

# MAJOR FLOOD EVENTS IN GREYMOUTH, NEW ZEALAND: 1862-1988.

J.L. Benn,  
The West Coast Regional Council,  
P.O. Box 66,  
Greymouth, New Zealand.

## ABSTRACT

Twenty one of the most significant flood events in the Grey River to have inundated the town of Greymouth are described. The events are listed chronologically from the first European record in April 1862 to the last and most disastrous case in September 1988. Where possible the following flood information is provided: Dates, causes, durations, levels, discharges, velocities, damage to property, loss of life and financial costs. Flood alleviation measures used throughout the town's history are also described.

## INTRODUCTION

Due to its frequency of flooding, it is reasonable to assume that the town of Greymouth (figure 1) has probably suffered more regularly from the effects of natural hazards than any other urban area in New Zealand. It can be inferred from Benn (1990) that between 1862 and 1988 the town had been flooded to various degrees at least 120 times from a number of sources. These included flooding from the Grey River (most damaging generally), Sawyers Creek, backup water through the town's stormwater/sewage system, seepage through the ground, and surface impoundment incurred by local intense rainfalls.

The major flood events affecting the South Island's West Coast in May and September 1988 received wide media and public attention, mainly due to the devastation that occurred in Greymouth. Since those events, flooding in Greymouth has become a topic of interest and many requests have been made to the West Coast Regional Council (Regional Council) for historical information pertaining to such events. In response to those requests, this paper provides a concise descriptive chronology of the major events to have affected the town between 1862 and 1988. Only those floods directly attributable to the Grey River are discussed and hence some significant events to have affected the town are excluded from this paper ( e.g. 1978 Sawyers Creek flooding and numerous cases of severe surface flooding).

## SOURCE MATERIAL

The majority of events described were derived from Benn (1990). The impetus for that volume was the work of Cowie (1957), with subsequent information being provided by newspaper accounts, historical books (based largely on various Borough Council records), reports, files and hydrological data from the Westland Catchment Board and Regional Water Board (Catchment Board), technical reports and disaster recovery reports. Supplementary information to Benn (1990) is provided in Carson (1990).

The original source material is cited in each description presented.

## **ACCURACY**

The accuracy of this paper is directly related to that of Benn (1990) and other source material used. The following sources of error recorded by Benn are applicable to this paper.

i) Some records were not readily available (e.g. those in North Island libraries and institutions, and records being misplaced during restructuring of Government departments such as the Ministry of Works and Development).

ii) Many records have been destroyed by floods and fire (e.g. the Greymouth library has been flooded many times and the Greymouth Borough Council (Borough Council) records were destroyed by fire in 1947).

iii) Many old Catchment Board records were discarded a number of years ago.

iv) Newspaper reports and technical reports often varied slightly on such information as flood levels and discharges. In such cases best estimates have been made.

v) All units have been converted to metric and rounded off to the nearest 0.01m (for flood levels and velocities), except in direct quotes or where no specific value is presented (e.g. in terms such as 'several feet').

It is worth noting that although many of the old newspaper and historical accounts appear to be exaggerated in terms of damage descriptions, there is a surprisingly good photographic record extending back to the February 1872 flood event to substantiate many of the claims.

## **BACKGROUND**

The Grey River Catchment, located in north Westland (figure 1) covers an area of 3948km<sup>2</sup> (Griffiths and Glasby, 1985). From the headwater area of Lake Christabel, the Grey River flows for 112km to the Tasman Sea (Egarr and Egarr, 1985). Tributary channels are very short and steep, with catchment elevations rising to 1958 metres above sea level at Mt Alexander (New Zealand Map Service, 1982).

For much of its length the Grey River is a braided channel flanked by some of the broadest floodplains on the West Coast. However, the lower 14km, from Stillwater to Greymouth are confined to a single meandering channel; the change occurring abruptly as the river enters the Brunner Gorge. Greymouth, the largest urban centre on the West Coast (population around 8000) is built on the low lying river delta-tidal lagoon system at the river's mouth. The town was settled by Europeans in 1863, although it is generally accepted that the Maori people had occupied the site (Mawhera Pa) for several hundred years. The urban area of Greymouth prone to flooding includes the suburbs of Greymouth, Blaketown and Cobden.

High intensity rainfalls in the steep headwaters of the catchment can lead to rapid runoff and are the primary cause of flooding in the Grey River. The highest intensity rainfalls are usually associated with moist north-westerly airflows ascending the Southern Alps although heavy showers do occur from all directions at times. For the

catchment's headwater area, Tomlinson (1980) estimates a 24 hour rainfall with a five year return period of about 160mm on the Southern Alps Main Divide. Periods of prolonged rain are another common cause of flooding, and contribute to the high annual rainfall recordings of the catchment. For the main divide area of the catchment, Tomlinson estimates ~~can the~~ average annual rainfall at around 6400mm.

Flood levels in the Grey River can be elevated by the addition of melting snow in the ranges, and at Greymouth itself, by the flood peak coinciding with high tide and/or rough seas. The worst case flood scenario for Greymouth is a combination of intense or prolonged rain on a saturated catchment, snowmelt, high tide and rough seas, backup through the drainage/sewage system and surface impoundment. Fortunately only a few cases of all factors combining have been recorded.

Over the years many attempts have been made to protect the town from flooding. These have included a variety of artificial walls and banks, large scale alteration of the river mouth environment by narrowing and fixing the river channel with heavy rockwork more than a century ago (associated with the harbour development), and infilling large areas of the lagoon system (the Blaketown Lagoons and Range Creek Lagoon). Protection efforts have culminated in the Greymouth Flood Protection Scheme (the floodwall), completed in November 1990. It is expected that the floodwall will protect the town from events of greater than historical magnitude: The floodwall is designed to contain about 8500 cubic metres per second ( $\text{m}^3 \cdot \text{s}^{-1}$ ) before overtopping occurs, whereas the highest recorded discharge (September 1988) was  $5870 \text{ m}^3 \cdot \text{s}^{-1}$  (Catchment Board hydrological data). The floodwall was tested for the first time since completion on 10 January 1994 and contained a flood that would have otherwise overtopped the old wharf level and inundated the town.

Flood levels at Dobson refer the recording gauge site at Dobson township, approximately 8km upstream from Greymouth. It is important to note that levels presented before 1984 refer to the old Catchment Board imperial gauge. After 1984 levels refer to the telemetered metric gauge about 300m downstream and 1.14m lower than the old imperial gauge.

## MAJOR GREYMOUTH FLOOD EVENTS

### APRIL 1862 (date unknown)

After establishing Westland's first farm at Waipuna (upper Grey Catchment), Samuel Mackley's return journey to the mouth of the Grey River was hindered by a large flood. All the land in the middle reaches of the river (Totara Flat area) was flooded. At Mawhera Pa (Greymouth's present site), the land cleared by the Maoris was about 1.82m under water (Halket-Millar, 1959)

### 9 FEBRUARY 1864

In Greymouth, Lord (1928) stated that:

"This was reported by the Maoris to be the heaviest flood ever seen in the Grey, the water completely overflowing its banks two chains (40.23m) of which were washed out to sea. As a result of this, the Government depot, which was erected three chains (60.39m) from the river was left in a precarious position".

As a consequence, a new government depot was built at the head of the Blaketown Lagoons.

### **27 JUNE 1866**

Three days of warm north-west gales and heavy rain, combined with snowmelt caused all West Coast rivers to rise. The Grey River rose quickly and unexpectedly, and backed up by the high tide, overflowed the Greymouth banks at 8:00 a.m. on the 27th. Water flowed down Boundary Street and into the Blaketown Lagoons, flooding much of Blaketown and Greymouth. Mackay, Arney, Boundary and Gresson Streets were under 'several feet' of water. At the lower end of Richmond Quay there was about 1.52m of water in houses which themselves were built on 1.52m high piles. Boats were needed to travel around the centre of town and at the end of Werita Street, a boatman was swept out to sea and drowned (Grey River Argus, 29.6.1866).

### **6 NOVEMBER 1867**

Unsettled weather prevailed for a number of days and on the night of the 4th, heavy continuous rain commenced, lasting well into the night of the 5th (West Coast Times, 7.11.1867).

At day break on the 6th, the river in Greymouth was bank high and began overflowing the banks by 10:00 a.m.. Water flowed down Boundary Street and flooded much of the lower town. High tide at 5:00 p.m. increased the flood levels (Grey River Argus, 7.11.1867). Most of the costly embankment and wharf - only just completed, was washed away. The downstream end of the embankment gave way first at high tide. From the lower end of Wharf Street, about 200m of protective planks had been forced towards the river, and in some cases were laying horizontally. Further along, another section was completely washed away, whilst the upstream section of the wharf was greatly loosened; a deep channel was scoured around the piles (West Coast Times, 11.11.1867). The whole lower section of Greymouth and Blaketown were flooded by 5:30 p.m., with many buildings being torn off their foundations and washed away (Hokitika Evening Star, 7.11.1867).

The bridge between Greymouth and Blaketown was washed away, isolating the two settlements. In Greymouth sandbags were used to try and stop water entering businesses. By 8:30 p.m. water levels had fallen markedly (Grey River Argus, 7.11.1867).

### **31 DECEMBER 1867 - 2 JANUARY 1868**

Violent weather occurred for four days up to 2 January. Very heavy rain, thunder and lightning were recorded. Greymouth was flooded on three occasions in one week.

In the first instance on 31 December, little damage was done as the river flowed down Boundary Street. However, before daylight on 2 January, the river again flowed down Boundary Street, with flood levels being nearly as high as those of November 1867. Houses were flooded and damaged right down Arney and Albert Streets and the new tramway was almost completely destroyed. The river bank eroded so quickly it was feared buildings would fall into the river. About 7.5m of roadwidth opposite Arney Street, and 3.5m of roadwidth along Mawhera Quay were eroded. In some parts along Mawhera Quay only 4.5m of roadwidth remained between the river and the footpath (West Coast Times, 6.1.1868).

## **7 JANUARY 1868**

Continued bad weather caused the river to flow down the channel in Boundary Street, cut by the flood on the 2nd. Communications between Greymouth and Blaketown were almost impossible (West Coast Times, 8.1.1868).

Up until this time, Greymouth was administered by the Canterbury Provincial Council in Christchurch. However, Greymouth residents thought they could locally manage the flood problem more effectively: A public meeting was held in Greymouth soon after the floods of January 1868 and "The Greymouth Borough Council first came into being as a result of the fear of the flood menace from the Grey River". (Jackson, 1968).

It was noted by Carson (1990) that the editor of the Grey River Argus in 1868, suggested the main advantage of a local authority dealing with the flood problem was "A Borough Council would have the power to levy special and general rates, and also raise loans which was a need in the present situation".

## **9 FEBRUARY 1872**

Heavy south-west showers fell for over a week, and continuous rain for a 36 hour period began falling on the night of the 7th (West Coast Times, 9.2.1872).

By the 9th, the first 'great flood' occurred in the Grey River and at its peak, most of Greymouth was flooded (Jackson, 1968). The lower part of the town was quickly submerged as flood waters backed up against rough seas. The river rose rapidly during the day, breaking through the primitive protection works and carrying all away before it. The new Borough Council protection works of planks, piles and fascines were completely washed away at the lower end of the town, whilst at the upstream end of town, the protection works were severely shaken and considerable bank erosion opposite Custom Street occurred. Richmond Quay, west of Johnston Street was most severely affected, with whole blocks of offices, shops and other structures washed out to sea. From Johnston Street to Arney Street, it was estimated that at least 70 buildings were washed away, with a boy being drowned in one of them.

Water was 'several feet' deep down Boundary Street, and over shop counters and hotel bars along Mawhera Quay. Boats were used all night to rescue people (Grey River Argus, 9.2.1872). When news of the disaster reached the Premier (William Fox), he authorised the immediate construction of the stone training wall between the Cobden traffic bridge and Tainui Street at a cost of 5000 pounds (Lord, 1928).

Benn (1990) suggested estimates of the flood peak level can be made, based on the original 1875 specifications for the Taylorville swingbridge (West Coast Times, 1875) in the Brunner Gorge, 11 km upstream from the new Cobden road bridge. The specifications state that the base of the bridge was to be eight feet (2.43m) above the 1872 flood level and 30 feet (9.14m) above normal level. Thus it can be assumed that the February 1872 flood level was 22 feet (6.7m) above normal at the Taylorville swingbridge. This is comparable to the May and September 1988 events that were 5.4m and 5.8m respectively above normal at the new Dobson recording gauge, located about 3.25km downstream of the Taylorville bridge, on a wider section of the river.

## **6 JULY 1887**

Heavy north-west rain and warm temperatures led to snowmelt and wide spread flooding (West Coast Times, 7.7.1887). In Greymouth, the flood was reported to be the worst to that time - the flood waters being backed up against an extremely high tide. The river overflowed the wharf at 9:00 a.m., peaked at noon, and had receded by dusk (Jackson, 1968).

Flood levels were about 0.6m above the February 1872 levels. Every building along Mawhera Quay was flooded to a depth of at least a metre. Hundreds of people were rendered homeless and life boats from steamers tied up at the wharf were used to evacuate nearly 100 people (Grey River Argus, 6.7.1887). Asphalt pavements were destroyed and debris was strewn about the streets. Much planking on the new wharf needed replacing and the weighbridge office on Mawhera Quay was washed about 180m downstream. Gas mains were flooded, leaving much of Greymouth in darkness afterwards. At its peak, the river was reported to have been about a metre higher in the mid channel than at its banks and nearly touching the base of the old Cobden traffic bridge. The approach to this bridge on the Greymouth side was washed away. The Blaketown Lagoons breached several channels through the beach to the sea, alleviating some of the problem (West Coast Times, 8.7.1887).

The Grey River Argus (6.7.1887) recorded:

*"The stone breastwork constructed on the order of the Premier (now Sir William Fox) in 1872 prevented the flood breaking through where it found an outlet before. The wharves below it formed an equally effective barrier; and the wharf... served as a shield for the lower part of the town".*

Shortly after this flood the concrete nibwall along Mawhera Quay from the Cobden Bridge to Tainui Street was built one foot (0.3m) higher than the July 1887 flood level (Benn, 1990).

## **27 DECEMBER 1897**

Very little is known about this flood except it was reported that the river supposedly came over the wharf and flooded much of the town, with many stores and houses being damaged or destroyed. The event gained the title of 'The Royal Rain'.

Newspapers of the day reported very little detail and Borough Council records of the time have been destroyed by fire and floods. Weather summaries in the New Zealand Gazette also fail to mention flooding. The few details reported were presented in the Greymouth Evening Star (27.12.1957), when the town was threatened again 60 years to the day of 'The Royal Rain'. Doubt must be cast on the damage reported due to the lack of details, although old flood photographs dated '1890s' and historical flood level information exist (figure 2).

## **25 JUNE 1905**

Torrential rain associated with north-west gales caused the Grey River to rise rapidly, and between 5.00 a.m. and 5.30 a.m. (two hours after high tide), the river began to overflow the wharf. The on duty policeman raised the alarm by ringing the fire bell. Initially water levels in the town rose slowly, providing adequate time to lift carpet and stock in shops and to block doorways with planks and sandbags. By 9.00 a.m. premises on Mawhera Quay had to be evacuated and the streets were described as raging torrents. Streets were torn up and boats were needed to rescue people from all parts of town (Grey River Argus, 24.6.1905). The lower end of Greymouth was inundated to a depth of at least 1.52m and eventually the whole business district was flooded. Water flowing over the wharf tore away embankments that undermined and destroyed the railway tracks along Mawhera Quay. Every dwelling from Tainui Street back to the Tidal Creek and down to the Blaketown Lagoons had flood waters in them (Jackson, 1968; Hawker, 1977).

At around 10.00 a.m. the mayor authorised a channel to be cut from one of the Blaketown Lagoons to the sea, to alleviate the backup water in the town. About 50 men formed a shovel gang and although the work took sometime, it was considered a success as flood levels soon began to recede. The Grey River Argus (27.6.1905) reported that the work would have been completed sooner had two well known engineers insisted that it wouldn't work due to rough seas. The same edition of the paper also stated that:

*"The opinion is expressed by those who witnessed the flood in 1887 that on this occasion the river was much higher, but the water was not so deep in the streets. This is accounted for by the fact that the concrete wall from Cobden bridge to opposite the Bank of New Zealand was erected as a result of the 1887 flood. If the wall had not been erected the flood on Saturday would have been considerably greater"*.

## **31 MARCH 1913**

Strong north-westerly winds and heavy rain covered the West Coast for several days. Greymouth received 44mm of rain in 24 hours to 9.00 a.m. on the 31st, and Otira (just outside the Grey Catchment boundary) recorded 224mm on the 28th (New Zealand Gazette, 1.5.1913).

Much of the town was flooded to similar levels that occurred in 1905 (Grey River Argus, 31.3.1913), but few details are given. The New Zealand Gazette (1.5.1913) recorded that *"Extremely heavy rains occurred in the high level of the South Island and in Otago, causing floods in many of the large rivers"*.

There is considerable photographic evidence of this event - for example see Carson (1990).

### 10-12 OCTOBER 1936

Cowie (1957) recorded this event as follows:

"A north westerly storm together with high winds and heavy rains brought serious floods to West Coast Rivers. These floods were considered the biggest since 1867...The Grey River was in very high flood and invaded the town, causing extensive damage and serious losses, particularly to the business premises. In the vicinity of Revington's Hotel the water was 5ft (1.52m) deep, while in the hotel itself chairs in the dining room were afloat. Many houses had to be evacuated, some occupants being rescued by boats. When the flood waters subsided the streets were covered with a good thickness of silt. At the height of the flood the Grey River was flowing at 12 knots (6.1 ms<sup>-1</sup>) and enveloped the wharf, to overtop its banks at the lower end. Old residents who retained marks on the walls of their homes, indicated this flood exceeded the 1913 flood by nine inches (0.23m) and this was confirmed with levels at the Omoto Racecourse".

The Grey River Argus (10.10.1936) stated that the river flowed over the wharf around 4.00 a.m. and backed up by the high tide, soon burst through the rail embankment along Mawhera Quay and rapidly flooded the lower portion of Greymouth. When the tide receded just after 9.00 a.m., the flood level fell until noon when little water remained in the streets. Almost every business from Tainui Street to the sea and around the Blaketown Lagoons suffered damage. However, because of a reasonably early warning, most retailers were able to lift goods above the flood level, which was over 1.52m deep in places.

Cobden was severely hit due to a lack of warning (i.e. no fire bell) and water about 1.82m deep inundated many places. A number of people had to be evacuated by boat.

### 31 AUGUST 1970

A north-easterly storm affected the whole West Coast for a number of days causing widespread flooding. In the six days up to the 31st, areas in the Grey Catchment recorded up to 152mm of rain.

The Grey River reached its highest level since 1936 and by mid morning Civil Defence was an alert and shopkeepers in the business district were well advanced in lifting stock. By 11.00 a.m. the river was lapping the top of the wharf in the lower part of town, and it was considered that with the tide at its peak, the danger of a major flood was past. However, by mid-day water was over 0.3m deep in parts of the town and the Greymouth Evening Star (31.8.1970) reported that "Many shops had sandbagged their entrances and were relying on willing helpers to push the water out with brooms". The paper also recorded that water in Boundary Street extended from the river side of the traffic round-a-bout to Victoria Park. In Herbert Street water was up to a metre deep, and staff at Griffin and Smith's Hardware Store had to be evacuated by front-end loader.



Catchment Board hydrological records show that the river peaked at 1.19 p.m., 5.4m above normal at the Dobson gauge and discharged 4825 m<sup>3</sup>.s<sup>-1</sup>.

Blaketown and Cobden were flooded to a comparable extent as the 1936 flood, as flood levels were influenced by the lagoons backing up. In the central business district flood levels were considerably lower than those of 1936 and this was attributed to the railway embankment along Mawhera Quay - Richmond Quay acting as a stopbank; the embankment was grouted soon after the 1936 flood. Sand bagging along the wharf between the Commercial Hotel and Richmond Hotel also helped reduce flood levels (Catchment Board file 375).

### **17 SEPTEMBER 1970**

Westerly-northerly wind and rain prevailed for two weeks, causing West Coast Rivers to attain similar levels to those of 31 August 1970. The Grey River at Dobson peaked 5m above normal and discharged 4127 m<sup>3</sup>.s<sup>-1</sup> (Catchment Board hydrological data, file 375). The flood peak coincided with high tide (12.18 p.m.) and the lower parts of the town were again flooded extensively by water 0.3m deep flowing over the wharf. Little damage was recorded in Greymouth, although it was severe in country areas (Greymouth Evening Star, 17.9.1970).

Carson (1990) noted it was after this flood that the first serious discussions were opened for a flood protection scheme for the town.

### **19 JANUARY 1977**

This flood surpassed the 1970 events and was considered the worst in Greymouth since 1936, causing hundreds of thousands of dollars damage over the whole West Coast area. In 24 hours to 10.00 a.m. on the 19th, Greymouth recorded 150mm of rain. The river peaked at 3.30 a.m. at Dobson, being 5.4m above normal and discharging 4772 m<sup>3</sup>.s<sup>-1</sup>. In Greymouth the river peaked somewhere between 3.00 a.m. and 5.00 a.m. (Greymouth Evening Star, 19.1.1977, Catchment Board hydrological data).

By 1.30 a.m. the river overflowed the wharf at the Tainui Street - Mawhera Quay intersection, and eventually a wall of water about one metre deep and 400m long was flowing over the wharf, sending a torrent through the business district. The Greymouth Evening Star (19.1.1977) wrote "Many shop owners were caught napping by the suddenness of the flooding which peaked between 3 a.m. and 5 a.m. and watched helplessly as muddy water streamed through their premises". Cobden, Blaketown and the Leonard-Arney Street area in Greymouth bore the brunt of residential damage with forty people being evacuated from these areas; water was 1.52m deep in some houses. By mid-morning the river level had dropped, but was still only a few centimetres below wharf level.

A state of emergency was declared by the Mayor at 3.30 a.m. on the 19th near the flood peak time, and lasted until 4.00 p.m. on 22nd to allow the town centre to be cleared of silt. After the flood, the Mayor again raised the issue of a floodwall along Mawhera Quay, noting that it would be at least 60% more expensive than when originally proposed in 1970 (Carson, 1990).

## **24 - 25 JANUARY 1980**

Strong north-east winds accompanied by torrential rain brought the rivers in the Grey Catchment into high flood. At Dobson the Grey peaked 4.7m above normal at 9.45 p.m. on 24th (Greymouth Evening Star, 25.1.1980) and discharged  $3996 \text{ m}^3 \cdot \text{s}^{-1}$  (Catchment Board hydrological data). The peak in Greymouth occurred several hours later.

At about 2.00 a.m. the Mayor called for volunteers to construct a sandbag wall along the wharf and by 4.00 a.m. the wall stretched 100m, but the river was still rising and small waves began to overflow the wharf. However, the eventual 400m long wall prevented serious flooding in the business district even though the river level peaked at 0.38m above wharf level. Low lying residential areas were badly flooded with water being up to a metre deep in houses in the Leonard-Arney Street area, Cobden and Blaketown. Several dozen families had to be evacuated from these areas (Greymouth Evening Star, 25.1.1980).

Carson (1990) stated that for weeks after this event debate occurred between Cobden-Blaketown residents and the Borough Council and Catchment Board over the sandbagging along Mawhera Quay. The residents claimed the wall directed the river towards their areas and thus increased water levels in their homes. It was suggested by the residents that if such structures were built along Mawhera Quay in future events, they should receive the same. Carson also recorded that 252 insurance claims totalling \$231,000 were made, resulting in many insurance companies withdrawing cover from flood prone areas. This has remained a contentious issue.

## **9-10 JULY 1983**

The lower parts of Greymouth, Cobden and Blaketown were extensively flooded due to a combination of high river levels and severe surface flooding caused by torrential rain. In the 48 hours covering the 9th-10th, Greymouth recorded 205.5mm of rain (Greymouth Evening Star, 11.7.1983) and in the upper Grey Catchment at Mai Mai, 216mm were recorded in 24 hours. Lowe (1988) suggested rainfall of this intensity at Mai Mai had an estimated return period in excess of 100 years.

At Dobson the Grey River peaked at 3.15 a.m. on the 10th, 5.73m above normal (Greymouth Evening Star, 11.7.1983), and discharged  $4184 \text{ m}^3 \cdot \text{s}^{-1}$  (Catchment Board hydrological data). The flood damage report (Catchment Board file 375) said this was an unusual event in that the Grey River's main tributaries - the Big Grey River and Ahaura River, held their peaks for six hours, an exceptionally long time.

In Greymouth, the river overtopped the wharf at its lowest point near Boundary Street and between 2.00 a.m. and 3.00 a.m. on the 10th water began seeping through the railway embankment near King's Hotel on Mawhera Quay, damaging tar seal along the road. The railway embankment prevented the main body of water entering the business centre of town. Nonetheless, between 30-40 houses in Blaketown and Cobden were directly flooded by the river, with some Blaketown families being evacuated during the night of the 9th. Business were mainly affected by surface water - for example 0.6m of surface water entered the Union Hotel and was two thirds of the way up the foyer in the Regent Theatre. Sufficient warning

was given for most to lift furniture and stock thus minimising damage. By 8.00 a.m. the river level had dropped considerably. Pertaining to this event Carson (1990) remarked "Surprisingly perhaps, there were few insurance claims and no calls publicly for action to avert further flooding".

### **23-24 NOVEMBER 1984**

After days of westerly rain, rivers in the Grey Catchment had reached very high levels on the 23rd (Greymouth Evening Star, 23.11.1984). During that day rivers continued rising. At Dobson, the Grey River peaked late on the 23rd, 5.5m above normal and discharging  $4748 \text{ m}^3\text{s}^{-1}$  (Greymouth Evening Star, 24.11.1984, Catchment Board hydrological data).

In Greymouth the flood peaked around midnight on the 23rd, coinciding with the high tide. Water 0.6m deep overtopped the wharf and flowed into the town. Damage was severe despite the fact that 1200 volunteers had built a 400m long sandbag wall along Mawhera Quay during the night, diverting the main body of water from the town. More than half of Greymouth's businesses were flooded, some up to 1.52m deep. Many houses in Blaketown and Cobden were flooded resulting in many Cobden residents being rescued by boat or front-end loader. In Cobden, flood levels were reported to have been about 0.15m deeper than those of January 1980 even though a trench was cut from Range Creek Lagoon to the sea in an attempt to reduce river flow there. The report in the Greymouth Evening Star (24.11.1984) said "Water went through many houses, and almost through one house in Cobden which had been raised almost a metre after the disastrous floods in 1980". Many Cobden residents claimed this flood, was the worst on record to that time. The same edition of the paper also recorded that flood levels in Greymouth rose within minutes near the flood peak and dropped just as quickly.

After this flood one borough councillor suggested that matters of ongoing concern should be put aside and a flood protection scheme should become a priority. The new Mayor favoured moving the commercial centre of Greymouth southwards out of the flood zone, whilst the Catchment Board proposed a flood protection scheme that it had previously designed. With the majority support of the Borough Council, the Catchment Board was eventually to have its way (Carson, 1990).

### **19-20 MAY 1988**

After the driest April on record, heavy south west rain fell between the 8th and 19th, raising all West Coast Rivers to major flood levels (Fauth, 1988a).

At around 5.00 p.m. on the 19th, Catchment Board staff advised the Borough Council staff that inland rivers of the Grey Catchment were 0.3cm higher than November 1984 flood levels, and predicted the Greymouth Wharf would be overtopped by 10.00 p.m.. At 8.30 p.m. much of the low lying area of Greymouth was closed to the public as a precautionary measure, and by 9.00 p.m. the Blaketown Lagoons overflowed. This resulted in many houses and business in Blaketown and lower Greymouth being flooded. By 9.20 p.m. the river was overtopping the wharf at its lowest point near the Richmond Hotel, and by 9.40 p.m. water was flowing over much of the wharf (Carson, 1990).

At Dobson, the river peaked at 12.15 a.m. on the 20th, being 5.4m above normal, discharging  $5180 \text{ m}^3 \cdot \text{s}^{-1}$  and flowing at  $7 \text{ m} \cdot \text{s}^{-1}$  past Greymouth against rough seas and high tide (Fauth, 1988a, Catchment Board hydrological data). These were the highest combination of recordings ever made to that time. In Greymouth the flood peaked between 2.00 a.m. and 3.00 a.m., with a state of emergency being called at 1.00 a.m., coinciding with the high tide. The river poured over the whole length of the wharf and much of Mawhera Quay, inundating most of the town. Asphalt was ripped from the streets and the railway lines along Mawhera Quay were destroyed. Man hole covers in the streets were removed, exposing high voltage cables. Water was well over a metre deep in many places, making it impossible to negotiate many streets in the lower part of town (Fauth, 1988a). Over a metre of mud laden water flowed through the Union Hotel for the first time ever and water levels reached the window sills of the town library. The aerodrome resembled a lake, being at least a metre under water.

The newly constructed Cobden stopbank - the first completed section of the floodwall, stopped direct flooding of over 100 houses, although many were still inundated by surface water and water seeping through the stopbank (Greymouth Evening Star, 20.5.1988). At its peak, Fauth (1988a) noted that the river came within a metre of overtopping the Cobden stopbank for much of its length, and in the Range Creek Lagoon area was only 0.15m from the top.

In all, 400 people from 102 houses were evacuated, mainly from Blaketown and lower Greymouth (Stapleton, 1988), and the total loss of property was estimated by Works Development Services (1988) to be \$4 million, for the whole area affected.

### **13-14 SEPTEMBER 1988**

Fauth (1988b) reported that heavy north-west rain fell between the 10th and 13th, thoroughly wetting already saturated catchments. Total rainfall recorded in the Grey Catchment for this period was 291mm for the upper catchment and 169mm in Greymouth. In the Haupiri-Rotomanu area of the catchment, 150mm were recorded in 24 hours to 9.00 a.m. on the 13th and significant snowmelt was observed in this area.

Rivers in the Grey Catchment rose rapidly and the Catchment Board predicted that the river would overtop the Greymouth wharf by early morning on the 13th; by 8.30 a.m. the Blaketown Lagoons were overflowing, inundating houses in Blaketown and lower Greymouth. By this time the river was also coming over the wharf near the Richmond Hotel. Cobden was receiving protection from its stopbank (Carson, 1990).

At Dobson, the Grey river peaked at 1.45 p.m., discharging  $5768 \text{ m}^3 \cdot \text{s}^{-1}$  (Catchment Board hydrological data), and was 5.8m above normal level. These recordings superseded the May 1988 recordings by  $588 \text{ m}^3 \cdot \text{s}^{-1}$  and 0.4m respectively and thus the most disastrous flooding in Greymouth's history occurred. Carson (1990) noted the flood peak in Greymouth occurred at 3.35 p.m., combining with rough seas; high tide was around noon. Water about a metre deep flowed over the entire length of the wharf and Mawhera Quay, from the railway goods shed in Gresson Street to the signal box on Mawhera Quay, near the new Cobden traffic bridge (figure 2).

Much of Greymouth and Blaketown were flooded, resulting in 356 people from 183 houses being evacuated (Kerr, 1988). Many people were rescued by jet boat. The Press (21.9.1988) reported flood levels being over two metres deep in lower parts of the town, and over a metre deep on the aerodrome. Stormwater, sewage, and high pressure service pipes were broken; shop windows were smashed and goods were strewn about the streets, even though many were lifted above the May 1988 flood level. Thick silt was deposited over much of the town; a lot of it contaminated with oil and sewage. The town was placed under curfew for several days afterwards to allow the ensuing clean up operation to proceed smoothly. Carson (1990) noted that many homes were permanently condemned and demolished after this flood, and for many businesses still suffering from the May flood, this was the end.

Total flood damage costs were approximately \$16 million (Ministry of Civil Defence, 1994). It is interesting to note that no local newspaper details were immediately provided. This was accounted for by Carson (1990):

*"The Evening Star building which had been built to a level 18 inches (0.45m) above the 1936 flood had more than two feet (0.6m) of water through it. Publication was missed for three days, the first time the paper had been foiled by the forces of nature in its 122 year history".*

## SUMMARY

Throughout its history, Greymouth has been flooded on numerous occasions and from a variety of sources. Twenty one of the most significant events of the town being inundated by the Grey River have been described. It can be assumed from the events described, and others cited in various literature, that Greymouth, via flooding, has suffered more regularly from the effects of natural hazards than any other urban settlement in New Zealand. Structural, economic and social damage has been severe on numerous occasions but paradoxically, loss of life and injury has been very low.

Many attempts to protect the town from flooding have been made, finally resulting in the completion of the Greymouth Floodwall. The floodwall was designed to contain floods of significantly greater magnitude than those historically recorded. The floodwall has provided successful on three occasions - twice in 1988 when the structure was only partially complete (on the Cobden side of the river) and once in January 1994 when completed.

## REFERENCES

- Benn, J.L. 1990: *A Chronology of Flooding on the West Coast, South Island, New Zealand: 1846-1990*. The West Coast Regional Council, Greymouth, 159p.
- Carson, K. 1990: *No Surrender; Greymouth's Battle to Beat the Floods*. Greymouth Evening Star Ltd, Greymouth. 64p.
- Cowie, C.A. 1957: *Floods in New Zealand; 1920-1953, With Some Notes on Earlier Floods*. New Zealand Soil Conservation and Rivers Control Council, Wellington. 239p.
- Egarr, G.D.; Egarr, J.H. 1985: New Zealand Recreational River Survey, Part III, South Island Rivers. *Water and Soil Miscellaneous Publication, No. 15*. National Water and Soil Conservation Organisation, Wellington. 160p.
- Fauth, B.J. 1988a: Buller and Westland - Report on Major Flooding 19/20 May 1988. Unpublished Report, Westland Catchment Board and Regional Water Board, Greymouth. 21p.
- Fauth, B.J. 1988b: Buller and Westland - Report on Major Flooding, 13 September 1988. Unpublished Report, Westland Catchment Board and Regional Water Board, Greymouth. 24p.
- Greymouth Evening Star. 1867 - 1988: Extracts from 27.7.1957, 31.8.1970, 17.9.1970, 19.1.1977, 25.1.1980, 11.7.1983, 23.11.1984, 24.11.1984, 20.5.1988. Greymouth Evening Star Limited, Greymouth.
- Grey River Argus. 1866 - 1936: Extracts from 29.6.1866, 7.11.1867, 9.2.1872, 6.7.1887, 24.6.1905, 27.6.1905, 31.3.1913, 10.10.1936. Grey River Argus Limited, Greymouth.
- Griffiths, G.J.; Glasby, G.P. 1985: Input of River Derived Sediment to the New Zealand Continental Shelf. *Estuarine Coastal and Shelf Science* 21, 773-787.
- Halket-Millar, J. 1959: *Westland's Golden Sixties*. A.W. and A.H. Reed Ltd, Wellington. 223p.
- Hawker, E. 1977: *Centennial Survey of the Grey County, 1877-1977*. Greymouth Borough Council, Greymouth. 96p.
- Hokitika Evening Star. 1867: Extract from 7.11.1867. Hokitika Evening Star Ltd, Hokitika.
- Jackson, O. 1968: *Greymouth: The first 100 years - A Centennial Publication*. Greymouth Borough Council, Greymouth. 96p.
- Kerr, P. 1988: Disaster Recovery Co-ordinators Report. Unpublished Civil Defence Report, September 1988, Greymouth. 51p.
- Lord, E.I. 1928: *Te Wai Pounamu - Souvenir of the Grey District Diamond Jubilee, 1868-1928*. Andrew Batey and Co Ltd, Christchurch. 136p.
- Lord, E.I. 1976: *Old Westland*. Reprinted and Published by Carper Press Ltd, Christchurch. 258p.
- Lowe, L.K. 1988: Mai Mai Hydrological Study - Report on the storm 19 May 1988. Unpublished Report, Forestry Research Centre, Christchurch. 2p.
- Ministry of Civil Defence. 1994: *Tephra Vol. 13 (1)* May 1994. Ministry of Civil Defence, Wellington. 47p.
- New Zealand Gazette. 1913: Extract from 1.5.1913. Department of Internal Affairs, Wellington.
- New Zealand Map Service. 1982: Sheet K32, Lake Brunner, 1:50 000. Department of Land and Survey, Wellington.
- Stapleton, D. 1988: Recovery of the Regional Storm and Flooding Event 19-20 May 1988. Unpublished Report, West Coast Civil Defence Organisation. 7p.
- Tomlinson, A.I. 1980: The Frequency of High Intensity Rainfalls in New Zealand, Part 1. *Water and Soil Technical Publication No. 19*, Wellington. 36p plus maps.
- West Coast Times. 1875 - 1887: Extracts from 1875 (date unknown), 7.7.1887, 8.7.1887. West Coast Times Ltd, Hokitika.

Westland Catchment Board and Regional Water Board. 1947 - 1988: Unpublished Hydrological Data, and Flood Damage Reports Contained in File 375. Westland Catchment Board, Greymouth.

Westland Catchment Board and Regional Water Board. 1982: Greymouth Flood Protection Scheme. Unpublished Report Prepared by the Westland Catchment Board and Regional Water Board, October 1982. 24p plus appedices.

Works and Development Services. 1988: Flood Mitigation Report, Greymouth, September 1988. Prepared for the Disaster Recovery Co-Ordinator for Greymouth by the Consultancy Manager, Christchurch. 18p.