffic volumes	varies 17m (between intersections) to 19m (at intersections, with left turn bays)	varies 9.0m (between intersections) to 12.0m (at intersections with left turn bays)	varies 8.6m to 20m, depending on presence of angled parking
B.2	**Boulevard Features**						
	B.2.1.	**curb type (if present)**	barrier curbs at road edge and at median	barrier curbs at road edge	barrier curbs at road edge and at median	n/a	barrier curbs at road edge
	B.2.2	**sidewalks**	2 concrete 1.5m wide sidewalks located outside of tree corridor. (when a Greenway coincides with Riparian Zone, 3.0m multi-use pathway is included within Riparian Zone and one 1.5m concrete sidewalk can be eliminated)	2 concrete 1.5m wide sidewalks located outside of tree corridor	2 concrete 1.5m wide sidewalks located outside of tree corridor. (when a Greenway coincides with Riparian Zone, 3.0m multi-use pathway is included within Riparian Zone and one 1.5m concrete sidewalk can be eliminated)	2 concrete 1.5m wide sidewalks located outside of tree corridor	2 concrete 2.0m sidewalks located next to property line; it is recommended that an additional 1.0m width be included within the building set-back. Alternative pavement materials can be used, but there must be at least 2.0m clear of brushed concrete for wheelchair users
	B.2.3	**sidewalk/boulevard drainage**	2% slope to curb and gutter	2% slope to curb and gutter	2% slope to curb and gutter	2% slope to gravel drainage swale	2% slope to curb and gutter
	B.2.4	**drainage swale/infiltration pit (if present)**	Interim configuration has 5.0m wide grass swale in median which provides drainage for some of street run-off	n/a	n/a	2.4-2.9m gravel swales/infilatration pits on either side of travel way (combined with parking)	n/a
	B.2.5	**street trees/landscaping**	two street tree corridors on boulevards which vary from 2.2m (with left turn bay) to 3.2m (between intersections). 2.2m allows small trees only, spaced 8-10m apart. 3.2m allows for medium trees which should be spaced 10-12m to achieve good canopy and traffic calming effect. If median widened to 4.0m, small/medium street trees possible throughout median.	two street tree corridors on boulevards which vary from 2.4 (with left turn bay) to 3.9m (between intersections). 2.4m allows small trees only, spaced 8-10m apart. 3.9m allows for medium trees which should be spaced 10-12m to achieve good canopy and traffic calming effect.	two street tree corridors on boulevards which vary from 2.2m (with left turn bay) to 3.2m (between intersections). 2.2m allows small trees only, spaced 8-10m apart. 3.2m allows for medium trees which should be spaced 10-12m to achieve good canopy and traffic calming effect. If median widened to 4.0m, small/medium street trees possible throughout median.	two 3.0m tree corridors for medium street trees. Spacing should be 10-12m	2.0m corridor for small street trees in grates on both sides. Automatic watering system may be required. Spacing should be 8-10m. Additional street trees/landscaping possible in curb extensions at intersections, mid-block crossings, transit stops.
	B2.6	**total boulevard width (one side)**	varies 4.3m to 5.3m depending on presence of left turn bays	varies 4.5m to 6.0m depending on presense of left turn bays	varies 4.3m to 5.3m depending on presence of left turn bays	varies 7.5m to 9.0m depending on presence of left turn bays	varies 4.0-9.7m, depending of presence of angle parking

APPENDIX A.2: EAST CLAYTON
STREET PERFORMANCE STANDARDS

STREET CLASS CHARACTERISTICS				ARTERIALS				
				MAJOR: PARKWAY & RIPARIAN PARKWAY	MAJOR: TYPICAL 4 LANES	MINOR: PARKWAY 2 LANES	MINOR: TYPICAL 2 LANES	MINOR: MAIN STREET
CROSS SECTION CODE				A	B	A	C	D
B.3.	Utilities							
	B.3.1	Location of Underground features						
		B.3.1.1	Storm Sewers (if present)	minor storm water system under road pavement to deal with boulevard and street runoff. Runoff must be directed to wet ponds	minor storm water system under road pavement to deal with boulevard and street runoff. Runoff must be directed to wet ponds	minor storm water system under road pavement to deal with boulevard and street runoff. Runoff must be directed to wet ponds		minor storm water system under road pavement to deal with boulevard and street runoff. Runoff must be directed to wet ponds
		B.3.1.2	Sanitary Sewer line	under road pavement	under road pavement	under road pavement	under road pavement	under road pavement
		B.3.1.3	Water line	under road pavement	under road pavement	under road pavement	under road pavement	under road pavement
		B.3.1.4	Hydro/Tel/Cable lines	under sidewalk (may be overhead on Arterials)	under sidewalk (may be overhead on Arterials)	under sidewalk (may be overhead on Arterials)	under sidewalk (may be overhead on Arterials)	overhead in Commerial lane at rear of Mainstreet buildings
		B.3.1.5	Gas line	under boulevard, at edge of sidewalk	under boulevard, at edge of sidewalk	under boulevard, at edge of sidewalk	under boulevard, at edge of sidewalk	under sidewalk
		B.3.1.6	Street Light Lines	in street tree corridor or under sidewalk	in street tree corridor or under sidewalk	in street tree corridor or under sidewalk	in street tree corridor or under sidewalk	under sidewalk
	B.3.2	Location of Surface features						
		B.3.2.1	Hydro transformers, etc.	in street tree corridor or overhead on poles	in street tree corridor or overhead on poles	in street tree corridor or overhead on poles	in street tree corridor or overhead on poles	overhead in Commerial lane at rear of Mainstreet buildings
		B.3.2.2	Fire hydrants	in street tree corridor but offset from curb at least 0.8m	in street tree corridor but offset from curb at least 0.8m	in street tree corridor but offset from curb at least 0.8m	in street tree corridor but offset from curb at least 0.8m	in street tree corridor but offset from curb at least 0.8m
		B.3.2.3	Street Light Poles	in street tree corridor but offset from curb at least 0.8m	in street tree corridor but offset from curb at least 0.8m	in street tree corridor but offset from curb at least 0.8m	in street tree corridor but offset from curb at least 0.8m	in street tree corridor but offset from curb at least 0.8m
B.4.	Total Road Allowance Width			27.0m (excluding Riparian Zone which is part of the major drainage system, and wider 4.0m median)	27.0m	27.0m (excluding wider 4.0m median)	27.0m	28.0m

APPENDIX A.2: EAST CLAYTON
STREET PERFORMANCE STANDARDS

STREET CLASS CHARACTERISTICS			COLLECTORS			
			MAJOR: RESIDENTIAL	MAJOR: LIVE/WORK	MINOR: BUSINESS PARK	MINOR: RESIDENTIAL
		CROSS SECTION CODE	E	F	G	E
A. SERVICE FUNCTIONS AND CHARACTERISTICS						
	A.1	**Traffic Volume Ranges**	2,000 - 5,000 vpd; peak direction during peak hour from 300 to 600 vph	3,000-6,000 vpd; peak direction during peak hour from 300 to 600 vph	2,000-5,000 vpd; peak direction during peak hour from 300 to 600 vph	1,000 to 3,000 vpd; peak direction during peak hour from 200 to 400 vph
	A.2	**Flow Characteristics**	uninterrupted two-way flow except at traffic signals, stop signs and when parking manoevers occur. Transit stops do not require separate pull-outs	uninterrupted two-way flow except at traffic signals, stop signs and when parking manoevers occur. Transit stops do not require separate pull-outs but do require curb extensions. Major pedestrian zone requires "calmed" traffic	uninterrupted two-way flow except at traffic signals and stop signs, and when parking manoevers occur (limited). Transit stops do not require separate pull-outs	uninterrupted two-way flow except at traffic signals, stop signs and when parking manoevers occur. Transit stops developed by prohibiting parking. If operating speeds are higher than expected, some traffic calming measures would be appropriate, but not those associated with vertical deflection. Refer to Appendix A.3
	A.3	**Access/Intersection Characteristics**	local road access permitted but left turn bays only provided at major intersections. Rear lanes required for property access. Direct access should be limited as much as possible	short blocks bewteen 60m and 100m required. No mid-block access to individual properies; rear lanes required. Parallel back access roads/lanes required for adequate circulation and access to rear parking. Left turn bays only permitted at Arterial intersections	access to local roads permitted. Left turn bays at most intersections/main access points. Direct property access typically not permitted since parking is expected to be in shared, interior lots.	frequent local road access permitted but left turn bays only provided at major intersections, through banning parking. Rear lanes required for property access in most situations. Driveways allowed in special situations but not encouraged since they reduce space for trees. Driveway crossings of drainage feature must be carefully designed not to interrupt surface flow.
	A.4	**Design / Operating Speed**	50 km/h design speed; operating speed design objective is 40 km/h	50 km/h design speed; 20-30 km/h operating speed to support "pedestrian zone"	50 km/h design speed; 40 km/h operating speed	50 km/h design speed; 30 to 40 km/h operating speed
	A.5	**Frequent User Types**	all user types: passenger vehicles, small and large trucks, transit vehicles, pedestrians, cyclists	passenger vehicles, small trucks, transit vehicles, pedestrians, cyclists	small and large trucks, passenger vehicles, transit vehicles. Lower number of pedestrians and cyclists expected	passenger vehicles, small trucks, pedestrians, cyclists
	A.5a	**Design Vehicle(s) at Intersections**	fire trucks, WB-15 and transit vehicle must be able to make all turns without sweeping into opposing lanes of traffic on Arterials or Collectors (on Locals, 1.0m encroachment is permitted for trucks/fire trucks). Fire trucks can encroach fully into lanes of same-direction flow. Encroachment onto gravel shoulder permitted. No encroachment onto grass swale permitted.	WB-15 trucks and transit vehicles should be able to physically negotiate turns at intersections, but only at locations where they are regularly expected to be turning . 0.5m enroachment into opposing lanes is allowable since travel lanes are wide, but not for transit vehicles. Emergency vehicles permitted to mount curbs at intersections (large, flush curb let-downs possible)	fire, WB-15 and transit vehicles must be able to make all turns without sweeping into opposing lanes of traffic. No mounting of curbs permitted except for emergency vehicles.	Garbage/delivery trucks should be able to physically negotiate turns at intersections. Full enroachment into oncoming lanes of intersecting Local street is permitted but not for Arterials or Collectors where no encroachment is permitted. Fire trucks permitted full encroachment into oncoming lanes of all intersecting streets except for Arterials, where fire trucks are only allowed encroachment into same-direction traffic lanes.
	A.5b	**Design Scenario(s) for Travel Way Width**	transit bus (2.6m) or truck (2.6m) passing an oncoming car (2.1) and cyclist (1.0m) at operating speed with parked car on one side. Emergency vehicles expected to encroach into width provided for cyclists	transit bus (2.6m) passing an oncoming truck (2.6m) and cyclist (1.0m) at operating speed with parked cars on either side. Emergency vehicles (3.2m) expected to slightly encroach into space for cyclists but cyclists should be pulled over.	truck (2.6m) passing a transit vehicle or another truck (2.6m) at operating speed with parked car on one side. Note that travel way width must be carefully designed on curves (possibly widened) to allow for sweeping of truck overhangs. Wide curb lanes for cyclists must be "shared" when two large trucks pass.	garbage/delivery truck (2.6m) passing a car (2.1m) moving in the opposite direction, with parked cars both sides. Emergency vehicles (3.2m) expected to slightly encroach into oncoming lane (passenger vehicles should be pulled over). Cyclists expected to be integrated with traffic or take alternative route/rear lane
	A.6	**Role in Sustainable Drainage Scheme**	1. - be part of the overland flow path (major system) to safely convey stormwater runoff and to designated discharge location such as ponds, outfalls etc.	1. - be part of the overland flow path (major system) to safely convey stormwater runoff and to designated discharge location such as ponds, outfalls etc.	1. - be part of the overland flow path (major system) to safely convey stormwater runoff and to designated discharge location such as ponds, outfalls etc.	1. - be part of the overland flow path (major system) to safely convey stormwater runoff and to designated discharge location such as ponds, outfalls etc.
			2. - where required by the grading plan designs of developments, effectively transfer all cross flows to drainage swales/inlets.	2. - where required by the grading plan designs of developments, effectively transfer all cross flows to drainage swales/inlets.	2. - where required by the grading plan designs of developments, effectively transfer all cross flows to drainage swales/inlets.	2. - where required by the grading plan designs of developments, effectively transfer all cross flows to drainage swales/inlets.
			3. - where curbs are provided, provide for catchbasins with connection to the drainage swale/pipe system to safely transfer the roadway runoff. Biofiltration to occur prior to discharge into natural stream system			

APPENDIX A.2: EAST CLAYTON
STREET PERFORMANCE STANDARDS

STREET CLASS CHARACTERISTICS			COLLECTORS			
			MAJOR: RESIDENTIAL	MAJOR: LIVE/WORK	MINOR: BUSINESS PARK	MINOR: RESIDENTIAL
CROSS SECTION CODE			E	F	G	E
B. CROSS SECTION ELEMENTS						
B.1	**Roadway Features**					
	B.1.1.	**travel lanes**	one 4.5m travel lane in each direction to allow for bicyclists	one travel lane in each direction of 4.5m to allow for cyclists. Short marked left turn bays only at Arterial intersections, developed by banning parking.	one travel lane in each direction of 4.5m to allow for cyclists. Widens to 12m with with left turn bays at intersections	one 3.35m travel lane in each direction. No marked left turn bays; short space for turning vehicles at intersections made by prohibiting parking.
	B.1.2.	**parking bays/lanes**	parking one side only is permitted in parking pockets delineated by bollards; parking pocket locations to be approved by City - can be on either side of street	parking bays of 2.5m two sides in parking pockets. Pinch points at intersections, mid-block crossings and transit stops	one side limited parking bays. Parking bays should be implemented next to "Live/Work" area only.	two continuous parking lanes of 2.3m. Parking encouraged on-street to increase driver "side friction" and reduce operating speeds. At intersections, parking is prohibited and intersection throat can be "pinched" by reducing pavement width
	B.1.3	**median width**	none	none	4.0m raised concrete median with continuous street trees	none
	B.1.4	**overland flow path/street runoff**	2% crown drainage to swale/infiltration pits in boulevards on both sides of street	2% crown drainage to direct overland flow to curb/gutter and catch basins/minor storm sewers, which convey excessive stormwater runoff into designated outfalls. Biofiltration required before discharge into natural streams	2% cross slope drainage to curb and gutter system which has regular breaks; flow is then channelled to wet ponds on-site. Next to Live/Work area, minor storm system may be required	2% crown drainage to swale/infiltration pits in boulevards on both sides of street
	B.1.5	**total paved width**	11.3m (between intersections; could be less at "pinched" intersection locations)	varies 9.0m to 14.0m	13.0m	11.3m (between intersections, could be less at "pinched" intersection locations)
B.2	**Boulevard Features**					
	B.2.1.	**curb type (if present)**	none	barrier curb	barrier curb, with breaks for runoff. Sidewalk must be constructed over these breaks	n/a
	B.2.2	**sidewalks**	2 concrete 1.5m wide sidewalks located outside of tree corridor	2 concrete 2.0m sidewalks, located outside of tree corridor. In between street trees, decorative pavers/bricks or small plantings can be employed	one 1.5m concrete sidewalk; when next to Live/Work area, sidewalk should be on side of Live/Work	2 concrete 1.5m wide sidewalks located outside of tree corridor. On 70 Avenue Greenway, south side is to have 2.5m sidewalk and double row of trees
	B.2.3	**sidewalk/boulevard drainage**	2% slope to drainage swale/inflitration pit	2% slope to curb and gutter	2% slope to either on-site wet-pond or to breaks in curb & gutter; to be determined during detail design	2% slope to drainage swale/infiltration pit
	B.2.4	**drainage swale/infiltration pit (if present)**	2 grassed 3.25m swales/infiltration pits on either side of road surface. Bollards required to stop drivers parking on grass swale.	n/a	n/a	2 grassed 3.25m swales/infiltration pits on either side of road surface. Bollards required to stop drivers parking on grass swale.
	B.2.5	**street trees/landscaping**	3.35m corridor for trees on both sides shared with drainage swale/infiltration pit. Drainage considerations govern tree type/size/spacing	small street trees in grates on both sides within 2.0m corridor, spaced 8-10m. Automatic watering system may be required.	two 3.0m corridors for medium street trees spaced 10-12m. Only limited parking pockets permitted to minimze loss of tree canopy. 4.0m median for small/medium trees and other landscaping, spaced 10-12m. Vertical clearances for large trucks may require special species/pruning considerations.	two 3.35 corridors for trees shared with drainage swale/infiltration pit. Drainage considerations govern tree type/size/spacing. On 70 Avenue Greenway, an additional 2.0m wide corridor for second row of street trees on south side of street will be provided
	B2.6	**total boulevard width (one side)**	5.35m	varies 4.0m to 6.5m, depending on presence of parking	5.25m on side with sidewalk, 3.75m on side without sidewalk	5.35m (on south side of 70 Avenue Greenway, 8.35m)

APPENDIX A.2: EAST CLAYTON
STREET PERFORMANCE STANDARDS

STREET CLASS CHARACTERISTICS				COLLECTORS			
				MAJOR: RESIDENTIAL	MAJOR: LIVE/WORK	MINOR: BUSINESS PARK	MINOR: RESIDENTIAL
CROSS SECTION CODE				E	F	G	E
B.3.	Utilities						
	B.3.1	Location of Underground features					
		B.3.1.1	Storm Sewers (if present)	n/a	minor storm water system under road pavement to deal with boulevard and street runoff. Runoff must be directed to wet ponds	typically, none. Minor storm water system under road pavement may be to deal with boulevard and street runoff in special circumstances; in this case, runoff must be directed to wet ponds	n/a
		B.3.1.2	Sanitary Sewer line	under road pavement	under road pavement	under road pavement	under road pavement
		B.3.1.3	Water line	under road pavement	under road pavement	under road pavement	under road pavement
		B.3.1.4	Hydro/Tel/Cable lines	under sidewalk	overhead in rear lanes	under sidewalk	under sidewalk
		B.3.1.5	Gas line	under boulevard, at edge of sidewalk	under sidewalk	under boulevard, at edge of sidewalk	under boulevard, at edge of sidewalk
		B.3.1.6	Street Light Lines	in street tree corridor or under sidewalk	under sidewalk	in street tree corridor or under sidewalk	in street tree corridor or under sidewalk
	B.3.2	Location of Surface features					
		B.3.2.1	Hydro transformers, etc.	in street tree corridor	overhead in rear lanes	in street tree corridor	in street tree corridor
		B.3.2.2	Fire hydrants	in street tree corridor but offset from curb at least 0.8m	in street tree corridor, offset at least 0.8m from curb	in street tree corridor but offset from curb at least 0.8m	in street tree corridor but offset from curb at least 0.8m
		B.3.2.3	Street Light Poles	in street tree corridor but offset from curb at least 0.8m	in street tree corridor; setback at least 0.80m from curb.	in street tree corridor but offset from curb at least 0.8m	in street tree corridor but offset from curb at least 0.8m
B.4.	Total Road Allowance Width			22.0m	22.0m	22.0m	22.0m (25.0 m for 70 Avenue Greenway)

APPENDIX A.2: EAST CLAYTON
STREET PERFORMANCE STANDARDS

STREET CLASS CHARACTERISTICS		LOCALS				LANES	
		RESIDENTIAL: TWO-WAY WITH PARKING BOTH SIDES	**RESIDENTIAL: QUEUEING WITH PARKING BOTH SIDES**	**RESIDENTIAL: QUEUING WITH PARKING ONE SIDE**	**BUSINESS PARK**	**RESIDENTIAL LANE**	**COMMERCIAL LANE**
	CROSS SECTION CODE	**H**	**H**	**H**	**I**	**J**	**K**
A. SERVICE FUNCTIONS AND CHARACTERISTICS							
A.1	**Traffic Volume Ranges**	500-1,000 vpd	200-500 vpd; if ultimate projected volume is higher, then should use Two-Way flow standard or consider mid-block location for passing	generally <200 vpd, but depends on length of street, land use type and density. Approval required from City for use of this standard	1,000 to 4,000 vpd	varies depending on residential density and length of lane. Should not exceed 200 vpd in most cases	varies depending on type/intensity of commercial land use, location of parking access, and length of lane. Should probably not exceed 1,000 vpd
A.2	**Flow Characteristics**	uninterrupted two-way flow except at traffic signals, stop signs and when parking manoevers occur. On-street parking encouraged to reduce traffic speeds. Traffic calming measures at least every 100m encouraged - all types appropriate	interrupted, queuing operation. Traffic calming measures likely not required, but if they are, all types are appropriate. On-street parking encouraged to reduce speeds	uninterrupted two-way flow, except at stop signs and when parking manoevers occur. On-street parking encouraged to reduce speeds	uninterrupted two-way flow except at stop signs and when parking manoevers occur. On-street parking provided only where necessary in order to maximize trees canopy; most of parking supply should be on interior lots, screened from street. Traffic calming measures which entail horizontal/vertical deflection are not appropriate	interrupted, queuing operation for all vehicles. Traffic calming measures likely not required.	interrupted, queuing operation for any vehicles larger than small/medium passenger cars. Speed humps in commercial lanes appropriate if speeds become too high
A.3	**Access/Intersection Characteristics**	short blocks less than 100m encouraged, with frequent stops/traffic calming measures to reduce operating speeds. Rear lanes required for property access in most situations. Driveway access allowed in special circumstances but not encouraged because they reduce space for trees. Driveway crossings of drainage features must be carefully designed not to interrupt surface flow	short blocks less than 100m encouraged, with frequent stops to reduce operating speeds. If blocks are longer that 100m, parking must be banned on one side for fire truck access. Rear lanes required for property access in most situations. Driveway access allowed in certain circumstances but not encouraged because they reduce space for trees. Driveway crossings of drainage features must be carefully designed not to interrupt surface flow	short blocks less than 100m encouraged, with frequent stops to reduce operating speeds. If blocks are longer that 100m, parking must be banned for fire truck access. Rear lanes required for property access in most situations. Driveway access allowed in special circumstances but not encouraged because they reduce space for trees. Driveway crossings of drainage features must be carefully designed not to interrupt surface flow	access points to interior parking lots and their circulation roads permitted. Left turn bays not required.	frequent access to rear, residential garages permitted	access to rear parking lots of commercial street frontage and rear garages of adjacent residential or live/work permitted
A.4	**Design / Operating Speed**	40 km/h design speed, operating speed design objective is 30 km/h	30 km/h design speed, operating speed design objective is 20-30 km/h	30 km/h design speed, operating speed design objective is 20-30 km/h	40 km/h design speed, operating speed design objective is 30 km/h	20 km/h design speed, operating speed design objective is 10-20 km/h	20 km/h design speed, operating speed design objective is 10-20 km/h
A.5	**Frequent User Types**	garbage vehicles, cars, cyclists, pedestrians	garbage vehicles, cars, cyclists and pedestrians	garbage vehicles, cars, cyclists and pedestrians	small and large trucks, garbage vehicles, cars and pedestrians	garbage vehicles, passenger cars, cyclists and pedestrians	delivery trucks, garbage vehicles, passenger cars, cyclists and pedestrians
A.5a	**Design Vehicle(s) at Intersections**	delivery/garbage vehicles must be able to negotiate intersections with any other road class. Full encroachment into oncoming lanes is allowable at Local/Local intersections but no encroachment permitted at Arterial or Collector intersections. Restriction of parking near intersection may be required to ensure safe manoevers and sight distance	delivery/garbage vehicles must be able to negotiate intersections with any other road class. Full encroachment into oncoming lanes is allowable at Local/Local intersections but no encroachment permitted at Arterial or Collector intersections. Restriction of parking near intersection may be required to ensure safe manoevers and sight distance	delivery/garbage vehicles must be able to negotiate intersections with any other road class. Full encroachment into oncoming lanes is allowable at Local/Local intersections but no encroachment permitted at Arterial or Collector intersections. Restriction of parking near intersection may be required to ensure safe manoevers and sight distance	Large trucks must be able to make all turns without encroaching more than 1.0m into opposing lanes of traffic on local road. Emergency vehicles can fully encroach into opposing lanes	delivery/garbage vehicles must be able to negotiate intersections with any other road class. Full encroachment into oncoming lanes is allowable at Local intersections but no encroachment permitted at Arterial or Collector intersections. Restriction of parking in rear lane near intersection may be required to ensure safe manoevers and sight distance	delivery/garbage vehicles must be able to negotiate intersections with any other road class. Full encroachment into oncoming lanes is allowable at Local intersections but no encroachment permitted at Arterial or Collector intersections. Restriction of parking in rear lane near intersection may be required to ensure safe manoevers and sight distance
A.5b	**Design Scenario(s) for Travel Way Width**	two cars (2.1m) passing each another slowly with parking one side. Fire trucks expected to encroach into oncoming lanes. Cyclists integrated with traffic	car (2.1m) passing an oncoming cyclist (1.0m) slowly, next to parked cars on both sides. Fire trucks not expected unless block is longer than 100m, in which case parking will be banned one side to achieve 6.0m clear. Cyclists integrated with traffic	car (2.1m) passing a cyclist (1.0m) slowly next to a parked car on one side. Fire trucks not expected unless block is longer than 100m, in which case parking will be banned one side to achieve 6.0m clear. Cyclists integrated with traffic	two large trucks (2.6m) passing one another at operating speed. Cyclists are not expected frequently, but if present, will be integrated with traffic	truck (2.6m) slowly passing a parked car (which is partly pulled over onto lane "shoulder") Cyclists integrated with traffic	two passenger cars (2.1m) passing each other slowly opposite a parked car, or truck (2.6m) passing a parked car slowly. Cyclists integrated with traffic
A.6	**Role in Sustainable Drainage Scheme**	1. - be part of the overland flow path (major system) to safely convey stormwater runoff and to designated discharge location such as ponds, outfalls etc.	1. - be part of the overland flow path (major system) to safely convey stormwater runoff and to designated discharge location such as ponds, outfalls etc.	1. - be part of the overland flow path (major system) to safely convey stormwater runoff and to designated discharge location such as ponds, outfalls etc.	1. - be part of the overland flow path (major system) to safely convey stormwater runoff and to designated discharge location such as ponds, outfalls etc.	1. - be part of the overland flow path (major system) to safely convey stormwater runoff and to designated discharge location such as ponds, outfalls etc.	1. - be part of the overland flow path (major system) to safely convey stormwater runoff and to designated discharge location such as ponds, outfalls etc.
		2. - where required by the grading plan designs of developments, effectively transfer all cross flows to drainage swales/inlets.	2. - where required by the grading plan designs of developments, effectively transfer all cross flows to drainage swales/inlets.	2. - where required by the grading plan designs of developments, effectively transfer all cross flows to drainage swales/inlets.	2. - where required by the grading plan designs of developments, effectively transfer all cross flows to drainage swales/inlets.	2. - where required by the grading plan designs of developments, effectively transfer all cross flows to drainage swales/inlets.	2. - where required by the grading plan designs of developments, effectively transfer all cross flows to drainage swales/inlets.
							3. - where curbs are provided, provide for catchbasins with connection to the drainage swale/pipe system to safely transfer the roadway runoff. Biofiltration to occur prior to discharge into natural stream system

APPENDIX A.2: EAST CLAYTON
STREET PERFORMANCE STANDARDS

STREET CLASS CHARACTERISTICS			LOCALS				LANES	
			RESIDENTIAL: TWO-WAY WITH PARKING BOTH SIDES	RESIDENTIAL: QUEUEING WITH PARKING BOTH SIDES	RESIDENTIAL: QUEUING WITH PARKING ONE SIDE	BUSINESS PARK	RESIDENTIAL LANE	COMMERCIAL LANE
CROSS SECTION CODE			H	H	H	I	J	K
B. CROSS SECTION ELEMENTS								
B.1	**Roadway Features**							
	B.1.1.	**travel lanes**	two travel lanes of 3.0m	1 shared travel lane of 4.0m	1 shared travel lane of 4.0m	two travel lanes of 4.0m each	one shared travel lane of 4.0m	one shared travel lane of 5.0m
	B.1.2.	**parking bays/lanes**	two continuous parking lanes of 2.0m	two continuous parking lanes of 2.0m	one continuous parking lane of 2.0m	limited parking bays of 2.5m permitted within street tree corridor	none	no parking lane but parking permitted on "shoulders" in locations defined by hard surfaces (paving stones, bricks, asphalt)
	B.1.3	**median width**	none	none	none	none	none	none
	B.1.4	**overland flow path/street runoff**	2% cross fall drainage to swale/infiltration pit in boulevards on one side of street	2% cross fall drainage to swale/infiltration pit in boulevards on one side of street	2% cross fall drainage to swale/infiltration pit in boulevards on one side of street	2% crown drainage to direct overland flow to curb/gutter and catch basins/minor storm sewers, which convey excessive stormwater runoff into designated outfalls. Biofiltration required before discharge into natural streams	dish drainage with permeable pavement. Lot drainage should not drain to lanes unless sub-surface drainage system provided.	2% crown drainage to direct overland flow to curb/gutter and catch basins/minor storm sewers, which convey excessive stormwater runoff into designated outfalls and wet ponds. Bio-filtration required before discharge into natural streams.
	B.1.5	**total paved width**	10.0m	8.0m	6.0m	8.0m	4.0m	5.0m
B.2	**Boulevard Features**							
	B.2.1.	**curb type (if present)**	n/a	n/a	n/a	barrier	n/a	thin rollover curbs
	B.2.2	**sidewalks**	2 concrete 1.2m wide sidewalks located outside of tree corridor	2 concrete 1.2m wide sidewalks located outside of tree corridor	2 concrete 1.2m wide sidewalks located outside of tree corridor	2 concrete 1.5m wide sidewalks located outside of tree corridor	n/a, although pedestrians can use "shoulder" as refuge when vehicles are present	n/a, although pedestrians can use slightly raised "shoulder" as refuge when vehicles are present
	B.2.3	**sidewalk/boulevard drainage**	2% slope to drainage swale/infiltration pit	2% slope to drainage swale/infiltration pit	2% slope to drainage swale/infiltration pit	2% slope to curb and gutter	2% sloped "shoulders" drain to permeable pavement	2% sloped "shoulders" drain to curb and gutter
	B.2.4	**drainage swale/infiltration pit (if present)**	one 3.2m swale/infiltration pit. Bollards required on both sides to stop drivers parking on grass	one 2.7m swale/infiltration pit. Bollards required on both sides to stop drivers parking on grass	one 2.7m swale/infiltration pit. Bollards required on both sides to stop drivers parking on grass	n/a	n/a	n/a
	B.2.5	**street trees/landscaping**	one 3.2m street tree corridor for small to medium trees on side without swale. On side with swale, street tree type/size/spacing will be dependent of swale/infiltration design. Perforations in infiltration pipe discontinued adjacent to tree to avoid saturated soil conditions	one 2.7m street tree corridor for small to medium trees on side without swale. On side with swale, street tree type/size/spacing will be dependent of swale/infiltration design Perforations in infiltration pipe discontinued adjacent to tree to avoid saturated soil conditions	one 2.7m street tree corridor for small to medium trees on side without swale. On side with swale, street tree type/size/spacing will be dependent of swale/infiltration design. Perforations in infiltration pipe discontinued adjacent to tree to avoid saturated soil conditions	two 3.9m corridors for street trees/ shared with parking pockets. Minimize parking to minimize loss of street tree canopy.	n/a	n/a
	B2.6	**total boulevard width (one side)**	5.0m	4.5m	4.5m	6.0m	1.0m	1.5m

APPENDIX A.2: EAST CLAYTON
STREET PERFORMANCE STANDARDS

STREET CLASS CHARACTERISTICS				LOCALS				LANES	
				RESIDENTIAL: TWO-WAY WITH PARKING BOTH SIDES	RESIDENTIAL: QUEUEING WITH PARKING BOTH SIDES	RESIDENTIAL: QUEUING WITH PARKING ONE SIDE	BUSINESS PARK	RESIDENTIAL LANE	COMMERCIAL LANE
CROSS SECTION CODE				H	H	H	I	J	K
B.3.	**Utilities**								
	B.3.1	**Location of Underground features**							
		B.3.1.1	**Storm Sewers (if present)**	n/a	n/a	n/a	minor storm water system under road pavement to direct water from median curb and gutter to bio-filtration stream/ponds in business park	n/a	minor storm water system under road pavement to deal with boulevard and street runoff. Runoff must be directed to wet ponds
		B.3.1.2	**Sanitary Sewer line**	under road pavement	under road pavement	under road pavement	under road pavement	n/a	n/a
		B.3.1.3	**Water line**	under road pavement	under road pavement	under road pavement	under road pavement	n/a	n/a
		B.3.1.4	**Hydro/Tel/Cable lines**	under sidewalk	under sidewalk	under sidewalk	under sidewalk	n/a	overhead on poles
		B.3.1.5	**Gas line**	under boulevard, at edge of sidewalk	under boulevard, at edge of sidewalk	under boulevard, at edge of sidewalk	under boulevard, at edge of sidewalk	n/a	n/a
		B.3.1.6	**Street Light Lines**	in street tree corridor or under sidewalk	in street tree corridor or under sidewalk	in street tree corridor or under sidewalk	in street tree corridor or under sidewalk	n/a	street lighting provided in Commercial lanes on hydro poles
	B.3.2	**Location of Surface features**							
		B.3.2.1	**Hydro transformers, etc.**	in street tree corridor	in street tree corridor	in street tree corridor	in street tree corridor	n/a	overhead on poles
		B.3.2.2	**Fire hydrants**	in street tree corridor but offset from curb at least 0.8m	in street tree corridor but offset from curb at least 0.8m	in street tree corridor but offset from curb at least 0.8m	in street tree corridor but offset from curb at least 0.8m	n/a	n/a
		B.3.2.3	**Street Light Poles**	in street tree corridor but offset from curb at least 0.8m	in street tree corridor but offset from curb at least 0.8m	in street tree corridor but offset from curb at least 0.8m	in street tree corridor but offset from curb at least 0.8m	n/a	street lighting provided in Commercial lanes on hydro poles
B.4.	**Total Road Allowance Width**			20.0m	17.0m	15.0m	20.0m	6.0m	8.0m

APPENDIX A.3
APPROPRIATE APPLICATION OF TRAFFIC CALMING MEASURES

TYPE	MEASURE	APPROPRIATE APPLICATION				
		LOCAL ROADS		MINOR COLLECTOR ROADS		ARTERIAL & MAJOR COLLECTOR ROADS
		WITH CURBS	WITHOUT CURBS	WITH CURBS	WITHOUT CURBS	WITH CURBS
VERTICAL SHIFT (Primary Measures)						
	Raised Crosswalk	✔				
	Plateaus or Raised Intersections	✔				
	Rumble Strips	✔	✔	✔	✔	
	Sidewalk Extension	✔	✔	✔(1)	✔(1)	
	Speed Humps / Cushions	✔				
HORIZONTAL SHIFT (Primary Measures)						
	Chicane	✔				
	Curb Extension	✔		✔		
	Curb Radius Reduction	✔	✔	✔(2)	✔(2)	
	On-Street Parking	✔	✔	✔	✔	
	Raised Median Island	✔	✔	✔	✔	✔
	Traffic Circle	✔				
	Roundabout			✔		
OBSTRUCTION (Primary Measures)						
	Directional Closure	✔	✔			
	Diverter	✔	✔	✔	✔	
	Full Closure	✔	✔			
	Raised Intersection Channelization	✔	✔	✔	✔	✔
	Raised Median Through Intersection	✔	✔	✔	✔	

TYPE	MEASURE	APPROPRIATE APPLICATION				
		LOCAL ROADS		MINOR COLLECTOR ROADS		ARTERIAL & MAJOR COLLECTOR ROADS
		WITH CURBS	WITHOUT CURBS	WITH CURBS	WITHOUT CURBS	WITH CURBS
	Right-in/out Island	✔	✔			
SIGNING (Secondary Measures)						
	Maximum Speed Sign	✔	✔	✔	✔	
	Right/Left Turn Prohibition Sign	✔	✔	✔	✔	✔
	One-Way Sign	✔	✔			
	Stop Sign	✔	✔	✔(3)	✔(3)	
	Through Traffic Prohibited Sign	✔	✔			
	Traffic-Calmed Neighbourhood Sign	✔	✔	✔	✔	
	Yield Sign	✔	✔			
PAVEMENT TREATMENT (Secondary Measures)						
	Special Surfaces (colours, textures)	✔	✔	✔	✔(4)	✔(4)
	Road Markings	✔	✔	✔	✔	✔
SUPPORTING ENVIRONMENTAL FEATURES (Secondary Measures)						
	Landscaping	✔	✔	✔	✔	✔
	Entrance Details	✔	✔	✔	✔	

Notes:

The information contained in this table is based upon research and engineering judgement of Reid Crowther & Partners Ltd. and does not represent City of Surrey policy, or the policies of any other jurisdiction/industry publication.

(1) appropriate only if sidewalk extension is flush with road surface, i.e., not on a raised platform or flat-top hump
(2) must be individually reviewed to ensure larger vehicles on major collectors can perform turning manoevers without sweeping into opposing lanes on Major Collector
(3) subject to traffic analysis
(4) appropriate in boulevard or sidewalk crossings only

APPENDIX B

B.1 Proposed East Clayton Sanitary Sewer System Design Calculations

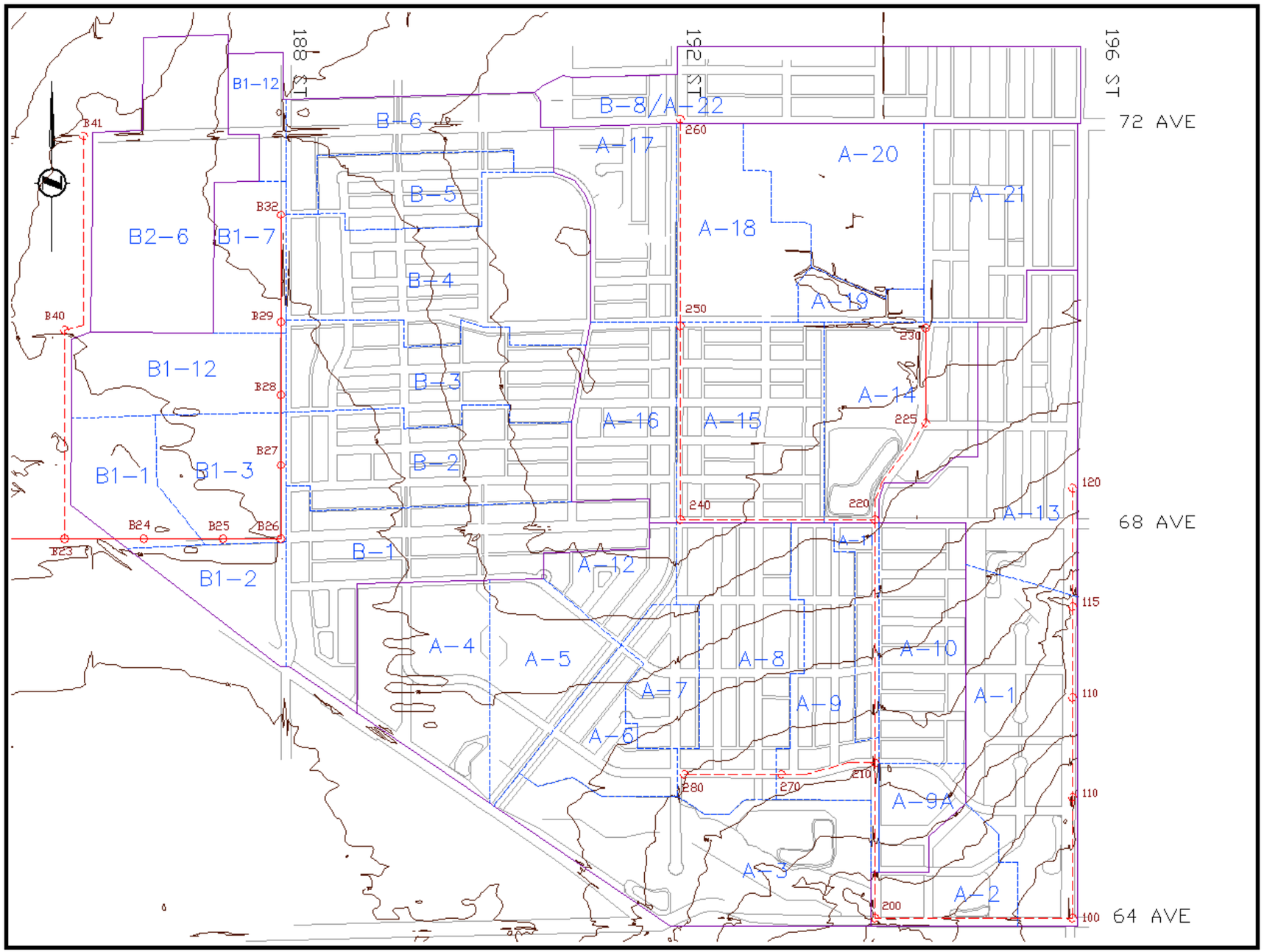
Appendix B.1 - Clayton Proposed Sanitary Trunk System Based on Peak Flows

Average Flow Per Person 350 l/day
Infiltration 0.1 l/ha

Conduit	Upstream Node	Downstream Node	New Contributing Areas				Tributary Population	Tributary Area (ha)	Average Qdaily (l/day)		>3.8	<2.5	Harman Peaking Factor	Qdaily peak (l/s)	Qinfil (l/s)	Qtotal (l/s)	Upstream Ground (m)	Upstream Invert (m)	Downstream Ground (m)	Downstream Invert (m)	Length (m)	Slope	Diameter (mm)	Velocity (m/s)	Qdesign (l/s)	Q/Qd
120	120	115	A-13	-	-	-	981	13.9	343479	4.39986265	3.8	4.39986265	3.80	15.1	1.4	16.5	63.38	62.00	51.11	49.48	244.7	0.051	150	1.95	34.4	0.48
115	115	110	-	-	-	-	981	13.9	343479	4.39986265	3.8	4.39986265	3.80	15.1	1.4	16.5	51.11	49.48	46.36	45.22	201.6	0.021	200	1.52	47.7	0.35
110	110	105	A-1	-	-	-	2406	27.7	842145	4.36016408	3.8	4.36016408	3.80	37.0	2.8	39.8	46.36	45.22	36.53	34.95	183.8	0.056	200	2.47	77.5	0.51
105	110	100	-	-	-	-	2406	27.7	842145	4.36016408	3.8	4.36016408	3.80	37.0	2.8	39.8	36.53	34.95	31.70	30.20	239.3	0.020	250	1.71	83.8	0.48
260	260	250	A-17	A-22	-	-	1161	23.2	406412	3.75721961	3.75721961	3.75721961	3.76	17.7	2.3	20.0	83.50	82.00	83.00	81.00	419.5	0.002	250	0.59	29.0	0.69
250	250	240	A-16	-	-	-	1536	30.6	537452	3.67217185	3.67217185	3.67217185	3.67	22.8	3.1	25.9	83.00	81.00	81.50	80.00	391.2	0.003	250	0.61	30.1	0.86
240	240	220	A-15	-	-	-	2350	42.7	822506	3.5302836	3.5302836	3.5302836	3.53	33.6	4.3	37.9	81.50	80.00	75.00	70.50	393.8	0.024	250	1.88	92.4	0.41
230	230	225	A-18	A-19	A-20	A-21	5872	74.4	2055219	3.17958809	3.17958809	3.17958809	3.18	75.6	7.4	83.1	**80.13**	**75.15**	**78.00**	**72.18**	191.8	**0.015**	**375**	1.98	218.2	0.38
225	225	220	A-14	-	-	-	6520	85.0	2282005	3.13628524	3.13628524	3.13628524	3.14	82.8	8.5	91.3	**78.00**	**72.18**	75.00	70.50	185.6	0.009	375	1.51	166.8	0.55
220	220	210	A-11	A-10	-	-	7733	96.0	2706641	3.06463066	3.06463066	3.06463066	3.06	96.0	9.6	105.6	75.00	70.50	55.00	53.50	491.7	0.035	375	2.95	326.0	0.32
290	290	280	A-4	A-5	A-12	A-6	2067	25.0	723281	3.57469417	3.57469417	3.57469417	3.57	29.9	2.5	32.4	68.00	66.50	61.00	59.50	283.8	0.025	250	1.90	93.4	0.35
280	280	270	A-8	A-7	-	-	3363	41.0	1177200	3.39973991	3.39973991	3.39973991	3.40	46.3	4.1	50.4	61.00	59.50	56.50	54.50	196.1	0.025	300	2.18	154.4	0.33
270	270	210	A-9	-	-	-	3974	48.7	1390798	3.33589644	3.33589644	3.33589644	3.34	53.7	4.9	58.6	56.50	54.50	55.00	53.50	192.5	0.005	375	1.14	126.4	0.46
210	210	200	A-9A	-	-	-	12167	147.7	4258558	2.86961642	2.86961642	2.86961642	2.87	141.4	14.8	156.2	55.00	53.50	40.00	38.50	314.1	0.048	525	4.34	939.8	0.17
200	200	100	A-2	A-3	-	-	13172	168.3	4610201	2.83502459	2.83502459	2.83502459	2.84	151.3	16.8	168.1	40.00	38.50	31.70	30.20	399.6	0.021	525	2.86	619.8	0.27
B1-51	B41	B40	B2-6	-	-	-	1160	14.2	405998	3.75751732	3.75751732	3.75751732	3.76	17.7	1.4	19.1	67.00	65.8	66.0	64.3	400.0	0.00	250	0.74	36.4	0.52
B1-52	B40	B23	-	-	-	-	1160	14.2	405998	3.75751732	3.75751732	3.75751732	3.76	17.7	1.4	19.1	66.00	64.3	64.3	61.1	425.0	0.01	250	1.05	51.6	0.37
B1-10	B32	B29	B2-7a	B-6	B-5	-	1292	14.8	452172	3.7255242	3.7255242	3.7255242	3.73	19.5	1.5	21.0	72.00	70.00	69.60	66.40	200.0	0.018	200	1.40	44.0	0.48
	Conduits B1-12e, B1-14e, B1-15e, B1-16e, B1-17e, B1-18e, and B1-19e are part of the existing sanitary sewer system (as per Coastland Engineering Asbuilts 7895-0205-00)																									
B1-12e	B29	B28	B1-7	B-4	-	-	2106	34.9	737084	3.56824614	3.56824614	3.56824614	3.57	30.4	3.5	33.9	**69.43**	**66.29**	**67.51**	**64.45**	**130.6**	**0.014**	**300**	1.62	114.5	0.30
B1-14e	B28	B27	B1-12	B-3	-	-	3300	52.2	1155002	3.40690786	3.40690786	3.40690786	3.41	45.5	5.2	50.8	**67.51**	**64.44**	**66.69**	**63.67**	**156.15**	**0.005**	**300**	0.97	68.4	0.74
B1-15e	B27	B26	B1-3	B-2	-	-	5211	68.9	1823971	3.22829258	3.22829258	3.22829258	3.23	68.2	6.9	75.0	**66.69**	**63.66**	**66.10**	**62.99**	**134.65**	**0.005**	**300**	0.96	68.2	1.10
B1-16e	B26	B25	B-1	-	-	-	6619	82.2	2316756	3.12999005	3.12999005	3.12999005	3.13	83.9	8.2	92.2	**66.10**	**62.99**	**64.39**	**62.15**	**150.9**	**0.005**	**375**	1.12	123.8	0.74
B1-17e	B25	B24	-	-	-	-	6619	82.2	2316756	3.12999005	3.12999005	3.12999005	3.13	83.9	8.2	92.2	**64.39**	**62.14**	**64.48**	**61.32**	**149.4**	**0.005**	**375**	1.12	124.1	0.74
B1-18e	B24	B23	B1-2	-	-	-	7464	86.4	2612531	3.07958865	3.07958865	3.07958865	3.08	93.1	8.6	101.8	**64.48**	**61.29**	**64.21**	**60.79**	**97.75**	**0.005**	**375**	1.12	124.1	0.82
B1-19e	B23	B22	B1-1	-	-	-	8696	105.3	3043609	3.0147066	3.0147066	3.0147066	3.01	106.2	10.5	116.7	**64.21**	**60.72**	**63.97**	**59.59**	**105.6**	**0.005**	**375**	1.13	124.4	0.94
B1-20	B22	B21	-	-	-	-	8696	105	3043609	3.0147066	3.0147066	3.0147066	3.01	106.2	10.5	116.7	63.97	59.47	61.00	56.90	380	0.007	375	1.34	147.8	0.79
	Conduits B1-21e through B1-40e are part of the existing sanitary sewer system (as per HY Engineering Asbuilts)																									
B1-21e	B21	B20	-	-	-	-	8696	105	3043609	3.0147066	3.0147066	3.0147066	3.01	106.2	10.5	116.7		**56.93**		**55.90**	**95.9**	**0.011**	**375**	1.65	181.7	0.64
B1-22e	B20	B19	-	-	-	-	8696	105	3043609	3.0147066	3.0147066	3.0147066	3.01	106.2	10.5	116.7		**55.92**		**52.82**	**95.8**	**0.032**	**375**	2.86	315.4	0.37
B1-23e	B19	B18	-	-	-	-	8696	105	3043609	3.0147066	3.0147066	3.0147066	3.01	106.2	10.5	116.7		**52.82**		**48.20**	**139.1**	**0.033**	**375**	2.89	319.5	0.37
B1-24e	B18	B17	-	-	-	-	8696	105	3043609	3.0147066	3.0147066	3.0147066	3.01	106.2	10.5	116.7		**48.20**		**46.73**	**49.5**	**0.030**	**375**	2.74	302.3	0.39
B1-25e	B17	B16	-	-	-	-	8696	105	3043609	3.0147066	3.0147066	3.0147066	3.01	106.2	10.5	116.7		**46.70**		**43.85**	**98.6**	**0.029**	**375**	2.70	298.1	0.39
B1-26e	B16	B15	-	-	-	-	8696	105	3043609	3.0147066	3.0147066	3.0147066	3.01	106.2	10.5	116.7		**43.85**		**40.66**	**95.0**	**0.034**	**375**	2.91	321.3	0.36
B1-27e	B15	B14	-	-	-	-	8696	105	3043609	3.0147066	3.0147066	3.0147066	3.01	106.2	10.5	116.7		**40.63**		**36.83**	**74.3**	**0.051**	**375**	3.59	396.5	0.29
B1-28e	B14	B13	-	-	-	-	8696	105	3043609	3.0147066	3.0147066	3.0147066	3.01	106.2	10.5	116.7		**36.83**		**32.46**	**98.1**	**0.045**	**450**	3.78	601.8	0.19
B1-29e	B13	B12	-	-	-	-	8696	105	3043609	3.0147066	3.0147066	3.0147066	3.01	106.2	10.5	116.7		**32.46**		**28.52**	**58.5**	**0.067**	**450**	4.65	739.8	0.16
B1-30e	B12	B11	-	-	-	-	8696	105	3043609	3.0147066	3.0147066	3.0147066	3.01	106.2	10.5	116.7		**28.52**		**26.57**	**99.1**	**0.020**	**450**	2.51	399.9	0.29
B1-31e	B11	B10	-	-	-	-	8696	105	3043609	3.0147066	3.0147066	3.0147066	3.01	106.2	10.5	116.7		**26.57**		**25.84**	**100.7**	**0.007**	**450**	1.53	242.7	0.48
B1-32e	B10	B9	-	-	-	-	8696	105	3043609	3.0147066	3.0147066	3.0147066	3.01	106.2	10.5	116.7		**25.84**		**24.86**	**38.2**	**0.026**	**450**	2.87	456.7	0.26
B1-33e	B9	B8	-	-	-	-	8696	105	3043609	3.0147066	3.0147066	3.0147066	3.01	106.2	10.5	116.7		**24.86**		**23.56**	**5.6**	**0.233**	**450**	8.65	1376.1	0.08
B1-34e	B8	B7	-	-	-	-	8696	105	3043609	3.0147066	3.0147066	3.0147066	3.01	106.2	10.5	116.7		**23.6**		**20.0**	**62.8**	**0.06**	**450**	4.31	685.2	0.17
B1-35e	B7	B6	-	-	-	-	8696	105	3043609	3.0147066	3.0147066	3.0147066	3.01	106.2	10.5	116.7		**20.0**		**16.9**	**72.1**	**0.04**	**450**	3.69	586.4	0.20
B1-36e	B6	B5	-	-	-	-	8696	105	3043609	3.0147066	3.0147066	3.0147066	3.01	106.2	10.5	116.7		**16.9**		**14.5**	**76.5**	**0.03**	**450**	3.19	507.1	0.23
B1-37e	B5	B4	-	-	-	-	8696	105	3043609	3.0147066	3.0147066	3.0147066	3.01	106.2	10.5	116.7		**14.3**		**9.0**	**144.4**	**0.04**	**450**	3.41	542.6	0.22
B1-38e	B4	B3	-	-	-	-	8696	105	3043609	3.0147066	3.0147066	3.0147066	3.01	106.2	10.5	116.7		**9.0**		**6.6**	**47.5**	**0.05**	**450**	4.07	647.5	0.18
B1-39e	B3	B2	-	-	-	-	8696	105	3043609	3.0147066	3.0147066	3.0147066	3.01	106.2	10.5	116.7		**6.9**		**4.8**	**44.0**	**0.05**	**750**	5.45	2408.9	0.05
B1-40e	B2	B1	-	-	-	-	8696	105	3043609	3.0147066	3.0147066	3.0147066	3.01	106.2	10.5	116.7		**4.8**		**1.2**	**112.2**	**0.03**	**750**	4.51	1991.7	0.06

TOTAL POPULATION SERVICED 24274

Bold Indicates Information from Asbuilts



Project:

City of Surrey

East Clayton NCP

Major Sanitary Catchment Boundary

Sanitary SubCatchment Boundary

5m Contour

Existing Sanitary Trunk Sewer

Future Sanitary Sewer

120 Sanitary Sewer Node ID

Not to Scale

Reid Crowther

Title:

City of Surrey

Appendix B.2

Proposed Clayton Sanitary Sewer System Schematic

APPENDIX C

C.1 Rational Method Design Calculations - With Deep Injection Wells

C.2 Rational Method Design Calculations - No Deep Injection Wells

Appendix C.1- Rational Method Design Calculations - With Deep Injection Wells

(see Figure 6.5.2 for node schematic)

Project #: 4E+06
Calcs By : JRA
Checked :
Date : July 27, 2000

Client Name: City of Surrey
Project Name: Clayton NCP
Drainage Area: East Clayton
Design Storm: 5 Year Design Event - With Deep Injection Wells

Remarks:

LOCATION			AREA			DESIGN FLOW										PIPE DATA					
									Time of Concentration			Minor System									
Street/ Right of Way	From MH	To MH	Incremental Area Code	Land Use Description	Incremental Area A (ha)	Runoff Coeff. R	Incremental A*R	Total A*R	To Entry (min)	Critical Time (min)	In Pipe Section (min)	Rainfall Intensity (mm/hr)	Total Flow (m3/s)	Deep Well Infiltration Flow (m3/s)	Net Pipe Flow (m3/s)	Pipe Capacity (m3/s)	Friction Factor n	Pipe Slope (%)	Actual Pipe Diameter (m)	Pipe Length (m)	Full Velocity (m/s)
								0.000		0.00											
	A200	A190	A-12		40.360	0.410	16.548	16.548	15.000	22.00	0.28	24.8	1.140	0.450	**0.690**	0.922	0.013	4.6%	0.525	205.0	3.851
	A190	A180	A-11		16.610	0.410	6.810	23.358	15.000	22.28	0.38	24.6	1.597	0.310	**0.837**	1.189	0.013	3.8%	0.600	235.0	4.205
	A210	A180	A-10		26.630	0.410	10.918	34.276	15.000	22.67	0.53	24.4	2.325	0.490	**1.075**	1.447	0.013	5.6%	0.600	400.0	5.119
	A180	A170	POND P-6												**0.860**	1.005	0.013	12.4%	0.450	485.0	6.319
	A170	A100	-												**0.860**	1.053	0.013	13.6%	0.450	310.0	6.620
	A160	A150	A-7		13.290	0.410	5.449	5.449	15.000	15.00	0.29	30.8	0.466		**0.466**	0.475	0.013	7.3%	0.375	255.0	4.299
	A150	A130	A-6		8.870	0.410	3.637	9.086	15.000	15.29	0.13	30.5	0.769		**0.769**	0.843	0.013	8.8%	0.450	115.0	5.303
	A140	A130	A-5		6.520	0.410	2.673	11.759													
			A-4		9.070	0.410	3.719	15.478	15.000	15.00	0.35	30.8	1.324		**1.324**	1.381	0.013	1.5%	0.750	190.0	3.126
	A130	A120	A-3		14.960	0.410	6.134	21.611	15.000	15.35	0.03	30.4	1.825		**1.825**	4.312	0.013	15.0%	0.750	65.0	9.760
	A110	A100	POND P-4												**0.890**	1.360	0.013	10.0%	0.525	155.0	6.282
	A240	A230	A-8		16.930	0.800	13.544	13.544	15.000	15.00	0.27	30.8	1.159		**1.159**	1.574	0.013	2.0%	0.750	450.0	3.564
	A230	A220	POND P-2		16.930										**0.170**	0.250	0.013	6.7%	0.300	495.0	3.532
	A220	A100	POND P-1,2		25.730										**0.150**	0.328	0.013	11.5%	0.300	440.0	4.647
	A100	OFFSITE	-			0.000	0.000	0.000	15.000	15.00		30.8	0.000		**0.000**	0.000	0.013		0.200	400.0	0.000
	B150	B140	B-5		12.580	0.460	5.787	5.787	15.000	15.00	0.43	30.8	0.495	0.100	**0.395**	0.521	0.013	3.3%	0.450	225.0	3.273
	B140	B130	-			0.000	0.000	5.787	15.000	15.43	0.38	30.4	0.488		**0.388**	0.638	0.013	5.0%	0.450	215.0	4.008
	B160	B130	B-4		15.910	0.460	7.319	7.319	15.000	15.81	0.34	30.0	0.610	0.350	**0.260**	0.405	0.013	5.3%	0.375	230.0	3.666
	B130	B120	-			0.000	0.000	13.105	15.000	16.15	0.28	29.6	1.079		**0.629**	0.638	0.013	5.0%	0.450	185.0	4.008
	B170	B120	B-3		7.930	0.460	3.648	3.648	15.000	16.43	0.00	29.4	0.298	0.290	**0.008**	0.000	0.013	5.6%	0.000	235.0	0.000
	B120	B110	-			0.000	0.000	16.753	15.000	16.43	0.37	29.4	1.367		**0.637**	0.868	0.013	2.0%	0.600	155.0	3.071
	B180	B110	B-2		11.530	0.460	5.304	5.304	15.000	16.80	0.38	29.1	0.429	0.290	**0.139**	0.392	0.013	5.0%	0.375	240.0	3.550
	B200	B190	B-1		13.070	0.800	10.456	10.456	15.000	17.18	0.34	28.7	0.835	0.340	**0.495**	0.713	0.013	6.3%	0.450	240.0	4.482
	B190	B110	-			0.000	0.000	10.456	15.000	17.51	0.27	28.5	0.827		**0.487**	0.514	0.013	1.4%	0.525	95.0	2.375
	B110	B100	-			0.000	0.000	32.513	15.000	17.78	0.49	28.2	2.550		**1.262**	1.331	0.013	1.4%	0.750	125.0	3.012
	B100	OFFSITE													**0.880**	1.005	0.013	1.4%	0.675	125.0	2.808

Bold Indicates Specified Pond Release Rate

Appendix C.2 - Rational Method Design Calculations - No Deep Injection Wells

(see Figure 6.5.2 for node schematic)

Project #: 4E+06
Calcs By : JRA
Checked :
Date : July 28, 2000

Client Name: City of Surrey
Project Name: Clayton NCP
Drainage Area: East Clayton
Design Storm: 5 Year Design Event - No Deep Injection Wells

Remarks:

LOCATION			AREA			DESIGN FLOW									PIPE DATA					
									Time of Concentration			Minor System								
Street/ Right of Way	From MH	To MH	Increment Area Code	Land Use Description	Increment Area A (ha)	Runoff Coeff. R	Increment A*R	Total A*R	To Entry (min)	Critical Time (min)	In Pipe Section (min)	Rainfall Intensity (mm/hr)	Total Peak Flow (m3/s)		Pipe Capacity (m3/s)	Friction Factor n	Pipe Slope (%)	Actual Pipe Diameter (m)	Pipe Length (m)	Full Velocity (m/s)
								0.000		0.00										
	A200	A190	A-12		40.360	0.410	16.548	16.548	15.000	22.00	0.73	24.8	1.140		1.319	0.013	4.6%	0.600	205.0	4.665
	A190	A180	A-11		16.610	0.410	6.810	23.358	15.000	22.25	0.80	24.3	1.579		2.156	0.013	3.8%	0.750	235.0	4.880
	A210	A180	A-10		26.630	0.410	10.918	34.276	15.000	22.60	1.12	23.9	2.272		2.624	0.013	5.6%	0.750	400.0	5.940
	A180	A170	POND P-6										**0.860**		1.005	0.013	12.4%	0.450	485.0	6.319
	A170	A100	-										0.860		1.053	0.013	13.6%	0.450	310.0	6.620
	A160	A150	A-7		13.290	0.410	5.449	5.449	15.000	15.00	0.99	30.8	0.466		0.475	0.013	7.3%	0.375	255.0	4.299
	A150	A130	A-6		8.870	0.410	3.637	9.086	15.000	15.29	0.36	29.7	0.750		0.843	0.013	8.8%	0.450	115.0	5.303
	A140	A130	A-5		6.520	0.410	2.673	11.759												
			A-4		9.070	0.410	3.719	15.478	15.000	15.00	1.01	30.8	1.324		1.381	0.013	1.5%	0.750	190.0	3.126
	A130	A120	A-3		14.960	0.410	6.134	21.611	15.000	15.35	0.11	29.7	1.782		4.312	0.013	15.0%	0.750	65.0	9.760
	A110	A100	POND P-4										**0.890**		1.360	0.013	10.0%	0.525	155.0	6.282
	A240	A230	A-8		16.930	0.800	13.544	13.544	15.000	15.00	2.10	30.8	1.159		1.574	0.013	2.0%	0.750	450.0	3.564
	A230	A220	POND P-2										**0.170**		0.250	0.013	6.7%	0.300	495.0	3.532
	A220	A100	POND P-1,2		25.730								**0.150**		0.328	0.013	11.5%	0.300	440.0	4.647
	A100	OFFSITE	-			0.000	0.000	0.000	15.000	15.00	#DIV/0!	30.8	0.000		0.000	0.013		0.200	400.0	0.000
	B150	B140	B-5		12.580	0.460	5.787	5.787	15.000	15.00	1.15	30.8	0.495		0.521	0.013	3.3%	0.450	225.0	3.273
	B140	B130	-			0.000	0.000	5.787	15.000	15.38	0.89	29.5	0.475		0.638	0.013	5.0%	0.450	215.0	4.008
	B160	B130	B-4		15.910	0.460	7.319	7.319	15.000	15.71	0.93	28.7	0.583		0.658	0.013	5.3%	0.450	230.0	4.140
	B130	B120	-			0.000	0.000	13.105	15.000	16.02	0.63	27.8	1.012		1.373	0.013	5.0%	0.600	185.0	4.856
	B170	B120	B-3		7.930	0.460	3.648	3.648	15.000	16.24	0.00	27.3	0.276		0.676	0.013	5.6%	0.450	235.0	4.252
	B120	B110	-			0.000	0.000	16.753	15.000	16.65	0.84	27.3	1.289		1.574	0.013	2.0%	0.750	155.0	3.564
	B180	B110	B-2		11.530	0.460	5.304	5.304	15.000	16.90	1.13	26.6	0.392		0.392	0.013	5.0%	0.375	240.0	3.550
	B200	B190	B-1		13.070	0.800	10.456	10.456	15.000	17.28	0.81	25.8	0.748		1.075	0.013	6.3%	0.525	240.0	4.967
	B190	B110	-			0.000	0.000	10.456	15.000	17.58	0.61	25.2	0.732		0.734	0.013	1.4%	0.600	95.0	2.596
	B110	B100	-			0.000	0.000	32.513	15.000	17.80	0.55	24.8	2.412		3.264	0.013	1.4%	1.050	125.0	3.769
	B100	OFFSITE											**0.880**		1.005	0.013	1.4%	0.675	125.0	2.808

Bold Font Indicates Specified Pond Release Rate

APPENDIX D

Unit Cost Estimates – Major Collectors

APPENDIX D
EAST CLAYTON NEIGHBOURHOOD CONCEPT PLAN
UNIT COST ESTIMATES: MAJOR COLLECTORS

Client: City of Surrey

Project No.: 36502-00
Estimate Type: Preliminary, for DCC Estimates

					East Clayton Major Collector Street Standards, Per Metre Costs					
					New Ultimate Major Collector			Upgrade Existing to Ultimate MC		
					Type E Residential	Type F Business Park	Type G Live/Work	Type E Residential	Type F Business Park	Type G Live/Work
ITEM	DESCRIPTION		UNIT PRICE	UNITS	$/M	$/M	$/M	$/M	$/M	$/M
1.0	**Site Works**									
1.1	Clearing & Grubbing		$25,000	ha	$60		$60	$60		
1.2	Erosion & Sediment Control		$10,000	ea.	$25		$25	$25		
1.3	Earthworks									
	1.3.1	common excavation	$22	cu.m.	$176		$132	$44		
	1.3.2	imported embankment fill	$20	cu.m.	$0		$0	$0		
2.0	**Road Subbase and Base**									
2.1	Subbase		$5	sq.m.	$60		$40	$10		
2.2	Subgrade Preparation		$2	sq.m.	$24		$16	$4		
3.0	**Asphaltic Concrete Pavement**									
3.1	Pavement (two lifts)		$9	sq.m.	$102		$68	$51		
3.2	Tack Coat		$0.50	sq.m.	$12		$8	$6		
4.0	**Sidewalk and Boulvevard**									
4.1	Concrete Curb and Gutter		$40	m	$0		$80	$0		
4.2	Concrete Sidewalk		$60	m	$120		$120	$120		
4.3	Bollards (5m spacing both sides)		$15	each (0.4 per m)	$0		$0	$6		
5.0	**Drainage and Sewer Works**									
5.1	Sanitary sewer with manholes		$400	m	$0		$0	$0		
5.2	Storm sewer with manholes & catchbasins		$435	m	$435		$435	$435		
5.3	Swale/Infiltration Trench and Pipe, including Lawn Drains		$200	m	$0		$0	$0		
6.0	**Water Works**									
6.1	watermain c/w fittings, hydrants, etc.		$320	m	$0		$0	$0		
6.2	Irrigation system for street trees (Type G)		$30	m	$0		$0	$0		
7.0	**Street Lighting**									
7.1	Pole c/w luminaire, ducts, etc. @ 30m spacing									
	7.1.1	Standard	$3,500	each (0.03 per m)	$0		$0	$0		
	7.1.2	Decorative (Type G)	$6,000	each (0.03 per m)	$180		$180	$180		
8.0	**Private Utilities**									
8.1	Hydro/Tel/Cable (including surface features)		$300	m	$300		$300	$300		
9.0	**Landscaping/Aesthetics**									
9.1	Grading and Hydroseeding of Boulevard		$6	sq.m.	$48		$24	$0		
9.2	Street Trees spaced at 10m centres (see Note 1)		$350	per tree (0.10 per m)	$35		$35	$35		
9.3	Plantings (shrubs and flowers, Type F)		$60	sq.m.	$0		$0	$0		
9.4	Stamped Concrete / Special Pavers (Type G)		$60	sq.m.	$0		$0	$0		
9.5	Street Furniture (Type G, see note 2 below)		$57	m	$57		$57	$57		
10.0	**Traffic Control**									
10.1	Signage		$5	m	$5		$5	$5		
10.2	Pavement Markings		$15	m	$15		$15	$15		
11.0	**Property Acquisition (Above 20m Dedication)**									
11.1	Residential		$200	sq.m.	$0		$0	$0		
11.2	Commercial		$300	sq.m.	$0		$0	$0		
TOTAL UNIT COST PER METRE					**$1,654**		**$1,600**	**$1,353**	**$0**	**$0**

NOTES
(1) these costs as per City of Surrey DCCs for street trees, and include tree cost, installation and watering after installation (as per Greg Ward, Parks and Recreation)
(2) from RS Means, 1998, assuming that every 100m there would be 4 benches ($950 each), 4 trash cans ($625 each) and 8 planter boxes ($400 each)

APPENDICES

Appendix 1 City of Surrey Corporate Report – General Clayton Land Use Plan
Appendix 2 Charrette Constituency Representatives and Issues
Appendix 3 Charrette Design Brief

APPENDIX 1

City of Surrey Corporate Report – General Clayton Land Use Plan

Corporate Report

NO: _____

COUNCIL DATE: _____

COUNCIL-IN-COMMITTEE

TO:	**Mayor & Council**	DATE:	**November 24, 1998**
FROM:	**General Manager, Planning & Development**	FILE:	**2350-004**
SUBJECT:	**Clayton Neighbourhood Concept Plan** **General Land Use Concept**		

RECOMMENDATION

The Planning & Development Department recommends that City Council:

1. Approve the attached Clayton General Land Use Concept (Appendix I) as a basis for preparing a detailed Neighbourhood Concept Plan for East Clayton (lands currently designated URBAN in Surrey's Official Community Plan);
2. Instruct staff to commence the preparation of a detailed Neighbourhood Concept Plan for East Clayton to include the type, size, location and densities of the specific land uses, road hierarchy and alignments based on the General Land Use Concept;
3. Instruct staff to incorporate sustainable development principles, standards and practices into the detailed Neighbourhood Concept Plan;
4. Instruct staff to prepare a comprehensive servicing, phasing and financial strategy for East Clayton that will demonstrate adequate funding for specific amenities, infrastructure and utilities; and,
5. Instruct staff to address the outstanding issues, as identified in Appendix VI, during the East Clayton Neighbourhood Concept Plan process.

INTENT

The intent of this report is:

a) To provide City Council with an overview of the General Land Use Concept for Clayton, including a summary of the planning process and the major components of the plan;
b) To recommend approval in principle of the proposed General Land Use Concept for Clayton to permit staff to proceed with preparing a detailed Neighbourhood Concept Plan for East Clayton; and,
c) To provide City Council with a summary of the outstanding issues that need to be addressed in conjunction with the detailed Neighbourhood Concept Plan.

BACKGROUND

Study Area Characteristics

The Clayton study area comprises approximately 809 hectares (2,000 acres) and is bounded by the Agricul-

tural Land Reserve on the north (approximately 84 Avenue), the Fraser Highway to the south, the Agricultural Land Reserve to the west (approximately 180 Street) and 196 Street (Langley border) to the east. The map in Appendix III attached illustrates the extent of the Clayton Study area.

Clayton is an expansive and diverse planning area. It has a definite "edge" which is where the suburban lands meet the agricultural lands. Clayton is characterized by a rural ambiance and the area provides excellent views of the mountains and lowlands. The focus of the community is a major park, school site and community hall in the vicinity of 70/72 Avenue and 184/188 Street in the centre of Clayton.

An environmental study indicates that there are many significant watercourses and forest blocks worthy of protection. There is a strong rural and agricultural presence in Clayton, including several existing one-acre subdivisions. There is no organized commercial development apart from some commercial along Fraser Highway and a small convenience store at 80 Avenue and 192 Street.

Policy Framework - Surrey's Official Community Plan

Surrey's Official Community Plan designates East Clayton as URBAN and the remainder of Clayton as SUBURBAN (see Appendix III). East Clayton is defined as the area east of 188 Street and south of 72 Avenue (nearest to Langley Township). The Urban Growth Concept contained in Surrey's Official Community Plan identifies East Clayton as an urban infill area and the remaining suburban land within Clayton as an area with potential long term development subject to land use planning with local residents. Given that East Clayton will be developed in advance of the remainder of Clayton, it is prudent to establish an overall planning structure for the entire Clayton area before proceeding with detailed planning and development of the lands in East Clayton. Due to the existence of an abundance of vacant urban land in Surrey's Neighbourhood Concept Plan areas, the area outside of East Clayton is considered to be a low priority for City servicing and development.

The Official Community Plan also provides guidelines and requirements for the preparation and content of Neighbourhood Concept Plans for Surrey's emerging urban areas. The General Land Use Concept for Clayton was prepared within this Neighbourhood Concept Plan policy framework.

During the Suburban Lands Review Study (1992) it was suggested that some lands adjacent to the Fraser Highway in Clayton be designated for a "workplace", in order to provide local employment opportunities. The planning process for Clayton also considered this recommendation.

Neighbourhood Concept Plan Process

Overview of the Planning Process (Appendix IV)

The table presented in Appendix IV outlines the planning process undertaken in preparing the General Land Use Concept for Clayton. The preparation of the General Land Use Concept (along with the servicing, phasing and drainage plans) is the first stage of planning after which will follow the preparation of more detailed Neighbourhood Concept Plans for the individual neighbourhoods of Clayton.

Clayton Citizen Advisory Committee (CAC)

To bring local knowledge to the planning process and to facilitate local discussion and communication, a Citizen Advisory Committee was established to assist City staff in preparing the General Land Use Concept. The Committee consisted of 15 full members and 15 alternate members equitably representing the three geographical areas of Clayton (east, west and north). The Committee met on an ongoing basis throughout the planning process and served as an invaluable resource in reviewing the proposed land use concepts, disseminating information to their constituents and assisting with the selection of a preferred land use concept.

Public Meetings & Open Houses

The planning process was initiated in November, 1996 with a public workshop at which approximately 300 people gathered in groups to brainstorm on what the vision for the future Clayton community should be. This was followed by subsequent public information meetings in May, 1997, December, 1997 and May, 1998 at which the residents and property owners could make comments on the various land use concepts presented.

Other Communications

The Clayton Community Association (representing all of Clayton) was kept apprised of the progression of the planning process and disseminated information to the residents of Clayton through its Newsletter and monthly meetings.

Staff also kept an ad-hoc group of East Clayton property owners updated on the status of the planning process. This group evidently met once a month at meetings organized by predominant developers in the area.

Input and Review by City Departments, Government Agencies & Langley Township

The City's project team involved in preparing the General Land Use Concept for Clayton included staff from Planning & Development, Engineering, Parks, Recreation & Culture, the School District and engineering and environmental consultants. This team-oriented approach has resulted in the optimal Land Use Concept which addresses the public, municipal and technical objectives of all stakeholders. It is noted that other government agencies were consulted at the outset of the planning process and throughout the process as necessary. In addition, staff worked closely with staff from the Township of Langley to ensure that the land uses and transportation network proposed for Clayton and Willoughby (land use plan in process) are compatible and congruous.

DISCUSSION

Planning Objectives for the Clayton Community (Appendix V)

Planning objectives for Clayton were identified through discussions with the Citizen Advisory Committee, through consultation with internal and external stakeholders and through a public workshop at which the Clayton community articulated answers to the question "What would make Clayton a good community to live in?"

The planning objectives for Clayton resulting from this consultative process which provided direction for preparing the General Land Use Concept are presented in Appendix V.

Overview of the Plan

Community Structure - Clayton as a Complete Community

The projected population at full build out (subject to detailed planning for the future urban area) under the proposed General Land Use Concept is expected to be 30,000 - 35,000. Consistent with the desires of the community, the Clayton area has been planned as a complete community with a village centre as outlined below:

- Clayton will have its own identity and community focus by having school/park sites, the community hall, commercial and institutional uses integrated within a "village centre" located in the central area of Clayton.
- To provide local employment opportunities, a comprehensively designed workplace/employment centre will be located near the intersection of Fraser Highway and 192 Street.

- To provide an innovative alternative to standard homes and offices, and to accommodate fragmented land ownership, a live/work area is proposed for the smaller parcels of land located near 64 Avenue and 192 Street.
- The Clayton community will be self-contained in that the residents will be able to obtain everyday shopping items, and attend to their recreational and social needs within the boundaries of their neighbourhoods.
- For school catchment and planning purposes, Clayton will be delineated into eight neighbourhoods with the elementary school/park serving as a focus.
- There will be direct and easy accessibility to transit (Fraser Highway), and a grid road system combined with greenways will enable residents to walk or cycle to all of the main schools, parks, services and facilities.

The Village Concept

The future Clayton Village neighbourhood (see Appendix II for neighbourhood location) currently accommodates Clayton Hall, a large active park, natural open space and the new Clayton Secondary School in the vicinity of 72 Avenue and 188 Street. Building upon this established focal point, the General Land Use Concept provides for the added vibrancy of this village centre by including some local commercial, mixed use, institutional and additional open space and greenways. The village centre concept will be the main contributing factor in establishing Clayton as a unique community with its own identity. A detailed Neighbourhood Concept Plan for the Village Centre neighbourhood will commence when the Neighbourhood Concept Plan for East Clayton is complete.

Residential

A variety of housing types are proposed for Clayton including multiple residential, single family (RF) standard lots, small lots, suburban lots, commercial/residential and live/work housing. It is anticipated that there will be in the range of 10,000 - 15,00 dwelling units of varying types that would ultimately be developed over time under the General Land Use Concept.

Multiple residential (e.g. townhouses, apartments) will be located toward the Willowbrook area (where higher densities in Langley Township are proposed) and around the Village Centre (to reinforce it). Additional multiple residential development will be concentrated along the Fraser Highway in between 184 Street and 188 Street.

Low and transitional density single family urban lots of varying sizes will be developed in the east and central area of Clayton. Suburban lots will be developed toward the north and west adjacent to the Agricultural Land Reserve, to act as a density transition toward the agricultural lands.

The General Land Use Concept incorporates the notion of accommodating a “transitional density area” between the multiple residential and urban residential designations and adjacent to the Business Park. The intent of this designation is to allow for a density and form of housing that will ease the transition between single family lots, for example, and apartments or townhouses.

Commercial

The General Land Use Concept contemplates about 5.26 hectares (13 acres) of commercial and commercial/residential in the Village Centre, along with small local commercial sites at 80 Avenue and 192 Street, and at 72 Avenue and 196 Street. Consistent with adjacent land uses in Langley, a mixed commercial/residential development is proposed for the north west corner of 64 Avenue and 196 Street. Additional local commercial opportunities may arise from the detailed Neighbourhood Concept Plan process, given that one of the objectives of sustainable development and livability is to provide the opportunity for residents to do their convenience shopping in the neighbourhood.

Business Park (Work Place)

In order to provide employment opportunities and in keeping with the idea of a complete community concept, a business park is proposed for the area west of 192 Street near the Fraser Highway. This is intended to be a low impact business park which will accommodate research and development companies, corporate offices, high tech manufacturers and distributors.

A business park study recently commissioned by the City reveals that Surrey has a severe shortage of lands available for corporate business park development. The study further identifies Clayton as an ideal location for such a comprehensively designed business park.

Live & Work Area

Approximately 23 hectares (57 acres) have been designated for live/work development. While the precise nature of this type of development is largely undefined, the market appeal and affordability potential prompted the inclusion of this innovative housing type in the Clayton plan. It is noted that the details of density, form and design of this type of development will be refined during the detailed Neighbourhood Concept Plan process. The City has also applied for a grant to cover the costs of developing and implementing the live/work housing concept in Surrey.

If, during the Neighbourhood Concept Plan process, the live/work concept is determined not to be feasible, the General Land Use Concept contemplates the option of business park uses for these lands.

Schools and Parks

In consultation with the Surrey School District No. 36, eight future school catchment areas, based upon projected student populations, have been delineated in the Clayton area. The plan attached in Appendix II identifies these general catchment areas. The elementary school catchment areas also serve to delineate the boundaries of the future neighbourhoods in Clayton. Each school catchment area or neighbourhood will consist of approximately 4,000 - 6,000 people.

It is noted that there are currently two elementary schools in Clayton (in Clayton Village and Clayton West catchment areas) which are intended to stay open. Clayton Secondary School on 188 Street is currently under construction and is expected to open in September, 1999. When the entire Clayton area is developed another secondary school will be required north of 72 Avenue.

Each elementary school will be associated with a park site to provide active and passive recreational opportunities for the neighbourhood (each school/park site will about 5.26 hectares (13 acres) in size). Other park and open space areas will include the main central park in the Village Centre, various greenways, watercourse protection areas, environmentally sensitive areas and open space associated with storm water detention ponds.

The locations of school/park sites and open space will be defined during the detailed Neighbourhoood Concept Plan process.

Preservation Areas, Environmentally Sensitive Areas and Watercourses

A Bio-Inventory Study of the Clayton area has revealed that there are several significant forest blocks and watercourses which should be protected as development occurs in the area (see the General Land Use Concept in Appendix I). The most significant forest block is located in the north area of Clayton in between 76 and 78 Avenue and 188 and 192 Street. The City owns several sites in the vicinity of this large forest block. Another significant forest block is located at the Langley border just north of 72 Avenue. In consultation with planning staff from Langley Township who are in the process of preparing a plan for Willoughby, it has been agreed that this forest block

should remain intact in the respective plans and that methods to preserve the forest be explored at the detailed planning stage.

There are a number of fish bearing watercourses which will be protected through the application of development setbacks. City staff will be examining alternative methods (e.g. gross density zoning, density bonusing, cluster zoning, alternative design standards, etc.) during the detailed Neighbourhood Concept Plan process, toward achieving the protection of the identified environmentally sensitive areas while at the same time, permitting some form of adjacent sensitive development.

Pedestrian and Bicycle Circulation (Linkages)

In keeping with the concept of a complete community and in order to ensure that the future residents of Clayton can easily access all of the main facilities in Clayton, an extensive pedestrian/ bicycle circulation system is proposed. In addition to major linkages between neighbourhood school/park sites and amenities, the existing gas transmission right-of-way will be utilized as a major east-west greenway (except for where it traverses Aloha Estates) connecting Clayton with Fleetwood to the west and Langley Township to the east.

Future Urban Area (North of 72 Avenue)

The area generally north of 72 Avenue has been identified on the General Land Use Concept as "future urban". This area is currently designated in the Official Community Plan as SUBURBAN, but has also been identified as a long term development area (subject to neighbourhood planning processes). Apart from some development interest in properties immediately north of 72 Avenue (see outstanding issues below), it appears that the area is not experiencing a demand for urban development. In addition, many of the residents wish to retain their rural lifestyle, at least for the medium term. Consequently, the area has been identified as future urban but will not be opened up for urban land uses until the Neighbourhood Concept Plan process has been undertaken and the lands are redesignated to URBAN in Surrey's Official Community Plan. At that time, issues such as the type and form of urban development and the matter of adequate transition areas between urban and permanent suburban areas will be addressed.

Institutional

The Clayton General Land Use Concept provides for two future institutional sites within the Village Centre in the vicinity of the Secondary School and commercial node. Another institutional site (owned by a local church group) is identified along the Fraser Highway at 68 Avenue. These sites are intended to accommodate such land uses as churches, seniors' facilities and housing, civic facilities, care facilities and general public assembly uses.

Phasing Issues

As more specifically described in the Clayton Master Drainage Plan and servicing reports, the timing of development in Clayton will be managed in accordance with the ability of the Serpentine Drainage System to accommodate storm water flows as well as the ability of the owners/developers to upfront the servicing costs. The public and property owners, through the land use planning and drainage planning processes have been advised of the servicing constraints and of the major impact drainage issues have on the General Land Use Concept for Clayton.

The related reports from the Engineering Department will further outline the issues related to servicing, phasing and drainage.

Engineering Issues

A general servicing strategy and overall road pattern has been developed to accompany the General Land

Use Concept. These issues will be addressed in a report and accompanying recommendations from the Acting General Manager of Engineering which is to be considered by Council concurrently with this report.

In addition, a Master Drainage Plan has been prepared in concert with the Land Use Concept. A report and recommendations from the Acting Manager of Engineering regarding the Drainage Plan will also be considered concurrently with this report.

Outstanding Issues (Appendix VI)

There are a number of issues arising from the general planning process which will be resolved during the Neighbourhood Concept Plan process. These issues are outlined below and are described in more detail in Appendix VI attached.

1) Alignment of 192 Street Near Fraser Highway
2) Servicing Limits North of 72 Avenue
3) Status of 196 Street - Fraser Highway to 72 Avenue
4) Aloha Estates - Existing Pocket of One Acre Lots
5) School, Park Site & Greenway/Linkage Locations
6) Property Acquisition for Detention Ponds, Schools & Parks
7) Use of Alternative Planning/Zoning Tools for Protecting Environmentally Significant Areas
8) Defining the Concept of Live/Work Developments
9) Adjustments to General Land Use Concept Due to the Applicability of Sustainable Development Principles.

The Next Step - Detailed Neighbourhood Concept Plan

Planning Process for East Clayton

Following the approval of the General Land Use Concept presented in this report, staff will commence preparing a detailed Neighbourhood Concept Plan for East Clayton (the lands designated URBAN in the Official Community Plan). Staff will again be working with a re-structured Citizen Advisory Committee, with a technical team of City staff and consultants, and with the public. As part of the detailed planning process, a financial plan and servicing strategy will be prepared to ensure that Clayton can be developed cost effectively.

Incorporation of Sustainable Development Principles, Standards and Practices

The City has embarked on an important policy direction related to ensuring that Surrey's new urban communities incorporate the principles of sustainable development. Clayton, particularly East Clayton, presents an ideal opportunity to implement the principles of sustainability by introducing standards and development practices consistent with global and regional sustainability objectives. It is proposed that detailed planning for the East Clayton area incorporate at least seven principles of sustainable development. These principles arose from a series of charettes and workshops in Surrey, conducted in association with the James Taylor Chair in Landscape and Livable Environments (UBC). The matter of sustainability was discussed with City Council at a shirt-sleeve session in July, 1998. The sustainable development principles are outlined in Appendix VII. Staff is seeking Council's approval to explore innovative servicing, storm water management, road standard and neighbourhood planning ideas with a view to incorporating them in a Neighbourhood Concept Plan and community consultation process for East Clayton.

In addition, the City has been approached to participate, along with other government agencies and industry representatives, in a Sustainable Development Demonstration Project. This is intended to be an actual development project, reverse engineered to incorporate sustainable development innovations. City staff is working with the development industry and an Advisory Committee in securing a suitable site for this project. A number of sites have been identified within

the Clayton area, and in the context of planning for a sustainable and complete community, these sites may be considered suitable. Once a site has been selected (whether it be in South Newton which was the subject of the charettes, or Clayton), a report will be forthcoming for Council's consideration.

CONCLUSION

A City project team, in consultation with the property owners and the public, have prepared a General Land Use Concept for the Clayton area. The intent of this Land Use Concept is to provide the basic framework within which more detailed Neighbourhood Concept Plans can be prepared and development can occur in an orderly and coordinated manner. It is proposed that in early 1999 the Neighbourhood Concept Plan process commence for East Clayton, and that sustainable development principles, standards and practices be incorporated into the detailed plan.

The General Land Use Concept for Clayton addresses the objectives identified by the community as a whole, and is consistent with the policy framework identified in Surrey's Official Community Plan. It is therefore recommended that, subject to Council's concurrence with the related reports from the Engineering Department, the General Land Use Concept for Clayton and the issues discussed in this report, be endorsed.

Murray D. Dinwoodie
General Manager
Planning & Development Department

Appendices:

- Appendix I: Clayton General Land Use Concept
- Appendix II: Clayton Community Structure Plan
- Appendix III: Clayton Study Area Boundary
  Appendix IV: Clayton General Land Use Concept - Planning Process
- Appendix V: Planning Objectives for the Clayton Community
- Appendix VI: Outstanding Issues
- Appendix VII: Some Principles of Sustainable Development

APPENDIX IV

CLAYTON GENERAL LAND USE CONCEPT PLANNING PROCESS

TASK	TASKS COMPLETED	MEETINGS HELD
1.	Initiate Planning Study & Seek General Comments	Introductory Public Meeting
	Confirm CAC membership	
	Distribute questionnaire	Public meeting (June, 1996)
2.	Selection and Orientation - Citizen Advisory Committee	Prepare background materials/mapping - Clayton area & planning process
	Prepare background material - CAC membership	
	Compile results of questionnaire	
	Finalize Terms of Reference & call for consultant proposals (Engineering/Environment) *	
	CAC meeting (October, 1996)	
3.	Establish Issues & Objectives	Consult with City Departments
	Consult with external agencies (e.g. ALC, Langley)	
	Hire consultants (Engineering/Environment) *	
	Consult with public & advise them of the members of the CAC	Internal stakeholder meeting (Nov., 1996)
	External stakeholder meeting (Nov., 1996)	
	Public workshop (Nov., 1996)	
4.	Document Opportunities & Constraints	Compile & review results of public & other consultation
	Evaluate & present data (including environmental & engineering); & discuss general direction for options	CAC meeting (January, 1997)
	CAC meeting (March, 1997)	
5.	Generate Land Use Alternatives	Prepare 3 land use options
	Options reviewed by consultants, City Departments	
	Brainstorming session with CAC	
	Present options to the public	CAC meeting (April, 1997)
	Public meeting (May, 1997)	
6.	Select Preferred Land Use Alternative	Compile & review results of public & other input
	Prepare preferred conceptual plan & present to CAC	CAC meeting (August, 1997)
	CAC meeting (September, 1997)	
7.	Prepare Engineering Reports, Master Drainage Plan &	

Finalize Preferred Land Use Concept **Prepare & finalize servicing concept**
Prepare & finalize Master Drainage Plan
Present preferred servicing concept, Master Drainage Plan & land use plan to the public *
Review results of public meeting
Obtain endorsement from environmental & other government agencies *
Make modifications to land use (if applicable) **CAC meeting (November, 1997)**
Public meeting (December, 1997)
CAC Meeting (March, 1998)
Final Public Meeting (May, 1998)
8. Seek Council's Approval **Prepare reports**
Submit General Land Use Concept to Council for approval
Council meeting (December, 1998)

CAC: Citizen Advisory Committee **ALC: Agricultural Land Commission**

*** Note: A consultant was engaged to prepare the Clayton Master Drainage Plan concurrently with the General Land Use Concept**

APPENDIX V
PLANNING OBJECTIVES FOR THE CLAYTON COMMUNITY

The following planning objectives for Clayton resulted from the consultative process, and provided direction for preparing the General Land Use Concept:

General

- To establish Clayton as a "complete community" whereby it is generally self-contained with a range of housing, services and employment opportunities.
- To establish a distinct community identity for Clayton.
- To ensure that Clayton is planned, coordinated and developed in efficient stages over the long term (10-20 years).
- To establish individual neighbourhoods designed to have their own recognizable structure while also forming part of the larger identifiable Clayton community.
- To recognize Willowbrook as a strong attraction for Clayton, and to ensure land use compatibility along the Langley border.
- To enable the future residents of Clayton to have the opportunity to work close to home.
- To ensure that Clayton will have an abundance of open space, green corridors and protected wildlife areas to allow the residents to enjoy passive and active outdoor activities and to keep some of the rural ambiance which currently exists in Clayton.

Housing and Housing Densities

- To provide a variety of housing types to accommodate a range of lifestyles.
- To recognize and protect existing established residential subdivisions, and to recognize that they have set a certain character that should be carried through the plan area.
- To consider higher residential densities (e.g. townhouses/garden apartments) near the Willowbrook/Langley area.
- To establish Clayton as a unique "rural" residential area within the lower mainland, especially areas near the Agricultural Land Reserve and where existing subdivisions have already set a rural character.

Commercial/Industrial

- To recognize the Cloverdale Town Centre and the Willowbrook Mall as important service centres for Clayton.
- To provide local shopping opportunities and to establish a neighbourhood village centre to provide some limited neighbourhood services.
- To provide local job opportunities for Clayton residents.
- To accommodate economic development and local jobs by establishing a workplace area within Clayton near the Fraser Highway.

Agricultural

- To recognize and protect the Agricultural Land Reserve Boundary and its interface with suburban/urban development.

- To take advantage of the view opportunities provided on the slopes adjacent to the Agricultural Land Reserve.
- To use the "agricultural heritage" and ambiance of Clayton in determining the built character and form of the buildings in Clayton.

Parks/Open Space/Natural Areas

- To retain significant environmental features including rivers, creeks, and important stands of vegetation.
- To ensure that Clayton has a variety of sizes and types (e.g. active and passive) of parks to serve the residents.
- To locate neighbourhood parks, open space and recreational facilities where they can be reached by Clayton residents on foot or by bicycle.

Cultural/Social Facilities, Schools & Institutions

- To retain significant cultural and heritage features, including historic buildings and Clayton Hall/Park.
- To provide the necessary schools and playing fields to serve the projected population of Clayton.
- To establish a "neighbourhood centre" where cultural, social and other facilities could be located to adequately serve the residents of Clayton.

Roads/Transportation/Pedestrian and Bicycle Circulation

- To maintain the established grid or "traditional" road pattern in Clayton.
- To use the road system and road standards to help define the rural character of Clayton.
- To ensure that Clayton is well served by public transit.
- To create walkable neighbourhoods by creating opportunities for pedestrian/bicycle routes to link the focal points in the community and the parks and agricultural lands.
- To ensure that Clayton is well served but self-contained in terms of a transportation network and that regional vehicular traffic is not routed through neighbourhoods but routed around them.
- To ensure that residential areas are not negatively effected by traffic on the Fraser Highway and other major traffic routes.

Infrastructure and Servicing

- To ensure the cost-efficient provision of adequate City services including sewer, drainage, water, roads and utilities, without placing a financial hardship upon the City's resources.

Coordination

- To recognize the interrelationship of Clayton with Langley and Cloverdale especially with respect to commercial, institutional and transportation needs.

APPENDIX VI
OUTSTANDING ISSUES TO BE ADDRESSED IN THE DETAILED NEIGHBOURHOOD CONCEPT PLAN (NCP)

The following outstanding issues have been identified through the planning process, and must be addressed during the preparation of the Neighbourhood Concept Plan for East Clayton:

1. Alignment of 192 Street Near Fraser Highway

The General Land Use Concept for Clayton proposes a realignment of the south leg of 192 Street (a major arterial) where it meets the Fraser Highway. Operational problems have been identified at the intersection of Fraser Highway, 64 Avenue and 192 Street, and this realignment appears to be feasible, although a complete analysis of this option and others will be undertaken in conjunction with the Neighbourhood Concept Plan.

2. Servicing Limits North of 72 Avenue

A number of property owners north of 72 Avenue (east of 188 Street) have expressed concern that their lands were not designated URBAN along with those south of 72 Avenue in East Clayton. The owners are making the argument that their lands could possibly be serviced (especially by sanitary sewer) at the same time as East Clayton. In a meeting with the owners, City staff committed to exploring the northerly limit to which properties north of 72 Avenue could be serviced. This will require a technical analysis of slopes and some topographic work. If some lands are financially and technically able to be serviced, consideration may be given to including them in the Neighbourhood Concept Plan process.

3. Status of 196 Street - Fraser Highway to 72 Avenue

The Engineering Department has recently commissioned a Functional Road Study of the Fraser Highway near Clayton which also has implications for the width, right-of-way requirements and function of 196 Street. The design and function of 196 Street (from the Fraser Highway to 72 Avenue) and its implications for adjacent land uses, will be further examined during the Neighbourhood Concept Plan process.

4. Aloha Estates - Existing Pocket of One Acre Lots

Several residents of Aloha Estates (an existing one-acre subdivision near the south-east corner of 72 Avenue and 192 Street) have advised City staff they do not necessarily support urban residential adjacent to their one-acre lots. Property owners from Aloha Estates are on the East Clayton Citizen Advisory Committee and staff will work with them to explore ways to alleviate any impacts of urban development on the existing subdivision.

5. School, Park Site & Greenway/Linkage Locations

Given the general nature of the plan, elementary school/park catchment areas and site size requirements have been identified, but precise locations for new school/park sites have not been selected . The location of schools, parks, open space and greenways/linkages will be ascertained through the Neighbourhood Concept Plan process. It is noted that the greenways and linkages will be located in such a way to link the schools, parks and amenities/focal points in the community and therefore their precise location will be determined when the corresponding destination sites are selected.

6. Property Acquisition for Detention Ponds, Schools & Parks

Policies and strategies to address the acquisition of detention ponds, schools and parks will be considered during the Neighbourhood Concept Plan process.

With respect to school site acquisition, the Provincial government has passed the legislation (Bill 35) enabling the introduction of a new charge, similar to a development cost charge, to raise funds to acquire school sites and

build schools. The legislation was recently passed and the enabling regulations are expected to be enacted in early 1999. The School District is expected to consult with the City toward identifying school site needs and timing of acquisition/construction after which appropriate levies on development would be implemented. The Surrey School District advised City staff that the Province is expected to provide 65% of the capital funding for new schools while the remaining 35% would be provided by developers through the levy.

The City has acquired several properties in Clayton, and provisions have been made in Surrey's park acquisition plan to acquire all park sites identified through the Neighbourhood Concept Plan Process.

The costs and specific locations of detention ponds identified in the Land Use Concept (and Master Drainage Plan) will be determined in the next stage of planning. Strategies to acquire properties for ponds will be pursued and, toward creating a sustainable neighbourhood, alternative storm water management practices will be explored with a view to reducing the size and property requirements for detention ponds.

7. Use of Alternative Planning/Zoning Tools for Protecting Environmentally Significant Areas

It has been noted that there are a number of large forest blocks and significant watercourses in Clayton. In accordance with the community's objective to retain open space and the rural ambiance in Clayton, staff will be exploring ways to retain these forest blocks without having to acquire the land for park purposes. Zoning tools such as density bonusing and density transfer are examples of methods used to achieve environmental protection without negating the development aspirations of the property owners.

8. Defining the Concept of Live/Work Developments

Specific densities and forms of the live/work developments proposed in Clayton will be determined during the Neighbourhood Concept Plan process. This type of housing/work opportunity is not currently available in Surrey and research is required to adapt this innovative product to the conditions in Clayton.

9. Adjustments to General Land Use Concept Due to the Applicability of Sustainable Development Principles

In designing sustainable neighbourhoods in Clayton, the Neighbourhood Concept Plan process may result in some minor adjustments to the general land use designations identified on the General Land Use Concept.

APPENDIX VII

SOME PRINCIPLES OF SUSTAINABLE DEVELOPMENT TO BE INCORPORATED INTO THE NEIGHBOURHOOD CONCEPT PLAN

Principle No. 1
Increase density to conserve energy by the design of compact walkable neighbourhoods to encourage pedestrian activities where basic services (schools, parks, transit, shops, etc.) are within 5 to 6 minutes walking distance from their homes.

Principle No. 2
Different dwelling types (a mix of housing types, a broad range of densities from single family homes to apartment buildings) in the same neighbourhood and even on the same street.

Principle No. 3
Communities designed for people; therefore all dwellings present a friendly face to the street to promote social interaction.

Principle No. 4
Car storage and services handled in lanes at the rear of dwellings.

Principle No. 5
Interconnected street network, in a grid or modified grid pattern, to provide for a variety of itineraries and to disperse traffic congestion; and public transit to connect with the surrounding region.

Principle No. 6
Narrow streets shaded by rows of trees to save costs and to provide a greener and friendlier environment.

Principle No. 7
Preservation of the natural environment and promotion of natural drainage systems where storm water is held on the surface and permitted to seep naturally into the ground.

APPENDIX 2

2.1 Charrette Constituency Representatives

2.2 Charrette Issues and Resolutions

Appendix 2.1 Charrette Constituents

Constituencies of Interest	Participants	*Workshop Date & Location*	Design Table Spokesperson	*Issues*
Developers	John Turner, Progressive Carla Kalke, Parklane James Evans, Suncor Ladan Ahmadzadeh Steve Hall, CMHC Kelvin Neufeld, Fraser Valley Real Estate Board Raghbir Gurm, Bridgewater Development Corp.	Feb 2 Clayton Community Hall	John Turner, Progressive Contracting Ltd.	-integrate open space uses to serve multiple functions -fees and levies currently discourage the construction of smaller units and secondary suites --flexibility in the plan to respond to market changes and allow for innovation -the sustainable concepts are marketable with challenges - forestry should serve both a function and aesthetics -blend densities -parking on street or in back lanes -consumer education is key to maintaining
City of Surrey	How Yin Leung, Judith Robertson, Wendy Whelen, Francisco Molina, Kris Nichols, Planning Eric Emery Leif Bjorseth Engineering, Ken Zondervan, Roads and Transportation Jean Lamontagne, Greg Ward, Parks, Rec and Culture John Strandt, Marc Berube, Fire Shirley Steele, RCMP Jane Farquharson Sudu Vatagodakumbura, Reid Crowther	February 22 Planning Room 1, City of Surrey	How Yin Leung Wendy Whelen, Planning Eric Emery Engineering Jean Lamontagne Parks John Strandt Fire	-need to incorporate alternatives for drainage -alternatives for street widths and servicing are required - integrate ideal sites for parks and water detention for cost effectiveness -allocate adequate space for trees -establish parking performance standards -resolve safety in back lanes -reduce City maintenance costs, i.e. increasing costs associated with trees and concrete competing for the same space -factor in liability issues early in the process -educate consumers and builders
City of Surrey Operations	Gerry McKinnon, Dale Hadden, Jeff Thomson, Operations Carrie Baron, Engineering	March 5 Works Yard, City of Surrey	Gerry McKinnon Dale Hadden Operattions	
Environment	Dave Nanson, Barry Chilibeck, DFO Marie Lou Verge, Environment Canada Brent Moore, Miles Stratholt, Krista Payette Environment, Lands & Parks Lynne Holt, Ross Wetzel, Surrey Environmental Advisory Committee Mike Bose, Surrey Agriculture Advisory Committee Mark Salerno, CMHC David Melnychuk, Agriculture & Food Bruce Gunn, Agricultural Land Commission	March 4 Clayton Community Hall	Barry Chilibeck DFO Erin Stoddard MELP	-establish a monitoring program to document the goals and the extent to which they are achieved -consider natural habitat protection -take the notion of sustainability to the household level(SMART houses) -increase awareness and stewardship through consumer education -monitor and promote energy use and efficiency -establish municipal official and decision maker buy-in
Utilities and Services	Ron Baker, Gary Richert, BC Tel Martin Kobayakawa, Translink Tom Vine, BC Hydro Robin Kingman, Canada Post Jennifer Woods, Roger's Cable	March 17 Clayton Community Hall	Allan Grant BC Hydro	-integrate transit and land use planning -explore alternative approaches to servicing in the Clayton area -postal services need to be involved at the time of subdivision -underground servicing is more efficient in higher density areas -lane width needs to accommodate all utilities
Community	Clayton Area Citizens Committee East Clayton Citizens Advisory Committee East Clayton Property Owners Society(Executive) Clayton Community Association (Executive) Port Kells Community Assoc. (President)	March 23 Clayton Community Hall	Norman Alexander CAC	-build trust in the planning process -safety and maintenance of back lanes is a concern -City by-laws currently prohibit aspects of the sustainable alternative -Will sustainability concepts translate well into Clayton, it is not an urban centre?

Appendix 2.2 Charrette Issues and Resolutions

Issues			Identification						Status					
			Workshop	Public	Charrette		CAC	Open House	Resolved (1)			Pending (2)		
					Design Team	Working Sessions			Design Team	Sub-table	External (3)	Design Table	Sub-table	Demonstration (4)	External
Planning															
	Densities		*	*	*	*	*	*	*	*					
	Land Uses & Allocation														
		Residential	*	*	*	*	*	*	*						
		Mixed Uses			*	*	*		*	*					
		Commercial	*		*	*	*	*	*	*					
		Business Park		*	*	*	*	*	*	*					
		Live/Work		*	*	*	*		*						
		Work/Live		*	*	*	*		*						
		Schools/Parks/Civic	*		*	*	*	*	*	*					
	Infrastructure														
		Drainage	*	*	*	*	*		*	*				*	
		Water/Sanitary	*	*		*	*				*				*
		Integrated Green Infrastructure	*		*	*	*		*	*				*	
	Utilities/Services														
	Transportation														
		Transit	*		*	*	*		*		*				
	Design	Arterials/Collectors	*		*	*	*		*	*				*	
		Local Streets	*	*	*	*	*		*	*				*	
		Parking	*	*	*	*	*	*	*	*				*	
		Lanes	*	*	*	*	*	*	*	*				*	
	Designation		*		*	*	*					*			*
	Energy														
		Greenhouse Gas Reduction	*		*	*			*				*	*	
	Public Safety														
		Street Pattern/Width	*		*	*	*		*	*					
		Lanes	*	*	*	*	*	*	*	*				*	
		Building Form	*	*	*	*	*	*	*	*		*	*	*	
		Crime Prevention	*	*	*	*	*	*	*	*		*	*	*	*
		Facilities	*			*	*								*
	Natural Environment														
		Green Spaces	*	*	*	*	*	*	*					*	
		Riparian Zones	*		*	*	*		*					*	
		Forestry	*		*	*	*		*					*	
		Natural Habitat	*		*	*	*		*						
		Water Quality	*		*	*	*		*					*	
		Soils	*	*	*	*	*	*	*	*				*	
	Agricultural Lowlands		*	*	*	*	*		*						*
	Marketability		*	*	*	*	*		*				*	*	*
	Liability		*		*				*					*	
	Planning Process														
		Resident/Landowners	*	*	*	*	*	*	*						
		Building Trust	*	*	*	*	*	*	*	*			*	*	*
		Policy Makers	*		*	*			*	*			*	*	*
		Buy-in	*	*	*	*	*	*	*	*				*	*
	Design/Construction														
		Integrated Green Infrastructure	*		*	*	*	*	*	*					
		Natural Drainage System	*	*	*	*	*	*	*	*					
		Landscaping	*		*	*			*					*	
		Urban Forestry	*	*	*	*	*	*	*				*	*	*
		Fire/Public Safety	*	*	*	*	*	*	*					*	*
		Cross Sections			*	*			*	*				*	
	Energy														
		Smart Housing	*		*	*							*		*
		District Heating	*		*	*			*			*			*
		Mixed Uses	*		*	*			*				*		
	Regulatory System														
		Flexibility	*		*	*	*						*	*	*
		DCC's/Fees/Levies	*		*	*	*			*			*	*	*
		Land Development System	*		*	*							*	*	*
		Compensation	*	*	*	*	*	*					*	*	*
	Stream Monitoring		*			*				*					
	Life Cycle Costs		*	*	*	*	*						*		*
	Maintenance		*		*	*			*	*			*		*
	Marketing		*		*	*							*		*

Notes:
(1) Resolved: Issue is advanced towards resolution or resolved.
(2) Pending: Issue is advanced and needs more attention.
(3) External: outside the scope of Planning Process.
(4) Demonstration: actual development.

APPENDIX 3

Charrette Design Brief

Note: The Design Brief provided a number of important performance targets for the charrette. During the charrette process, some targets were amended. These amendments are reflected in the NCP.

The East Clayton Neighbourhood Concept Plan and Sustainable Development Demonstration Project

DESIGN BRIEF

Part I
April 14/15, 1999

Part II
May 4/5 1999

Sponsors
B.C. Ministry of Municipal Affairs
Department of Fisheries and Oceans
Environment Canada
Federation of Canadian Municipalities
Greater Vancouver Regional District
Real Estate Foundation of B.C.

Canada Mortgage and Housing Corporation
B.C. Ministry of Environment, Lands and Parks

CONTENTS

The East Clayton Neighbourhood Concept Plan and Sustainable Development Demonstration Project

Design Brief

This document provides both general and explicit instructions for the design of the East Clayton district of Surrey. It is intended to be used as a means to first provoke discussion, and then agreement, between the many stakeholder agencies and entities involved in the process. When the elements of that agreement are incorporated into this document, it will be used as the primary basis for the design proposals for East Clayton.

This project has been possible because of the generous support received to date from the Real Estate Foundation of B.C., Environment Canada, B.C. Ministry of Municipal Affairs, Federation of Canadian Municipalities, Greater Vancouver Regional District and Department of Fisheries and Oceans.

Goal and Objectives of the East Clayton NCP and Sustainable Development Demonstration Project.

Goal:
To build a community in the East Clayton area of Surrey that meets local, provincial and federal policy objectives for sustainable development.

Objectives:
1. Produce a more sustainable community design model for Surrey and other British Columbia communities.
2. Work out and resolve the contradictions between often contradictory sustainability policy objectives.
3. Demonstrate the connection between sustainability and desirability
4. Resolve the conflicts between typical community subdivision and site and traffic engineering regulations and sustainability design objectives
5. Create a setting where designers can facilitate resolutions between those agencies and entities whose mandates can often be in conflict.
6. Broadly disseminate the results of this process through a variety of means and venues – to citizens, elected representatives, policy makers, and designers – and thereby influence the future urban development of our region.

City of Surrey Sustainability Principles for the East Clayton District.

The City of Surrey has added special new provisions for the Clayton District that have not previously applied in other development areas. By act of Surrey City Council, December 1998, the City has instructed staff to explore the application of sustainable development principles, standards and practices during the detailed Neighbourhood Concept Planning Process for East Clayton. The specific principles so identified are as follows:

1. Different dwelling types (a mix of housing types, a broad range of densities from single family homes to apartment buildings) in the same neighbourhood and on the same street.
2. Increase density to conserve energy by the design of compact walkable neighbourhoods to encourage pedestrian activities where basic services (school, parks, transit, shops, etc.) are within five to six minute walking distance from their homes.
3. Communities designed for people; therefore all dwellings present a friendly face to the street to promote social interaction.
4. Car storage and services handled in the lanes at the rear of dwellings.
5. Interconnected street network, in a grid or a modified grid pattern.
6. Narrow streets shaded by rows of trees to save costs and provide a greener and friendlier environment.
7. Preservation of the natural environment and promotion of natural drainage systems where water is held on the surface and permitted to seep naturally into the ground.

The Development of the Performance Criteria and the Design Brief for the East Clayton NCP.

The following document is intended to encapsulate, in words, all of the requirements for the new community. The process of producing this document had two stages. First we culled through the key policy documents relating to sustainable development that have been promulgated in the past few years. These works include: The British Columbia Energy Council, Planning Today for Tomorrow's Energy. An Energy Strategy for British Columbia; BC Hydro, Bringing Electricity to the Livable Region (BCH); The City of Vancouver, Clouds of Change, Final Report of the City of Vancouver Task Force on Atmospheric Change (CV); The Commission on Resources and Environment: Finding Common Ground: A Shared Vision for Land Use in British Columbia (CORE); The Province of British Columbia: Municipal Act Section 942 and Section 945 (Growth Management Legislation);(MA) The Greater Vancouver Regional District: Livable Region Strategic Plan (LRSP); BC Transit , Transit and Land Use Planning (BCT). These policy documents have provided the basis for not just this project, but have been key documents informing *previous Sustainable Urban Landscapes Design Charrettes* and the design principles for sustainable communities that have emerged from that work. In addition to these regionally applicable documents, we have also incorporated documents particular to the City of Surrey. Included in this second category are: The Clayton Neighbourhood Concept Plan: General Land Use Concept (CNCP), and the City of Surrey Official Community Plan (OCP).

These publicly arrived at policy documents have been scanned for items that have implications for community design. These items are used as the primary and initial basis for the many design directives contained herein (referenced where appropriate). Consequently this document is based only on publicly arrived at policy. In this way the community design resulting from this project should reflect that policy, and be neither more, nor less than the public has mandated. Policy directives included in these reports that have an obvious impact on site and community design have been converted into design *performance criteria* or the *design brief* as appropriate. The *performance criteria* are listed in the first section below in three categories: land and water; the built environment, and energy use. These criteria all support the goal of more sustainable neighbourhoods and communities; however, they are often contradictory when applied. The *design brief* makes up the second part of this document. It contains the more empirical and specific requirements for the community, spelling out (among other things) specific residential densities and number of acres of recreation required per thousand inhabitants.

We held a series of workshop meetings with the various stakeholder groups during the second stage of building this document. These meetings involved scores of people from an almost equal number of agencies and entities; however, they were grouped into a more limited number of categories by common interests and agency mandates. These categories included: the city, environmental managers, transit providers, citizens, developers, education providers, other impacted communities (Langley City and Langley Township), and energy providers to name a few. At these meetings we solicited specific performance targets for the new community as seen from their perspective. We used these performance targets to help calibrate the *performance criteria* and the *design brief* to the specific constraints and opportunities inherent to the East Clayton district.

Performance Criteria for the 1999 East Clayton NCP and Sustainable Development Demonstration Project Design Charrette:

Policy directives included in the above listed reports that have an obvious impact on site and community design have been converted into the design performance criteria listed below. They fall into three categories: land and water; the built environment, and energy use. These criteria all support the goal of more sustainable neighbourhoods and communities; however, they are often contradictory when applied.

The Land and Water

The goal of British Columbian and Canadian public policy is to protect the ecological integrity of our land and rivers, both for their intrinsic value and for their value to present and future citizens. The organisers assume that urban development that protects the ecological integrity of the land and water must start "from the ground up." The ecological health of the region is dependent on the ecological health of the sites that make up the region. For exam-

ple, degraded storm-water (non point-source pollution) shipped “off sites” into streams and tributaries is the major threat to the health of Georgia Basin salmon streams. The rivers and streams that empty into the Georgia Basin comprise the world’s most important salmon producing ecosystem; extraordinary efforts are required to protect it.

1. Environmental Protection. Protect and enhance all environmentally sensitive and/or degraded areas (wetlands, watercourses, ravines, watersheds, ground water recharge areas, critical wildlife habitat areas, areas with fragile or unstable soils) maintaining and/or enhancing the ecological performance of native habitats, hydrology, and landforms.[1]

2. Open Space Linkage. Preserve, create, and link urban and rural open space, including parks and recreation areas. Maintain and enhance public access to streams, where environmentally sustainable. [2]

3. Open Space Quality. Identify and enhance special recreation opportunities within the site, i.e. streams, topographic features, natural areas etc. [3]

4. Integrate Green Infrastructure and Natural Drainage:
   a) Protect natural habitat and improve stream flows and water quality to contribute to fish protection consistent with federal and provincial fish protection legislation.
   b) Create an integrated and linked system of green and open spaces that serves multiple functions.
   c) Integrates an urban forestry strategy with a water conveyance strategy: Incorporate natural drainage infrastructure compatible with fire protection systems.

5. Storm drainage. Insure that the storm drainage system does not alter stream hydrology. Explore the use of natural drainage systems to this end.

The Built Environment

The goal of British Columbian and Canadian public policy is to provide adequate, affordable, and appropriate housing for all citizens.

A more sustainable site and community design must integrate, not segregate land uses, income groups, and family types. Services and jobs must be located near homes and transit. Participants are challenged to develop a plan that integrates and locates these various land uses.

The dominance of the automobile in our new urban landscapes must be significantly reduced. Destinations must be close and convenient before walking and biking can be viable alternative to the car. Participants must produce designs that will *connect* people with their destinations so that the car is *not* the *only* option.

1. Housing Equity. Provide a balance of housing types that meet the needs of a range of ages and lifestyles and are affordable to groups and individuals within a wide range of incomes. At least 20 of the housing shall be for persons with family incomes in the bottom third. [4]

2. Density & Mixed Housing: Supply higher density housing in areas in proximity to commercial areas. Mixed housing and densities are to be blended and balanced. Interfacing with existing uses—built residential areas, agricultural, commercial/industrial—using compatible densities, housing type, lot sizes and effective buffering.

3. Special Needs Housing. Provide adequate special needs housing (seniors, disabled, family crisis victims etc.)[5]

4. Safety. Employ proven methods of enhancing community safety and sociability.[6]

5. Public Safety and Fire Systems: Ensure fire equipment can be maneuvered effectively through the streets. Set definitive service boundary for the provision of fire protection and ambulatory services—Clayton, East

Clayton area.

6. Jobs. Provide workspace in commercial, office, or light industrial facilities for the working population. The Clayton Neighbourhood Concept Plan calls for over 1,275,000 sq. ft. of "business park" and nearly 400,000 sq. ft. of "business residential" live-work space. [7]

7. Schools: Locate schools away from major transportation corridors, within five minute walking distances from residential units and in quieter neighborhoods.

8. Integration of Land Uses. Create a mix of building and land uses, integrating residences, work, shopping, and services (community, professional, commercial and institutional).[8]

9. Lane system: Ensure municipal services and utility work crews can access lanes with appropriate width and surface materials. Explore the use of various permeable low cost materials for surfacing lanes.

10. A utilities and technical system:
    a) Determine the mix, if any, of overhead and underground services
    b) Utility trenches need to be wide enough to ensure accessibility by all utilities reducing possibility of utilities accidentally interfering with each other's equipment.
    c) Ensure ease of access to meters or assume remote reading devices.
    d) Protect and secure electrical and telephone service boxes.
    e) Provide adequate lighting
    f) Identify a location in East Clayton for a telephone main station to provide high speed features that support computer and home office use. Locate in a central location in the planning area that will ensure a maximum distance for servicing wire of 3 kilometers. A 7mX7m area is required to house highly sensitive switching equipment—stand alone housing unit or a public facility.

11. Access to Transit. Ensure that most persons live and work close to transit and services to reduce dependence on the automobile, promote pedestrian activity and bicycle use.[9]
Fraser Highway has been designated as a major transit corridor. Develop ways to allow commercial, transit, pedestrian, housing, and cars to all occupy this corridor.Adapt existing guidelines to sustainability standards.

12. Interconnected Street System: Local transportation must compliment the regional and whole planning area transportation requirements. Set road design elements within sustainable development design:
    a) Roadway width
    b) Intersection corner radii
    c) Intersection angle
    d) Design speed, operating speed
    e) Traffic volumes
    f) Street type hierarchy
    g) Local road network layout
    h) Parking lanes and width
    i) Lighting
    j) Turning lanes
    k) Driveway width, grade, paired/shared

Consider traffic calming devices to meet sustainable development performance standards

13. Parking Systems: Set parking standards assuming 10units/acre gross density overall. Parking in

streets or on lots.

14. Design/Construction/Building:
    a) Integrate the urban forestry strategy, the water conveyance strategy and the integrated green infrastructure.
    b) Incorporate postal service requirements at the design stage.
    c) Ensure contractors at the construction stages adhere to guidelines for dealing with the disturbance and replacement of soils to maintain filtration rates.
    d) Build in contingencies for landscape development, including provisions for maintaining the placement of aggregates where necessary until they stabilize including subdivision green spaces and natural drainage areas.
    e) Place fee simple units on the market but do not use block strata.

Energy Use

The goal of British Columbian and Canadian public policy is to reduce energy consumption and the pollution that this consumption causes, even while population continues to increase. Any progress toward a more sustainable future will requires large per capita reductions in the amount of energy required for building conditioning and transportation. Many of the gains to be made in this area lie in the realm of improved building technologies and improved vehicle efficiencies, and are thus outside the scope of this site and community design demonstration project. However, certain site and community design factors can powerfully affect the amount of energy required for building conditioning and transportation.

District heating can be practical at certain densities and site configurations. Geothermal technologies are available for small scale or district scale installation. Solar access for winter warmth is significant in our region, where the coldest winter days tend also to be the sunniest. West facing dwelling units (with the large expanses of glass common in our region) require summer air conditioning - even though our summers are quite cool. Urban forests can significantly influence energy use. Participants are challenged to design the community with due regard for climatic imperatives.

Integrating land uses and accommodating pedestrians and bicycles can cut per capita consumption of energy for transportation by almost half.[10] Participants should show how pedestrians and bicycles are accommodated and how destinations are located within walking distance of services, transit, and jobs.

1. Solar Heat. Reduce building energy requirements by providing optimal solar orientation for active and passive solar heating, for hot water, and for day lighting.[11]

2. Energy Infrastructure. Aim for the efficient use of utility infrastructure by considering utility system design as part of the community design. Clayton Neighbourhood Concept Plan: General Land Use Concept (CNCP) [12]

3. Alternative Energy. Provide as appropriate, or maintain flexibility to provide in the future, energy service from alternative technologies such as community scale generating systems, district heating and co-generation. [13]

4. Design with Climate. Enhance community microclimate through design response to wind, sun, vegetation, and precipitation. [14]

5. Auto Trip Reduction. Reduce number and length of commuter and daily use automobile trips. [15]

6. Auto Alternatives. Provide safe, comfortable, barrier-free and direct pedestrian access to transit route. Provide a multi-modal community route system that gives walking and biking priority over auto travel.[16]

Planning and Engineering Systems

Municipal Planning Systems:
Maintain an integrated planning approach in both development of the plan policy, standards and bylaws and consistency in implementation of the plan allowing flexibility and innovation.
Protect the rights of property owners and build confidence that infringement on their ability to enjoy the legal use of their property is not infringed upon by encroachment of incompatible uses.

The East Clayton NCP and Sustainable Development Demonstration Project Design Brief

RESIDENTS

Total Site Area:
533 acres (net of roads)

Proposed Community Population[17]
Minimum 13,500
Maximum 16,000

Proposed Total Dwelling Units
Minimum 4,600
Maximum 6,400

Residential Parking Standard
1.25 spaces per dwelling unit B .25 spaces per elderly or special needs unit.[18] Parking can be on street or in surface lots.

Gross Residential Density
Minimum 8.6 DU per acre gross (average for entire site)

OPEN SPACE[19]

Open Space: Total of 4.2 hectares per 1,000 residents
Made up of:
City Parks: 2.0 hectares per 1,000 residents
Community Parks: 0.8 hectare per 1,000 residents
Neighbourhood Parks: 0.6 hectare per 1,000 residents
Nature Preserve and Linkages: 0.8 hectare per 1,000 residents

PUBLIC TRANSIT

Frequent transit stops on Fraser Highway. Bus stops within five minute walking distance (.5 K) of all homes. [20]

COMMERCIAL

Commercial Space[21]

Minimum, 20,000 sq. ft. per 1,000 population. Minimum area 6 acres net.
Maximum, 42,000 sq. ft. per 1,000 population. Maximum area 9 acres net.

Commercial Parking Standard

Light Industrial / Office
750 sq. ft. or 70 sq. mtr. (3 spaces) per 1000 sq. ft. retail. On street, underground, or off street parking. [22]

Distribution/ Corporate Office Space
39 acres corporate and other light industrial and distribution work space in approx. 1,700,000 sq. ft. Net FSR approx. 1. Up to 20 acres of this amount can include residential uses. [23]

PUBLIC BUILDINGS

Elementary Schools
Two schools at 35,000 sq. ft. (or 3,200 sq. mtr.) each, for 500 students, access to 8 acres (3.25 hectares) of outdoor recreation space (outdoor recreation space can count toward minimum open space requirement). On street or off street parking for 25 cars.[24]

Child Care Facilities and Preschools
2,560 sq. ft. (240 sq. mtr.) interior space, 4,800 sq. ft. (445 sq. mtr.) exterior play space per 1,000 dwelling units. [25]

Community Centre and Library
One at 36,000 sq. ft. (3,340 sq. mtr.) - on street or off street parking for 32 cars.

Fire Hall
One at 11,000 sq. ft. (1,020 sq. mtr.).

Churches/Multi Faith Centre with Assembly Hall
One per 4,000 population at 10,000 sq. ft. (930 sq. mtr.). On street or off street parking for 60 cars. Parking can be shared with non competing use. [26]

Bibliography

Initials that introduce each reference correspond to initials in footnotes above.

BCEC
Planning Today for Tomorrow's Energy: An Energy Strategy for British Columbia. 1994. Vancouver, British Columbia: British Columbia Energy Council.
BCH
Bringing Electricity to the Livable Region. 1994. Vanvouver, British Columbia: BC Hydro
BCT
Transit and Land Use Planning. 1994. Surrey, British Columbia: BC Transit Long Range Planning.
CORE
Finding Common Ground: A Shared Vision for Land Use in British Columbia. 1994. Vancouver, British Columbia: Commission on Resources and Environment.
CS
City of Surrey Official Community Plan Background Report No. 1; Surrey: Existing Policies. 1994. Surrey, British Columbia: City of Surrey .
CV
Clouds of Change: Final Report of the City of Vancouver Task Force on Atmospheric Change. 1990. Vancouver,

British Columbia: City of Vancouver.

LRS

Livable Region Strategy: Proposals. 1993. Burnaby, British Columbia: Greater Vancover Regional District. (Also see 1995 Livable Region Strategic Plan, Approved in Principle by the GVRD Board of Directors, Dec 9, 1994)

MA

Bill 11 - 1995, Growth Strategies Statutes Amendment Act, 1995. 1995. Victoria British Columbia: Province of British Columbia Legislative Assembly and Minister of Municipal Affairs. (see also: **Growth Strategies Statutes and Amendment Act: Explanatory Notes**. 1995. Victoria British Columbia: Province of British Columbia, Ministry of Municipal Affairs.)

Appendix 1

Current Issues Identified by the Constituency Workshops Related to the East Clayton NCP and the Application of the Sustainable Development Standards.

The constituency groups consulted in preparation of this design brief identified the following issues. These constituencies included City Team, Public, Clayton Advisory Committee, Environment, Agriculture, Fisheries, Utilities and Services, Transit, Developers and Energy.

Different Dwelling Types

Densities and Blending Mixed Housing
In the areas designated for construction it may be difficult to achieve 10 units per acre of gross area without certain compromises. Attempts must be made to blend residential densities throughout the East Clayton NCP area.

Density

Water and Sanitary

In the Clayton area, there are two supply areas and servicing areas known as area 1, 2 and 3 which should pose no servicing problems, although some pipes may need to be oversized. In terms of water supply, outstanding questions relate to consumption. Infrastructure must be planned based on population changes. Sanitary servicing will be based on gravity flow. By the time Clayton's population projections are realized the new servicing will be in place. Some of the servicing issues include the use of basements to increase density. Bathrooms in basements tend to lower the whole sanitary systems to gravity drain wastewater.

School Development

The school district is trying to get away from locating schools in corridors and place them in quieter areas. This could result in 5 minute walking distances in different directions. . Yet schools can also be key elements in a village center design. How can these conflicting desires be resolved?

Energy Use

Consider energy use for car trips by occupants to and from the neighbourhood.

Utilities

Telephone service to developing areas is planned on the basis of maximum density. As densities increase so does the initial capital cost for providing the service and cable size. Overhead/aerial wiring has a visual impact, which is more prevalent when densities increase and thicker cables are used. Use of aerial wiring should not be allowed on streets, possibly on lanes. Underground wiring on streets requires wider roads. Transformers and connection boxes are numerous and highly visible. Transformers can explode. The telephone utility plans for maximum density, which translates into bigger cables and higher initial costs for them.

Communities Designed for People

Land Use Compatibility

Built Residential Environments: New developments that encroach on existing built neighborhoods characterized by a quasi-rural life style usually on large lots need to be developed in a manner that respect the rights of those who have invested in that life style and expect it to be protected. For example, existing pockets of one acre or large lots such as Aloha Estates.

Agriculture: Account for potential conflicts that generally arise where urban and agricultural uses interface.

Langley Township: Account for what being done to service adjacent lands to East Clayton located within Langley Township. City boundaries must be taken into consideration.

Commercial/Industrial: How the principles will be applied in an industrial site will also have to be examined determined. Local work centres would allow people to work locally and reduce their reliance in the car. If you provide the alternative people can make the choice not to go downtown to work. Define the concept of Live/Work development areas.

Level of Satisfaction

Although it is difficult to measure statistically, some bases for comparison of social acceptability for alternative developments should be developed and implemented.

Lanes

Lanes and Rear Yards

Safety issues, real or perceived, related to the use of back lanes will have to be addressed. Perceptions of crime and clutter are widespread. Some argue that putting in lanes necessarily adds to the infrastructure costs and wasted space. Other models for small lot subdivisions should be explored including wider lots with shallower backyards eliminating the need for lanes but retaining small size.

Municipal Services

Lanes will need to be functional to ensure services such as garbage collection can be effectively provided. Overhanging elements will have to be taken into consideration.

Eliminate Swales between Properties

The presence of lanes should alleviate the need for swales between properties. These property line swales have their own problems.

Maintenance

Regular maintenance costs for gravel lanes and suggested need to be determined. Some concern exists about potential higher ordinary costs for maintaining green infrastructure streets.

Postal Services

The uncertainty of the number of units will create some difficulty for the sizing and siting of delivery service boxes. Mail assumes that one point of access is available to each subdivision and that most mail pick-ups will be made by folks stopping their cars on the way in and out. This contradicts pedestrian orientation and interconnection sustainability principles.

Natural Corridors

Lanes can be viewed as natural corridors.

Servicing Access

If lanes are unpaved heavy service vehicles may break down the surfaces if not correctly constructed. Narrow lanes will be blocked when service vehicles are in them. Lanes therefore need two points of access.

Utility

Utility trenches also have to be wide enough to ensure that when the equipment needs to be serviced one utility does not interfere with the other.

It is difficult to reduce the lane width to less than 20ft because all utilities compete now for space. For example, BCTel now has competitors who will require a corridor.

If transformers were placed in lanes there would also be potential safety concerns if areas were not provided to locate them in a place where vehicles cannot hit them. A 2m barrier may be required to protect them.

Servicing houses with Hydro from the lane creates access problems for meter readers. Coming in through the backyards is not always the best option. Electronic meters that can be remotely read may be required. The up front expense of automatic meter readers has to be considered.

Tree trimming can present an additional maintenance cost when services are above ground, indicating that underground service might be a cheaper alternative. Conflicting reports exist even within BC Hydro itself on the cost of underground vs. above ground wiring. If hydro goes underground so does telephone.

Service boxes would have to have manholes or something-heavy duty to protect them under impact.

Lighting

Lighting is an issue in terms of night servicing. If the servicing trucks have to go into the lanes then either lights are brought in with the trucks or there are lights in the lane.

Interconnected Street Network

Transportation

The region and the whole planning area will have to be taken into consideration when determining transportation requirements. One issue is regional transportation services and the capacity of Fraser Highway. Plans exist to make Fraser Highway 6 lanes to service the area and meet anticipated future demand for through traffic. The Clayton area is outside the CMA, therefore it may not be serviced by BC Transit and an alternate service may be required. Transit reps suggest that GVTA is open to smaller scale transit options and that 13,000 persons may create sufficient demand to justify internal routing, particularly if the land use and street pattern is transit friendly.

Some road design elements, which would require performance standards/goals, are:

- the roadway width: what is the design scenario? queuing operation vs. two-way flow. What is the design vehicle size?
- Intersection corner radii - what is the design vehicle? can sweeping into opposing lanes be allowed?
- intersection angle - in what cases is 90 degrees required and when can it be relaxed?
- design speed for roads
- operating speed
- traffic volumes: what is appropriate for various street types?
- street type hierarchy: is there one?
- local road network layout: block lengths, connectivity
- parking lanes and width
- lighting: for traffic or for pedestrians, or for both?
- turning lanes: when required, if at all?
- cul-de-sac allowed in certain circumstances? If so design and radius
- driveway widths, grades, paired/shared
- traffic calming: when is it needed and how can it fit?

Traffic patterns that result in short cuts through rural areas could lead to conflicts between farm vehicles and commuter traffic.

Transit

The Fraser Highway is designated as a major transit corridor. Alternative approaches to local servicing in the Clayton area are being explored.

Transit considerations include: minimum road widths, stopping areas, bus storage, integration of pedestrian ways and land use planning with transportation planning, a transferring facility, and a bus interface. Guidelines exist, however, with alternative standards some adaptation will be required.

Narrower Streets

Water & Sanitary

Middle alignment of mains may have to change as street widths are altered.

The narrow street presents difficulty for work crews at times when lines need to be worked on or replaced. The reduced width means there is a limited amount of room for crews and equipment pipe storage etc. and therefore streets will have to be closed to traffic. The "alternative" ROW width is actually no narrower than new City of Surrey standards.

Utilities

The biggest impediment to implementing alternative road standards is the installation of utilities, particularly when no lane is available to accommodate a portion of the utilities. The utility companies are examining how to service developments that use alternative road standards.

Parking

The limited research available on on-street parking demand versus land use form/density makes it difficult to predict parking demand and, therefore, the need for on street parking. Parking performance measures have to be set and due to the lack of research measures will have to be developed. The densities will impact on parking requirements.

Some suggest that in developments where a status quo street width has been used residents tend to park on the street. Where street widths have been narrowed they tend to park in the back lanes.

Depending on the grade it will take time for the gravel areas to settle to the point where the aggregate serves as an effective parking area. Early on gravel tends to migrate.

Maintenance

Road width is not an issue other than snow removal. Removal of snow during a couple of weeks a year must be considered. Surrey presently only plows arterials. No local roads or lanes are plowed.

Postal Services

Narrow streets may cause congestion when people stop to pick up their mail.

Transformer

Customers are not particularly fond of having transformer boxes in their front yards.

PUBLIC SAFETY AND FIRE

Fire services can be adapted to alternate types of development as long as some fundamental requirements are met. Narrower streets can impede larger vehicles meeting their anticipated arrival time. The vehicles have to be maneuvered through the streets efficiently. The incidence of fire spreading from unit to unit increases with higher density. However, in an area with a definitive boundary it is easier to use alternative ways to meet both fire and medical demands. The relationship between density and response time needs to be examined. Additional points of access to the structure (i.e. lanes) can be helpful.

Preservation of Natural Environment

INTEGRATE GREEN SPACES.

There is a need for those who influence the use of open spaces in the City to come together and integrate open space uses. For example parks and green infrastructure need to be amalgamated. Currently, the space required for detention ponds is an engineering concern and not a park issue. They should serve both a water detention function and parks function or multiple functions should be applied to open spaces.

The integration of open space functions could lower the costs and still meet the objectives for open spaces.

A challenge will be to integrate the characteristics of an “ideal” site for both parks and detention ponds.

Level of Recreational Use

The level of recreational use that a corridor can withstand before it becomes a detriment will have to be considered.

URBAN FORESTRY & VERTICAL LANDSCAPE ELEMENTS

Tree rooting volume is directly proportional to crown volume. It would be better to depict the actual canopy of trees in the drawings produced out of the charrette or planning process. The type and size of trees will dictate the materials used under infrastructure e.g. sidewalks in order to accommodate the principle rooting space achieve canopy volumes.

Space allowances for trees need to be large enough to accommodate a well-drained rooting space. Normally trees appearing in swales will produce a shallow root system and trees are lost during high wind events.

Conflicts exist with the present tree bylaw. For example: anything that is 200-250mm has to be marked for preservation, however, if the sub-surface structure is changed the trees will die. A better approach is to save them in the green spaces. There is a need to look at urban forestry as a function rather than just aesthetics. Plant the right trees in the right places.

The widths that are required to allow a tree to stand on its own are outlined in the planning department publications. Often there is not enough land to meet the standards.

There is also a relationship between tree location and property lines and the NCP should take that into consideration. The burden of preserving all the trees is often put on one family and ways must be found to distribute the responsibility.

At present there appears to be inconsistent policy on the planting of large trees to hide overhead hydro lines. Consistent policy is required.

Maintenance
Change is required in the number of lots that allow trees to come right up to the lot line. When water no longer enters the area, the trees decline and then have to be removed. This adds a burden to maintenance.

Sensitive Areas
Sensitive areas need to be identified, prioritized and special requirements set out for protection/ preservation. An environmental consultant may need to be hired to identify and assess them.
Use of alternative planning/zoning tools for protecting environmentally significant areas.

Natural Habitat
Natural habitat protection has to be considered including wildlife and vegetation.
Methods to protect the forest blocks and/or old field habitat will have to be developed.
Incorporating forest blocks into the City's greenways could be an option.

Food
When discussing the concept of sustainable development we should consider food production systems within the East Clayton area.

Telephone Utility
Increased use of open spaces can require longer runs through the open spaces and back to the main stations. No customers will be on the lines in the open spaces. The result is increased maintenance and service costs which is reflected in the customer's monthly bills.

Natural Drainage Systems
Consider any unique engineering requirements for the East Clayton area that may not apply to other areas.

Drainage Alternatives are needed to develop land. This concept of sustainable development offers an alternative that is being looked at in Washington State. Increased paving increase drainage problems and detention ponds are getting bigger and more problematic to locate.

The relationship between road gradient and its implications for a natural drainage system has to be considered.

Grass coming right up to the pavement could be problematic to the drainage system functioning properly. Gravel verges and other solutions for trapped water should be explored.

Surface Water Impact On Creeks
In addition to groundwater, surface water's impact on creeks also has to be considered. The lack of a tree canopy is also an issue with regards to surface water.
The relationship between the uplands and lowlands with respect to drainage patterns and rates need to be factored in with the planning.

Soils
The soils of the East Clayton area are clay type soils having limited filtration capacities. More information is required regarding the soils of the area. City Engineering will engage the services of Reid Crowthier to prepare soils information. When soils are disturbed water will run off in an entirely different manner than prior to disturbance.

Surface Water
In the East Clayton area, the forested land already has a lot of surface water that needs to be dissipated. A surplus of water can provide a resource for irrigation of agricultural land. A retention system could hold water to meet agricultural demands.

Water Quality
Would directing flow through public gardens could lead to water quality problems? If it were going on to soil areas would there be unacceptable levels of contaminants and bacteria?

Fire
Fire is required to flush out its water systems on a periodic basis, consideration will have to be given to flushing at great water pressures and its impact on natural drainage systems.

There will have to be some care associated with the type of industry selected for the site and there will have to be stricter building requirements.

Building Character

Smart Houses
Addressing household water consumption patterns would take the notion of sustainability to a higher level. This could extend into an examination of eco-housing that might include water flow monitoring, the use of perforated pipes, energy conservation, and other innovative ideas.

Water Conservation
Home water conservation could be something to explore.

Energy Use
Consider energy use within buildings for space and water heating.

Basements
Houses with inhabited basements will mean that sanitary piping will have to be placed at a significant depth.

Outdoor Space
People like to have private outdoor space. How can this be done and still maintain the density targets?

Design/Construction

Urban Forestry
The presence of mature trees and the implications of their removal during the construction stage will have to be considered. Disturbance of the soils during excavation can result in the trees dying.
Builders need education on what to protect and why. Currently development clears everything away. Typically all of the topsoil is stripped away leaving behind compacted clay soils that are impervious, negatively affecting the efficiency of the drainage system.

Landscaping
Landscaping is a key issue when trying to make this development attractive to the consumer.
Up front landscaping costs to bring the neighborhood to an acceptable level aesthetically will be greater.
Wooden fences in back lanes can be unsafe as they blind views from the lanes and accessing the lane from drive-ways. This also applies to front yard driveways.

Fire/Public Safety
Fire needs to know building styles, rooflines, setbacks etc. before they can completely and knowledgeably address the issue of alternative standards.
The need for new fire halls or expansion to existing fire halls will need to be addressed which also relates back to the buildings and what fire protection systems are used e.g. sprinkler systems.

Postal Services
The normal practice is to identify the specific number of units that will need to receive postal services and then design the appropriate customer delivery system. Therefore, planning for the number of customers' needs to be done at the time of subdivision. Working with the builder to determine the number of customers and siting the customer delivery boxes is the most effective way. At present, convenience of access to the delivery boxes, including distance and places where people pass by on the way home are site location factors.

Prototypes
Prototypes can guide actual developments under the sustainable development principles.

Maintenance
Attention must be paid to site excavation and construction stages in terms of such things as soil composition and ensuring appropriate filtration rates are maintained in the soils. Builders need education on what to protect and why. Currently development clears everything away.

Maintenance

It is important to develop cheaper ways to operate the whole system. This cost reduction would benefit the City and taxpayers.

Gravel Use
Citizens of the city will often complain about gravel on street verges and lanes. Maintenance with sealers to control dust will reduce permeability. Other options such a porous pavement and other aggregates should be investigated. Any aggregate used should be conditional on cost and ease of maintenance. The Vancouver experiences with gravel lanes and street verges should be determined. The concern is that owners of properties in the alternative developments will want to pave lanes, which will affect the natural drainage system. Education and deed restrictions are required.

Grass
Regular cutting of grass in deeper ditches with standing water is unnecessary. The City should just let the grass grow so it can slow down the water.

Urban Forestry
Surrey has a young forest and the City is soon going to have to handle the costs associated with replacing hard landscaping as the trees and concrete compete for the same space. Softer infrastructure and more generous space for trees is suggested.

Maintenance Budget
Maintaining an appropriate maintenance budget for alternative type developments is essential. Currently Surrey uses a "gold plated" standard in the hopes that maintenance can be deferred indefinitely.

Swales
There are cases where developments using swales took about two to three years before they worked properly. This means a longer maintenance period for the developer because they have to correct the problems that arise.

Liability
Liability issues related to drainage system failure will have to be identified and taken into account.

From a servicing perspective there are liability issues and servicing requirement that need to be considered. It would be best to address these early on in the process so that people will know what to expect from the alternative servicing methods.

Ways to address potential liability issues will need to be identified if an integrated approach between City Depart-

ments and agencies, the school district, parks and engineering.

Vegetation management liability issues also have to be considered

Marketing

In general, a development like the sustainable alternative is marketable, however there are challenges that will need to be met. There is consumer's willingness to accept a new style and the maintenance of a comparative cost advantage.

Projects that are modeled after communities like Kitsilano are very popular with the consumer. They like the fact that they can walk and that their kids will be in a safe neighbourhood. With this type of development you are offering a quality lifestyle.

It is difficult, however, to transfer the sense of community that is associated with a place like Kitsilano into a new development. Developments on the scale of East Clayton, were they consistent, could possibly be successful in this regard.

With new developments the term affordable housing is often viewed as a form of low cost social housing. You can talk about affordability but you cannot market it as affordable housing. Additional units can help to ease mortgage payments because they can be rented out.

Caution is required on overselling the cost reductions because the savings could evaporate in unanticipated site development costs.

One issue for the consumer will be the delay in maturing neighborhood green spaces and natural drainage areas. A challenge will be to determine how to sell the lots during the development stages—linear or random lot sales. Gravel will have to be installed after the units are finished which is a potential marketing problem. Alternative approaches will have to be examined.

A challenge will be how to make the units fee simple. The block strata are not the way to go. Legal costs associated with strata corporations would be an impediment.

Consumer Education

Public opinions on roadside swales and puddles have to be taken into account.
Increased public awareness and stewardship could lead to innovative and alternative approaches to corridor protection which might include the use of and methods of protecting riparian zones.

With respect to building energy use, the demonstration project should include consumer education on the benefits of energy efficient construction and provide incentives for builders to construct energy efficient and durable buildings.

It is hard to sell reducing car dependency in "a little community in the boonies". East Clayton is not a downtown urban centre, at least not yet.

There is a need to educate the consumer so they understand the principles behind the sustainable community and can work to maintain it over the long term. In some cases, residents feel like second class citizens without curbs and paving. They also have been known to fill in swales and prevent on street parking. Dust is an on-going issue and the current tolerance level is very low. Long term maintenance means ensuring those second and third generation buyers do not want to revert back to status quo developments.

A challenge will be to prevent 2nd and 3rd generation buyers from demanding status quo infrastructure like removal of the gravel areas, installation of curbing etc. A consumer education program will be required to increase understanding of the sustainable neighbourhood and that is based on a natural drainage system linked to other features. They will need to know what to expect from the neighbourhood and how the sustainable system works and its life style benefits. People tend to want perfect drainage but need to be educated on drainage water as a resource and its link to stream water quality and saving the salmon.

Monitoring

Streams

It is important to measure pre and post development stream flows.
An inventory is required of what information and data already exists.

When implementing alternative approaches we should document our goals and determine the extent to which we achieve them. This requires monitoring, which should start now so we can establish a baseline. The requirements for monitoring can be determined by working back from the objectives. We should set up a program to monitor and explore the possibility of using DCC money and other sources for collecting drainage data.

An assessment on the productivity of the streams and knowledge of existing physical inventories and soil inventories are necessary.

Greenhouse Gas Reduction

Lay the groundwork now to allow for the monitoring of all energy uses and the associated reduction in Greenhouse Gas emissions and improved air quality both within the community and within its buildings.

Municipal Planning

An Integrated Approach
The role of the landowners is essential since they have a vested interest. However, they are not always the ones that are going to have to live with the decisions.

NCP process requires accountability and to build trust.
The process must be expedited.
An integrated approach will require increased communication and interaction, which will require greater investment of senior management's time in order to obtain policy acceptance.
Integration between transit planning and land use planning in order to address issues of access and safety is required. Ideally, the transit plan would be developed concurrently with the NCP.

Policy

In order to implement the sustainable development principles and the associated performance standards, municipal officials and other decision-makers at all levels will have to buy- in.

Policy adjustments at a senior level will require the involvement and buy-in of senior level decision-makers.

In a similar way if these developments are to have overhead power lines in back lanes a joint policy needs to be worked out between BC Hydro and the City.

The plan policy and regulatory system must provide some confidence in those who invest in properties that future developments will fall within the performance standards set under the plan and regulation/bylaw.

Planning System

A challenge is to establish a more flexible municipal planning system to accommodate sustainable development proposals. The problem will not be in finding someone to build it but overcoming the specific requirements of planning and zoning bylaws that tend to be inflexible.
It may not be possible to incorporate all seven principles at first; however, we can work towards achieving the principles with each new development in the East Clayton area moving closer to meeting the principles as successes are experienced. Flexibility in the planning system to allow innovation is key.

Regulatory/Bylaw

The proposed development principles, from an environmental perspective, look sound. However, there are existing regulatory requirements that will need to be identified and addressed in order to implement the principles.

Municipalities can control a lot through zoning, they have the authority so they should use it.

City by-laws currently prohibit a lot of things that are being suggested. Each of these by laws will need to be examined.

Flexibility needs to be built into the NCP that will allow adjustments to such things as market conditions. We need to understand the implications of such flexibility for the future built environment. For example, if developers and builders are required to designate specific number of units at the NCP level then we will not be able to easily respond to market changes.

The success of sustainable developments will largely depend on the flexibility in innovation permitted to allow innovate building design and character. Therefore, any development permit system should provide the flexibility necessary to achieve innovative designs in housing character. OCP's have a tendency to get out of date and the plan policy does not keep up with the market place.

Fees & Levies

Smaller housing units have to be placed on the market at a lower value than larger units, so densities have to increase. Fees and levies charged for residential densities discourage the builder to construct smaller units. An alternative formula is required to make smaller units more attractive.

In traditional developments, like Kitsilano, single family houses were converted into duplexes. With a new development you now have disclosures to file on each unit. Consequently, there are legal costs the consumer must consider when buying a new home within a multiple unit building.

The present application of DCC's to secondary suites within areas designated for secondary suites make them impractical. A workable approach is to adopt the levy charged on secondary suites created after original construction, 2-3 years later, when a suite fee is charged.

City Council

City council is not just a part of the process but ultimately is responsible for adopting any policies and standards.

As the process unfolds, effective communication to City Council and senior management on the planning process proposed policy and standard changes are required.

Maintaining Integration

Integrating the various functions to achieve the objectives for sustainability require those functions to remain integrated over time. In the face of differing mandates a way needs to be found if we want to maintain concepts like integrated green infrastructure or a continuous park system.

Life cycle Costs

An analysis of projected lifecycle costs for alternative developments will be required before the NCP goes to City Council. Replacement costs, however distant they are into the future, should be factored into this analysis.

Contingency

A back up plan might be a good idea because we are trying new concepts. The question of whether or not DCC's can be put aside for the implementation of a contingency plan to help upgrade should be explored.

Demonstration

When considering the actual size of the development site for demonstration we must consider what benefits there

will be to the environmental system.The post development hydrology system needs to mimic what existed prior to development. We need to be innovative and try a drainage system with no pipes and determine the costs. Demonstrate that an alternative approach can work and then it can be taken to other municipalities.

Appendix 2

Matters Arising out of East Clayton NCP Constituency Workshops that will Significantly Impact on the Implementation and Longevity of Alternative Sustainable Developments

Some of the following matters will be addressed during the afternoon session of Day 2 of the design charrettes. Constituency members will join a number of working sessions that will develop parameters and actions required moving these matters forward. Under each matter is a list of suggested working session participants others interested in joining the working sessions are welcome. Stream Monitoring and Green Infrastructure working sessions are now underway.

PRE-CHARRETTE

1. Stream Monitoring Program

A program is required to monitor stream and water quality improvements in the East Clayton NCP area. (Status: Workgroup in progress)

Working sessions include:

- Fisheries & Oceans
- Ministry of Environment, Lands and Parks
- City Engineering – Eric Emery, Carrie Baron
- Surrey Environmental Advisory Committee

2. Integrating Green Infrastructure

Current practices establish open spaces that perform separate purposes to achieve different objectives. Ways need to be explored as to how these areas can be linked and integrated into one system to achieve maximum value from a drainage perspective, habitat protection, schools, parks and recreation. (Work in Progress)

Working sessions include:

- City Engineering and Operations
- City Planning
- City Parks and Recreation
- School District
- Fisheries and Oceans
- Ministry of Environment, Lands and Parks

PRE AND POST CHARRETTE

3. East Clayton

Some of the matters that are specific to the East Clayton Area include: the fragmented ownership issues, issues related to development and equity, phasing in development as servicing becomes available, owner expectations and awareness, owner and developer commitments, plan implementation, parking standards and zoning. Zoning matters include exploring concepts for live/work and office park areas that integrate office, lunch area, residential, recreational and natural zone functions.

Working sessions might include:

- East Clayton Advisory Committee
- City Planning

- City Engineering
- Developers
- Real Estate

4. Life Cycle Costs of Green Infrastructure

An analysis of projected lifecycle costs for alternative developments will be required before the NCP goes to City Council. Replacement costs, however distant they are into the future, should be factored into this analysis.

Working sessions might include:

- City of Surrey Engineering and Planning
- Canada Mortgage and Housing Corporation
- Ministry of Municipal Affairs
- Urban Development Institute
- GVRD

5. Monitoring Greenhouse Gas Reductions

Develop and implement a monitoring system for measuring greenhouse gas emissions.

Working sessions might include:

- BC Hydro
- Canada Mortgage and Housing Corporation
- Environment Canada
- BC Transit/GVTA
- GVRD
- Ministry of Environment, Lands and Parks
- City of Surrey Engineering and Planning
- East Clayton Advisory Committee

6. On-site Construction

The capacity for natural drainage systems to work efficiently will largely depend on performance at the construction stage and the applications of best practices by the contractors and builders. For example, after soils have been disturbed during the construction period mimicking soil infiltration rates is difficult to accomplish and therefore will require care during the construction phase to reach infiltration rates necessary to maintain an effective natural drainage system. What are best practices and what must be done to ensure they are practiced?

Working sessions might include:

- City Engineering (Drainage)
- City Planning, Building & Development
- Legal
- Developers/Builders
- Ministry of Environment, Lands and Parks
- East Clayton Advisory Committee

POST-CHARRETTE

7. Maintaining the Sustainable Development Standards over the long term.

In cases where alternative approaches i.e. natural systems, gravel verges, etc. have been used residents have later demanded conventional infrastructure i.e. pipes and curbs be installed at a higher cost. These concerns need to be resolved. City Operations identified developments that have incorporated some of the features of the sustainable development principles in the City. A review of what happened in the case of Amble Green development (16th Ave and 132nd street) should be conducted. Areas of work include: a consumer education program, legal instruments, agreements, institutional organizations, review of existing experience and liability

Working sessions might include:

- Developer/Builder
- Engineering and Operations
- Planning
- Legal
- Environment Canada
- Ministry of Environment, Land and Parks
- Canada Mortgage and Housing
- East Clayton Advisor Committee

8. Building Design and Use

Buildings that are constructed in a sustainable community should enhance sustainable community objectives. Explore ways that building design and use incorporate energy efficiencies, water consumption and healthy-flex housing principles. Explore the implications for local building codes.

Working sessions might include:

- City Urban Design
- BC Hydro
- Developer/Builder
- Canada Mortgage and Housing
- Real Estate
- East Clayton Advisory Committee

9. Regulatory System

The Developer Industry suggests that in order to implement alternative standards an appropriate regulatory system-bylaws, application requirements, information requirements, and day to day approval and review systems will need to be in place to accommodate the alternative development approaches. With City planners, the Developers want to explore areas where flexibility is necessary in the system and whether or not it is possible.

Working sessions might include:

- Developers/Builders
- City Planning: approval officers and front line planners

[1] CORE pgs. 14 - 18; MA 942.11; CS pg. 10, 28.

[2] MA 942.11(ll); LRS pg. 43; CORE pg. 14, 17.

[3] CORE pg. 18; CS pgs. 10, 13.

[4] LRS pg. 45; CS pg. 31; CORE pg. 15; MA 942.11; BCEC App. pg. 1; CS pgs. 8, 2.

[5] MA 942.11 (h), 945; CORE pg. 15.

[6] CORE pg. 14; BCT pg. 13; CS pg. 19.

[7] Clayton Neighbourhood Concept Plan: General Land Use Concept

[8] LRS pg. 44; CV pg. 46; BCH pg. 47; BCT pg. 10; BCEC App. pg. 1.

[9] CORE pg. 14; LRS pg. 44; MA 942.11 (b); BCT pg. 6, 11; CV pg. 46; CS pg. 16, 31: BCH pg. 47; BCT pg. 6.

[10] BC Hydro/Criterion Study.

[11] BCH pg. 46; MA 942.11 (m); CORE pg. 14, 16; BCEC App. pg. 2.

[12] BCH pg. 46; BCEC App. pg. 2; CORE pg. 17; MA 942.11 (m).

[13] BCEC App. pg. 5; BCH pg. 17; MA 942.11 (m).

[14] BCH pg. 46; CORE pg. 16.

[15] MA 942.11 (b); CORE pgs. 14, 16; LRS pgs. 43, 44; BCT pg. 3; BCEC App. pg. 2; CV pgs. 36, 46.

[16] LRS pg. 43; CORE pg. 16; CV pgs. 34, 46; BCEC App. pg. 3; MA 942.11 (b), BCT pg. 13; CS pg. 16.

[17] Minimum and maximum population, total dwelling units, and gross density figures are derived from a variety of sources that suggest eight dwelling units per acre is the minimum density at which a good range of commercial services can be economi-