CITY OF RICHMOND

REPORT TO COMMITTEE

TO: General Purposes Committee **DATE:** August 22, 2002

FROM: Terry Crowe, Manager, Policy Planning **FILE:**

RE: CITY WIDE FLOOD PROTECTION AND MANAGEMENT STRATEGY

STAFF RECOMMENDATION

That, as per the Manager, Policy Planning report (dated August 22, 2002), Phase One of the Work Program for preparing a comprehensive updated City-wide 2021 Flood Protection and Management Strategy be approved.

Terry Crowe
Manager, Policy Planning

Att. 6

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ROUTED TO: **CONCURRENCE**	**CONCURRENCE OF GENERAL MANAGER**
Emergency and Environmental Programs Y ☑ N ☐ Engineering ..... Y ☑ N ☐ Roads & Dykes ..... Y ☑ N ☐ Parks Design, Construction & Programs .. Y ☑ N ☐	

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Staff Report

Origin

This report seeks Council's direction for staff to establish a steering committee to prepare a comprehensive City-wide 2021 strategy on flood protection and management for the City of Richmond and to undertake the first phase of a two part work program.

The motivation for this undertaking is rooted in a number of documents, commitments and necessities:

- Council's 1989 Floodplain Management Implementation Policy (**Attachment 1**) commits to completing and adopting a Floodplain Management Plan utilizing the Hay and Company Report (1989) as the technical basis, and to encouraging floodproofing in Urban Exempt Areas.

- In 1996 Council adopted a memorandum of understanding (**Attachment 2**) with the Greater Vancouver Regional District which included the following resolution:

  That West Richmond is a strategic growth area and should Richmond and the Province agree on a mutually acceptable implementation plan for flood and seismic protection, and should Richmond have adopted land use policies and by-laws consistent with the achievement of a future Richmond population comparable to objectives for growth within the Growth Concentration Area, then West Richmond would be considered as an area qualifying for priority in transportation services and facilities, as described in the Livable Region Strategic Plan policy.

- Richmond's 1999 Official Community Plan identifies the objective of improving flood protection measures in the portions of Richmond susceptible to flood protection (**Attachment 3**). Associated policies include:
  a) Maintain and upgrade the perimeter dyke systems on Lulu and Sea Islands;
  b) Construct the internal dyke system identified in the Hay and Company Report;
  c) Work with the Ministry of Environment in resolving improved flood protection measures for the historic settlement areas.

- As the dyking authority for the Lulu Island and a portion of Sea Island, the City has certain obligations and responsibilities under the Dike Maintenance Act (**Attachment 4**) for maintenance of the City's dykes and the prevention of flooding.

- It is generally acknowledged that no single approach to flood protection (e.g. a dyke alone) will completely eliminate flood hazards. However, as noted in a recently released brochure by the Fraser Basin Council (**Attachment 5**), the application of an integrated planning and management approach to flood protection, inclusive of floodproofing designs and techniques, land use planning, flood protection works, emergency preparedness, and disaster financial assistance, etc., can significantly reduce the risks and damages associated with flooding.

- There are growing concerns regarding the implications of climate change and sea level rise over time that could impact Richmond.

- A strategic approach is required to manage the impacts and implications of flood protection upon the economic well being of the community, and to achieve results while ensuring compatibility with other strategic initiatives being undertaken by the City (e.g. Agricultural Viability Strategy).

- The Provincial Government is currently undertaking a Flood Hazard Management Program Review which will result in a reformed flood hazard management service model and possible future legislative changes. These changes will affect Richmond. An opportunity is afforded to provide effective feedback on local issues and position the City to better respond to changes that may be made at the Provincial level.

Related Policies & Studies

There are two documents of specific relevance to flood protection in Richmond:
- The 1989 Hay and Company's Technical Report: Floodplain Management Study; and,
- Richmond's Floodplain Management Implementation Policy (**Attachment 1**).

The Hay and Company's Technical Report: Floodplain Management Study
Among its objectives, the Hay and Company report addressed the following:
- Examined the City's dyke elevation levels;
- Provided a rationale for predicted river flood levels in the main arm and the north/middle arm;
- Detailed a number of sea/river flood scenarios that could affect the City;
- Used a computer model to simulate a breach scenario and describe its impacts; and
- Discussed the implications of global sea level rise scenarios.

Notably, the report concluded that a river flood scenario would have greater impacts, both in terms of the length of disruption and extent of damage, than a sea dyke breach. It also suggested that, based upon the information available at the time, the dykes were adequately designed for shorter term expected sea level rise (50 yrs from 1989), but also suggested that the implications should be reviewed as more information became available.

The report reviewed five river and ocean flood management strategies for Lulu Island:
- Compartmentalizing and containing floods using highways as internal dykes;
- Closure of a breach;
- Flood relief through opening a sea dyke to release flood waters at low tide;
- Specifying flood construction levels above maximum flood levels; and,
- Widening the dykes.

None of these strategies were determined to be fully effective on their own.

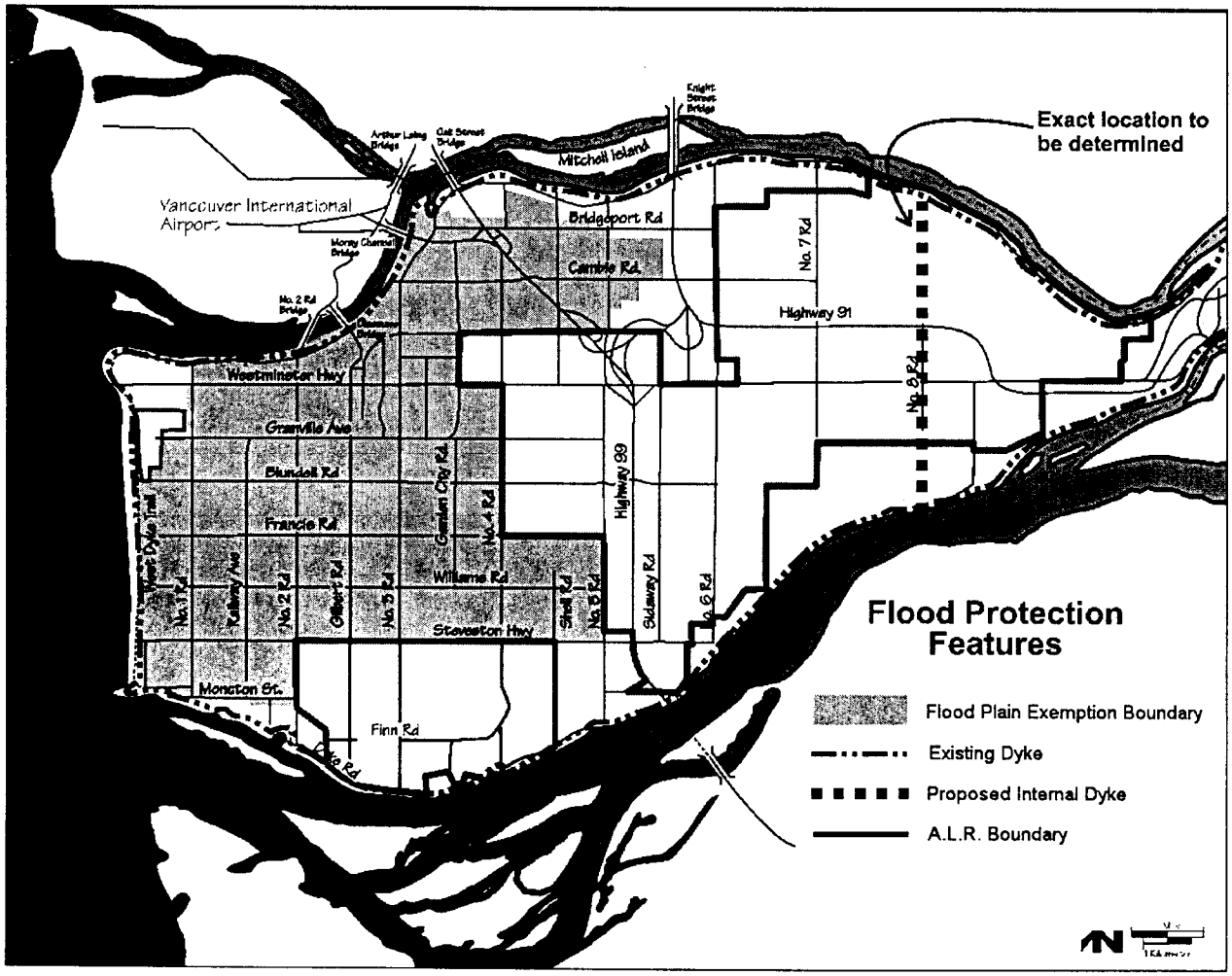
One of the report's key conclusions and recommendations proposed raising the elevation of No. 8 Road to 3.8 m geodetic, or higher, coupled with the addition of two short dykes near Highway 99 and Steveston Hwy, and under the Knight Street Bridge approach ramps. The intent of these internal dyke structures would be to create a system of containment compartments to protect the areas west of No. 8 Road from flooding in the event of the worst case scenario -- a dyke breach in the Queensborough area.

The recommendations from the Hay and Company Report formed the basis for the development of the City's current Floodplain Management Implementation Policy.

Current Floodplain Management Implementation Policy

The Floodplain Management Implementation Policy was adopted in 1989. The Policy was developed in consultation with the Provincial Ministry of Environment and committed the City to the following actions:

- Establishing flood construction levels for different uses and locations within the City;
- Adopting a Floodplain Management Plan using the Hay and Company report as the technical basis;
- Re-affirmed the submission of subdivision plans outside the Exempt Area to the Ministry of Environment until a Floodplain Management Plan is adopted;
- Assigning a high priority to the construction of a No. 8 Road Dyke and the other associated dykes identified in the Hay Report contingent to coordination of financing and construction with the Ministry of Transportation and Highways;
- Satisfying the terms of the Dyke Operations and Maintenance Manual;
- Establishing and administration of floodproofing and protection regulations for development; and,
- Encouraging floodproofing in the Urban Exempt Areas.



Analysis

Both the Hay and Company Technical Report and the City's Floodplain Management Implementation Policy form the basis for Richmond's overall approach to flood protection. Since 1989 the City has:

- Worked to strengthen and upgrade the dyking system to meet the Provincial 200 Year Flood Standard;
- Added an extensive drainage and pumping system to control water levels;
- Followed a program of referrals for all non-exempt area subdivisions to the Ministry of Water Land and Air Protection;
- Implemented a full dyke monitoring and maintenance program;
- Prepared a flood response plan; and,
- Adopted a policy of flood construction levels (FCL) to regulate development.

In partnership with external agencies through the Fraser Basin Council, staff have directed a series of related studies to improve our understanding of flood protection, and developing options for mitigating the impacts of flooding. Some of the works undertaken include:

- A consultant's report on Floodproofing Options For Historic Settlement Areas (May 2001);
- Topographic Mapping of Sea Island (2001);
- Preparation of Flood Hazard Information Brochures;
- Updating flood damage estimates for the Lower Mainland (currently underway).

Mid Island Dyke Concept

Several key recommendations of the Hay report that are referenced by the Floodplain Management Implementation Policy, have never been fully implemented. Most notably the new dyke works proposed for No. 8 Road, Knight Street and Highway 99, were never constructed. Tied to the undertaking of these dyke works, the Floodplain Management Plan called for by the Floodplain Management Implementation Policy was similarly never completed. Some of the reasons for this situation include the following:

- Cost of construction and lack of commitment by the Federal and Provincial Governments to share in the funding;
- Concerns by farming interests that the agricultural activities east of No. 8 Road were being sacrificed to the urban areas of the community;
- Further concerns from farming interests are the impacts of the No. 8 Road dyke itself in terms of further disruption to the movement by farming equipment (the east-west connector is perceived by many as a major impediment to equipment movements);
- Concerns related to the impacts of a No. 8 Road dyke upon drainage flows for cranberry farming operations;
- Concerns that the creation of a No. 8 Road dyke would lead to the push for new bridge connections between Vancouver and Delta – further impacting the City's farmlands; and,
- Physical changes, such as the grade improvements made at the Fraser River Port Authority lands, and the industrial developments in East Richmond and Hamilton, change the situation in East Richmond enough that alternative options to the No. 8 Road dyke may now be viable.

In August, 2000, discussions were held with a range of stakeholders and representatives from senior government agencies including the Ministry of Agriculture, the Agricultural Land Commission, the Ministry of Water, Land and Air Protection and the Richmond Farmers

Institute. The purpose of these discussions was to begin to address these, and other related concerns regarding the flood protection measures for Richmond. Across the board there was a recognition that, although Richmond has taken significant steps forward in its flood protection measures, things had not quite come together as envisioned in terms of developing an integrated flood protection strategy for the community, and that the previously proposed solutions would not fully address Richmond's unique set of circumstances. Among the participants, there was an openness to exploring the problems and new approaches to addressing these concerns. In particular, there was a willingness from all the parties to explore alternatives to the No. 8 Road dyke proposed by the Hay Report.

Developing a Comprehensive, Integrated Flood Protection and Management Strategy

The earlier reference to the Fraser Basin Council's brochure and the benefits of an integrated planning and management approach to flood protection outlines the technical elements (i.e. floodproofing designs and techniques, land use planning, flood protection works, emergency preparedness, and disaster financial assistance) which should be considered in an integrated plan.

A long term flood protection and management strategy for Richmond will also have the following objectives:

- Take a long term view (e.g. plan to 2021 and beyond);
- Seek innovative Richmond based solutions;
- Propose solutions that are fiscally, socially and environmentally responsible;
- Where appropriate, be integrated with other ongoing City corporate strategies;
- Be coordinated with other strategies in the region for managing flooding in the Lower Fraser basin;
- Involve affected stakeholders; and,
- Be implemented with senior government and stakeholder assistance and financial resources.

Elements that could be addressed in a comprehensive, integrated flood protection strategy include:

- Public Education;
- Dyke Enhancement / Development;
- Flood Management and Emergency Response Strategies;
- Building Design Approaches;
- Raising Grade Elevations During Redevelopment;
- Zoning Requirements;
- Building Code Amendments;
- Existing Flood Plain Management Policy Initiatives;
- Exempt and Non-Exempt Area Specific Strategies;
- Subdivision Application Referrals To The Province;
- Drainage Control Strategies;
- Sensitivity to Other Ongoing Strategies and Policies (e.g. Agricultural Viability Strategy, Environmentally Sensitive Areas, Trails Policies, etc);
- Partnerships;
- Funding / Financing Options; and,
- Other.

Staff Recommendations

To determine the best combination of technical information, recommendations and options to use in developing a comprehensive, integrated flood protection strategy for Richmond, the available information, and particularly the Hay and Company Report, needs to be brought up to date and re-assessed. In addition, the recent research in areas such as the Fraser Basin Council's report on Floodproofing Options for Historic Settlement Areas should be assessed for their applicability to Richmond's unique conditions. Finally, a comprehensive package of elements from the ones listed above needs to be reviewed in terms of finding practical solutions to reducing the risks to the community.

Given the clear need to develop a long term, comprehensive and ongoing commitment to flood protection for the City **staff recommend that Phase One of the Work Program shown in Attachment 6 for preparing a City-wide 2021 Flood Protection Strategy, be approved.** As part of Phase One, an interdepartmental Steering Committee would be established to undertake and guide the work.

In general, it is suggested that the Steering Committee would do the following:

- Review the proposed two phase approach;
- Identify and assess elements of an overall strategy;
- Assess the recommendations of recent studies for applicability in Richmond;
- Update key components of the Hay Report to bring facts and assumptions up to date;
- Identify and assess alternatives to the No. 8 Road Dyke – including the enhancement of the perimeter dyke in East Richmond and Hamilton – that would functionally meet or exceed the Hay report proposals but address, to the extent possible, the range of other identified concerns/interests;
- Explore alternative funding/partnering options;
- Based upon this assessment provide options and recommendations to Council for the development and implementation of a comprehensive, integrated flood protection strategy for Richmond; and,
- Assess and make recommendations on a work program for subsequent phases of work.

It is anticipated that, in undertaking this work, the committee would draw upon and partner with external agencies as required to complete Phase One and establish a basis for undertaking subsequent stages of the work. It is also anticipated that the Steering Committee will utilize the services of a consultant to assist with various tasks.

Possible external agencies to be consulted / partnered with include:

- Agricultural Land Commission
- Richmond Farmer's Institute
- Ministry of Water Land and Air Protection
- Provincial Ministry of Agriculture & Food

Financial Impact

Phase One: Analysis and Strategy Development (2002-2003)

1. For 2002 Council has allocated funds in the amount of $100,000 for part of Phase One.
2. **For 2003 an additional $50,000 will be required for Phase One and will be presented as an additional level in the upcoming 2003 budget process.**

Phase Two: 2021 Flood Protection and Management Strategy Implementation (2004 – onward)

Budgetary considerations to implement the overall strategy will be identified at the conclusion of Phase One.

Possible funding implications include:

- For the East Richmond Dyke Improvements (e.g. mid island dyke and alternatives):
  - Pre-Design – estimated at $300,000;
  - Construction - estimated at up to $20 million dollars.
- Participation and contributions for implementation will need to be sought from the federal and provincial governments, the City and other stakeholders at various stages.
- The use of City staff time and resources as "in kind" contributions will also need to be explored.

Conclusion

A proposal is made for undertaking the first phase of work toward establishing an updated multi-year phased comprehensive City-wide 2021 Flood Protection and Management Strategy for Richmond. The work would be undertaken by a Steering Committee with the assistance of external agencies and a consultant.

David Brownlee
Planner 2

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LIST OF ATTACHMENTS

Attachment 1 Council's 1989 Floodplain Management Implementation Policy

Attachment 2 1996 Memorandum Of Understanding

Attachment 3 Flood Protection Provision In The Official Community Plan

Attachment 4 Dike Maintenance Act

Attachment 5 Fraser Basin Council Brochure: Floodproofing in Historic Settlement Areas

Attachment 6 Proposed Work Program For Richmond's 2021 Flood Protection Strategy

FLOODPLAIN MANAGEMENT IMPLEMENTATION POLICY ADOPTED BY COUNCIL ON SEPTEMBER 11, 1989

That the following Floodplain Management Implementation Policy and Program, including a written commitment to the following, **BE ADOPTED:**

1. Flood construction levels are to be as follows:

   (a) New dyke works to be constructed at the No. 8 Road alignment, under the Knight Street Bridge and Highway 99 near Massey Tunnel are to be at a **3.8 m (12.46 ft.)** GSC level. The City will apply to the Provincial Government for Federal/ Provincial funding for a cost sharing arrangement;

   (b) The minimum habitable or commercial building floor elevation is to be **3.5 m (11.48 ft.)** GSC east of No. 8 Road;

   (c) The minimum habitable or commercial building floor elevation is to be **3.0 m (9.84 ft.)** GSC between No. 8 Road and the Knight Street/Highway 99 corridor;

   (d) The minimum habitable or commercial building floor elevation is to be **2.6 m (8.53 ft.)** GSC in the non-Exempt lands on Lulu Island west of the Knight Street/ Highway 99 corridor, with provision for transition to existing land use adjacent to the non-Exempt lands;

   (e) City standards only for minimum habitable or commercial building elevations in Exempt Areas;

2. A commitment to complete and adopt a Floodplain Management Plan utilizing the Hay and Company Report as the technical basis, is reconfirmed;

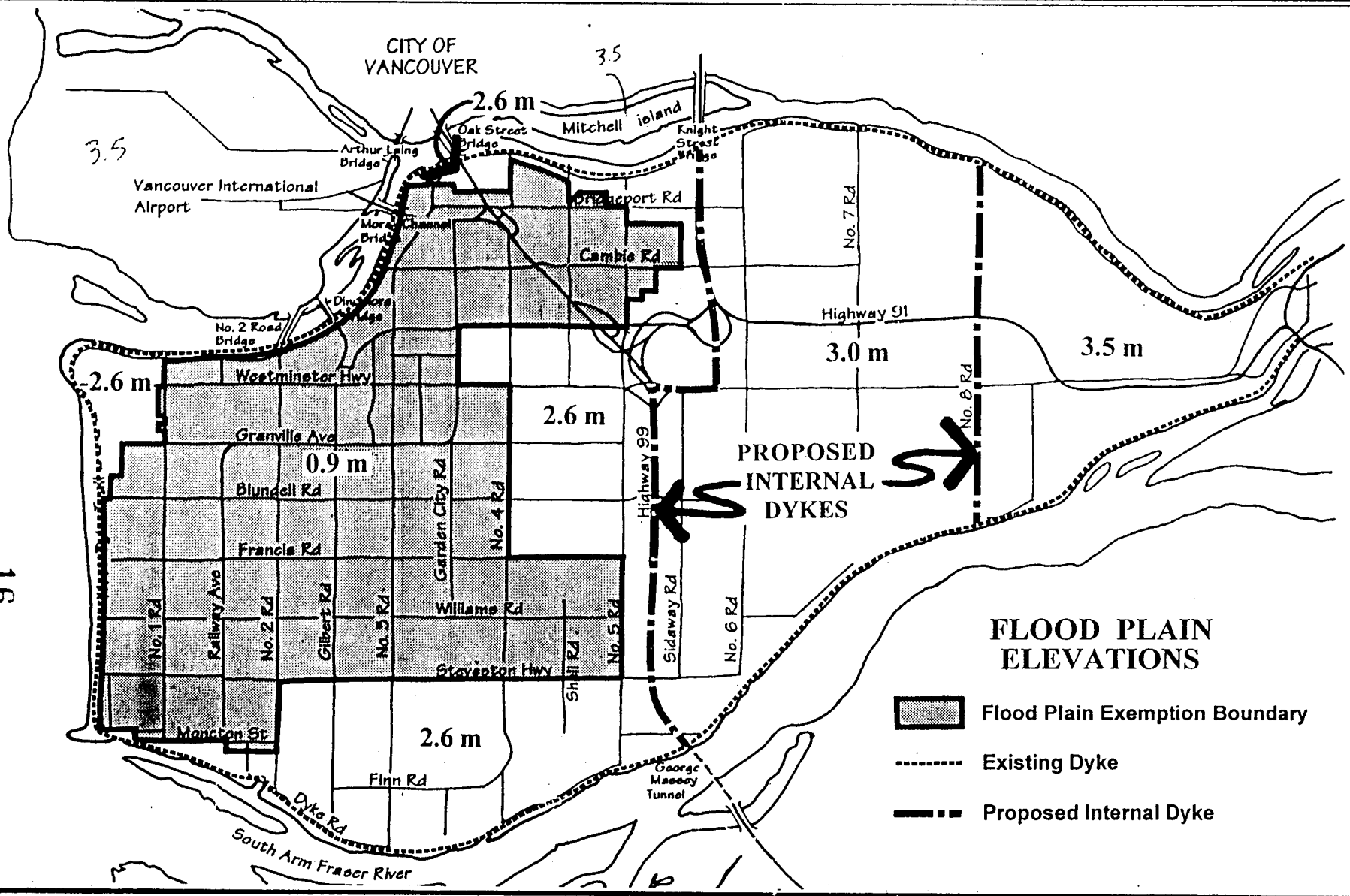
3. Subdivision plans outside the Exempt Area will continue to be referred to the Ministry of Environment for approval, pursuant to Section 82 of the Land Title Act until such time as a Floodplain Management Plan is adopted;

4. The construction of a No. 8 Road dyke and other minor dykes identified in Hay and Company Report on dyke construction will be identified as high priority (e.g. will be included in the 1990 ten year Capital Works Plan); and financing and construction will be coordinated with the Ministry of Transportation and Highways in light of recent transportation studies;

5. The terms of the Dyke Operations and Maintenance Manual shall be satisfied;

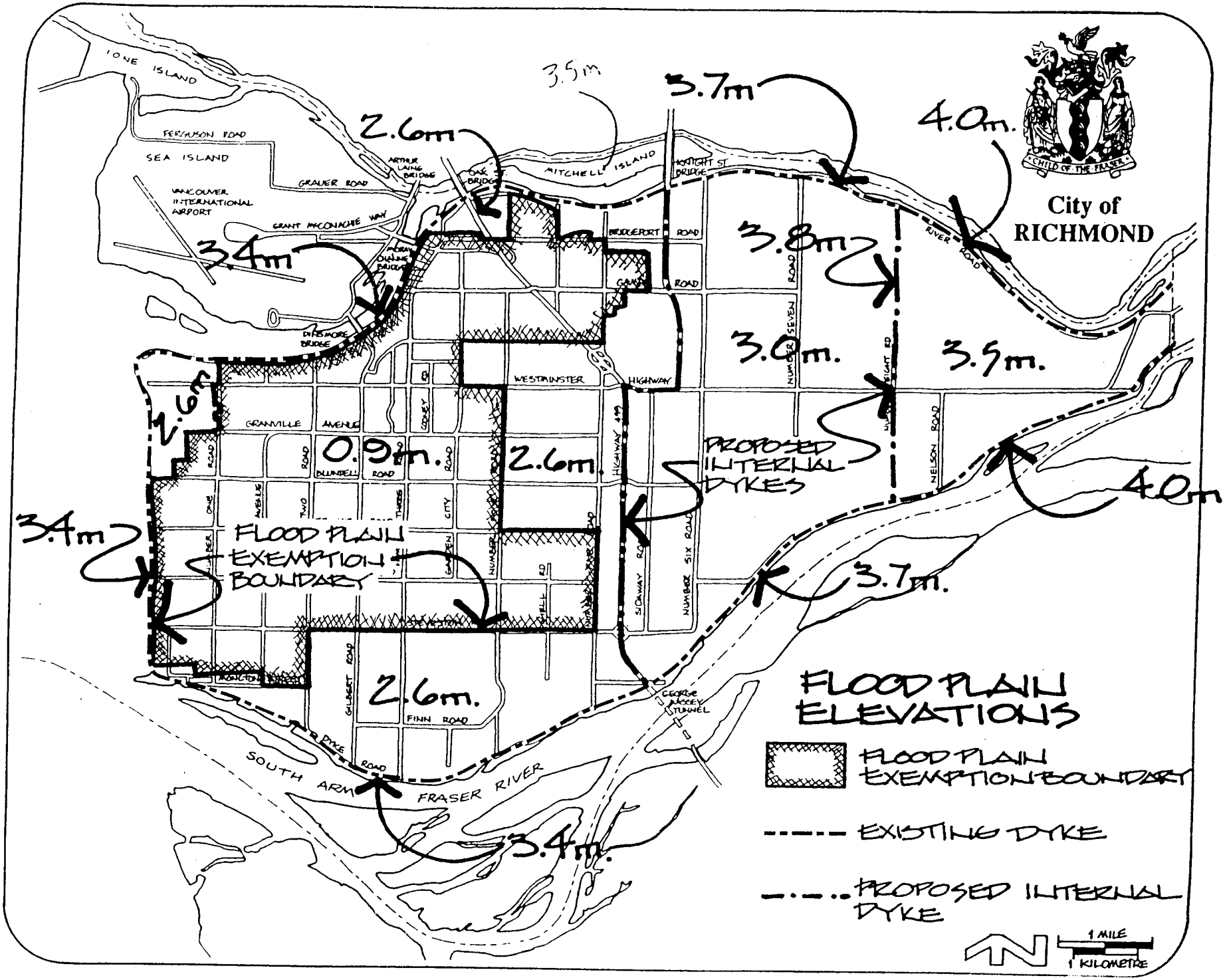
6. The establishment and administration of floodproofing and protection regulations for development in the floodplain, shall be undertaken; and

7. Floodproofing in Urban Exempt Areas will be encouraged.



FLOOD PLAIN ELEVATIONS

Date
01/13/00


City of RICHMOND
"CHILD OF THE FRASER"
LULU ISLAND
FERGUSON ROAD
SEA ISLAND
GRAUER ROAD
VANCOUVER INTERNATIONAL AIRPORT
GRANT MACONACHIE WAY
ARTHUR LAING BRIDGE
OAK BRIDGE
MITCHELL ISLAND
KNIGHT ST BRIDGE
BRIDGEPORT ROAD
RIVER ROAD
GARDEN CITY ROAD
NUMBER SEVEN ROAD
NO. 3 ROAD
DINSMORE BRIDGE
WESTMINSTER HIGHWAY
GRANVILLE AVENUE
BLUNDELL ROAD
GILBERT ROAD
FINN ROAD
NUMBER SIX ROAD
SIDAWAY RD
NELSON ROAD
GEORGE MASSEY TUNNEL
DYKE ROAD
SOUTH ARM FRASER RIVER
3.5m
3.7m
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3.8m
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PROPOSED INTERNAL DYKES
4.0m
3.4m
FLOOD PLAIN EXEMPTION BOUNDARY
3.7m.
2.6m.
3.4m.
FLOOD PLAIN ELEVATIONS
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EXISTING DYKE
PROPOSED INTERNAL DYKE
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1 MILE
1 KILOMETRE

(c) *that the "Livable Region Strategic Plan" recognizes that rapid transit to Richmond, which will shape and serve the growth in the Richmond Regional Town Centre, is a fundamental requirement for the success of the plan;*

(d) *that the Board will continue to press the Province and B.C. Transit for commitments to construct all three transit lines on the basis that all those lines are necessary for the full realization of the Livable Region Strategic Plan's objectives;*

(e) *that West Richmond is a strategic growth area and should Richmond and the Province agree on a mutually acceptable implementation plan for flood and seismic protection, and should Richmond have adopted land use policies and by-laws consistent with the achievement of a future Richmond population comparable to objectives for growth within the Growth Concentration Area, then West Richmond would be considered as an area qualifying for priority in transportation services and facilities, as described in the Livable Region Strategic Plan policy;*

(f) *that should the conditions in (e) be fulfilled, then an amendment to the Livable Region Strategic Plan to include West Richmond in the Growth Concentration Area shall be prepared and brought forward for consideration by the GVRD Board.*

(g) *that the City of Richmond withdraws its objection to the Livable Region Strategic Plan on the basis set out in this agreement."*

CARRIED

RISE AND REPORT

CW96/2-27 It was MOVED and SECONDED

That Committee of the Whole rise and report (10:22 p.m.).

CARRIED

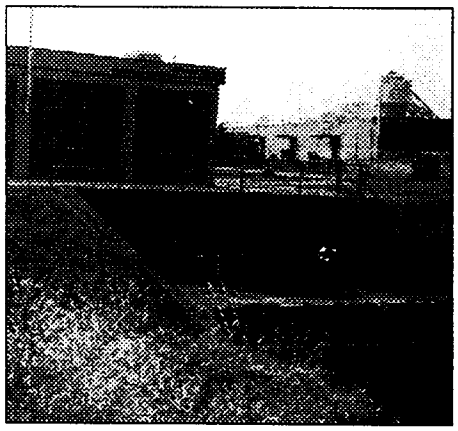
7.6 FLOOD PROTECTION

Richmond's dyke system provides floodproofing protection

ISSUE:

A perimeter dyke system designed to withstand a 1-in-200-year flood event has been constructed around Lulu Island, protecting most of Richmond from all but extraordinary flooding. The airport on Sea Island is also protected by a perimeter dyke. Parts of Sea Island, Mitchell Island, and the peripheral unsettled islands remain unprotected from significant flood hazards. It is also noted that portions of the dyke shoreline have fish and fish habitat values.

A study undertaken by the City and the Ministry of the Environment (Hay Report) identified the need for internal dykes to compartmentalize any flood hazard on Lulu Island. The report also suggested minimum building elevations which would further reduce the flood hazard. Much of the historic urban settlement on Lulu Island is below these suggested minimum building elevations, but raising sites on a piecemeal basis is an ineffective solution. Richmond needs to ensure ongoing appraisal, maintenance, and upgrading of its dyke system to minimize property damage and human suffering.



Drainage Pumphouse

OBJECTIVE 1:

Improve flood protection measures in the portions of Richmond susceptible to flood damage.

POLICIES:

a) Maintain and upgrade the perimeter dyke systems on Lulu and Sea Islands;

b) Construct the internal dyke system identified in the Hay and Company Report;

c) Explore senior government funding opportunities to maintain and upgrade Richmond's dyke system;

d) Work with the Ministry of Environment in resolving improved flood protection measures for the historic settlement areas;

e) Work with the provincial and federal governments on an approach to implement a revised set of Environmental Guidelines for Dyke Maintenance appropriate to Richmond's situation.

DIKE MAINTENANCE ACT

[RSBC 1996] CHAPTER 95

[Updated to September 6, 2000]

Contents

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3 Failure to carry out order of inspector
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Definitions

1 In this Act:

"dike" means an embankment, wall, fill, piling, pump, gate, floodbox, pipe, sluice, culvert, canal, ditch, drain or any other thing that is constructed, assembled or installed to prevent the flooding of land;

"diking authority" means

(a) the commissioners of a district to which Part 2 of the *Drainage, Ditch and Dike Act* applies,

(b) a person owning or controlling a dike other than a private dike,

(c) a public authority designated by the minister as having any responsibility for maintenance of a dike other than a private dike, or

(d) a regional district, a municipality or an improvement district;

"improvement district" means an improvement district within the meaning of the *Local Government Act*;

"inspector" means the Inspector of Dikes referred to in section 2 and includes the Assistant Inspector of Dikes;

"municipality" means a municipality as defined for the purposes of the *Local Government Act*;

"order" includes a decision or direction of the inspector;

"private dike" means a dike built on private property without public funds to protect only the property of the person owning the private dike.

Inspector of dikes

2 (1) There is to be an official of the ministry known as the Inspector of Dikes.

(2) The inspector has general supervision of all dikes and the operation of all diking authorities relative to the construction and maintenance of dikes.

(3) Without limiting subsection (2), the inspector has the power to do one or more of the following:

(a) enter on any land and on a dike at any time;

(b) require a diking authority to repair, replace, renew, alter, add to, improve or remove a dike, or a part of a dike, or anything used in connection with a dike;

(c) require a diking authority to construct or install a work or thing that in the opinion of the inspector is necessary to protect a dike or to increase its efficiency;

(d) require a person who is physically fit and over age 17 and under age 60, except a railroad worker, telegrapher or dispatcher on duty, or a medical practitioner, to do or assist in any work of dike construction or repair believed necessary to prevent the flooding of property;

(e) require a person to make available to the inspector equipment or material owned or controlled by the person and believed by the inspector to be necessary to prevent the flooding of property;

(f) authorize and empower any person, on conditions the inspector may impose, to place, construct, renew, alter, repair, maintain, operate and use any buildings, structures, machinery, ways, rails, roads, pipes, poles, towers, cables, wires, conduits, conveyers or other works on, along, across, through, over or under any dike in charge of a diking authority or any land, so far as an interest in it is held by a diking authority, and to enter into and on a dike or land, so far as an interest in it is held by a diking authority.

(4) The inspector, the assistant inspector and those employees considered necessary may be appointed under the *Public Service Act*.

(5) Except with the approval in writing of the inspector, a diking authority must not do any of the following:

(a) lower, or cause or allow to be lowered, the elevation of a dike or decrease, or cause or allow to be decreased, the width or cross section of a dike;

(b) install, or cause or allow to be installed, any culvert, pipe, flood box or any structure through a dike;

(c) construct, or cause or allow to be constructed, any works on or over a dike or dike right of way;

(d) alter, or cause or allow to be altered, the foreshore adjacent to a dike.

Failure to carry out order of inspector

3 If a diking authority fails to carry out an order or direction of the inspector by the date required, the inspector may do the things required, either by contract or otherwise, and that cost, including any interest the inspector may have to pay, is a debt owing by the diking authority to the government.

Failure by diking authority to fulfil obligations

4 If a diking authority fails to pay to the government any sum payable under section 3, the sum may be recovered by the government in any court of competent jurisdiction.

Appeals

5 (1) An appeal lies to the minister from every order of the inspector.

(2) An appeal under this section must be taken within 15 days from the date on which the inspector makes the order appealed from.

(3) An appeal is taken within the meaning of this section when notice of intention to appeal has been delivered to the minister and a copy delivered to the inspector.

(4) The appellant must give such further notice of the appellant's intention to appeal as may be directed by the inspector.

(5) On an appeal under this section, the minister may confirm, quash, vary or add to the order appealed from and make any order as to costs that the minister considers just.

(6) The minister's decision under subsection (5) is final.

Offence

6 A person commits an offence who does any of the following:

(a) injures or interferes with a dike or its operation;

(b) hinders a diking authority, the inspector or a person acting on behalf of either of them from protecting property from flooding;

(c) contravenes section 2 (5) or an order of the inspector or the minister.

Orders made by inspector

7 An order made by the inspector must be

(a) in writing, signed by the inspector, and

(b) delivered or sent by registered mail to the person or authority to whom it is directed.

Power to make regulations

8 The Lieutenant Governor in Council may make regulations referred to in section 41 of the *Interpretation Act*.

ATTACHMENT 5

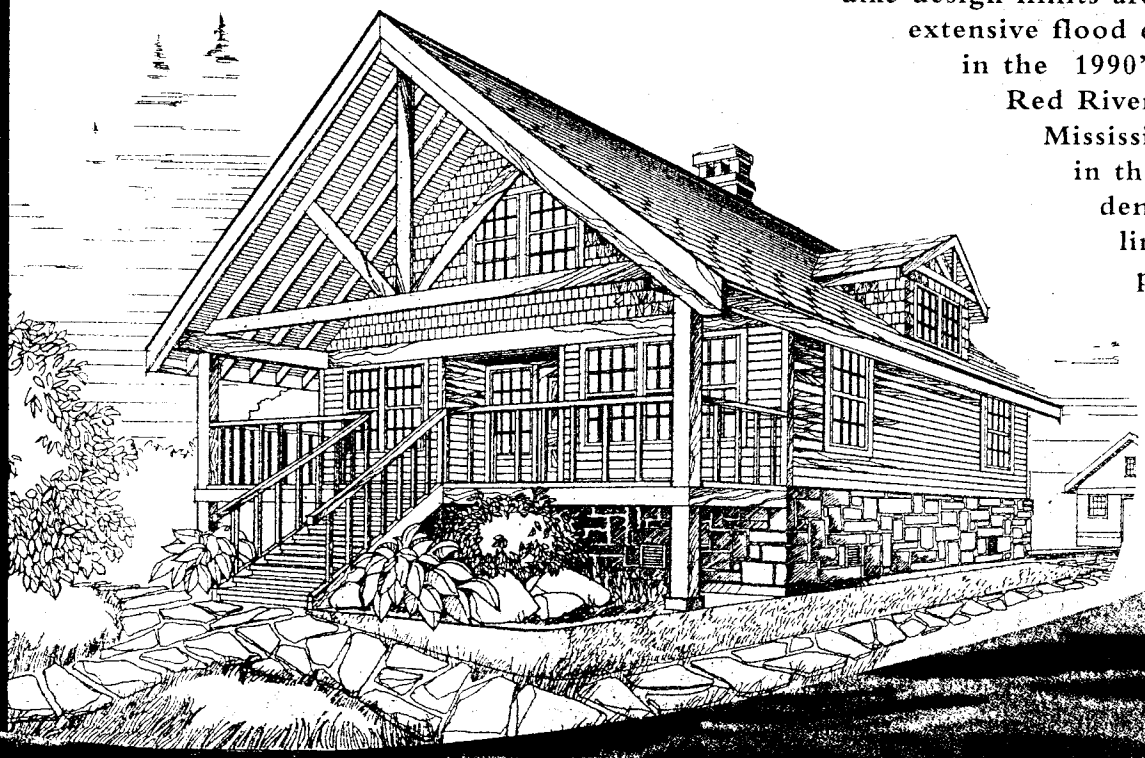
Fraser Basin Council

FLOODPROOFING IN HISTORIC SETTLEMENT AREAS

Flood Hazards

The flooding of the Fraser River in 1948 resulted in the largest natural disaster losses ever to occur in BC. This is partly because many of BC's settlements were established along major transportation routes and fertile agricultural lands on the lower Fraser floodplain. Only later were the risks and vulnerabilities to flooding fully realized.

Since 1948, over $200 million in today's dollars have been spent by provincial, federal, and local governments, constructing, improving, and maintaining some 250 km of dikes and other flood protection works to protect communities located throughout 55,000 hectares of floodplain. It is estimated that 300,000 people currently live or work in the Lower Fraser River floodplain. Although dikes provide significant protection, they only provide partial security. Despite extensive diking throughout the lower Fraser River, the potential damages from a Fraser River flood of record could well exceed $2 billion when dike design limits are exceeded. The extensive flood damages witnessed in the 1990's with Manitoba's Red River flood and the Mississippi River flood in the United States, demonstrate the limitations of flood protection works, and the risks associated with relying on dikes alone.



Managing Flood Hazards

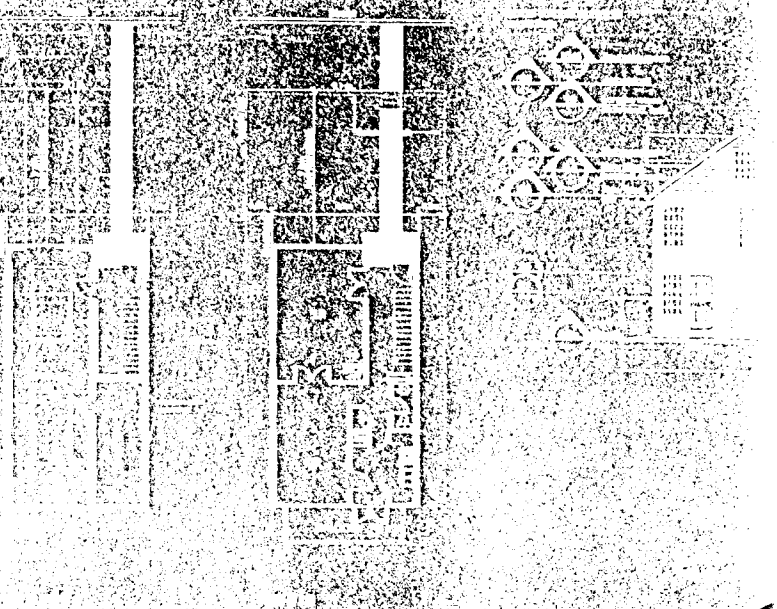
Flood hazards cannot be eliminated entirely, but the risks and damages associated with flooding can be significantly reduced through careful planning and management. By applying an integrated approach, those areas at-risk of flooding will be less vulnerable to the potential devastation of a major flood. An integrated approach includes:

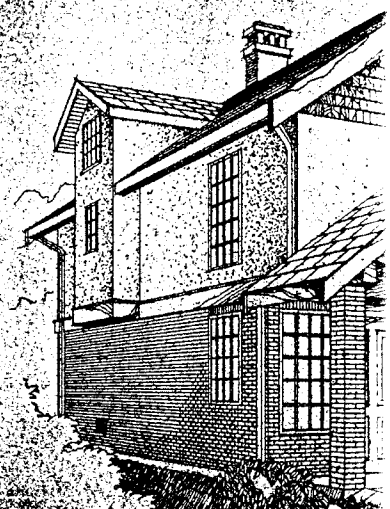
- **Floodproofing designs and techniques to reduce flood damages**
- **Land use planning to avoid flood hazards**
- **Dikes and other flood protection works to reduce flood frequency**
- **Emergency preparedness to minimize the vulnerability of communities at risk**
- **Disaster Financial Assistance to assist communities with post-flood recovery**

Floodproofing in Historic Settlement Areas

This information brochure is designed to provide practical guidelines to assist local governments, builders, developers, and architects in identifying suitable and practical floodproofing measures for use in historic settlement areas. It is not intended to represent government policy. To determine specific local regulatory requirements for floodproofing, such as floodplain bylaws, please contact your local government.

Floodproofing in new subdivisions is typically achieved by raising the natural grade above the flood level using fill (e.g. sand). During the redevelopment of infill lots within already 'built-up' historic settlement areas, there are a variety of special circumstances which require different approaches to floodproofing. It is important to address both regulatory and aesthetic issues including the building envelope, external design, streetscape, height limitations, livability, and marketability.





Choosing a Floodproofing Design

There are several basic approaches to floodproofing. Suitability depends on factors such as:

- Height that habitable space must be constructed above grade to achieve the Flood Construction Level (FCL)
- Lot size
- Zoning requirements
- Compatibility with neighbourhood character
- Attached garage/carport versus detached parking with lane access
- Soil conditions

Options

A) Construct habitable space above the FCL except for an entrance foyer and an attached garage or carport, which would occupy most of the space at ground level. This will allow a single building on a site where the floodproofing height is up to 2.5 metres (8 feet) above grade. Living areas of over 1,500 square feet can be accommodated even on a 9.1 metre wide (30-foot) lot. See the above illustration.

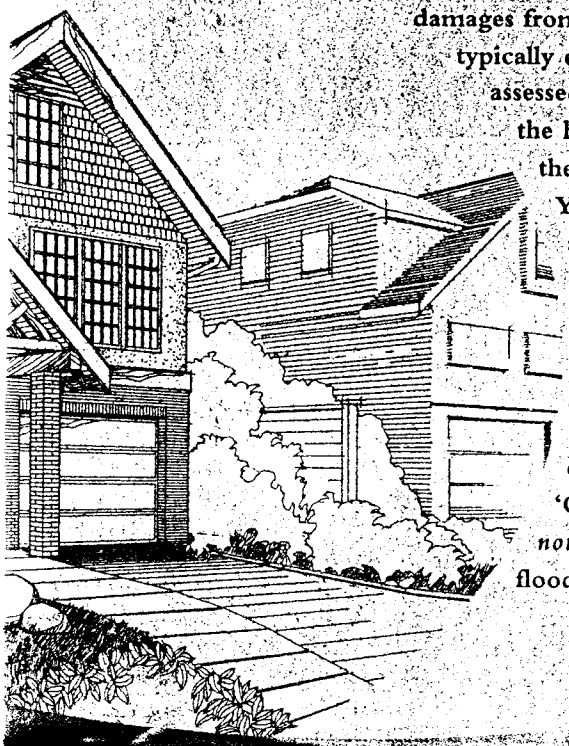
B) Construct habitable space above the FCL using fill (e.g. sand) or a crawl space within the building to reach the FCL. This approach is suitable in historic and contemporary neighbourhoods where rear lanes are provided to access a detached garage or carport. This approach may be limited to a floodproofing height of 1.5 metres (5 feet) although it could be increased with lot grading and/or a small retaining wall. See the front cover illustration.

C) Construct the entire house above the FCL using fill (e.g. sand), and a retaining wall if necessary on narrow lots. This approach is suitable if the lot width is 12.2 metres (40 feet) or more, and where the floodproofing height is less than 1.5 metres (5 feet). Grades exceeding 3 horizontal to 1 vertical are not recommended.

Checklist of Design Features for Flood Hazard Areas

DESIGN FEATURES	COMMENTS
Lot Elevation • Lot grading • Use of fill (e.g. sand) • Use of retaining walls	• Building site should be at least 1 foot above crown of adjacent road • Fill is most suitable for large lots • A retaining wall may be suitable for narrow lots • Walls higher than 1.2 metres (4 feet) to be designed by a professional engineer
Uses permitted below FCL • Parking • Crawl space • Entrance foyer	• Living areas may be built above a garage, carport, entrance foyer, and/or crawl space • Maximum height 1.5 m (5 feet) for crawl space • Entrance foyer limited to 118 square feet if below FCL
Furnace Hot water heater Electrical panel	Locate above FCL
Flood resistant building materials	Use in construction below FCL
Pressure relief openings	Needed for all enclosed spaces below FCL in order to protect the building structure
Back flow prevention valve	Provides protection against sewage backup
Pile foundations	May be required in soft or organic soils

The cost of floodproofing a small family dwelling varies, depending on the house design. For example, using construction techniques and flood-resistant building materials for a house like the one illustrated on the front of this brochure would cost about 10% more than the cost of a house *without* floodproofing. In any case, a house built with floodproofing will suffer significantly less damage, and its restoration costs will be dramatically lower than a house without floodproofing. In the 1997 Red River flood in Manitoba, the damages from flooding typically exceeded the assessed value of the houses themselves. You may ask 'Can I afford to floodproof' my home. Perhaps the better question is 'Can I afford *not* to floodproof?'



Key Terms

Historic Settlement Area: an area within the floodplain developed with early settlement patterns and committed to further development through infilling.

Floodproofing: the practice of making habitable space and contents flood-safe—the Flood Construction Level (FCL).

Habitable Space: any enclosed space that may be used for residential purposes including the storage of goods susceptible to damage by floodwater. In a residential dwelling, vehicle parking, a small entrance foyer, and a crawl space may be constructed below the FCL.

Flood Construction Level (FCL): the minimum allowable [illegible] space (above mean sea level). This height is determined [illegible] engineering [illegible] construction, the underside [illegible] system or top of a concrete slab must be [illegible] than

Floodplain: a lowland area subject to flooding from an adjoining river, stream, lake, ocean or other watercourse.

Crawl Space: any enclosed area within a building with a floor to ceiling height of 5 feet (1.5 metres) or less.

Flood Resistant Building Materials

In addition to floodproofing designs that help avoid flood damages, there are many flood resistant building materials that can be used for construction below the FCL. These help to minimize flood damages and include a wide variety of attractive options. Some examples include:

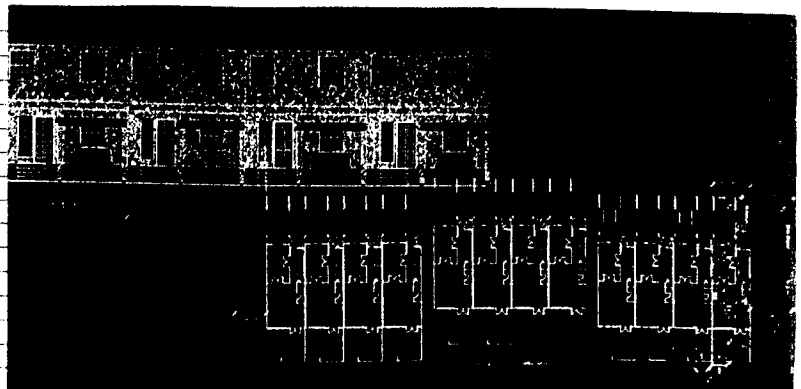
Flooring materials

- Clay or concrete tiles
- Rubber or vinyl tiles with chemical set adhesives
- Mastic flooring
- Precast or in situ concrete
- Terazzo
- Pressure treated or naturally decay resistant wood

Wall Materials

- Brick
- Glass
- Natural or artificial stone with waterproof grout
- Ferrous metals
- Pressure treated or marine grade plywood
- Concrete and concrete block
- Closed cell (rigid) insulation
- Metal hollow doors
- Wonderboard
- Pressure treated or naturally decay resistant wood
- Polyester epoxy and other waterproof paints

Note: These construction materials are rated as flood resistant by the U.S. Federal Emergency Management Authority based on testing undertaken by the U.S. Army Corps of Engineers.



Regulatory Requirements

Local and senior governments regulate many aspects of flood hazard management. Examples include:

- Subdivision and development of land subject to flooding (Land Title Act)
- Local zoning and floodplain bylaws
- Development Permit Areas (designated by local government)
- Site specific engineering report
- B.C. Building Code

Some Examples of Historic Settlement Areas:

- Clayburn and Matsqui Villages in Abbotsford
- Downtowns: Chilliwack, Aggasiz and Harrison Hot Springs
- Ladner and Boundary Bay Village in Delta
- Parts of Haney and Port Hammond in Maple Ridge
- Queensborough and New Westminster Quay
- Much of downtown Port Coquitlam
- West and southwest Richmond
- Bridgeview and Crescent Beach in Surrey
- Downtown Squamish and Brackendale

More Information:

A detailed report titled *Floodproofing Options for Historic Settlement Areas* by the Arlington Group Planning and Architecture Inc. was prepared for the Fraser Basin Council and is available upon request.

The Fraser Basin Council gratefully acknowledges financial assistance from:

- **Ministry of Water, Land and Air Protection**
- **Western Economic Diversification Canada**
- **Municipalities of Delta, Kamloops, New Westminster, Richmond, and Surrey**

The Fraser Basin Council was established in 1997 to advance the environmental, economic and social sustainability of the Fraser River Basin. Integrated flood hazard management is one of the Council's sustainability priorities.

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Proposed Work Program For Richmond's 2021 Flood Protection Strategy

Purpose

To prepare and implement a comprehensive City-wide 2021 Flood Protection and Management Strategy for Richmond. The proposed work program has two phases:

Phase One: Analysis and Strategy Development (2002-2003)

a) Establish a Steering Committee to undertake and guide the work described in the report from the Manager, Policy Planning (dated July 26, 2002) and as outlined herein. The Committee will be interdepartmental and will draw upon expertise from external agencies and senior Government as required and will enlist the services of a consultant to assist with carrying out the work.

It is proposed that the Committee include representatives from the following Departments:

- Policy Planning (Lead – Co-ordinator & Contract Management);
- Engineering & Public Works (City Hall and Works Yard staff);
- Zoning;
- Transportation;
- Emergency and Environmental Programs
- Parks, Recreation and Cultural Services.

b) The Steering Committee shall:

- Review and refine the proposed multi-year phased work program and the estimated time lines; namely:
  a. Phase 1: 2002 – 2003
  b. Phase 2: 2004 and beyond.

- Establish the role and terms of reference for a consultant to assist in Phase One. Hire, monitor, guide and provide information and resources to the consultant and review the consultant's findings.

- Analyze and document the current appropriateness of Richmond's flood protection measures, programs, policies and regulations for the long term;

- Analyze and document relevant Federal and Provincial policies, initiatives and assistance programs on flood protection and management for Richmond's benefit;

- Determine the Richmond specific components of an integrated planning and management approach to flood protection desired by the appropriate external agencies (e.g. Provincial MWLAP);

- Review and provide a synopsis and an update of all necessary concepts, assumptions and recommendations, in the 1989 Hay and Company report to ensure that Richmond's Flood Protection Strategy is based on sound concepts, principles, and current information;

- Examine the issues from the perspectives of the Agricultural Land Commission, The Provincial Dyking Authority, the City, the Advisory Committee on the Environment, local farming interests, and other relevant stakeholders. Determine the implications for farming viability and flood protection integrity (overall structural integrity).

- Identify and assess alternatives to the No. 8 Road Dyke – including the enhancement of the perimeter dyke in East Richmond and Hamilton – that would functionally meet or exceed the Hay report proposals but address, to the extent possible, the range of other identified concerns/interests;

- Provide estimates of costs for each of the dyking alternatives and explore alternative funding/partnering options. (For example, explore cost sharing with senior levels of government and stakeholders, as well as alternatives such as expanding the range of uses adjacent to new or enhanced dykes through zoning to facilitate their development. This approach may necessitate the removal of lands from the ALR. Consideration may also be given to allowing, for example, high tech industrial or industry compatible with farming to occur in these areas to help pay for the dyke construction enhancements);

- Review and assess any other relevant studies and their recommendations for potential application to Richmond (e.g. the Fraser Basin Council's report on Floodproofing Options for Historic Settlement Areas.);

- Review and assess any the other elements identified in the report by the Manager, Policy Planning that should be included within the overall flood protection and management strategy;

- Explore and assess any other additional information needed to make a recommendation; and,

- Based upon the information reviewed, provide options, recommendations and cost estimates to Council on Phase 2: Strategy Implementation, the development and implementation of a 2021 integrated flood protection and management strategy for Richmond (inclusive of structural, policy, regulatory and program components for flood protection and management).

- Council would review the recommendations and select a preferred course of action for Phase 2.

Phase Two: 2021 Flood Protection Strategy Implementation (2003 – onward)
Implement the Council approved Flood Protection Strategy inclusive of policy, program, regulatory and construction initiatives.

Construction related initiatives will be undertaken in two stages:
- Pre-design of the selected solutions (e.g. mid-island or eastern perimeter dyke improvements) (2003 – 2005); and,
- Construction (estimated to begin after 2006)