redwood

Redwood Heights

Neighbourhood Concept Plan

CITY OF SURREY | Community Planning

Redwood Heights Neighbourhood Concept Plan
APPROVED BY COUNCIL May 4, 2020

Planning and Development, Engineering, and Parks, Recreation and Culture
City of Surrey, 13450 104 Avenue Surrey, British Columbia V3T 1V8

CITY OF SURREY | Community Planning

Contents

I Finding Things

WHAT KIND OF COMMUNITY DO WE WANT TO BE?

Today, community building is about ensuring the success of our residents and our community now and into the long-term future. One of the main challenges for cities is to become smarter and be able to respond cohesively to the ongoing effects of climate change.

At the same time, we need to accommodate new residents while maintaining the level of amenities and services needed by all. We are facing increased demand for housing, energy, infrastructure and recreational, health and social programs. Growth brings more greenhouse gas emissions, congestion and waste. It also puts pressure on our local natural systems.

The planning of our neighbourhoods must take these factors into account. We must plan and grow sustainably to create healthy, resilient and livable communities. We will do this by greening our neighbourhoods, protecting sensitive ecosystems, encouraging transit and active transportation and planning our communities and buildings to be more compact and efficient.

Plan Summary

Redwood Heights Plan **Highlights**

Redwood Heights Neighbourhood Concept Plan

The Redwood Heights Neighbourhood Concept Plan (NCP) is a comprehensive strategy to guide the development of a new community in Grandview Heights. The plan presents a vision of a compact, environmentally friendly, and sustainable community. It was developed through extensive public and stakeholder consultation, with support from the Redwood Heights Citizen's Advisory Committee (CAC), City staff and project consultants.

How Will the Plan Impact the Neighbourhood?

The plan presents a framework for the comprehensive development of the Redwood Heights neighbourhood. It will guide the development of new housing for residents, shops, and new employment, paths and new community amenities. It also presents a clear strategy for the protection and preservation of key wildlife habitat and sensitive ecosystems.

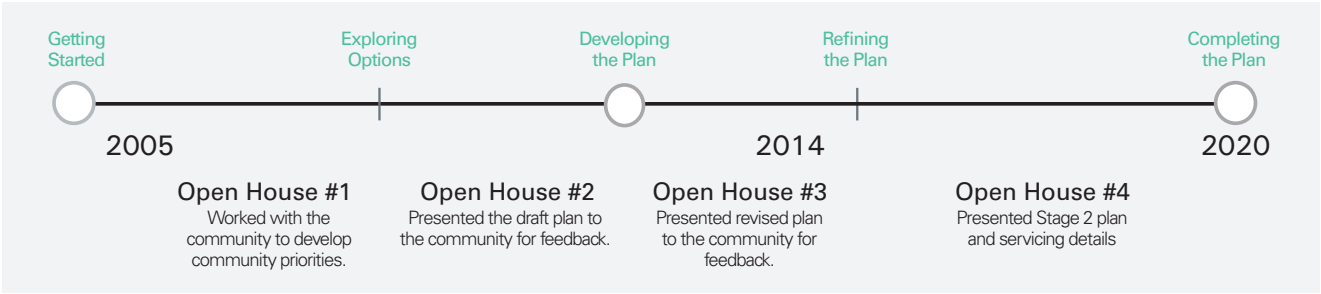
What's a Land Use Plan?

Land use plans designate what can be built and where. They guide the height, use, and look of new buildings, as well as locations and funding for new streets, parks, and other public services.

Public Engagement

We conducted an integrated multi-stakeholder engagement process with a broad range of residents and stakeholders. A Citizen's Advisory Committee (CAC) made up of a cross-section of property owners in the plan area was formed. We worked with the community and CAC members to identify and prioritize land use planning principles and decisions.

14 Years of Engagement



4 Ways Stakeholders Were Notified

- MAILER
- WEBSITE
- NEWSPAPER
- SOCIAL MEDIA

4 Ways Stakeholders Participated

- PUBLIC OPEN HOUSES
- EMAIL & PHONE CONVERSATIONS
- SURVEY
- 1 ON 1 MEETINGS

Growth Objectives

The vision for Redwood Heights as a healthy, sustainable and livable village will be achieved by:

Protecting Natural Areas

An extensive parkland and green infrastructure network made up of hubs, corridors, and sites will:

- Protect environmentally sensitive areas such as wetlands, riparian areas and forested areas.
- Provide community and neighbourhood scale parks within walking distances of residents.

Providing Local Amenities

A central mixed-use commercial village and neighbourhood commercial node will:

- Support walkability within the Plan Area; and,
- Encourage a "Complete Community" with employment, entertainment, and services close to home.

Enhancing Housing Diversity

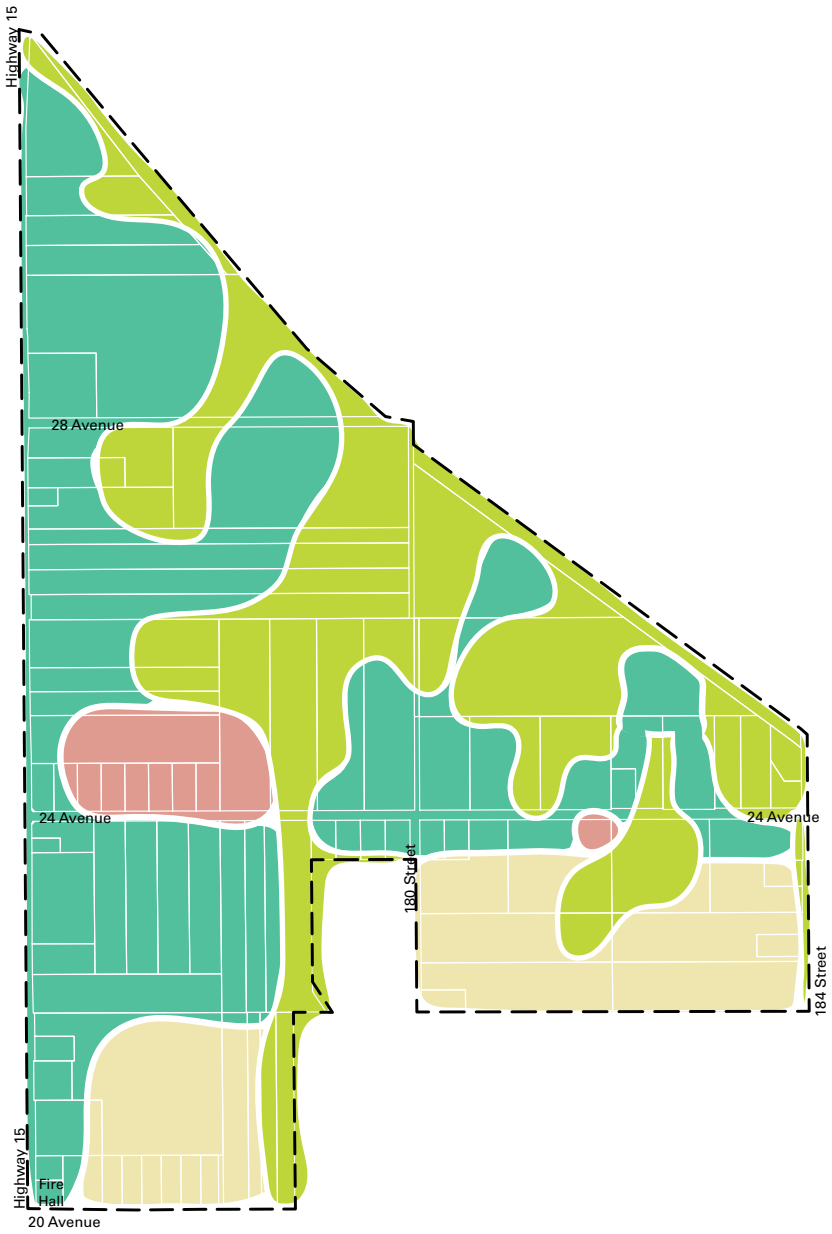
Areas of higher density development located around the neighbourhood centre and in close proximity to a future frequent transit corridor will:

- Improve the balance of housing types and affordability; and,
- Focus new housing within walking distance of amenities and public transit.

Interfacing with Rural Neighbours

Single family lots at the Plan Area's southern interface will:

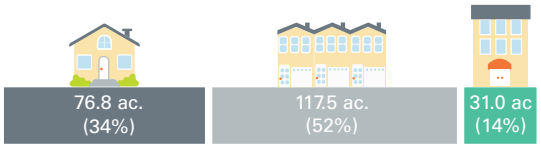
- Provide valued single family housing;
- Transition with the existing rural lots in the Redwood Park Estates area.



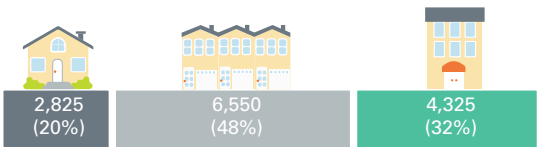
Growth Projections

The NCP provides for an average of 5,300 dwelling units and is estimated to support a future build-out population of over 13,500 people. Approximately 1,223 - 1,615 students will be enrolled in public schools at full build out of the NCP area.

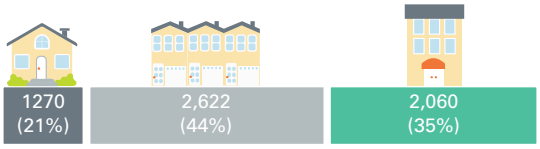
Land Use	%
Parks, Natural Areas, & Buffers	12.7
Multiple Residential	11.3
Townhouse	8.3
Institutional	6.6
Riparian Area	6.4
Detached Residential	5.8
Cluster Residential	5.7
Low Rise Apartment	3.7
Stormwater Detention Pond	3.5
Residential Transition	2.7
Low Rise Mixed Use	2.1
Multiple Residential or Detached Residential	1.4
Semi-Detached Residential	0.9



PROJECTED LAND AREA BY BUILDING TYPE

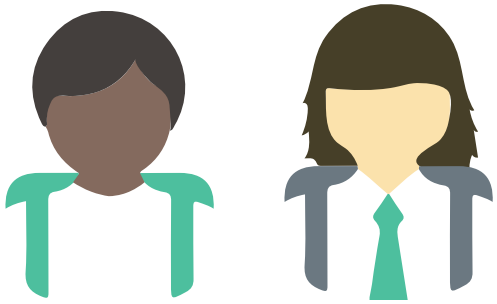


PROJECTED POPULATION BY BUILDING TYPE



PROJECTED UNITS BY BUILDING TYPE

PROJECTED ELEMENTARY AND SECONDARY STUDENTS AT FULL NCP BUILD OUT



809 -1,069

414 - 546

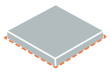
Land Use Strategy

This land use plan shows where and how land uses fit together to create a coordinated plan. Corresponding land use designations includes example images and summary descriptions for the different types of land uses that can occur within the plan area.

WHAT IS FAR?

Floor Area Ratio (FAR) is a measure of density. It is a ratio of the building's floor area divided by the site's area. FAR alone does not determine a building's height.

For example, a building with 1 FAR could have...



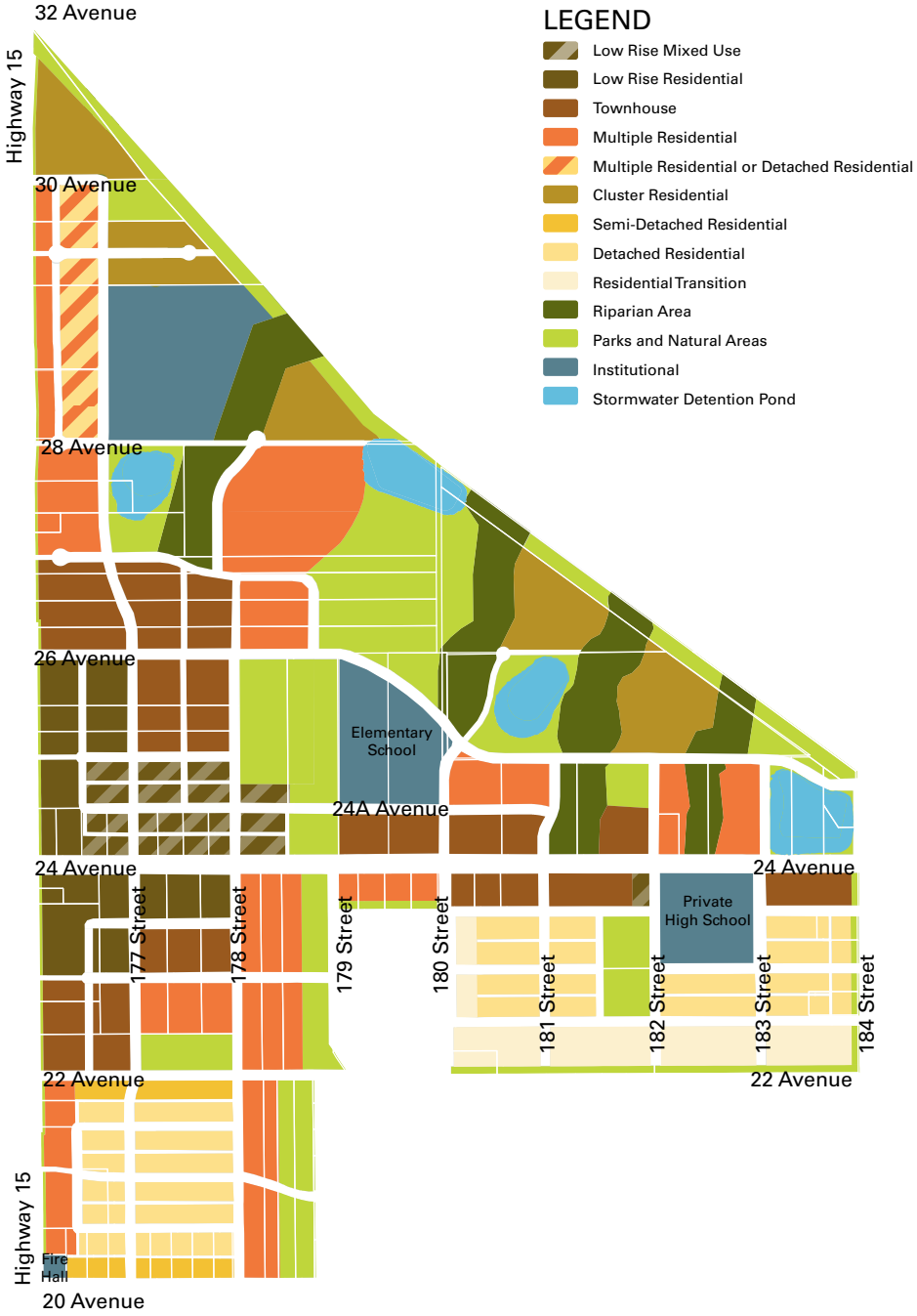
1 storey covering the entire site

OR

2 storeys covering half the site

OR

4 storeys covering a quarter of the site



Land Use Designations

Low Rise Mixed Use

Low rise apartments with ground-oriented commercial space.

DENSITY RANGE
Up to 2.0 FAR

TYPICAL HEIGHTS
5-6 storeys

TYPICAL OWNERSHIP
Strata or Rental

Low Rise Residential

Multi-family housing with ground-oriented units at base.

DENSITY RANGE
Up to 2.0 FAR

TYPICAL HEIGHTS
4-6 storeys

TYPICAL OWNERSHIP
Strata or Rental

Townhouse Residential

Ground oriented townhouses.

DENSITY RANGE
Up to 75 UPH (30 UPA)

TYPICAL HEIGHTS
13.0 m.

TYPICAL OWNERSHIP
Strata

Multiple Residential

Wider/larger townhouses or row houses.

DENSITY RANGE
Up to 55 UPH (22 UPA)

TYPICAL HEIGHTS
9.0 - 11.0 m.

TYPICAL OWNERSHIP
Strata or Fee Simple

Semi-Detached Residential

Duplex or lower density fee-simple row housing.

DENSITY RANGE
Up to 37 UPH (15 UPA)

TYPICAL HEIGHTS
9.5 m.

TYPICAL OWNERSHIP
Fee Simple (Free Hold)

Cluster Residential

Mix of detached single family, detached, and multiple residential cluster to protect natural areas.

DENSITY RANGE
Up to 25 UPH (10 UPA)

TYPICAL HEIGHTS
9.0 m.

TYPICAL OWNERSHIP
Strata or Fee Simple

Detached Residential

Narrow/wide front or rear loaded detached houses.

DENSITY RANGE
Up to 30 UPH (12 UPA)

TYPICAL HEIGHTS
9.0 m.

TYPICAL OWNERSHIP
Fee Simple (Free Hold)

Residential Transition

Larger suburban detached lots.

DENSITY RANGE
Up to 10 UPH (4 UPA)

TYPICAL HEIGHTS
9.0 m.

TYPICAL OWNERSHIP
Fee Simple (Free Hold)

Institutional

Public and private community spaces such as churches, universities, schools, museums, libraries and community centres.

Riparian Area

Areas that are adjacent to ditches, streams, lakes, and wetlands. Riparian areas play a critical role in supporting fish habitat and a range of vegetation.

Parks and Natural Areas

The planning of new parks will ensure that riparian areas and significant biodiversity hubs and corridors are protected and all future residents will live within a 10 minute walk of a park.

Stormwater Detention Pond

Stormwater storage facilities will be generally placed near the downstream point of every catchment to service as much of the catchment as possible.

Street Network

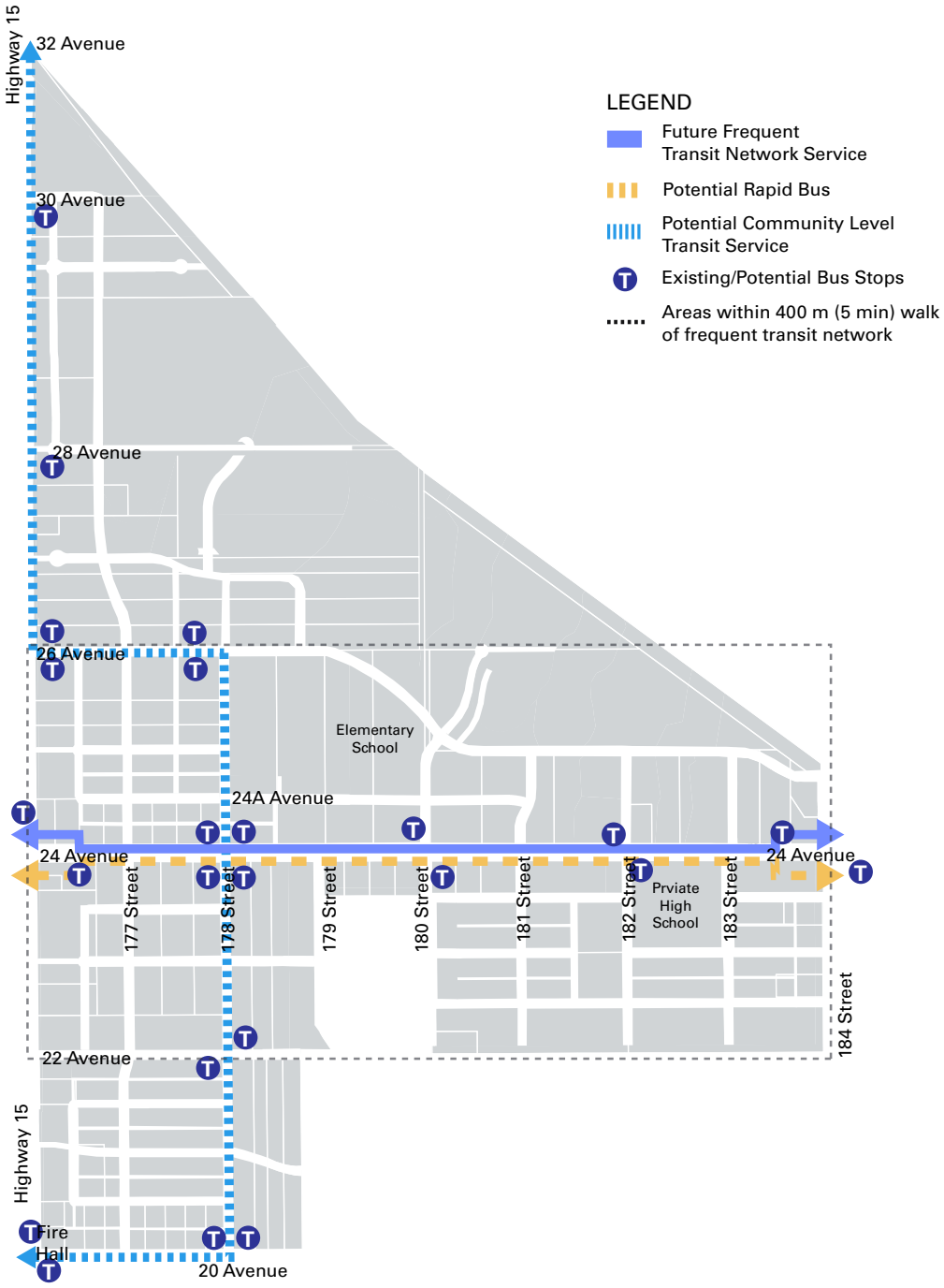
The transportation strategy builds on existing infrastructure to deliver a comprehensive finer grain road network. It is based on the City's Transportation Strategic Plan and supplementary plans, including the Walking Plan and Cycling Plan. It provides an open, connected, and continuous street network that supports cycling and pedestrian connectivity, transit service, and compact neighbourhood development.

Bicycle & Pedestrian Network

Pedestrian infrastructure is planned throughout the plan area and will be delivered largely through new development as well as through City capital projects. This includes sidewalks, multi-use pathways, street lighting, pedestrian crossings, and cycling facilities. Multi-use pathways will provide connections to and from parks within the plan area. All new walking and cycling infrastructure will reflect the road cross sections outlined in the plan.

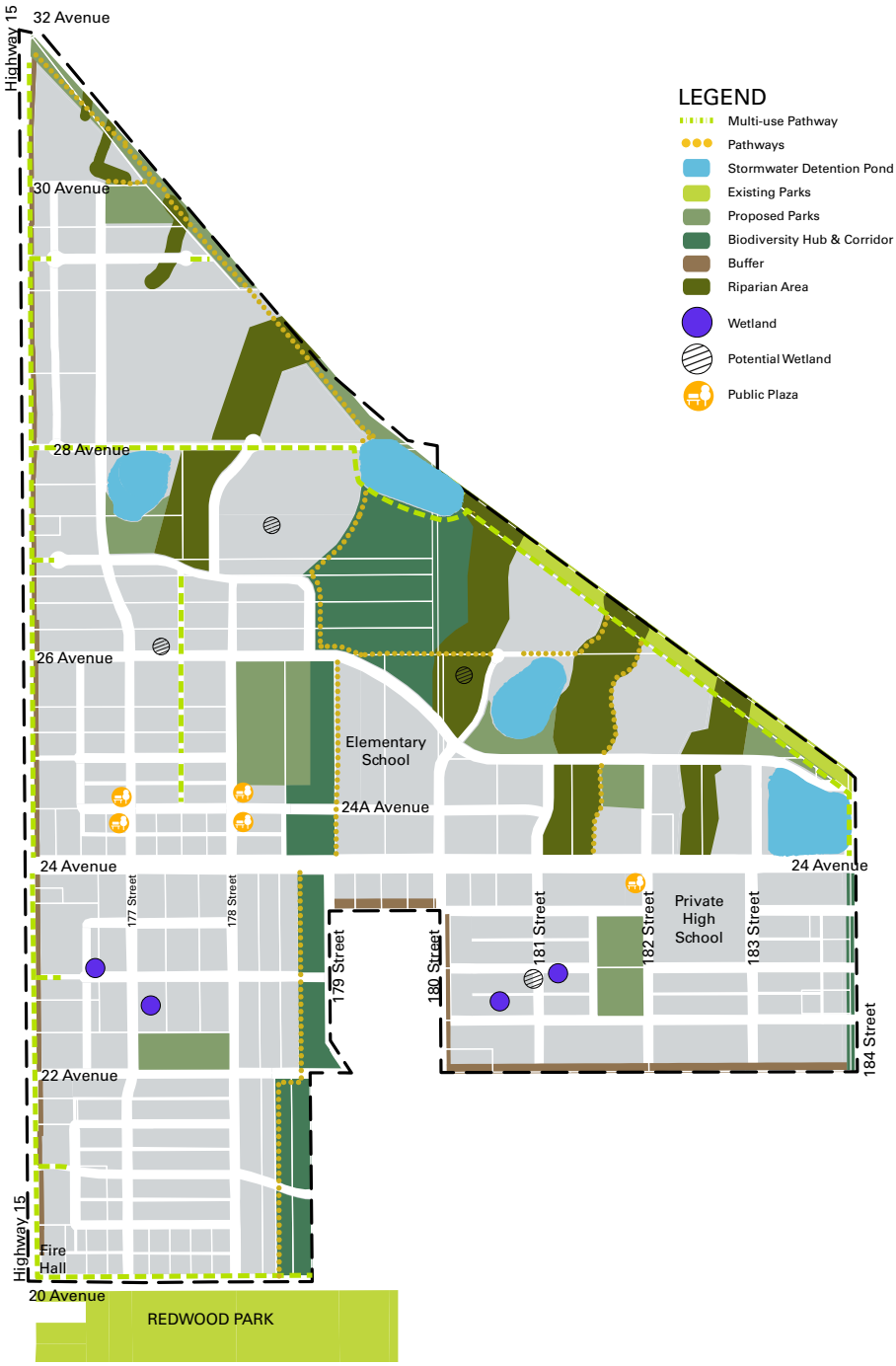
Transit Network

The transit plans for Surrey are guided by TransLink's South of Fraser Area Transit Plan (SoFA TP). The SoFA TP identified 24 Avenue as a potential candidate for future Frequent Transit Network service. Looking beyond 2031 and with the ultimate build out of the entire Grandview Heights area, 24 Avenue is a good candidate for future Rapid Bus.



Parks & Open Space Strategy

Parks and natural areas are essential to the overall health and wellness of residents. Providing access to high quality parks is crucial to support daily life, active lifestyles, and opportunities for social interaction. The plan delivers eight new active park sites, along with a large biodiversity hub and central biodiversity corridor that links to Redwood Park. All streams and riparian areas will be conveyed to the City to be protected as natural area parkland.



Introduction

| Why a plan for Redwood?

In 2003 the City identified the Grandview Heights area as being suitable for new development. Redwood Heights is the eastern most neighbourhood in the broader Grandview Heights community. The Redwood Heights plan will guide future neighbourhood development, provision of amenities and services, and the preservation of biodiversity hubs and corridors.

THE PLAN DOCUMENT

The plan is organized into the following sections:

1. **Background** provides an overview of the planning context and process.
2. **Plan Framework** outlines the vision and objectives.
3. **Land Use** outlines each land use and associated design guidelines.
4. **Transportation** outlines new road connections and active transportation initiatives.
5. **Parks & Natural Areas** identifies parks, natural areas and outlines development considerations.
6. **Utilities** details infrastructure improvements to support development.
7. **Implementation** outlines policies and financing required to build out the plan.

What's a land use plan?
Land use plans designate what can be built and where. They guide the height, use, and look of new buildings, as well as locations and funding for new streets, parks and other public services.

How will the plan improve the neighbourhood?
Many public facilities and services are used daily by residents. These include community centres, cultural spaces, childcare facilities and libraries. When new development and rezoning occurs in an area with a land use plan, developers must make contributions to help fund these amenities. They are also required to upgrade sidewalks and other infrastructure.

POLICY CONTEXT

Community planning and development in Surrey is conducted and administered within a series of plans, policies and by-laws. These include the Metro Vancouver Regional Growth Strategy, Surrey Official Community Plan, Neighbourhood Concept Plans, the Zoning By-law, as well as several other City by-laws and Provincial regulations.

Within the hierarchy of plans, the Official Community Plan (OCP) must conform to the Metro Vancouver Regional Growth Strategy while all the other Plans and By-Laws must conform to the OCP.

Metro Vancouver Regional Growth Strategy

Redwood Heights is identified as a 'future growth area' within the Metro Vancouver Regional Growth Strategy. The NCP area is projected to receive nearly 4.7 - 9.0% of Surrey's residential unit growth and 1.4 - 1.7% of the population growth as part of the Region's Plan by 2041.

Surrey's Official Community Plan

At the initiation of this plan, the area was designated 'Suburban-Urban Reserve' in the City's Official Community Plan (OCP). Land within this designation is intended to support the retention of Suburban land uses in areas where future urban development is expected and is subject to City Council initiation and approval of a Neighbourhood Concept Plan.

Grandview Heights General Land Use Plan

In 2005, Surrey City Council approved the Grandview Heights General Land Use Plan (GLUP). It provided a concept for future neighbourhoods in Grandview Heights including parks, schools, businesses and residential land uses.

Redwood Heights Neighbourhood Concept Plan

In 2009, Council adopted the recommendations of Corporate Report No. R175; 2009, which authorized the preparation of a Stage 1 Land use Plan for Grandview Heights Area #4 (Redwood Heights NCP).

The Official Community Plan

> *"The City of Surrey will continually become a greener, more complete, more compact and connected community that is resilient, safer, inclusive, healthier and more beautiful."*

The OCP identifies five long-term sustainability goals to help address the challenges of urban growth, climate change and demographic shifts:

Accommodate population growth by maximizing the efficient use of urban land while minimizing the impacts of change in existing neighbourhoods.

Protect and Enhance Habitat Features and Connectivity to support the rich variety of species in Surrey, particularly those that are at risk, threatened, or endangered, and to facilitate species movement.

Improve the balance of local jobs to population in order to reduce commuting time, traffic congestion, and greenhouse gas emissions while reducing the burden of property taxes on residential properties by diversifying the local tax base.

Reduce automobile reliance by re-orienting land use patterns to include higher density, mixed use developments with access to transit, cycling and walking.

Promote a compact urban form that supports transit and renewable district energy infrastructure while reducing costly infrastructure extensions and avoiding development in environmentally sensitive areas.

Serve the needs of the City's population by providing housing diversity and community programs to support all ages and socio-cultural groups.

Section 1

I How We Got Here

The Redwood Heights Neighbourhood Concept Plan (NCP) was developed through extensive public and stakeholder consultation, with support from the Redwood Heights Citizen's Advisory Committee (CAC), City staff and project consultants. The intent of the plan is to guide the development of a compact, livable, and sustainable community.

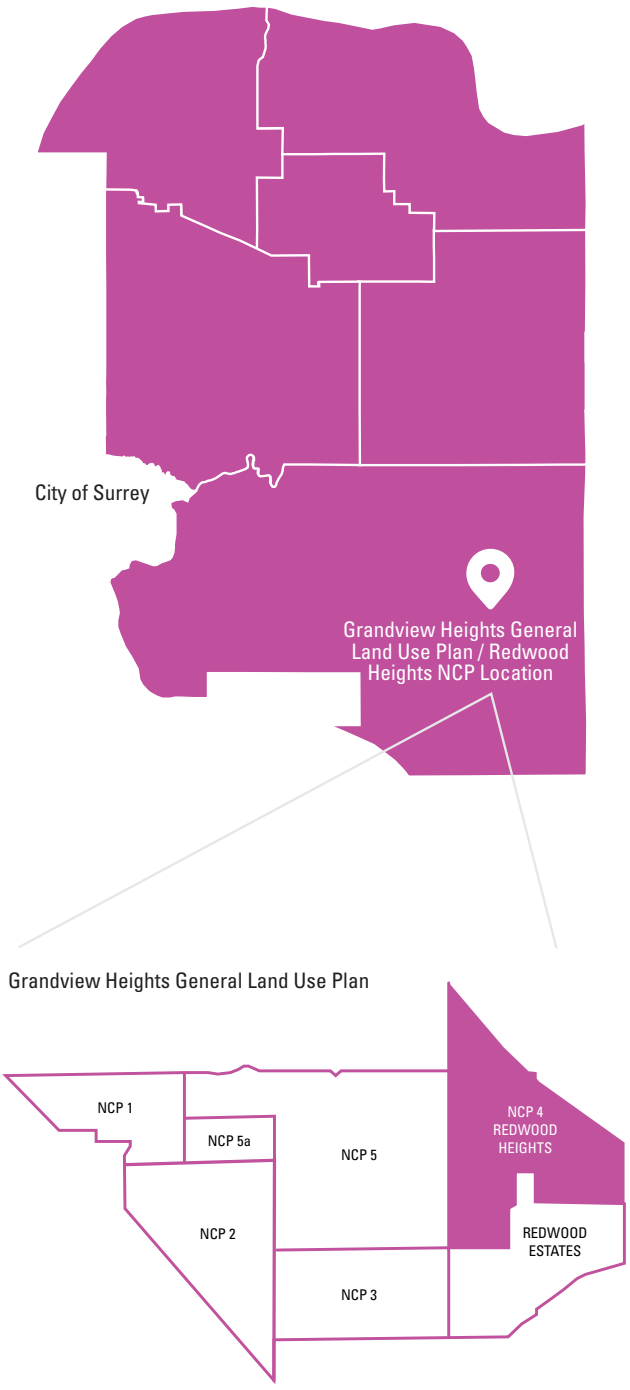
1.1 PLAN AREA

Redwood Heights is located at the easterly end of the Grandview Heights community. It is bounded by the Agricultural Land Reserve (ALR) to the north and east, 20 Avenue and the existing Redwood Estates to the south and 176 Street (Highway 15) to the west.

The area is primarily made up of large acreage and rural lots, between one and 40 acres, zoned A-1 (General Agriculture), A-2 (Intensive Agriculture) and RA (One Acre Residential). There are also some parcels zoned CD (Comprehensive Development).

A portion of the historic Great Northern Railway right-of-way, now owned by the City, is located between 180 Street and 184 Street boundary at the toe of the slope along the ALR boundary.

It has an area of approximately 210 hectares (519 acres) and included 92 properties at plan initiation.



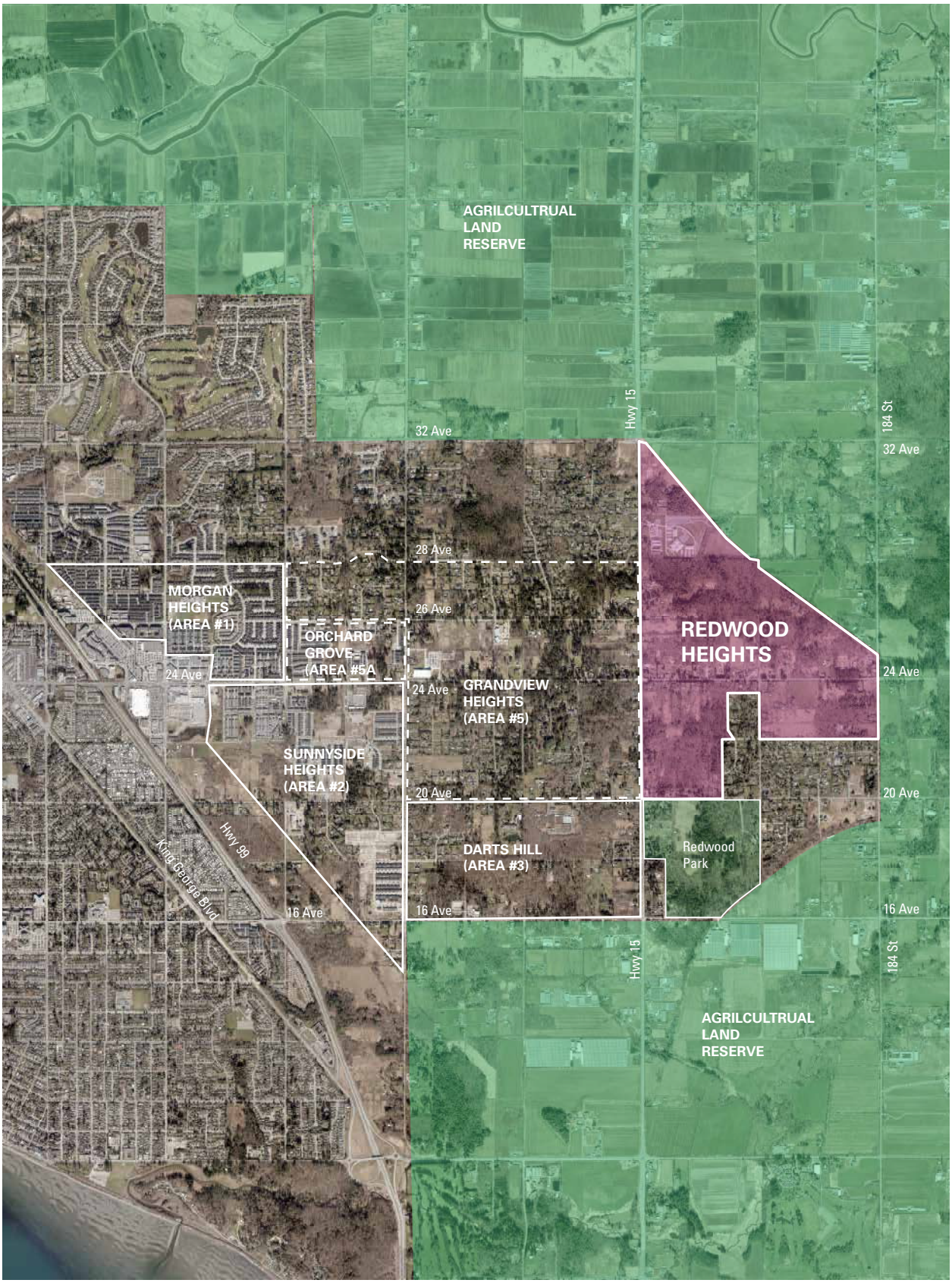


Figure 1.1 Redwood Heights Context Map

1.2 GEOGRAPHY & ENVIRONMENT

Redwood Heights is generally characterized by north-easterly slopes ranging from 5%to 15%, with the steepest slopes in the north-east adjacent to the ALR. A number of ravines and creeks bisect the area, draining from the uplands to the lowlands within the ALR.

A significant portion of the area between 24 Avenue and 28 Avenue is identified as a Biodiversity Hub in the City's Biodiversity Conservation Strategy (BCS). A north-south Biodiversity Corridor is also identified within the BCS, linking this area with Redwood Park to the south (See Figure 1.2). These areas are relatively intact natural hubs and corridors of woodland that provide valuable wildlife habitat and support fish habitat in tributaries to Erickson Creek.

The NCP is located in an area of Surrey called the Campbell Upland which gives the neighbourhood its distinct topography. These were more open areas, with scattered groves of spruce and hemlock, intermixed with cedar, alder and birch. Grassy areas, usually fairly swampy, were combined with heavy underbrush of hardhack, willow, crab-apple, and a variety of shrubs and reeds.

The area features significant stands of second growth forest which generally consists of red alder and big-leaf maple mixed with coniferous trees. The area also features a number of old fields consisting of grasses and sedges intermixed with shrubs. The dominant shrub covers are deciduous species such as hardhack, Himalayan blackberry, or planted crops. This vegetation is found in areas previously logged in the early 20th century.

1.3 HISTORY

FIRST NATIONS TRADITIONAL TERRITORY

The area in which Redwood Heights is located is the traditional territory of a small Halkomelem speaking group of the Snokomish First Nation. Their territory included the shores of Boundary Bay, and the drainage basins of the Serpentine, Nicomekl and Campbell Rivers. They intermarried with the Semiahmoo First Nation, shared a weir site near the mouth of the Campbell River, and a common hunting territory. Shortly before 1850 the Snokomish People were almost entirely wiped out by a smallpox epidemic.

EARLY SETTLEMENTS

Early European settlement in Grandview Heights began with David Brown, who arrived in Surrey from Ontario in 1878 and took up residence at the corner of the Clover Valley and North Bluff Roads (176th Street and 16th Avenue). Pioneering families followed and expanded logging and agricultural opportunities. In 1886, a logging railway was built east through Grandview Heights to support the expansion of logging and agricultural activity.

When the New Westminster and Southern Railway was completed in 1891, the logging railway was extended and linked east of Hall's Prairie Road. In 1910, The Royal City Planning Mills owned three quarter-sections of Redwood Heights, an indication of the importance of the area for timber supply. They established an operation east of Elgin, near the Nicomekl River, to log the areas south of Kensington Prairie. The Royal City Planning Mills, Brunette Mills, and later, the Campbell River Timber Company, all operated in the area, the last as late as 1927.

As the timber was depleted and the area cleared for settlement, farming began in earnest. The Pacific Coast Highway opened South Surrey up to small-agricultural and non-agricultural residential settlement in the 1920s. Quarter sections were subdivided into holdings of only a few acres. Some of these small farms still exist today.

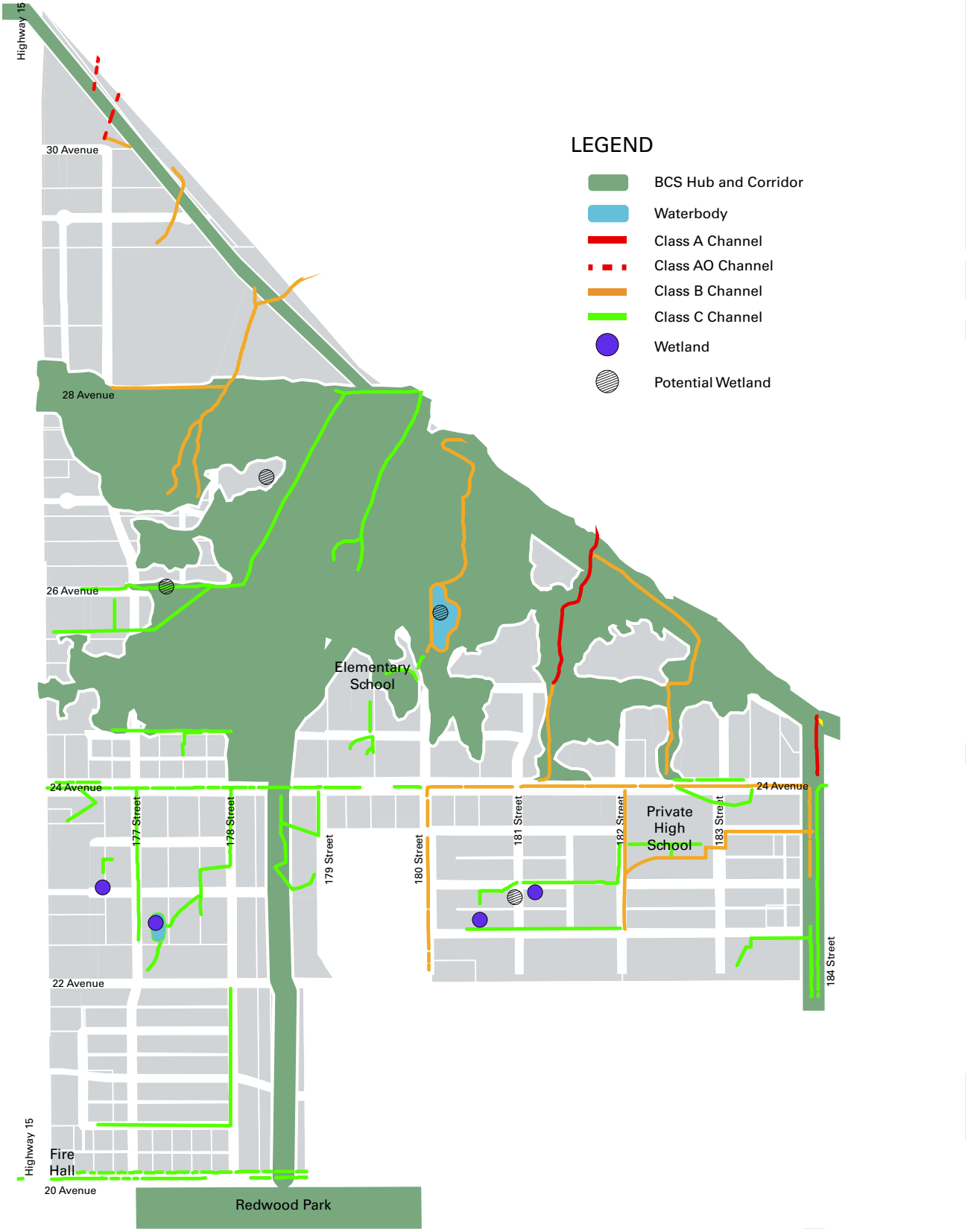


Figure 1.2 BCS Hub and Corridor and Watercourses

1.4 COMMUNITY PROFILE

In 2020 the Redwood Heights area had a population of approximately 300 residents, with 92 rural and suburban residences. The population density for the area was estimated at approximately 0.2 residential units per hectare (0.6 persons per acre).

The demographic profile of the area is to change dramatically as the plan area builds out.

1.5 PLANNING PROCESS

This plan was developed using a five step, two stage land use planning process (Figure 1.3), combining thorough community and stakeholder consultation with evidence based analysis. The best available information was gathered through consultation, research, study and other sources, to support a systematic and rational approach to land use planning.

The Stage 1 planning process began in 2010 with preliminary public consultation. The Stage 1 plan was adopted by Council in October 2013. In 2015 the Stage 2 process was initiated, although delayed due to transportation impacts related to the Provincial transportation network. The final Stage 2 plan was endorsed by Council in early 2020.

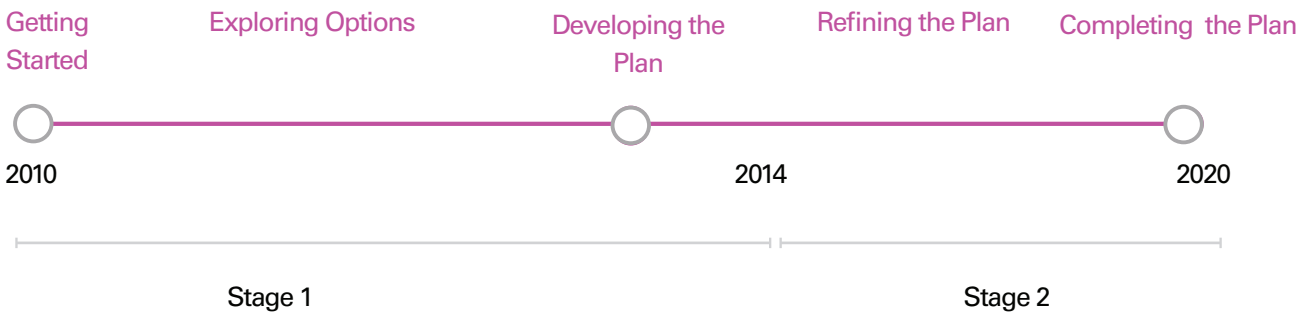


Figure 1.3 NCP Planning Process

1.5.1 Overview

PUBLIC CONSULTATION

An integrated community and multi-stakeholder approach was used to identify and prioritize land use planning principles and decisions. Efforts were taken to ensure a broad range of residents and stakeholders across the plan area and broader geography of Grandview Heights and Surrey were consulted. Engagement activities included open houses, online surveys, workshops, one-on-one meetings, interagency meetings, and advisory committees.

CITIZEN'S ADVISORY COMMITTEE

A Citizens' Advisory Committee (CAC) was formed and met regularly to provide advice and comments on the Plan as it was developed. The CAC included a cross-section of property owners from within the plan area, representatives from adjacent neighbourhoods, and citizens at-large representing the broader interests of the City.

PUBLIC OPEN HOUSE MEETINGS

Public open houses were held to gather broad public input throughout the NCP process, as follows:

- *May 12, 2010 - Open House #1*, to commence the NCP planning process and establish a Citizen's Advisory Committee;
- *May 3, 2011 - Open House #2*, to provide an opportunity for input on a draft vision and planning principles, and preliminary land use options for the area;
- *February 6, 2013 - Open House #3*, to review and provide input on the Stage 1 preferred land use plan and the preliminary servicing strategy; and
- *March 6, 2018 - Open House #4*, to review and provide input on the Stage 2 land use concept, transportation plan, design and development guidelines, and servicing/financial strategy.

INTER-AGENCY MEETINGS

Several meetings were held with an Inter-agency Committee comprised of representatives from utilities, third parties, Metro Vancouver, TransLink, and Provincial ministries (including the Agricultural Land Commission/Ministry of Agriculture and the Ministry of Transportation and Infrastructure). Regular meetings also took place with staff of the Surrey School District to ensure coordinated planning for schools in the area.

CITY ADVISORY COMMITTEES

At various stages throughout the planning process presentations to provide updates and receive ongoing feedback were made to the Agriculture & Food Security Advisory Committee (AFSAC), Heritage Advisory Commission (HAC), Development Advisory Committee (DAC), Environment & Sustainability Advisory Committee (ESAC), and the Transportation and Infrastructure Committee (TIC).

YOUTH ENGAGEMENT

A youth engagement exercise was hosted at a pre-teen dance at the South Surrey Recreation and Arts Centre, gathering feedback from more than 75 youths who participated in various activities. In addition, youth and young adults where consulted at the public open houses.

NAMING OF THE NCP

During the third open house, people were asked to identify a preferred name for the NCP area. Based on feedback from the public meeting and the CAC, "Redwood Heights" was selected as the name for this NCP Area. The iconic Redwood Park which is adjacent to the NCP area was significant in relation to this name along with the Surrey tradition of naming upland areas as "heights".

TIMELINE AND KEY MILESTONES

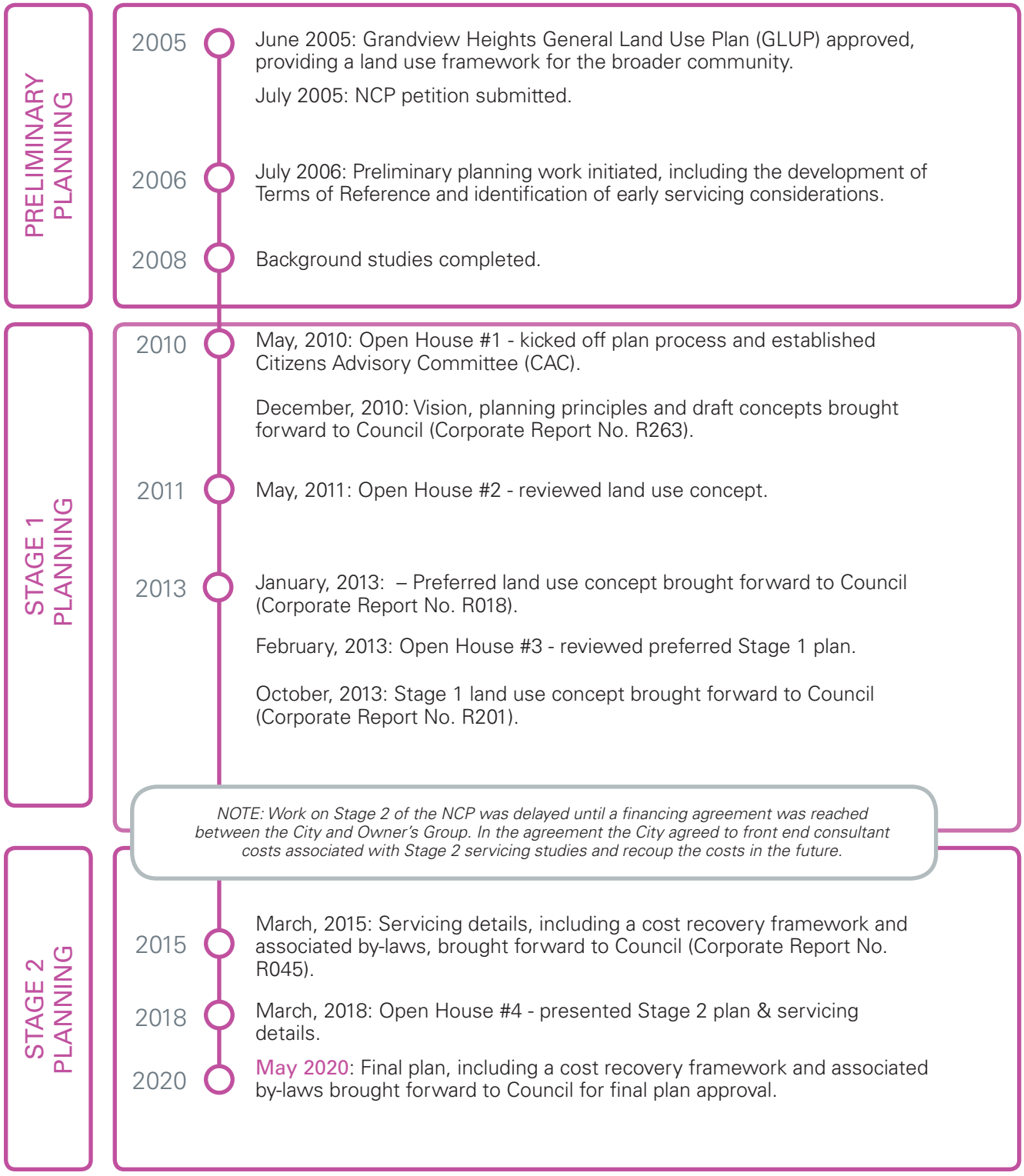


Figure 1.4 Timeline and Key Milestones

1.5.2 Background Studies

Background studies were undertaken to identify opportunities and challenges, providing context for the planning process. Studies included an environmental assessment and tree canopy survey, commercial market assessment and urban design and place-making study.

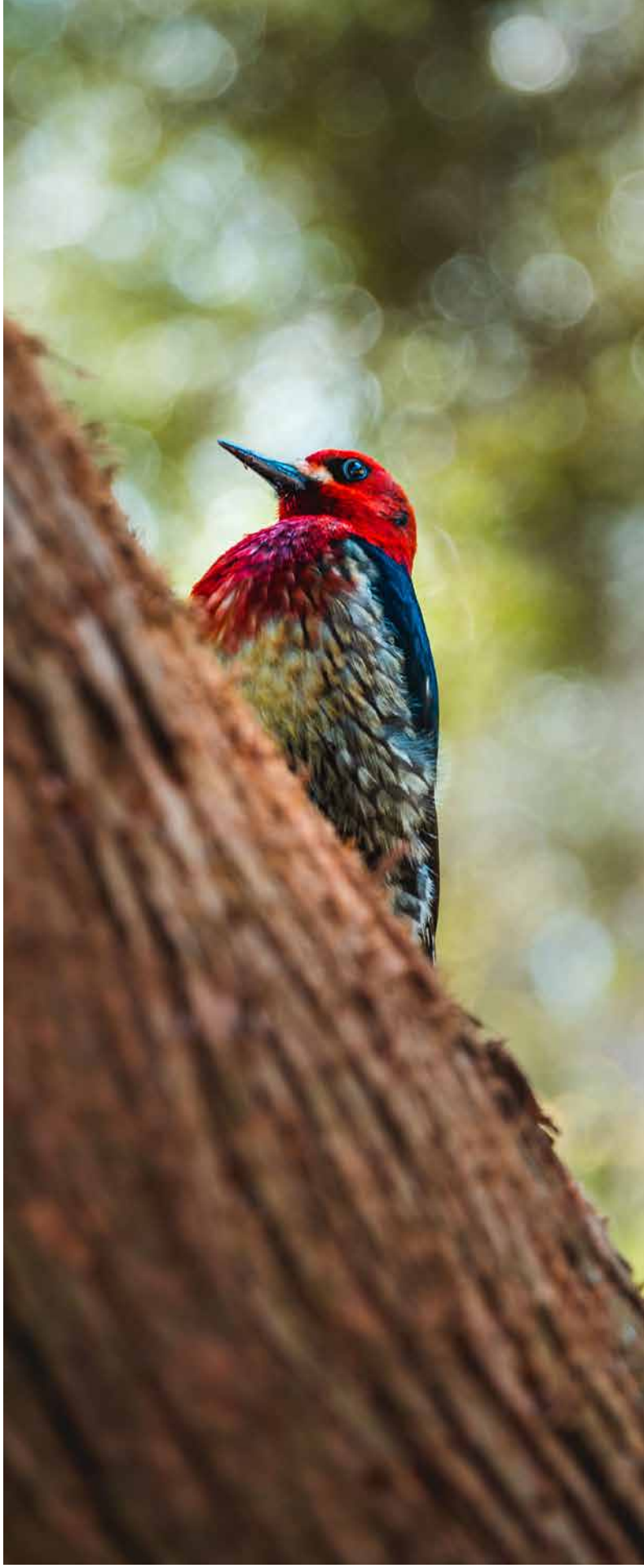
ENVIRONMENTAL ASSESSMENT & TREE SURVEY

In 2008, Madrone Environmental Services completed an environmental assessment and tree survey for the Grandview Heights community, including Redwood Heights. The objective of the study was to identify, classify, and inventory the significant environmental features and tree stands in the area. The study also provided recommendations for the preservation of important environmental features and sensitive ecosystems through development.

Since the completion of the report, changes have been made to the Water Sustainability Act and Riparian Areas Protection Regulation. In light of changes to both pieces of legislation, Dillon Consulting completed a wetland inventory and watercourse assessment and reviewed previous environmental assessments in the area. The Dillon report further informed future land uses in the area to ensure proposed developments are compliant with Provincial legislation and based on the most up to date environmental conditions.

COMMERCIAL MARKET ANALYSIS

Coriolis Consulting completed a study to estimate market demand for additional commercial development in Grandview Heights. Findings of the report suggested that the area could support one more major supermarket and some smaller commercial centres scattered throughout the neighbourhood. This additional commercial space could range from 200,000 to 400,000 square feet of retail and service space.



Section 2

I The Big Picture

Stakeholders and community members helped develop and refine the guiding elements and vision for Redwood Heights. The input and objectives captured throughout the planning process are reflected in the following plan framework.

2.1 COMMUNITY VISION

PLANNING THEMES

The foundation of the Redwood Heights plan is based on three key planning themes that emerged during community and stakeholder consultation:

THEME 1: A model neighbourhood for livability and habitat preservation.

THEME 2: A plan that can be practically implemented.

THEME 3: A diverse community with exceptional and unique character.

PLANNING VISION

> *"Redwood Heights is a healthy, sustainable and livable village with a diversity of housing types, inter-connected transportation choices and local amenities that serve a population of different ages and lifestyles.*

Redwood is centred on a mixed use commercial village that is easily accessible by cycling and walking and offers a range of commercial services, community amenities and vibrant gathering places.

The neighbourhood is characterized by its cherished natural areas and parks that provides ample outdoor spaces and protection of critical natural systems and wildlife habitat. The neighbourhood's relationships with surrounding communities is respectful and works to preserve and enhance the area's overall natural assets, fostering a unique sense of place.

Redwood is designed with innovation and quality to foster a place that is a happy and healthy 'home', embodied with community pride and spirit. The neighbourhood is a place that is safe and welcoming."

2.2 PLANNING PRINCIPLES

The following planning principles were developed to guide the implementation of this plan to ensure that resulting development is supportive of the vision of a healthy, sustainable and livable community.

HOUSING PRINCIPLES

1. Provide homes for a varied demographic and affordability range (seniors, young families, empty nesters, etc.).
2. Higher densities will be located near community amenities and services, within proximity to future transit services.
3. Development will foster a cohesive neighbourhood design through the implementation of urban design guidelines (see Section 3)
4. Transition density along the edge of the rural residential and agricultural areas.

TRANSPORTATION & MOBILITY PRINCIPLES

1. Cycling and walking opportunities will be prioritized to support active living and a healthy neighbourhood.
2. A finer grid road network will provide multiple choices for getting around enhancing connectivity.
3. Focused development density will support improved public transit.
4. Multi-modal connections will link the neighbourhood to adjacent communities and destinations (e.g. Redwood Park).
5. The former Great Northern Rail alignment around the edge of the neighbourhood will be converted into a regional greenway.
6. The transportation network will prioritize Vision Zero principles with a Safe Systems approach.

ENVIRONMENTAL PRINCIPLES

1. Biodiversity corridors and green spaces should be continuous and located in areas that best support & enhance biodiversity.
2. Maximize the amenity of riparian areas by providing adjacent public pathways.
3. Water courses will be protected with appropriate riparian setbacks and conveyed to the City for preservation and management.
4. Transitions (landscaping, buffering) will be provided along the edge of the Agricultural Land Reserve in keeping with Surrey Development Permit Guidelines.
5. A tree management, preservation and enhancement strategy will be incorporated into future developments.
6. The overall form of development will be compact to ensure land resources are used responsibly and efficiently.
7. Development will enhance biodiversity values through the use of landscaping that employs native plant species and the reestablishment of natural habitat.
8. Preserve or enhance natural view corridors.

COMMUNITY PRINCIPLES

1. Development will foster a safe community by being responsive to principles of Crime Prevention Through Environmental Design (CPTED).
2. Central gathering places will provide opportunities for neighbourhood celebrations, social interaction, place making and public art.
3. Neighbourhood parks should be provided within walking distance of all residents.
4. Parks should be located off busy arterial roads wherever possible.
5. Commercial areas should be easily accessible, within walking distance of most residences, and integrated with the community to contribute to neighbourhood placemaking.
6. A new elementary school site will be accessible from local or collector roads and have frontage on at least two roads.

SERVICING PRINCIPLES

1. The neighbourhood will be serviced to full urban standards in an efficient manner consistent with the overall servicing plan for the area.
2. Incorporate sustainable Low Impact Development standards (LID) and best management practices in the design of the neighbourhood where appropriate.
3. Ensure the overall storm water management system protects existing streams and downstream agricultural lowlands.
4. There will be neutral drainage impacts on the adjoining agricultural lands.

2.3 KEY FEATURES

There are a number of key features that will define the look and feel of the Redwood Heights community as it develops. These include:

Housing Variety: A range of housing including single family, townhouses and 4-6 storey apartment buildings.

Transit Focus: Transit supportive land uses and densities adjacent to roads where transit services are expected.

New School: A new public elementary school and potential private high school.

Mixed Use Commercial Village: A main street commercial village and a smaller neighbourhood node.

New Parks, Biodiversity Hub & Corridor: Eight new park sites and a network of natural areas to protect the existing watercourses and establish a large natural biodiversity hub and corridors.

Distinct Design Elements: Place-making elements including a gateway feature into the neighbourhood and special design features in the mixed-use commercial areas.

Active Transportation Network: Walking, cycling, and other active transportation modes will be facilitated by a network of cycling facilities and multi-use pathways to and from destinations and connecting to transit.

Figure 2.1 Key Features

2.4 GROWTH CONCEPT

PROTECTING NATURAL AREAS

An extensive parkland and green infrastructure network made up of hubs, corridors, and sites will:

- Protect environmentally sensitive areas such as wetlands, riparian areas and forested areas.
- Provide community and neighbourhood scale parks within walking distances of residents.

PROVIDING LOCAL AMENITIES

A central mixed-use commercial village and neighbourhood commercial node will:

- Support walkability within the Plan Area; and,
- Encourage a "Complete Community" with employment, entertainment, and services close to home.

ENHANCING HOUSING DIVERSITY

Areas of higher density development located around the neighbourhood centre and in close proximity to a future frequent transit corridor will:

- Improve the balance of housing types and affordability; and,
- Focus new housing within walking distance of amenities and public transit.

INTERFACING WITH RURAL NEIGHBOURS

Single family lots at the Plan Area's southern interface will:

- Provide valued single family housing;
- Transition with the existing rural designated lots in the Redwood Park Estates area.

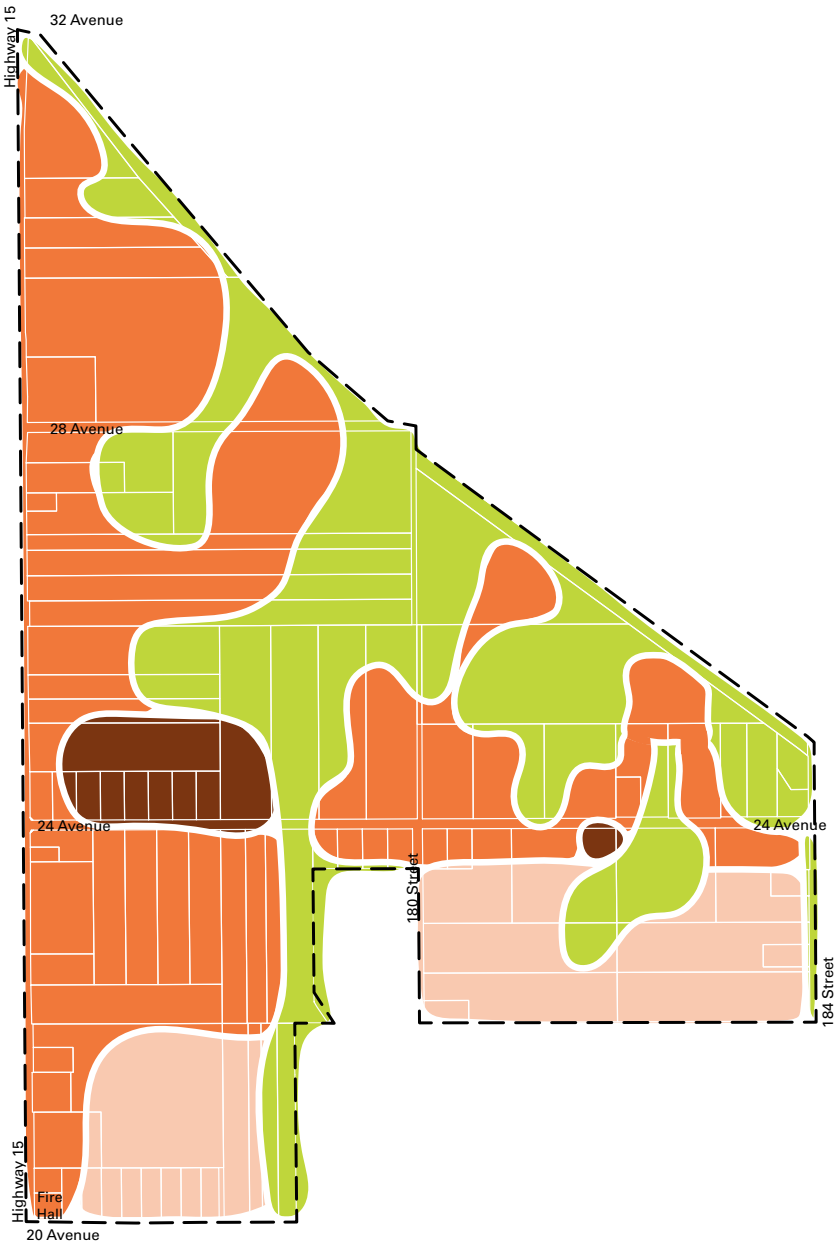


Figure 2.2 Growth Concept

2.5 GROWTH PROJECTIONS

2.5.1 Population and Unit Projections

The NCP includes 91hectares (225 acres) of future residential land and 4.45 hectares (11 acres) of land where residential units are allowed above commercial within mixed-use development. Together these designation areas account for about 42% of the gross NCP Area.

The NCP provides for an average of 5,300 dwelling units. Redwood Heights is estimated to support a future build-out population of over 13,500 people, based on a ratio of between 2.1 - 3.0 persons per dwelling unit (depending on housing type), and an assumed 1.45 persons per projected secondary suites in single family designated areas. This forecasts an average density of around 25 people per gross acre for the NCP, which is similar to the overall density of the adjacent Sunnyside Heights NCP area.

Redwood Heights is expected to account for approximately 22% of the population growth in Grandview Heights.

2.5.2 Student Projections

It is estimated that between 809 - 1,069 elementary students and 414 - 546 secondary students will be enrolled in the public school system from the NCP area once it's fully built out. The future demand for a new elementary school will be met by a new 80 / 525 capacity (nominal) school.

Student projections within the NCP are based on the highest number of units estimated and approximate build-out timeline, assuming 95% build-out by 2035. The School District model assumed a 63% participation rate in public school, which is the average participation rate in the Grandview Area, and assumes existing programs remain at East Kensington Elementary. Projections also take into account the impact of students attending choice programs in the District (i.e. French Immersion, Montessori, etc.).

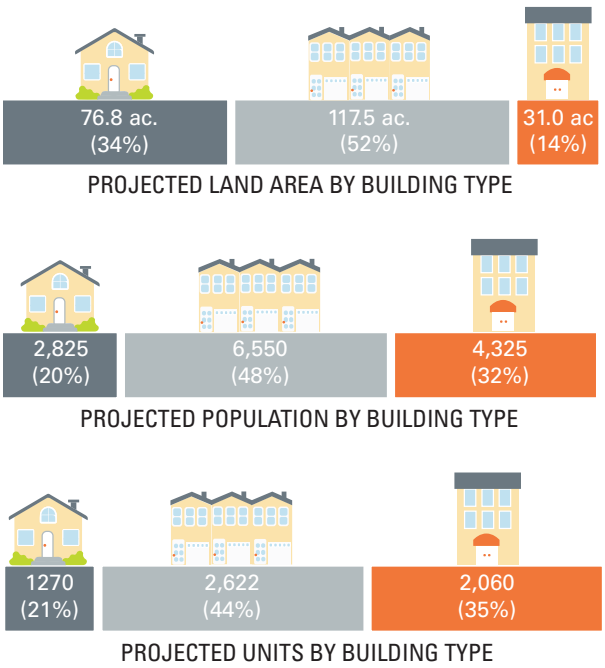


Figure 2.3 Projected Population and Units by Building Type

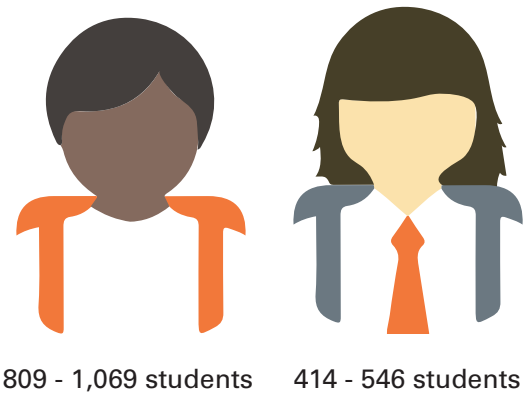


Figure 2.4 Projected Elementary and Secondary Students

2.5.3 Employment Projections

The NCP includes 4.45 hectares (11 acres) of mixed-use/commercial designations, including a main street commercial village and an ancillary neighbourhood commercial node. This accounts for about 2.1% of the NCP area. The larger main street commercial village area can accommodate approximately 11,150 square metres (120,000 square feet) of commercial space including a small (20,000-30,000 square foot) anchor store such as a drug store or grocery store and additional space for smaller retail shops and service commercial outlets. The smaller neighbourhood commercial node can accommodate approximately 1,000 square meters (11,000 square feet) of commercial space including small commercial retail units and offices (1,000-4,000 square feet).

It is estimated that these commercial and mixed-use areas will provide between 160 to 220 jobs within the NCP. Additional existing and proposed institutional uses, including future schools, will provide an additional 262 to 306 jobs.

REDWOOD HEIGHTS STAGE 2 - LAND USE CONCEPT PLAN PROJECTIONS

Land Use	Hectares (Acres)	Average Projected Residential Units	Average Projected Population	Average Projected Secondary Suites	Average Projected Secondary Suite Population	Total Average Projected Units including Suite Units	Total Average Projected Population with Suites
Institutional	14.4 ha (35.6 ac)	0	0	0	0	0	0
Residential Transition	5.9 ha (14.7 ac)	44	132	44	64	88	196
Cluster Residential	12.4 ha (30.7 ac)	245	736	245	356	491	1,092
Detached Residential	12.7 ha (31.4 ac)	346	1,037	346	501	691	1,538
Semi-Detached	1.9 ha (4.8 ac)	71	178	0	0	71	178
Flex (Multiple Residential or Detached Residential)	3.0 ha (7.5 ac)	113	281	0	0	113	281
Multiple Residential	24.6 ha (60.8 ac)	1,218	3,045	0	0	1,218	3,045
Townhouse	17.9 ha (44.4 ac)	1,220	3,051	0	0	1,220	3,051
Low Rise Apartment	7.9 ha (19.7 ac)	1,378	2,894	0	0	1,378	2,894
Mixed Use Apartment	4.6 ha (11.4 ac)	682	1,432	0	0	682	1,432
TOTAL	**105.3 ha (260.2 ac)**	**5,317**	**12,786**	**635**	**921**	**5,952**	**13,706**

Table 2.1 Land Use Concept Plan Projections / *Calculations are based on the average projections

Section 3

How We Grow

The land use strategy reflects the vision and principles of the plan, providing direction on the form and character of Redwood Heights as it grows. Land use designations guide where and how homes, shops, pathways, parks, and natural areas fit together to create a complete community. Council, staff and residents expect future development to correspond with this concept plan.

3.1 URBAN DESIGN STRATEGY

3.1.1 Neighbourhood Design

The development of Redwood Heights will be the result of careful planning and thoughtful design. A coordinated neighbourhood design will promote a high quality of life for residents while protecting natural features and habitat.

Land Uses have been developed to foster a compact transit-supportive urban form where environmental habitat and landscapes are preserved and integrated throughout Redwood Heights. Parks, natural areas, and pathways will provide opportunities for recreation and active transportation while enhancing wildlife connectivity.

New development will recognize and integrate the unique natural and pastoral landscape. Form and character will be guided by urban design guidelines outlined within each land use designation. All development should adhere to the following general neighbourhood design guidelines:

DESIGN

The overall design of the neighbourhood will draw from a foundation of environmental preservation and integration.

1. Foster cohesive neighbourhood design through respectful integration of common design styles and complementary transitional scales.
2. Architectural design will reflect the natural heritage of Redwood Heights through the use of natural materials such as wood, brick, and stone.
3. Common architectural and landscape elements should complement the surrounding environment.
4. Visual interest along streets should be provided with active building frontages, landscaping, and high quality building details.
5. The City's Biodiversity Design Guidelines will be integrated into buildings and landscaping.
6. Development will prioritize native species of plants and trees (e.g. Douglas Fir, Big Leaf Maple, and Red Alder), including significant native conifer plantings within on-site landscaping.
7. On-site stormwater management will consider natural drainage to minimize risk and flooding.
8. Contemporary architecture with traditional forms and materials is encouraged.

BUILDING SITING, HEIGHT, AND MASSING

1. Existing natural features should be preserved and integrated within development.
2. Site buildings in a manner that is sensitive and responsive to the existing local ecology.
3. Provide generous setbacks to include natural features, landscaping, and trees.
4. Create enjoyable, functional open spaces that take advantage of natural light.
5. Buildings should optimize views towards streets and public spaces as well as existing natural landscape features.
6. Promote neighbourhood safety and sociability by designing for overlook and activity along streets, pathways, and natural areas.
7. Reduce scale and design lower floors of multi-storey residential buildings to be in scale with the pedestrian environment.
8. Thoughtful placement of doors, windows, decks, and patios should maintain privacy of adjacent dwellings.

BUILDING MATERIALS

1. Use materials that reduce energy use and waste while maximizing the life of the building.
2. Whenever possible, local and regional native and natural materials (e.g. stone and wood) that are durable should be used.
3. Structural expression is encouraged using mass timber.
4. Colour palettes should be inspired by the region's existing natural environment.

3.1.2 Gateway and Entrance Treatment Area Requirements

Contribute to the unique neighbourhood character with special design treatment along 24 Ave at the Mixed Use Commercial Village and Commercial Node.

Development in these areas should incorporate the following design features:

- "Landmark" buildings with signature architecture, enhanced massing, height, and public realm features that defines the intersection;
- Unique building corner features that create a strong presence onto the streetscape;
- Public art;
- Pedestrian ornamental lighting;
- Coordinated streetscape furniture (i.e. benches, bike racks etc.);
- Coniferous trees accentuating immediate gateway area;
- Ornamental tree grates, such as with 'Redwood Heights' text embedded; and,
- Specialty paving such as coloured stamped asphalt and/or concrete.

Figure 3.1 Gateway and Entrance Treatment Area

3.1.3 Five and Six Storey Development Requirements

Low rise mixed-use and residential developments with building heights greater than 4 storeys are required to demonstrate design feasibility through the following analysis:

SERVICING STUDY

A servicing feasibility study to demonstrate that municipal services (water, sanitary sewer, storm drainage, roads and fire suppression) can accommodate the proposed development.

TRAFFIC IMPACT ASSESSMENT

A traffic study to address pedestrian and vehicular movements of the proposed development, including off-street parking arrangements and ingress/egress to the site.

GEOTECHNICAL STUDY

A geotechnical study to demonstrate that the site is suitable for the proposed development.

SUSTAINABLE DEVELOPMENT SUMMARY

A summary outlining sustainable and energy efficient building practices and technology being used.

VIEW IMPACT ANALYSIS

A view impact analysis to reduce impact on views down road corridors, and to and from the ALR.

3.2 LAND USE STRATEGY

Future development and land uses will define the look and feel of Redwood Heights and contribute to the ultimate sense of place of the neighbourhood. Mixed land uses are centered on a main street (24A Avenue) commercial village which is supported by apartment residential and street level commercial. A range of housing, transitioning in density away from 24 Avenue, provides variety in unit types and tenure. Densities along 24 Avenue and new collector roads will support more frequent transit service.

A new elementary school and community level park are centrally located to serve the broader neighbourhood and offer community amenities within walking distance of the highest density residential areas. A biodiversity corridor adjacent to the school provides key north-south habitat connectivity through the plan area, linking Redwood Park to a protected biodiversity hub in the central north portion of the plan area. These areas also support portions of a neighbourhood-wide greenway and pathway network which encourages active transportation and links to additional new parks and natural areas across Redwood Heights.

Low Rise Mixed Use

Low rise apartments with ground-oriented commercial space.

DENSITY RANGE
Up to 2.0 FAR

TYPICAL HEIGHTS
5-6 storeys.

TYPICAL OWNERSHIP
Strata or Rental

Low Rise Residential

Multi-family housing with ground-oriented units at base.

DENSITY RANGE
Up to 2.0 FAR

TYPICAL HEIGHTS
4-6 storeys.

TYPICAL OWNERSHIP
Strata or Rental

Townhouse Residential

Ground oriented townhouses.

DENSITY RANGE
Up to 75 UPH (30 UPA)

TYPICAL HEIGHTS
13.0 m.

TYPICAL OWNERSHIP
Strata

Multiple Residential

Wider / larger townhouses or row housing

DENSITY RANGE
Up to 55 UPH (22 UPA)

TYPICAL HEIGHTS
9.0 - 11.0 m.

TYPICAL OWNERSHIP
Strata or Fee Simple

Semi-Detached Residential

Duplex or lower density fee-simple row housing.

DENSITY RANGE
Up to 37 UPH (15 UPA)

TYPICAL HEIGHTS
9.5 m.

TYPICAL OWNERSHIP
Fee Simple (Free Hold)

Cluster Residential

Mix of detached single family, detached, and multiple residential cluster to protect natural areas.

DENSITY RANGE
Up to 25 UPH (10 UPA)

TYPICAL HEIGHTS
9.0 m.

TYPICAL OWNERSHIP
Strata or Fee Simple

Detached Residential

Narrow / wide front or rear loaded detached houses.

DENSITY RANGE
Up to 30 UPH (12 UPA)

TYPICAL HEIGHTS
9.0 m.

TYPICAL OWNERSHIP
Fee Simple (Free Hold)

Residential Transition

Larger suburban detached lots

DENSITY RANGE
Up to 10 UPH (4 UPA)

TYPICAL HEIGHTS
9 m.

TYPICAL OWNERSHIP
Fee Simple (Free Hold)

Institutional

Public and private community spaces such as churches, universities, schools, museums, libraries and community centres.

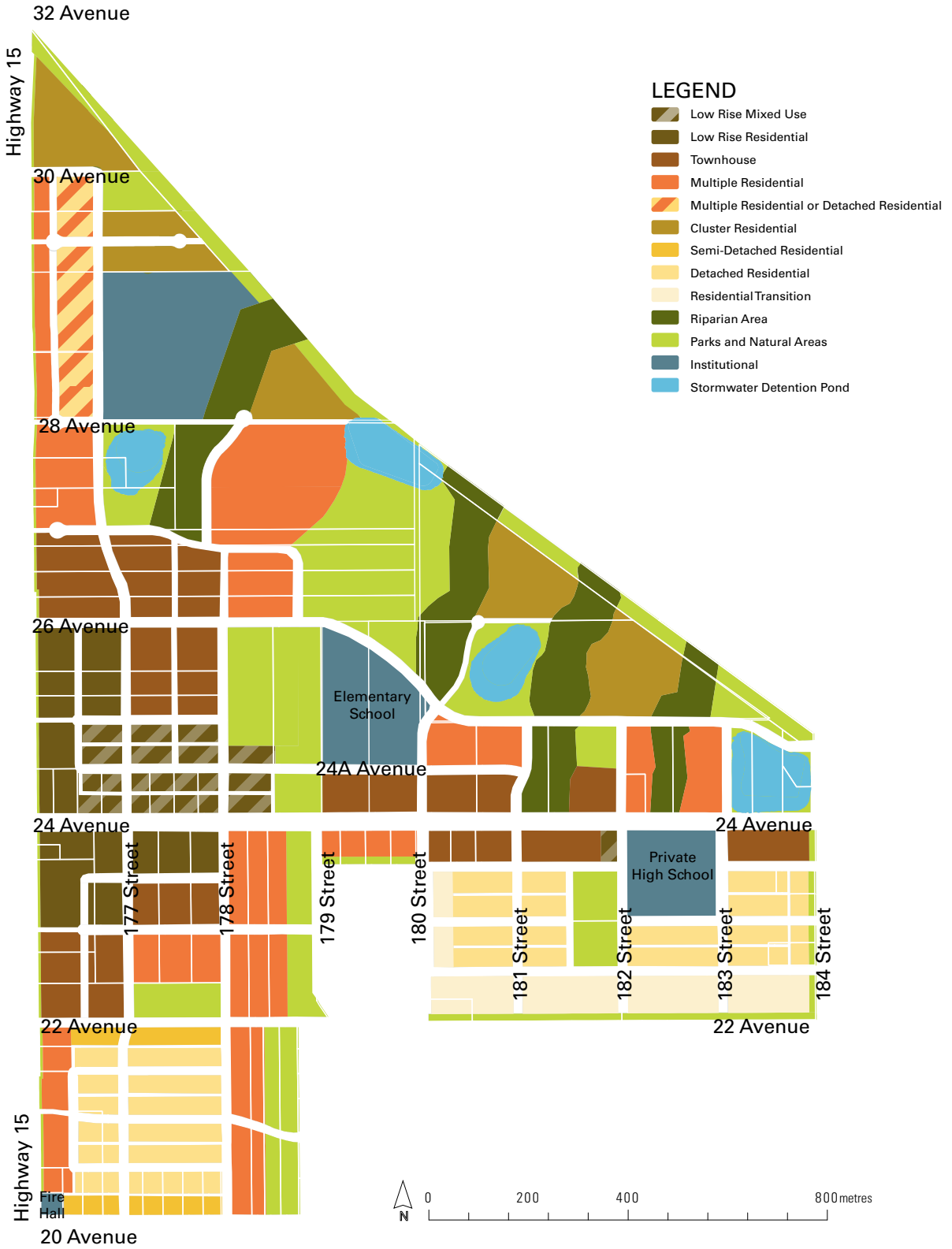


Figure 3.2 Land Use Map

Figure 3.3 Graphic Illustration of Redwood Heights at Full Build Out

LAND USE DESIGNATION SUMMARY

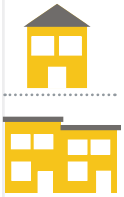
Land Use Plan Designation	 Residential Transition	 Cluster Residential	 Detached Residential	 FLEX: Detached or Multiple Residential	 Semi-Detached Residential	 Multiple Residential	 Townhouse Residential	 Low Rise Residential	 Low Rise Mixed Use
Typical Density	Up to 10 UPH (Up to 4 UPA)	Up to 25 UPH (10 UPA)	Up to 30 UPH (12 UPA)	Up to 30 or 55 UPH (Up to 12 UPA or 22 UPA)	Up to 37 UPH (15 UPA)	Up to 55 UPH (22 UPA)	Up to 75 UPH (30 UPA)	Up to 2.0 FAR	Up to 2.0 FAR
Typical Ownership	Fee Simple (Free Hold)	Strata or fee simple	Fee Simple (Free Hold)	Fee Simple or Strata	Fee Simple (Free Hold)	Strata or Fee Simple	Strata	Strata or Rental	Strata or Rental
Typical Building Forms	Larger suburban detached lots	Mix of detached single family, attached, and multiple residential cluster to protect natural areas	Narrow/ wide front or rear loaded detached houses	Single detached lane served houses or townhouses	Duplex or lower density fee-simple row housing	Wider/larger townhouses or row housing	Ground oriented townhouses	Low rise apartments with ground oriented units at street level	Low rise apartments above ground oriented commercial
Typical Heights	9.0 m.	9.0 m.	9.0 m.	9.0 - 11.0 m.	9.5 m.	9.0 - 11.0 m	13.0 m	4-6 Storeys	5-6 Storeys
Total Area	5.9 ha (14.7 Acres)	12.4 ha (30.7 ac)	12.7 ha (31.4 ac)	3.0 ha (7.5 ac)	1.9 ha (4.8 ac)	24.6 ha (60.8 ac)	17.9 ha (44.4 ac)	7.9 ha (19.7 ac)	4.6 ha (11.4 ac)
% of Residential Area	2.7%	5.7 %	5.8 %	1.4 %	0.9 %	11.3 %	8.3 %	3.7 %	2.1 %

Table 3.1 - Residential Land Use Designation Summary

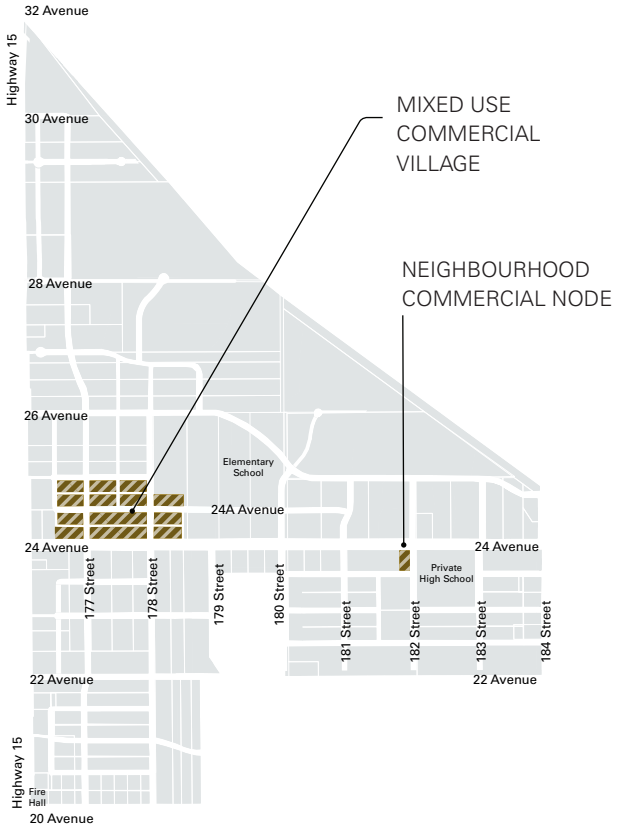
3.3 MIXED-USE DESIGNATIONS

Two commercial mixed-use areas are designated in the plan: a central mixed-use commercial village along 24A Avenue, between 177 Street and 178 Street, and a smaller neighbourhood commercial node area at the 24 Avenue and 182 Street.

The mixed-use village is the primary centre for Redwood Heights and will support a variety of uses such as a grocery store, neighbourhood pub, restaurant, drug store, financial institution, and other commercial retail/office uses.

The neighbourhood commercial node will supplement the mixed use village to provide commercial uses within walking distance of the surrounding neighbourhood.

Both the mixed-use village and commercial node will provide public plazas as publicly accessible open space (Refer to Figures 3.1 and Section 5.4)



DEVELOPMENT PARAMETERS:

	Type 1: Mixed Use Commercial Village	Type 2: Neighbourhood Commercial Node
Intent	Community servicing retail, commercial and office with the option for residential on upper floors.	Neighbourhood serving ground-oriented commercial with the option for apartments above.
Typical Zone	C-15, RM-45, RM-70, CD	C-5, RM-45, RM-70, CD
Typical Density	Up to 2.0 FAR	Up to 2.0 FAR
Maximum Height	Up to 6 storeys	Up to 5 storeys; 4 storeys adjacent to residential uses
Typical Lot Coverage	50% +	30-50%
Parking	Underground parking	All resident parking spaces underground. No parking is permitted in the front of the building.
Cellular Infrastructure	Locate roof top equipment – HVAC Units, antennas, etc – so that it is not visible from the adjacent streets or public spaces. Provide screening when necessary. Screening should be designed to be integrated into the building form (e.g. adjacent or on top of the elevator overrun) and constructed of a material complementary to the building architecture.	
Note	Commercial at grade, residential or office above. Rezoning and development permit applications should include a minimum development area not less than 2.0 ha (4.9 ac). A smaller minimum development area will be considered only where adjacent properties are developed or under application. The first application should provide an overall comprehensive development plan. Building design and site layout should be included in the overall comprehensive development plan.	

DESIGN GUIDELINES

Form & Massing	• Buildings on 24A Avenue should reinforce the vision for a commercial 'high street' to anchor village retail. • Signature buildings should define the intersections, serving as the entrance to the village core and to mark the arrival at the centre of Redwood Heights. • Laneways should be in the middle of blocks to separate back-of-house activities from the commercial frontage reserved for the street interface. • A system of publicly accessible pedestrian spaces (pedestrian corridors, small plazas, etc.) should be integrated into private development. • Ensure commercial viability with a minimum commercial retail unit depth of 11 m, and convenient access to loading and garbage, separate from residential. • Sensitive height and massing should be considered for buildings adjacent to the future elementary school. • Set back above the fourth storey or design upper storeys to reduce the impact of visual bulk.
Building Interface	• Front primary commercial and retail frontages towards the street. • Locate anchor tenant(s) with their entrances facing onto the 'high street' and adjacent intersections. Anchor tenants should not dominate the street frontage, instead smaller retail units should share street frontage onto the 'high street'. The majority of storefronts on the 'high street' should be small scale commercial with individualized storefronts. • Avoid locating back-of-house activity towards the street. • Buildings should have entries flush with the sidewalk for ease of access between the retail space and the street. • Retail and restaurant uses should occupy the ground floor of mixed-use buildings, with offices, commercial or residential uses on upper floors. • Residential and associated indoor amenity spaces can not be located on the ground floor except for lobby entrances. • Integrate outdoor seating areas into the overall design of the village. • Locate entries to mixed use multi-family residential lobbies on non-retail street if available, with entries flush with the adjacent sidewalk. Grade transitions should be internalized inside the lobby. Where entries to residential uses must occur within a retail streetscape, the frontage must be minimized, yet distinguished from the commercial treatment. • Provide street facing commercial development at minimum setbacks. • Street-fronting building facades, balconies and floor edges, should be flush with the ground floor, except that the uppermost storey for buildings with more than 4 storeys, should be set back. • Where there is no commercial retail at grade, include two storey townhouse expression for residential units at grade on street interfaces. • Provide continuous weather protection along all commercial frontages with a minimum projection of 1.5 m. Canopies may not project over the property line. • Ground level residential units should include porches and stairs with weather protection over top. Direct access from the porch to the adjacent sidewalk should be provided. Each ground level residential unit should set its floor elevation between 0.6 m to 1.2 m above the adjacent sidewalk level
Setbacks	• Setbacks in the commercial area should be a minimum of 2.0 metres to create an intimate neighbourhood feel and allow for protection (awnings). • Building floors should not encroach into the setbacks along the streets, neither ground level nor above.
Materiality & Detailing	• Use contemporary architectural forms treated in traditional building materials (such as, brick, high quality masonry, wood and glass). • Feature fabric awnings (not vinyl) to create a less formal appearance. Awnings should have slope (approximately 30 degrees) generally consistent between properties. • Have storefronts that feature different design elements and materials and are not simply comprised of an aluminum storefront glazing system. Colonnades or overly deep recessed glazing should be avoided.
Signs	• Primary retail signage should be simple fascia signs. • Emphasize variety and interest for pedestrians, include attractive pedestrian scale under canopy suspended signage. • Back-lit sign boxes are not supported.

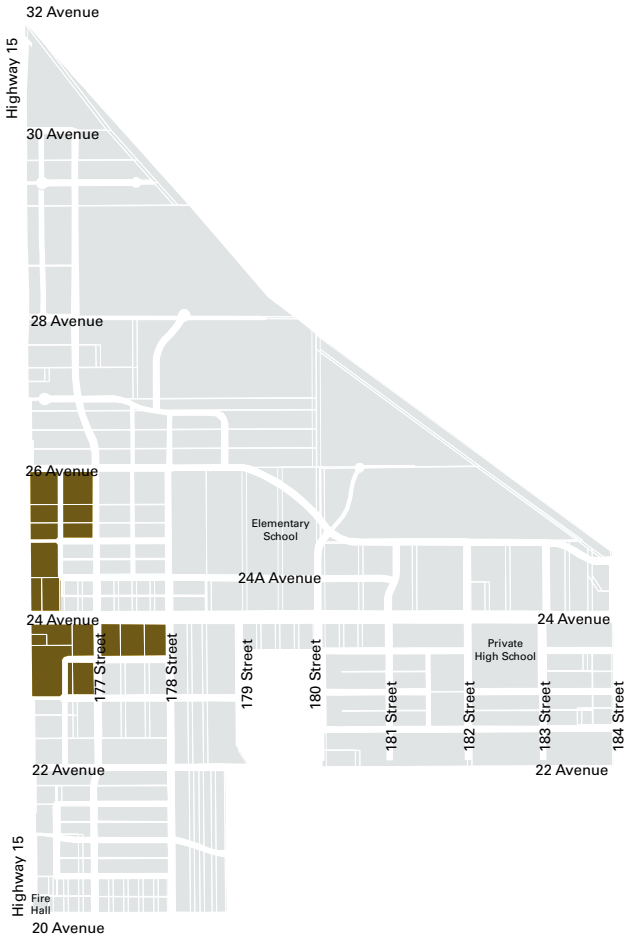
3.4 Residential Designations

3.4.1 Low Rise Residential

Areas of higher density development are generally located around the neighbourhood centre, in close proximity to a future frequent transit corridor along 24 Avenue, and adjacent to Highway 15.

The highest density areas are envisioned as six storey apartment buildings adjacent to the main street commercial village.

Development within this designation adjacent to the Mixed Use Commercial Village may be suited for at-grade retail at key intersections and along key street frontages.



DEVELOPMENT PARAMETERS:

Intent	Low rise apartment buildings with related amenity spaces. In combination with the apartment buildings, some ground-oriented stacked townhouses may also be permitted subject to comprehensive development.
Typical Zone	RM-45, RM-70, CD
Typical Density	Maximum FAR of 2.0
Typical Coverage	35-45%
Maximum Height	Up to 6 storeys
Parking	Resident parking spaces should be provided as underground parking or as parking within the building envelope. No parking should be visible from the street or permitted in the front of the building of a multiple unit residential building.
Cellular Infrastructure	For apartment buildings 4 storeys or greater locate roof top equipment – HVAC Units, antennas, etc – so that it is not visible from the adjacent streets or public spaces. Provide screening when necessary. Screening should be designed to be integrated into the building form (e.g. adjacent or on top of the elevator overrun) and constructed of a material complementary to the building architecture.
Note	Walkability and pedestrian access are key considerations. Provide a range of unit sizes from 1-3 bedrooms.

DESIGN GUIDELINES

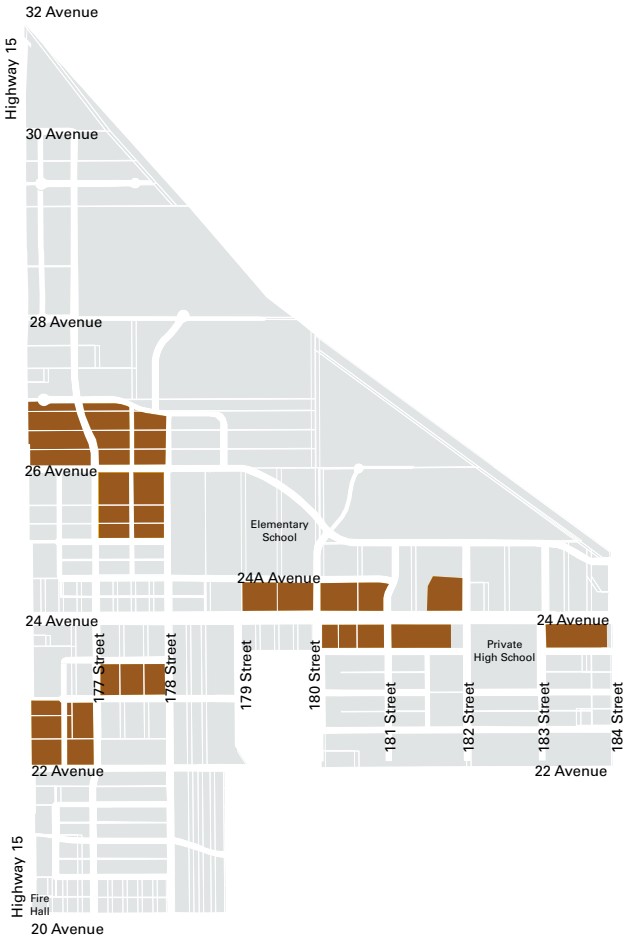
Form & Massing	• Contemporary architecture with traditional forms and materials are encouraged. • Site buildings to achieve privacy and enjoyable open space between them. Buildings should be separated by at least 20 m between front and rear view faces and 8.0 m between side faces. • Visually scale down buildings to a length of 50 metres. Add scale and visual interest at street level by articulating the building facade or changing building cladding material. • If applicable, step back above the fourth storey or design the upper storeys to reduce the impact of visual bulk where interfacing with lower density area.
Building Interface	• Design lower floors to be in scale with the pedestrian environment. • Where facing the public realm, provide a two to three storey visual exterior expression of townhouses at the base of the building to engage and create street life. • Frame development sites with built edges against all streets. • Extended porches and recessed entries should be used to articulate facades and reinforce residential character. • Non-active uses such as indoor amenity rooms and service spaces should be located away from street interfaces of any prominent frontage. • Indoor and outdoor amenity areas should be located together to ensure they can be used at the same time.
Setbacks	• Provide a minimum street frontage setback of 5.0 m to incorporate landscaping, natural features and trees. • Provide additional building setback and landscaped buffering along Hwy 15 in keeping with Section 3.6 Urban Transition Areas (Transition 3.6.1). • Front yard fencing is discouraged, however; if proposing, set back at least 1.0 m from the property line and pair with layered landscaping in front. Fencing should be no more than 0.9 m in height.
Materiality & Detailing	• Materials should vary from building to building to provide variation and diversity in the streetscape. Limit the number of materials used within a single building. • Use simple window configurations.

** Refer to the OCP Guidelines for Form and Character Development Permits. Where there is a conflict between NCP and OCP guidelines, the NCP's Guidelines take precedence.*

*** Street level commercial may be considered within this designation where adjacent to the Mixed Use Commercial Village. In such cases, consideration may also be given to the design parameters and guidelines within the Low Rise Mixed Use designation.*

3.4.2 Townhouse Residential

This designation is intended to accommodate urban townhouses in areas adjacent to major roads and around the mixed use commercial village. Typical developments consist of attached buildings that house multiple ground-oriented dwelling units with shared indoor and outdoor amenity spaces.



DEVELOPMENT PARAMETERS:

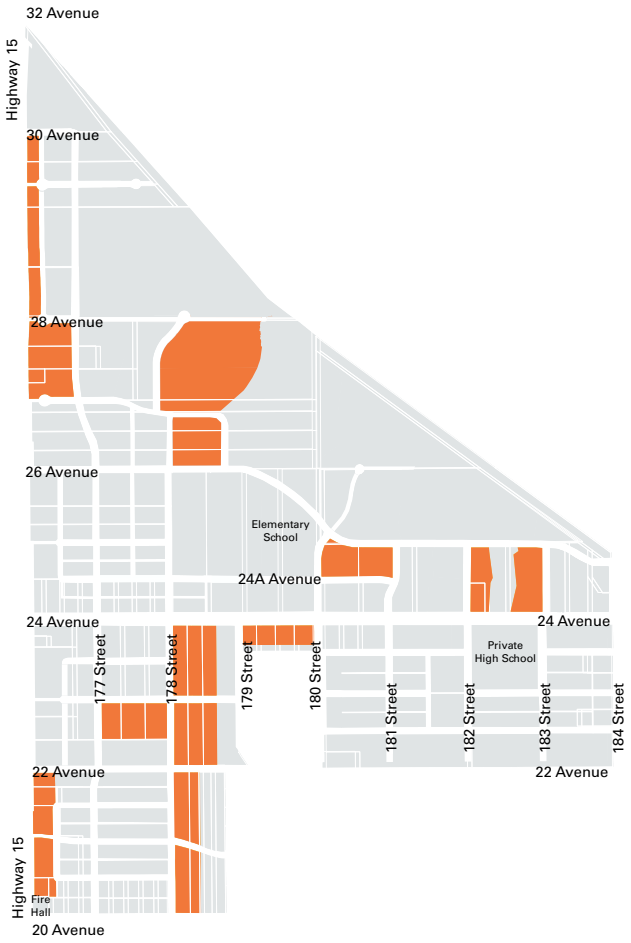
Intent	Ground-oriented multiple residential townhouse buildings and related amenity spaces developed in accordance with a comprehensive design.
Typical Zone	RM-30.
Typical Density	Maximum FAR of 1.0. Up to 75 UPH (30 UPA)
Parking	Vehicle access restricted to a rear lane.
Note	Homes adjacent to Highway 15 will be separated by a 15 metres (50 ft) wide landscaped buffer to mitigate impacts from the highway traffic.

Form & Massing	• Simple traditional architecture with verandas and porches are encouraged. • Minimum 3 attached units; maximum of 6 units per building, to create a comfortable neighbourhood scale. • Roof top decks are encouraged. • Extended porches and recessed entries should be used to articulate facades and reinforce residential character. • Design lower floors to be in scale with the pedestrian environment. • Reduce scale by visually receding upper storeys. • Vertical expression and identification of individual units should be emphasized while reinforcing a unified character.
Building Interface	• A separate entry porch to each unit should be expressed at the street level with weather protection over each entrance. • Corner units with street frontage should equally treat all street exposed sides as a primary facade, showing articulation, windows and doors. Avoid blank walls, while maximizing window opportunities. • Pairing of doors and shared porches is discouraged, in favour of split doors and separated roof overhangs. • Front doors and porches should face the street with steps leading straight to the street (not turned). • Individual entrances should be complemented with landscaping including a tree. • Shrubs and low hedges should be used in lieu of front yard fencing. If fencing is proposed, set fencing back 1.0 metre beyond the sidewalk and provide landscaping in front. Low fences (0.9 m height) between units will be permitted. • Avoid raised front yards. If necessary, they will only be permitted if associated retaining walls are faced with high quality materials in character with the architecture of the building and landscaping is provided. Required landscaping includes a minimum of 1.0 metre of irrigated landscaping directly in front of the base (sidewalk adjacent) and 0.5 metres of irrigated landscaping at the top of the retaining wall, in front of any fencing or guard rails. Retaining walls are limited to 0.6 metres in height. Tiered landscaping will be required for any retaining wall interfaces over 0.6 metres in height. • Avoid placing balconies directly above the porch to retain the sense of entry at ground level. • Active living spaces, such as living, dining rooms and kitchens, should face the street with overlooking windows at grade. Private bedrooms should be located on upper floors or away from unit frontages. • Main floor elevations should be set between 0.6 to 1.2 metres above the adjacent sidewalk grade. Step main floor elevation between units to follow the sidewalk grade.
Setbacks	• Provide a minimum street frontage setback of 5.0 m to incorporate landscaping, natural features and trees. • Provide additional building setback and landscaped buffering along Hwy 15 in keeping with Section 3.6 Urban Transition Areas (Transition 3.6.1). • Provide 1.5 - 2.0 m driveway aprons to include trees along drive aisles between garages. • There should be at least one tree in each individual unit's yard.
Materiality & Detailing	• Building materials should be durable and of high quality. • Design of buildings should encourage noise mitigation strategies such as building orientation, the number and locations of windows, dense landscaping, and construction details such as triple-glazed windows and sound barrier insulation. • Use simple, thoughtful detailing including intentional transitions between materials. • Historic details such as brackets and gable vents are discouraged.
Signs	• Freestanding signs are discouraged. Incorporate address into architectural landscape features.

** Refer to the OCP Guidelines for Form and Character Development Permits. Where there is a conflict between NCP and OCP guidelines, the NCP's Guidelines take precedence.*

3.4.3 Multiple Residential

This designation is intended to accommodate medium density townhouses and fee simple row houses. Townhouses and rowhouses provide an affordable alternative to detached housing. Two different types of development will be considered within this designation.



DEVELOPMENT PARAMETERS:

	Type 1	Type 2
Intent	Low density, ground-oriented strata townhouse buildings and related amenity spaces which are to be developed in accordance with a comprehensive design.	Fee simple attached row housing on lots contained in a multiple residential building with sharing party walls.
Typical Zone	CD based on RM-15 or RM-30	RM-23.
Typical Density	Up to 55 UPH (22 UPA)	Up to 55 UPH (22 UPA).
Typical Height	11 m.	9.5 m.
Typical Lot Width		6.3 m.
Parking	No tandem parking spaces permitted. Parking access only from strata lane.	Parking garages in the rear of lot with access provide by public lane.
Typical Floor Area		140 sm (1,500 sf).
Note	Homes adjacent to Highway 15 will be separated by a 15 metres (50 ft) wide landscaped buffer to mitigate impacts from the highway traffic.	Homes adjacent to Highway 15 will be separated by a 15 metres (50 ft) wide landscaped buffer to mitigate impacts from the highway traffic.

DESIGN GUIDELINES

Form & Massing	• Simple traditional architecture with verandas and porches are encouraged. • Minimum 3 attached units; maximum of 6 units per building, to create a comfortable neighbourhood scale. • Roof top decks are encouraged. • Extended porches and recessed entries should be used to articulate facades and reinforce residential character. • Design lower floors to be in scale with the pedestrian environment. • Reduce scale by visually receding upper storeys. • Vertical expression and identification of individual units should be emphasized while reinforcing a unified character.
Building Interface	• A separate entry porch to each unit should be expressed at the street level with weather protection over each entrance. • Corner units with street frontage should equally treat all street exposed sides as a primary facade, showing articulation, windows and doors. Avoid blank walls, while maximizing window opportunities. • Pairing of doors and shared porches is discouraged, in favour of split doors and separated roof overhangs. • Front doors and porches should face the street with steps leading straight to the street (not turned). • Individual entrances should be complemented with landscaping including a tree. • Shrubs and low hedges should be used in lieu of front yard fencing. If fencing is proposed, set fencing back 1.0 metre beyond the sidewalk and provide landscaping in front. Low fences (0.9 m height) between units will be permitted. • Avoid raised front yards. If necessary, they will only be permitted if associated retaining walls are faced with high quality materials in character with the architecture of the building and landscaping is provided. Required landscaping includes a minimum of 1.0 metre of irrigated landscaping directly in front of the base (sidewalk adjacent) and 0.5 metres of irrigated landscaping at the top of the retaining wall, in front of any fencing or guard rails. Retaining walls are limited to 0.6 metres in height. Tiered landscaping will be required for any retaining wall interfaces over 0.6 metres in height. • Avoid placing balconies directly above the porch to retain the sense of entry at ground level. • Active living spaces, such as living, dining rooms and kitchens, should face the street with overlooking windows at grade. Private bedrooms should be located on upper floors or away from unit frontages. • Main floor elevations should be set between 0.6 to 1.2 metres above the adjacent sidewalk grade. Step main floor elevation between units to follow the sidewalk grade.
Setbacks	• Provide a minimum street frontage setback of 5.0 m to incorporate landscaping, natural features and trees. • Provide additional building setback and landscaped buffering along Hwy 15 in keeping with Section 3.6 Urban Transition Areas (Transition 3.6.1). • Provide 1.5 - 2.0 m driveway aprons to include trees along drive aisles between garages. • There should be at least one tree in each individual unit's yard.
Materiality & Detailing	• Building materials should be durable and of high quality. • Design of buildings should encourage noise mitigation strategies such as building orientation, the number and locations of windows, dense landscaping, and construction details such as triple-glazed windows and sound barrier insulation. • Use simple, thoughtful detailing including intentional transitions between materials. • Historic details such as brackets and gable vents are discouraged.
Signs	• Freestanding signs are discouraged. Incorporate address into architectural landscape features.

** Refer to the OCP Guidelines for Form and Character Development Permits. Where there is a conflict between NCP and OCP guidelines, the NCP's Guidelines take precedence.*

3.4.4 Semi-Detached Residential

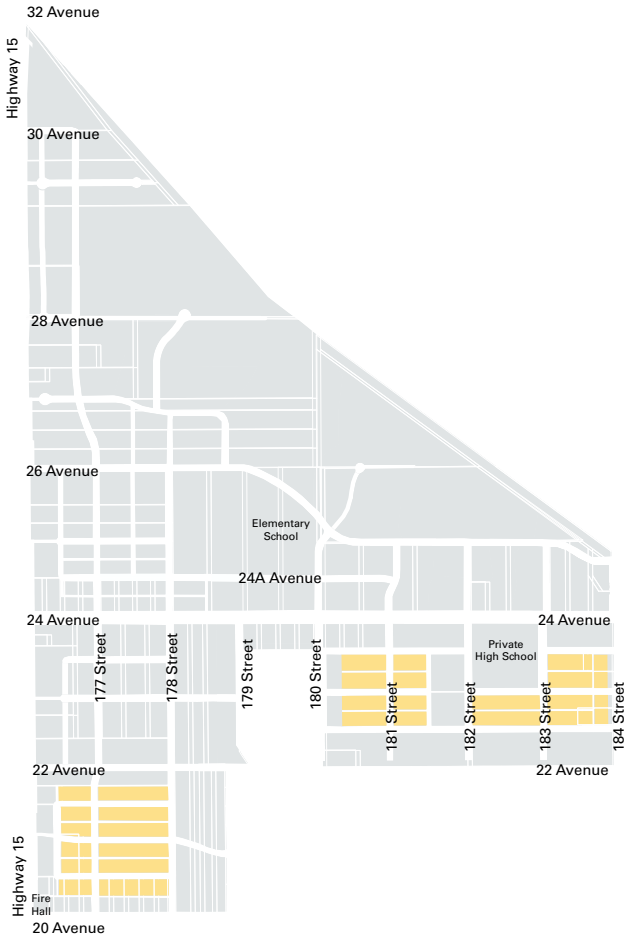
Semi-detached areas are proposed on the north side of 20 Avenue across from Redwood Park, and on the south side of 22 Avenue. Development within this designation may include a mix of duplex and manor homes. Each dwelling should have separate, individual lane access with front doors facing the street. Two different types of development will be considered within this designation.

DEVELOPMENT PARAMETERS:

	Type 1	Type 2
Intent	Fee-simple semi-detached residential buildings joined by a common party-wall.	Multi-unit strata units such as manor homes on urban lots.
Typical Zone	RF-SD	Site Specific Comprehensive Development Zone
Typical Density	Up to 37 UPH (15 UPA)	Up to 37 UPH (15 UPA)
Typical Height		9.5 m
Typical Lot Size	265 sm.	550 sm.
Typical Lot Width	7.2 m (9.0 m if double garage provided)	18 m
Maximum # of Attached Units in a Row	2 - 3	4 connected strata dwelling units within a building in accordance with a comprehensive design.
Parking	A driveway is permitted only from a lane.	A driveway is permitted only from a lane.
Note		No more than 10% Type 2 developments permitted as part of a comprehensive development site.

3.4.5 Detached Residential

This designation is intended for detached family homes on urban sized lots. Secondary suites or laneway housing is allowed for a maximum of two dwelling units per lot. At least 50% of lots should be TYPE 1 (lane served) within this designation.



DEVELOPMENT PARAMETERS:

	Type 1	Type 2
Intent	Single family dwellings on small rear accessed narrow urban lots.	Single family dwellings on front accessed urban lots.
Typical Zone	RF-10	RF-13
Typical Density	Up to 31 UPH (12 UPA)	Up to 28 UPH (11 UPA)
Typical Lot Width	Minimum 9.0 m for rear loaded.	Minimum 13.4 m for front loaded lots.
Typical Max Floor Area	217 sm. [2,335 sf.]	265 sm. [2,860 sf.]
Parking	Driveway permitted only from rear lane	Driveway encouraged from rear lane but is permitted to local roads. Collector road driveway access should be avoided and Arterial access is not permitted.

3.4.6 Cluster Residential

This designation is intended to accommodate development of ground-oriented housing on large sites in the form of single-family dwellings, duplexes or low intensity townhouses. Buildings are encouraged to have pastoral and farmhouse features to reflect the existing surrounding character by incorporating elements such as front porches, verandas, gable roofs, and split rail fences.

In all cases, substantial public open space will be set aside within the development site in accordance with a comprehensive design. Three different types of development will be considered within this designation.

For all three types, gross density is considered when a minimum of 35% of the site area is provided as mature vegetation, ravines, biodiversity hubs or corridors worthy of preservation, through contributions of open space conveyance as public park and/or as landscaped buffer.

DEVELOPMENT PARAMETERS:

	Type 1	Type 2	Type 3
Intent	Accommodate detached dwellings or duplexes on single lots with a minimum of 35% of open space set aside for landscaped buffers and environmental features.	Accommodate single family homes on urban sized lots with a minimum of 35% public open space set aside within the subdivision.	Accommodate ground-oriented townhouses with open space (35-50%) and/or a combination of low-density single family housing and amenity spaces developed in accordance with a comprehensive design as opposed to a fee simple subdivision.
Typical Zone	CD based on RC, RF, RF-G or RM-D	CD based of RF-G, RF, or RF-13	CD based on RM-10, RM-15, RC
Typical Density	Up to 15 UPH (6 UPA)	Up to 20 UPH (8 UPA)	Up to 25 UPH (10 UPA)
Typical Lot Size	Varies	375 sm. (4,000 sf.) for a maximum of 50% of lots in the plan	325 sm., Bare Land Strata Lot
Typical Lot Width	Varies	13.4 m	9.0 m - 13.4 m
Typical Lot Depth		28 m - 30 m	27 m - 30 m
Parking	Driveway access from public street or strata road	Driveway access from public street or strata road	Driveway from strata road

CLUSTERING AT DIFFERENT DENSITIES ON A GROSS SITE AREA OF 10 ACRES

Gross Site Density in Units Per Gross Acre (UPGA)	% of Open Space	Net Developable Land in acre	% of Public Road Requirement *	Resulting Net Density in Units Per Net Acre (UPNA) **	Probable Building Forms
6	35%	7	15	8	Larger Single Family lots in combination with RF and RM-D form.
	40%	6	15	10 (11.8)	Single Family lots in a combination of RF, RF-G and RM-D lots and/or row houses
	50%	5	15	12 (14.1)	Single Family lots in a combination of RF-G and RF-13 lots and/or row houses
8	35%	7	15	10	Single Family lots in small RF and RF-13 form.
	40%	6	15	13.3 (15.7)	Single Family lots in a combination of RF-13 and/or row houses
	50%	5	10	16 (17.8)	Single Family lots in RF-10 or in a combination of RF-10, and RF-SD semi-detached lots and row houses.
10	35%	7	15	12	Single Family lots in combination with RF-13, RM-D lots.
	40%	6	10	16.7 (18.5)	Single Family lots in a combination of RF-10 lots, RM-10 lots
	50%	5	0	20	Possibly developed as semi-detached row houses and townhouse development in a combination of RM-10, RF-SD, and RM-15 lots.

* Assuming 15% of the remaining site area needs to be dedicated for public road for single family subdivisions. If a combination of single family lots and other forms of attached housing is contemplated, the road requirement is reduced to 10%.

** Net density is based on the net developable site area. Where public roads are dedicated for single family subdivision, a net density based on the net site area excluding public road dedication is provided in brackets "( )".

Table 3.2 - Cluster Residential Density Transfer Formula and Building Forms

INTENT

Cluster Housing designation will preserve significant environmental features and open space by providing flexibility in land use and the siting of buildings. This designation enables the redistribution of development potential from one location to another on the same site, while supporting community development, agricultural buffers, urban planning and environmental management goals.

DENSITY TRANSFER AREA

The following areas should be prioritized for inclusion as Density Transfer areas:

- Biodiversity Hubs & Corridors;
- Areas used to provide Agricultural Land Reserve (ALR) buffers;
- Non-riparian ecologically significant areas;
- Steep Slopes (>15% Slope);
- Utility Right-of-Ways;
- Clusters of significant trees that have noted arboriculture values; and,
- Significant view shed areas.

The following areas or land uses may not be counted as a part of designated density transfer areas:

- Areas covered by any structures or buildings;
- Public road rights-of-ways;
- Strata lanes;
- Property setbacks and private front or backyard areas; and,
- Streamside protection setback areas as prescribed in the City of Surrey Zoning Bylaw.

DEVELOPMENT SUBMISSION

The boundaries of designated density transfer areas should be clearly delineated on plans, including subdivision plans, rezoning plans, and marked in the field with signage during construction approved by the Planning and Development Department. The intent is to distinguish these areas from private or common property.

CLUSTER RESIDENTIAL DEVELOPMENT POLICIES

POLICY 1

Cluster residential density will apply to gross site area before dedications (e.g. ALR buffer), except road dedications and other undevelopable areas as defined in the City of Surrey Zoning bylaw which will be deducted from the developable area.

POLICY 2

The minimum parent parcel size for cluster housing is 4 hectares/10 acres, unless it can be demonstrated that development located on a smaller site can be designed to properly reflect the site topography, preserve environmental features and trees, provide suitable site access, and achieve the minimum target of 35% for natural open space.

POLICY 3

Cluster housing should include a mix of unit sizes and types, including single, duplex, triplex, and quad-plex under a strata-type development.

POLICY 4

Sites downslope of a proposed detention pond facility may be considered in a bare land strata form. Bare land strata's may also be considered in circumstances that reduce the need for gridded roadways for an environmentally sensitive area, and allows for more opportunities for on-site drainage management. The siting of units should reflect the location of existing trees, environmental features and watercourses, which are to be illustrated in the site design. Bare land stratas are not essential however, for single detached units, provided they form part of a comprehensive development plan.

POLICY 5

Cluster housing areas should be developed under a comprehensive development (CD) zone with special regulations to reflect the purpose of the cluster housing concept that identifies amounts of developable and open space areas.

POLICY 6

All cluster housing developments require development permits to reinforce design and environmental objectives. A cluster housing development application will include a site assessment analysis by a qualified professional(s), who will identify potential environmentally sensitive areas to be protected.

POLICY 7

Density transfer areas may be "community space" and conveyed to the City. Uses may include passive or active recreation, community gardens, or rainwater management facilities that meet all design, construction, maintenance, and public safety requirements set forth by the City of Surrey.

POLICY 8

At least 75% of designated open green space should be contiguous, with no portion less than 20 meters wide.

POLICY 9

The amount of green space preservation required should generally increase with land use density, because of the feasibility of protecting open space and to offset the cost of development. In lower density cluster designs (less than 10 units per acre), different techniques such as clustering homes into small groups may be used. In higher density designs (10 units per acre), small lot zoning and multiple family dwellings can be used to intensify development. This may be more appropriate in specific locations such as near roads, on flatter slopes, and away from the ALR or environmentally sensitive features. Densities in the cluster designations should meet the intent of the formula and building forms outlined in the Table 3.2.

POLICY 10

Where there is required biodiversity conservation on a subject property, the provisions of the Sensitive Ecosystem Development Permit Area should apply.

POLICY 11

Provide a minimum 11 m building setback and landscaped buffering along Hwy 15 in keeping with Section 3.6 Urban Transition Areas (Transition 3.6.1).

3.4.7 Residential Transition

This designation is intended to accommodate a lower density suburban residential transition. It is specific to the plan's southern interface with the Redwood Park Estates rural area. Three different types of development will be considered within this designation.

DEVELOPMENT PARAMETERS:

	Type 1	Type 2	Type 3
Intent	Suburban sized detached lots of one-half acre or larger.	Smaller suburban sized detached half acre lots, with substantial public open space set aside within the subdivision.	Detached small suburban lots, where lot size may be reduced with substantial public or strata held open space set aside within the subdivision.
Typical Zone	RH	RH-G, CD	RQ
Typical Density	Up to 5 UPH (2 UPA)	Up to 5 UPH (2 UPA)	Up to 10 UPH (4 UPA)
Typical Height	9.0 m. 2-2½ storeys	9.0 m. 2-2½ storeys	9.0 m. 2-2½ storeys
Typical Lot Size	2,000 sm.	1,120 sm.	775 sm.
Lot Width	Minimum 30 m	Minimum 24 m	Minimum 20 m
Parking	Driveway from public street	Driveway from public street	Driveway from public street
Note	Provide 10 m wide landscape buffers on private property adjacent to Redwood Rural Estates to enhance the edge transition.	Provide 15 m wide park land adjacent to Redwood Rural Estates to enhance the edge transition.	Flexibility in the minimum residential lot size may be considered to encourage the retention of open space to provide 20 m wide parkland corridor adjacent to Redwood Rural Estates.

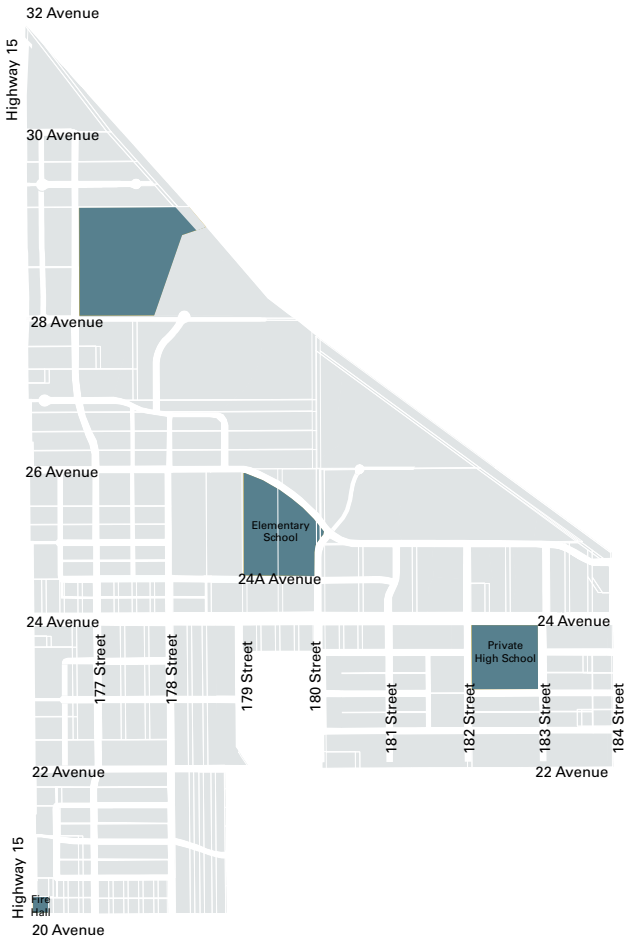
3.5 OTHER LAND USE DESIGNATIONS

3.5.1 Institutional

Institutional and civic uses support the social, educational, recreational, and cultural foundation of a community. A range of institutional and civic uses include a retreat centre, Fire Hall and an elementary school.

Redwood Heights falls within the existing East Kensington Elementary catchment. East Kensington Elementary is located within the Agriculture Land Reserve, outside of the plan area and the urban growth containment boundary. As a result, the School District is unable to expand the school to meet the future need of the Redwood Heights neighbourhood.

To meet future needs a 3.5 hectare (8.6 acre) elementary school site has been identified. The new school will supplement East Kensington's capacity. Any future changes to the existing East Kensington School will be reviewed and approved by the Surrey School Board. It is assumed that it will continue to operate as an elementary school.



DEVELOPMENT GUIDELINES

Institutional and civic uses will integrate the City's Biodiversity Design Guideline features into the development of new buildings, landscapes, and infrastructure. Schools will be sited to prioritize safe pedestrian access and a positive street presence.

Institutional designations include the following:

- A centrally located elementary school near 26 Avenue and 178 Street;
- A site owned by the Roman Catholic Archdiocese of Vancouver, planned for a Catholic secondary school;
- The existing Science of the Soul worship and retreat centre, planned to be retained; and
- The existing Civic Fire Hall at 20 Avenue and 176 Street.

3.5.2 Parks, Natural Areas, Riparian Areas and Wetlands

PARKS & NATURAL AREAS

The Parks and Natural Areas designation outlines the locations of new and existing parks, as well as key landscape buffers.

An interconnected principle that will guide the planning of new parks and natural spaces is the goal of delivering parks that are within 500 metres or a 10 minute walk of all future residents.

RIPARIAN AREAS & WETLANDS

Riparian areas will be conveyed and managed as habitat corridors to protect fish and fish habitat. Some riparian areas will have public paths along their outer edges to provide opportunities to enjoy nature.

LIGHTING

Light pollution can profoundly reduce biodiversity in protected areas. Invertebrates, birds, mammals, fish, amphibians, plants and reptiles are all negatively impacted by the effects of light pollution. Given that light pollution can cause a measured 80-90% reduction of biodiversity in riparian areas, it is critical that development mitigates the negative impact on vulnerable natural areas.

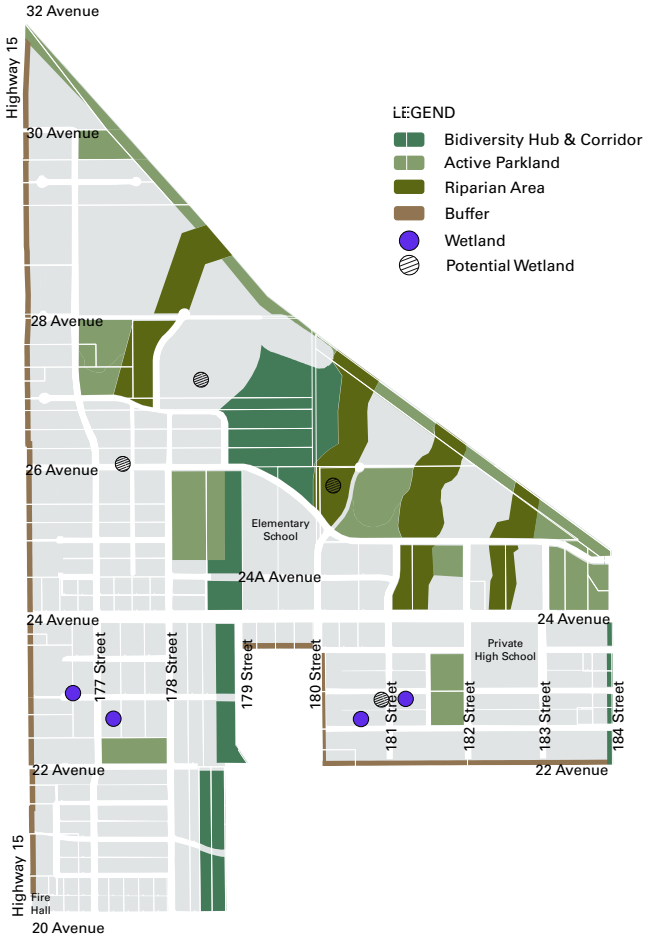
Development near natural areas will adhere to the following lighting requirements:

1. Do not use blue-tinted LED lighting. Use yellow, orange, or red-tinted (warm) lighting which has less negative impact on wildlife.

2. Reduce light pollution and bleeding of light by

    - Using timed lighting;
    - Directing light to where it needs to go; and,
    - Spacing light sources appropriately

3. Do not use soft lighting along the sides of buildings that are adjacent to natural areas.



3.6 URBAN TRANSITION AREAS

Special interface cross-sections have been developed to accommodate unique design consideration for areas adjacent to riparian areas, agricultural edges, habitat corridors, landscape buffers, and along hillsides.

These unique transition areas are intended to maximize the amenity of public land and natural areas, while also respecting the sensitivity of agricultural uses and existing residential areas.

New development is expected to conform to these urban transitions identified and illustrated in figures 3.4 - 3.9

Figure 3.4 Unique Urban Interface Areas

3.6.1 Transition 1

Transition 1 is intended to support a multi-use pathway and boulevard adjacent to Highway 15. It includes a 10 metre road corridor with a 4.0 metre multi-use pathway and treed boulevard. Additional landscaped buffering should be located between the new property line and future development. Development will fund noise reduction features such as berms or walls as required (on private property).

TRANSITION 1 - HIGHWAY 15

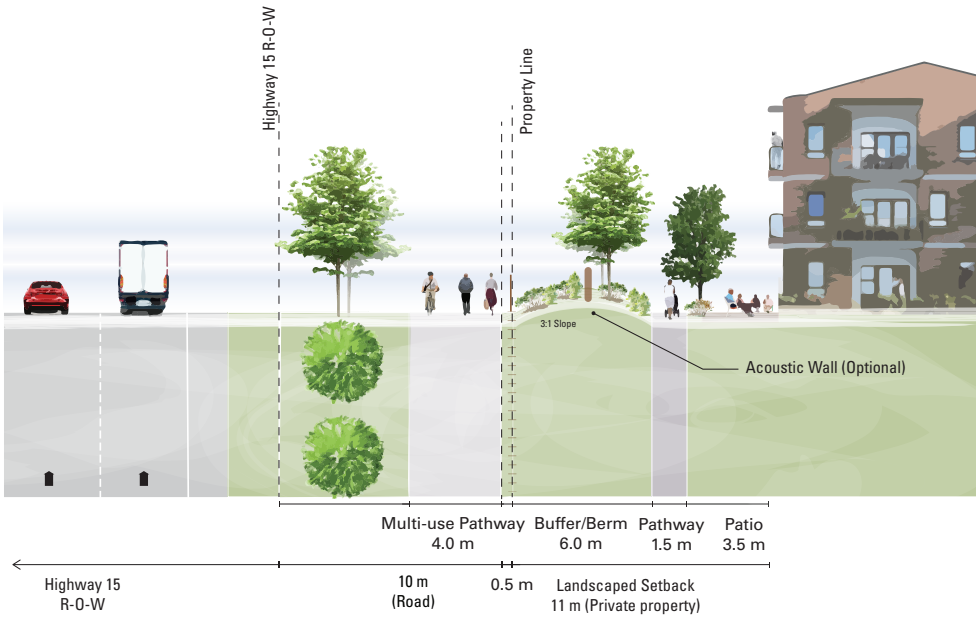


Figure 3.5 Transition 1 - Highway 15

3.6.2 Transition 2

Transition 2 is intended to create a landscaped buffer to lands adjacent to the ALR along 184 Street. The resulting 20 m parkland buffer will be landscaped with natural vegetation and trees.

TRANSITION 2 - 184 ST ALR BUFFER

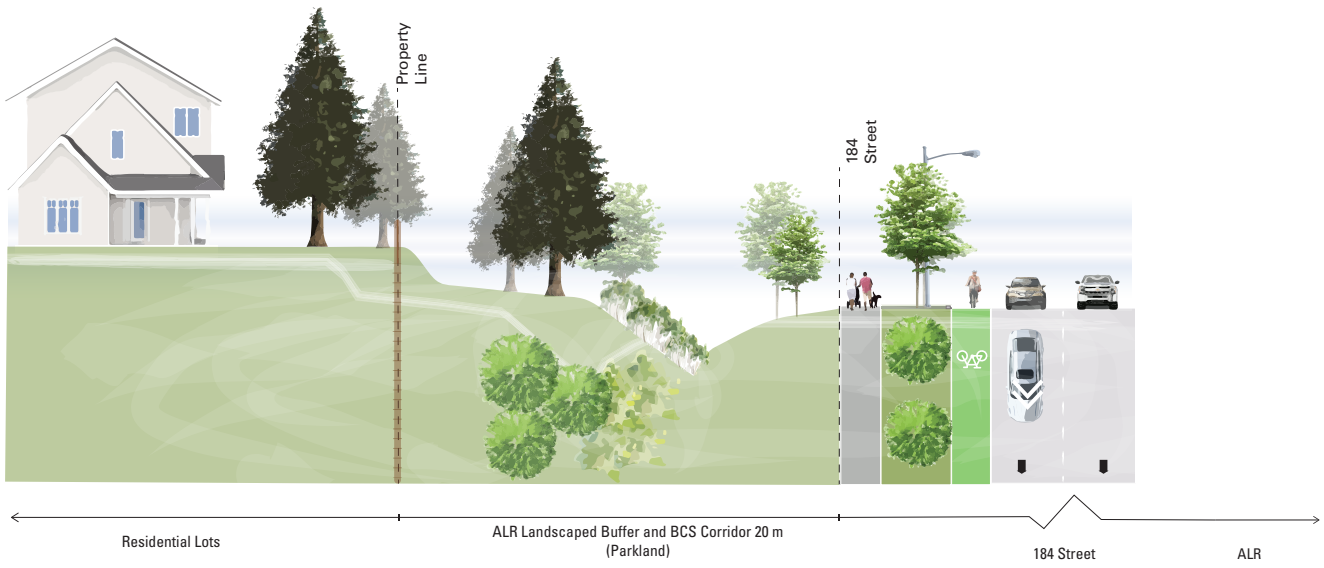


Figure 3.6 Transition 2- 184 St ALR Buffer

3.6.3 Transition 3

Transition 3 is intended to create a landscaped buffer to lands adjacent to Great Northern Railway Park & ALR Boundary. The resulting buffer includes a total of 40 m of natural area parkland, inclusive of a 10 m greenway supporting a multi-use pathway.

TRANSITION 3 - GREAT NORTHERN RAILWAY PARK & ALR BUFFER

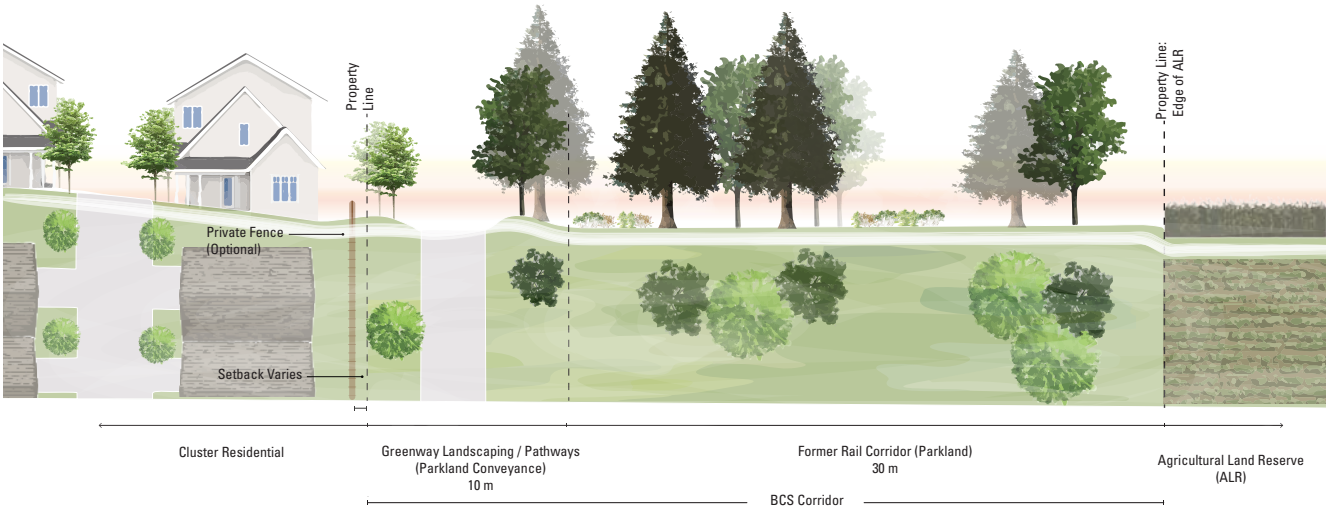


Figure 3.7 Transition 3 - Great Northern Railway Park & ALR Buffer

3.6.4 Transition 4

Transition 4 is intended to support a significant biodiversity corridor through the neighbourhood. It applies to all development adjacent to the corridor. The transition includes a 10 m greenway supporting a multi-use pathway, located adjacent to the biodiversity corridor.

TRANSITION 4 - BIODIVERSITY CORRIDORS ADJACENT TO REDWOOD ESTATES

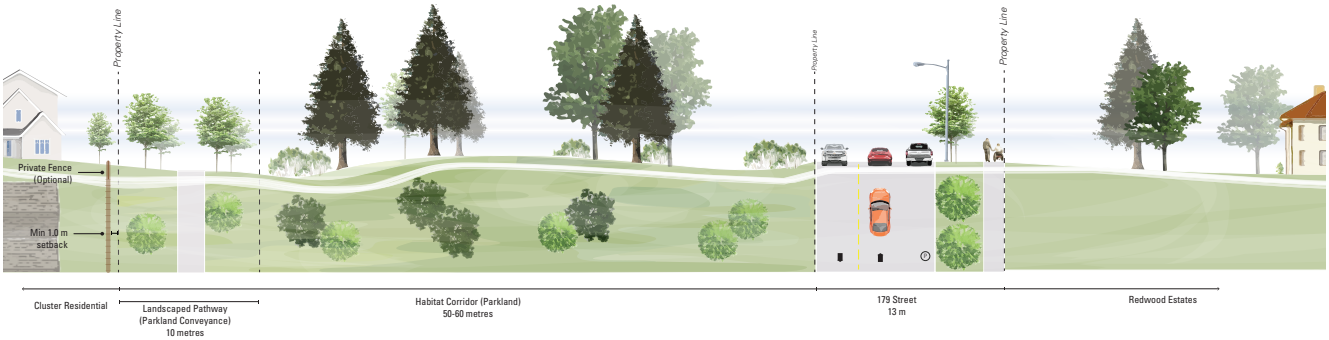


Figure 3.8 Transition 4 - Biodiversity Corridors Adjacent to Redwood Estates

3.6.5 Transition 5

Transition 5 is intended to create a landscaped buffer to lands adjacent to Redwood Estates. It provides natural area transition between higher density development in Redwood Heights and the existing rural area to the south.

TRANSITION 5 - REDWOOD ESTATES INTERFACE

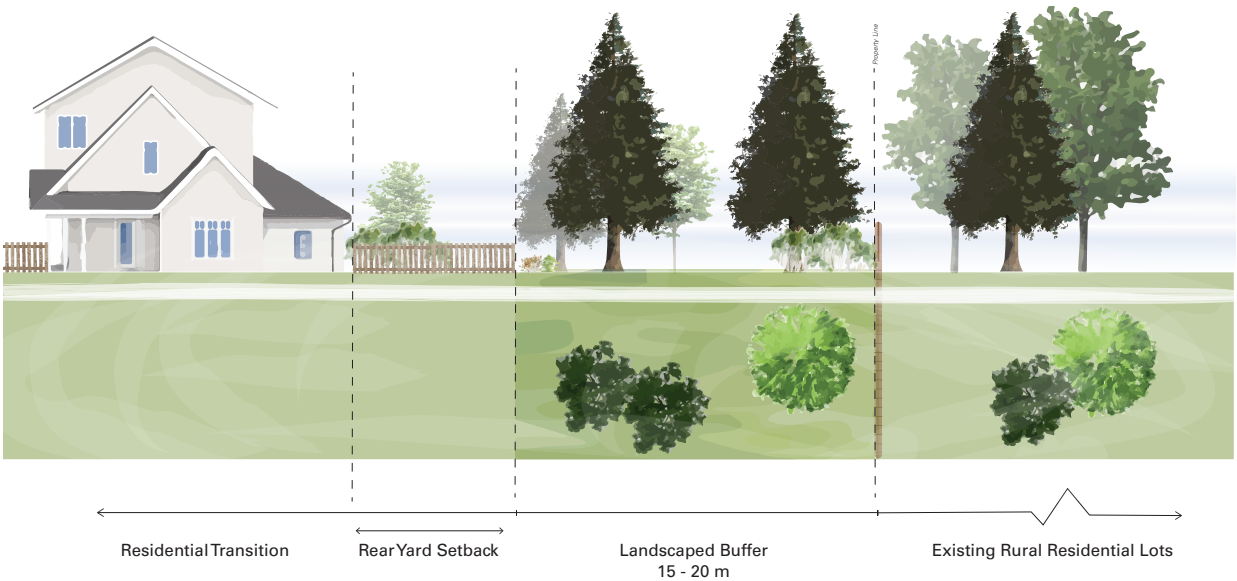


Figure 3.9 Transition 5 - Redwood Estates Interface

3.7 ACTIVE RESIDENTIAL FRONTAGE AREAS

A number of key public spaces have been identified as locations requiring active residential frontage. These requirements promote public safety and access to nature while encouraging a vibrant public realm.

Frontage is the manner in which a building orients towards and meets the public realm. Thoughtful placement of front-facing doors, windows, porches and balconies promote "eyes on the street', creating a sense of safety while encouraging pedestrian activity.

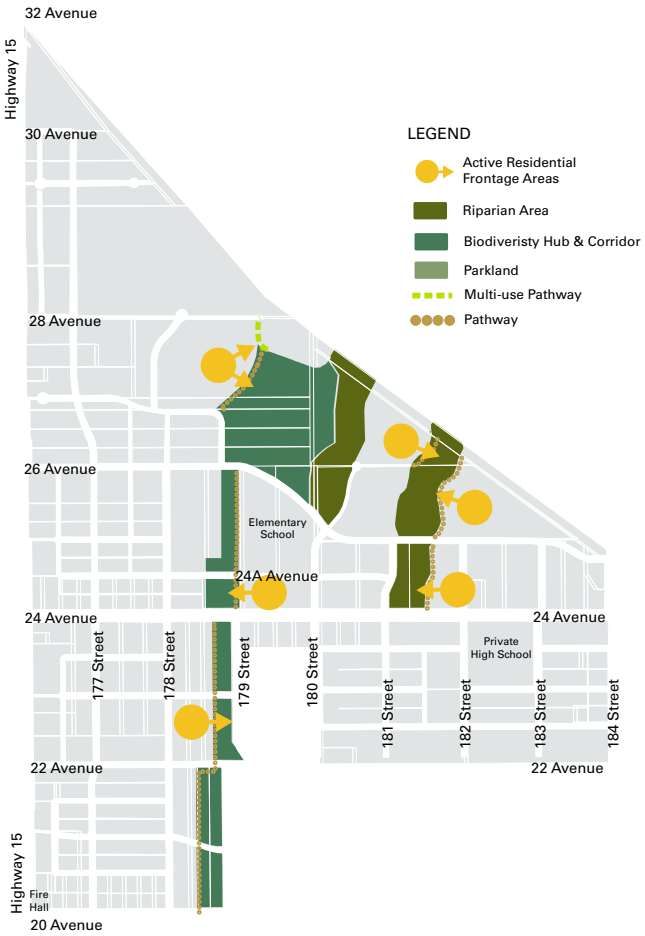
New development in these areas are expected to conform to these cross-sections.

Figure 3.10 Active Residential Frontage Areas

3.7.1 Active Frontage 1

Apply Active Frontage 1 to developments adjacent to natural and riparian areas where a park pathway is identified.

Development should front onto the pathway with front-facing doors, windows, and porches. Private fencing (optional) should be permeable, no higher than 0.9 m, and located on private property set back a minimum of 1.0 m from the property line with layered planted landscaping in front.



ACTIVE FRONTAGE 1 - NATURAL & RIPARIAN AREAS WITH PUBLIC PATHWAY

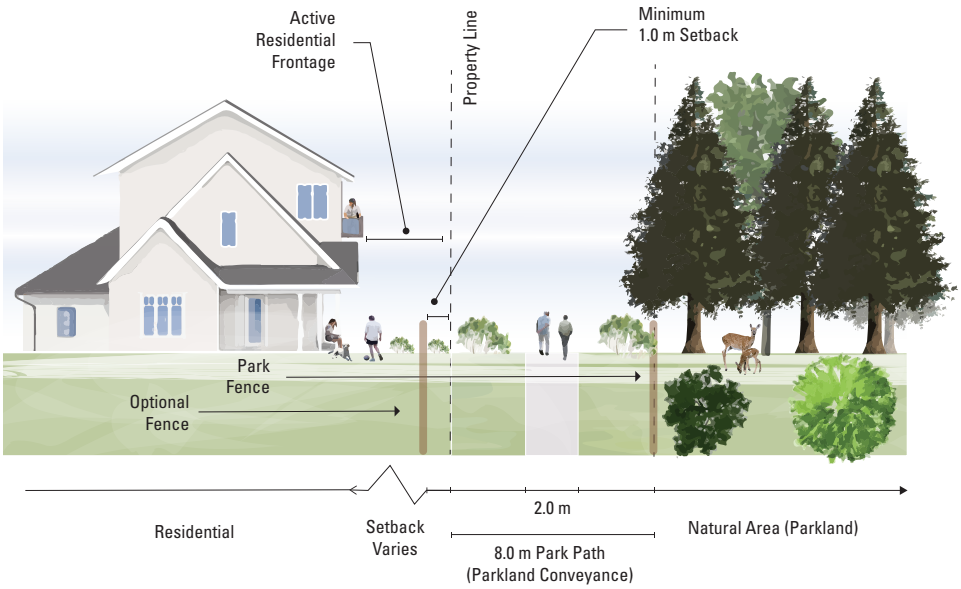


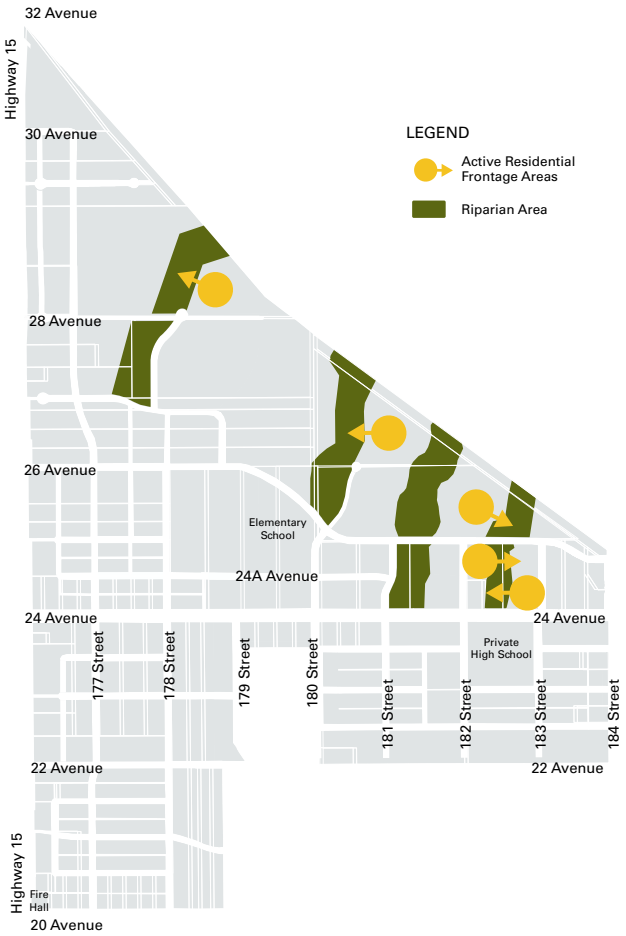
Figure 3.11 Active Frontage 1 - Natural & Riparian Areas with Public Pathway

3.7.2 Active Frontage 2

Apply Active Frontage 2 to areas adjacent to riparian areas where a public pathway is not identified.

Cluster Residential development in the form of stratified multiple residential is encouraged to provide a minimum 1.8 m pathway on private property setback 0.5 m from the riparian areas.

Development should front onto the Riparian Area with front facing doors, windows, active rooms, and porches. Private fencing (optional) should be permeable and no higher than 0.9 m, setback 1.0 m away from the walkway.



ACTIVE FRONTAGE 2 - RIPARIAN AREAS WITHOUT PUBLIC PATHWAY

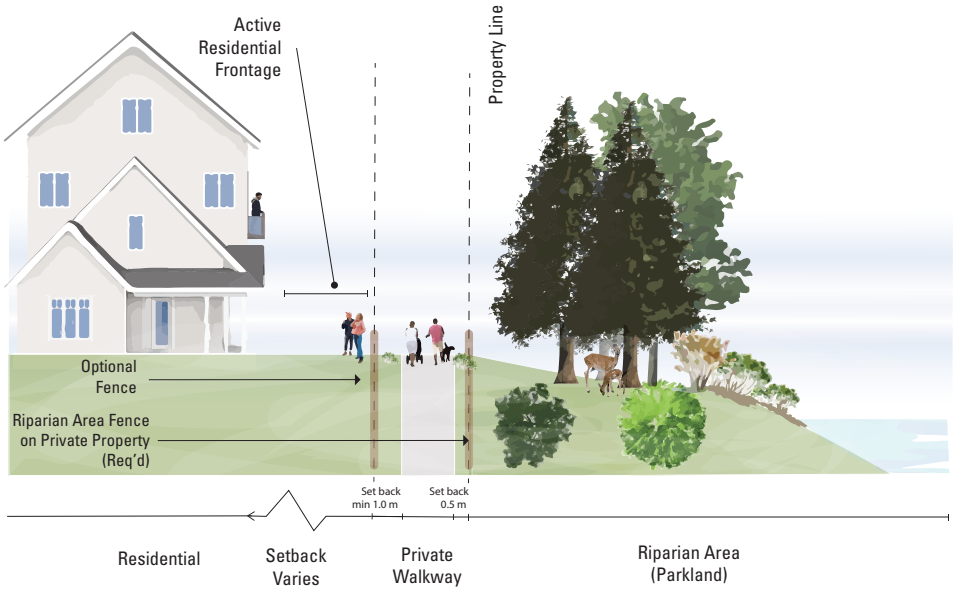
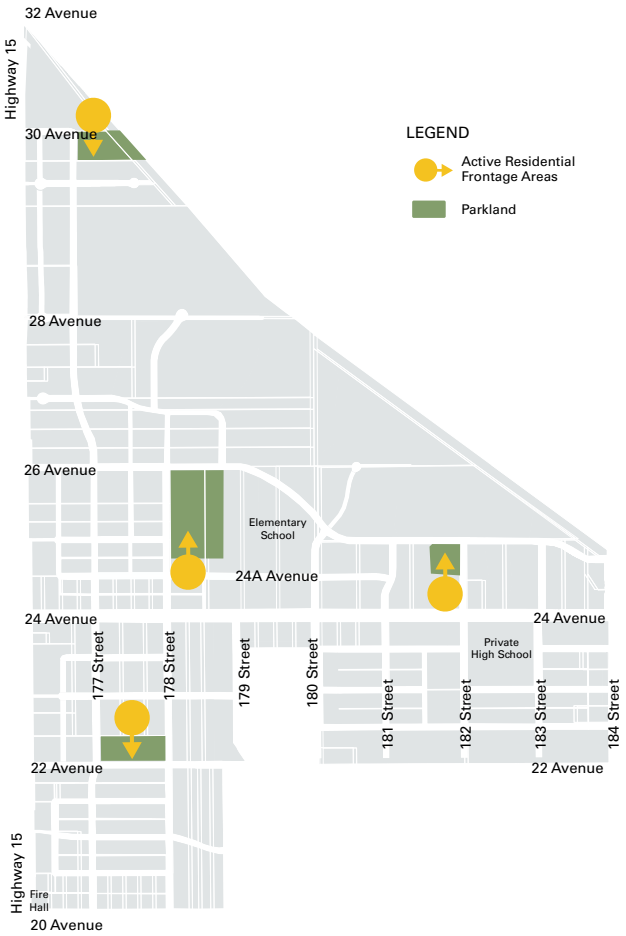


Figure 3.12 Active Frontage 2 - Riparian Areas Without Public Pathway

3.7.3 Active Frontage 3

Apply Active Frontage 3 to areas adjacent to active parkland.

Development should front onto active parkland with front facing doors, windows, active rooms, and porches. Private fencing (optional) should be permeable, no higher than 0.9 m, and located on private property set-back a minimum of 1.0 m from a required on-site pathway with layered planting/ landscaping in front. Development should provide frontage pathway along the park interface located on private property with no fence between the path and parkland.



ACTIVE FRONTAGE 3 - AREAS ADJACENT TO ACTIVE PARKLAND

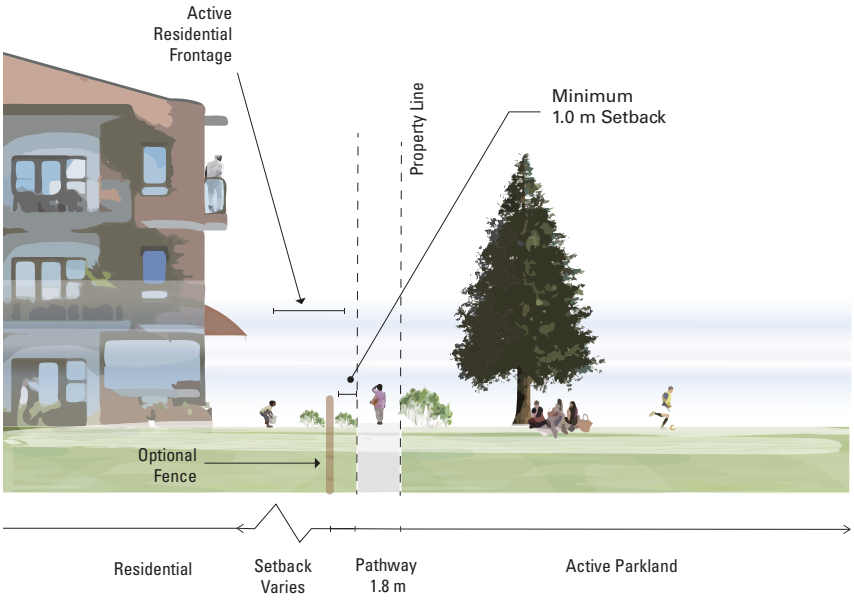


Figure 3.13 Active Frontage 3 -Areas Adjacent to Active Parkland

3.7.4 Active Frontage 4

Apply Active Frontage 4 to areas adjacent to dedicated multi-use corridors.

Development should front, where possible onto the multi-use pathway. Corridors include a 4.0 m multi-use pathway with 3.0 m treed boulevards on either side.

Private fencing (optional) should be permeable, no higher than 0.9 m and located on private property setback a minimum of 0.5 m from the pathway dedication.

ACTIVE FRONTAGE 4 - AREAS ADJACENT TO 10 m MULTI-USE CORRIDORS

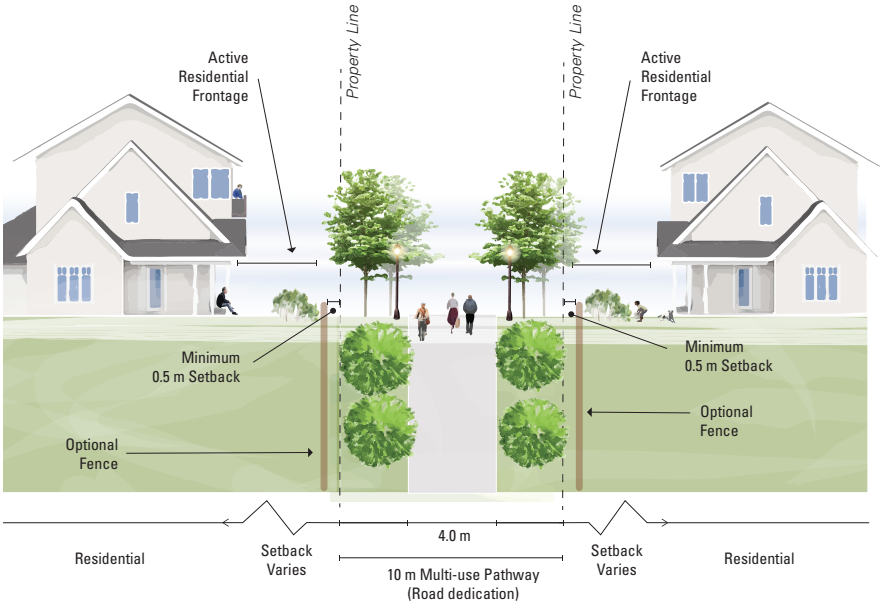


Figure 3.14 Active Frontage 4 - Areas Adjacent to 10 m Multi-use Pathways

Section 4

I How We Get Around

The transportation network provides an open, connected and continuous street grid that integrates efficiently into the surrounding area. The network promotes cycling and pedestrian connectivity, transit service, and compact neighbourhood development.

4.1 EXISTING CONDITIONS

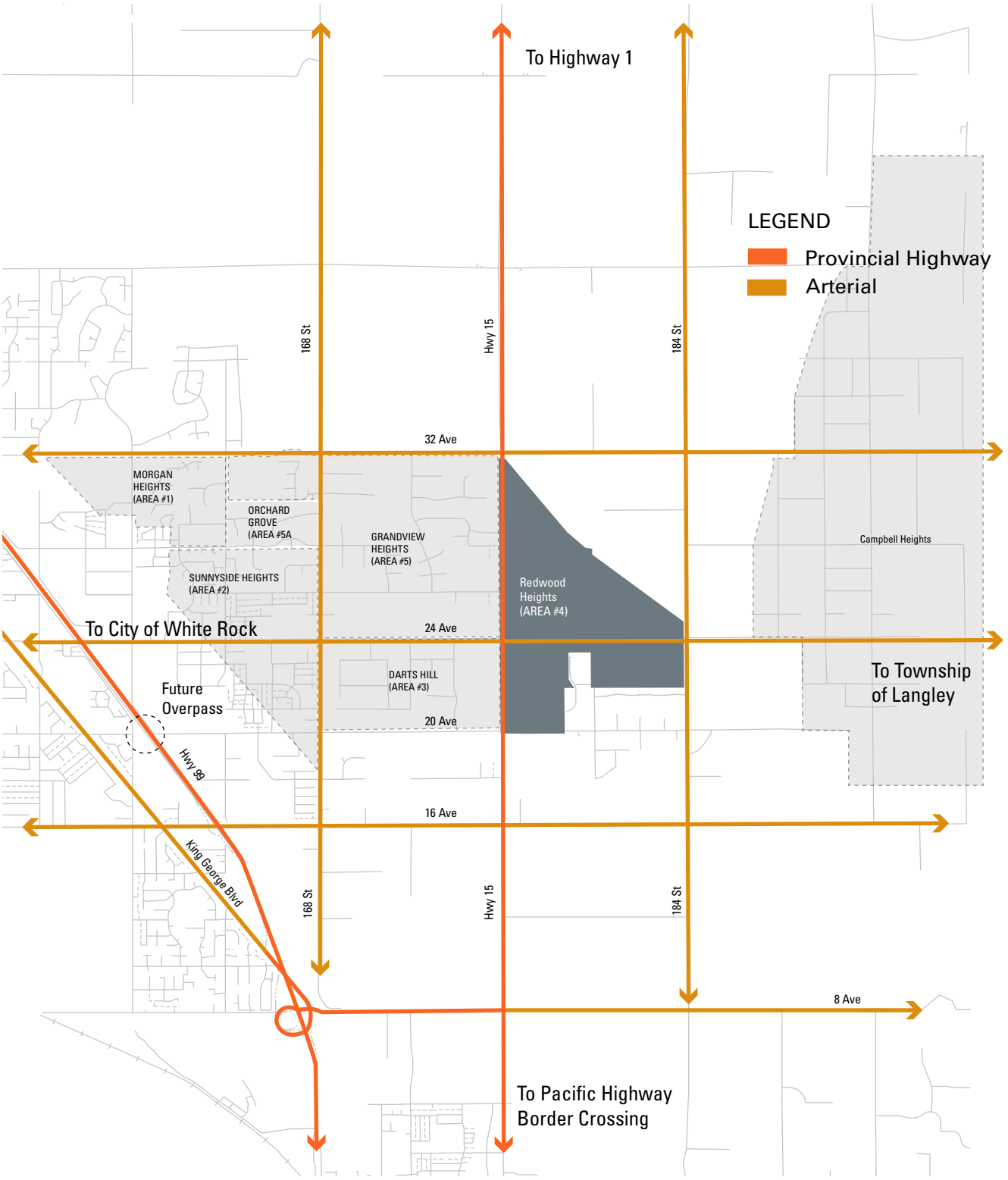


Figure 4.1 Existing Road Network

EXISTING ROAD NETWORK

The existing road network in Redwood Heights was developed to serve the rural and suburban land uses. There are predominantly large lots without a significantly developed local road network and existing traffic relies on a few key roadways.

Neighbouring areas to the north and east are within the Agricultural Land Reserve where the road network is limited to local roads that service farm land. Existing arterial and collector roads within the area are described below:

- Highway 15 (Pacific Highway) is a four lane Provincial highway along the western boundary of Redwood Heights that connects Highway 1 in the north, to the Pacific Highway (Truck) border crossing in the south.
- 24 Avenue is an east-west arterial road that connects Grandview Heights with the Semiahmoo Peninsula to the west, and Campbell Heights and Township of Langley to the east. A future interchange at Highway 99 and 24 Avenue, will enhance connectivity for the area.
- 184 Street is a north-south arterial road along the eastern boundary of the plan area. It currently connects from 0 Avenue at the international border to the south, and to 80 Avenue to the north.
- 20 Avenue is a two-lane east-west collector road at the southern boundary of the plan area. Currently, the road terminates at Hwy 99 to the west. Ultimately 20 Avenue will be connected to King George Boulevard and the rest of the Semiahmoo Peninsula with a planned overpass of Highway 99. To the east, 20 Avenue connects to 184 Street and serves the rural and suburban properties in the area.

TRAFFIC VOLUMES

Traffic volumes in Redwood Heights have experienced significant growth between 2006 and 2016 due to residential and employment growth east and west of the plan area. Specifically, 24 Avenue and 32 Avenue have experienced a high percentage of traffic increase (69% and 32% respectively), as these roads act as important east west connections between Highway 99, South Surrey, and the Township of Langley.

WALKING AND CYCLING NETWORKS

The existing local roads within Redwood Heights do not currently have sidewalks or formal cycling infrastructure and were constructed to previous rural road standards that did not require sidewalks at the time.

Arterials like 32 Avenue and 24 Avenues currently have very limited gravel shoulders and are ultimately planned to be upgraded through City capital projects.

TRANSIT NETWORK

There is currently one transit service, Route 531, which runs along 24 Avenue through the plan area, and connects White Rock to the west and the City of Langley (Langley Centre and Willowbrook Mall) to the northeast.

4.2 PLANNED STREET NETWORK

Figure 4.2 Transportation Strategy

GRID NETWORK

The road network for Redwood Heights will integrate into the existing and planned road network for the broader Grandview Heights community. It will follow the principles of the City's Transportation Strategic Plan, and provide a finer grid road pattern that enhances connectivity.

The network provides multiple route options to increase network resiliency and reduce overall vehicular congestion, while improving walkability, access to transit, and emergency response time. In general, the Redwood Heights road network consists of 200 metre by 100 metre blocks. Areas with higher densities and commercial designations, where walkability and traffic distribution is more important, typical block sizes are in the range of 80 metres by 150 metres.

Due to the amount of environmentally sensitive areas within the plan, the grid road network has been modified to maximize conservation efforts. Other constraints that factored in the road network include the ALR along the north boundary of the plan, designated school sites, topography (e.g. slopes), and proximity to anticipated signalized intersections.

ROAD CLASSIFICATIONS

The road network for the plan area is classified into a number of typologies

Arterial Highway - Highway 15 (176 Street) is under the jurisdiction of the Ministry of Transportation and Infrastructure (MoTI). It is an inter-regional transportation corridor that connects the Pacific Highway Truck Crossing to Highway 10, Highway 1, and Highway 17.

Arterials - Multi-modal roads that are the principle intra-city and regional corridors and connects Surrey's 5 communities to each other and the rest of the Metro Vancouver region. They are planned to accommodate higher volumes, transit, and act as designated truck routes where identified.

Collectors - Multi-modal roads that provide connections between neighbourhoods and within communities. They can also provide direct access to properties and accommodate transit. They frequently accommodate on-street parking with some exceptions.

Locals - Provide the principle access to property and connections to the Collector and Arterial road network and accommodate on-street parking.

Commercial High Street - Provides an interface for an activated ground oriented retail street that will include on-street parking and consideration for unique features.

Flex Streets - Designed with the intent of a local road but may have variable alignments and cross sections that preserve natural areas, or accommodate topographical challenges as long as the principle of the road connection and intersection locations remain.

Pedestrian Streets - Roads for non-motorized active uses to provide added neighbourhood connectivity.

Local Road BCS Crossings - Roads with a unique and minimized cross section in order to limit impacts to the natural protection areas.

Lanes - Provide vehicle access to underground parking or lane served residential as well as service access for commercial.

4.3 TYPICAL ROAD SECTIONS

OVERVIEW

Generally, all roads within the plan area will follow the City's Engineering Design Criteria and Supplementary Standard Drawings.

The City's Vision Zero: Safe Mobility Plan identifies a vision where there are zero killed or seriously injured using a Safe Systems Approach. Roads should be designed to reduce the risk of crashes occurring and reduce the severity of an injury, should a collision occur. These safety features include separating different kinds of road users, as well as traffic moving in different directions or at different speeds.

This is also consistent with a Complete Streets approach to road design to ensure that all roads will accommodate safe mulitmodal transportation for all users.

4.3.1 Arterial Roads

The foundation of the road network is based on a central east-west arterial spine (24 Ave), as well as a supporting adjacent north-south arterial (184 St).

24 AVENUE

The role of 24 Avenue is significant for both Redwood Heights and all of Grandview Heights. It is one of only three east west arterials, along with 32 Avenue and 16 Avenue, that spans the South Surrey area and connect Township of Langley, Campbell Heights, Grandview Heights, Semiahmoo Peninsula, and White Rock.

Due to its regional connectivity and transit supportive land uses, 24 Ave is planned to accommodate dedicated curb side bus lanes. This will support both planned Frequent Transit Network service and potential high order transit service of Rapid Bus. It will include 1.8 metre wide one-way protected cycling facilities that will form part of the Grandview Heights Greenway.

ARTERIAL - 24 AVE INTERIM 4 TRAVEL LANES (37 m CROSS-SECTION)

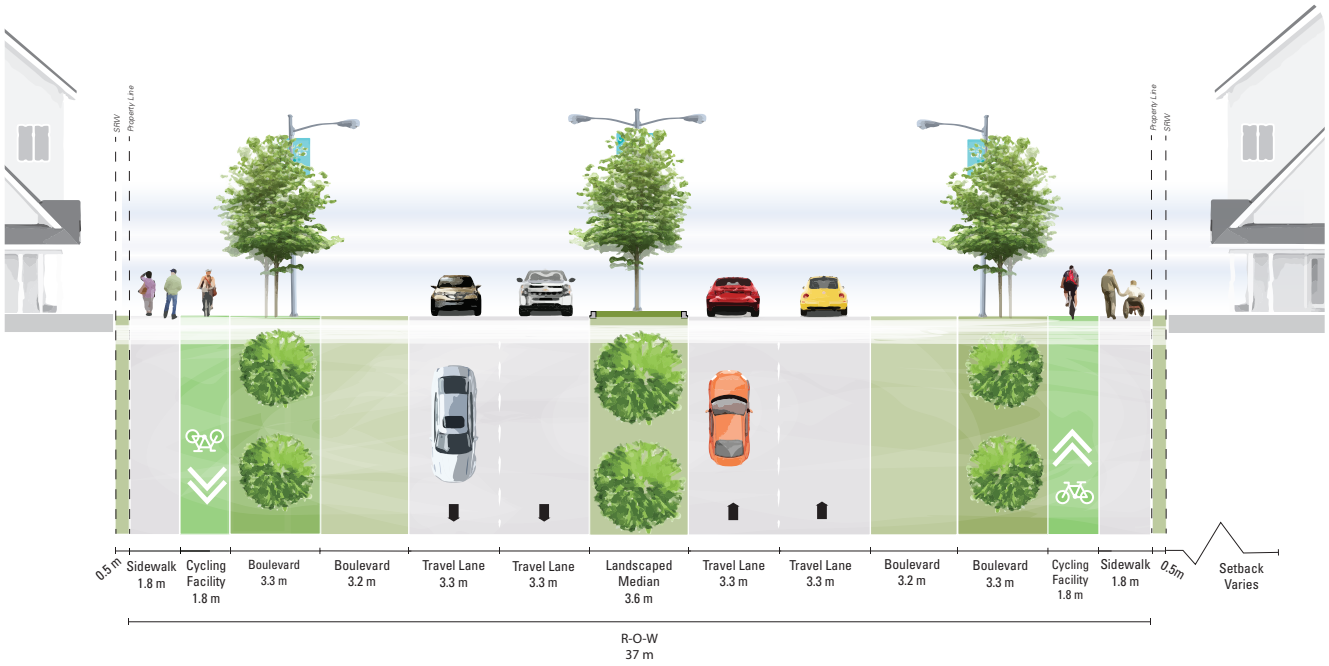


Figure 4.3 Arterial - 24 Avenue Interim 4 Travel Lanes (37 m Cross-section)

ARTERIAL - 24 AVE ULTIMATE CURBSIDE BUS LANES (37 m CROSS-SECTION)

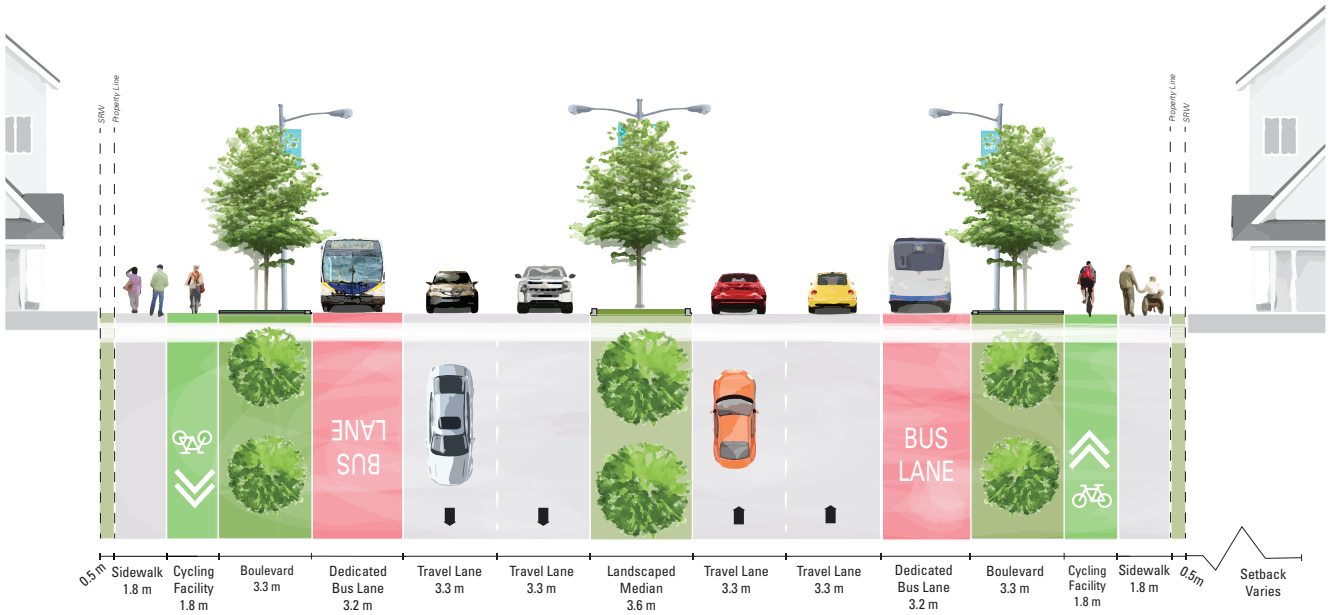


Figure 4.4 Arterial - 24 Ave Ultimate Curbside Bus lanes (37 m Cross-section)

24 AVENUE WILDLIFE CROSSING

Central to the plan area is a critical corridor connecting Redwood Park in the south with the protected biodiversity hub and ALR lands in the north. It will be a minimum of 50 m wide with limited public access. There will be special design cross section including a wildlife underpass where this corridor crosses 24 Avenue. The underpass will be a 1.0 metre high x 3.0 metre wide specialized culvert to support small animal crossing. Refer to Section 5.3 for additional details.

184 ST & 32 AVENUE

Both of these arterials are within and/or bordering the ALR and will serve as alternate parallel corridors to Highway 15 and 24 Avenue respectively. Both roads are protected for widening to the Rural Arterial Standard with four travel lanes, a landscaped median, and active mode facilities.

ARTERIAL RURAL STANDARD - 32 AVE/184 ST (30 m CROSS-SECTION)

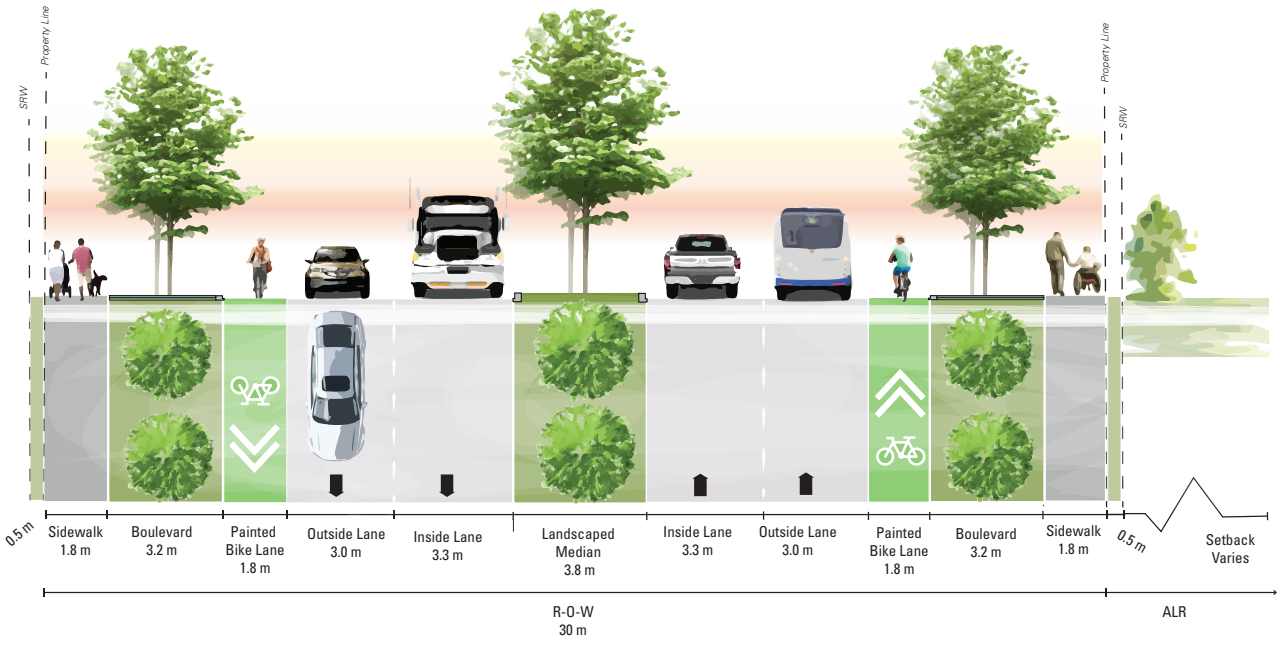


Figure 4.5 Arterial Standard - 32 Ave/184 St 30 m Cross-section

4.3.2 Collector Roads

The road network will also introduce several new collector roads, including: 26 Avenue; 177 Street; 178 Street; and 182 Street.

Collectors will typically require a 24 m road allowance standard unless special standards are noted. The road will be constructed to a Complete Streets standard which will include sidewalks, separated cycling facilities, parking both sides and curb bulges at intersections.

STANDARD COLLECTOR 24 m CROSS-SECTION

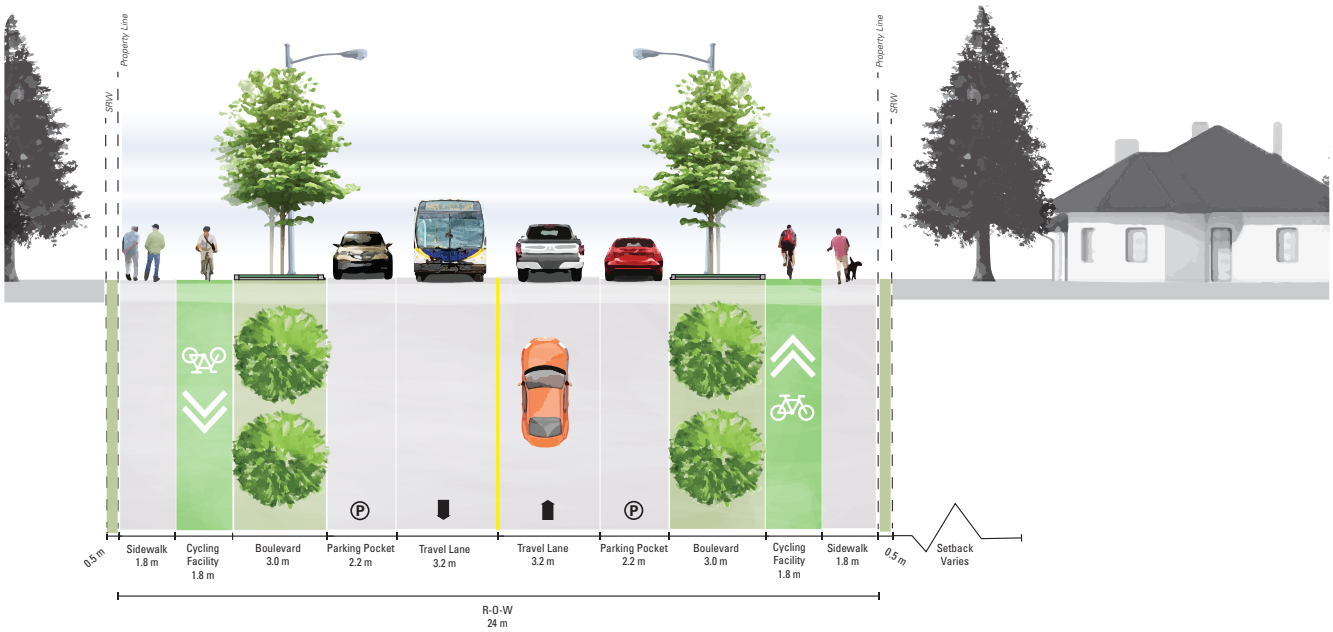


Figure 4.6 Standard Collector Road 24 m Cross-section

4.3.3 Local Roads

An extensive network of local roads compliment the collector and arterial road network to complete the road grid. Typical local roads will be a 20 m wide road allowance with 10.5 m pavement and parking on both sides with two way operations.

All roads will have sidewalks on both sides and curb bulges at intersections.

STANDARD LOCAL 20 m CROSS-SECTION

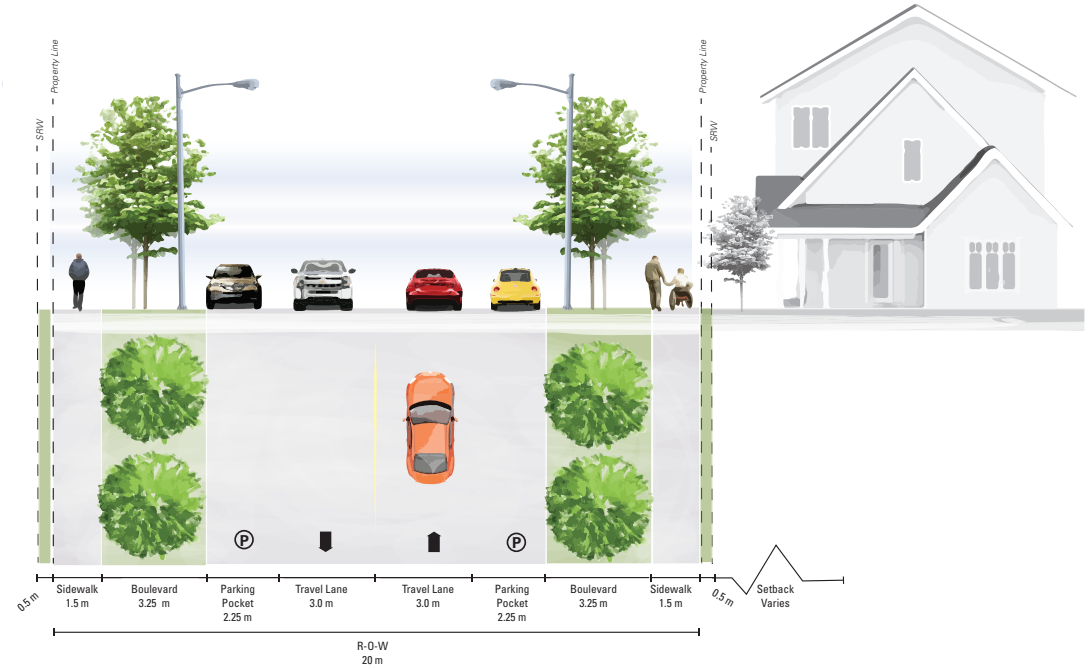


Figure 4.7 Standard Local Road 20 m Cross-section

4.4 UNIQUE ROAD SECTIONS

A number of unique cross-sections have been developed for Redwood Heights and are described in tables and illustrated on the following pages.

These unique street typologies exist where roads intersect biodiversity corridors, parkland, and within the mixed use commercial village

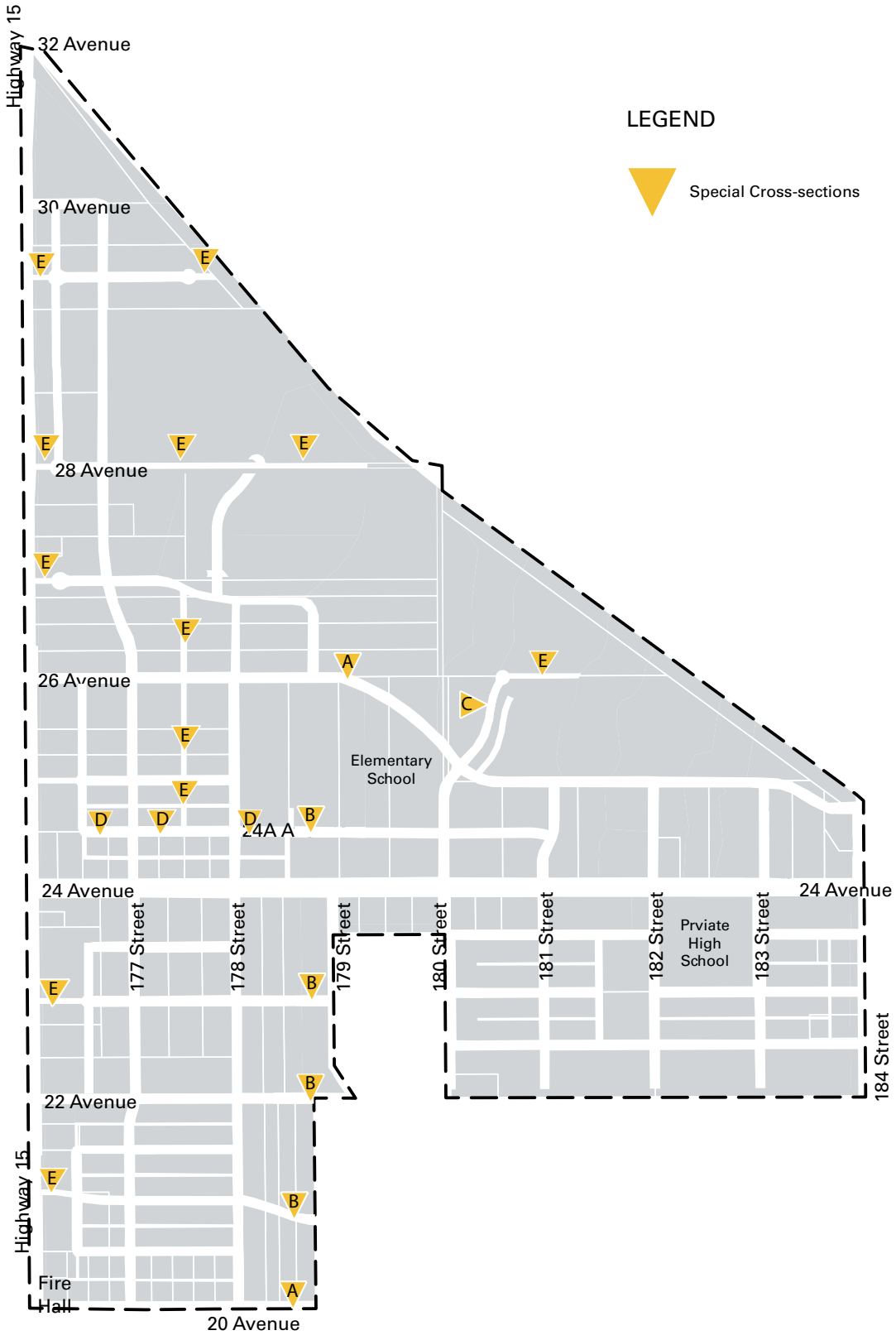


Figure 4.8 Special Cross-sections

4.4.1 Unique Street Section A

This is a modification to a standard collector road, to be used where it crosses a BCS corridor.

Dedication	17.8
SROW	0.5 m on both sides
Pavement Width	6.6 m
Parking	None
Sidewalks	1.8 m on both sides
Boulevards	2.0 m on both sides

UNIQUE STREET SECTION A - 17.8 m COLLECTOR BCS ROAD CROSSING

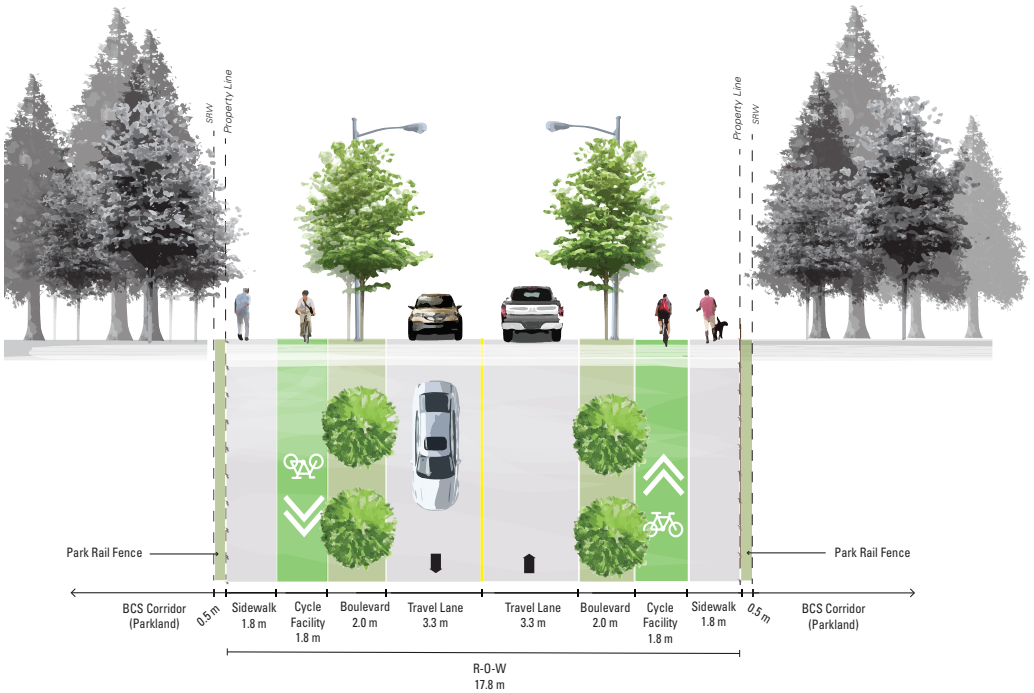


Figure 4.9 Collector BCS Road Crossing - 17.8 m Cross-section

4.4.2 Unique Street Section B

This is a modification to a standard local road, to be used where the road crosses a BCS corridor.

Dedication	13.6 m
SROW	0.5 m on both sides
Pavement Width	6.6 m
Parking	None
Sidewalks	1.5 m on both sides
Boulevards	2.0 m on both sides
Street Lighting	Both sides

UNIQUE STREET SECTION B - 13.6 m LOCAL BCS ROAD CROSSING

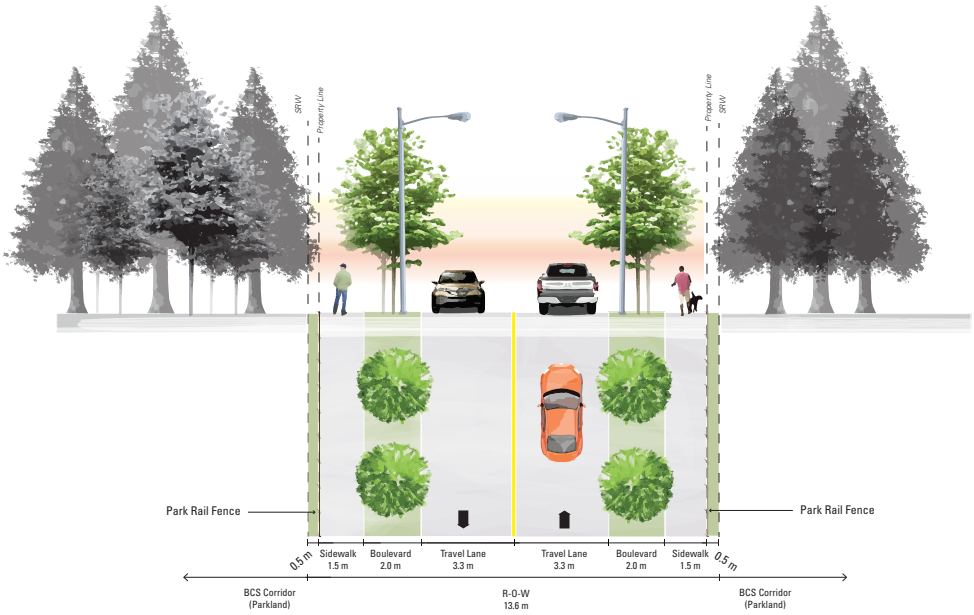


Figure 4.10 Local BCS Road Crossing 13.6 m Cross-section

4.4.3 Unique Street Section C

This is a modification to a standard local road, to be used where the road parallels a biodiversity corridor. All boulevard features are eliminated on one side to minimize biodiversity impacts with 8.25 m pavement. Full road construction cost are to be absorbed by cluster development.

Dedication	13 m
SROW	0.5 m on both sides
Pavement Width	8.25 m
Parking	One Side
Sidewalks	1.5 m on one side
Boulevards	3.25 m on non-park side
Street Lighting	One side

UNIQUE STREET SECTION C - 13 M LOCAL ROAD ADJACENT TO BCS CORRIDOR

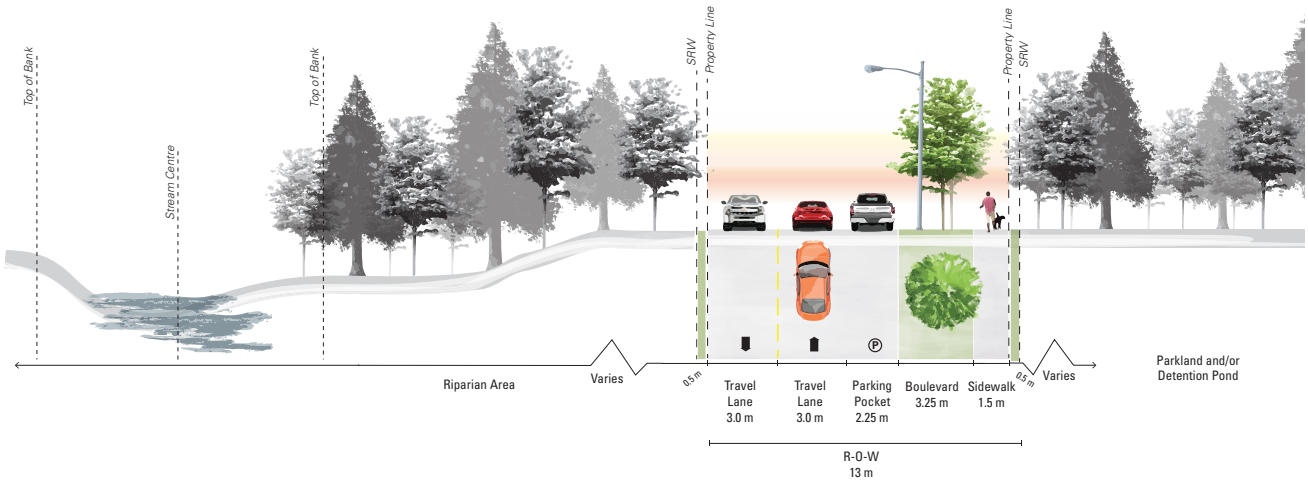


Figure 4.12 Local Road Adjacent to BCS Corridor 13 m Cross-section

4.4.4 Unique Street Section D

This is a modification to a standard local road, to be used in the Mixed-Use Commercial Village area as a High Street standard. Boulevard is an urban condition with protected trees. Planted curb bulges at all intersections. Adjacent buildings are set back 2.0 m to accommodate on-site weather protection and allow for retail supporting street furniture.

Dedication	20 m
SROW	0.5 m on both sides
Pavement Width	11.6 m
Parking	Parallel parking on both sides
Sidewalks	2.0 m on both sides (Structural soil under sidewalk)
Boulevards	2.5 m on both sides, hard surfaced with treed planting pockets (Structural soil under hard surface)
Street Lighting	Pedestrian lighting on both sides

UNIQUE STREET SECTION D - 24A AVE COMMERCIAL VILLAGE HIGH STREET

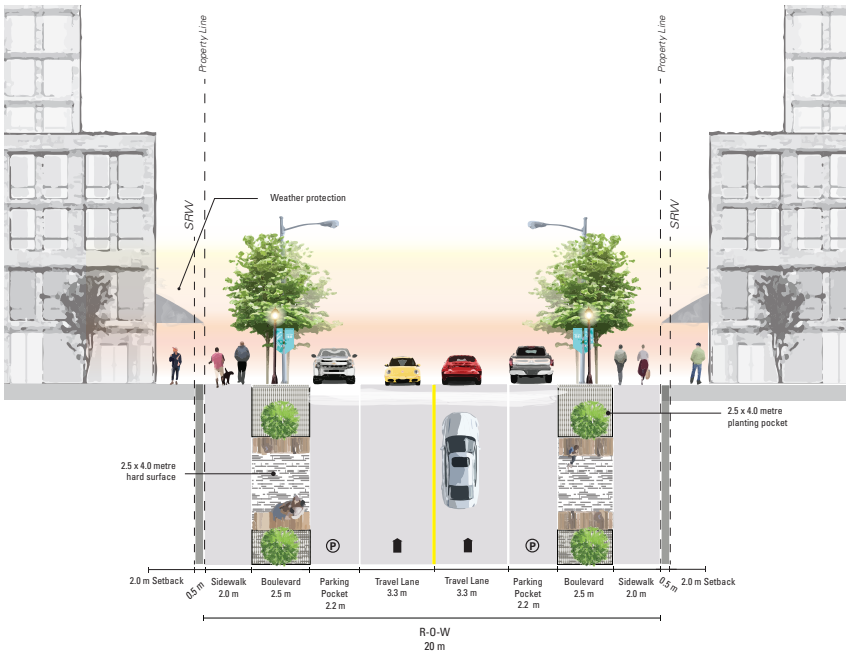


Figure 4.13 24A Ave Commercial Village High Street with Parking 20 m Cross-section

4.4.6 Unique Street Section E

This is a pedestrian-only street that accommodates a paved pathway, lighting, and grassed boulevards with trees.

Dedication	10 m
SROW	n/a
Pavement Width	n/a
Parking	n/a
Multi-use Pathway	4.0 m
Street Lighting	Pedestrian lighting on both sides (except where adjacent to parkland)

UNIQUE STREET SECTION E - 10 M PEDESTRIAN STREET

Figure 4.14: 10 m Pedestrian Street

4.5 ACTIVE TRANSPORTATION

WALKING NETWORK

As per the City's Engineering standards, all roads identified within the Redwood Heights NCP are planned to support safe and comfortable routes for pedestrians and to promote walking. The following features will be implemented within the NCP:

- All roads will have either concrete sidewalks on both sides of each road and/or asphalt multi-use pathways.
- Sidewalks and multi-use pathways are separated from vehicle traffic by boulevards with trees.
- 1.5 m sidewalks on both sides of local roads
- 1.8 m sidewalks on both sides of Arterial and Collector Roads.
- Enhanced sidewalks (2.0 m or greater) in areas of high pedestrian demand (e.g. adjacent to schools or commercial areas).
- Construction of the sidewalk and protected cycling facility on 24 Ave in conjunction with adjacent development (in advance of Capital Construction of ultimate road)
- Enhanced pedestrian street lighting along identified multi-use pathways.
- Off-street multi-use pathways of sufficient dedication (minimum 8.0 - 10 m) to maintain sight lines, accommodate street lighting, and comply with Crime Prevention Through Environmental Design (CPTED) principles.
- Encouraging lane access for single family lots with protected cycling facilities on their frontage to minimize the number of driveway crossings.
- Where appropriate, curb bulges at all intersections to narrow pedestrian crossing distances.
- With the grid road network system and diverse land use the plan area will result in a highly walkable neighbourhood with most people in the plan area being within a 10 -15 minute walk of transit, parks, schools, and retail areas.

CYCLING NETWORK

Protected Cycling Facilities (Cycle Tracks)

The City is moving towards a standard that replaces on-street bike lanes on both sides of arterial and collector roads with one-way protected cycling facilities (commonly referred to as cycle tracks). The City's Vision Zero Safe Systems approach for road design identifies that providing separation for cyclists from vehicles reduces the severity of collisions as cyclists are a vulnerable road user. This approach is consistent with the Complete Streets approach to road design to provide physically separated cycling facilities. This approach facilitates an attractive and safe corridor for cyclists of all ages and abilities.

As a result all Collector and Arterial roads will ultimately have one-way protected separated cycling facilities. Where cycling facilities intersect, protected intersection design will allow for full movement turns for cyclists.

Multi-Use Pathways

A multi-use path network has also been developed, and will provide off-street cycling connections. Multi-use pathways are asphalt and shared by cyclists, pedestrians, and other forms of non-motorized transport. In addition to paralleling streets, a diagonal pathway is also planned along the northeast ALR boundary. Off-street path designs include street lighting and either one or two boulevards, to maximize safety and security in keeping with Crime Prevention Through Environmental Design (CPTED) principles.

The Multi-use pathways will compliment protected cycling facilities and provide a comprehensive cycling network that will allow for the whole plan area to be within approximately a 10 -20 minute bike ride. Additionally these facilities will accommodate new micro-mobility technology solutions such as electric assist bike and scooters.

Figure 4.15: Bicycle and Pedestrian Network

4.6 TRANSIT

24 Avenue

The transit plans for Surrey are guided by TransLink's South of Fraser Area Transit Plan (SoFA TP). The SoFA TP, developed in 2007, was a plan for transit service up to 2031. The plan first identified the need for transit service in the emerging Grandview Heights area which led to the introduction of Route 531 with service from White Rock Centre (Semiahmoo Town Centre) to Langley Centre via 24 Avenue.

The SoFA TP identified that due to the central location of 24 Avenue along with the planned growth in the area, 24 Avenue would also be a good candidate for future increases in service levels up to the Frequent Transit Network (FTN). The FTN provides a minimum of 15 minutes frequency from 6:00 am Monday to Friday, 7:00 am Saturday, and 8 am Sundays and Holidays until 9:00 pm.

Looking beyond 2031 and with the ultimate build out of the entire Grandview Heights area, 24 Avenue is a good candidate corridor for a higher order of transit service including Rapid Bus. The corridor is consistent with TransLink's Service Guidelines for Demand Oriented Service that identify the 6Ds which are:

- Destinations: There are major destinations anchoring and along the corridor, which include Semiahmoo Town Centre, Campbell Heights and Langley Centre.
- Distance: A well connected street network that is highly walkable and has a high intersection density exists along the corridor. All of the land use plans along 24 Avenue maintain the principles of the grid road network with 100m by 200m block spacing.
- Design: The corridor is multi-modal. 24 Avenue is planned for sidewalks and cycling facilities inviting all active modes of transportation.
- Density: There is transit supportive densities along the corridor. The highest intensity of multi-family residential is located within 800m (10 minutes) walking distance of 24 Avenue.
- Diversity: There is a mix of land uses along the corridor. 24 Avenue already has residential, commercial, employment, and institutional throughout Grandview and Campbell Heights.
- Demand Management: Transit oriented measures are used to discourage unnecessary driving. Considerations for parking relaxations along corridor will be provided on a case by case basis. In consideration of this, 24 Avenue will be protected for future dedicated curb side bus lanes with the existing 37 metre wide road allowance. Ultimate stop locations for a potential Rapid Bus service will be determined in the future once it is identified in a future TransLink Investment Plan

Community Level Service

With numerous collector roads serving the area and a need for north south service protection for a potential route on 20 Avenue, service along 178 Street and 26 Avenue is planned for. This service could ultimately connect Sunnyside Heights with Redwood Heights and potentially extend north to Cloverdale in the future.

Potential Stop Locations

Existing and potential stop locations along with the routing options are identified in figure 4.16.

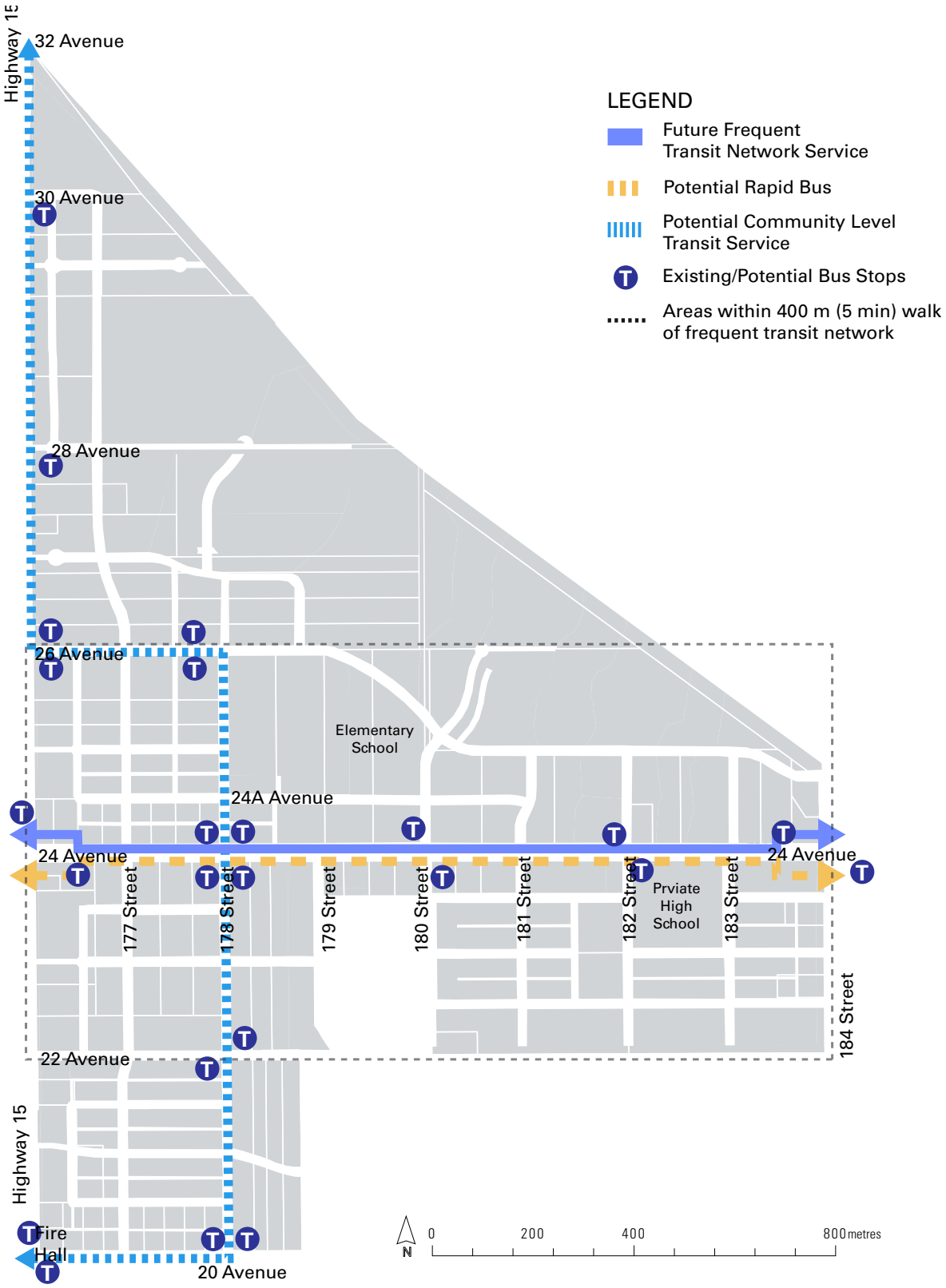


Figure 4.16 Transit Network

4.7 TRAFFIC CONTROL MANAGEMENT

SIGNALIZED INTERSECTIONS

Consistent with typical practice, traffic signals are planned at all arterial-arterial and arterial-collector intersections. The traffic signals are typically installed on an engineering warrant basis which includes a criteria of traffic volumes, pedestrian demand, and safety assessments. The typical spacing for signalized intersections on the main arterial of 24 Avenue is roughly every 400 metres (two blocks) with one additional signal at 177 Street. This is standard signalized intersection spacing and can easily be coordinated through the City's Traffic Management Centre.

ROUNDABOUTS

Single lane roundabouts are planned at the collector-collector intersections as they reduce the number and severity of potential collision points at intersections and therefore satisfy the Vision Zero Safe Systems approach to Road Design. Roundabouts also have the added benefit of being generally more efficient. Roundabouts will generally be installed when the required land is secured through adjacent development and when warranted.

ACCESS RESTRICTIONS

Left turning movements will be restricted at highway-local and arterial-local intersections where traffic controls are not anticipated and consistent with the City's Design Criteria requirements for access management. Right turns into and out of the local road will be permitted to improve overall safety and efficiency of these intersections.

HIGHWAY 15 AT 26 AVENUE

The City envisions the need for a traffic signal at the intersection of Highway 15 and 26 Avenue to facilitate turning movements. 26 Avenue is an important collector road for Redwood Heights and will act as a critical alternate route to 24 Avenue for circulation and distribution of traffic throughout the neighbourhood.

As Highway 15 is within the jurisdiction of the Ministry of Transportation and Infrastructure (MoTI), the proposed signalized intersection of 26 Avenue and Highway 15 was brought forward for their review. MoTI indicated that their practice was for signalized intersections no closer than every 800 metres and to avoid signals on steep grades due to higher truck volumes.

In support of the review for the intersection traffic modeling, analysis was conducted on future transportation network scenarios both with and without this intersection. The analysis results indicated that the signalization of 26 Avenue at Highway 15 provided an overall benefit to the surrounding network by improving travel times along the Highway 15 corridor as it relieved congestion (and number of turning movements) at both the 24 Avenue and 32 Avenue intersections.

MoTI has currently indicated that they will review the installation of a signalization intersection in the future. In consideration of the benefits to both the plan area and the Highway corridor, the signal is proposed at this intersection in the future.

Figure 4.17: Traffic Control Management

4.8 COSTS & FINANCING

Tables 4.1 and 4.2 provides details of the DCC-eligible projects and estimated costs.

ARTERIAL ROADS - DCC-ELIGIBLE TRANSPORTATION SERVICING COSTS

Arterial Road	Unit Price	Quantity	Portion to Redwood Heights	Cost to Redwood Heights
24 Avenue, 168 Street to Highway 15 (interim 4 lane)	$6700/metre	1600 metres	50%	$5,360,000
24 Avenue, Highway 15 to 184 Street (interim 4 lane)	$6700/metre	1600 metres	100%	$10,720,000
24 Avenue, 184 Street to 188 Street (interim 4 lane)	$6700/metre	800 metres	50%	$2,680,000
24 Avenue, Wildlife Crossing	$2500/metre	40 metres	100%	$100,000
184 Street, 16 Avenue to 22 Avenue	$9500/metre	1200 metres	100%	$11,400,000
184 Street, 22 Avenue to 25 Avenue	$9500/metre	600 metres	100%	$5,700,000
184 Street, 25 Avenue to 32 Avenue	$9500/metre	800 metres	100%	$7,600,000
32 Avenue, 168 Street to Highway 15	$9500/metre	1600 metres	50%	$7,600,000
20 Avenue / Highway 15 Traffic Signal (modification)	$300,000	1	100%	$300,000
24 Avenue / Highway 15 Traffic Signal (modification)	$300,000	1	100%	$300,000
26 Avenue / Highway 15 Traffic Signal (addition)	$300,000	1	100%	$300,000
24 Avenue / 177 Street Traffic Signal	$300,000	1	100%	$300,000
24 Avenue / 178 Street Traffic Signal	$300,000	1	100%	$300,000
24 Avenue / 180 Street Traffic Signal	$300,000	1	100%	$300,000
24 Avenue / 182 Street Traffic Signal	$300,000	1	100%	$300,000
24 Avenue / 184 Street Traffic Signal	$300,000	1	100%	$300,000
25 Avenue / 184 Street Traffic Signal	$300,000	1	100%	$300,000
20 Avenue / 184 Street Traffic Signal	$300,000	1	100%	$300,000
TOTAL				$54,160,000

Table 4.1 DCC-Eligible Transportation Servicing Costs - Arterial Roads

NON-ARTERIAL ROADS - DCC-ELIGIBLE TRANSPORTATION SERVICING COSTS

Non-Arterial Road	Unit Price ($/m)	Quantity	Portion to Redwood Heights	Cost to Redwood Heights
20 Avenue, Highway 15 to 184 Street	$1,600	1600 metres	50%	$1,280,000
26 Avenue, Highway 15 to 184 Street	$1,600	1600 metres	100%	$2,560,000
177 Street, 24 Avenue to 30 Avenue	$1,600	1200 metres	100%	$1,920,000
30 Avenue, Highway 15 to 177 Street	$1,600	200 metres	100%	$320,000
178 Street, 20 Avenue to 26 Avenue	$1,600	1200 metres	100%	$1,920,000
180 Street, 20 Avenue to 22 Avenue	$1,600	400 metres	50%	$320,000
180 Street, 22 Avenue to 25 Avenue	$1,600	600 metres	100%	$960,000
182 Street, 22 Avenue to 25 Avenue	$1,600	600 metres	100%	$960,000
20 Avenue / 180 Street Traffic Signal	$300,000	1	100%	$300,000
20 Avenue / 178 Street Roundabout	$650,000	1	100%	$650,000
26 Avenue / 177 Street Roundabout	$650,000	1	100%	$650,000
26 Avenue / 178 Street Roundabout	$650,000	1	100%	$650,000
25 Avenue / 180 Street Roundabout	$650,000	1	100%	$650,000
25 Avenue / 182 Street Roundabout	$650,000	1	100%	$650,000
TOTAL				$13,790,000

Table 4.2 DCC-Eligible Transportation Servicing Costs - Non-Arterial Roads

Section 5

| Keeping it Green

Parks in Surrey are planned and designed though the lens of various plans, strategies and policies. These include the Parks, Recreation and Culture Strategic Plan, the Biodiversity Conservation Strategy (BCS) and Parks Design Guidelines along with various sub-plans and strategies including dog off-leash areas, playgrounds, natural areas and greenways.

5.1 Overview

Within Redwood Heights, there are two foundational principles that guide the planning of new parks and natural spaces.

1. To deliver local, neighbourhood parks for all future residents within a 10 minute walk (500m). This ensures everyone has access to public open space for relaxation, play and exercise in their day to day lives.

2. To protect the riparian areas and significant biodiversity hubs and corridors identified in the BCS that run through Redwood Heights connecting Redwood Park to the ALR lands to the north.

The Redwood Heights plan delivers on both of these principles through a comprehensive parks and natural areas network (Figure 5.1). The network features eight new active park sites, along with a large biodiversity hub and a central north-south linear biodiversity corridor that links to Redwood Park. Park sites have been located adjacent to riparian areas, stormwater ponds and BCS areas to maximize opportunities for nature connectivity. All streams and riparian areas will also be conveyed to the City, to be protected and maintained as natural area parkland and biodiversity corridors.

Together, these parks, open spaces, stormwater ponds and landscape buffers total 49.10 hectares (121.32 acres) of green space. Publicly accessible space on private property (such as corner plazas) are in addition to this.

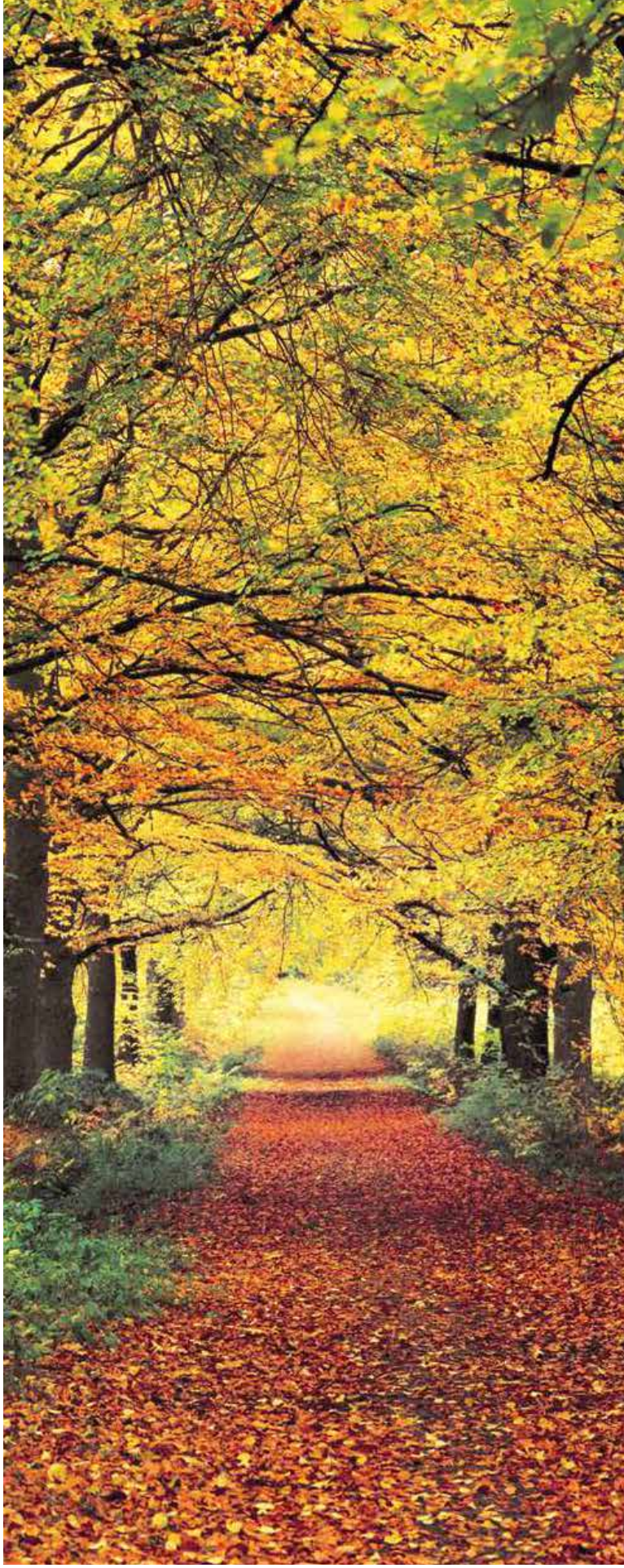


Figure 5.1: Parks and Open Space Strategy

5.2 Parks

COMMUNITY & NEIGHBOURHOOD PARKS

Community level parks provide a variety of amenities that attract residents from outside of their immediate neighbourhood, serving the broader community. The park at 26th Ave and 177 St is the largest park in Redwood Heights at 3.04 hectares (7.51 acres) and most central to the mixed-use village core of the area. It will likely contain active amenities, such as sports field(s), sports court(s), a playground, paths and seating opportunities. It will also be the feature gathering location for celebrations and active uses in the community.

Neighbourhood parks are typically smaller local parks that serve the open space needs of local residents and include amenities such as playgrounds, paths and seating, while in some cases also doubling as the location for detention ponds and protection of riparian areas. The plan will deliver several new neighbourhood parks to ensure that all future residents live within close proximity of parkland.

PARK DESIGN GUIDELINES

Successful parks are the result of meaningful consultation with neighbours and thoughtful planning and design. A key component of this design success is the interface with adjacent roads and private spaces. Development adjacent to parkland should positively contribute to design and function of each park by complying with the following guidelines:

GUIDELINE 1:

Development adjacent to, or across the street from all parks and public pathways should apply CPTED design principles such as unit orientation, clear sight lines, active rooms and windows facing public spaces. Adjacent commercial or retail developments should provide active frontage and avoid loading or other 'back of house' functions adjacent to public space.

GUIDELINE 2:

Multi-family development adjacent to parkland should orientate the front of units and incorporate main entry doors facing onto parkland. The private development should have a walkway on its property line to provide access to its parkland fronting units. Shrubbery to delineate private property is preferred over fencing. Fencing is discouraged, but if required, will be no more than 0.9 m high, visibly open and setback at least 1.0 m from the property line with landscaping in front of the fencing.

GUIDELINE 3:

Development should meet the existing natural grade of parkland. If retaining walls are required adjacent to parkland, they must be entirely on private property including any underpinning with all necessary setbacks required for maintenance of private property, such as machinery access.

GUIDELINE 4:

If rights of way for servicing or any other access (temporary or permanent) are required through existing or future parkland, compensation for the access and cash in lieu for the restoration re-planting are required, to Parks standard.

GUIDELINE 5:

Any development adjacent to an existing or future park must submit an arborist report including the first 15 m of land within the park and report on all trees 8.0 cm Diameter at Breast Height (DBH) or greater. Removal of any tree on parkland requires advanced written approval from the Parks Division.

GUIDELINE 6:

If any of the detention ponds that are adjacent to existing parkland are relocated through the development process, the equivalent park area outside the footprint of the detention pond must also be relocated or reallocated through the pond relocation process.

5.3 Natural Spaces

Redwood Heights is characterized as one of Surrey's most ecologically significant areas, with substantial mature forest, fish bearing creeks and a variety of wildlife habitat. Primary environmentally sensitive features identified within the NCP area include: a biodiversity hub and corridors, watercourses and riparian areas.

The proposed plan protects approximately 18 hectares (45 acres) of GIN land including approximately 50% of Hub H, an important hub in the BCS. The plan also protects the two aforementioned BCS corridors, which will be managed as natural area parkland.

There will be impacts on environmentally sensitive areas that require mitigation through the implementation of this plan. Development will abide by all required regulations, by-laws and policies, including the guidelines outlined within the plan.

The proposed underground piping for water, sanitary, and stormwater servicing will be mostly located within the proposed road network to minimize impact to natural areas. Underground utilities that are proposed along or across biodiversity corridors will be installed with minimal impact and with appropriate natural restoration to maintain functions as biodiversity corridors.

BIODIVERSITY CONSERVATION STRATEGY

The City's Biodiversity Conservation Strategy (BCS) was adopted in 2014 with the goal to preserve, protect and enhance Surrey's most sensitive biodiversity, an interconnected system of natural areas and open space, known as the Green Infrastructure Network (GIN). Protecting land within the GIN will provide long-term benefits to both wildlife and people.

Within the plan GIN area, north of 24 Avenue, is a large intact forest with mature trees of significant size, known as Hub H. Hub H contains terrestrial, riparian and stream habitat including conifer and mixed forest stands and Justin Brook, a fish-bearing creek.

The central terrestrial hub identified by the BCS is one of the most important in the City in terms of its biodiversity and ecological value. The protected hub will be approximately 14.2 ha (35 acres) in size in conjunction with the adjacent riparian areas. There will be limited public access in order to prioritize wildlife habitat protection and enhancement while still allowing for some educational and passive access to the area.

WETLANDS & WATERCOURSES

While there have been several assessments of wetlands and watercourses within Redwood, recent amendments to the Provincial Water Sustainability Act and Riparian Areas Protection Regulation required further analysis to ensure compliance with changes to Provincial legislation.

In December 2019, Dillon Consulting conducted an updated review and identified major wetland features and watercourses. However, it's important to note that the inventory identified conditions as of December 2019 and may not be comprehensive. Furthermore, ongoing changes to environmental conditions may impact existing channels and wetlands. As such, a Qualified Environmental Professional may be required to conduct further detailed review to identify and assess existing wetlands and watercourses, and the presence of potential wetlands and watercourses in accordance with current regulations prior to development.

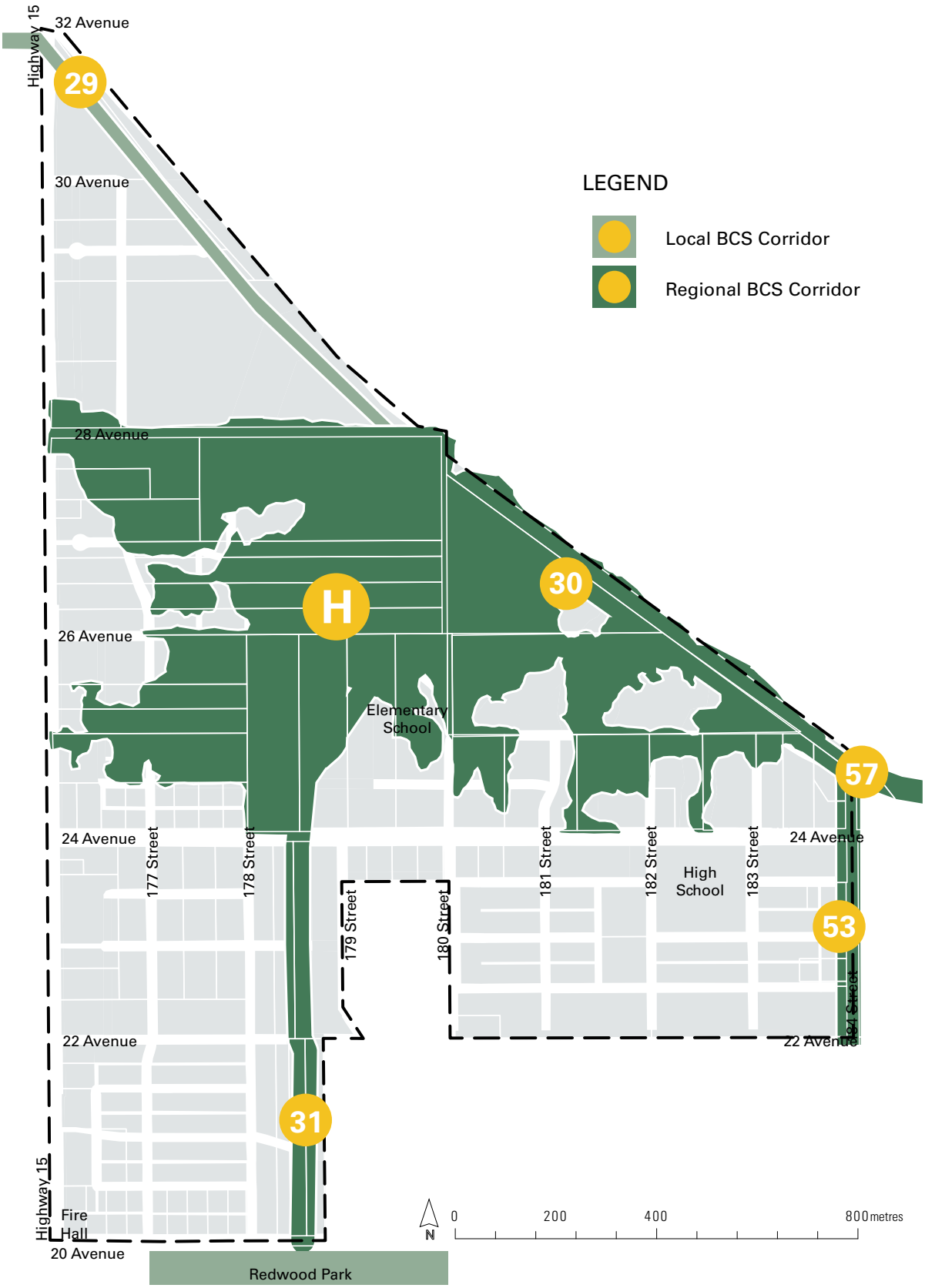


Figure 5.2 BCS Hubs and Corridor Areas

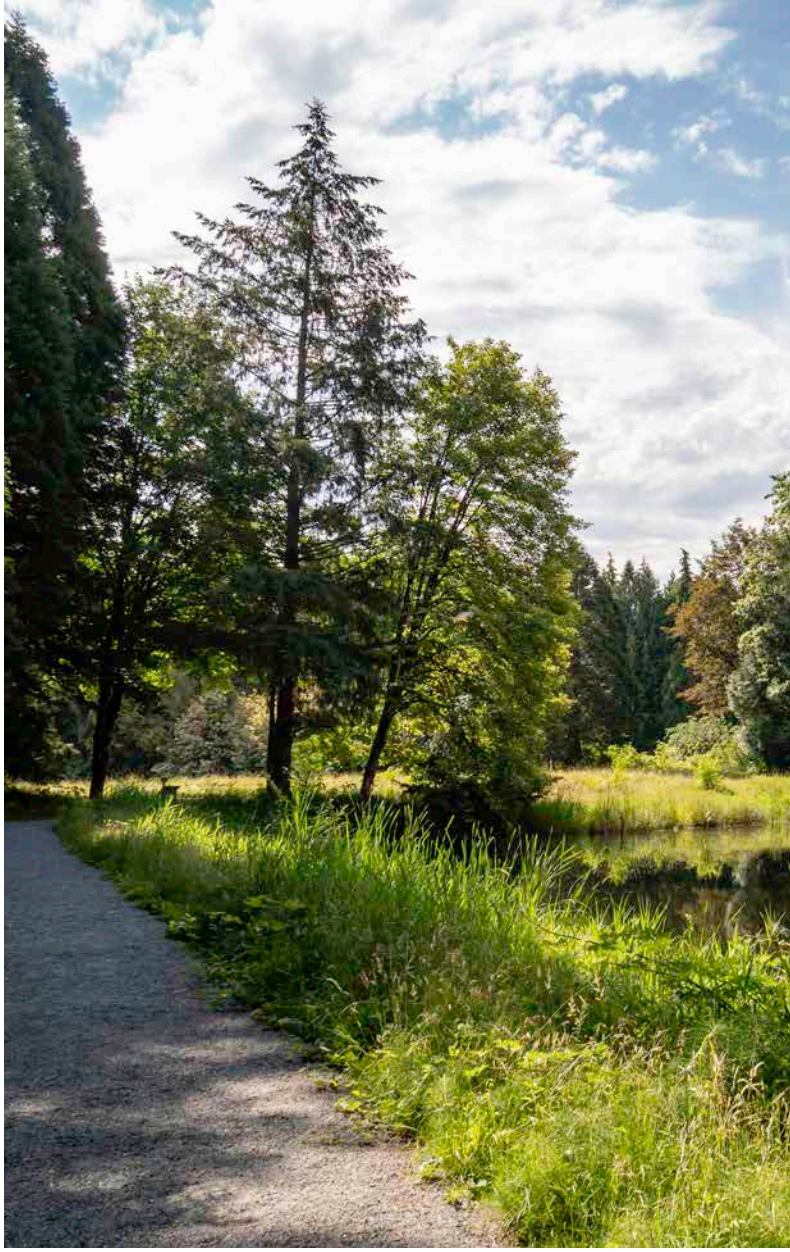
Figure 5.3 Wetlands and Watercourses

BIODIVERSITY CORRIDORS

Biodiversity corridors, as identified within the BCS, are intended to protect the intrinsic value of natural areas with a focus on ensuring habitat connectivity between larger ecosystems. Central to the plan area is a critical corridor connecting Redwood Park in the south with the protected biodiversity hub and ALR lands in the north. It will be a minimum of 50 m wide with limited public access. There will be special design cross sections where it crosses roads including a wildlife underpass crossing under 24 Avenue.

A second biodiversity corridor runs along the northern edge of the NCP, within the old railroad right of way and is primarily existing parkland. Riparian areas will also be conveyed and managed to protect fish and fish habitat values. Some riparian areas will have public paths along the outer edge, providing important off-street pedestrian connections while allowing for residents to engage and explore natural spaces in their neighbourhood.

Both biodiversity hubs and corridors will be managed as natural area parkland with a strong focus on habitat enhancement and protection.



WILDLIFE CORRIDOR CROSSING GUIDELINES

The following design elements should be considered for all wildlife crossing areas:

1. Wildlife Signage – to notify of typical wildlife that may be present in the area.
2. Fencing – drift fencing to direct wildlife to a crossing structure or location.
3. Road x-section – Review opportunities to narrow the road to minimize crossing distance. If typical road has a centre median, reposition median to the edges to minimize overall crossing distance.
4. Lighting – LED street lighting should be a light frequency tuned to minimize negative effects on wildlife.
5. Curbs – roll over curbs should be implemented to allow small mammals and amphibian to cross easier.
6. Wildlife crossing culverts – Fisheries culverts should be oversized to accommodate wildlife at low flows. Dry culverts should be installed to facilitate wildlife movement under the roadway.
7. Vegetation planting – plant native vegetation to provide maximum cover on either side of the road.
8. Trees – plant trees which provide large overhanging branches across the roadway to allow birds, insects and arboreal animals (e.g. squirrels) easy access limb to limb
9. Wildlife passage under 24 Avenue will be facilitated by a wildlife culvert for small mammal crossings with ultimate design influenced by Surrey's Biodiversity Design Guidelines under development in 2020 (See Figure 5.4).

24 AVE WILDLIFE UNDERPASS CONCEPT (37 m CROSS-SECTION

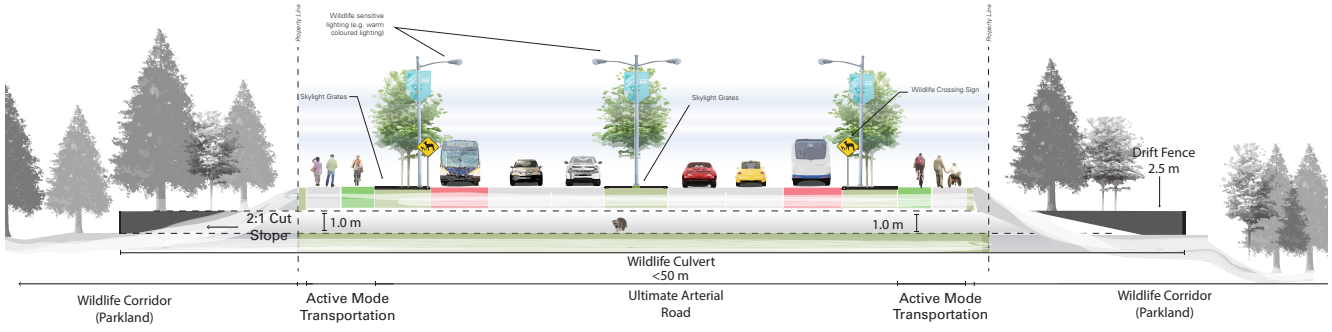


Figure 5.4 24 Ave Wildlife Underpass Concept

ENVIRONMENTAL GUIDELINES

The topography of the NCP slopes steeply northeast to low lying agricultural land, including several creek ravines. Most of the water flowing down this slope is conveyed to Erickson Creek, which flows out to the Nicomekl River.

The following environmental guidelines should be in effect in Redwood Heights:

GUIDELINE 1

Identified environmental features, including watercourses, treed areas, and open field habitat should be conserved and protected though Streamside Protection Areas and/or other conservation designations. Where the GIN runs through private property, the provisions of the Sensitive Ecosystem Development Permit Area should apply.

GUIDELINE 2

Recreation trails or pathways are encouraged adjacent to natural areas, provided the ecological integrity is not adversely affected by trail development and use. Significant tree removal must be avoided and additional native vegetative planting may be required.

GUIDELINE 3

Public access will be limited to sensitive natural areas where access is deemed detrimental to habitat integrity and viability.

GUIDELINE 4

Active park sites and community facilities are encouraged adjacent to conservation areas provided they do not adversely affect ecological integrity or viability.

GUIDELINE 5

Trees should be protected and preserved in accordance with the City's Tree Protection Bylaw.

GUIDELINE 6

All creeks within the NCP are protected by applicable streamside protection and enhancement areas.

GUIDELINE 7

All protected riparian areas should be conveyed at no cost to the City, through development, for their long term protection and management.

GUIDELINE 8

Where removal of natural vegetation through development is unavoidable, and approved by the City, on-site landscaping should predominantly use native species.

GUIDELINE 9

Control of sedimentation and erosion in runoff should be required during the construction of new development, in accordance with the City's Erosion and Sediment Control Bylaw.

GUIDELINE 10

All development applications should be reviewed with the intent of protecting and maintaining the environmental integrity and viability of natural features.

GUIDELINE 11

Installation of the sanitary trunk sewer, proposed at the base of the northeastern slope adjacent to the ALR, should minimize impact to natural watercourses through the use of trenchless construction technology. For utilities crossing Justin Brook, impact should be minimized by securing the pipes to the bridges that cross over the watercourse.

GUIDELINE 12

Construction of stormwater detention ponds should limit disturbance to the adjacent watercourses and limit the removal of forest vegetation. Any disturbed areas will be restored and enhanced through the planting of native species.

GUIDELINE 13

Integrate and implement approaches outlined in the City-wide Biodiversity Design Guidelines.

GUIDELINE 14

Prior to development a Qualified Environmental Professional should identify and assess wetlands and watercourses, as well as the presence of potential wetlands and watercourses, in accordance with current regulations.

5.4 Plazas

Plazas contribute to the livability of the public realm by encouraging social interaction and activity. Their central locations are fundamental to their intent as urban community gathering spaces.

Similar to parks, plazas require a strong program of use and design concept. Careful thought should be given to a plaza's principal function and its relationship with the adjacent public realm (i.e. streets, public parks), activities and architecture. Individual plazas function best as part of a hierarchy of open spaces within the neighbourhood open space network. Plazas should be delivered as publicly accessible open space through private development. Plaza design guidelines include:

GUIDELINE 1

Plazas should be a minimum of 100 sm.

GUIDELINE 2

Layout and site design should be planned comprehensively within identified sites to complement and extend public streets, pathways and parks, while also achieving maximum solar access.

GUIDELINE 3

Open space should be designed to serve specific functions and activities for adjacent buildings and support uses such as outdoor seating, eating and play.

GUIDELINE 4

Provide clear street visibility to indicate the space is public, and to encourage street activity and public safety. Avoid screening or blocking off the plaza from the street.

GUIDELINE 5

Grade at street level to avoid retaining walls, stairs and ramps in order to provide clear access for all.

GUIDELINE 6

Take advantage of distant views to mountains, agricultural land, and other landmarks wherever possible.

GUIDELINE 7

Plazas should be linked to surrounding open spaces, as well as interior spaces such as lobbies and adjacent retail, to create a more useful, dynamic, and coherent urban environment.

GUIDELINE 8

Integrate landscaping with shade trees and durable planting to soften the hardscaping. In-ground planters should be used instead of raised planters. Furthermore, rain gardens should be incorporated into the curb bulges at the Mixed-Use Village.

GUIDELINE 9

Plazas should maximize seating opportunities and comfort, including:

- opportunities for sitting walls, steps, planters, and feature edges;
- seating oriented to views, amenities or attractions;
- variety of seating types with opportunities for universal accessibility;
- comfortable seating with character elements (e.g. wood) seat backs and armrests; and,
- opportunities for weather protection, specifically sun and rain.

GUIDELINE 10

Plazas should be furnished with a variety of amenities to encourage public usage and to create a sense of liveliness and excitement. Key amenities can include bike racks, drinking fountains, tables and chairs, games and public art.

GUIDELINE 11

Successful plazas are generally characterized by multiple activity generators, such as adjacent food and retail outlets, as well as entertainment, which attracts users and encourages socializing and relaxation. Provide infrastructure for events (e.g. electrical outlets, water supply and lighting) and to facilitate activity.

GUIDELINE 12

Plazas delivered as publicly accessible open space within development should be oriented towards multi-family outdoor amenity space at 50% ratio.

Section 6

The Nuts and Bolts

Future population growth in Redwood Heights will require improvements to utility infrastructure, including water, sanitary and drainage systems.

6.1 EXISTING DRAINAGE

The Redwood Heights NCP area is approximately 210 hectares in size and is located within the Erickson Creek watershed.

Stormwater in the area generally flows north east towards Erickson Creek which drains through the ALR to the Nicomekl River. The ALR begins at the north east border of the NCP area and is sensitive to flooding caused by increased flow rates and volumes.

The NCP area is currently comprised of single family residential lots, many of which are over one acre in size. The land has significant grass and tree cover, promoting rainwater capture, infiltration, and natural attenuation of flows. There is minimal drainage infrastructure within the study area. Local drainage is accomplished by roadside ditches with driveway culverts and intermittent stormwater pipes that convey flow to the various watercourses.

Drainage flows north east towards Justin Brook and several smaller tributaries, most of which flow into Erickson Creek. A floodbox and pump station outfall arrangement located downstream within the agricultural lowlands conveys flows into Nicomekl River.

SOIL CONDITIONS

The NCP Stage 1 and Erickson Creek Integrated Stormwater Management Plan (ISMP) indicate that the soils in Redwood Heights generally consist of peat underlain by clay deposits, which are often saturated. Infiltration of annual rainfall and stormwater on a mid to large scale was not deemed feasible. Investigations in the NCP Stage 2 confirmed these findings.

As part of NCP Stage 2, geotechnical exploration was conducted to confirm soil and groundwater conditions and infiltration potential. Surface organics and fill were encountered to a depth of 0.6 m, with stiff silt mixed with trace sand and gravel below. Groundwater was not encountered in the 1.5 m deep test pits. Percolation tests were conducted in the silt layer of all test pits, yielding an average percolation rate of 1.5 mm/hr, which were reported as typical for stiff silt. This is generally considered low permeability and, therefore, poor infiltration capacity. As a result, full infiltration is not a viable option for the NCP area.

The presence of a thick layer of organics at the surface indicates potential for significant rainfall capture and low surface runoff rates. The low permeability layer beneath indicates that there is little deep aquifer percolation. It is expected that the organic layer absorbs water and provides a subsurface flow path for water to gradually reach a point of seepage or discharge into a receiving water course. This is known as base flow or interflow and is an important component of the area's hydrology.

Future development will likely strip the organics layer in favour of the more structural soil, but with less permeability. This will interrupt the existing rainfall capture and interflow patterns which will require mitigation to protect downstream infrastructure, agricultural lands, streams / channels, and aquatic habitat. Approaches that retain rainwater from smaller rainfall events and simulate the interflow process, such as Low Impact Development techniques, should be included as part of the overall drainage servicing strategy for Redwood Heights.

6.2 DESIGN CRITERIA & ANALYSIS

Design criteria and targets for peak flow conveyance, runoff rate control, and runoff volume control were obtained from the City's 2016 Design Criteria Manual, the Erickson Creek ISMP, and the NCP Stage 1 Plan. Further hydraulic analysis was completed under the NCP Stage 2 using advanced modeling software. A control point was established for each catchment at its downstream point of discharge. These points were used to compare pre and post development flow rates and volumes.

6.2.1 Conveyance

The City requires that the minor, piped systems have a minimum capacity for the 5-year return period flow. The 100-year return period flow is allowed to surcharge to the surface as long as there is an adequate surface flow route to a safe discharge point.

Having the potential for in-ground basements requires the minimum basement elevation to be at least 0.3 m above the 100-year hydraulic grade line, which precludes the possibility of using a surface flow route for the 100-year flow. A piped system must be designed to have capacity for the 100-year return period flow and a minimum depth of cover of 2.5 m to allow for in-ground basements for single family dwellings in the Redwood Heights NCP area.

6.2.2 Runoff Rate

Future development will increase impervious area, thus increasing peak runoff rates as well as runoff volume. Increased runoff rates have the potential to overload downstream infrastructure and conveyance channels and cause flooding during the peak of a storm event. Controlling the peak runoff rate is typically accomplished by temporarily storing runoff in a pond during peak flows and slowly releasing it.

The runoff rate targets for the Redwood Heights NCP were established using the City's Design Criteria Manual, as being the more stringent of:

- Control the 5-year post-development flow to 50% of the 2-year post-development rate, or
- Control the 5-year post-development flow to the 5-year pre-development flow rate.

Both criteria were applied to the 1, 2, 6, 12, and 24-hour duration storms for the given return periods. For this analysis, pre-development conditions refer to existing conditions as recommended as a basis of comparison in the Erickson Creek ISMP. It was found that the first criterion and the 24-hour duration storm were limiting for all catchments. A design concept was chosen to satisfy all criteria.

Stormwater storage facilities (detention ponds) are designed as wet ponds using an active storage depth of 1.5 m and a permanent water depth of 1.5m, as per the City's Design Criteria. The maximum side slopes of 4:1 are used for this design to minimize the total footprint area required for the pond.

Ponds are generally placed near the downstream point of every catchment to service as much of the catchment as possible. Not all areas will be serviced by a pond; areas not serviced are assumed to generate uncontrolled runoff. The ponds in such catchments will, therefore, over-detain the rest of the catchment so that the overall release rate meets the required target. In such instances, any development located downstream of a detention pond cannot proceed prior to construction of the upstream pond.

Minimizing any increases in flooding of the sensitive ALR lands directly downstream of Redwood Heights was a design consideration. The summer and winter storms in the BC Agricultural and Rural Development Subsidiary Agreement (ARDSA) criteria were simulated under pre-development and post-development conditions and results tabulated to confirm that downstream infrastructure will be able to handle the post development flows.

Pre-development and post-development runoff rates from single event storms were obtained by computational modeling. Table 8.1 presents results for the design criteria listed above. The control points listed are shown in Figure 8.1. It should be noted that the proposed drainage servicing changes the catchment area of each control point. However, this will not cause deleterious effects on the creeks as the post development runoff rates at each control point are adequately controlled to the original pre-development level.

EXISTING DRAINAGE

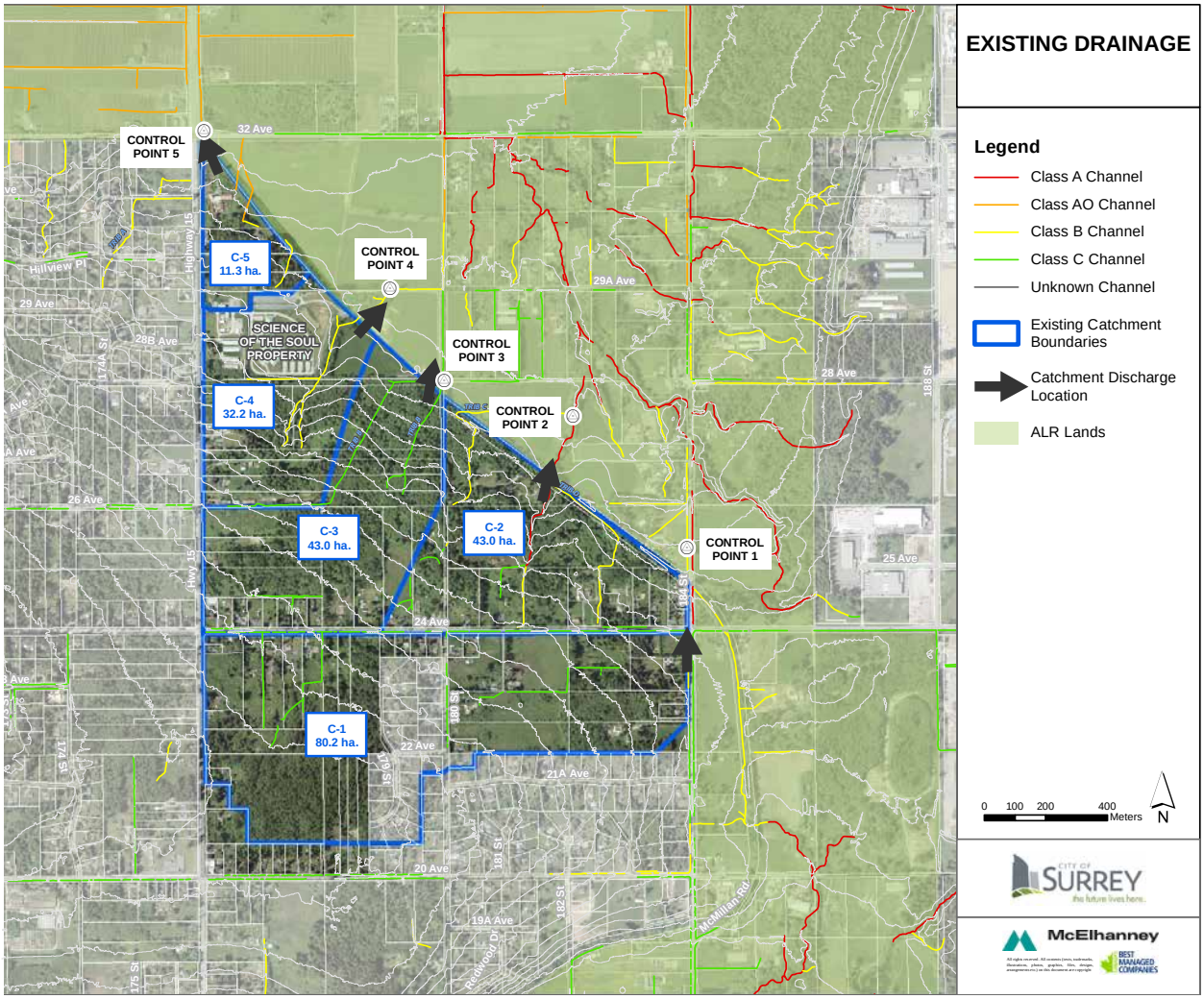


Figure 6.1: Existing Drainage

RUNOFF RATES

Control Point	5 Year Pre- development Runoff		50% 2 Year Post-development Runoff		100 Year Pre-development Runoff
	Area (ha)	Flow Rate (L/s)	Area (ha)	Flow Rate (L/s)	Flow Rate (L/s)
1	80.2	970	74.9	352	1910
2	43.0	670	45.9	209	1140
3	43.0	540	44.8	155	1060
4	32.2	420	36.6	143	810
5	11.3	170	14.6	78	300

Table 6.1 Runoff Rates

6.2.3 Runoff Volume

Development will convert a significant area of existing pervious and absorbent ground to impervious and unabsorbent surfaces. This will cause an increase in runoff volume and a decrease in infiltration. Increased runoff volume can increase erosion in downstream channels, pose a flooding risk to downstream agricultural lands, and place additional demand on farmland drainage infrastructure. Decreasing infiltration also reduces summertime baseflows in downstream channels which has a negative impact on its ecosystem.

The Erickson Creek ISMP and NCP Stage 1 completed a water balance model to estimate the fraction of annual rainfall that produces runoff. The results indicate that 29% of annual rainfall currently produces runoff while 15% infiltrates and the remainder evapotranspirates. Under post-development conditions, there is limited capability to retain significant vegetation cover and evapotranspiration. As a result, 71% of the total annual rainfall volume is required to infiltrate in the post-development scenario as determined by computational hydrologic modeling using recorded rainfall data.

NCP Stage 1 recommended several low impact development (LID) strategies for meeting the runoff volume target. The most practical are 450 mm of topsoil and other absorbent landscaping, disconnected roof leaders, permeable paving, infiltration swales, and infiltration trenches.

Infiltration swales and trenches were designed and modeled with an underflow designed to take the LID from full to empty within 3 to 4 days after the storm ends. This will allow the storage capacity of the LIDs to be available to capture volume from subsequent rainfall events while providing a slow release of runoff that mimics base flows. As a result, nearly every storm will have a significantly reduced runoff volume.

6.2.4 Methodology

Hydrologic and hydraulic modeling was carried out with PCSWMM software. Various inputs to the model were required, as presented in Table 6.2. Soil parameters were chosen based on the geotechnical investigation as well as information presented in the Erickson Creek ISMP and the NCP Stage 1. A conservative infiltration rate was chosen to account for clogging that may reduce infiltration rates over time.

Impervious Manning's Number	0.013
Pervious Manning's Number	0.035
Impervious Depression Storage (mm)	1.5
Pervious Depression Storage (mm)	7
Zero Impervious Depression Storage (%)	0
Green-Ampt Conductivity (mm/hr)	1.2
Green-Ampt Suction Head (mm)	239
Green-Ampt Initial Moisture Deficit (frac)	0.091

Table 6.2 Hydrologic and Hydraulic Modeling Inputs

6.2.5 Single Event Modelling

Single event modeling was used to assess the performance of the proposed conveyance and detention infrastructure in safely passing the 100-year flow without surcharging and controlling the 5-year flow to the established target. The winter and summer ARDSA storms were modeled to assess flooding impact on downstream agricultural lowlands.

Design storms were obtained from the City of Surrey's Design Criteria Manual for the Municipal Hall station. The 2, 5, and 100-year return period and 1, 2, 6, 12, and 24-hour duration storms were used to assess the performance of the proposed design.

A detailed hydrologic and hydraulic model was created with sub-catchments representing various areas within each major catchment. Trunk sewers were modeled to confirm pipe sizes and slopes to convey the required flow and sewer depths and grades were reviewed to confirm alignments, basement potential and congruency with sanitary sewer alignments.

6.2.6 Continuous Simulation

Continuous simulation was used to prepare a water balance analysis to assess the performance of the specified LIDs to reduce runoff volume by infiltration and evapotranspiration.

A geotechnical investigation indicated an average percolation rate of 1.5 mm/hr based on 4 test holes within Redwood Heights. A factored and conservative value of 1.2 mm/hr, characteristic of sandy clay, was specified to model the infiltration capacity over the site.

Monthly evapotranspiration averages obtained from Environment Canada were used to model evapotranspiration losses from the catchment. Hourly rainfall data collected between 1963 and 1999 for the Municipal Hall station was used in the continuous simulation.

A catchment level water balance model was developed to represent the post-development major catchments. On-lot and off-lot LIDs were applied to this model to confirm that volume reduction targets were achieved.

Water that exited the model via a LID underdrain was counted as runoff and did not count towards volume reduction. Runoff was routed through on-lot LIDs and then through off-lot LIDs as appropriate, bearing in mind that not all runoff will be intercepted by a particular LID.

6.3 PROPOSED DRAINAGE SYSTEM

The proposed drainage system is specified to achieve the targets and criteria to mitigate and reduce the impacts to downstream infrastructure and habitat by reducing discharge rates and volumes. Catchment sizes and boundaries are kept as similar to existing as possible in order to maintain current flow patterns. The main components comprising the drainage system proposed for the Redwood Heights NCP include:

- Underground storm sewer system to collect and convey runoff from the various lots proposed within the neighbourhood;
- Detention ponds to control post-development flows to established rates for the 5-year return period; and
- Low impact development (LID) measures located throughout the development to provide stormwater retention in order to meet runoff volume targets.

The proposed drainage system for the NCP area has 5 drainage catchments and 4 detention ponds, as shown in Figure 6.2.

POND INFORMATION SUMMARY

Pond #	Pond Catchment Area (ha)	Pond Volume (m3)	Unit Storage (m3/ha)	Area at High Water Level (ha)	5-year Release Rate (m3/s)
1	68.8	14,000	205	1.15	0.32
2	38.3	8,500	221	0.73	0.18
3	29.1	11,200	384	0.93	0.03
4	23.8	5,900	247	0.53	0.10

Table 6.3 Pond Information Summary

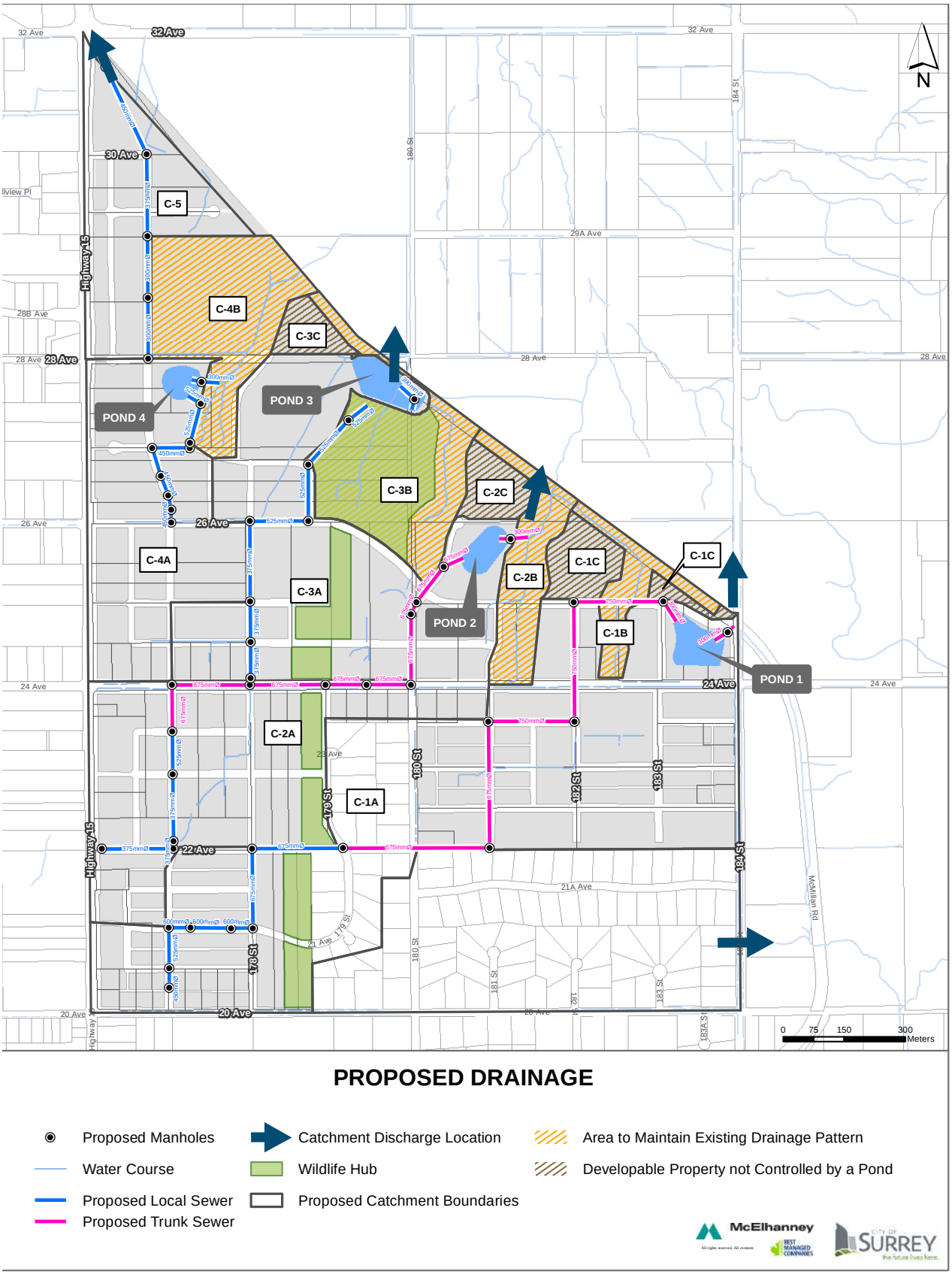


Figure 6.2 Proposed Drainage

6.3.1 Runoff Rate Control

Runoff rates from Redwood Heights will be controlled by detention ponds for the majority of the areas, with the exception of Catchment 5 and several areas downstream of proposed ponds that will be controlled through the use of on-lot and off-lot LIDs. All detention ponds will be designed as wet ponds to promote stormwater treatment through settling of suspended solids during and between rainfall events.

Some catchments contain properties that are unable to drain to the detention pond and will, therefore, discharge uncontrolled into the receiving water course. Over-detention will be used to compensate for uncontrolled runoff so that the total runoff rate meets the requirement.

Some catchments also contain areas designated as riparian or wildlife hubs which are not designated for development. Table 6.3 shows the area of each catchment and Figure 6.2 shows the catchment areas, proposed pond locations, control points, and areas not serviced by a pond.

CATCHMENT 1

Catchment 1 has 72.4 ha of developable land and will drain into a Class B ditch on the west side of 184 Street. Control Point 1 is located in this ditch immediately downstream of the NCP boundary. Pond 1 will require a total storage volume of 14,000m3 and will control approximately 68.8 ha of Catchment 1. The remaining 3.6 ha will run off uncontrolled so that the total peak runoff rate from the 5-year 24-hour storm will be less than 352 L/s.

Control Point 1 drains 74.9 ha of developable and riparian area. Catchment 1 contains 12 ha of land that was not included in the NCP area, but will drain to Pond 1. For design purposes, this land was assumed to be a mix of park, residential, and commercial property with an average imperviousness of 65%.

CATCHMENT 2

Catchment 2 has 40.7 ha of developable land and will drain into a Class A watercourse called Justin Brook which passes through Control Point 2 just downstream of a confluence with a Class B water course. Pond 2 will require a total storage volume of 8,500m3 and will control approximately 38.3 ha of Catchment 2. The remaining 2.4 ha will run off uncontrolled so that the total peak runoff rate from the 5-year 24-hour storm will be less than 209 L/s. Control Point 2 drains 45.9 ha of developable and riparian land.

CATCHMENT 3

Catchment 3 has 31.0 ha of developable land and will drain into Tributary B which is a Class C channel that passes through Control Point 3. The west fork of Tributary B will be diverted to a proposed piped stormwater system on 26 Avenue to accommodate development. The piped flow will then drain to the east fork of Tributary B, which then flows northward to the proposed detention pond for the catchment. Tributary B has insignificant aquatic habitat so eliminating a portion of the watercourse has little environmental impact.

Pond 3 will require a total storage volume of 11,200m3 and will control runoff from the approximately 29.1 ha of Catchment 3, while the remaining 1.9 ha will run off uncontrolled. Pond 3 will over-detain the runoff from the 29.1 ha to compensate for the uncontrolled 1.9 ha. The total runoff rate from Catchment 3 during the 5-year 24-hour storm will be less than 155 L/s. Control Point 3 drains 44.8 ha of land including the developable land and the riparian areas for the remaining water courses and wildlife hub. Flow from Catchment 3 will contribute to Justin Brook, a Class A watercourse further downstream.

CATCHMENT 4

Catchment 4 will drain into Tributary A which is a Class B channel and passes through Control Point 4. Runoff from Catchment 4 is controlled by Pond 4 which requires a total 5-year storage volume of 5,900m3 and is constrained to release runoff from the 5-year 24 hour storm at 143 L/s.

The Science of the Soul property (2932 176 Street) north of Pond 4 and west of Tributary A is also in the tributary; it currently has a stormwater control. It is recommended that any future development on the Science of the Soul property be mandated to control their own runoff rate and volume to the current values.

The riparian area around Tributary A will maintain pre- development conditions and will therefore not require any control. Catchment 4 is 23.8 ha which

does not include the Science of the Soul property or the riparian area as these areas will not be routed to the proposed detention facility. Control Point 4 drains a total of 36.6 ha.

CATCHMENT 5

Control Point 5 is located in the ditch system directly downstream of Catchment 5 as shown on Figure 8.2. Catchment 5's area of 14.6 ha is too small to be serviced by a pond. As a result, Catchment 5 will have extra LIDs sufficient to control the runoff rate and volume. All pervious area is required to have a minimum of 450mm of top soil. Single family units should have disconnected roof leaders to encourage mitigation of runoff by the top soil. Additionally, infiltration trenches will be installed in the road right-of-way with 1.0m wide trenches in front of each lot and extending the length of the lot. This will be in addition to the 12% road right-of-way trench that is recommended for the NCP area. The trench should have 450mm of drain rock with the underdrain invert 100mm above the trench invert. Typical details of the road right-of-way LIDs are shown in Figure 6.3 and Figure 6.4. These controls produce a 1:5-year post-development runoff rate of 77 L/s.

Outlets from each pond will be controlled with a flow control manhole as per City of Surrey Supplemental Standard Detail D10. Outfalls into natural channels will use headwalls and energy dissipation where necessary to avoid erosion around the headwall.

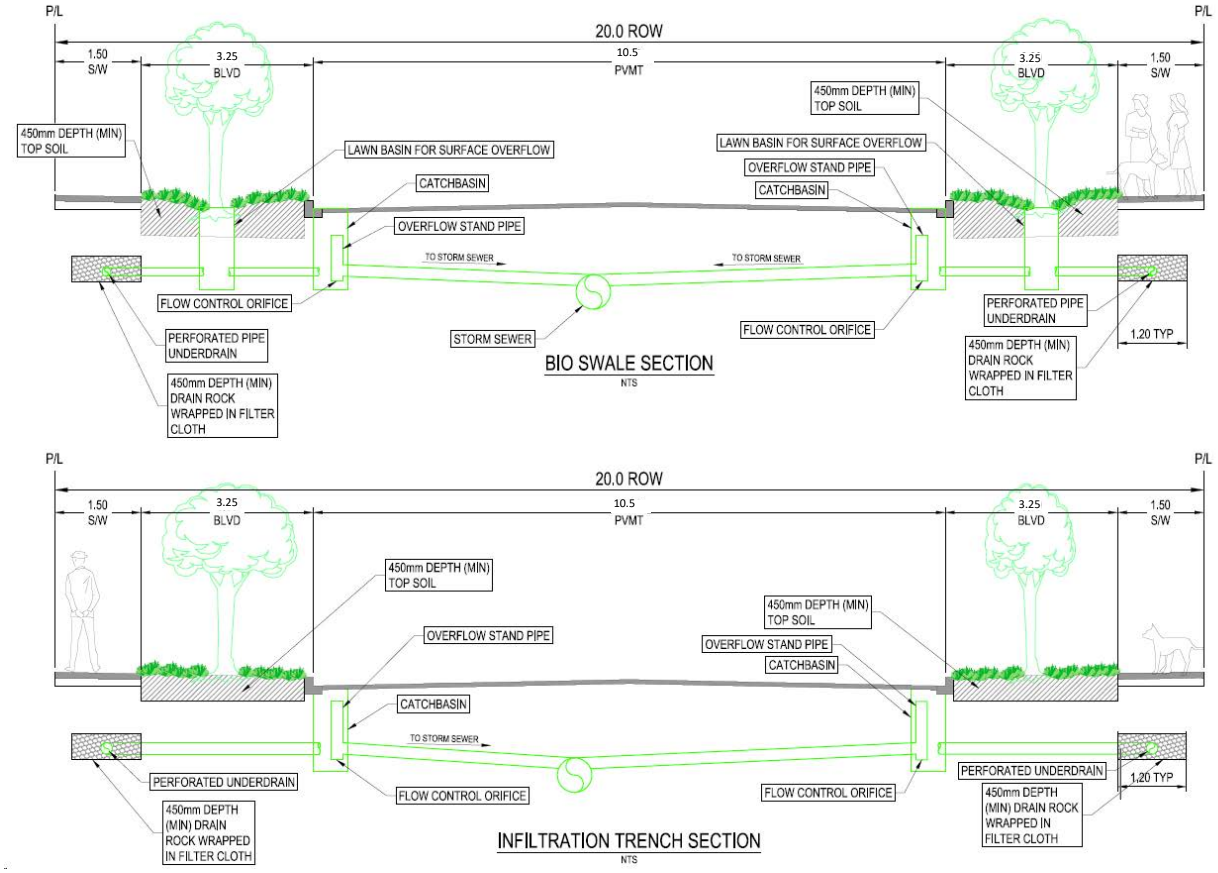


Figure 6.3 20 M Road Right-of-Way Bioswale & Infiltration Trench Cross-sections

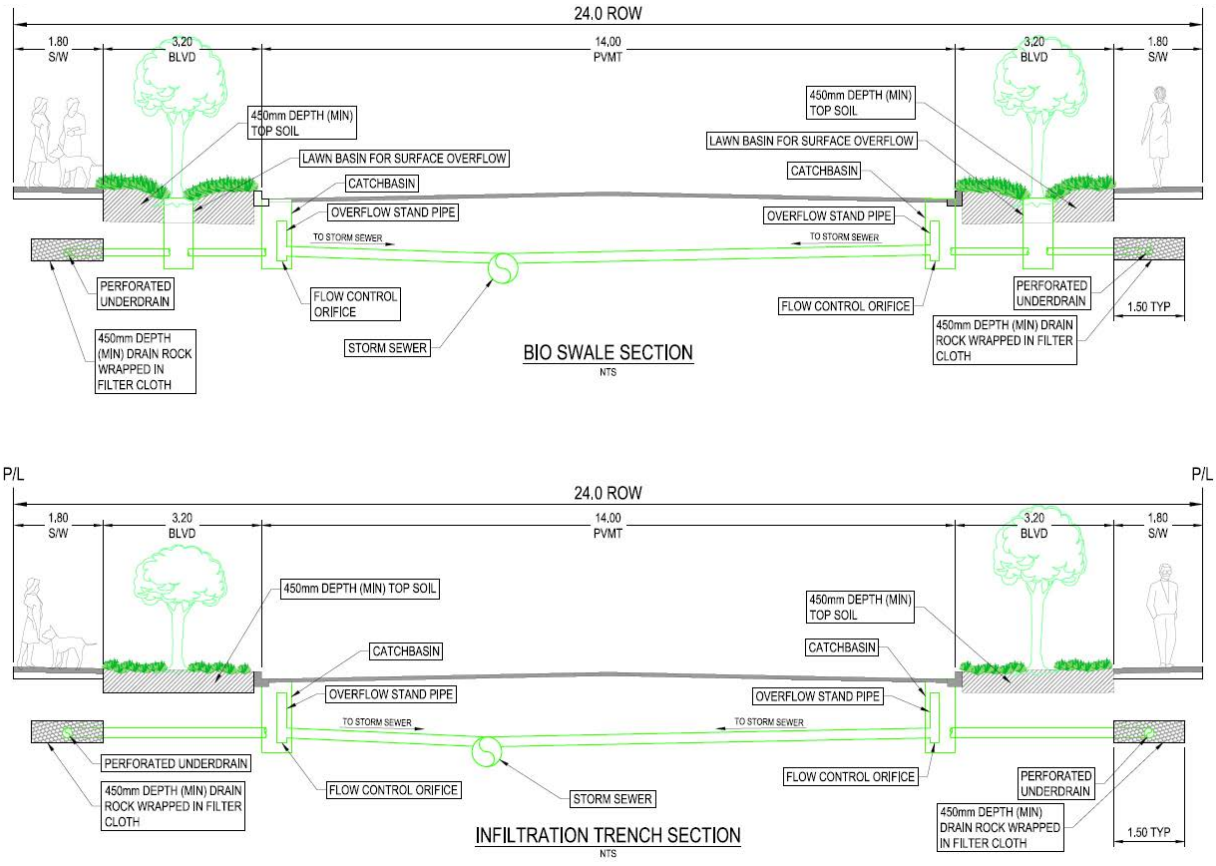


Figure 6.4 24 M Road Right-of-Way Bioswale & Infiltration Trench Cross-sections

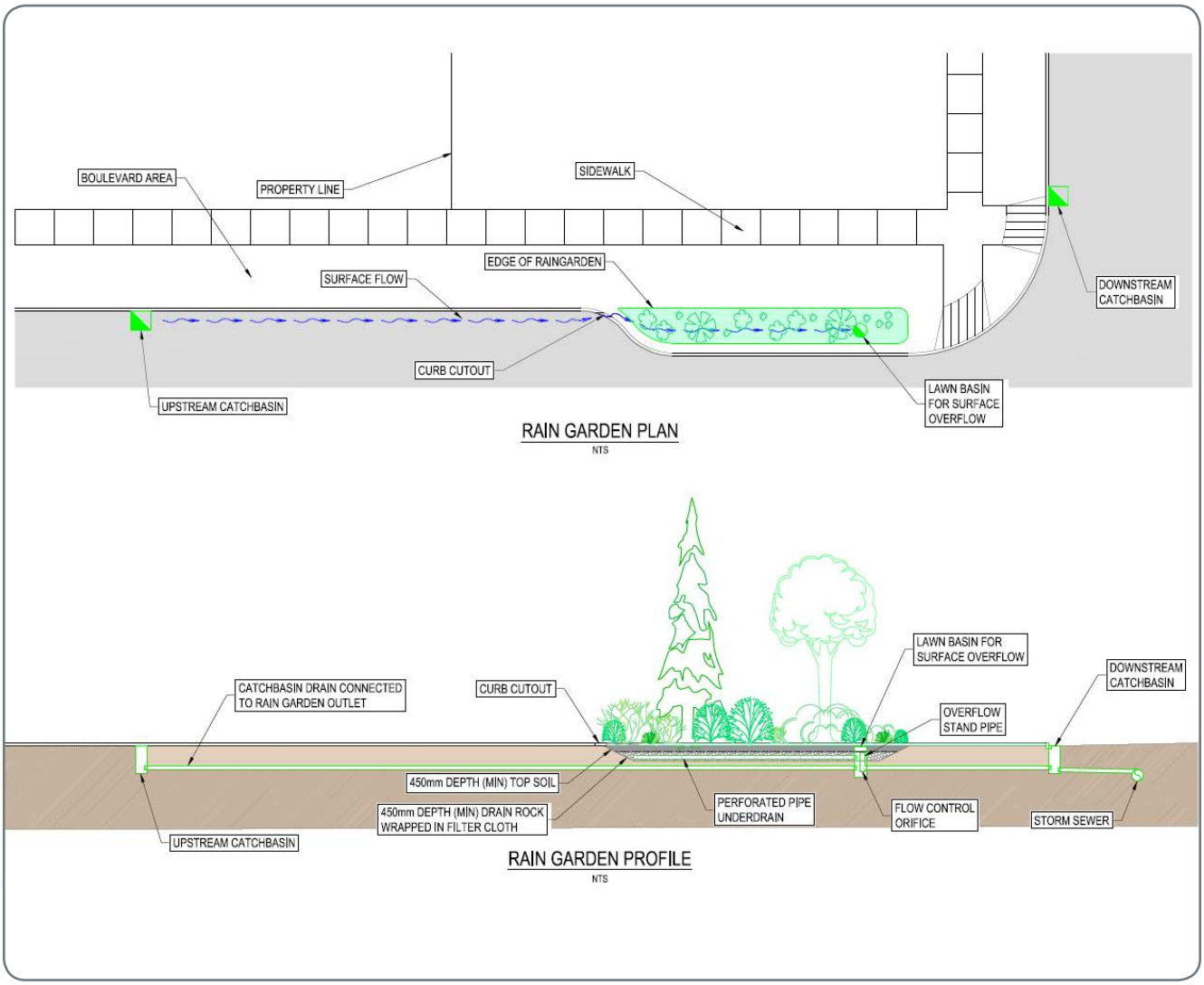


Figure 6.5 Rain Garden LID Details

6.3.2 Runoff Volume Control

Flow duration curves were obtained for each control point under pre-development and post-development conditions. These curves indicate a substantial reduction in the duration of flow rates for catchments controlled by a detention pond and LIDs as well as equivalent performance for Catchment 5.

LIDs were design by water balance modelling using PCSWMM software as described in Section 6.3.1. The exact percentages were obtained by an iterative analysis to match post-development runoff coefficients to the pre- development value of 0.29, as reported in the Erickson Creek ISMP. The proposed design specified LIDs conservatively to account for clogging and loss of function that will occur over time.

ON LOT LIDS

Absorbent landscape consists of minimum 450mm top soil and is required for all pervious areas within all properties and right of ways. Single family houses are also required to have disconnected roof leaders such that roof runoff will drain onto pervious area and have the opportunity to infiltrate.

Multifamily developments are required to have an area of infiltration trench, bioswale, or rain garden equal to 7% of the total development area. All pervious and impervious areas are to be directly connected to the infiltration trench, bioswale, or rain garden. For example, a 0.5 ha townhouse development could satisfy these criteria with a 350 sq. m rain garden. The rain garden should be as per Metro Vancouver's Stormwater Source Controls Design Guidelines (as amended from time to time) and receive runoff from the whole site, including roof leaders. The outlet of the rain garden should include an underdrain and surface overflow to the storm sewer. The underdrain would be orifice controlled such that the rain garden would be drained from full to below the underdrain within 3-4 days.

Commercial, industrial, institutional, and school properties are required to have an area of infiltration trench, bioswale, or rain garden equal to 12% of the total property area. All pervious and impervious areas are to be directly connected to the infiltration trench, bioswale, or rain garden. Typical details of a rain garden are shown in Figure 6.5. Provisions must be made to minimize clogging and maintain infiltration capacity such as an oil / grit separator upstream of the rain garden or trench. The design recommendations of the Metro Vancouver Stormwater Source Control Design Guidelines are to be followed for sizing such a unit. Maintenance of on lot infrastructure will be the responsibility of the property owner.

For example, a 1 ha shopping center could satisfy these criteria with a 1,200 sq. m bioswale located along the downstream edge of the parking lot. The bioswale should receive runoff along its entire length from the whole site. The outlet should include an underdrain and surface overflow to the storm sewer. The underdrain should be orifice controlled such that the rock layer would be drained from full to below the underdrain within 3-4 days.

A summary of the required LID for each zone is provided in Table 6.4.

ROAD LIDS

ROW LIDs may include any combination of rain gardens, roadside swales, and infiltration trenches. The total area of road ROW LIDs must be minimum 12% of the road ROW area. All pervious and impervious surfaces must be directly connected to the LID such that no uncontrolled runoff enters the piped system.

For example, a 20m wide road ROW can satisfy these criteria with two 1.2 m wide infiltration trenches, one on each side. Catch basin leads should be fitted with an orifice and stand pipe such that flow from the catch basin to the storm sewer is controlled. This will allow water to backup into the infiltration trench and provide storage as well as infiltration. Small events will mostly infiltrate with little flow passing through the orifice. Large events will saturate the drain rock layer and engage the overflow stand pipe to prevent flooding of the paved surface.

In Catchment 5 (where LIDs are required to control runoff rate and volume) an additional 1.0m wide infiltration trench is required to control runoff from the residential properties. This additional trench is not to be located on private property. This trench may be substituted by equivalent area of bioswale or rain garden. Typical sections of each off-lot LID

option can be found in Figure 6.3, 6.4 and 6.5.

RESULTS

The runoff coefficients from pre-development, post-development with no improvements, and post-development with improvements are summarized in Table 6.5.

As shown, the LID infrastructure significantly reduces the runoff coefficient to below pre-development levels. This was done to account for the reduced functionality of the LIDs as time progresses. Developing the Redwood Heights NCP area without drainage improvements would increase runoff volumes and rates which would cause significant damage to the downstream conveyance, aquatic habitat, and ALR lands. The management strategy presented in this document will serve to mitigate this effect and control runoff rates and volumes to near or below pre-development levels.

The proposed drainage infrastructure for the NCP will maintain flood patterns in the downstream ALR lands as well as preserve critical aquatic habitat by reducing erosion during all rainfall events. The LIDs and ponds will control both runoff rate and volume such that downstream will experience lower flow rates and velocities than currently experienced. The proposed infrastructure will also promote a healthy aquifer by maintaining inputs into the groundwater table.

MAINTENANCE

Any private and road right-of-way LIDs, such as underground infiltration systems, rain gardens, and bioswales would generally require some maintenance to keep the systems operational. Maintenance would consist of cleaning of the connecting catch basin and lawn basin sumps along with collection of accumulated debris within bioswales and rain gardens. Regular street sweeping of gutters and curb-cuts at the inlet of rain gardens is recommended.

CONVEYANCE

A conventional storm sewer system is proposed for runoff collection and conveyance in this neighbourhood. A trunk sewer and local sewer system was designed for each major catchment to convey runoff from the 100-year storm to detention facilities located in each catchment. Trunk sewers are defined as a storm sewer servicing over 20 ha of land; sewers with smaller catchments are local sewers.

The trunk sewer of Catchment 1 conveys flow from the south west portion of the NCP area and across a portion of land not currently slated for development. The trunk sewer is entirely in the proposed road right-of-way. In Catchment 3, pond 3 is located inside the wildlife hub; however, this should not impact the wildlife hub function. The majority of impact will occur during construction; it is recommended that an erosion and sediment control plan be prepared to protect and isolate undisturbed areas and restore affected areas as needed. The rest of the trunk sewers are expected to be entirely within the road right-of-way, not conflicting with other utilities, and approximately 2.5m deep.

Figure 6.6 shows the stormwater control plan based on the proposed drainage system.

LID REQUIREMENTS BY LAND USE

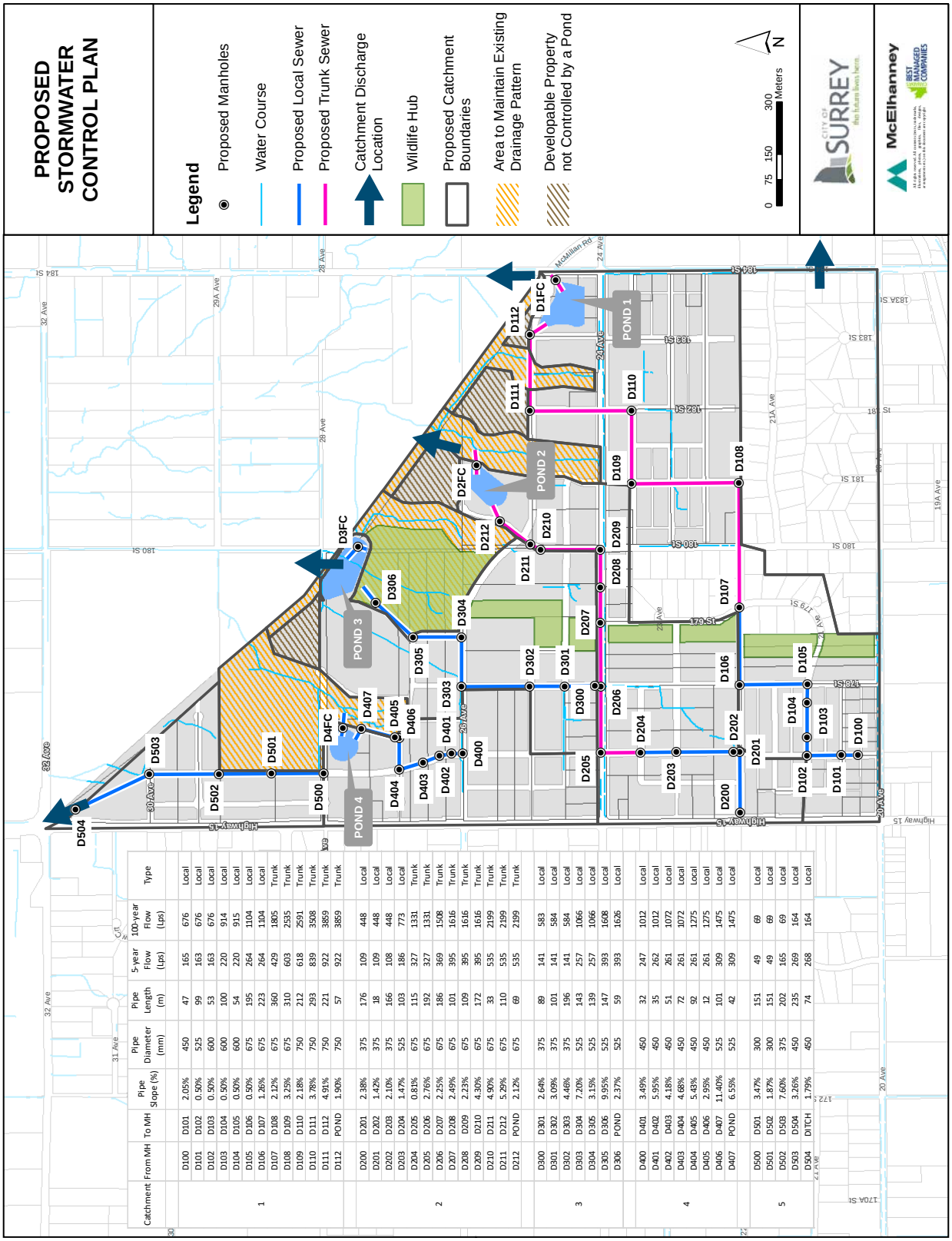
Land Use	LIDs Required
Half Area Residential	450mm top soil on all pervious areas
Single Family Residential	450mm top soil on all pervious areas
Single Family Residential	450mm top soil on all pervious areas
Multiple Family Residential	450mm top soil on all pervious areas and infiltration trench, bioswale, and/or rain garden equal to 7% of the total property area
Commercial and Industrial	450mm top soil on all pervious areas and infiltration trench, bioswale, and/or rain garden equal to 12% of the total property area
Institutional	450mm top soil on all pervious areas and infiltration trench, bioswale, and/or rain garden equal to 12% of the total property area

Table 6.4 LID Requirements by Land Use

RUNOFF COEFFICIENTS

Scenario	Pre-development	Post-development (No Improvements)	Post-development (With LIDs)
Runoff Coefficient	0.29	0.90	0.19

Table 6.5 Runoff Coefficients



Catchment	From MH	To MH	Pipe Slope (%)	Pipe Diameter (mm)	Pipe Length (m)	5-year Flow (lps)	100-year Flow (lps)	Type
1	D100	D101	2.05%	450	47	165	676	Local
	D101	D102	0.90%	525	99	163	676	Local
	D102	D103	0.90%	600	53	163	676	Local
	D103	D104	0.50%	600	100	220	914	Local
	D104	D105	0.50%	600	54	220	915	Local
	D105	D106	0.50%	675	195	264	1104	Local
	D106	D107	1.26%	675	223	264	1104	Local
	D107	D108	2.12%	675	360	429	1805	Trunk
	D108	D109	3.25%	675	310	603	2335	Trunk
	D109	D110	2.18%	750	212	618	2591	Trunk
	D110	D111	3.78%	750	293	839	3508	Trunk
	D111	D112	4.91%	750	221	922	3859	Trunk
	D112	POND	1.90%	750	57	922	3859	Trunk
2	D200	D201	2.38%	375	176	109	448	Local
	D201	D202	1.42%	375	18	109	448	Local
	D202	D203	2.10%	375	166	108	448	Local
	D203	D204	1.47%	525	103	186	773	Local
	D204	D205	0.81%	675	115	327	1331	Trunk
	D205	D206	2.76%	675	192	327	1331	Trunk
	D206	D207	2.25%	675	186	369	1508	Trunk
	D207	D208	2.49%	675	101	395	1616	Trunk
	D208	D209	2.23%	675	109	395	1616	Trunk
	D209	D210	4.30%	675	172	395	1616	Trunk
	D210	D211	4.90%	675	33	535	2199	Trunk
	D211	D212	5.29%	675	110	535	2199	Trunk
	D212	POND	2.12%	675	69	535	2199	Trunk
3	D300	D301	2.64%	375	80	141	583	Local
	D301	D302	3.09%	375	101	141	584	Local
	D302	D303	4.46%	375	196	141	584	Local
	D303	D304	7.20%	525	143	257	1066	Local
	D304	D305	3.15%	525	139	257	1066	Local
	D305	D306	9.95%	525	147	393	1608	Local
	D306	POND	2.37%	525	59	393	1626	Local
4	D400	D401	3.49%	450	32	247	1012	Local
	D401	D402	5.95%	450	35	262	1012	Local
	D402	D403	4.18%	450	51	261	1072	Local
	D403	D404	4.68%	450	72	261	1072	Local
	D404	D405	5.43%	450	92	261	1275	Local
	D405	D406	2.95%	450	12	261	1275	Local
	D406	D407	11.40%	525	101	309	1475	Local
	D407	POND	6.55%	525	42	309	1475	Local
5	D500	D501	3.47%	300	151	49	69	Local
	D501	D502	1.87%	300	151	49	69	Local
	D502	D503	7.60%	375	202	165	69	Local
	D503	D504	3.26%	450	235	269	164	Local
	D504	DITCH	1.79%	450	74	268	164	Local

Figure 6.6 Proposed Storm Water Control Plan

6.3.3 Flood and Erosion Control

Increased impervious area typically results in increased peak runoff rates and runoff volumes that can cause significant damage to downstream aquatic habitat. Increased flow rates cause increased velocities in natural channels so that loose sediment can be eroded away. This can cause bank destabilization and failure, decreased habitat, and the potential for large woody debris to enter the stream. Maintaining runoff rates and volumes to existing channels mitigates this risk. Reducing flow volumes reduces the duration of high flows and further protects downstream channels from significant erosion. These measures also reduce the risk of flooding in the sensitive downstream agricultural lands.

To quantify the impact of the proposed development to the potential for flooding, summer and winter ARDSA storms were modeled under pre-development and proposed conditions. The results can be seen in Table 6.6.

As shown in Table 6.6 there is significant reduction in total discharge rates and a slight reduction to marginal increase in runoff volumes to the downstream system during the summer and winter storms. There are several active erosion sites downstream of, but none within, the NCP area, as indicated in the Erickson Creek ISMP.

6.3.4 Water Quality

The use of wet ponds and LID's has benefits for stormwater quality. LID's such as bioswales, rain gardens, and infiltration trenches can provide water quality benefits through settling-out of suspended solids in storage zones of such LID's and through reduction of water volume through absorption, evapotranspiration and infiltration.

Literature and analysis undertaken in past studies have shown reported similar benefits to LIDs with respect to removal of total suspended solids. Furthermore, the proposed detention ponds will also provide water quality benefits as they will incorporate a permanent water level to allow both dynamic and quiescent settling of suspended solids. The detention ponds should be optimized during detailed design to provide water quality benefits. Examples include maximization of retention time of runoff, prescription plantings to promote water quality, and use of submerged outlets for trapping floatable debris. These water quality benefits will allow for healthy streams and ecosystems.

10 YEAR MUNICIPAL HALL STORM RUNOFF RATE AND VOLUME

Catchment / Control Point	Winter Pre-development (L/s)	Winter Post-development (L/s)	Summer Pre-development (L/s)	Summer Post-development (L/s)	Winter Pre-development (m3)	Winter Post-development (m3)	Summer Pre-development (m3)	Summer Post-development (m3)
1	200	344	300	271	8,590	6,280	5,580	3,493
2	560	296	730	150	24,250	27,690	15,780	16,309
3	730	464	910	416	32,300	31,121	21,020	15,039
4	770	403	1,180	294	32,630	41,056	21,210	24,094
5	1,320	603	1,550	432	60,030	68,254	39,060	39,980
Total	3,580	2,110	4,670	1,563	157,800	174,401	102,650	98,915

Table 6.6 10 Year Municipal Hall Storm Runoff Rate and Volume

6.3.5 Cost & Financing

Table 6.7 presents a Class 'D' cost estimate for stormwater management infrastructure that services more than 20 ha, including trunk sewers and detention ponds. Please note that costs were not calculated for Catchment 5 as it is less than 20 ha. Land acquisition costs are based on $2,500,000 per acre.

CLASS 'D' COST ESTIMATE FOR DRAINAGE INFRASTRUCTURE

Catchment	Item	Cost
1	Trunk Sewer	$2,986,560
	Pond	$5,170,600
	Land Acquisition (5.92 ac)	$14,800,000
	SUB-TOTAL	**$22,957,160**
2	Trunk Sewer	$2,152,260
	Pond	$2,858,900
	Land Acquisition (4.77 ac)	$11,925,000
	SUB-TOTAL	**$16,936,160**
3	Pond	$3,788,350
	Land Acquisition (4.34 ac)	$10,850,000
	SUB-TOTAL	**$14,638,350**
4	Pond	$1,812,250
	Land Acquisition (3.76 ac)	$9,400,000
	SUB-TOTAL	**$11,212,250**
	TOTAL	**$65,743,920**

Table 6.7 Class 'D' Cost Estimate for Drainage Infrastructure

6.4 EXISTING SANITARY

There is no existing municipal sanitary sewer infrastructure within the Redwood Heights NCP area. The properties in the NCP area currently use private septic tanks and septic fields for wastewater.

The NCP area slopes in a southwest to northeast direction with the highest point located at 2100 block and Highway 15 at an elevation of approximately 91 metres. The lowest point is at the intersection of Highway 15 and 32 Avenue with an elevation of approximately 2 to 3 metres. As shown in Figure 6.7, all the properties in the NCP area can be serviced within the same sanitary catchment area.

6.5 DESIGN CRITERIA & ANALYSIS

The NCP area will require the construction of a sanitary sewer system to service future residential and commercial growth. As part of the Stage 2 study, a system of gravity local and trunk mains is proposed, taking into consideration future peak sewage flows. These mains will convey sewage to a pump station adjacent to 32 Avenue and approximately 340m west of 176 Street. The sewage pump station will direct sewage flow to the Grandview Heights Interceptor Phase 3 via a force main. This section discusses the design criteria and analysis for the proposed sanitary system.

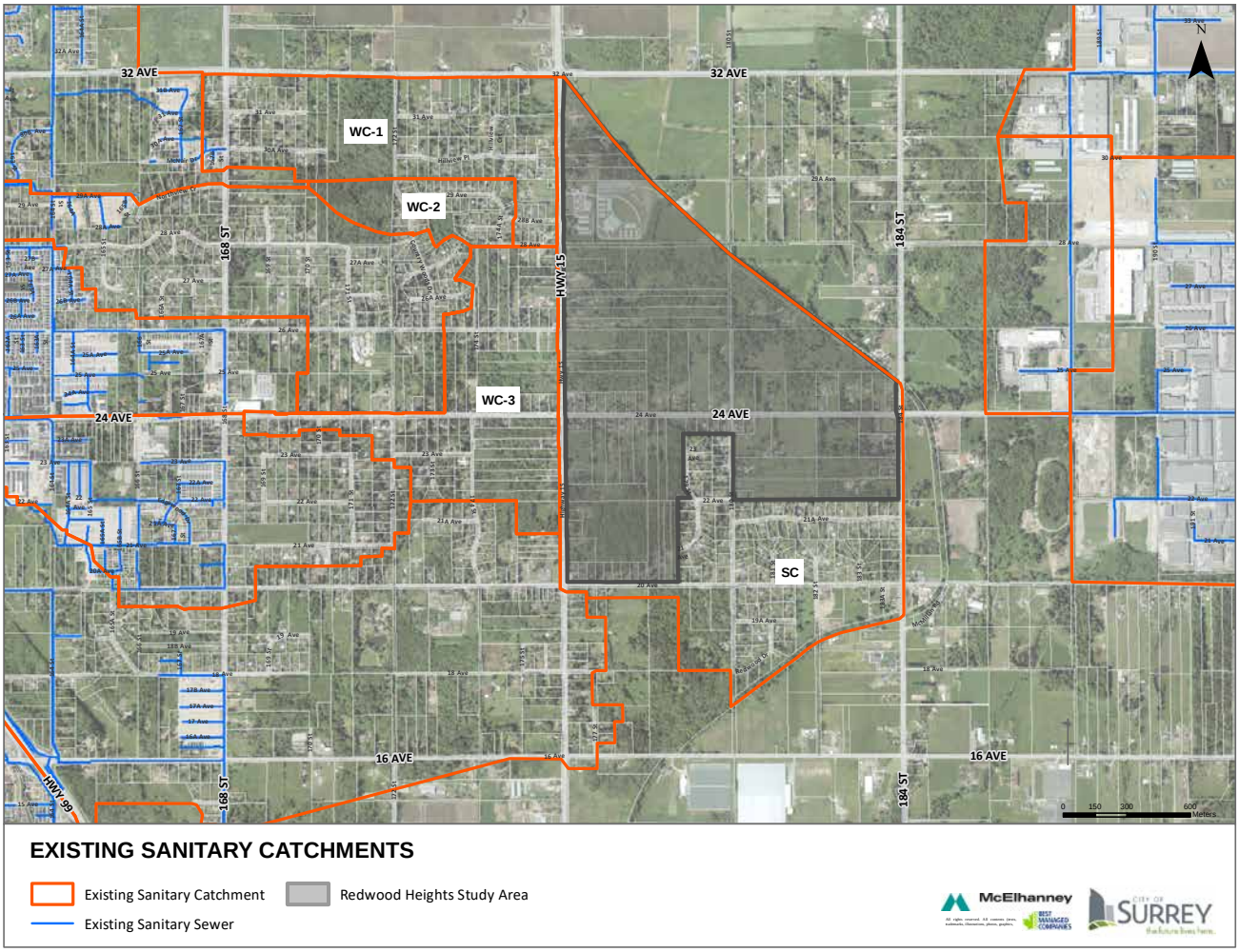


Figure 6.7 Existing Sanitary Catchments

6.5.1 Design Criteria

The proposed sanitary sewer system for the NCP area has been designed in accordance with the City of Surrey's 2016 Design Criteria Manual. Key design criteria are summarized as follows:

- Average day dry weather flow per person of 350 L/day.
- Groundwater infiltration of 11,200 L per hectare per day.
- Manning coefficient of roughness of 0.013 for all pipes.
- Minimum velocity of 0.6 m/s based on partial pipe flow hydraulics.
- Pipe grades less than 0.5% may be used if the flow equal to 0.7 x Peak Dry Weather Flow attains a minimum velocity of 0.6 m/s.
- The sewer flow in sanitary (local) mains does not exceed 40 l/s.
- Depth of flow in local mains should not exceed 50% of the internal diameter.
- Depth of flow in trunk mains should not exceed 70% of the internal diameter.
- Minimum sewer size of 200 mm diameter for single family residential lands and zones with less than 90 ppha, and 250 mm diameter for other areas.
- Sewer depth between 2.0 and 3.5 m

The peaking factor, which is the ratio of peak dry weather flow to the average dry weather flow, is calculated using the Harman equation. The Peak Wet Weather Flow (PWWF), which consists of the peak dry weather flow plus inflow and infiltration, is used as the design flow for sizing the pipes.

The population densities, used to determine total population and to compute average day dry weather flow, are provided in Table 6.8.

6.5.2 Sanitary Sub-Catchments

WITHIN NCP BOUNDARIES

The NCP area is divided into five sanitary sub-catchments, as shown in Figure 6.8. Each sub-catchment has sanitary sewer mains to collect wastewater and convey it to a trunk main that runs along the north boundary of the NCP, at the toe of the slope. This trunk extends from manhole T.1, as shown in Figure 6.8, to the proposed pump station located adjacent to 32 Avenue and approximately 340 m west of 176 Street.

A distribution collection network is defined for each sub-catchment and the corresponding pipes are sized following the design criteria in Section 6.5.1. Design calculations considered the pipe slope, pipe length, invert elevations, and design flows. Secondary pipes connecting to the collecting lines were sized following the minimum size requirement of 200 mm diameter for single family residential zones and 250 mm diameter for all other zones.

OUTSIDE NCP BOUNDARIES

The proposed sanitary mains within the NCP area will receive sewage flow from areas located upslope of the NCP boundary. These areas are shown as the south catchments (SC) in Figure 6.8. The pump station will also serve areas outside the NCP area that are located downslope of Grandview Heights interceptor; these areas are shown as west catchments (WC) IN Figure 6.8.

Table 6.9 presents a summary of the land area and estimated population for the catchments outside the NCP. The estimated populations consider future residential development.

LAND USE POPULATION DENSITIES

Land Use	Land Use Designation	Land Use Density (upha)	People per Unit (ppu)	People per Secondary Suite (ppu)	Total People per Unit (ppu)	People per Hectare (ppha)	Total Area (ha)	Total Population
Residential Transition	RH-G, RQ	10	2.96	1.45	4.41	44	5.9	260
Cluster Residential	RF, RF-G, RM-10	25	2.96	1.45	4.41	110	11.89	1,311
Detached Residential	RF-10, RF-13	35	2.96	1.45	4.41	154	13.15	2,030
Flex: Detached / Multiple Residential	RF-10, RF-13, RF-15	35	2.96	0	2.96	104	3.3	342
Semi-Detached	RF-SD, RF-10	35	2.96	0	2.96	104	2.1	218
Multiple Residential	RM-15	50	2.96	0	2.62	131	24.1	3,157
Townhouse	RM-30	75	2.62	0	2.62	197	20.6	4,048
Apartment	RM-45, RM-70	111	1.36	0	1.36	151	8.3	1,253
Commercial / Residential Mixed-Use	C-15, RM-70	88	2.62	0	2.62	231	5.63	1,298
Elementary School	PI					50	3.48	174
Proposed Institutional	PI					50	3.04	152
Existing Institutional	PI					50	7.69	385
TOTAL							**109.18**	**15,036**

Table 6.8 Land Use Population Densities

SANITARY CATCHMENTS OUTSIDE REDWOOD HEIGHTS NCP

Catchment Area	Area (ha)	Estimated Population
WC-1	85.3	568
WC-2	23.6	194
WC-3	81	5,252
SC	72.3	766

Table 6.9 Sanitary Catchments outside Redwood Heights NCP

6.6 PROPOSED SANITARY SYSTEM

The proposed sanitary system includes local and trunk sewers within the NCP area, a pump station, and a force main that will convey wastewater to the Grandview Heights Interceptor.

6.6.1 Local Sewers

Local sewers have a flow under 40 litres per second and are the upstream mains of the sanitary system. Local sewers make up the entire collection system within sub-catchments C-1, C-2 and C-5, and the upstream mains within sub-catchments C-3 and C-4. The alignments of local sewers are placed within roads or at the edge of the riparian areas.

The area south of the NCP area is divided into five sub-catchments, shown in Figure 6.8. Wastewater from sub-catchments SC-1, SC-2 and SC-3 will discharge into the local sewers within the NCP sub-catchment C-4. A collection main will be required to convey the wastewater from sub-catchments SC-4 and SC-5 via 184 Street and 22 Avenue to the main trunk sewer at manhole T.1. The alignment of this sewer will run along a proposed right-of-way between manhole S6.4 and S6.6; and along an existing park dedication between manholes S6.6 and S6.11.

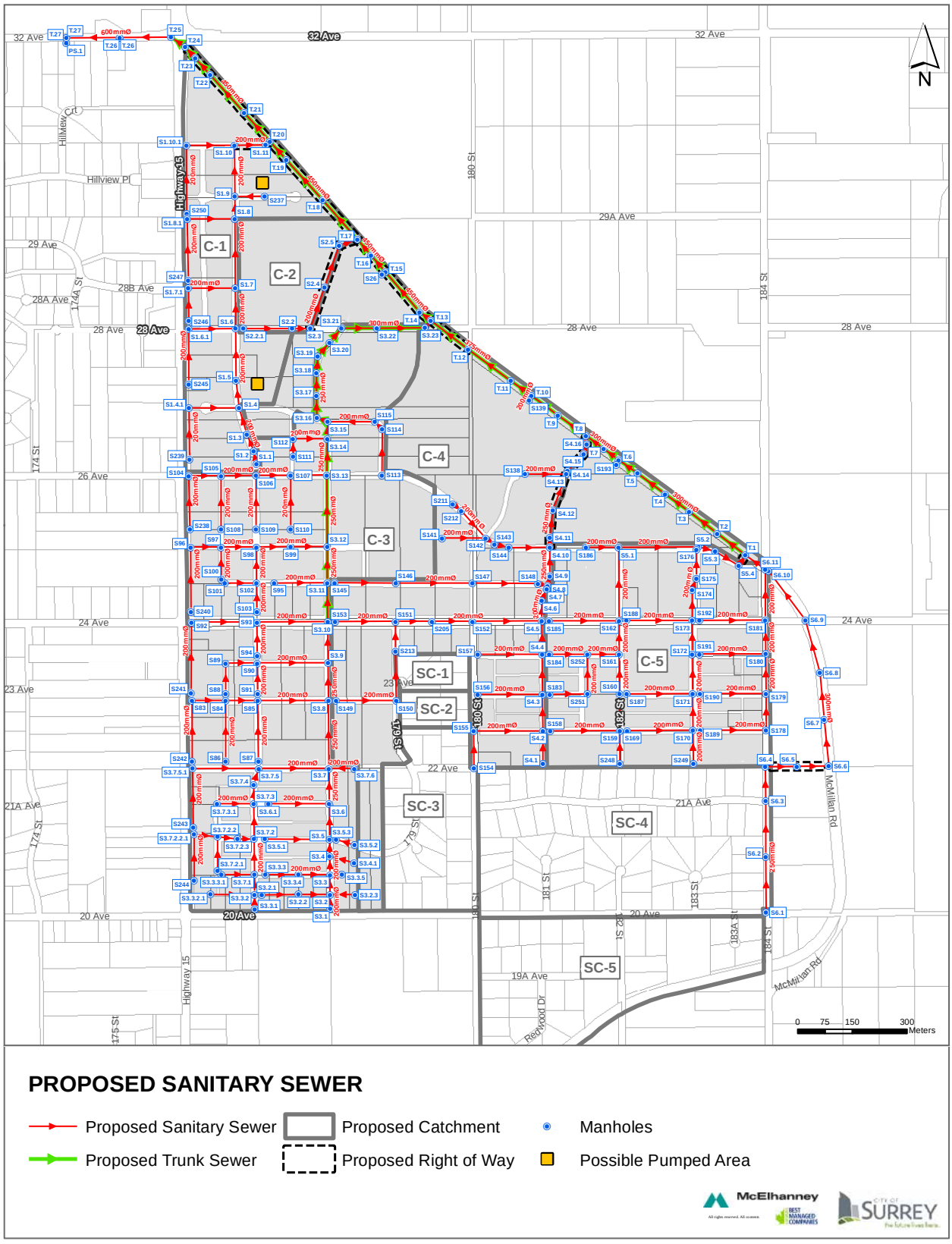


Figure 6.8 Proposed Sanitary Catchments

6.6.2 Trunk Sewers

Trunk sewers are pipes that convey a peak wet weather flow in excess of 40 litres per second. Following this criterion, the proposed pipes between manholes S3.10 and T.13 in sub-catchment C-3 and between manholes S4.13 and T.8 in sub-catchment C-4 are also considered trunk sewers.

The trunk sewer that runs along the north boundary of the NCP will convey wastewater for the entire Redwood Heights area and the southern catchments into the proposed pump station. This trunk sewer will run through riparian areas and the transition buffer zones defined along the NCP's north boundary. The cover depth of this sewer ranges from 1.5m to 3.5m, with the exception of the pipes between manhole T.26 and the pump station, where the cover exceeds 5m for a short section. Although the slope of these pipes is less than 0.5%, the flow velocity under 0.7 x PWWF conditions is greater than 0.6 m/s. As shown in Figure 6.9, this trunk sewer will cross Justin Brook via an aerial pipe bridge located between manholes T.7 and T.8.

Most of the trunk sewers in sub-catchment C-3 are located within roads, with the exception of the pipe between manholes S3.21 and T.13, which is located in a future right-of-way. The cover depth of this sewer line is within 1.5m and 3.5m. The trunk sewer in sub-catchment C-4 is entirely located at the edge of the riparian area of Justin Brook.

The plan and profile view the trunk sewers in the system are shown in Figure 6.9 and Figure 6.10

6.6.3 Pump Station

The proposed pump station is located adjacent to 32 Avenue and approximately 340m west of 176 Street. The pump station will collect wastewater from the NCP area as well as from other areas located south and west of Redwood Heights, including future NCP areas.

The proposed catchment boundaries for the pump station are shown in Figure 6.11. The populations and design flows for the pump station catchments are provided in the Table 6.10. Based on these calculations, the total PWWF design flow to the pump station that will also flow into the upper end of the Grandview Heights Interceptor is 292 litres per second.

The in-ground infrastructure for the pump station will be sized for ultimate buildout including the wet well and pump chamber, valve chamber, electrical / mechanical housing room, odour control / mitigation facilities, emergency storage tank, and emergency generator. Based on the ultimate design flow of 292 litres per second, the pump chamber and valve chamber is likely to accommodate 4 pumps ultimately. Section 6.6.5 discusses phasing for interim and ultimate pump sizing.

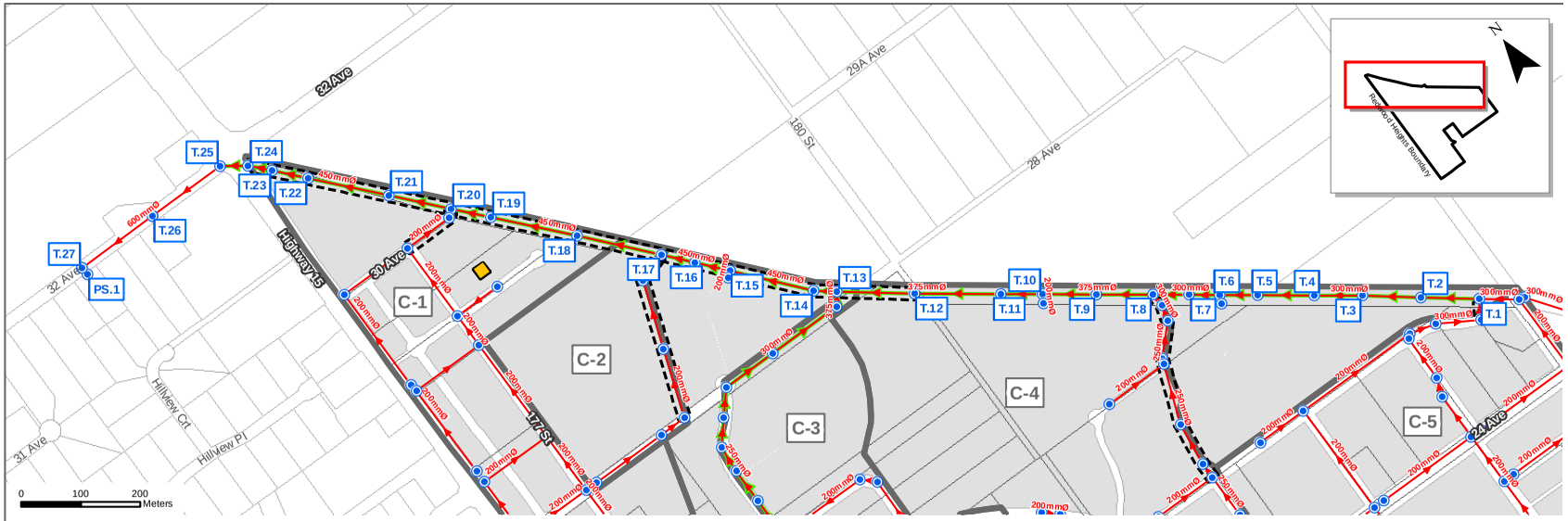
The emergency storage requires a capacity of 0.5 hours at peak wet weather flow (PWWF). This will require a volume of 533 cubic metres, based on total build-out.

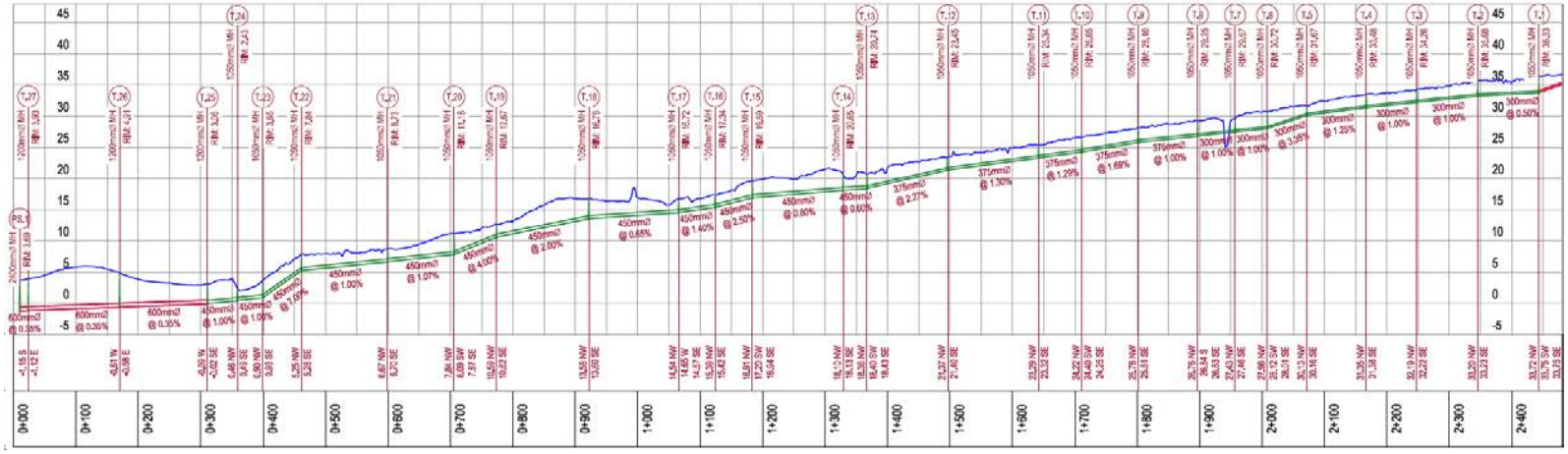
PUMP STATION SANITARY FLOW CALCULATION

Catchment	Area (ac)	Area (ha)	Estimated Population	Peak Factor	ADSF (L/d)	ADWF (L/s)	Infiltration Flow (L/s)	PWWF (L/s)
WC-1	210.8	85.3	568	3.95	350	2.30	11.06	20.14
WC-2	58.3	23.6	194	4.15	350	0.79	3.06	6.32
WC-3	200.1	81.0	5,252	3.23	350	21.28	10.50	79.11
SC	205.5	72.3	881	3.83	350	3.57	10.78	24.47
Redwood Heights	512.13	207.3	15,032	2.78	350	60.89	26.88	196.99
Total (Average)	**1,187.0**	**469.5**	**21,927**	**(2.61)**	**(350)**	**88.83**	**62.28**	**291.90**

Table 6.10 Pump Station Sanitary Flow Calculation

Figure 6.9 Sanitary Trunk Plan and Profile





SANITARY TRUNK PLAN AND PROFILE

Proposed Sanitary Sewer
Proposed Trunk Sewer
Proposed Catchment
Proposed Right of Way
Manholes
Possible Pumped Area

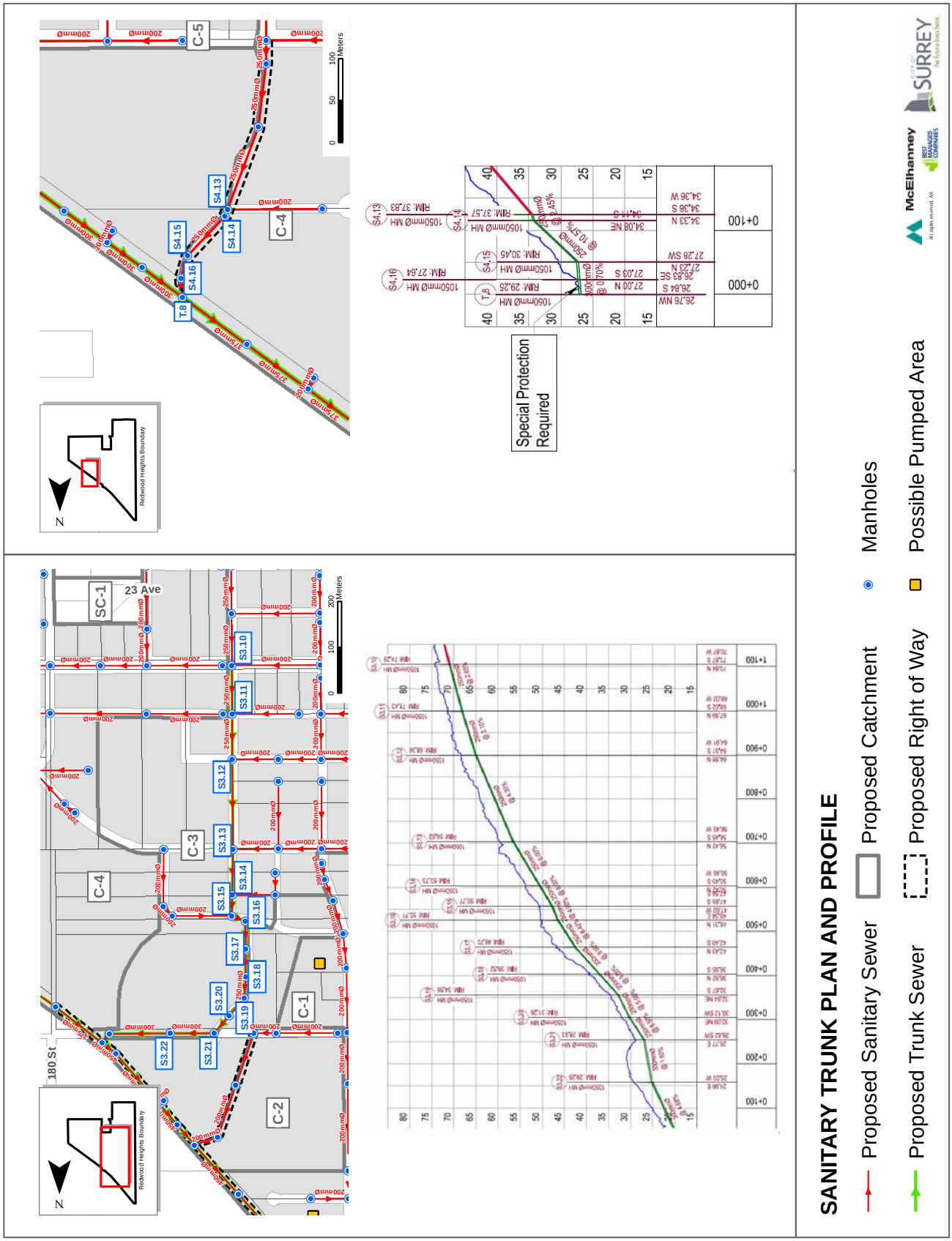


Figure 6.10 Sanitary Trunk Plan and Profile

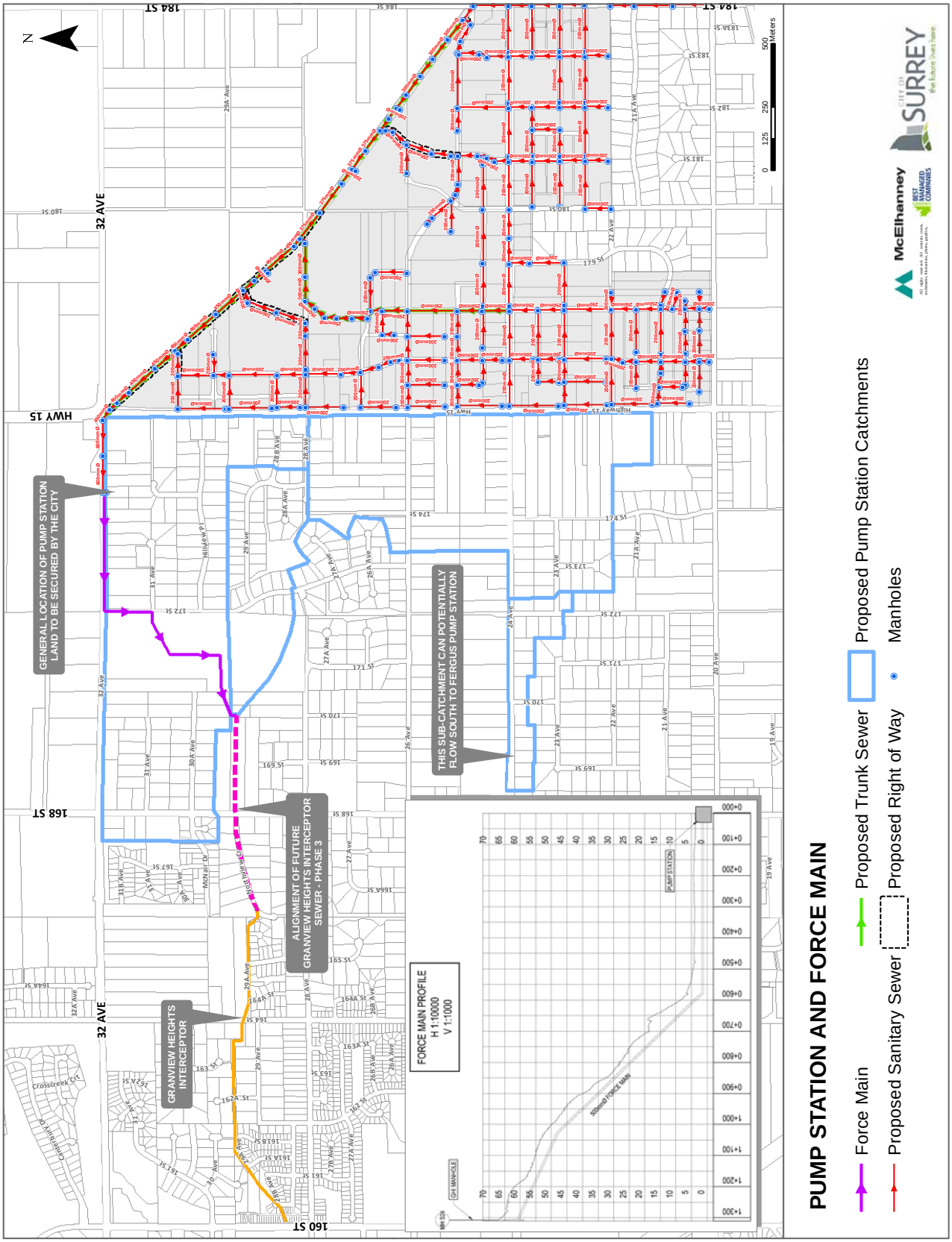


Figure 6.11 Pump Station and Force Main

6.6.4 Force Main

The alignment of the force main was studied in the Stage 1 report and a recommended alignment was selected for Stage 2. The force main alignment needs to be coordinated with future or instream development so that easements and right-of-ways can be secured, following road right-of-ways where possible. Transient analysis should be carried out before the alignment of the force main is confirmed.

The force main will be sized to account for full build-out conditions of the areas serviced by the pump station. The calculations show that a 445 mm internal diameter force main is required. Figure 6.11 shows a preliminary profile for the proposed force main.

6.6.5 System Phasing

There are no existing sewer facilities within the NCP area; therefore, all applicable downstream infrastructure needs to be constructed prior to development. This includes local and trunk sewer mains from the proposed development to the proposed pump station, the pump station, force main, and part of the Grandview Heights Interceptor. The Grandview Heights Interceptor must be completed to its terminus per the City's Grandview Heights Interceptor Phase 2 and 3 design and construction plans. The Interceptor is currently constructed up to 2934 165B Street.

It is recommended that all trunk sewers, the pump station, and force main be constructed to their ultimate sizes to avoid increased costs of replacement in the future. The pump station wet well, emergency generator and emergency storage tanks should be constructed to their ultimate size; however, the number of pumps can be staged to allow for interim conditions prior to building the ultimate configuration.

6.6.6 Cost & Financing

Table 6.11 summarizes the cost estimates of DCC-eligible items related to the Redwood Heights NCP area. DCC-eligible costs include the proposed trunk sewers, pump station and force main that are attributable to the NCP.

Up sizing costs for the Grandview Heights Interceptor are already included in the City's current 10-Year Servicing Plan.

SUMMARY OF SANITARY DCC-ELIGIBLE COSTS

Item	Description	Total DCC-Eligible Costs	DCC-Eligible Costs Attributable to Redwood Heights NCP	DCC-Eligible Costs Attributable to Areas Outside Redwood Heights NCP
1	Trunk Sewer including upsizing in Catchment 3 (S3.10 - T.13)	$959,100	$959,100	$0
2	Trunk Sewer in Catchment 4 (S4.13 - T.8)	$449,000	$449,000	$0
3	Truck Sewer including upsizing in Catchment 5 (S5.2 - T.1)	$78,100	$78,100	$0
4	Sewer outside NCP (S6.1 - T.1)	$2,177,400	$0	$2,177,400
5	Main Trunk Sewer (T.1 - T.24)	$7,990,300	$7,990,300	$0
6	Main Trunk Sewer Outside NCP (T.24 - PS.1)	$1,402,600	$1,316,400	$86,200
7	Pump Station	$5,618,000	$3,771,000	$1,847,000
8	Land Acquisition for Pump Station including BCS corridor	$1,590,000	$1,067,300	$522,700
9	Odour Control Facility	$988,800	$663,700	$325,100
10	Force Main	$2,312,600	$1,552,300	$760,300
	TOTAL	**$23,565,900**	**$17,847,200**	**$5,718,700**

Table 6.11 Summary of Sanitary DCC-Eligible Costs

6.7 EXISTING WATER SYSTEM

The Redwood Heights NCP area lies within the Grandview water service area, which is supplied by the Grandview reservoir and pump station, located at 16666 24 Avenue. The NCP area is mostly within the existing 142 metre pressure zone, with the exception of the area north of 29A Avenue which is within the 80 m pressure zone, as shown in Figure 6.12.

Existing water supply mains along 24 Avenue, Highway 15, 20 Avenue and 184 Street that supply the 142 m pressure zone are fed by the Grandview pump station. These mains have pipe diameters between 50 and 200 mm, which do not have capacity to service the proposed land uses in the NCP area.

6.8 DESIGN CRITERIA & ANALYSIS

The existing water system that supplies the Redwood Heights NCP area does not have the capacity to meet future demands. The construction of a new water supply system is proposed. The proposed system will be fed directly from the Grandview reservoir and pump station through two large feeder mains along 24 Avenue: a low pressure main to service low lying areas in the neighborhood, and a high pressure main to service areas with higher elevations. Adjustments to the existing pressure zone boundaries are also proposed. Details on the proposed water system are provided in Section 6.9. This section discusses the design criteria used and analysis completed for the proposed water system.

FIRE FLOW DEMANDS

Land Use	Zone	Fire Flow (L/s)
Residential Transition	RH-G, RQ	60
Cluster Residential	RF-10, RF, RF-G	120
Detached Residential	RF-13, RF-10	60
Flex-Detached / Multiple Residential	RF-10, RM-13, RM-15	60
Semi-Detached	RF-SD, RF-10	60
Multiple Residential	RM-15	120
Townhouse	RM-30	120
Commercial / Residential Mixed-Use	C-15, RM-70	200
Apartment	RM-45	120
Institutional	PI	120

Table 6.12 Fire Flow Demands

6.8.1 Design Criteria

The proposed water distribution system has been designed in accordance to the City of Surrey 2016 Design Criteria Manual. Key design criteria are as follows:

- Average Day Demand (ADD) of 500 L/capita/day.
- Maximum Day Demand (MDD) of 1000 L/capita/day.
- Peak Hour Demand (PHD) of 2000 L/capita/day.
- Hazen-Williams friction coefficient of 125 for watermain with a pipe diameter of 250mm and larger.
- Hazen-Williams friction coefficient of 100 for watermains with a pipe diameter 200mm and smaller.
- Minimum operating pressure of 28 m during peak hour.
- Minimum residual head of 14 m at the discharge of a fire hydrant during maximum day plus fire flow condition.
- Maximum hydraulic grade of 0.5% for mains with a pipe diameter larger than 250 mm.
- The velocity of water in pipes should be lower than 2 m/s.
- Minimum pipe diameter of 200mm for new water mains.

Projected populations and water demands are based on the proposed land use plan for Redwood Heights. Since the proposed water system will also serve areas outside the NCP, these water demands are also considered in the analysis. For areas outside the NCP, equivalent population projections are used to estimate future water demands. These areas includes Kensington Zones A, B and C and Grandview Zones A, B and C, which are located within Grandview Heights Area #3 and #5, as shown in Figure 6.13.

The projected land uses for areas outside the NCP are residential only with the exception of Grandview Zone B which has a mixed-use commercial and residential land use component. For the commercial component, an employment projection of 18 to 31 employees is used. The employment projections are the equivalent populations for the commercial component, based on equivalent populations derived from gross densities from Table 2.3.1 of the City's Engineering Design Criteria Manual.

Fire flow and water demands are shown in Tables 6.12 and 6.13.

WATER DEMANDS

Land Use	Low Pressure Main				High Pressure Main / Pump Station			
	Equivalent Population	Demands (L/s)			Equivalent Population	Demands (L/s)		
		ADD	MDD	PHD		ADD	MDD	PHD
Residential Transition	260	1.5	3.0	6.0				
Cluster Residential	1,311	7.6	15.2	30.3				
Detached Residential	1,102	6.4	12.8	25.5	928	5.4	10.7	21.5
Flex-Detached Residential / Medium Density	342	2.0	4.0	7.9				
Semi-Detached					218	1.3	2.5	5.0
Multiple Residential	2,106	12.2	24.4	48.8	1,461	8.5	16.9	33.8
Townhouse	3,276	19.0	37.9	75.8	772	4.5	8.9	17.9
Commercial / Residential Mixed-Use					1,253	7.3	14.5	29.0
Apartment	676	3.9	7.8	15.6	620	3.6	7.2	14.4
Institutional	711	4.1	8.2	16.4				
Subtotal	**9,783**	**56.6**	**113.2**	**226.5**	**5,251**	**30.4**	**60.8**	**121.6**
OUTSIDE REDWOOD HEIGHTS								
Kensington Zone A	1,965	11.4	22.7	45.5				
Kensington Zone B					91	0.5	1.1	2.1
Kensington Zone C	516	3.0	6.0	12.0	1,175	6.8	13.6	27.2
Grandview Zone A					7,004	40.5	81.1	162.1
Grandview Zone B								
Residential					2,527	14.6	29.2	58.5
Commercial					31	0.2	0.4	0.7
Grandview Zone C					1,523	8.8	17.6	35.3
Subtotal	**2,481**	**14.4**	**28.7**	**57.5**	**12,351**	**71.4**	**143.0**	**285.9**
TOTAL	**12,264**	**71.0**	**141.9**	**284.0**	**17,602**	**101.8**	**203.8**	**407.5**

Table 6.13 Water Demands

6.8.2 Hydraulic Analysis

Hydraulic modeling of the proposed network was carried out using EPANET software. The model considered the future water demands in Table 6.13. The water demands were allocated at nodes at main grid intersections. Similarly, fire flows were allocated at critical locations throughout the system. The following boundary conditions were defined for the model:

- The water elevation at the Grandview reservoir was assumed to be 109 m (one-third full).
- The exit pressure at the Grandview pump station was set to 35 m for a total head of 142 m.
- The high pressure feeder main along 24 Avenue will be connected to the pump station's 600 mm outlet pipe, as shown on Figure 6.14
- Demands for Grandview Heights Area #3 and #5 were allocated at the feeder main nodes located at 168 Street and 172 Street.
- Demands for the Kensington Zone A (Grandview Heights Area #3 – 110 m) were allocated in the southern nodes of the Redwood Heights NCP – 110 m.
- The pressure reducing valves between the 110 m and 142 m distribution systems are closed during normal operations. Similarly, the gate valves between the 90 m and 110 m distribution systems are closed during normal operations.

The following water model simulations were conducted:

1. PHD for Redwood Heights NCP demands.
2. MDD for Redwood Heights NCP demands.
3. MDD for Redwood Heights NCP demands and a 120 L/s fire flow at node 148.
4. MDD for Redwood Heights NCP demands and a 120 L/s fire flow at node 126.
5. MDD for Redwood Heights NCP demands and a 200 L/s fire flow at node 186.
6. MDD for Redwood Heights NCP demands and a 120 L/s fire flow at node 182.
7. MDD for Redwood Heights NCP and Grandview Heights Area #3 and #5.
8. MDD for Redwood Heights NCP, Grandview Heights Areas #3 and #5, and fire flows at nodes 148 and 186.
9. PHD for Redwood Heights NCP and Grandview Heights Areas #3 and #5.

Simulations 1 through 6 were conducted to establish the required water main pipe sizing to service the Redwood Heights NCP area. Simulations 7, 8 and 9 were conducted to determine water main feeder main upsizing required to service Redwood Heights NCP and Grandview Heights Area #3 and #5. The demands for these areas are presented in Table 6.12.

Figure 6.15 identifies the model nodes and shows where the fire flow demands were allocated.

6.9 PROPOSED WATER SYSTEM

The proposed water system will be fed directly from the Grandview reservoir and pump station through two large feeder mains along 24 Avenue: a low pressure main to service low lying areas and a high pressure main to service areas with higher elevations. Adjustments to the existing pressure zone boundaries are also proposed.

6.9.1 Proposed Pressure Zones

Based on the elevations in the NCP area, three pressure zones are proposed for 90 m, 110 m, and 142 m hydraulic grade line (HGL). New pressure zones for the 90 m and 110 m HGL will follow the topographic elevations. Figure 6.16 shows the boundaries of the proposed pressure zones.

A new high pressure feeder main supplied by the Grandview pump station along 24 Avenue will service the 142 m pressure zone. A new low pressure feeder main supplied by the Grandview reservoir along 24 Avenue will service the 110 m pressure zone. The new feeder main supply connections are shown in Figure 6.14.

The 90 m pressure zone within the NCP will include areas currently located in the 80 m pressure zone and some additional areas south of 29A Avenue. The 80 m pressure zone, west of 176 Street, may be adjusted to a 90 m pressure zone and interconnected with the 90 m zone within the NCP area for redundancy. The 90 m pressure zone within the NCP area will be fed from the 110 m pressure zone, through pressure reducing valves (PRVs). The locations of the PRVs are shown in Figure 6.17. The 110 m system will be connected to the high-pressure 142 m system with PRVs for phasing and emergencies situations. Phasing is discussed in Section 6.9.8.

The existing 500 mm main along 24 Avenue and east of 184 Street has a maximum HGL of 72 m. As a result, connections from this main to service the 110 m and 90 m pressure zones will not be permitted.

6.9.2 Feeder Mains

The low pressure and high pressure feeder mains along 24 Avenue were sized based on the water model simulations discussed in Section 6.8. Scenarios were modeled based on water demands for Redwood Heights NCP area only and for Redwood Heights NCP plus Grandview Heights Area #3 and #5.

The water demands for the Redwood Heights NCP area require a 500 mm low pressure feeder main on 24 Avenue from the Grandview reservoir to 176 Street (Highway 15) that reduces to a 450 mm feeder main from 176 Street to 180 Street to service the 110 m and 90 m pressure zones. A 400 mm high pressure feeder main is required on 24 Avenue from the Grandview pump station to 176 Street that reduces to a 350 mm feeder main from 176 Street to 178 Street to service the 142 m pressure zone. These feeder mains are shown in Figure 6.18.

When the demands from Grandview Heights Area #3 and #5 are considered, the feeder mains need to be upsized. Figure 6.19 shows the size of the feeder mains when demands for Redwood Heights NCP and Grandview Heights Area #3 and #5 are considered. Under this condition, the 500 mm low pressure feeder main requires upsizing to a 600 mm feeder main from the Grandview reservoir to 172 Street. In addition, the 400 mm feeder main requires upsizing to a 500 mm feeder main on 24 Avenue from the Grandview pump station to 168 Street and to a 450 mm main from 168 Street to 172 Street.

6.9.3 Distribution Mains

The proposed water distribution main network within the NCP area has pipe diameters ranging from 200 mm to 300 mm, as shown in Figure 6.17. The distribution mains will be looped to avoid dead-end pipes that exceed 100 metres in length. Distributions mains may extend across 176 Street for looping and improved connectivity of the system, if the interconnections are within the same pressure zone.

6.9.4 Abandonment of Existing Mains

The following existing mains are under-sized and recommended for removal or abandonment:

- The 150 mm diameter main along 24 Avenue, between Highway 15 and 184 Street.
- The 50 mm / 150 mm diameter main along Highway 15, between 20 Avenue and 24 Avenue.
- The 150 mm diameter main along 20 Avenue, between Highway 15 and 178 Street.
- The 150 mm diameter main along 184 Street, between 21A Avenue and 24 Avenue.

6.9.5 Tie-in to Existing Mains

As shown in Figure 6.17, the proposed water mains will be tied-in to existing mains in several locations:

90M PRESSURE ZONE

- Tie-in to the 250 mm main along Highway 15 at 30 Avenue.

110 M PRESSURE ZONE

- Tie-in the proposed 300 mm major grid main along 24 Avenue to the existing 250 mm main along 180th Street. The proposed 200mm distribution lines would also tie-in to this existing line.
- Extend the proposed 250 mm water main along 184 Street and tie-in to the existing mains at 21A Avenue.
- Tie-in to the 250 mm main along Highway 15 at 28 Avenue.

142 M PRESSURE ZONE

- Tie-in the proposed 300 mm major grid main along 20 Avenue to the existing 150 mm main on this avenue at 178 Street.
- Extend the proposed 250 mm and 200 mm water mains along 21 and 22 Avenues and tie-in to the 250 mm mains.
- Tie-in to the 250 mm main along Highway 15 at 26 Avenue.

6.9.6 Pressure Reducing Valves

The distribution mains in the 90 m pressure zone will be connected to the mains in the 110 m pressure zone through pressure reducing valves (PRVs). The locations of these PRVs are shown in Figure 6.17. The connecting main at 177 Street between the 110 m and the 142 m pressure zone will also have a PRV, but it will be closed during normal conditions and will be opened only for emergency situations.

The proposed adjustment of the pressure zones would require the installation of two PRVs on existing mains on 21A Avenue and 20 Avenue. The location of these valves is also shown in Figure 6.17. The existing gate valve on 180 Street at 20 Avenue will be normally closed.

6.9.7 Grandview Pump Station

The Grandview pump station has adequate pumping capacity for future development, based on the water demand projections in Table 6.12. This capacity was defined as the pumping capacity at 35 m head which will provide a total head of 142 m. As shown in Table 6.14, the total capacity of the 6 pumps is 1,000 L/s, while the peak hour demand at total buildout within the study area will be 408 L/s. The peak hour demand from total buildout for the year 2,046 is expected to be 725 L/s. This flow value includes demands from areas outside of Redwood Heights and Grandview #3 and #5. The Grandview pump station has enough capacity to meet the demands from total buildout.

GRANDVIEW PUMP STATION CAPACITY

Pump	Capacity (L/s)
Pump 1	200
Pump 2	200
Pump 3	200
Pump 4	200
Pump 5	200
Pump 6	200
TOTAL	**1,000**

Table 6.14 Grandview Pump Station Capacity

6.9.8 Phasing

In order to facilitate full buildout, two separate feeder mains must be constructed from the Grandview reservoir and pump station to the NCP area along 24 Avenue. To minimize the initial cost due to the construction of the feeder mains, the following phasing is proposed.

PHASE 1

Build the high pressure 400 mm feeder main from 172 Street to Redwood Heights, and connect to the existing 300 mm water main that runs between the Grandview pump station and 172 Street. This allows for a total MDD plus fire flow demand of 215 L/s in Redwood Heights. The amount of development that can build-out will depend on the density/population and zoning, as each of these factors will dictate the MDD and fire flow required. Table 6.16 shows some examples of the maximum populations that could support this design flow.

New developments will require the construction of water mains from the high pressure feeder main to the development site at their ultimate size and location within existing and/or proposed right-of-ways. Developments in the low pressure zones (90 m and 110 m) will also require the installation of the PRV at 177 Street. The distribution mains in the low pressure zones will be fed from the high pressure network through this PRV until the low pressure feeder main is constructed (phase 3), at which time this PRV would then be closed under normal operating conditions.

PROPOSED PHASING

Phase	Construction	Impact
1	High pressure feeder main from 172 Street to Redwood Heights	Development in Redwood Heights up to 215 L/s, including fire flow.
2	High pressure feeder main from Grandview pump station to 172 St.	Allows for build-out in Redwood Heights up to 4,700 people or 400 L/s including fire flow for Redwood Heights and Grandview Heights Area #3 and #5.
3	Low pressure feeder main	Allow for full build-out in Redwood Heights and Grandview Heights Area #3 and #5.

Table 6.15 Proposed Phasing

PHASE 2

Build the remaining high pressure feeder main from the Grandview pump station to 172 Street. Ultimately, the complete high pressure feeder main is sized to serve the 142 m pressure zone within Redwood Heights and Grandview Heights Area #3 and #5. However in the interim, the complete high pressure main can also service the 90 m and 110 m pressure zones in addition to Grandview Heights Area #3 and #5, up to certain threshold before the low pressure main will be required. This threshold is a population of 4,700 people within Redwood Heights or a total design flow (MDD plus fire flow demand) of 400 L/s for Redwood Heights and Grandview Heights Area #3 and #5, whichever is reached first.

PHASE 3

The low pressure feeder main will be required once the threshold described above is reached.

As development progresses within Redwood Heights and Grandview Heights Area #3 and #5, the proposed phasing and specific thresholds will require further review.

Table 6.15 is a summary of the proposed phasing.

EXAMPLES OF INTERIM DEMANDS IN REDWOOD HEIGHTS DURING PHASE 1

Housing Type	Units	Number of People	Total Population	MDD (L/s)	Fire Flow (L/s)	MDD + Fire Flow (L/s)	PHD (L/s)
Townhouse	3,100	2.62	8,122	94	120	214	188
Commercial/ Residential Mixed-Use	500	2.62	1,310	15	200	215	30

Table 6.16 Examples of Interim Demands in Redwood Heights during Phase 1

6.9.9 Cost and Financing

Table 6.17 is a summary of the DCC-eligible infrastructure costs with a breakdown of costs attributable to the Redwood Heights NCP area and areas outside the NCP.

Upsizing costs are for the difference between the cost of the distribution main base size (200 mm) and the required size (250mm or larger). The trunk mains in the 110m pressure zone have a pipe diameter larger than 300 mm.

SUMMARY OF DCC ELIGIBLE WATER INFRASTRUCTURE COSTS

Item	Description	Total DCC-Eligible Costs	DCC-Eligible Costs Attributable to Redwood Heights NCP	DCC-Eligible Costs Attributable to Areas Outside Redwood Heights NCP
	High Pressure Feeder Main			
1	600mm from PS to 168 St	$625,000	$600,000	$25,000
2	450mm from 168 to 172 St	$1,338,000	$1,282,000	$56,000
3	400 mm from 172 to 176 St	$1,340,000	$1,340,000	$0
4	350mm from 176 to 178 St	$600,000	$600,000	$0
	Subtotal	**$3,903,000**	**$3,822,000**	**$81,000**
	Low Pressure Feeder Main			
5	600mm from Reservoir to 172 St	$2,025,000	$1,972,000	$53,000
6	500mm from 172 to 176 St	$1,375,000	$1,375,000	$0
7	450mm from 176 to 180 St	$1,380,000	$1,380,000	$0
	Subtotal	**$4,780,000**	**$4,727,000**	**$53,000**
8	Trunk mains in 110m pressure zone	$635,000	$635,000	$0
9	Upsizing in 142m pressure zone	$1,375,000	$1,375,000	$0
10	Upsizing in 110m pressure zone	$1,370,000	$1,370,000	$0
11	Upsizing in 90m pressure zone	$700,000	$700,000	$0
	Subtotal	**$4,080,000**	**$4,080,000**	
12	PRV between 142m and 110m zone	$200,000	$200,000	$0
13	4 PRVs between 110m and 90m zone	$800,000	$800,000	$0
	Subtotal	**$1,000,000**	**$1,000,000**	**$0**
	TOTAL	**$13,763,000**	**$13,629,000**	**$134,000**

Table 6.17 Summary of DCC-Eligible Water Infrastructure Costs

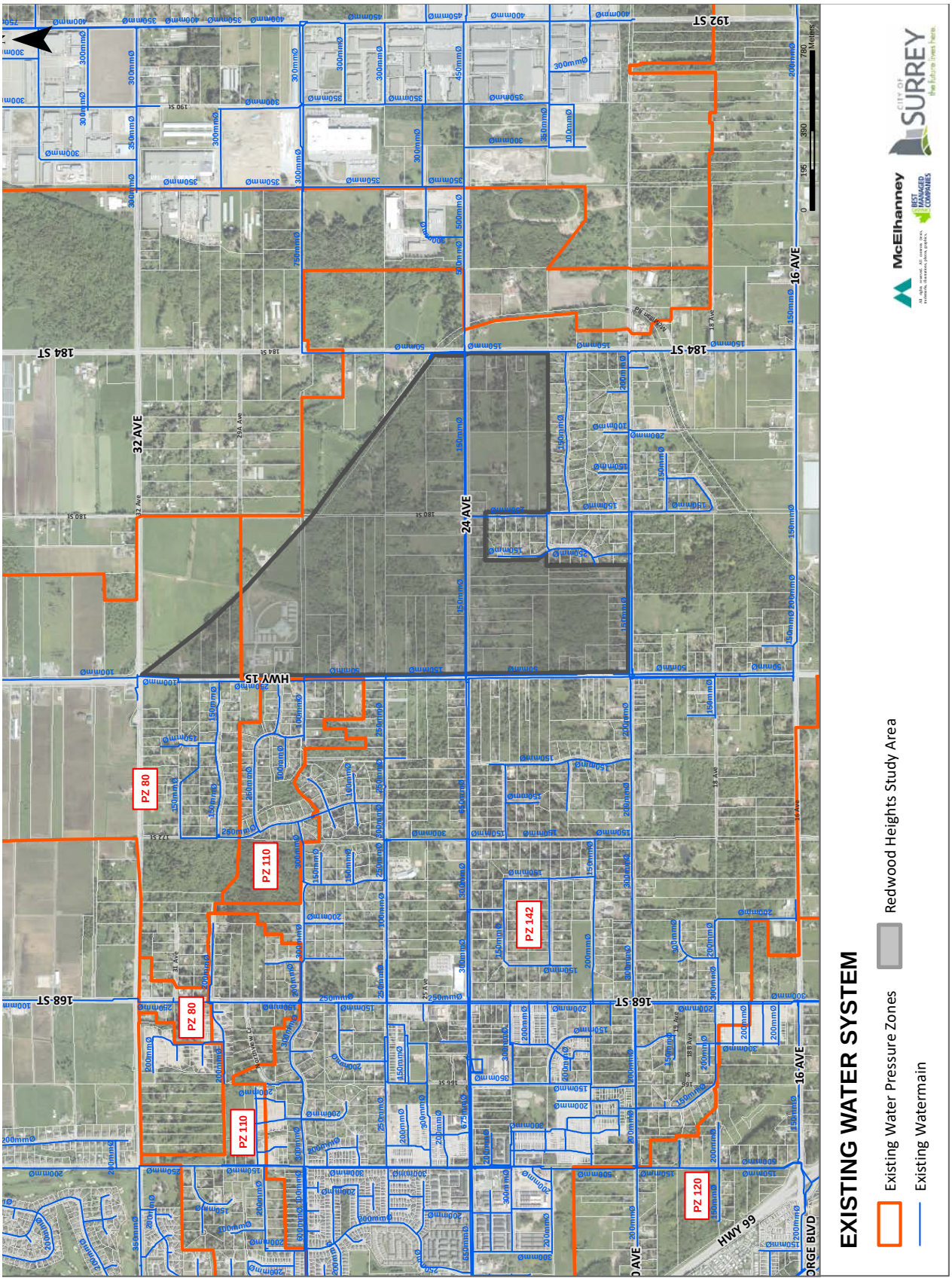


Figure 6.12 Existing Water System

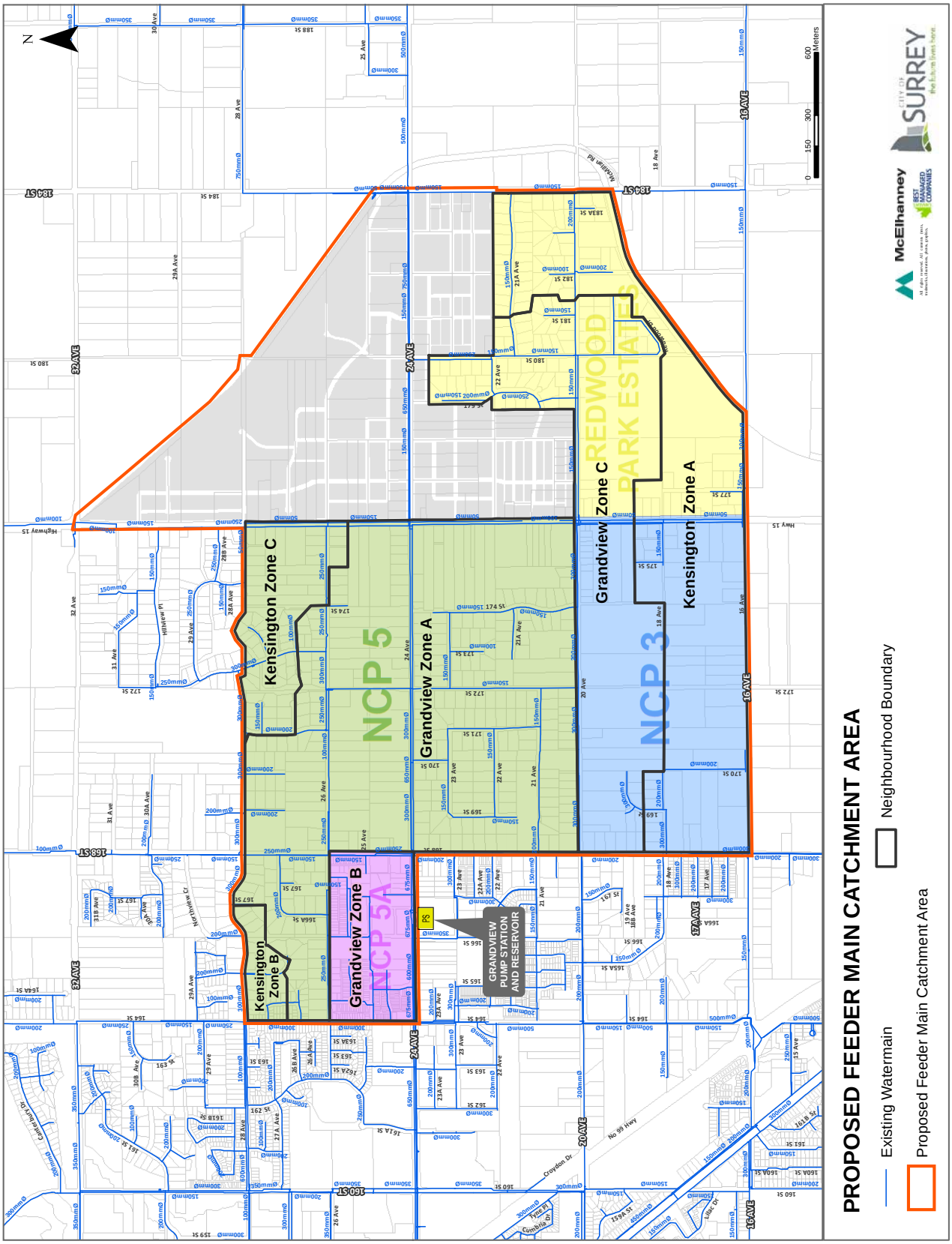


Figure 6.13 Proposed Feeder Main Catchment Area

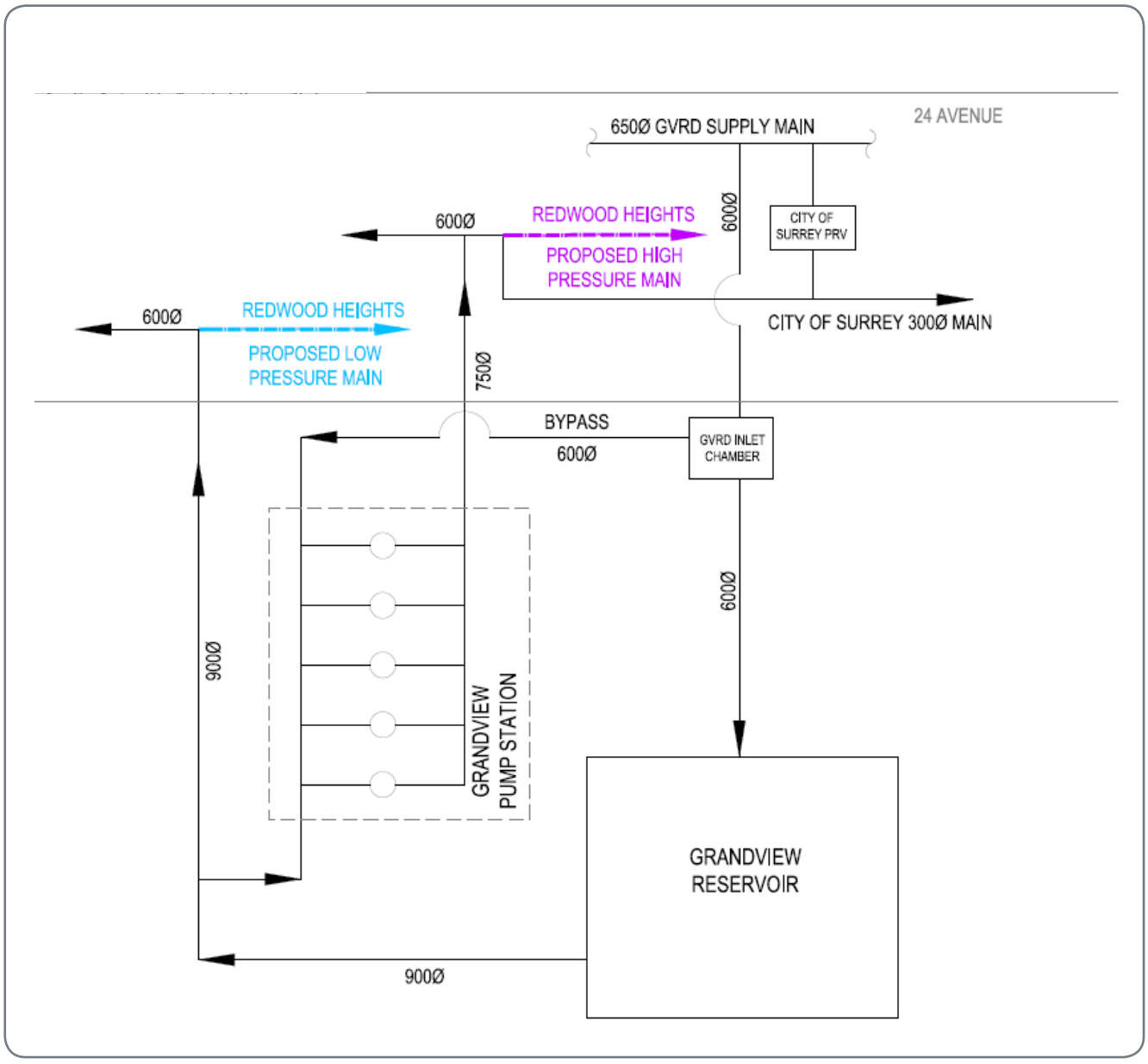


Figure 6.14 Proposed Feeder Main Connections

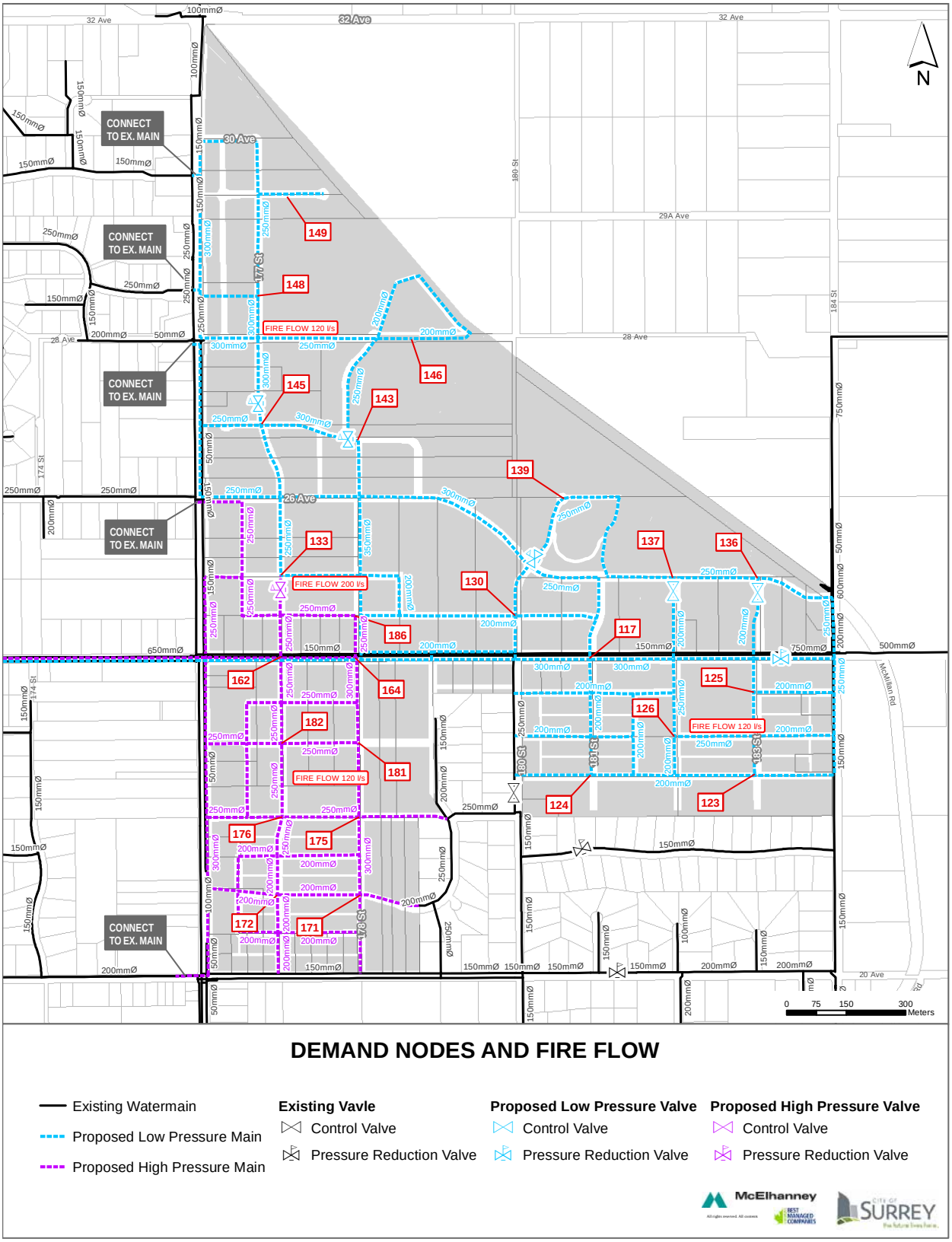


Figure 6.15 Demand Nodes and Fire Flow

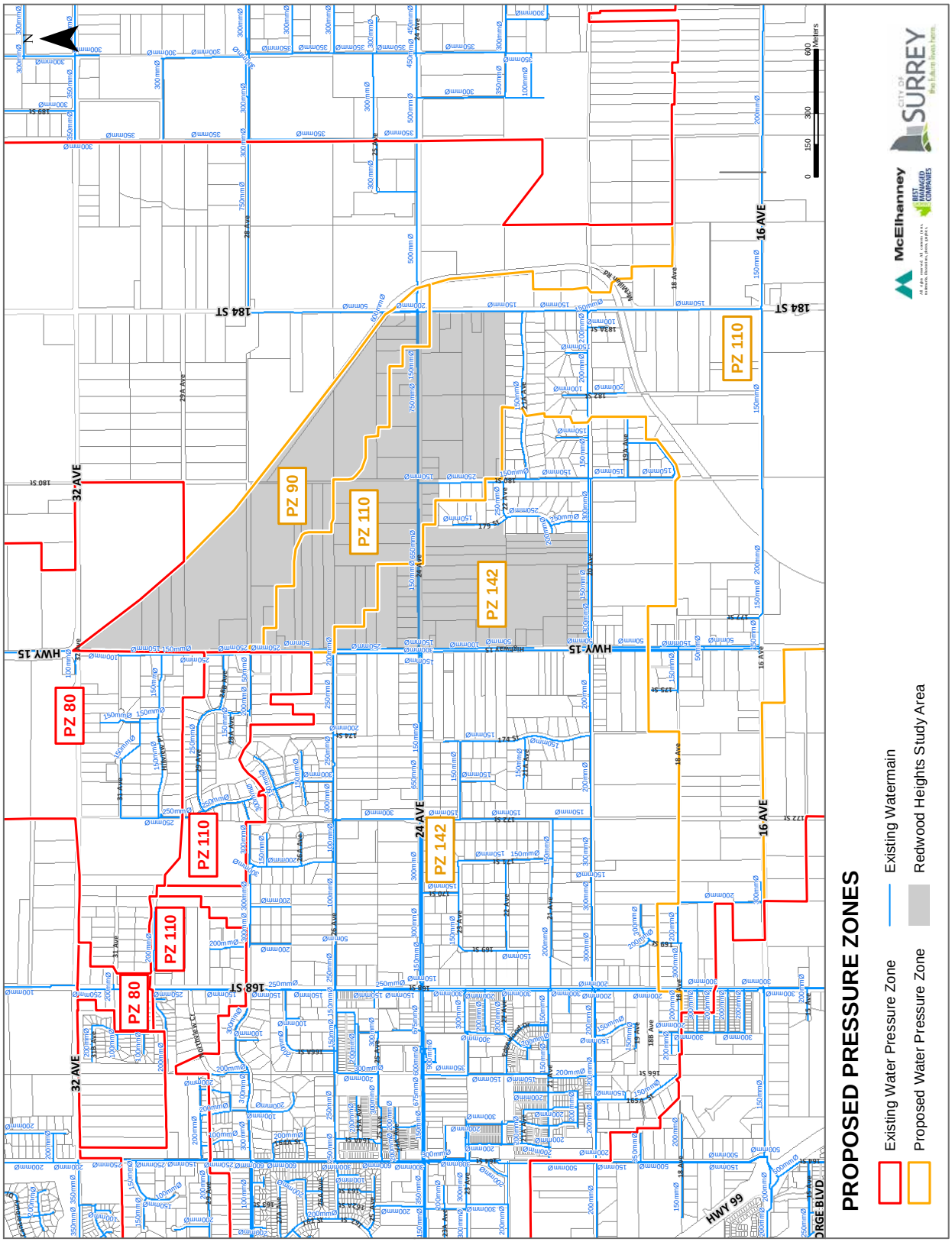


Figure 6.16 Proposed Pressure Zone

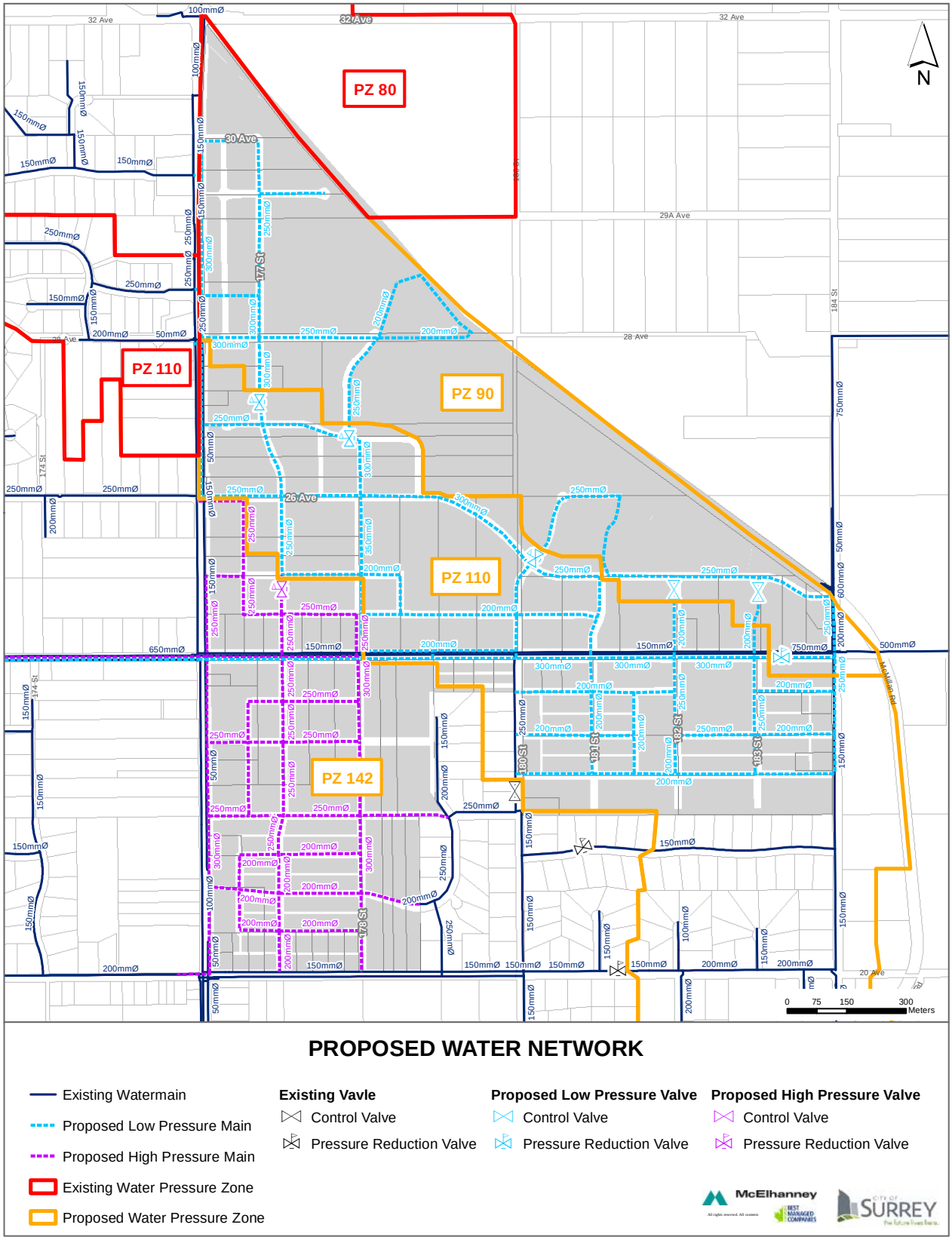


Figure 6.17 Proposed Water Network

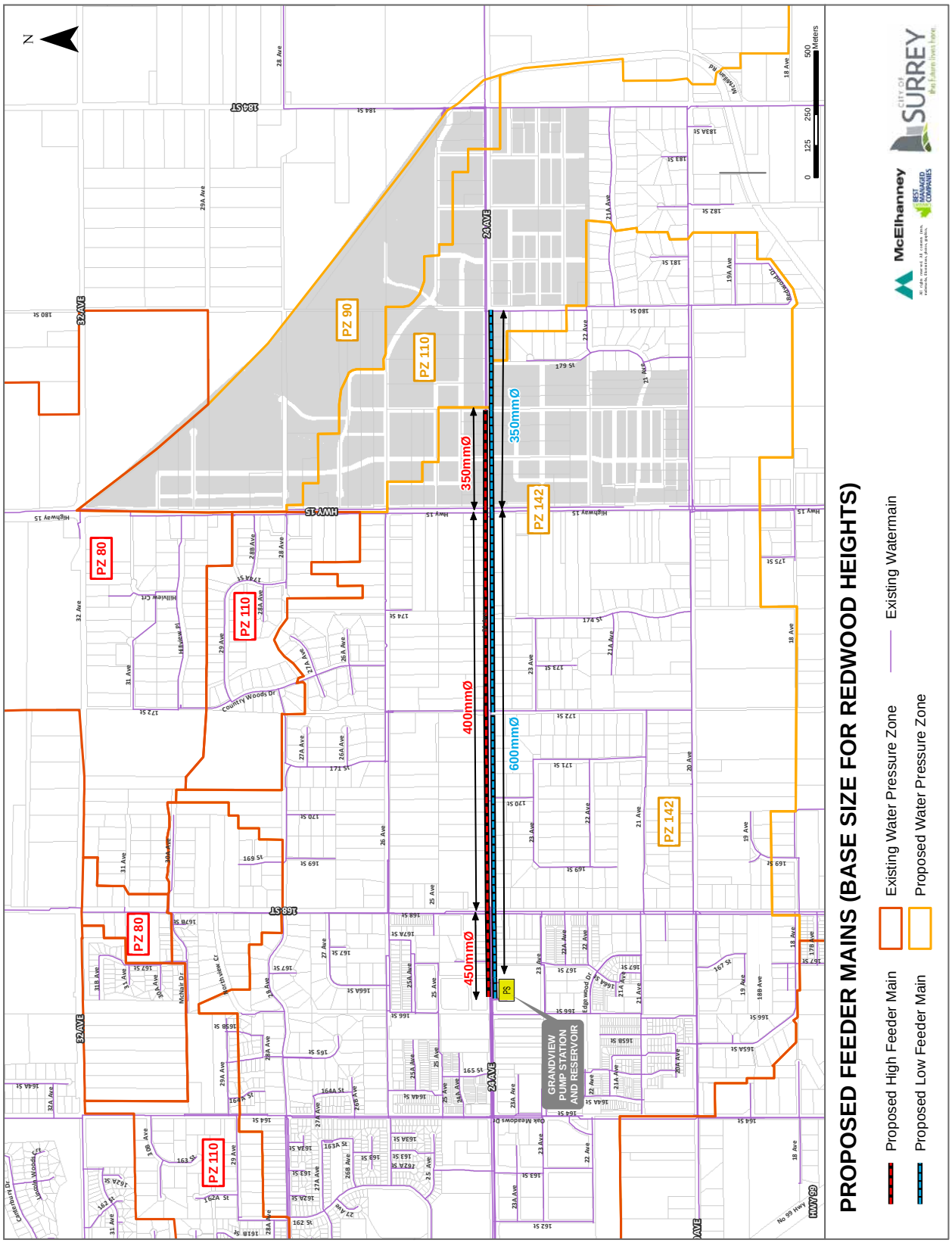


Figure 6.18 Proposed Feeder Mains (Inside)

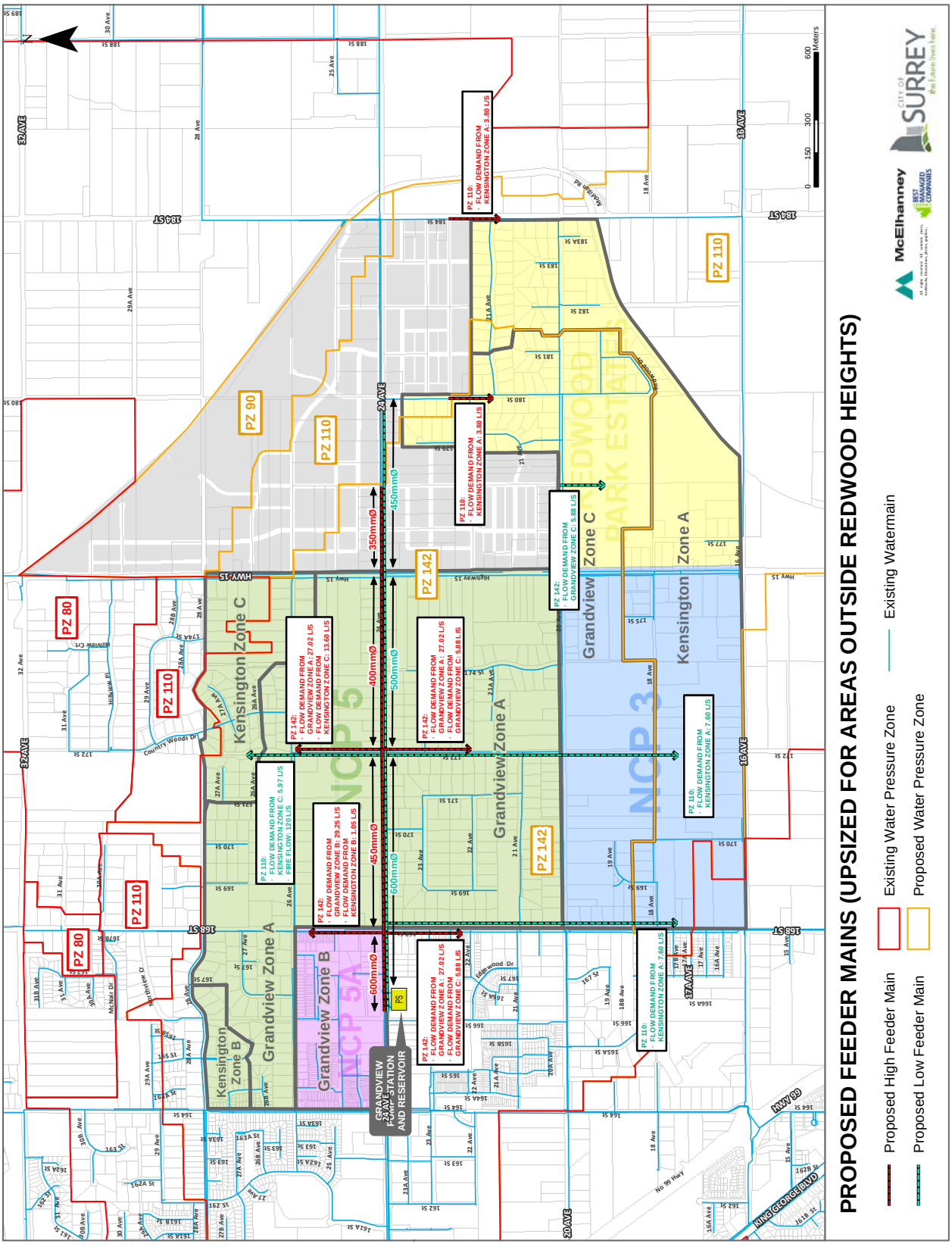


Figure 6.19 Proposed Feeder Mains (Outside)

Section 7

I Making it Work

The plan will increase development intensity and population. To address the impacts of growth, funding will be required to improve local amenities and infrastructure necessary for a high quality of life. A number of area specific considerations, such as flooding and watercourse protection, must also be considered as the area grows.

7.1 LAND CONSOLIDATION STRATEGY

In several areas of the NCP, lot consolidation will be required to ensure efficient development of properties. These land consolidation opportunities will, in most circumstances, be determined on a case-by case basis at development application.

In some cases, however, consolidation requirements have been identified to avoid creating remnant pieces created by fragmented ownership. These remnants would not be developable on their own or limit the development potential of an adjoining lot.

Land consolidation areas have been generally identified in Figure 7.1 to inform developers and owners of the consolidation strategy guidelines, to ensure compatibility and feasible development areas, and to achieve an equitable distribution of road dedication and construction costs across properties. If land consolidation is proven not to be possible or feasible during the development process, the developer must:

- Demonstrate that the development potential of the excluded property is not compromised, to the satisfaction of the City; and
- Share any required road construction costs amongst properties shown in the land consolidation area.
- Provide additional road or lane and pedestrian access dedications to the satisfaction of the City.

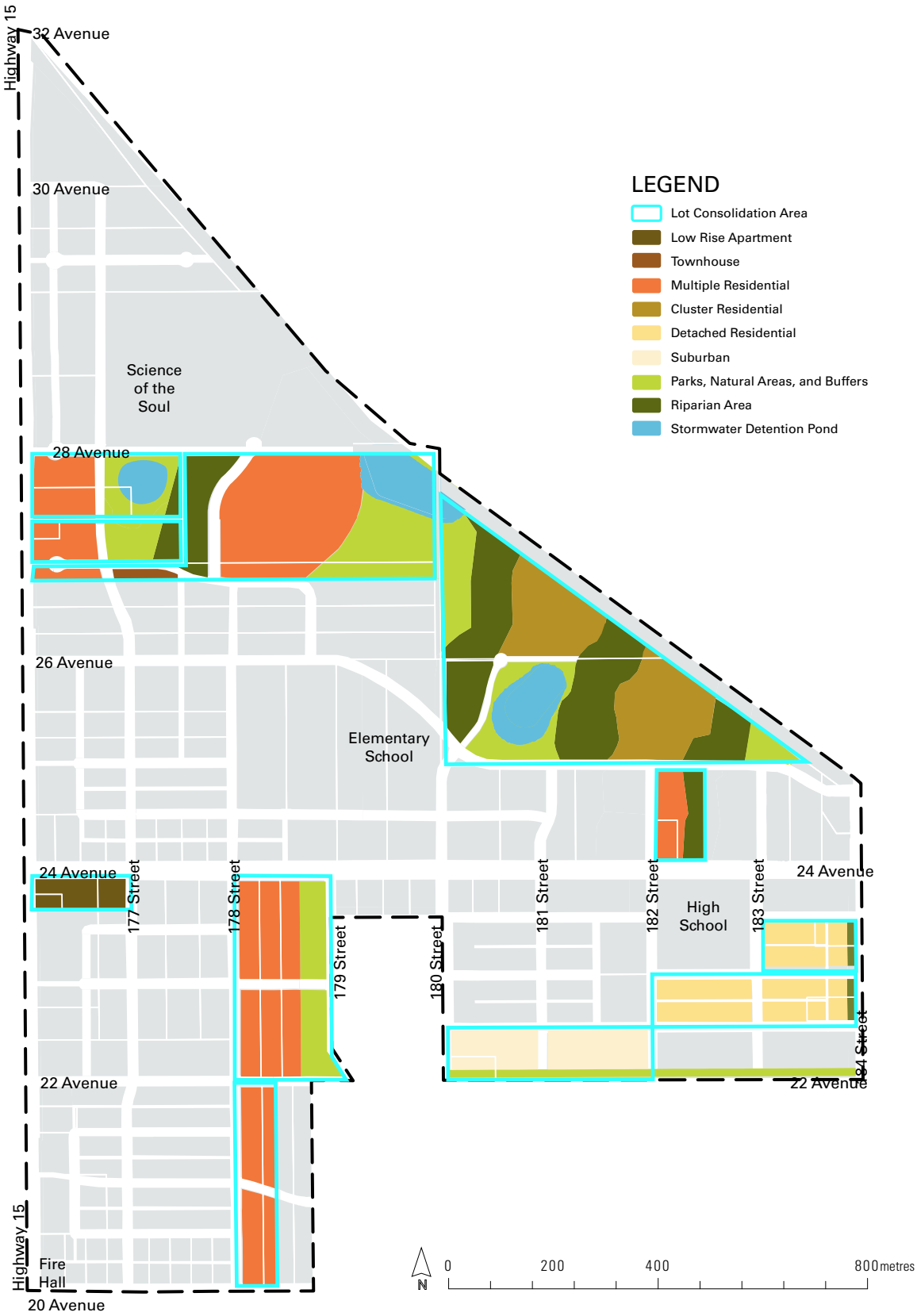


Figure 7.1 Land Consolidation Strategy

7.2 OFFICIAL COMMUNITY PLAN AMENDMENT

Redwood Heights is currently designated Suburban-Urban Reserve in the OCP (Figure 7.2). Bylaw amendment changes to the OCP land use designations are required to proceed to rezoning following the approval of the Redwood Heights NCP, as generally illustrated in Figure 7.2 and 7.3.

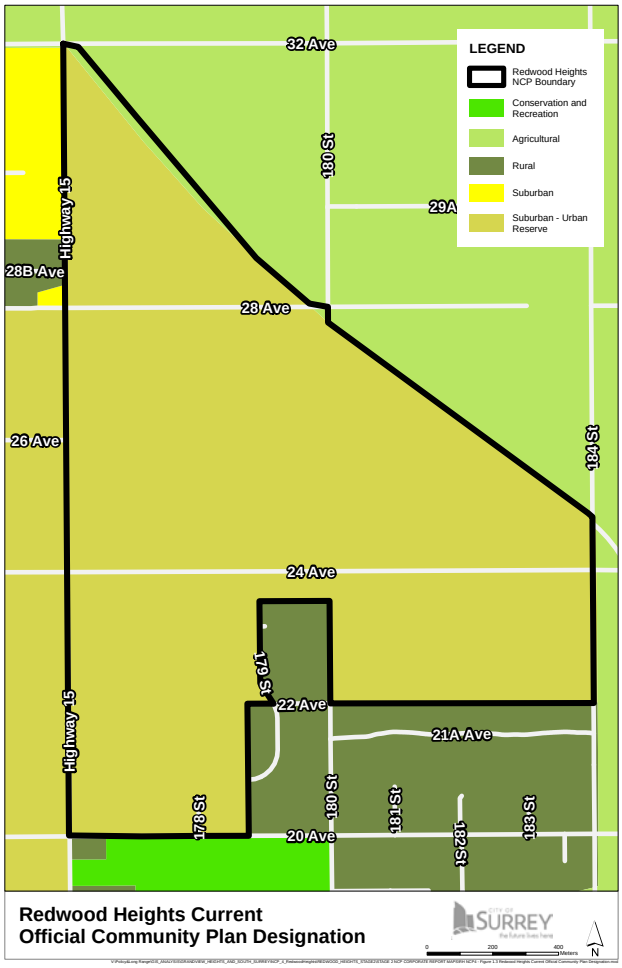


Figure 7.2 Current OCP Designations

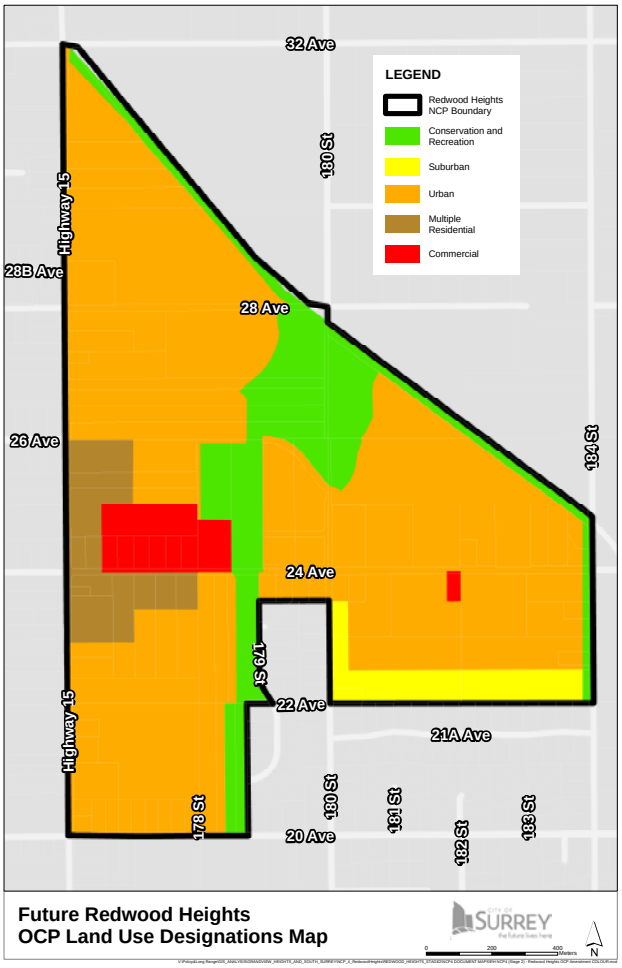


Figure 7.3 Future OCP Designations

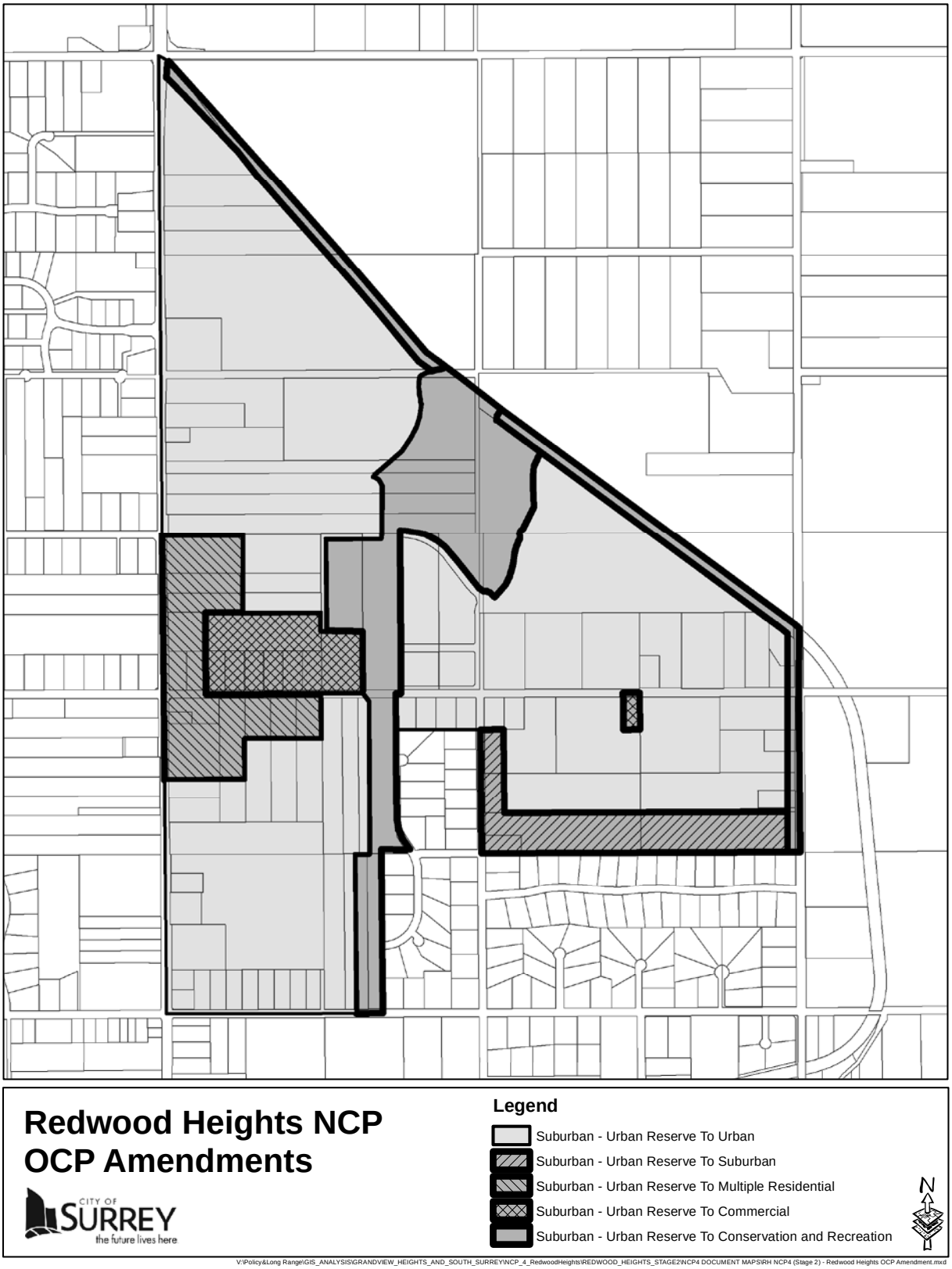


Figure 7.4 OCP Amendments

7.3 DESIGN GUIDELINES

In the case of single-family residential development, approved building schemes will be required to control housing designs. Where single family developments are located in designated Development Permit Areas (DPA), as well as for any multiple unit residential development, design guidelines will be implemented through the review and approval of a Development Permit.

7.4 DEVELOPMENT PERMIT AREAS

Where developments are located in designated Development Permit Areas (DPA), as identified in the OCP (steep slopes, farm protection, environmentally sensitive areas, etc.), as well as in the case of multiple unit residential or commercial developments, the OCP Design Guidelines will be implemented through the process of reviewing and approving the related Development Permit at the time of development application.

Figure 7.5 Farm Protection DPA Map

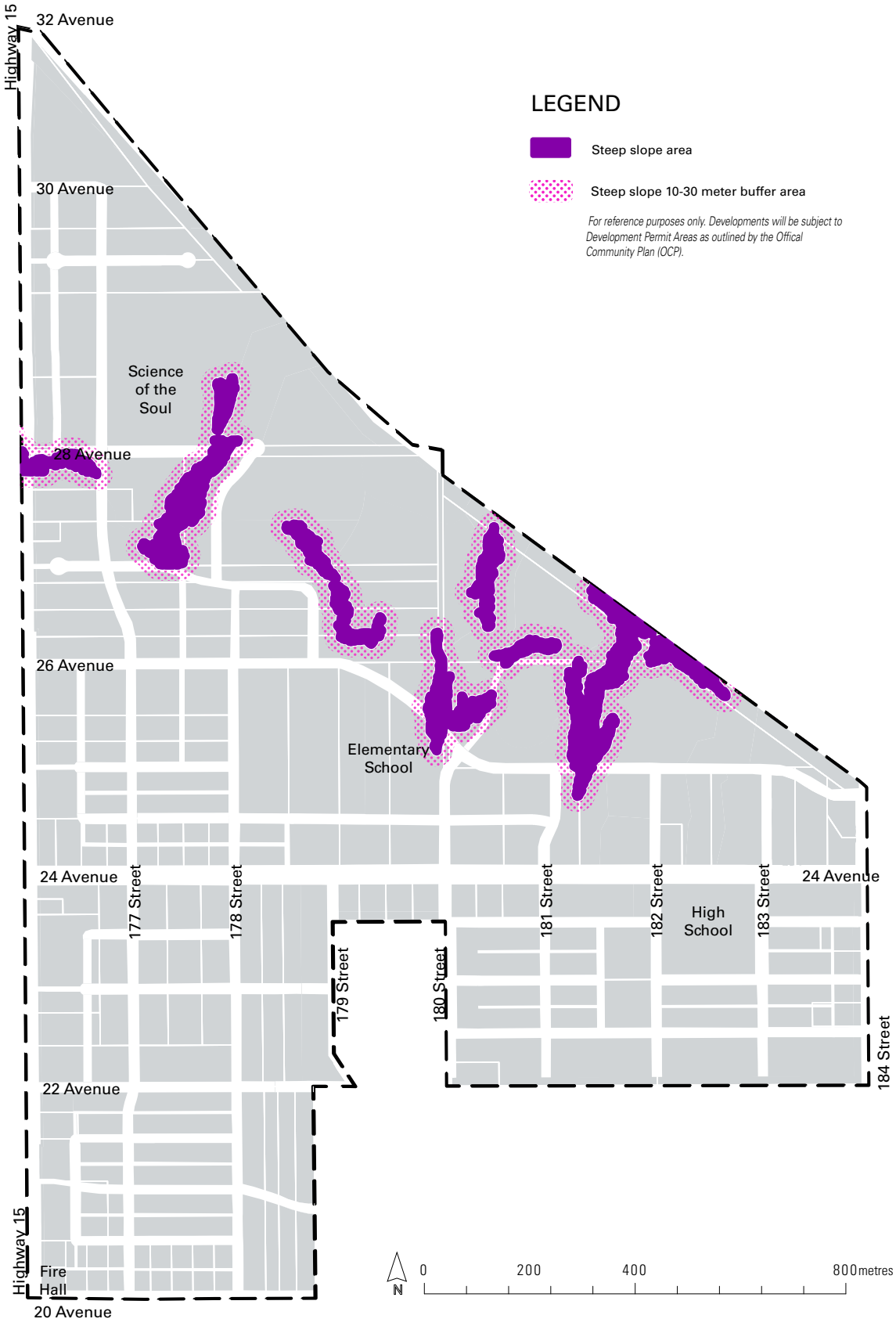


Figure 7.6 Steep Slopes Hazard DPA Map

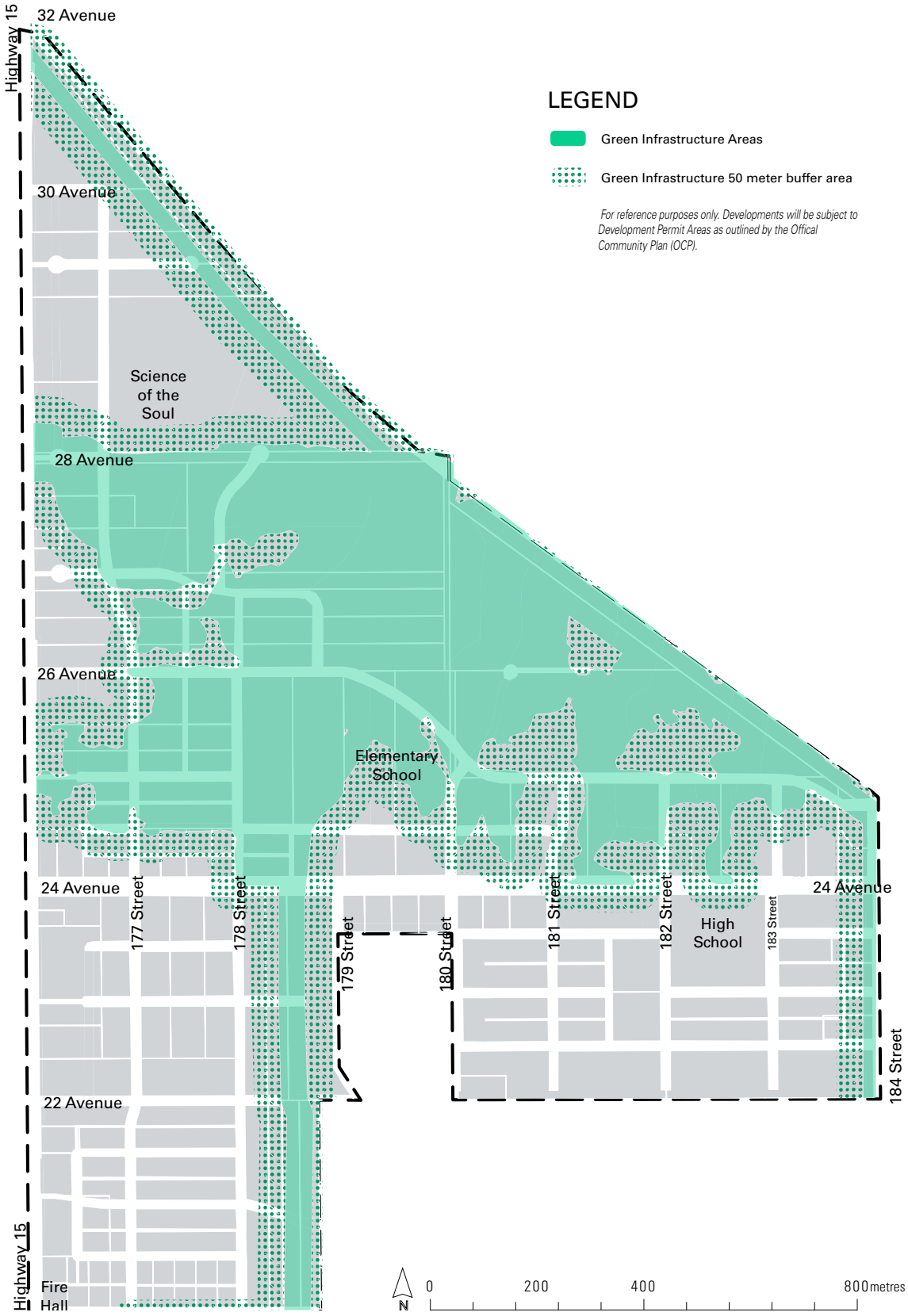


Figure 7.7 Sensitive Ecosystem Infrastructure Network DPA Map

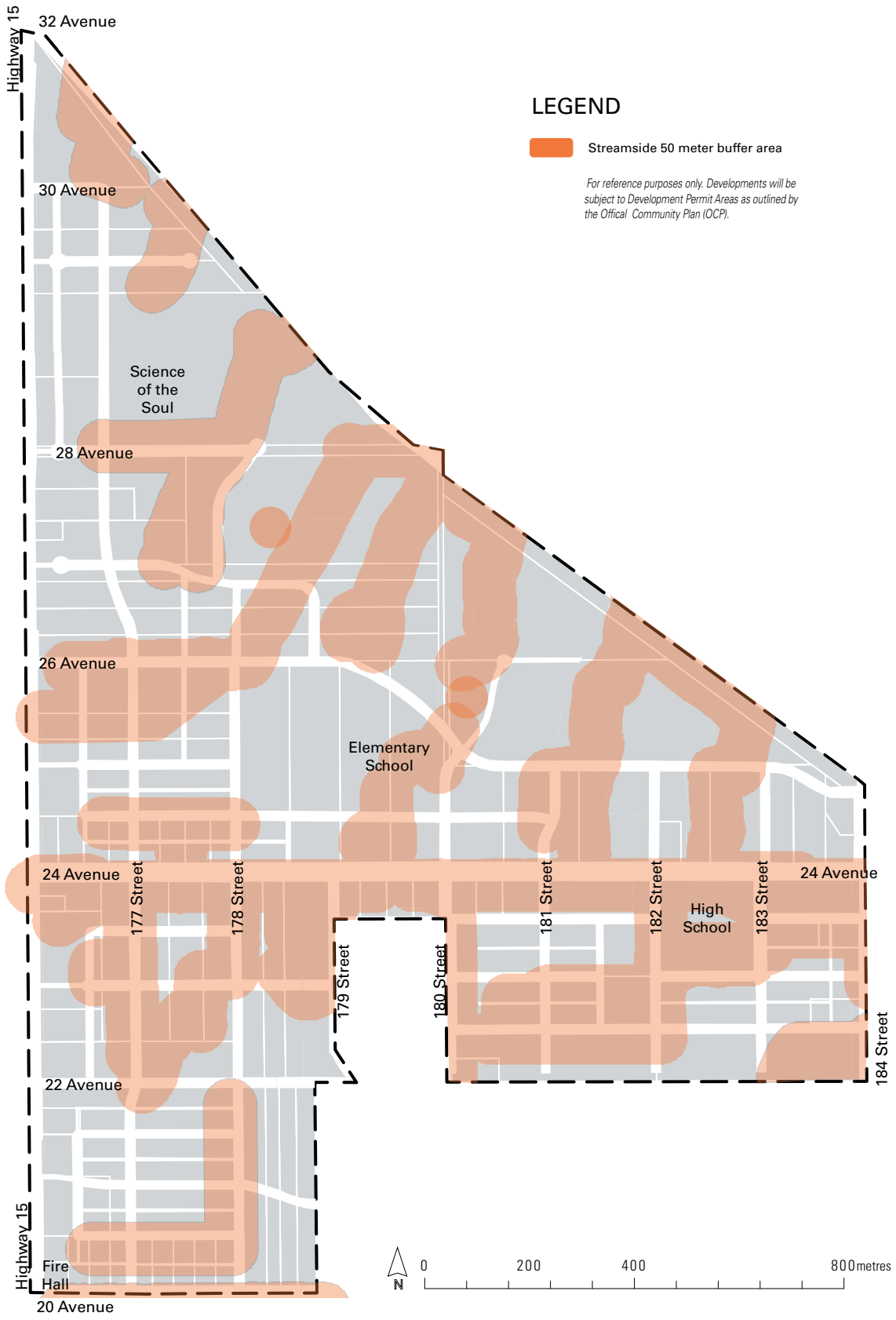


Figure 7.8 Sensitive Ecosystem Riparian DPA Map

7.5 COMMUNITY AMENITY CONTRIBUTIONS

Growth and development will lead to increased demand for community amenities. To secure these amenities, Surrey uses density bonus zoning ("Density Bonusing") in accordance with Section 482 of the Local Government Act.

Community Amenity Contributions (CAC's) are collected as cash contributions provided by developers at time of rezoning or building permit. They are offered by developers when City Council grants increased development rights through re-zoning properties for increased density in accordance with Schedule G of Surrey Zoning Bylaw #12000. These contributions help offset the impacts of growth and help fund new community facilities and services.

- Tier 1 CAC's apply to all residential rezoning's seeking increased density (with some exceptions) and is applicable to the portion of units that are consistent with the density within the Redwood Heights Plan/or the Official Community Plan (OCP), whichever is lower. Tier 1 CAC's include area specific Secondary Plan CAC's (Parks, Libraries, Fire, Police), and City-wide Capital Project CAC's, and Affordable Housing CAC's.
- Tier 2 CAC's will only apply when residential rezoning's seek increased density (Plan Amendment) above Redwood Heights Plan or OCP designations in accordance with Surrey's Density Bonus Policy O-54. Tier 1 is applied up to the Plan or OCP designations and Tier 2 is then applied to the portion of density above the Plan or OCP designation.

Tier 1 - Area Specific Redwood Heights CAC's

To enact the area specific Secondary Plan CAC's noted above, the Zoning By-law will be amended to add Redwood Heights to the list of area specific Plan areas within which monetary amenity contributions are required. The monetary contributions toward parks, police, fire and library materials will offset capital costs of providing services to new development and are applied on a standardized basis in all of Surrey's Secondary Plans. The monetary contributions toward parks, open spaces and pathway development are based upon an estimated capital costs of improvements for this NCP. The total cost is divided by the average anticipated number of dwelling units (acreages in the case of non-residential development) to ensure an equitable contribution.

The estimated costs of the various amenities are distributed evenly to each dwelling unit. Therefore, if the number of dwelling units in a proposed development is lower than that anticipated by the NCP, the applicant will be expected to "top up" the amenity fees based on the number of the dwelling units used to calculate the amenity charge to ensure that there is no shortfall in the funding for the proposed.

City Wide CAC's

Universal City-Wide CAC's such as Affordable Housing and Capital Projects CAC's, are also applicable to future development in Redwood Heights as identified in Schedule G of Surrey Zoning Bylaw.

7.5.1 Parkland & Pathway Development

The scope of parkland development within the NCP will include eight (8) new parks, a Biodiversity Preserve and a linear Habitat Corridor. The estimated cost of developing park amenities is $13,146,013.14 which results in a $2,509.26 per dwelling (in 2020 dollars) per dwelling unit. This estimate includes the construction of onsite park amenities, such as playgrounds, washroom buildings, parking lots, sports courts, athletic fields, tree and horticultural plantings, park pathways, seating areas, viewing platforms and passive open spaces. This also includes natural and riparian area management within land acquired by Parks.

Park amenity calculations do not include riparian area works on land conveyed to the City through the development process, such as invasive species removals, fence construction, replanting and naturalization, in-stream works and any other related riparian area costs, including planning and design costs, which are to be accounted for as part of the development process and subject to the Zoning By-Law.

7.5.2 Library Materials

A study of library requirements in Surrey's new neighbourhoods has established that a contribution of $181.17 (in 2020 dollars) per dwelling unit (non-residential development is exempt) is necessary to cover the capital costs for library materials and services, which is sensitive to population growth. Consequently, a total of approximately $949,149.63 will be collected from Redwood Heights towards materials such as books, computers, and electronic media.

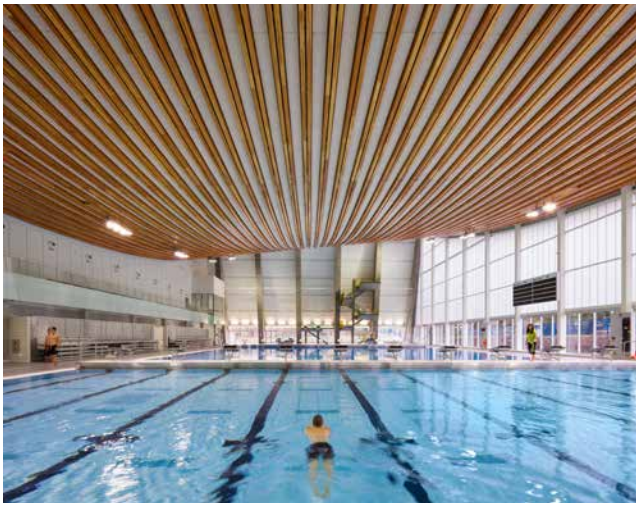
7.5.3 Fire Protection

Future development in this neighbourhood will drive the need to upgrade existing fire and police protection facilities. A study of fire protection requirements in Surrey's new neighbourhoods has established that a contribution of $347.89 per dwelling unit and $2,087.34 per acre of non-residential development (in 2020 dollars) will cover the capital costs for fire protection. This will result in a total capital contribution from Redwood Heights of approximately $1,862,046.44 toward fire protection.

7.5.4 Police Protection

A contribution of $80.52 per dwelling unit and $483.12 per acre of non-residential development will cover the capital costs for police protection. This will result in a total capital contribution from Redwood Heights of approximately $430,975.25 toward police protection.

7.5.5 Capital Projects



The NCP area will be subject to Capital Plan Project CAC's for future rezonings, as identified in Surrey's Zoning Bylaw #12000. The Capital Project contribution rates are phased in over 2 years, with rates increasing from $1,000 to 1,500, to $2,000 from January 1, 2020 to January 1, 2022 as outlined in Section B.4 of Schedule G of the Zoning Bylaw. The proposed development will provide the phased zoning bylaw rates that are applicable at the time the future Building Permit is issued. This will result in a total capital contribution from Redwood Heights of approximately $10,478,000 toward civic projects such as cultural, sport or recreation facilities within the larger Grandview Heights area.

7.5.6 Affordable Housing

The NCP is subject to Affordable Housing CAC's for future rezonings, as identified in Schedule G of Surrey's Zoning Bylaw. The (2020) Affordable Housing contribution rates are $1,000 as outlined in Schedule G of the Zoning Bylaw. Proposed development will provide the bylaw rates that are applicable at the time the future Building Permit is issued. This will result in a total affordable housing contribution from Redwood Heights of approximately $5,239,000 toward civic affordable housing projects in the South Surrey area.

REDWOOD HEIGHTS COMMUNITY AMENITY CONTRIBUTION PROJECTION SUMMARY

The estimated (2020 Rate) CAC's and total projected revenues expected from development in Redwood Heights is expected to be over $32 Million dollars. The specific CAC's for Redwood Heights NCP area summarized below and are documented in Table 7.1.

REDWOOD HEIGHTS NCP COMMUNITY AMENITY CONTRIBUTION RATES

CAC	Per Unit Contribution All Residential (Approx. 5,239 dwelling units @ average density)	Per Acre Contribution All Non-Residential Uses (21.4 Acres)	Anticipated Total Revenue at Build Out
Police Protection	$80.52 per dwelling	$483.12 per acre	$430,975.25
Fire Protection	$347.89 per dwelling	$2,087.34 per acre	$1,862,046.44
Parks & Open Spaces	$2,509.26 per dwelling	n/a	$13,146,013.14
Library Materials	$181.17 per dwelling	n/a	$949,149.63
Civic Projects	$2,000 per dwelling	n/a	$10,478,000
Affordable Housing	$1,000 per dwelling	n/a	$5,239,000
Total contribution (per unit or per acre)	$6,022.62 per dwelling	$2,570.46 per acre	
ANTICIPATED TOTAL CAC REVENUE			$32,105,184.46

Table 7.1 Community Amenity Contribution Rates

7.6 COST RECOVERY SURCHARGE

Several consultants were retained to assist with the preparation of the Redwood Heights NCP, including heritage, environmental, watercourse, commercial, transportation, financial, and engineering service studies. The total cost of consultant services to the City was $587,926.59. The Fee Imposition By-law is to be amended to provide for the recovery of these NCP preparation costs through the payment of application surcharge fees at time of development.

A per unit surcharge fee will be based on the anticipated 5,239 units at the mid-range density and will result in a per unit fee of $112.22. See Table 7.2.

Should the actual number of proposed units fall below the number anticipated on any site, the applicant will be required to make up the shortfall in the surcharge fee to ensure the City's NCP preparation costs are fully recovered. For non-residential development the equivalent application surcharge fee will be based on the gross lot area at a rate of 10 units per hectare or $1,122.00 hectare.

REDWOOD HEIGHTS NCP PREPARATION COST RECOVERY (SURCHARGE FEE)

Consultant Study	Cost	Per Unit Fee (Based On 5,239 Units)
Stage 1 Planning & Engineering	$334,351.59	$61.28
Environmental and Tree Studies	$10,000.00	$1.83
Stage 2 Engineering Servicing Studies (Water, Sanitary, Drainage)	$195,402.00	$35.81
South Surrey Transportation Study	*$130,756.00 (25% to be paid by NCP #4)	$5.99
Watercourse & Wetland Assessment	15,484.00	$2.95
Total Consultant Study Costs:	$587,926.59	$112.22

Table 7.2 NCP Preparation Cost Recovery (Surcharge Fee)

7.7 FINANCING

New water, sanitary sewer, storm sewer and transportation infrastructure is required to support development in the NCP. Table 7.3 summarizes the projected DCC revenues and construction costs for each of the major infrastructure systems that will be needed to support build-out.

Revenues are based on the proposed DCC rates that are anticipated to come into effect on May 15, 2020 and include the DCC municipal assist factor for all DCC-Eligible Costs attributable to the NCP for each utility, as summarized in Table 7.5.

Included in these costs are road improvements that will be necessary for the development of this NCP but will also benefit development outside of this NCP area. In this regard, the NCP has only been burdened with a proportionate share of the total costs related to the road improvements.

The four drainage ponds in the NCP require acquisition of land, which makes up approximately 73% of drainage costs. Land costs are based on an average land acquisition price of $2,500,000 per acre, as estimated by Realty Services Division staff.

7.7.1 Financing Approach

As shown in Table 7.3, the cost to provide the necessary water, sanitary sewer and drainage infrastructure to support development in the NCP exceeds the expected DCC revenues from development in the area, and currently there is no funding system in place to acquire the lands identified in the BCS.

This revenue shortfall will necessitate the introduction of additional levies to support development of this NCP.

RECOMMENDED FINANCING APPROACH

Given that there is a DCC funding shortfall for water, sanitary sewer, and drainage infrastructure, and for the acquisition of the BCS lands in the NCP, it is recommended that:

1. An area specific DCC be established as the means to pay for water and sanitary sewer, and for the acquisition of the BCS lands in the NCP;
2. The Citywide DCC be used as the means to pay for arterial and non-arterial road infrastructure and for parkland acquisition in the NCP area; and
3. A combination of the Citywide DCC and Development Works Agreements (DWA) to recover any DCC funding shortfall be used as the means to pay for drainage infrastructure, including stormwater detention ponds, to service this NCP.

An area-specific DCC was explored, in order to address the drainage funding shortfall; however, given that the cost of each stormwater detention pond varies and the DCC revenues generated by the benefiting area of each stormwater detention pond varies, the area-specific DCC approach would result in some front-ending developers not having the opportunity to fully recover their investment. As such using a combination of the in City-wide DCC and DWAs to recover any DCC funding shortfall as the means to pay for the stormwater detention ponds servicing this NCP area will provide the opportunity for each front-ending developer to fully recover their investment.

FINANCING IMPLEMENTATION

The 10-Year Servicing Plan establishes the City's capital expenditure plan for the construction of engineering infrastructure to service existing neighbourhoods and to support new growth across the City. It also forms the basis for establishing the City's DCC rates. Table 7.6 shows the DCC rates for the recommended approach.

With the completion of this NCP, it is recommended that the infrastructure needs identified in this NCP be added to the next update of the 10-year Servicing Plan, and the DCC rates be included in the next DCC bylaw update.

FINANCING LAND FOR THE BCS

The estimated cost to acquire BCS lands in the NCP is $112,500,000, based on an average acquisition cost of $2,500,000 per acre. Currently, there is no funding system in place to fund the acquisition of these lands. Recommended area specific DCC's, including a municipal assist factor, are detailed in Table 7.6.

7.7.2 Operation and Maintenance

The development of the NCP area will increase the total length of infrastructure that the City is required to operate, maintain and eventually replace. The increases to the City's major infrastructure categories are shown in Table 7.7.

The midline build-out population estimate of 13,500 persons in the Plan area represents a 2.6% increase in the City's population. The infrastructure needed to support this increase in population results in the City's infrastructure inventory increasing by 0.3 to 1.7%. Therefore, the added infrastructure to support the development of the Plan area is positively balanced when compared against the increase in population.

DCC SURPLUS/SHORTFALL FOR ENGINEERING INFRASTRUCTURE

Service	Estimated DCC Revenues	DCC-Eligible	Anticipated Total Revenue at Build Out
Water	$10,110,000	$13,630,000	**-$3,520,000**
Sanitary Sewer	$14,570,000	$17,850,000	**-$3,280,000**
Drainage	$10,110,000	$65,750,000	**-$55,640,000**
Arterial Roads	$60,410,000	$54,160,000	**$6,250,000**
Non-Arterial Roads	$14,060,000	$13,790,000	**$270,000**

Table 7.3 DCC Surplus/Shortfall for Engineering Infrastructure

MUNICIPAL ASSIST FACTOR FOR BCS LANDS

Service	Municipal Assist Factor	Cost of the Municipal Assist Factor
Biodiversity Conservation Strategy Lands	1%	$1,125,000

Table 7.4 Municipal Assist Factor for BCS Lands

MUNICIPAL ASSIST FACTOR FOR ENGINEERING INFRASTRUCTURE

Service	Municipal Assist Factor	Cost of the Municipal Assist Factor
Water	1%	$101,100
Sanitary	1%	$145,700
Drainage	1%	$101,100
Arterial Roads	1%	$ 604,100
Non-Arterial Roads	1%	$ 140,600

Table 7.5 Municipal Assist Factor for Engineering Infrastructure

PROPOSED DCC RATE FOR EACH COMPONENT FOR REDWOOD HEIGHTS

	Arterial 2020 City Wide	Non-Arterial 2020 City Wide	Parks 2020 City Wide	Drainage 2020 City Wide*	Sewer Area Specific	Water Area Specific	BCS Lands Area Specific	Total
SF (RF, RF-12) (per lot)	$18,969	$4,409	$9,889	$3,542	$4,855	$3,707	$30,599	**$75,970**
SF Small Lot (RF-10) (per lot)	$17,273	$4,015	$9,005	$2,090	$4,063	$3,103	$25,608	**$65,157**
RM-10, RM-15 & RM-30 (per sq.ft. of DU)	$7.13	$1.66	$9.07	$1.33	$2.16	$1.65	$13.64	**$36.64**
RM-45 and RM-70 (per sq.ft. of DU)	$9.28	$2.16	$9.24	$0.93	$2.98	$2.27	$18.76	**$45.62**
Commercial (ground floor) (per sq.ft. of BA)	$7.05	$1.64	$0.00	$2.30	$1.35	$1.03	$8.49	**$21.86**

Note: * excludes potential DWA charges.
Acronyms: SF (single family), DU (dwelling unit), BA (building area)

Table 7.6 Proposed DCC Rate for Each Component for Redwood Heights

Infrastructure Type	Existing Inventory	Increase to Inventory	Increase to Inventory (%)
Sewer mains	1,595 km	27.3 km	1.7%
Water mains	1,862 km	25.6 km	1.4%
Drainage mains	1,955 km	6.5 km	0.3%
Local, Collector, and Arterial Roads (centreline length)	1,750 km	24.7 km	1.4%

Table 7.7 Increases to Major Infrastructure Categories for Redwood Heights

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