THE WEST COAST REGIONAL COUNCIL

GREYMOUTH FLOODWALLS

ASSET MANAGEMENT PLAN

October 2014

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EXECUTIVE SUMMARY

Under the Local Government Act 2002 Councils are required to develop 'Asset Management Plans' to demonstrate that they are managing the infrastructure for which they have responsibility. The purpose of this Asset Management Plan is to provide a statement as to how assets associated with the 'Greymouth Floodwall Rating District' will be managed over their lifetime.

The plan lists the current scheme assets that include:

- 7.0 kilometres of stopbanking
- rock rip rap in various bank protection structures

The total replacement value of these assets at 30 June 2008 was estimated at $6 million. The Greymouth floodwall upgrade in 2010 cost an additional $3.3M.

The Asset Management Plan indicates the level of protection provided by the assets, the methods of monitoring the condition of the assets, and discusses the annual maintenance needed to retain the service level.

The average annual maintenance of the Greymouth Floodwall has been $46,682.

The floodwall upgrade in 2010 raised the walls to the 1 in 50 year flood level (6,600 cumecs) plus freeboard, with those areas built with permanent materials raised to the 1 in 150 year flood level (7,400 cumecs) plus freeboard. The community did not feel it was affordable at the time to raise the whole wall to the 150 year level but did feel that the concrete structures should be raised to that level and the earth bund areas could be lifted up to the 150 year level at a later date. At the time the estimated costs of the 150 year upgrade were estimated at $9 million. In a more competitive tendering market, bringing the walls up to the 150 years level may cost less.

The scheme assets will be maintained such that they continue to provide their level of service in perpetuity. Because they are maintained in perpetuity the scheme assets will not be depreciated resulting in no requirement to fund depreciation.

The Greymouth Flood Protection Scheme stopbanks have been constructed to manage the risk of flooding of Greymouth, Cobden and Blaketown from the Grey River. The estimated capital value of the assets afforded this protection is $700 million.

SECTION 1: DESCRIPTION

1.1 PURPOSE OF ASSET MANAGEMENT PLAN

Asset Management Plans define the objectives and performance standards of flood protection schemes for which the Regional Council has the maintenance responsibility and provide a basis upon which their effectiveness can be measured. This plan:

- Identifies the service level for the Greymouth Flood Protection Scheme
- Describes the methods used to maintain the service capacity of these assets.
- Complies with the regulatory requirements of the Local Government Act 2002.

1.2 BACKGROUND

From the earliest days of settlement the communities of Greymouth, Blaketown and Cobden have been exposed to the risk of flooding from the Grey River.

Major floods have occurred in 1867, 1868, 1872, 1884, 1887, 1897, 1905, 1936, 1940, 1967, 1970, 1976, 1977 and 1978. In the late 1970's the Westland Catchment Board began investigative work on the development of flood protection measures for these communities.

On March 25, 1985, the Westland Catchment Board presented an updated report and design, indicating an approximate cost of $3 million. The design embodied a set of strategically placed stopbanks intended to contain a Grey River flood peak of 5,500 cumecs which at that time was estimated to have a return period in the order of 50 years. Financial approval was sought from Government and in December 1986, the approval for a $3.2 M scheme was given on the basis of 60% Government funding: 40 % local funding.

Work commenced in 1986 but during the construction of the Cobden stopbanks two major floods occurred on 19 May and 13 September 1988 which caused extensive inundation and consequential damage. These events gave both urgency to the completion of the project and the need to re-assess the scheme standard. The technical review which ensued resulted in the upgrading of the scheme design to 6,100 cumecs with 900 mm of freeboard. The revised scheme represented a re-assessment of the peak flow expected with an average annual exceedance probability of 2 % i.e. a retention of the 50 year return period flood capability.

This amended proposal was forwarded to Government and approval for an upgraded $4.2 M scheme was approved on the basis of 80% Government funding: 20% local funding.

The first contract was let for the Cobden Stage 1 stopbank in November 1986 and the final contract for the raising of the Blaketown Tiphead Road was completed in September 1990. It was completed at an overall cost of $4M. (80% Government 20% Grey District Council).

Since the completion of the protection works the system has experienced flood flows in excess of 5,500 cumecs on two occasions i.e. 5,812 cumecs (16 December 1997) and 5,667 cumecs (19 October 1998). Although some minor seepage was observed, in several places, through and beneath the scheme stopbanks during such events the structures have performed satisfactorily and averted what would otherwise have been widespread flooding and consequential damage to these communities. Concerns had been expressed by

sections of the Cobden community relating to the extent of seepage observed during major floods and the implications that this might have for the structural integrity of the stopbanks.

Acting on these concerns the West Coast Regional Council commissioned an investigation of the stopbank. The purpose of this investigation was to assess the nature, cause, potential threats and remedies for the seepage problem and report findings to the Greymouth Joint Flood Wall Committee which is a joint committee of both the Grey District Council and the West Coast Regional Council.

The investigation was undertaken by Civil and Environmental Consulting Ltd. and resulted in "Greymouth Flood Protection System Integrity Report" (31 March 1999). This report concluded that there was a need to modify the Cobden stopbank to incorporate seepage control measures in order to lessen the risk of seepage induced instability. This strengthening works were carried out in 2000. The report also recommended that consideration be given also to a re-evaluation of hydraulic capacity of the system using updated river flood flow and tide information.

As a result, the return period for the scheme design capacity event of 6,100 cumecs was determined to be in the order of 30 year event, rather than a 50 year event as previously calculated. As a result of the revised analysis, the Joint Floodwall Committee, in 2006, decided to design an upgrade to the floodwall to a new service level of 6,600 cumecs (the revised 50 Year Return Period Flood Event) with 600mm freeboard.

As a result of further deliberations by the Joint Floodwall Committee, it was decided to apply for a second option of a higher threshold to the 7,400 cumecs flow with 600 freeboard, which equates to a 150 year design flood. This would ensure that future development of the structure, if required, would not require an additional resource consent. Resource consents for this were applied for in 2006 and were granted in December 2008. Tenders for this work were let in 2009, and work was completed in 2010 to the 50 year event level with concrete work to the higher 150 year level.

It is anticipated that in future the community will wish to bring the entire wall up to the higher flood protection level.

1.3 DESCRIPTION OF ASSETS

The Greymouth Flood Protection Scheme consists of 7 kilometres of stopbanks. The detailed register of assets is contained in an accompanying infrastructural assets register that forms part of this asset management plan.

1.4 MAINTENANCE EXPENDITURE

The average annual expenditure on maintenance and capital works since 1995 has been $46,682. Expenditure levels may change now that the upgrade has been completed.

SECTION 2: SERVICE LEVELS

2.1 EXISTING STANDARDS

The scheme now protects the town from a 6,600 cumec flood event (the revised 50 Year Return Period Flood Event) with 600mm freeboard. A flood of this size has a 2% chance of occurring in any given year. Parts of the floodwalls (the concrete sections) have been built up higher to the 7,400 cumec plus freeboard level in anticipation that the community will eventually wish to built the earth structures up to this higher protection level.

2.2 OBJECTIVE

The objective of the Greymouth Floodwall Rating District is to prevent flooding of the townships of Greymouth, Cobden and Blaketown from the Grey River for flood events up to 6,600 cumecs.

2.3 MAINTENANCE

The maintenance of the Greymouth Stopbank can be broken into two categories. Stopbanking and Erosion Control.

Stopbank Maintenance

Maintenance includes repair of any scouring, vegetation removal to facilitate access and to optimize berm flow, control of vehicle access to prevent damage to stopbank batter slopes, topping up of stopbanks as required to maintain stopbank capacity in terms of design, maintenance of grass cover, maintenance of drainage provision, routine and flood surveillance operations and reporting.

Construction of drainage and sewage lines and other utility services that penetrate the bank provide potential lines of weakness through the structure. Unless proper precautions are taken in the design and construction of these penetrations there is a risk that they may become preferential lines for seepage flow. Where pressurised pipelines such as pumped drainage outfalls are installed or malfunctioning floodgates exist premature saturation of the stopbank core can occur under flood conditions which in turn may lead to a loss of strength from elevated soil pore water pressures or induce internal erosion of the stopbank core or its foundation.

Stopbanks can be damaged in the event of an earthquake by cracking where displacement occurs, or by liquefaction of the foundation material. These actions may result in subsidence, slumping or spreading. The probability of seismic damage coinciding with a flood is considered remote.

Erosion Control Works

Erosion control works consist of continuous rock riprap facings of specific sections of stopbanking. Erosion control facings are designed and constructed to provide protection to the stopbanks core from the rivers erosive forces during floods.

Rock is used in the formation of these facings of the required grading to resist the forces (velocity) of the river. Routine maintenance ensures the coverage and stability of rock rip rap on stopbanks is maintained to lessen the risk of failure.

Any slumping of rock rip rap is topped up with rock that has acceptable durability, angularity and appropriate grading to provide the required protection to the underlying structure.

Where slumping of rock rip rap facings has occurred an assessment needs to be made to ascertain cause prior to remedial works being executed in order to ensure as far as is reasonably practical the failure mechanism is thoroughly understood and an appropriate remedy found.

2.4 MAINTENANCE PROGRAMME

An annual maintenance programme will be prepared each year in consultation with the Joint Floodwall Committee prior to adoption by the Regional Council for inclusion in the Annual Plan.

In preparing the annual maintenance programme consideration will be given to:

- an inspection to identify works requiring immediate repair.
- Works anticipated as being required given a 'normal' season.
- Flexibility to meet unbudgeted damages.
- Surveillance, reporting and investigations

An annual report will be presented to the Joint Flood Wall Committee outlining maintenance expenditure for the financial year.

2.2 DAMAGE EXPOSURE

River control works are constructed in a very high energy environment with the purpose of resisting and absorbing some of that energy. It is considered that no matter what the standard of maintenance carried, it is inevitable that damage will occur to structures.

In the years since their construction the sections of bank faced with rock riprap have been exposed to three flood events with flows in excess of 4,000 cumecs without appreciable damage.

The mean annual flood of the Grey River at the Dobson hydrometric station is currently estimated at 3,840 cumecs. Whilst the possibility exists for premature failure of the stopbanks, performance to date indicates that the most likely cause of failure will be over topping with flows in excess of the design capacity.

SECTION 3: FUNDING

3.1 MAINTENANCE

Maintenance is funded by rates, the level of rating being determined each year in the Annual Plan process. This involves:

(a) Preparation of an annual works programme and corresponding budget in consultation with the Joint Flood Wall Committee.
(b) Adoption of works programme and budget by the Joint Floodwall Committee.
(c) Adoption of the budget in the Annual Plan by Council.

3.2 DAMAGE REPAIRS

Routine damage repairs are funded by a combination of:

- carrying out work as scheduled in annual works report.
- Re-prioritizing works identified in the annual works programme.
- Use of financial reserves.

Major damage repairs would be funded by loans repaid by the rating district over a number of years, or by the owner Council's (GDC) insurance scheme.

3.3 FINANCIAL RESERVES

Financial reserves are held within each rating districts account to:

- meet the costs of unscheduled works.
- enable an immediate response to flood damage repairs.
- prevent major fluctuation in rating levels annually.

The level of financial reserves held in each rating account are determined by the likelihood of a need for un-programmed works.

3.4 DEPRECIATION

River control schemes are designed to be maintained in perpetuity by constantly repairing and replacing component parts which are damaged by floods or by the constant wear and tear encountered in a river environment.

The performance measure is that the infrastructure assets are maintained to meet their service levels at all times.

As there is a constant cycle of replacement of elements of the infrastructure as necessary, depreciation of the value of the assets is not appropriate and funding of depreciation is not necessary. This approach is consistent with the NZ Infrastructure Asset Valuation and Depreciation Guidelines (Section 5.4.4).

SECTION 4: PERFORMANCE MEASURES:

The overall performance measure is that the infrastructure assets are maintained to meet their service levels at all times. This includes:

(a) Ensuring all floodbanks continue to protect the town from a 6,600 cumec flood event plus freeboard.
(b) Maintaining rock rip rap facings and grass cover on stopbanks to prevent active erosion of the stopbank core.
(c) Maintaining stopbank drainage systems to control seepage flows and prevent internal erosion of the stopbank core and foundation and loss of stability.

The following procedures will be adopted to measure the adequacy of maintenance.

Annually

(i) Inspect all works and prepare a maintenance programme and budget.
(ii) Produce an annual works report for Joint Floodwall Committee, to include the type of work to be undertaken, quantities, locations and costs.
(iii) Organise contracts for agreed scheme work, oversee contract completion and report to Council.
(iv) Report on works and investigation undertaken during the previous financial period to the Joint Flood Wall Committee and the Council.

Performance Measures

1. No reports of reduced freeboard anywhere along the stopbank system, without an agreed hydraulic and hydrological investigation in progress as a precursor to consideration of appropriate response measures.
2. No reports of stopbanks and bank protection erosion requiring repairs without an agreed programme of remedial work in progress.
3. No reports of sand size or greater erosion products being present in seepage flows exiting the stopbanks or their foundations under flood conditions without an agreed program of remedial work in progress.
4. No reports of increasing seepage flows exiting the stopbanks or their foundations under flood conditions without an agreed program of remedial work in progress.
5. No reports of obstructed stopbank drainage facilities without an agreed program of remedial work in progress.
6. No reports of cracking of stopbank crest, no evidence of slumping or foundation heave without an agreed program of remedial work in progress.

10 - Yearly

(i) Re-survey all river cross-sections between the Grey River mouth and the Cobden bridges and re-evaluate the hydraulic capacity of the stopbank system and report findings against the current design standard.
(ii) Re-measure cross section river profiles and carry out a comparative analysis with preceding surveys to establish possible bed level trends and effects on flood carrying capacity.
(iii) Carry out an assessment of hydrology at the Dobson recorder and update for scheme design discharge and report findings.
(iv) Revaluation of the existing infrastructural assets to include any additional volumes to stopbanks and bank protection works from previous reviews.
(v) Critically evaluate the performance of the stopbank under service conditions with particular emphasis on seepage control and stability.

APPENDIX I - DEFINITION OF TERMS

AGGRADATION	The deposition of bed material resulting in the raising of the riverbed level and a reduction in the flood carrying capacity.
EROSION	Erosion includes processes of wearing away of the land surface by natural agents and the transport of the material that results.
EROSION CONTROL WORKS	Works designed to protect stopbanks or natural banks from erosion to maintain channel stability.
FLOOD CARRYING CAPACITY	The ability of a river to carry flood flows within its bed without exceeding its banks whilst maintaining design freeboard.
FLOODPLAIN	The area of land adjacent to a river over which floodwater has historically or could potentially flow. The fan that has been built up in geological time by the river.
INFRASTRUCTURE	Those built structures necessary for operating and supplying utilities and services to the community (including, but not limited to, telecommunications, natural or manufactures fuel, bridge, electricity, water, drainage, sewerage, road and rail links, seaports and airports.
MAINTENANCE	Work required to keep the existing flood protection works in good repair and able to perform to design expectations, and includes spraying of stopbanks for weed control, topping up of earthwork for stopbanks and rock replacement.
SEEPAGE	Slow movement of water through a compacted earth embankment or its foundation resulting from a difference in water level between the inside and outside of the stopbank and the capacity of the material of which the embankment and foundation are compound to transit water i.e. permeability.
STOPBANK	Compacted earth structures generally parallel to the river channel designed to increase the depth of water and hence capacity without overflow.
SUFFOSION	Removal of fines from the body of a compacted earth embankment or its foundation under the influence of seepage flows resulting in a porous skeletal structure prone to collapse.
TOE OF STOPBANK	The intersection of the batter of the stopbank with the natural ground.

APPENDIX II

GREYMOUTH FLOOD PROTECTION SCHEME

EXPENDITURE AND FUNDING SINCE 1995

Asset Valuation as at December 2006	$ 6.00 million
Capital Valuation as at June 2008	$ 700,112,700
Asset as Percentage of Capital Value	0.86%

Period	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Expenditure	$ 53 567	$ 33,239	$ 13 664	$ 10 231	$ 40 677	$88,468

Period	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Expenditure	$30,284	$50,715	$100,400	$93,687	$29,152	$16,103

Period	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Expenditure	$84,140	$24,762	$386,759	$2,965,415	$0	$0

Period	**2013**	**2014**
Expenditure	$0	$109,507

Average Expense Post Scheme Works	$46,682
Average Expense as % Asset Value	0.78%
Average Expense as % Capital Value	0.01%
Average Separate Rate	$133,333

Note:
Likely future maintenance demand will be in the order of $ 50 000 per annum.