"JT-1"

January 2011
Flood Event

Report on the uncontrolled spillway dams

7 September 2011

seqwater
WATER FOR LIFE

GLOSSARY

In this report, the following terms are defined as below:

"Act" means the Water Supply (Safety and Reliability) Act 2008;

"AEP" means Annual Exceedance Probability, the probability of a specified event being reached or exceeded in any one year. This may be expressed as a ratio (e.g. 1 in Y) or a percentage;

"AHD" means Australian Height Datum;

"ALERT" means Automated Local Evaluation in Real Time System, a system of monitoring and displaying rainfall and water level data. It is a combination of field stations, communication networks and data collection software;

"BoM" means the Bureau of Meteorology;

"Controlled Document" means a document subject to managerial control over its contents, distribution and storage. It may have legal and contractual implications;

"DERM" means the Queensland Government department, the Department of Environment and Resource Management;

"EL" means elevation in metres Australian Height Datum;

"Enviromon" is the Bureau of Meteorology data collection software used to collect and display rainfall and water level data;

"Flood Operations Centre" means the office location used by Flood Operations Engineers during a flood event to manage the event;

"FSL" or "Full Supply Level" means the level of the water surface when the reservoir is at maximum operating level, excluding periods of flood discharge;

"Gauge" when referred to in (m) means river level referenced to AHD or a local datum, and when referred to in (m^3/s) means flow rate in cubic metres per second;

"m^3/s" means a rate of water flow being one cubic metre of water per second or 1,000 litres of water per second;

"Rating" means the relationship between height and flow at gauging stations, demonstrated using a Rating Curve or Rating Table;

"Seqwater" means the Queensland Bulk Water Supply Authority, trading as Seqwater;

"URBS" means Unified River Basin Simulator.

TABLE OF CONTENTS

APPENDICES

1 INTRODUCTION

Seqwater owns and operates 26 referable dams in South East Queensland. These dams fulfil an important role within the community by providing water for urban, industrial and irrigation use as well as providing hydroelectric power generation, flood mitigation and community recreation.

Four of Seqwater's 26 dams (Wivenhoe, Somerset, North Pine and Leslie Harrison) have controlled spillways. During flood events these four dams are operated in accordance with procedures contained in detailed operational Manuals to protect the safety of the dams and where possible to provide flood mitigation benefits to downstream communities.

The remaining 22 of Seqwater's 26 dams are uncontrolled spillway dams. It is not possible to influence the outflow from an uncontrolled spillway dam during a flood event. Once an uncontrolled spillway dam fills, additional inflows into the dam will overflow from the dam in an uncontrolled manner to downstream watercourses. This is how these dams were designed and constructed and, in general, no significant flood mitigation benefits would be generated by constructing infrastructure to control spillway outflows from these dams. Seqwater's primary responsibility during flood events impacting uncontrolled spillway dams is to monitor the safety of the dam and to provide dam outflow information to the relevant emergency agencies as required. Such agencies will generally be the Bureau of Meteorology and the Local Authority responsible for the area impacted by the dam outflow.

This report examines the performance of Seqwater's uncontrolled spillway dams during January 2011 when significant floods impacted upon South East Queensland. The dams considered in this report are displayed in the following table:

DAM	FULL SUPPLY LEVEL (m AHD)	FULL SUPPLY CAPACITY (ML)	HAZARD CATEGORY
Atkinson	65.72	30,488	High C
Baroon Pocket	217.00	61,000	High A
Bill Gunn	110.00	6,947	High A
Borumba	135.01	45,952	High A
Bromelton	44.50	8,210	High C
Cedar Pocket	100.90	730	High C
Clarendon	96.00	24,276	High A
Cooloolabin	295.91	13,800	High A
Enoggera	74.37	4,567	Extreme
Ewen Maddock	25.30	16,587	Extreme
Gold Creek	92.75	801	High A
Lake Macdonald	95.33	8,018	High A
Lake Manchester	51.90	26,217	Extreme
Little Nerang	168.02	6,705	High C
Maroon	207.14	44,319	High A
Moogerah	154.91	83,765	High A
Nindooinbah	122.80	322	High C
Poona	152.70	655	High C
Sideling Creek	20.42	14,370	Extreme
Wappa	44.81	4,694	High A

Although both Hinze Dam and Wyaralong Dam are uncontrolled spillway dams currently owned by Seqwater, neither dam is considered in this report because both of these dams were managed or owned by agencies other than Seqwater during January 2011.

In relation to the floods of January 2011 and the performance of Seqwater's dams, this report considers:

- Seqwater's Flood Preparation for the 2010/11 Wet Season.
- Seqwater's Flood Event Procedures.
- Seqwater's Flood Modelling Systems.
- The performance of Seqwater's Emergency Management System.
- The performance of Seqwater's Dam Safety Management Program.
- An assessment of Flood Event Magnitude.
- Dam Inflow and Outflow Details.
- Flood Event Communications.

The report also contains recommendations for system and procedural improvements for the 2011/12 wet season.

2 FLOOD PREPARATION FOR THE 2010/11 WET SEASON

The failure of any one of Seqwater's dams can have significant consequences ranging from loss of life or injury, to economic loss and damage to property and the environment, to loss of critical water supplies.

Seqwater must be prepared for flood events at any time. Accordingly, Seqwater carries out a comprehensive Dam Safety Management Program which seeks to ensure that each of its dams is operated and maintained in a manner that is both safe and minimises the risks associated with a dam failure. The Dam Safety Management Program is central to Seqwater's preparation for flood events and it applies to all of Seqwater's dams, including Wivenhoe, Somerset and North Pine.

Seqwater's Dam Safety Management Program matches or exceeds equivalent programs operating throughout the world.

A copy of Seqwater's Dam Safety Management Program is Appendix C to this report and further comments are provided on the plan in Section 6.

In terms of flood preparation, the Dam Safety Management Program involves three key elements:

- systematic inspections and surveillance in accordance with Queensland Dam Safety Management Guidelines and the ANCOLD Guidelines on Dam Safety Management;
- emergency action planning;
- operational preparations, including clear flood procedures and training of personnel.

These elements are discussed in more detail below.

2.1 Dam Safety and Surveillance

Annual Inspections

Prior to January 2011, Seqwater had completed Annual or Comprehensive Inspections of all its dams to ensure that the dams were structurally sound and able to withstand the impacts of large floods. These inspections are conducted by a Registered Professional Civil Engineer in accordance with the Queensland Dam Safety Management Guidelines and the ANCOLD Guidelines on Dam Safety Management. In general, the inspections concluded that Seqwater was maintaining its dams in an excellent manner and that the dams were in a state of readiness should major flood events be experienced.

Regular Structural Inspections

In addition to the Annual and Comprehensive Inspections, Seqwater staff undertake regular structural inspections of all Seqwater dams in accordance with the recommendations

contained in the ANCOLD Guidelines for the Management of Large Dams. This is considered best practice for the management of large dams in Australia. This relates to both routine visual inspection of the dams and also the gathering and analysis of data from dam safety instrumentation installed at the dams.

Regular structural inspections of dams allow identification and reporting of dam safety deficiencies by visual observation. These inspections are undertaken by the staff responsible for day to day operations at the dams as part of their duties at the dam. Frequency of inspection is dependent on dam hazard category and is undertaken in accordance with ANCOLD guidelines. Examination of all routine structural inspection records leading up to the 2010/11 wet season and the January 2011 floods has shown no identified deficiencies with the potential to impact on the structural ability of Seqwater's dams to safely withstand large floods.

In addition to regular structural inspections, Dam Safety Instrumentation is used to further assess the structural performance of a dam. This instrumentation monitors a range of dam safety parameters that vary from storage to storage but can include rainfall, storage level, seepage, pore pressure, surface movement, internal movement and post tensioning. Frequency of data gathering is dependent on dam hazard category and is undertaken in accordance with ANCOLD guidelines.

Examination of all instrumentation results leading up to the 2010/11 wet season and the January 2011 floods has shown no identified deficiencies with the potential to impact on the structural ability of Seqwater's dams to safely withstand large floods.

2.2 Emergency Action Planning

Seqwater has well developed comprehensive systems for emergency management. These systems are described in Section 5 of this report and the value and success of these systems can be demonstrated by Seqwater's ability to provide continuity of water supplies to the communities of South East Queensland throughout the January 2011 floods. The adverse conditions impacting on the region's water supplies during this period were the worst ever experienced and Seqwater's ability to provide water supply continuity throughout this period is testament to its excellent emergency management systems and processes and the dedication of its staff.

In addition to the emergency management systems as described in Section 5 of this report, Seqwater has developed specific emergency managements systems for flooding at its dams. In accordance with these systems, each year Seqwater undertakes specific emergency action planning activities in relation to flooding and the operation of its dams. The basis of this system is the Emergency Action Plans developed for each of its 26 dams. Copies of the Emergency Action Plans for each of the 20 dams examined in this report are contained in Appendix A.

The Emergency Action Plans recognise the agencies and personnel who have emergency action responsibilities associated with flooding at Seqwater's dams and this is summarised for flood event emergencies in the following table:

AGENCIES AND PERSONNEL	RESPONSIBILITIES
Seqwater	• Undertake emergency response at the dam for the duration of the flood emergency. • Provides Disaster Response Agencies with actual and projected dam outflow information if such information is required.
Director Dam Safety (DERM)	• Provides regulatory input during a flood emergency impacting on a Seqwater dam.
Regional or City Council	• Exercises primary responsibility for disaster response and management within its boundaries, in accordance with the Queensland Disaster Management Act 2003. • Deploys all appropriate resources to contribute to response and recovery during flood emergency, until its resources are fully committed. • Mobilises disaster response assistance from other relevant Disaster Response Agencies, as appropriate during the flood emergency.

Every year, before the commencement of each wet season, Seqwater undertakes the following specific emergency action planning activities in relation to flooding and the operation of its dams.

- Contacts all emergency response agencies listed in the Emergency Action Plans for the dams to confirm contact details and arrangements for the upcoming wet season.
- Meets with all City and Regional Councils whose areas are impacted from flood outflows from Seqwater's dams to discuss the contents of the Emergency Action Plans, confirm responsibility arrangements and ensure that all available relevant information is contained in the Plans.
- Undertakes a detailed review of each Emergency Action Plan and updates each Plan as necessary.
- Issues each Emergency Action Plan as controlled documents in both hardcopy and softcopy formats to all City and Regional Councils whose areas are impacted from flood outflows from Seqwater a dam, the State Disaster Coordination Centre and DERM.

These activities were all completed in preparation for the 2010/11 wet season and the floods that occurred in January 2011.

2.3 Operational Preparations

The 20 uncontrolled spillway dams considered in this report generally contain earth and rockfill structures that cannot withstand overtopping without damage or risk of failure. The exceptions to this are Little Nerang Dam and Moogerah Dam that can withstand some limited overtopping without risk. The structural safety of the dams is paramount as failure of a dam could have catastrophic consequences due to the magnitude of the flood damage which could be caused downstream. Accordingly Seqwater ensures that all dam spillways are kept clear, well

maintained and ready for flood outflows at all times. The frequency of spillway inspection is dependent on the dam hazard category and is undertaken in accordance with ANCOLD guidelines as shown in the following table.

HAZARD CATEGORY	INSPECTION FREQUENCY
Extreme	Daily
High	Daily to Tri Weekly
Significant	Twice Weekly to Weekly

Seqwater gives urgent priority to any maintenance associated with spillway clearing and all of Seqwater's dam spillways were generally maintained in excellent condition in preparation for the 2010/11 wet season and the January 2011 flood events.

In addition to ensuring that all dams and dam spillways are always well maintained in a state of readiness for a large flood event, Seqwater maintains the following arrangements and infrastructure in place at all times at each of its dams in accordance with the requirements of the Flood Procedure Manual:

- Emergency action planning training and dam safety and surveillance training is provided to Dam Operators on an annual basis.
- A competent Dam Operator trained in emergency action planning and dam safety and surveillance is on close call and ready to attend a dam within 2 hours if required on a 24/7 basis.
- Current copies of the following documents are available for each dam:
    - Emergency Action Plan.
    - Standing Operating Procedures.
    - Operation and Maintenance Manuals.
- The following facilities are available to Dam Operators attending site in a flood event:
    - Suitable facilities to allow Dam Operators to remain at a dam for extended periods as required.
    - Mobile telephone and email communication systems.
- All preventive maintenance work is kept up to date at each dam in accordance with the Operation and Maintenance Manuals for each dam.

These arrangements were in place for all Seqwater dams in preparation for the 2010/11 wet season. In addition to these arrangements, the following preparation arrangements are in place at all times.

- All dams comply with dam safety guidelines.
- A close working relationship is maintained with the Queensland Dam Safety Regulator. This involves the Dam Safety Regulator attending a Seqwater Board meeting at least once per year.
- Senior staff provide internal briefing to Executive Management and the Seqwater Board on flood preparation and Dam Safety at least once per year.

3 FLOOD EVENT PROCEDURES

Given their potential significant impact on downstream populations, it is imperative that Seqwater's dams are operated during flood events in accordance with clearly defined procedures to minimise impacts to life and property. Accordingly, Seqwater has developed a Flood Procedure Manual that describes the responsibilities of Seqwater personnel for flood event preparation, mobilisation and operation, in relation to Seqwater's dams. This manual is maintained as a controlled document and is distributed to all key personnel within Seqwater with flood management responsibilities at Seqwater dams, as well as DERM.

For the controlled spillway dams, the Flood Procedure Manual refers to Flood Mitigation Manuals that contain operating principles under which decisions relating to the release of water from these dams during flood events are made. The uncontrolled spillway dams do not have associated Flood Mitigation Manuals as it is not possible to in any way influence flood releases from these dams during flood events.

As described in the Flood Procedure Manual, in preparation for a flood event that impacts Seqwater's uncontrolled spillway dams, Seqwater has developed hydrologic models that enable predictions to be made of peak dam outflows for each dam. The predictions can be based on both the rainfall recorded in the dam catchments as well as forecast rainfall. The models can be run in real time against a broad range of operational scenarios and are useful as an emergency action planning tool. The model results are provided to impacted Local Authorities on request. Seqwater has operational models in place for all uncontrolled spillway dams in preparation for the 2010/11 wet season and the floods that occurred in January 2011. Results from the models for the January 2011 floods are contained in Section 7 of this report.

In addition to the hydrologic models, through the Flood Procedure Manual, Seqwater has assigned specific responsibilities to key personal for flood preparation at Seqwater's uncontrolled spillway dams. A summary of these responsibilities is set out below.

Seqwater has three Operations Coordinators for its dams that control regional areas in the north, south and central area catchments of Seqwater's area of responsibility in South East Queensland. The responsibilities for the management of dams and river basins for these three Operations Coordinators are summarised in the following table:

Operations Coordinator	Basin	Dams in Basin
North Area	Mary River	Cedar Pocket Dam Borumba Dam
	Sunshine Coast	Lake Macdonald Baroon Pocket Cooloolabin Dam Poona Dam Wappa Dam Ewen Maddock Dam
	Pine Rivers	North Pine Dam Sideling Creek Dam
Central Area	Brisbane (excluding Bremer)	Somerset Dam Wivenhoe Dam Atkinson Dam Bill Gunn Dam Clarendon Dam Enoggera Dam Gold Creek Dam Lake Manchester Dam
South Area	Bremer	Moogerah Dam
	Tingalpa Creek	Leslie Harrison Dam
	Logan-Albert Rivers	Bromelton Maroon Dam Nindooinbah Dam Wyaralong Dam
	Nerang River	Little Nerang Dam Hinze Dam

Operations Coordinators are responsible for ensuring the following in relation to flood preparation for Seqwater's uncontrolled spillway dams:

- Dam Operators trained in emergency action planning and dam safety and surveillance are on close call and ready to attend all dams within 2 hours of being required on a 24/7 basis.
- Current copies of the following documents are available for each dam:
  - Emergency Action Plan.
  - Standing Operating Procedures.
  - Operation and Maintenance Manuals.
- The following facilities are available to Dam Operators attending site in a flood event:
  - Suitable facilities to allow Dam Operators to remain at a dam for extended periods as required.
  - Mobile telephone and email communication systems.
- All preventive maintenance work is kept up to date at each dam in accordance with the Operation and Maintenance Manuals for each dam.

- Dam spillways are maintained in a constant state of operational readiness for Flood Events.
- Seqwater's Principal Engineer (Dam Safety) is advised of any issue that has the potential to adversely impact on flood operations at an uncontrolled spillway dams.
- During flood events, dams are monitored in accordance with instructions from the Principal Engineer Dam Safety and Principal Hydrologist and suitable staffing arrangements are in place to undertake any monitoring duties.

If called to undertake duties during a flood, the Dam Operators are responsible for the following:

- Ensuring all notifications specified in the Flood Manuals and Emergency Action Plans are made.
- Conducting handovers that provide the following information to incoming officers:
    - Reservoir storage elevations at each dam.
    - Status of the communication systems.
    - Any areas of concern associated with the management of the Flood Event.
- Advising the Operations Coordinator of any emerging issue that has the potential to adversely impact on dam safety during the Flood Event.
- Undertake water level monitoring in accordance with the following table:

DAM	SPILLWAY LEVEL (m AHD)	STORAGE LEVEL FOR DAILY MANUAL WATER LEVEL RECORDING (m AHD)	STORAGE LEVEL FOR TWICE DAILY MANUAL WATER LEVEL RECORDING (m AHD)	STORAGE LEVEL FOR SIX TIMES DAILY MANUAL WATER LEVEL RECORDING (m AHD)
Atkinson Dam	65.72	*	65.72	*
Baroon Pocket Dam	217.00	217.00	218.50	219.50
Bill Gunn Dam	110.00	*	110.00	*
Borumba Dam	135.01	135.01	138.00	139.00
Bromelton	80.00	*	80.00	*
Cedar Pocket	100.93	100.93	102.00	*
Clarendon Dam	96.00	*	96.00	*
Cooloolabin	295.91	295.91	296.30	296.50
Enoggera	74.37	74.37	78.00	80.00
Ewen Maddock	25.30	25.30	26.40	26.60
Gold Creek	92.75	92.75	96.60	97.40
Lake Macdonald	95.32	95.32	96.20	96.50
Lake Manchester	51.09	51.09	52.10	52.60
Little Nerang	168.02	168.02	170.00	*
Nindooinbah	122.80	*	122.80	*
Maroon Dam	207.14	207.14	208.90	209.30
Moogerah Dam	154.91	154.91	155.90	156.90
Poona Dam	152.70	152.70	152.90	*
Sideling Creek Dam	20.42	20.42	20.80	21.20
Wappa Dam	44.81	44.81	46.00	46.90

During the Floods of January 2011, all of the Operations Coordinators and Dam Operators undertook their duties in a most successful manner in relation to the uncontrolled spillway dams, in accordance with their responsibilities as defined above and in the Flood Procedure Manual.

4 FLOOD MODELLING SYSTEMS

4.1 Rainfall and Stream Height Data Collection

A real-time flood monitoring and forecasting system has been established to monitor rainfall and water levels in the catchments of Seqwater's dams that are spread throughout South East Queensland. The system aims to provide adequate, accurate and timely information to allow inflow and outflow predictions for the dams to be made in real time.

Field stations consisting of rainfall and water level gauges use the Event Reporting Radio Telemetry System (ERRTS) to communicate data to Seqwater's Flood Operations Centre. More than one gauge may be located at an individual field station. Water level gauges are often located at DERM gauging stations. In these instances, DERM is responsible for maintaining the water level gauges and Seqwater for maintaining the ERRTS equipment.

Rainfall gauges consist of a standard tipping bucket. Water level gauges vary in type and model but include shaft encoders, wet pressure transducers and dry pressure transducers. At a rainfall gauge, an event is defined as the tip of the bucket. At a water level rainfall gauge, an event is defined as an incremental increase or decrease in water level. When an event is triggered at a gauge, data is transmitted via VHF radio through a series of redundant radio repeaters to the Flood Operations Centre and other data collection centres including BoM and the majority of the Local Authorities.

Each signal has a unique identification number. When the signal arrives at the Flood Operations Centre base station, it is relayed to a computer hardware platform serial port via a decoder. It is then time stamped, read, decoded, accepted or rejected, filtered, validated and then stored in a gauge database in the Centre's Enviromon database. Redundant base stations at Mineral House and the Land Centre in Brisbane's CBD are synchronised with the Flood Operations Centre database.

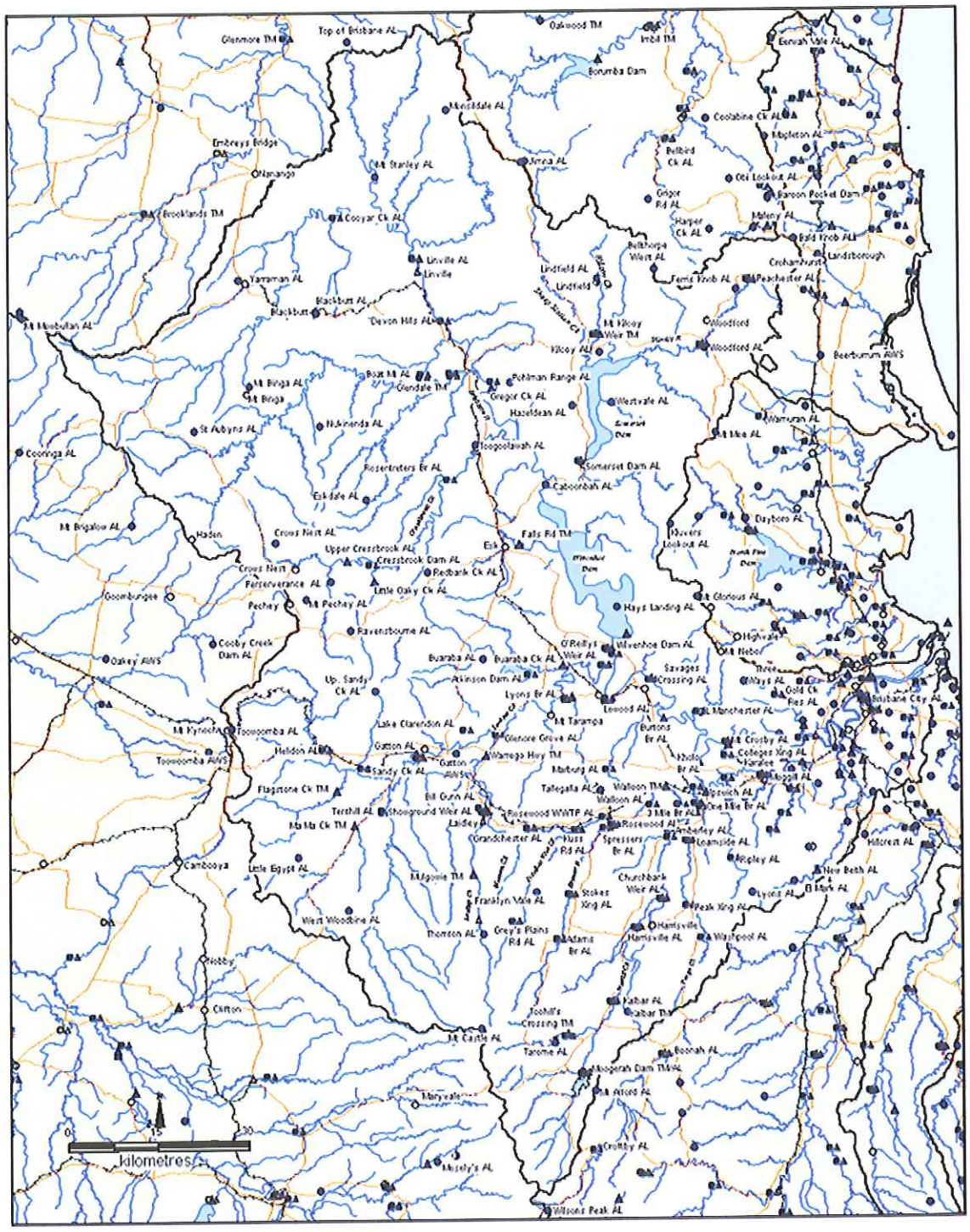
The Enviromon database contains gauge details including:

- Gauge name;
- ALERT number;
- Type of gauge;
- Calibration information;
- Alarm thresholds.

Enviromon allows filtered gauge data to be viewed in either a text or graphical format.

The combination of ERRTS field stations, rainfall gauges and water level gauges, radio network and data collection software is referred to as an ALERT system. ALERT, or Automated Local Evaluation in Real Time System, has become a standard for flood warning systems in Australia and the United States of America, and is widely used by the Bureau of Meteorology (BoM) and most other major flood warning agencies throughout the world.

Enviromon collects data from 225 rain gauges and nearly 200 water level gauges throughout South East Queensland. Locations of these 425 rainfall and stream height stations are shown in the diagram below.



At all critical locations, more than one gauge is located on an individual station site. This allows for the expected periodic non-operation of individual gauges that occurs due to the gauge (by necessity) being located in an exposed and harsh field environment. Accordingly, due to this in-built network redundancy, the presence of occasional non-operational gauges does not impact data quality.

4.2 Hydrologic Models

For its uncontrolled spillway dams, Seqwater uses an URBS modelling system to process rainfall data and to estimate stream flow hydrographs. This system is also used by BoM for flood forecasting throughout Australia. The system contains a number of individual catchment models to provide coverage over the area of South East Queensland containing Seqwater's dams. The following table summarises the details of these catchment models.

BASIN/REGION	RIVER/STREAM	SUB-BASIN URBS MODEL	DAM INCLUDED IN SUB-BASIN MODEL
Pine Rivers	North Pine River	North Pine River to North Pine Dam	North Pine Dam
Pine Rivers	Sideling Creek	Sideling Creek	Sideling Creek Dam
Pine Rivers	South Pine & North Pine River	Lower Pine Rivers (including South Pine)	-
Brisbane (Creeks)	Enoggera Creek	Enoggera Creek to Enoggera Dam	Enoggera Dam
Brisbane (Creeks)	Gold Creek	Gold Creek to Gold Creek Dam	Gold Creek Dam
Brisbane (Creeks)	Cabbage Tree Creek	Cabbage Tree Ck to Lake Manchester	Lake Manchester Dam
Caboolture River	Caboolture River	Caboolture River to End of System	-
Logan-Albert Rivers	Logan River	Upper Logan River to Round Mountain	Maroon Dam
Logan-Albert Rivers	Logan River	Teviot Brook to The Overflow	-
Logan-Albert Rivers	Albert River	Albert River	-
Logan-Albert Rivers	Logan River	Lower Logan River to end of system	-
Mary River	Deep Creek	Deep Creek to Cedar Pocket Dam	Cedar Pocket Dam
Mary River	Yabba Creek	Yabba Creek to Borumba Dam	Borumba Dam
Mary River	Mary River	Upper Mary River to Gympie	Borumba Dam
Nerang River	Nerang River	Nerang River to Clearview	Little Nerang Dam Hinze Dam
Sunshine Coast	Six Mile Creek	Six Mile Creek to Lake MacDonald	Lake Macdonald

BASIN/REGION	RIVER/STREAM	SUB-BASIN URBS MODEL	DAM INCLUDED IN SUB-BASIN MODEL
Sunshine Coast	Obi Obi Creek	Obi Obi Creek to Baroon Pocket Dam	Baroon Pocket
Sunshine Coast	South Maroochy River	South Maroochy River to Yandina	Cooloolabin Dam Poona Dam Wappa Dam
Sunshine Coast	Addlington Creek	Addlington Creek to Ewen Maddock Dam	Ewen Maddock Dam
Tingalpa Creek	Tingalpa Creek	Tingalpa Creek to Leslie Harrison Dam	Leslie Harrison Dam
Brisbane	Stanley River	Stanley River to Somerset Dam	Somerset Dam
Brisbane	Upper Brisbane River	Upper Brisbane River to Wivenhoe Dam	Wivenhoe Dam Perseverance Dam Cressbrook Dam
Brisbane	Lockyer Creek	Lockyer Creek to O'Reillys Weir	-
Brisbane	Bremer River	Bremer River to Walloon	-
Brisbane	Warrill Creek	Warrill Creek to Amberley	Moogerah Dam
Brisbane	Purga Creek	Purga Creek to Loamside	-
Brisbane	Lower Brisbane River	Lower Brisbane River to Brisbane Bar	Lake Manchester Dam

These catchment models run at discrete times selected by the Flood Engineers based on how rainfall is occurring in the dam catchments. Output from URBS models changes as rainfall occurs and forecasts change and the Flood Engineers generally select model run times with this in mind. The output from this URBS modelling is provided to emergency response agencies on request.

URBS catchment models are not available for Atkinson, Bromelton, Bill Gunn, Clarendon and Nindooinbah Dams. This is because these dams are off-stream storages and have very small natural catchment areas. Accordingly outflows from these dams are not a significant contribution to downstream flooding. This was certainly the case in January 2011.

The URBS models use runoff-routing to estimate the surface runoff from rainfall within a catchment area. This process uses concentrated storages distributed over a geographical area, which have a non-linear storage-discharge relationship. Runoff-routing processes are calibrated using historical flood events and all models have been operationally tested and verified. During the January 2011 floods, Seqwater's URBS models performed well and outputs from these models for Seqwater's uncontrolled spillway dams are summarised in Section 7 of this report.

5 EMERGENCY MANAGEMENT SYSTEMS

Seqwater has developed a comprehensive emergency management and response system that includes a formal Emergency Response Plan. During the January 2011 floods, Seqwater's Emergency Response Plan was activated for the purposes of managing the impacts of floods on Seqwater's responsibility for managing, storing and treating urban water supplies for the communities of South East Queensland.

An integral part of this plan is that:

- The Plan is reviewed annually and at the time of the recent flood event was current and approved by the Water Grid Manager.
- Employee training and scenario planning is prescribed to be undertaken annually for which the last full scale grid wide training exercise was undertaken in March 2010 prior to the flood event.
- The Emergency Response Plan is aligned with the Grid Emergency Response Plan to ensure consistency and integration of emergency management procedures.

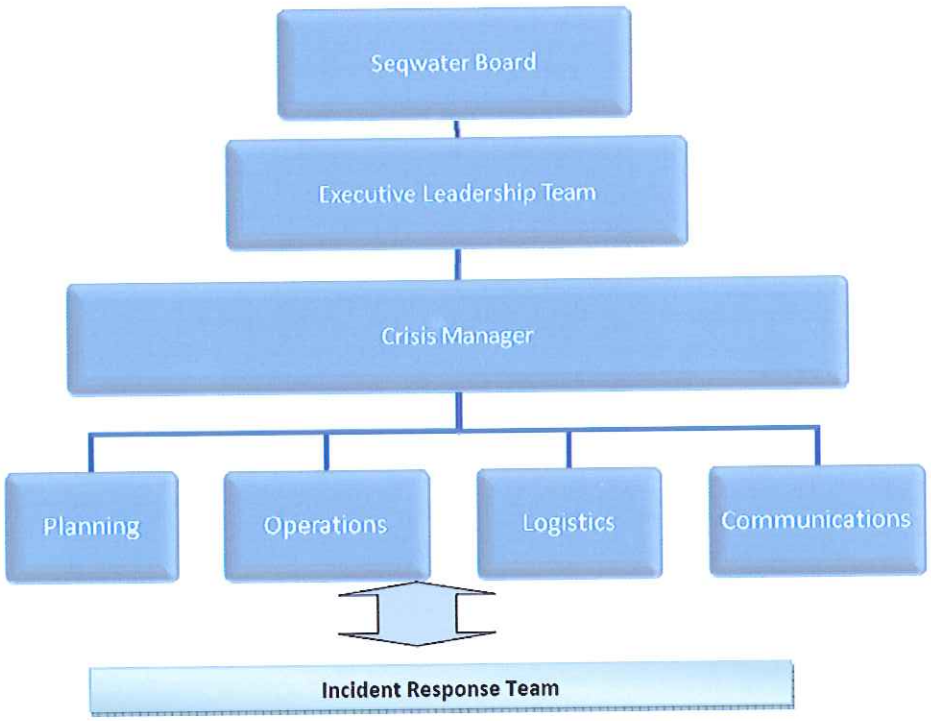
Seqwater's Emergency Response Plan defines an emergency as an incident that impacts on water quality, water supply reliability and/or public reassurance, and has an overall severity rating of Level 3, 4 or 5 under the severity classification approach outlined in the table below.

Severity Level	General Principle	Example of Event
Level 1 – Insignificant	• Little disruption to normal operating events	• Minor storm damage to asset. • Minor spike in discharge concentrations.
Level 2 – Minor	• Incident can be dealt with by the resources of the Grid Participant	• Storm causes minor interruptions due to loss of power supply. • Short-term adverse media at a local level.
Alert	• Classification for incidents with a possible severity of 3-5 where the consequences have not yet occurred.	• Natural disasters, such as cyclone, flood, fire that is forecast or in progress and likely to cause an impact, though this has not yet happened.
Level 3 –Moderate	• Minor impact for a large population. • Major impact for a small population.	• Unplanned halt to production by water treatment plant for longer than 24 hours, resulting in failure to meet Grid Contract obligations and interruption to customer supply to a small population for less than 8 hours.
Level 4 – Major	• Single or multiple regions affected. Multiple Grid Participants and the Grid Manager with State Government departments involved.	• Localised natural disaster or security event.
Level 5 – Catastrophe	• Large-scale impact across South-East Queensland, other utilities affected. Requires Government intervention at State and Federal levels to manage the incident.	• Dam wall breach.

Seqwater utilises a team based approach to manage and respond to alerts and incidents as they occur. For higher level incidents, an Executive Management Crisis Team is formed and oversees the response process.

Seqwater has adopted a structure that provides clear delegation of responsibility for the management of all incidents to ensure that all management and information functions,

including incident control, operations, planning and logistics, are appropriately performed. This approach also provides for the command and coordination of multi-agency incidents should they occur. The structure of this team based approach to incident response is shown in the following diagram:



Seqwater Incident Response - Communications Flow Chart.

An Executive General Manager or appropriate Senior Manager is appointed as the Incident Manager within the Incident Response Team. If the incident is defined as Level 4 or above, the Incident manager must be a General Manager. Members of the Incident Response Team are selected by the Incident Manager to ensure that appropriate and adequate expertise is available to properly respond to the incident. The Chief Executive Officer and Executive General Managers of Seqwater are advised of all incidents and incident alerts as they are declared and provide input and advice when and as required.

5.1 Performance of Emergency Management System in January 2011 Floods

Overall, the performance of Seqwater's Emergency Management System in the January 2011 Floods can be described as excellent. Significant highlights of Seqwater's performance using the support provided by this system are as follows:

- Impacts of the flood events on Seqwater's portfolio of major dams and water treatment plant assets were monitored and managed in an efficient and proactive manner, in accordance with the applicable emergency response plans.

- Seqwater maintained continuity of drinking water supplies to the communities of South East Queensland throughout January 2011 despite the very significant impacts of the floods.
- Throughout and following the January 2011 Floods, the vast majority of South East Queensland was not subjected to water restrictions or boiled water notices. The only exceptions were limited areas serviced by Atkinson Dam and Lowood Water Treatment Plants.
- The maintenance of drinking water supply via the Grid by Seqwater, in collaboration with other Grid Participants, was achieved notwithstanding intermittent power outages, limited access, poor raw water quality and damage to physical infrastructure associated with Seqwater's water treatment facilities.
- To achieve this continuity of supply, Seqwater teams were airlifted to locations where access had been cut and water treatment facilities inundated to complete restoration works and reinstate treatment operations. Seqwater developed contingency supply arrangements in conjunction with other Grid Participants to ensure supply was maintained during periods when ordinary water treatment operations had been interrupted, including at the Mount Crosby WTPs which are essential to the Grid's ability to provide drinking water to customers.

Seqwater's performance in the January 2011 floods is testament to the careful preparation and planning undertaken by Seqwater in the lead up to the 2010/11 wet season. Without such plans and preparations in place, the excellent result in providing drinking water supply continuity could not have been achieved.

6 DAM SAFETY MANAGEMENT PROGRAM

Potential hazards that impact on the safety of Seqwater's dams include:

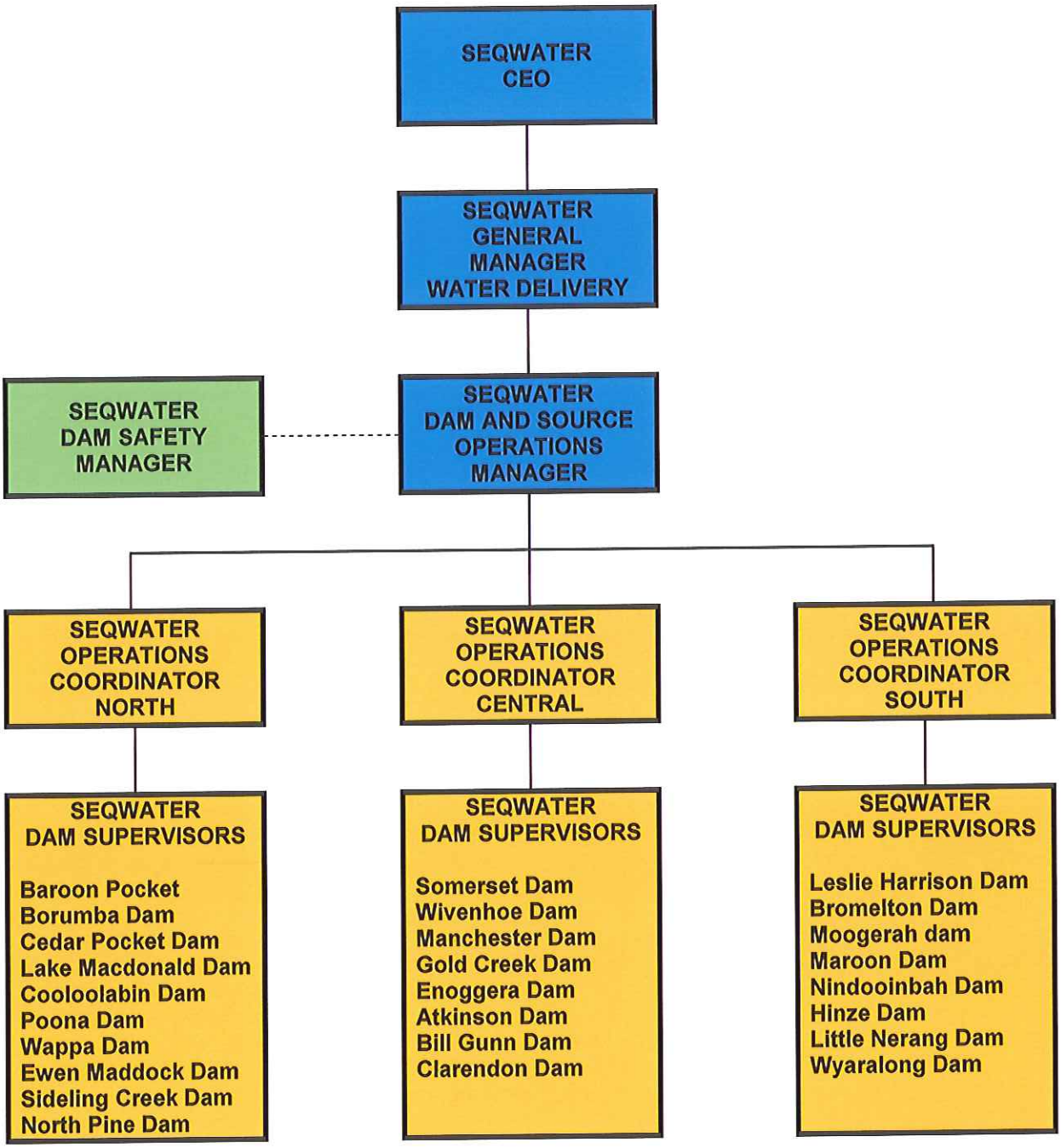
- Flood;
- Earthquake;
- Potential design or construction flaws currently unknown;
- Deterioration of dam infrastructure over time;
- Interference with dam infrastructure by an external influence.

Seqwater is committed to dam safety, and as explained above, carries out a Comprehensive Dam Safety Management Program which provides for staff training, dam safety documentation, dam surveillance and inspection, dam safety review and dam operations and maintenance.

Seqwater is committed to ensuring the continued safe operation of its dams, by managing its dams in accordance with the Queensland Dam Safety Management Guidelines and the ANCOLD Guidelines on Dam Safety Management.

Seqwater contains a dedicated Dam Safety Team that is responsible for the overall management of Seqwater's Dam Safety Management Program. The Dam Safety Team is located within the Water Delivery Group of Seqwater, one of four Groups under the organisations Chief Executive Officer.

Day to day operations and maintenance of the dams is the responsibility of Operations Coordinators also located within the Water Delivery Business Unit of Seqwater. There are three Operations Coordinators, each having a defined geographic region of responsibility. There is a distinct management separation between the Dam Safety Team and the Operations Coordinators. This ensures an independence of accountability in managing the program. This organisational structure is summarised in the following diagram.


SEQWATER CEO
SEQWATER GENERAL MANAGER WATER DELIVERY
SEQWATER DAM SAFETY MANAGER
SEQWATER DAM AND SOURCE OPERATIONS MANAGER
SEQWATER OPERATIONS COORDINATOR NORTH
SEQWATER OPERATIONS COORDINATOR CENTRAL
SEQWATER OPERATIONS COORDINATOR SOUTH
SEQWATER DAM SUPERVISORS
Baroon Pocket
Borumba Dam
Cedar Pocket Dam
Lake Macdonald Dam
Cooloolabin Dam
Poona Dam
Wappa Dam
Ewen Maddock Dam
Sideling Creek Dam
North Pine Dam
SEQWATER DAM SUPERVISORS
Somerset Dam
Wivenhoe Dam
Manchester Dam
Gold Creek Dam
Enoggera Dam
Atkinson Dam
Bill Gunn Dam
Clarendon Dam
SEQWATER DAM SUPERVISORS
Leslie Harrison Dam
Bromelton Dam
Moogerah dam
Maroon Dam
Nindooinbah Dam
Hinze Dam
Little Nerang Dam
Wyaralong Dam

Seqwater undertakes dam surveillance in accordance with the recommendations contained in the ANCOLD Guidelines for the Management of Large Dams. This is considered best practice for the management of large dams in Australia. This relates to both routine visual inspection of the dams and also the gathering and analysis of data from dam safety instrumentation installed at the dams.

Seqwater operates its dams in accordance with the Standing Operating Procedures developed for each dam and maintains its dams in accordance with the Operation and Maintenance Manuals developed for each dam. These procedures and manuals have generally been developed in accordance with the Queensland Dam Safety Management Guidelines and the ANCOLD Guidelines on Dam Safety Management and contain accepted best practice principles for dam safety management.

Renewals and refurbishment programs for the dams are generated from the Annual and Comprehensive Inspection Reports and the Dam Safety Reviews. There is also an opportunity for renewal and refurbishment projects considered necessary for dam safety reasons to be added to the program though the annual budget review process by Seqwater's Dam Safety Manager.

Seqwater makes annual funding allocations available for all renewal and refurbishment work required at the dams, to maintain the dams at a safety standard that is consistent with the recommendations of the Queensland Dam Safety Management Guidelines and the ANCOLD Guidelines on Dam Safety Management.

6.1 Uncontrolled Spillway Dams

As explained above, uncontrolled Spillway dams do not have associated Flood Mitigation Manuals as it is not possible to in any way influence flood releases from these dams during flood events. Seqwater's primary responsibility during such events is to monitor the safety of the dam and provide dam outflow information to the relevant emergency agencies as required. Such agencies will generally be the Bureau of Meteorology and the Local Authority responsible for the area impacted by the dam outflow.

Seqwater ensures that its dam spillways are kept clear and well maintained and ready for flood outflows at all times and that a Dam Supervisor is always available to monitor flood releases as required.

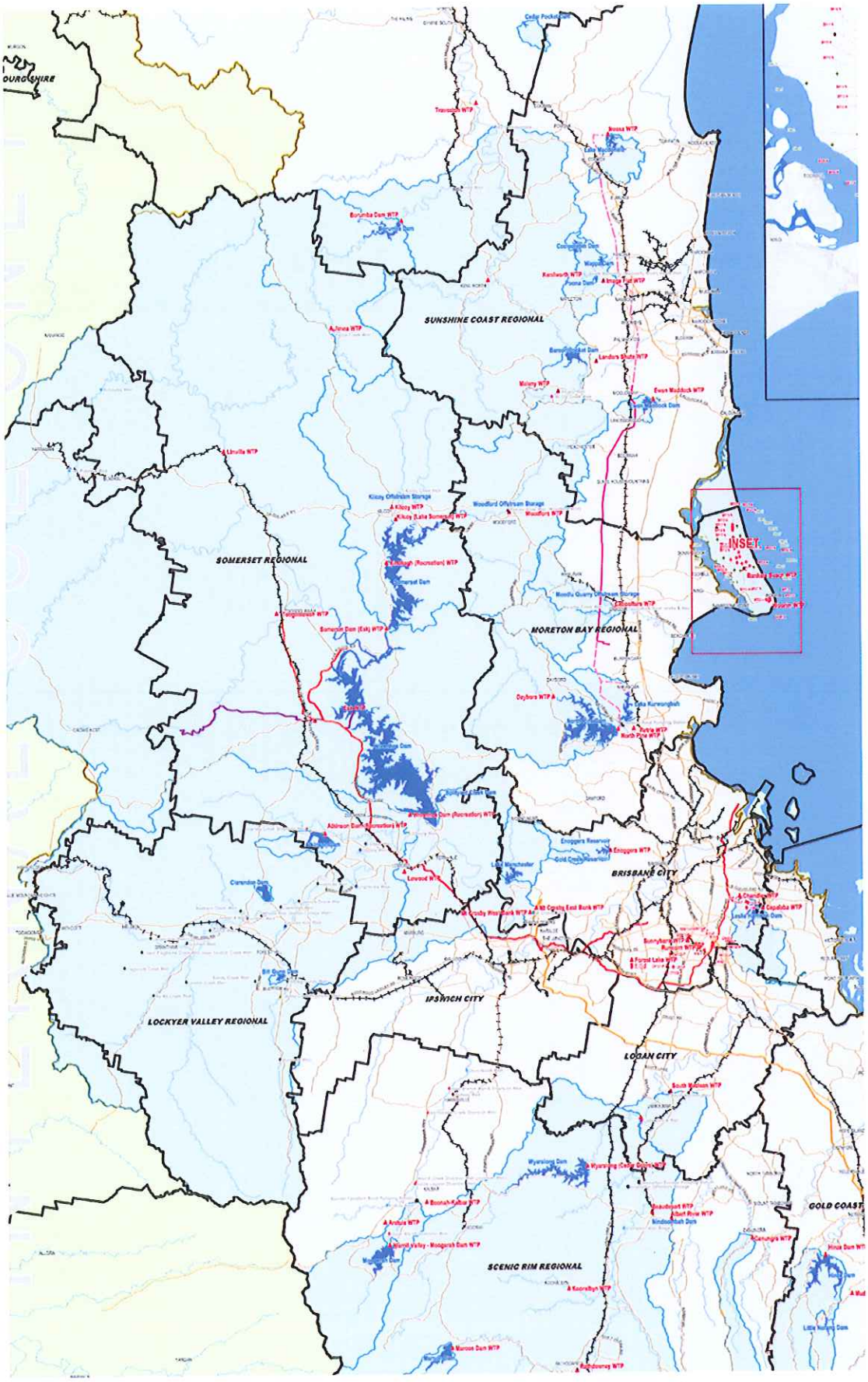
Seqwater has developed and maintains procedures that describe the responsibilities of Seqwater personnel for flood event preparation, mobilisation and operation, in relation to its uncontrolled spillway dams. During the January 2011 floods these procedures ensured that Seqwater's dams were in a suitable state of preparedness to withstand the impacts of major flooding without incident. No dam safety incidents were recorded at Seqwater's uncontrolled spillway dams during the January 2011 floods and the dams performed in an excellent manner over the duration of the floods. Certainly this is testament to the excellent planning and preparation work undertaken by Seqwater at its uncontrolled spillway dams prior to the 2010/11 wet season and the major floods of January 2011.

7 DAM INFLOW AND OUTFLOW DETAILS

7.1 List of Dams

The table below lists the uncontrolled spillway dams examined in this report and their FSL details. Following the table is a map detailing the locations of Seqwater's dams and water treatment plants across South East Queensland.

DAM	FULL SUPPLY VOLUME (ML)	FULL SUPPLY LEVEL (m AHD)
Atkinson Dam	30,488	65.72
Baroon Pocket Dam	61,000	217.00
Bill Gunn Dam	6,947	110.00
Borumba Dam	45,952	135.01
Bromelton Dam	8,600	44.50
Cedar Pocket Dam	730	101.07
Clarendon Dam	24,276	96.00
Cooloolabin Dam	13,800	296.00
Enoggera Dam	4,567	74.37
Ewen Maddock Dam	16,587	25.38
Gold Creek Dam	801	92.75
Lake Macdonald Dam	8,018	95.33
Lake Manchester Dam	26,409	50.90
Little Nerang Dam	6,705	168.02
Maroon Dam	44,319	207.14
Moogerah Dam	83,765	154.91
Nindooinbah Dam	322	122.80
Poona Dam	655	152.70
Sideling Creek Dam	14,370	20.42
Wappa Dam	4,694	44.81


SUNSHINE COAST REGIONAL
SOMERSET REGIONAL
MORETON BAY REGIONAL
INSET
BRISBANE CITY
IPSWICH CITY
LOCKYER VALLEY REGIONAL
LOGAN CITY
GOLD COAST
SCENIC RIM REGIONAL

7.2 Flood Event Magnitude

The table below contains a summary of the key flood data for the uncontrolled spillway dams examined in this report in relation to the January 2011 Flood Event, including an assessment of flood event magnitude at each dam.

Dam	Maximum Recorded Historical Level (m AHD)	Maximum Recorded Historical Level (Date)	Approximate Time of January 2011 Peak	January 2011 Peak Level (m AHD)	January 2011 Peak metres above FSL (m)	Estimated Event AEP 1 in Y	EAP Trigger Level (m AHD)	EAP Triggered (Yes/No)
Atkinson Dam	66.14	Jan 2011	11/01/2011 16:00	66.14*	0.42	5-10	65.70	Yes
Baroon Pocket Dam	220.2	Feb 1999	11/01/2011 15:00	219.64	2.64	20-50	217.00	Yes
Bill Gunn Dam	110.61	Jan 2011	11/01/2011 16:00	110.61	0.61	>2,000	110.00	Yes
Borumba Dam	140.98	Feb 1999	11/01/2011 05:00	138.25	3.24	5-10	135.01	Yes
Bromelton Dam	44.50	Jan 2008	13/01/2011 06:00	44.37	-0.13	-	44.65	No
Cedar Pocket Dam	102.63	Feb 1999	09/01/2011 23:00	102.17	1.10	5-10	100.93	Yes
Clarendon Dam	<96.0	N/A	19/01/2011 21:00	94.65	-1.35	-	96.00	No
Cooloolabin Dam	296.41	Jan 2011	09/01/2011 19:00	296.41	0.41	20-50	296.00	Yes
Enoggera Dam	78.05	May 1996	11/01/2011 16:00	77.80	3.43	10-50	75.00	Yes
Ewen Maddock Dam	N/A	N/A	11/01/2011 17:00	26.60	1.22	50	25.50	Yes
Gold Creek Dam	96.46	Jan 2011	11/01/2011 14:00	96.46	3.71	10-50	95.75	Yes
Lake Macdonald Dam	96.84	Jun 2008	20/01/2011 13:00	95.62	0.29	20	95.38	Yes
Lake Manchester Dam	53.13	Jan 2011	11/01/2011 15:00	53.13	2.23	100	50.90	Yes
Little Nerang Dam	169.93	Feb 2001	11/01/2011 07:00	168.88	0.86	-	169.00	No
Maroon Dam	206.14	Nov 1999	12/01/2011 05:00	209.95	2.81	10	207.14	Yes
Moogerah Dam	158.14	Jan 1974	11/01/2011 19:00	157.60	2.69	20-50	154.91	Yes
Nindooinbah	N/A	N/A	11/01/2011 19:00	122.90*	0.01	-	123.00	No
Poona Dam	153.00	1983	09/01/2011 15:00	152.94	0.24	50	152.70	Yes
Sideling Creek Dam	21.64	1986	11/01/2011 14:00	21.34	0.92	50	21.00	Yes
Wappa Dam	46.80	1983	09/01/2011 15:00	46.00*	1.19	10	44.80	Yes

*Estimated Value

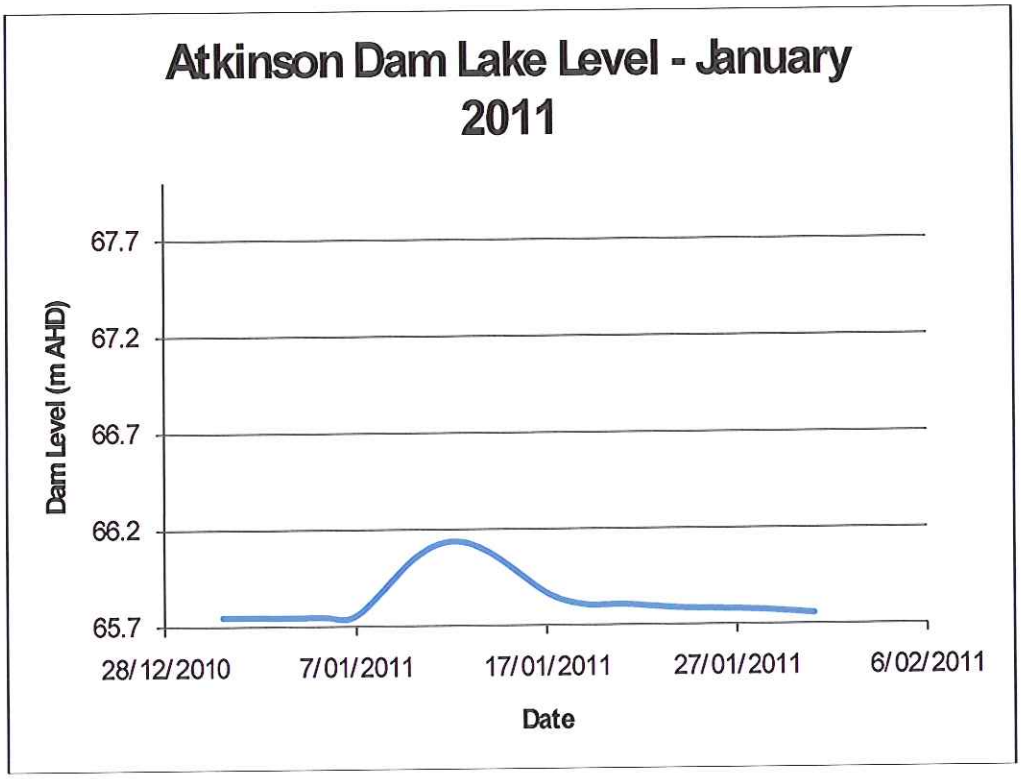
The following sections contain details of the flood levels and URBS model results for each of the dams in the above table where the EAP was triggered. For the remaining dams, the floods of January 2011 were not significant events and the outflows from the dams did not significantly contribute to downstream flooding in January 2011.

7.3 Atkinson Dam

Atkinson Dam has been owned by Seqwater since 1 July 2008. It is part of the Lower Lockyer Irrigation Project and is an offstream storage formed by the construction of an embankment across the outlet of Atkinson's Lagoon. Water for the storage is obtained mainly by diverting runoff from the nearby catchments of Buaraba Creek, Seven Mile Lagoon and Lake Clarendon.

The dam is a modified homogeneous earthfill embankment comprising of earthfill that is protected by filter and rip-rap on the upstream and miscellaneous material on the downstream side. The embankment has a maximum height of 12 metres above stream bed and a crest length of approximately 2.1 kilometres. The as built dam crest level is at EL 68.6 metres AHD and full supply level is at 65.72 metres. The dam spillway has a 69.47 meter long ogee type reinforced concrete crest. The crest is at EL 65.72 metres AHD.

An URBS catchment model is not available for Atkinson Dam. This is because Atkinson Dam is an off-stream storage with a very small natural catchment area. Accordingly outflows from Atkinson Dam are generally not a significant contribution to downstream flooding. This was certainly the case in January 2011, with the peak outflow from the Dam being less than $20m^3/s$. The lake level of Atkinson Dam during January 2011 is shown in the graph below.



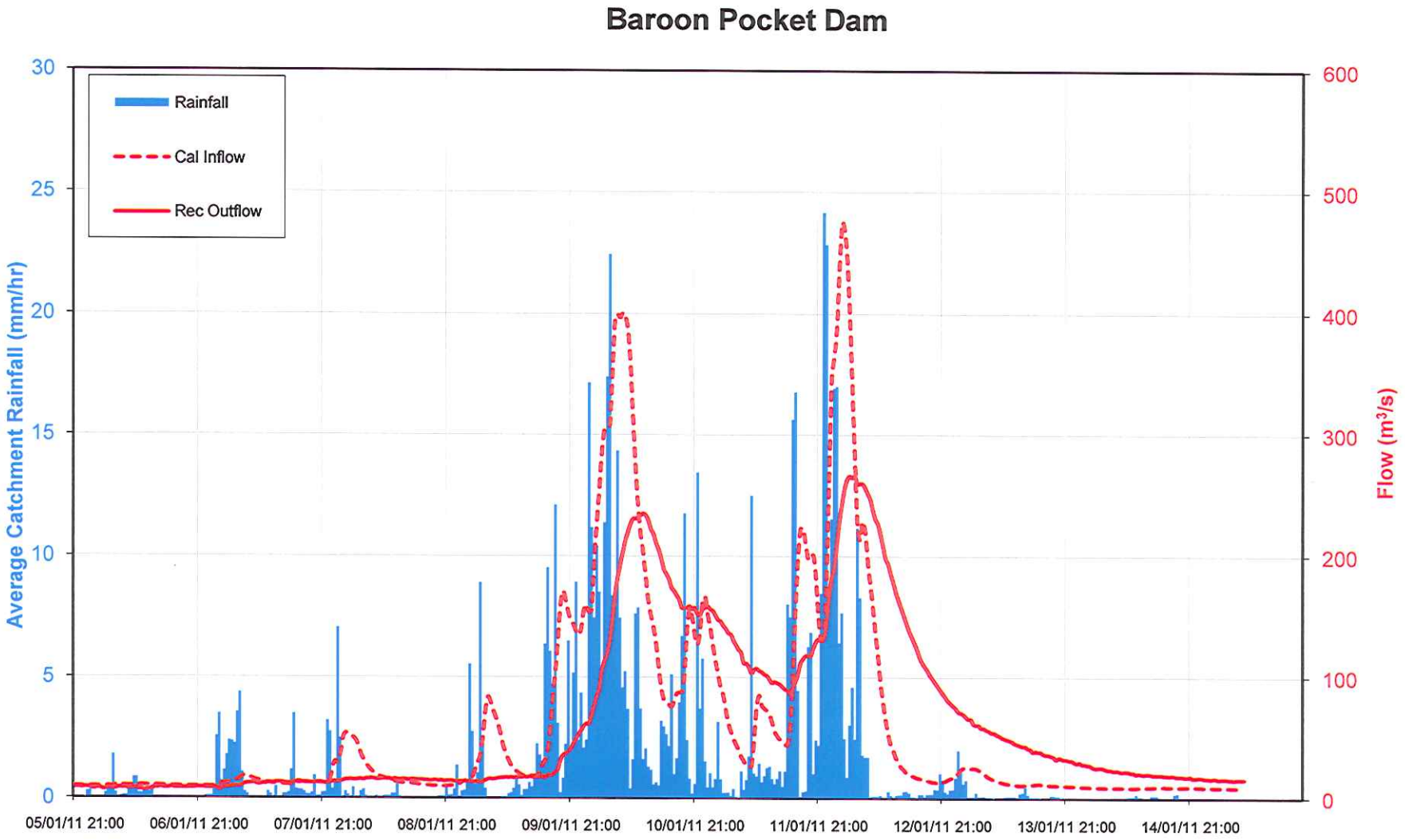
7.4 Baroon Pocket Dam

Baroon Pocket Dam has been owned by Seqwater since 1 July 2008. The main embankment at Baroon Pocket Dam is a 56 metre high rockfill embankment with central clay core, 370 metres in length, damming the Obi Obi Creek, a significant tributary of the Mary River. The adjacent saddle dam is a 15 metre high embankment 300 metres long, similar to the main dam but with flatter slopes due to weaker foundations. The zoning and materials used were the same as for the main dam. A three-line grout curtain was constructed under the left bank and part of the right bank.

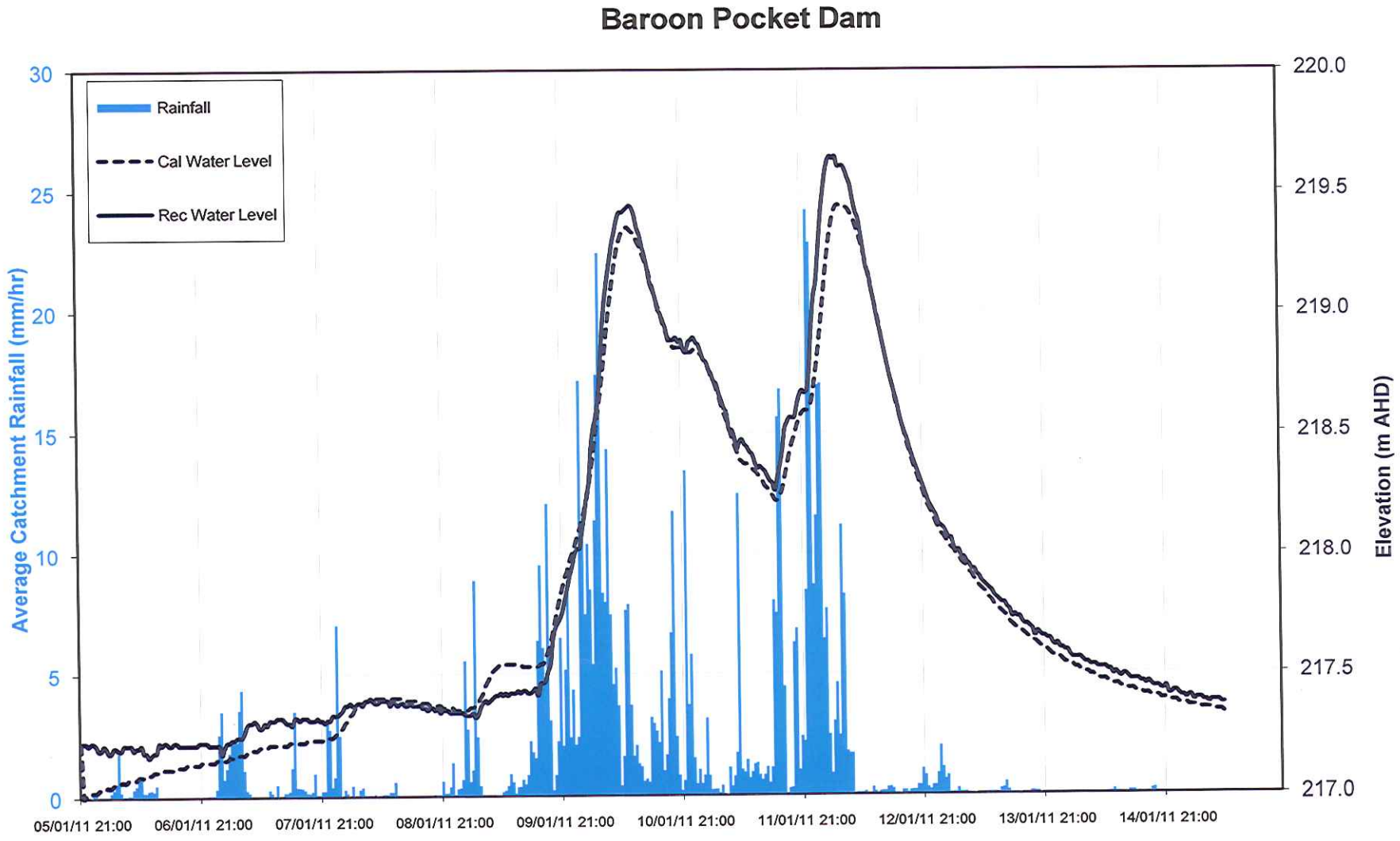
The spillway is an un-gated mass concrete overflow section with an ogee crest 32 metres wide. The spillway walls have mass concrete gravity sections. The spillway floor is reinforced concrete anchored to the underlying rock. A grid of under-drains is provided to prevent excessive uplift under the spillway. A flip bucket at the downstream end of the chute discharges flow into the creek downstream of the dam. The right side spillway approach channel is a cut slope in highly to extremely weathered rock. To protect this from erosion by wave action or velocity of flow a shotcrete coating of minimum thickness 75 mm was provided over part of the area.

An URBS catchment model is available for Baroon Pocket Dam. As shown in the following graphs, the URBS catchment model performed well for the January 2011 flood event and was able to provide a useful prediction of dam outflow based on recorded rainfall. The peak outflow from the Dam during the January floods was in the order of 250m^3/s.

January 2011 – Inflows/Outflows



January 2011 – Water Level



7.5 Bill Gunn Dam

Bill Gunn Dam has been owned by Seqwater since 1 July 2008. Bill Gunn Dam was developed to increase the capacity of the existing Lake Dyer, a natural lake adjacent to Laidley Creek. With a very small natural catchment, the dam is filled by diverting flood flows from Laidley Creek at the Laidley West Recharge Weir into Bill Gunn Dam. The stored water is released back into Laidley Creek to assist in augmenting groundwater and surface water supplies in the area.

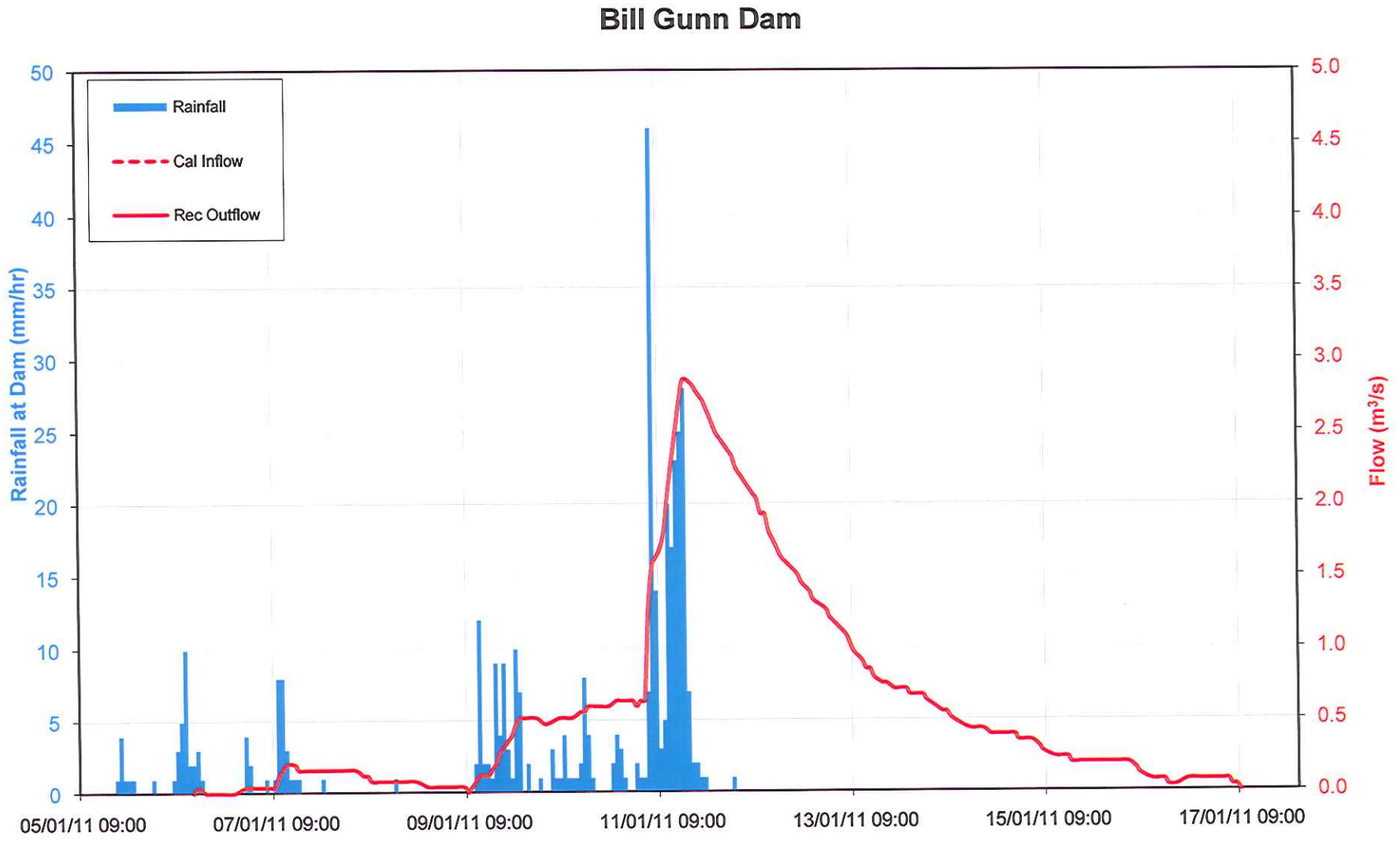
The main embankment is a 1170 metre long earthfill embankment with a central clay core constructed to a crest elevation of EL 112 m AHD. The crest width is 6 metre and the embankment reaches a maximum height above foundation of 12.7 m. The main embankment includes upstream and downstream weighting zones to an elevation of EL 106 m AHD.

The Saddle Dam (also described as the golf course embankment) was constructed to a level of EL 111.5 m AHD to exclude an existing golf course from inundation during flood events. It has a crest width of three metres and consists of a compacted sandstone core and miscellaneous earthfill.

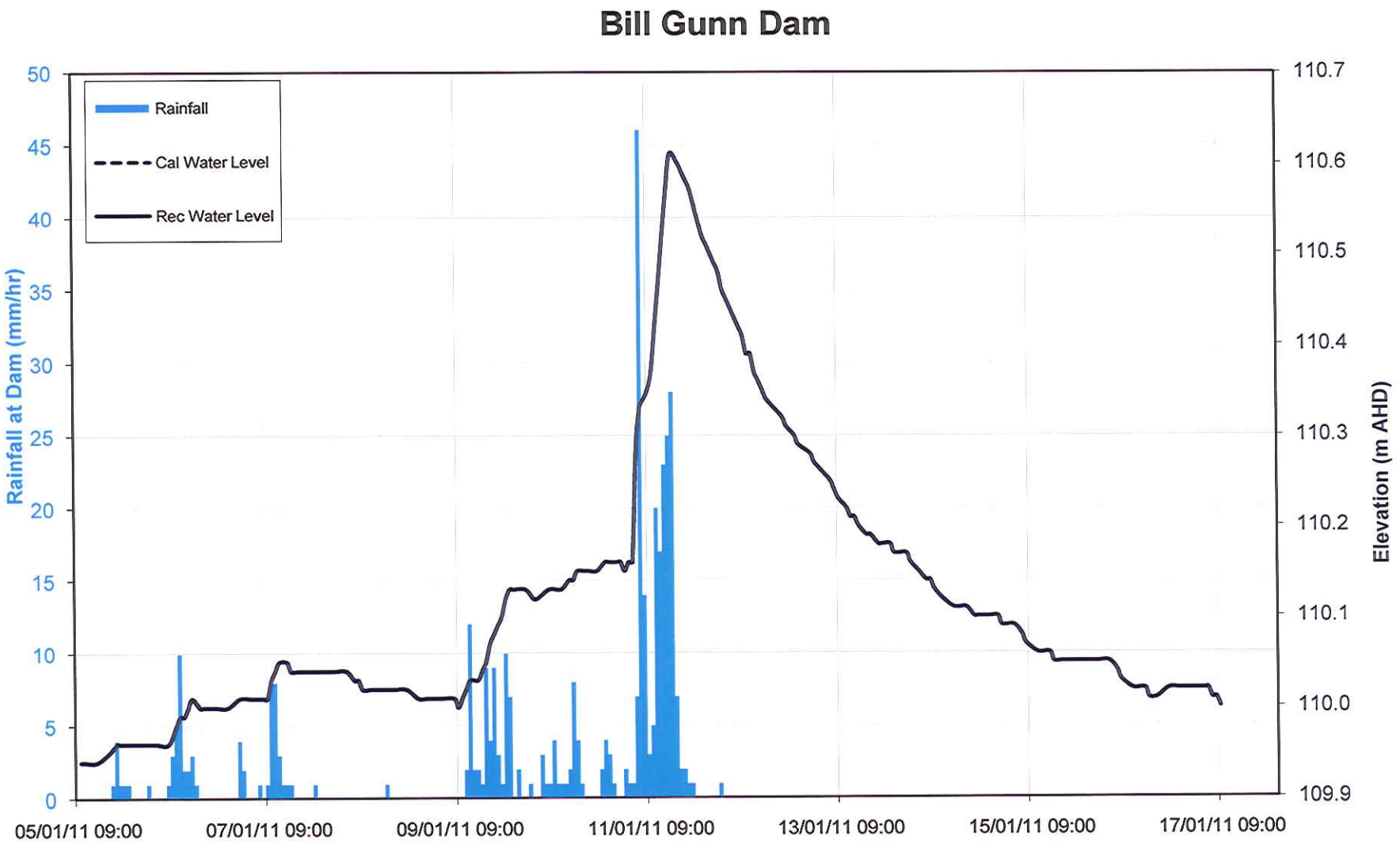
The dam has a drop inlet spillway incorporated in the outlet works. A pipe from the spillway leads to an energy dissipation structure. The normal inflow-outflow and the spillway discharge run through separate pipes each of which is 1200 mm in diameter. The spillway and outlet works are fully screened and the inlet/outlet pipe can be sealed and dewatered for inspection and repair.

An URBS catchment model is not available for Bill Gunn Dam. This is because Bill Gunn Dam is an off-stream storage with a very small natural catchment area. Accordingly outflows from Bill Gunn Dam are generally not a significant contribution to downstream flooding. This was certainly the case in January 2011, with the peak outflow from the Dam being less than 3 m^3/s. The lake level of Bill Gunn Dam during January 2011 is shown in the graph below.

January 2011 – Inflows/Outflows



January 2011 – Water Level



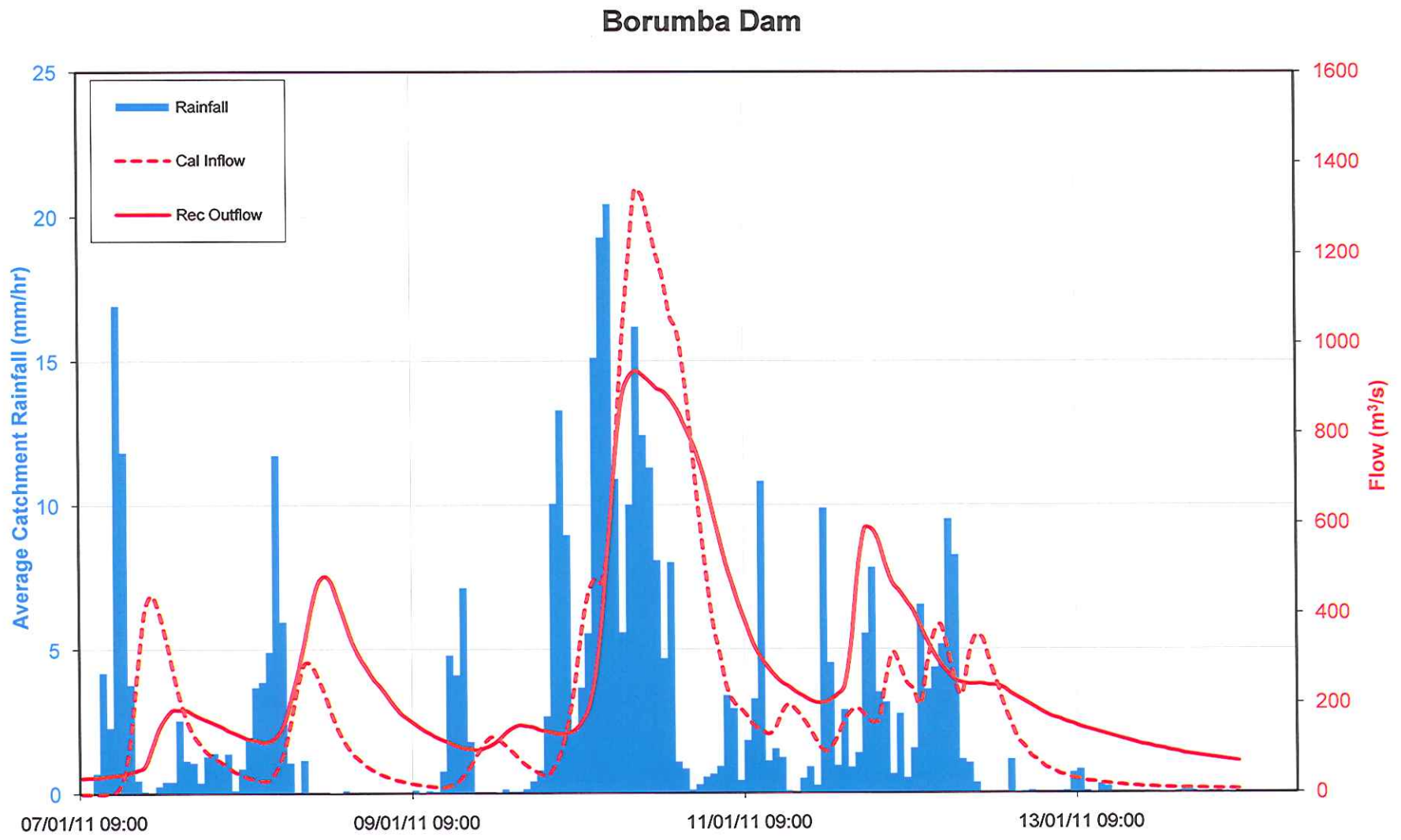
7.6 Borumba Dam

Borumba Dam has been owned by Seqwater since 1 July 2008. Borumba Dam was originally built to provide water supply and irrigation water for the Sunshine Coast and the Mary River valley. It was raised to increase its storage capacity in 1998.

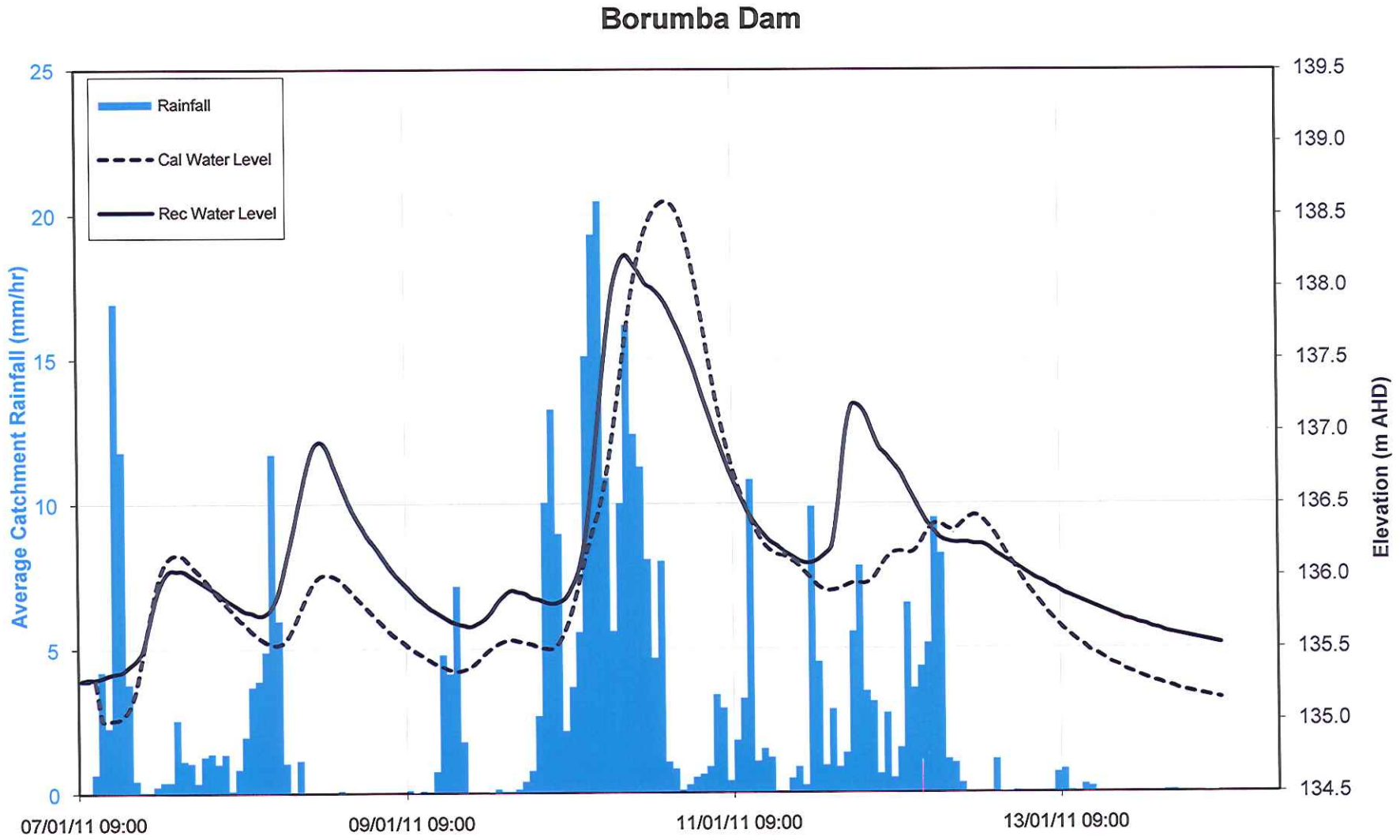
Borumba Dam is a rockfill dam with an impervious concrete slab on the upstream face. The embankment crest length is 343 metres. The reservoir Inlet Tower is a reinforced concrete structure of column and beam design. Water is drawn from the reservoir via a single outlet conduit at the base of the tower. The main purpose of the Inlet Tower is to provide a means of closing off the inlet to the conduit by lowering a steel bulkhead gate. Raising and lowering of the gate is carried out by using a winch on the tower.

An URBS catchment model is available for Borumba Dam. As shown in the following graphs, the URBS catchment model had some difficulties in estimating inflow into the dam for the January 2011 flood event and could only provide an indicative prediction of dam outflow based on recorded rainfall. The peak outflow from the Dam during the January floods was in the order of 950m^3/s.

January 2011 – Inflows/Outflows



Janauary 2011 – Water Level



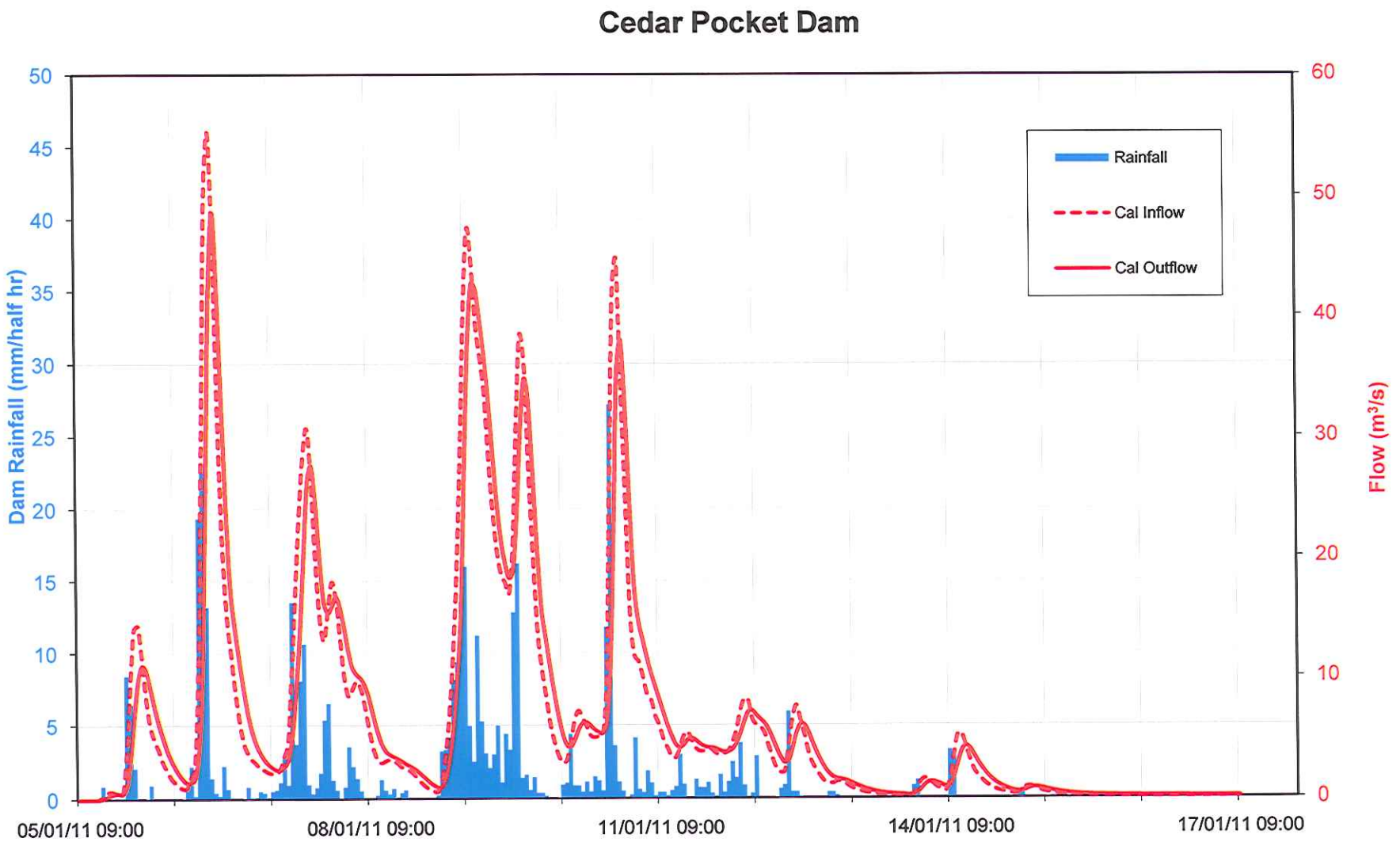
7.7 Cedar Pocket Dam

On 1 July 2008, the ownership of Cedar Pocket Dam was transferred to the new Seqwater entity. The main purpose of Cedar Pocket Dam is to provide an irrigation water supply for dairy land pastures downstream of the dam.

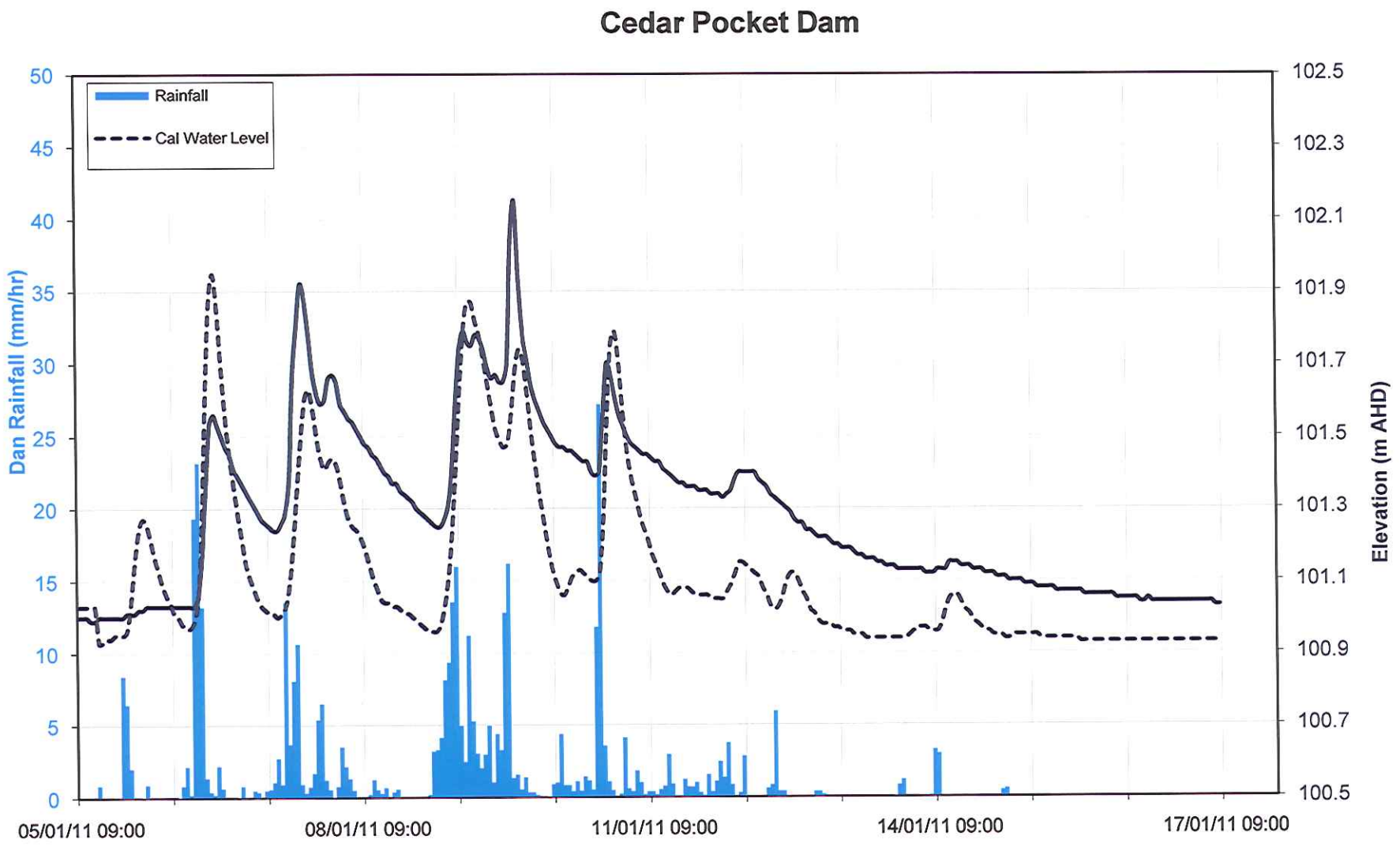
Cedar Pocket Dam is a mass concrete structure, partially earth and rock fill with a central clay core structure. The dam has a maximum height of 20 metres above the downstream toe. The dam spillway, located towards the LHS of the embankment, has an ogee crest with a slot in the centre for small spills. Two opposing training walls/chutes redirect stage two spills towards the centre of the stream. Large overflows (stage three) will drown all of above.

Although an URBS catchment model is available for Cedar Pocket Dam. Cedar Pocket Dam is a small dam that acts more like a weir than a dam, with the dam ponding only a relatively small amount of water above the banks of Deep creek. Outflows from Cedar Pocket Dam are generally not a significant contribution to downstream flooding. This was certainly the case in January 2011, with the peak outflow from the Dam being in the order of 70 m^3/s. The lake level of Cedar Pocket Dam during January 2011 is shown in the graph below.

January 2011 – Inflows/Outflows



January 2011 – Water Level

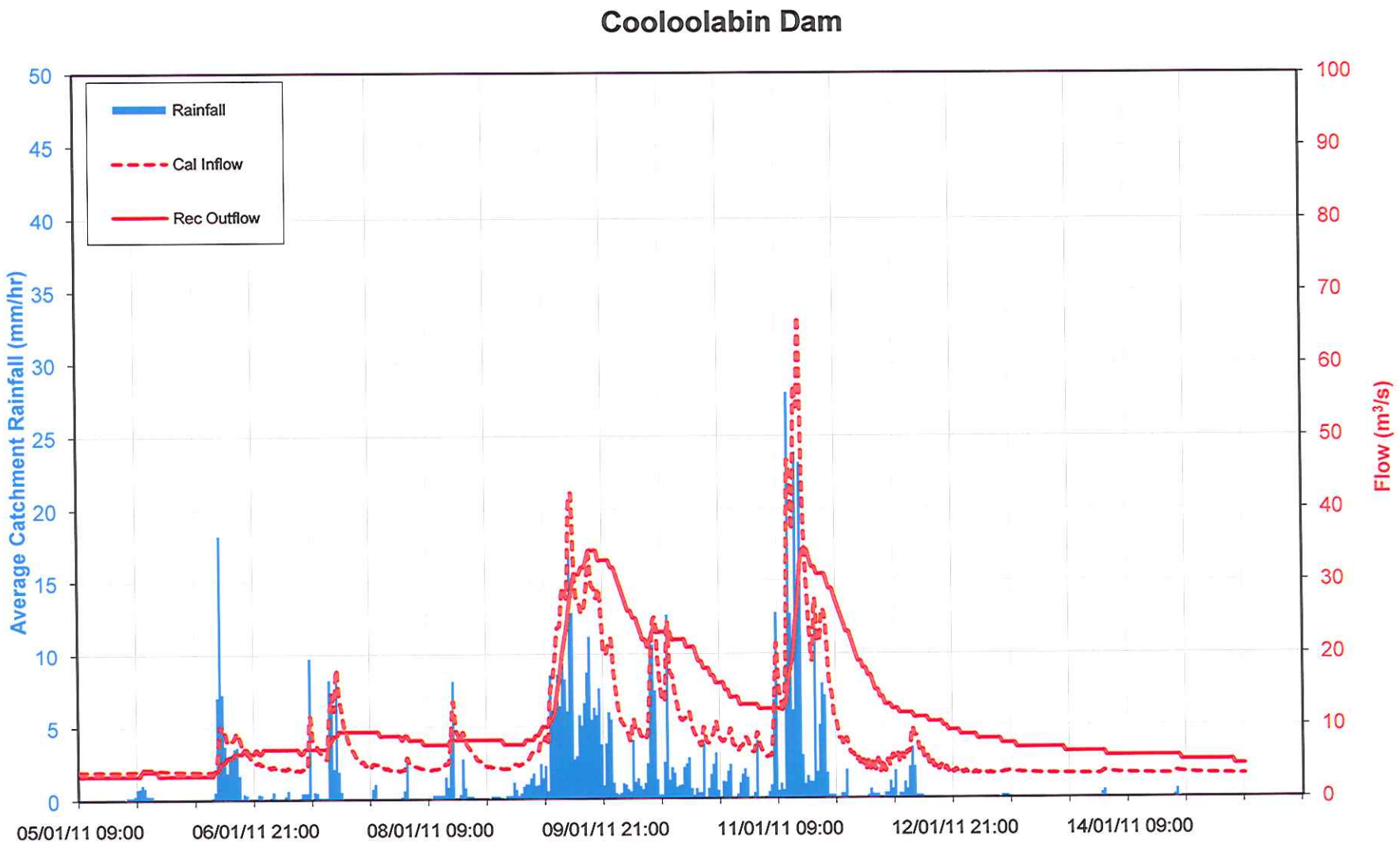


7.8 Cooloolabin Dam

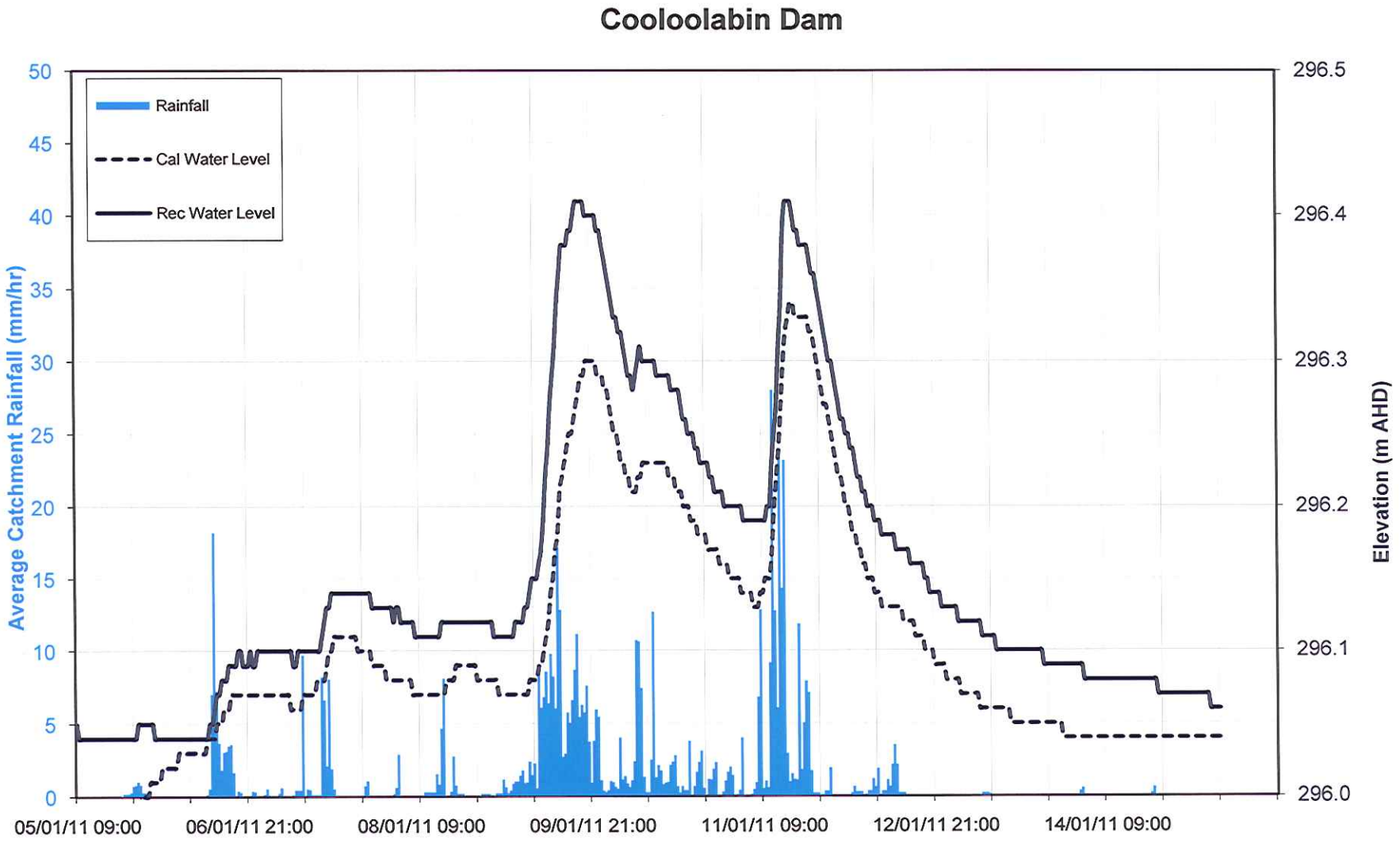
Cooloolabin Dam has been owned by Seqwater since 1 July 2008. Cooloolabin Dam comprises a concrete gravity dam of 19 metres height with overflow section, earth embankment abutment sections and five saddle dams up to 13 metres high. The main concrete embankment is 115 metres long, with 128 metres of earth embankments on the abutments. The total length of the earth embankment saddle dams is 1,100 metres. The dam has a concrete gravity spillway with an uncontrolled concrete ogee and a central low flow section.

An URBS catchment model is available for Cooloolabin Dam. As shown in the following graphs, the URBS catchment model performed in a reasonable manner for the January 2011 flood event and was able to provide a useful prediction of dam outflow based on recorded rainfall. The peak outflow from the Dam during the January floods was only in the order of 35 m^3/s.

January 2011 – Inflow/Outflow



January 2011 – Water Level



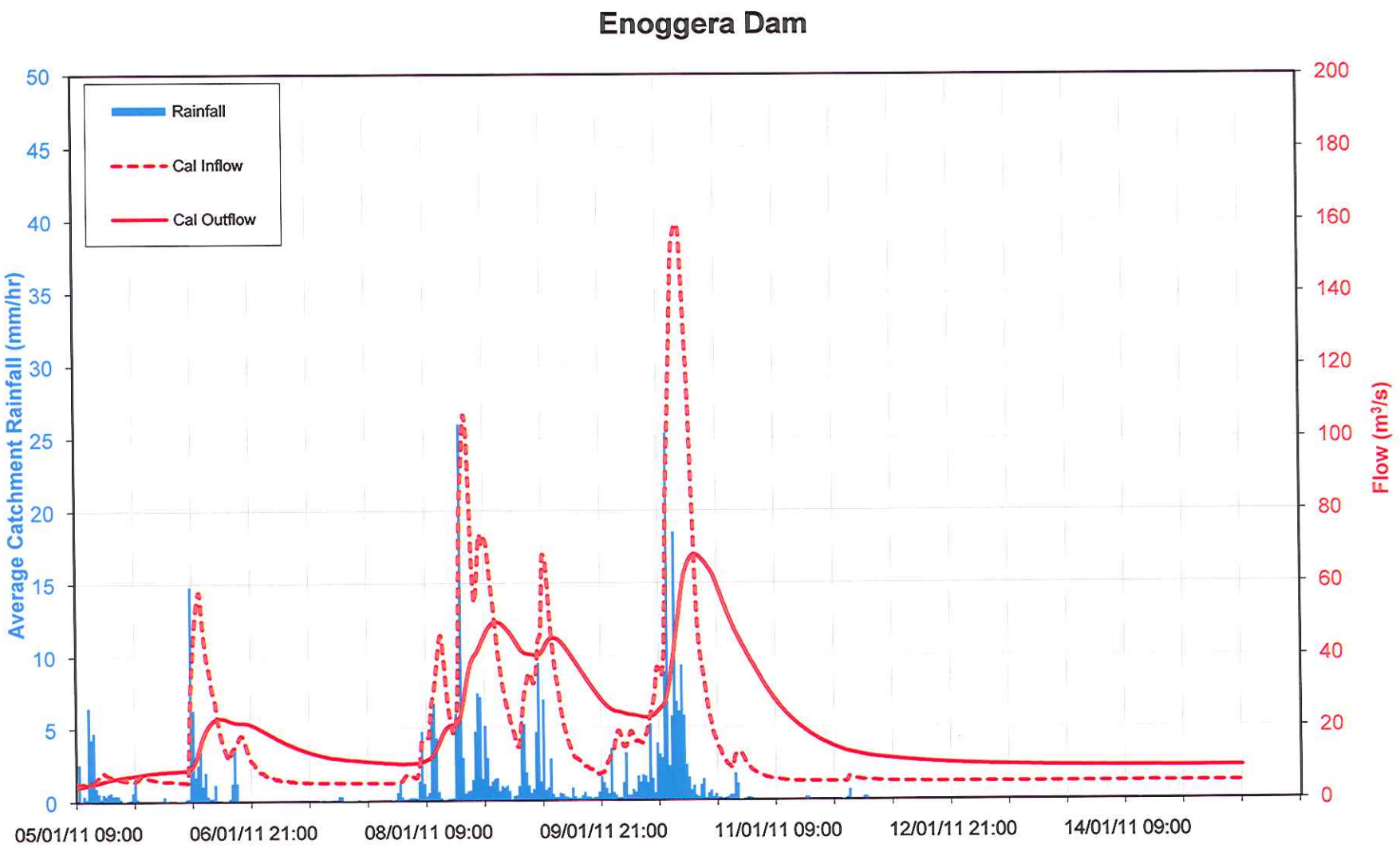
7.9 Enoggera Dam

Enoggera Dam has been owned by Seqwater since 1 July 2008 and was the first major dam built in Queensland and upgraded in 1976. Enoggera Dam is a 23.5 metre high embankment dam on Enoggera Creek. The original dam, constructed in 1866 comprised a 360 metre long earthen embankment with a puddle clay core. The original dam was raised and strengthened in 1976 using a concrete faced rockfill construction method. The new concrete face was keyed into a plastic concrete core wall installed within the original puddle clay core. A grout curtain was also provided in the 1976 raising at the base of the core wall to minimise leakage under the embankment.

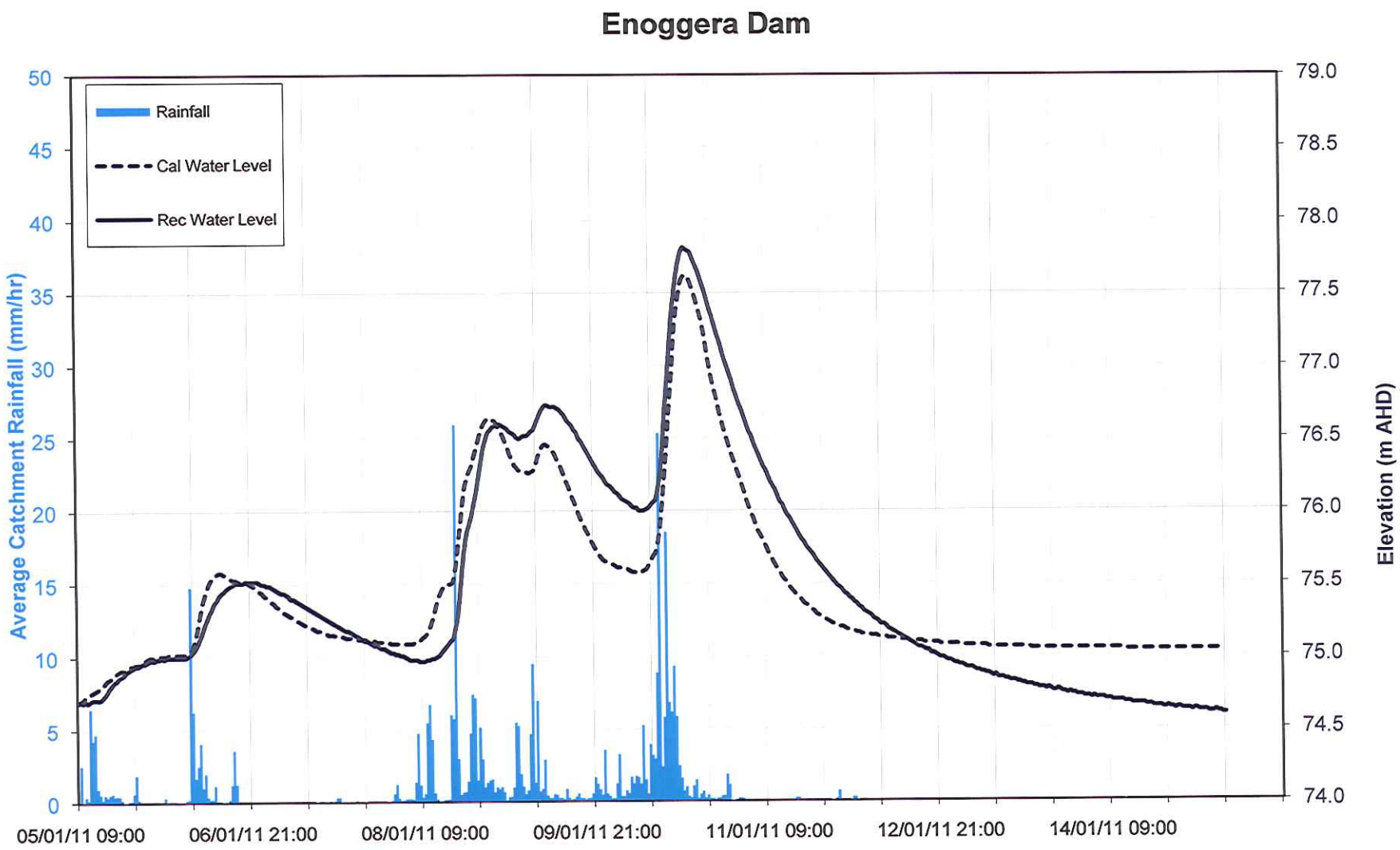
The dam has a concrete gravity spillway structure on the left bank comprising a low level un-gated sluice for flood retention and an uncontrolled higher level ogee crest for the passage of floods exceeding 1 in 100 year events. Spillway stabilisation works, comprising the addition of a one metre thick wall of concrete to the upstream face of the spillway were completed in 2004.

An URBS catchment model is available for Enoggera Dam. As shown in the following graphs, the URBS catchment model performed well for the January 2011 flood event and was able to provide a useful prediction of dam outflow based on recorded rainfall. The peak outflow from the Dam during the January floods was in the order of $70m^3/s$.

January 2011 – Inflow/Outflow



January 2011 – Water Level



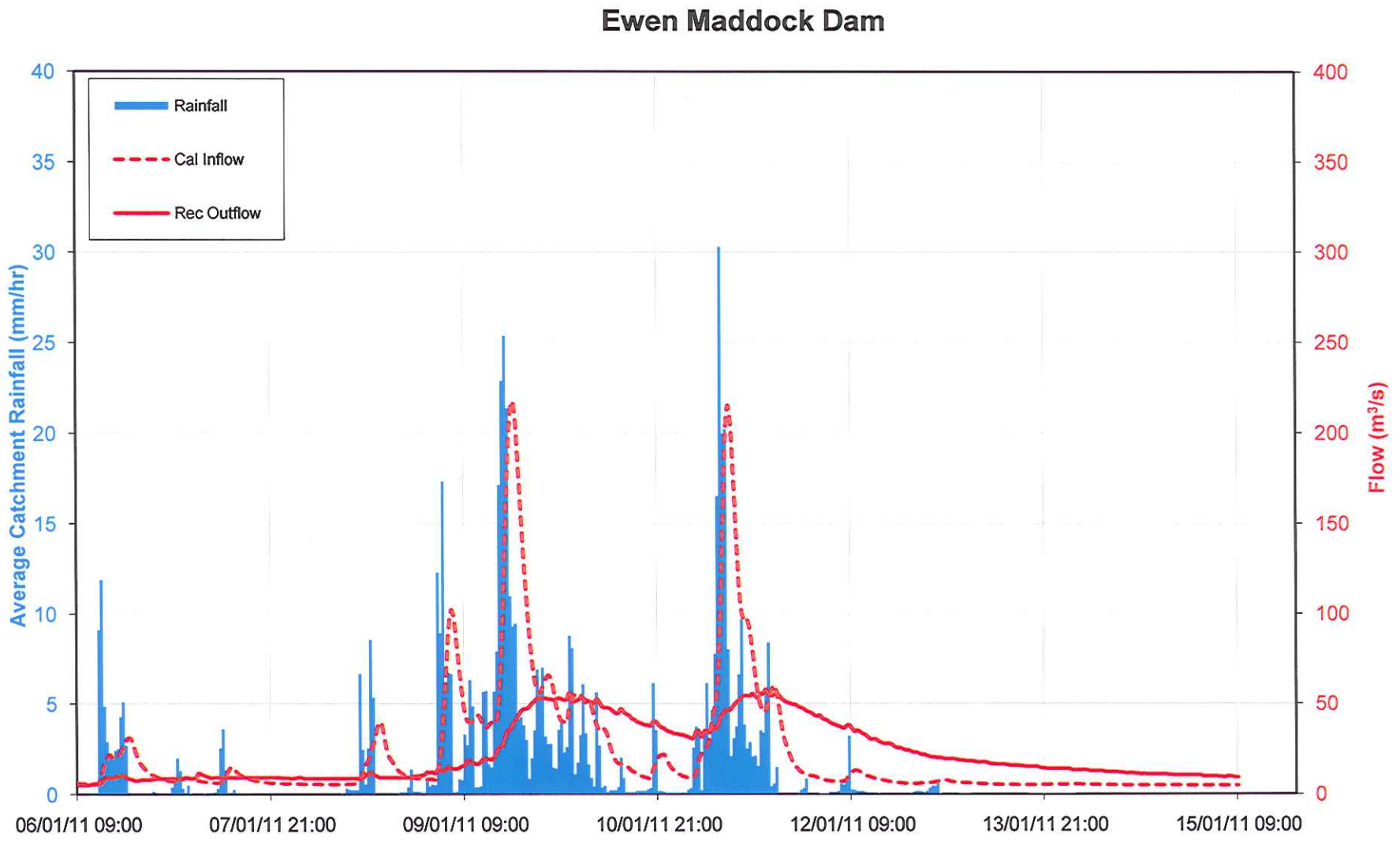
7.10 Ewen Maddock Dam

Ewen Maddock Dam has been owned by Seqwater since 1 July 2008. The storage is located on Addlington Creek, a tributary of the Mooloolah River and was completed in 1975 as a zoned earthfill embankment dam. The dam was raised in 1982 to its current level, with a 660 metre long and 14.5 metre high embankment.

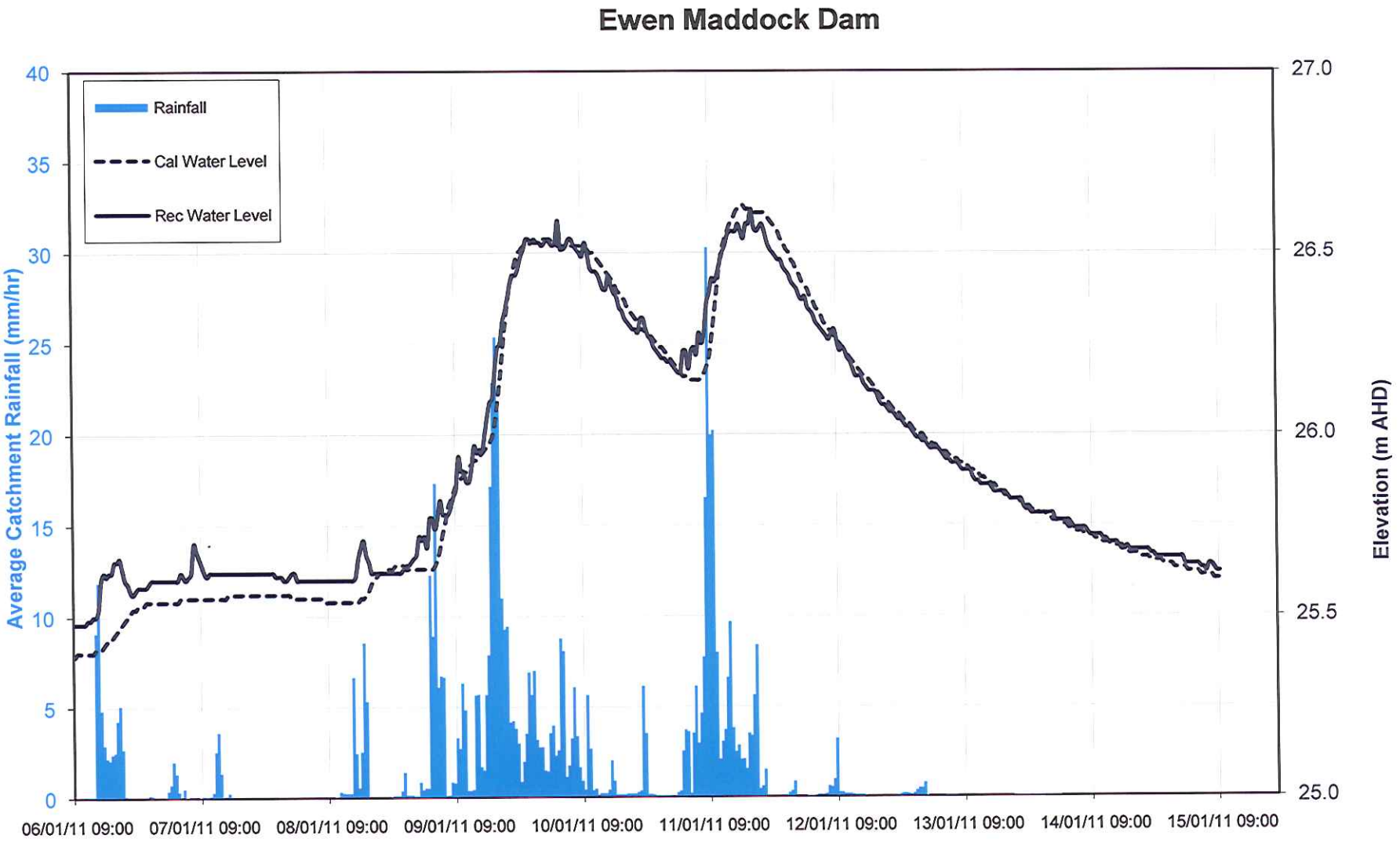
The dam spillway located on the right abutment has a 18.3 metre wide ogee crest and discharges into a parallel chute and a 21 metre long stilling basin.

An URBS catchment model is available for Ewen Maddock Dam. As shown in the following graphs, the URBS catchment model performed well for the January 2011 flood event and was able to provide a useful prediction of dam outflow based on recorded rainfall. The peak outflow from the Dam during the January floods was in the order of 60 m^3/s.

January 2011 – Inflow/Outflow



January 2011 – Water Level



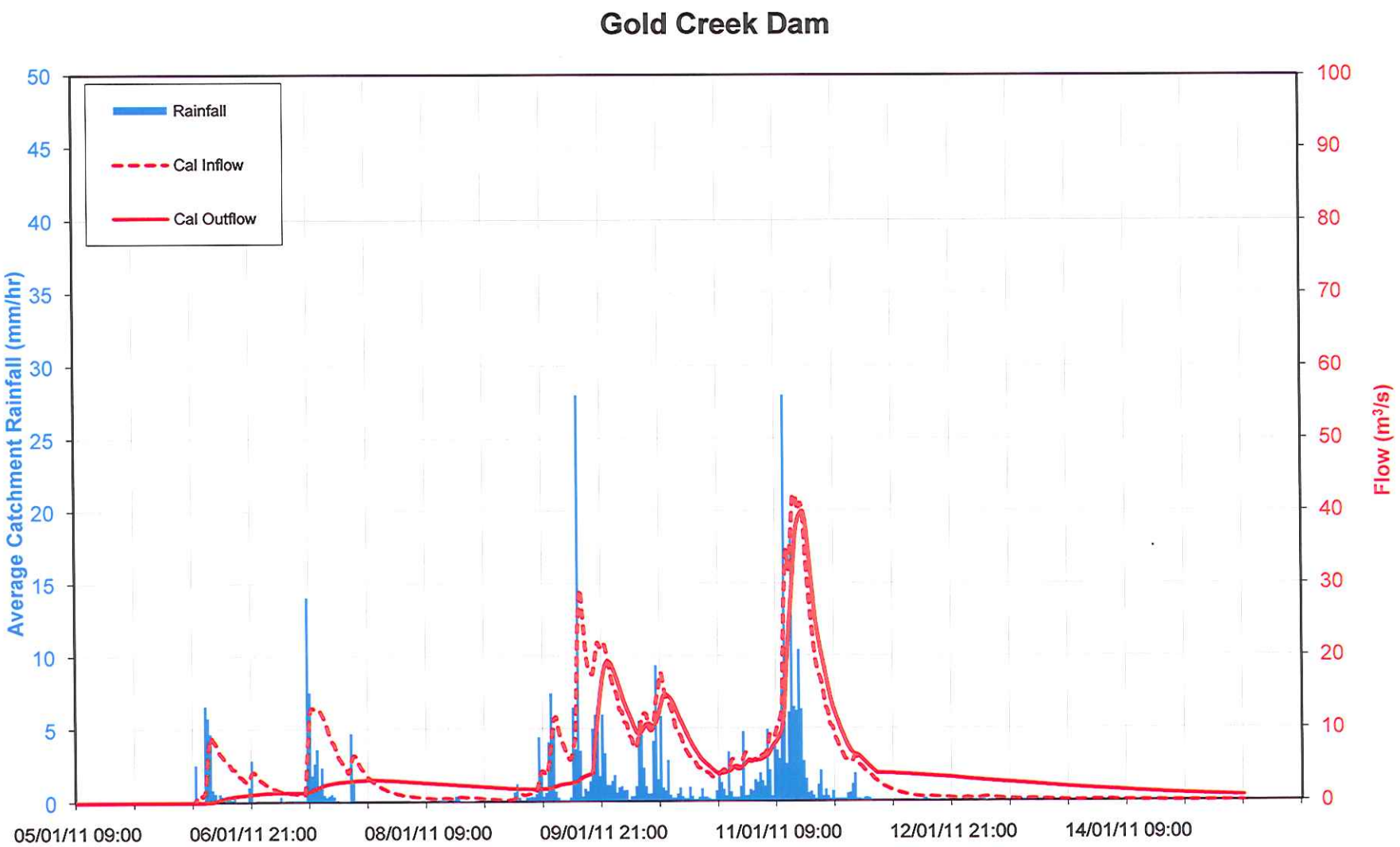
7.11 Gold Creek Dam

Gold Creek Dam has been owned by Seqwater since 1 July 2008. The original Gold Creek Dam was an earthfill dam with a puddle clay core constructed between 1882 and 1886. The dam was constructed and owned by the Brisbane City Council. The original intake tower was of cast iron construction, and collapsed in 1897. It was replaced soon after by the present concrete Intake Tower.

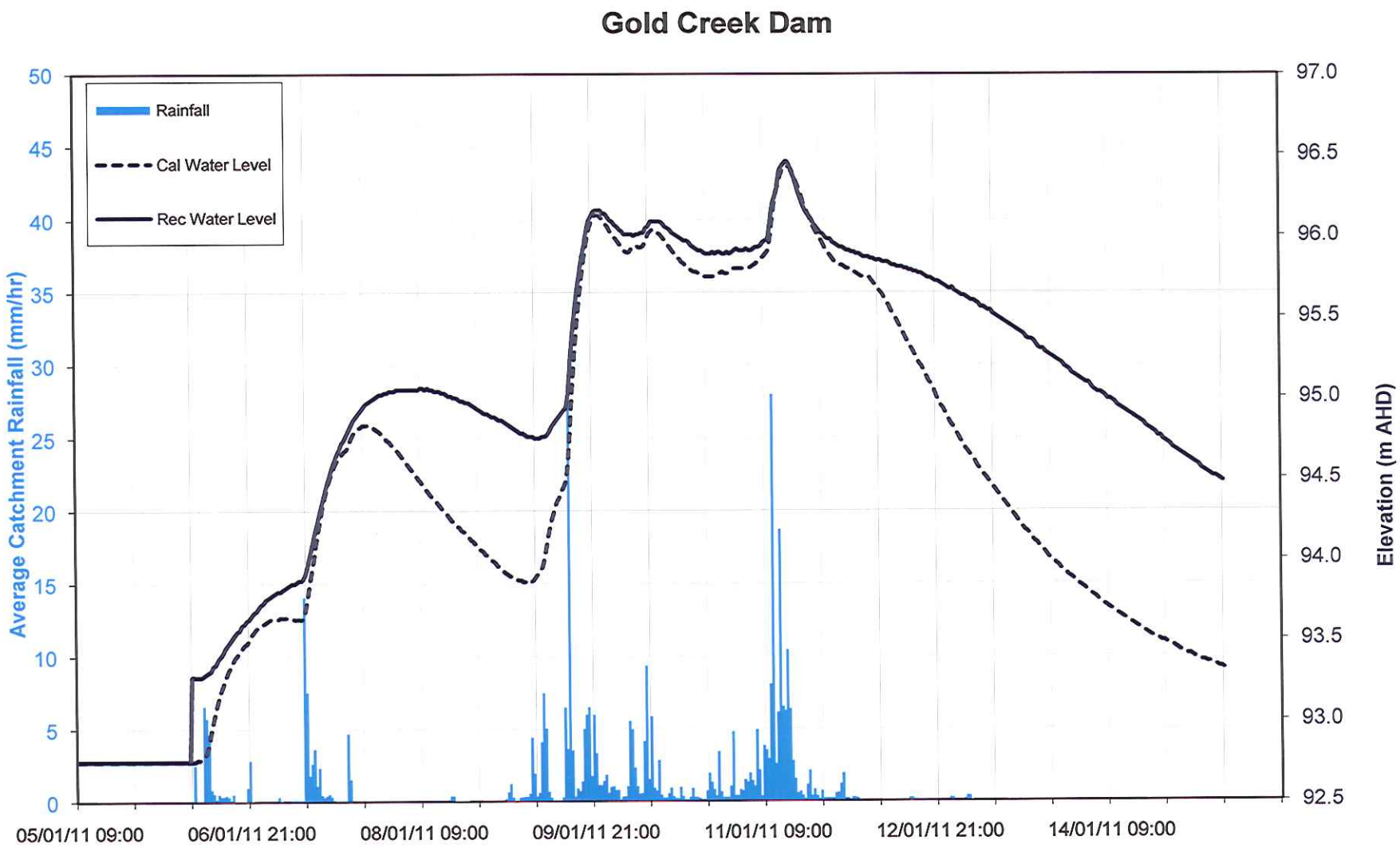
The 1974 flood caused some concern with regard to the capacity of the spillway. Accordingly, in 1975 the spillway was lowered by 1.2 metres and the resulting spoil placed over the downstream toe. Further lowering of the Full Supply Level (FSL) occurred in 1997 by 0.5 metre to RL 95.75 and the material placed into a weighting zone at the downstream toe. Because the dam is not currently used to provide a water supply, in 2008 the FSL was lowered by another 3 metres to maximise the limited flood mitigation potential of the Dam. Further lowering of the dam is not currently possible due to the potential for environmental harm including adverse impacts on local platypus populations.

An URBS catchment model is available for Gold Creek Dam. As shown in the following graphs, the URBS catchment model performed in a reasonable manner for the January 2011 flood event and was able to provide a useful prediction of dam outflow based on recorded rainfall. The peak outflow from the Dam during the January floods was in the order of 40 m^3/s.

January 2011 – Inflows/Outflows



January 2011 – Water Level



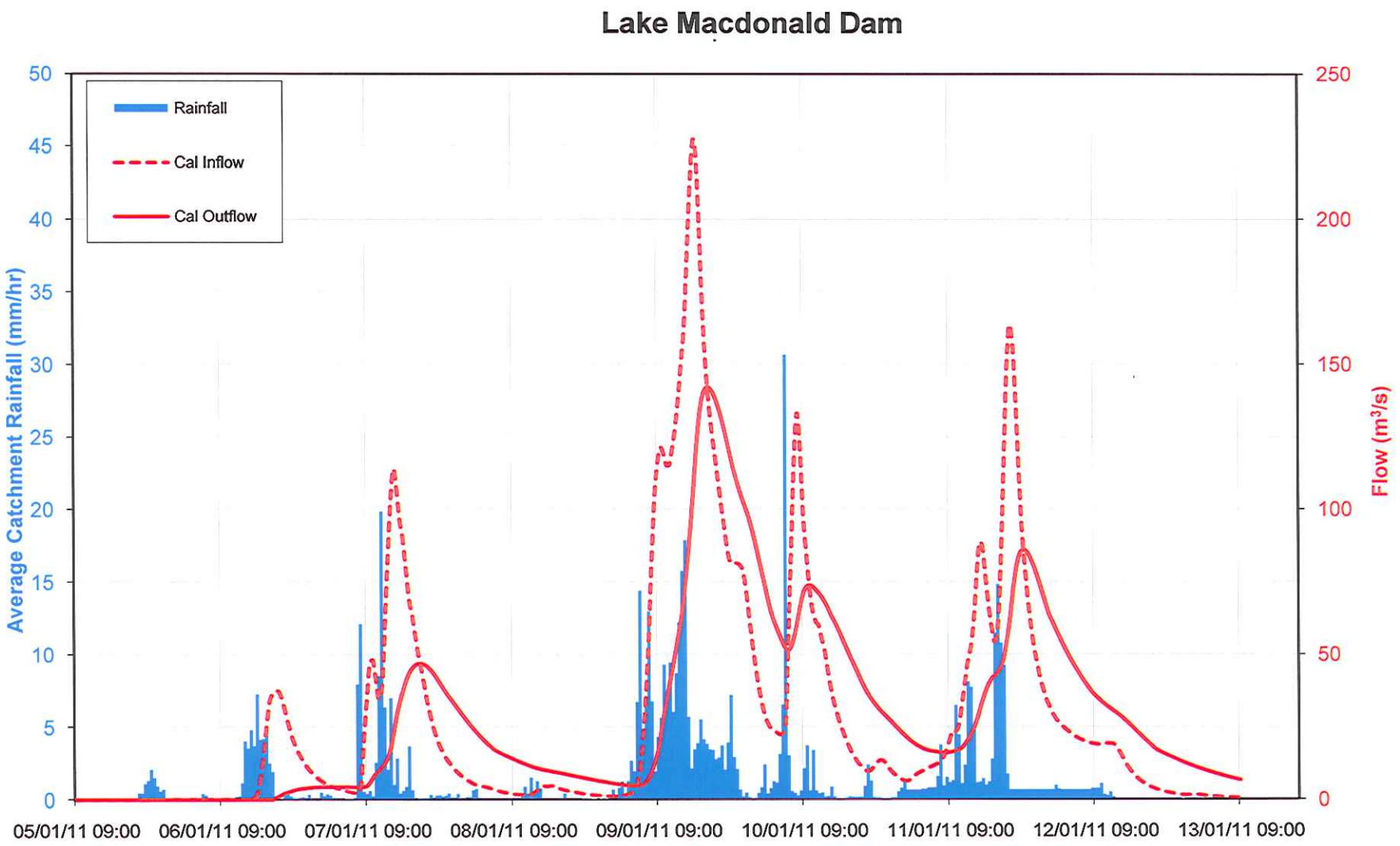
7.12 Lake Macdonald Dam

Lake Macdonald Dam has been owned by Seqwater since 1 July 2008. The dam embankment consists of a 501 meter long zoned earth and rockfill embankment to a maximum height of 11.5 metres. A further 3.6 metres was added to the height of the dam in 1980 increasing the storage to its current capacity.

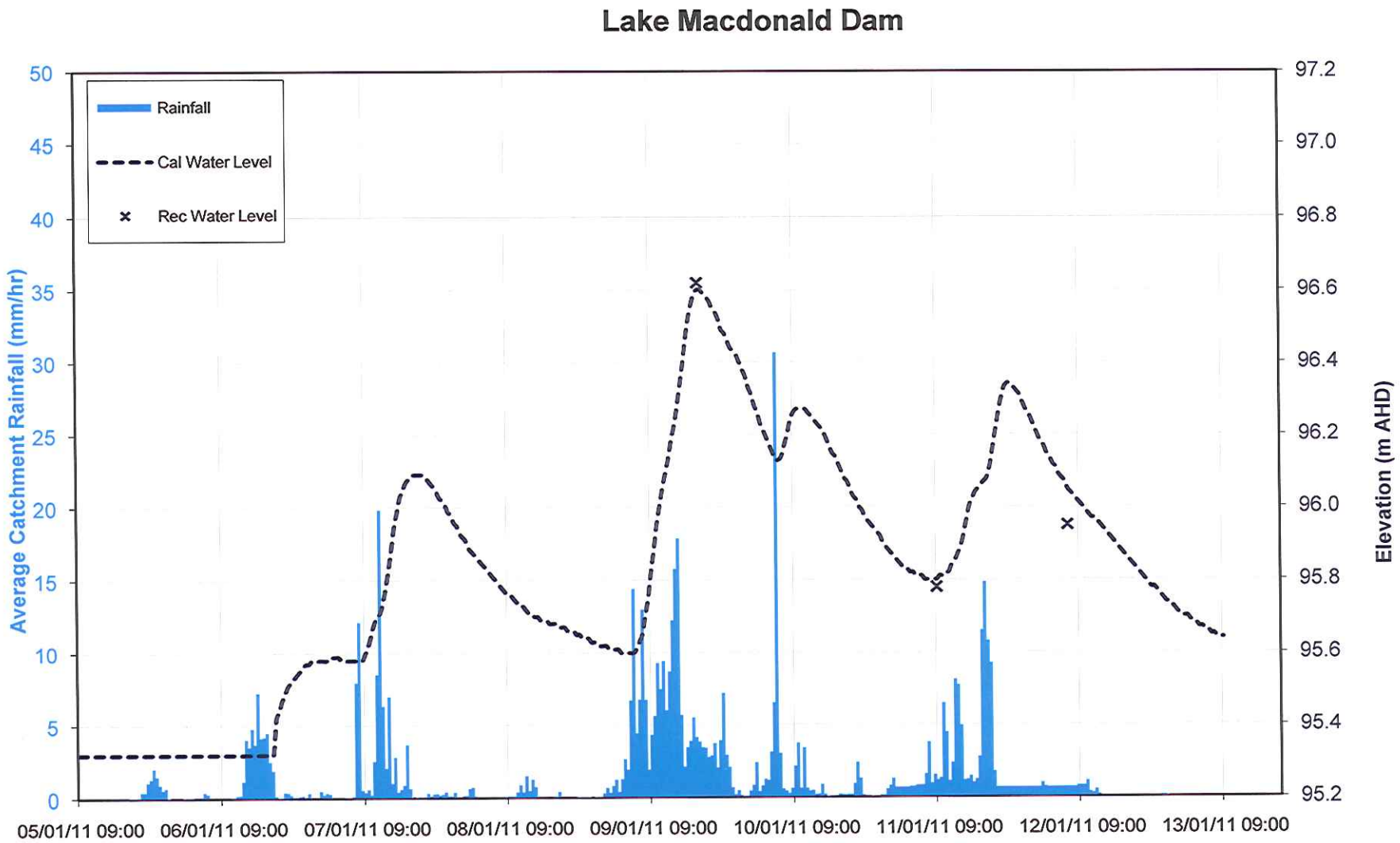
The Spillway consists of a 79 meter long un-gated concrete slab crest located at the middle of the embankment. The spillway is constructed of compacted fill surmounted at the crest and the slopes by 200 mm thick reinforced concrete underlain by 200 mm thick filter material. The energy dissipation occurs at the buckets located at the toe of the Spillway.

An URBS catchment model is available for Lake Macdonald Dam. As shown in the following graphs, the URBS catchment model performed reasonably well for the January 2011 flood event and was able to provide a useful prediction of dam outflow based on recorded rainfall. The peak outflow from the Dam during the January floods was in the order of 140 m^3/s.

January 2011 – Inflows/Outflows



January 2011 – Water Level



7.13 Lake Manchester Dam

Lake Manchester has been owned by Seqwater since 1 May 2009. Lake Manchester Dam was originally designed by the Metropolitan Water and Sewerage Board of Brisbane (now Brisbane Water) in 1912. The dam was constructed by a private contractor between 1912 and 1916. The dam was completed in 1916 to provide a source of water for Brisbane.

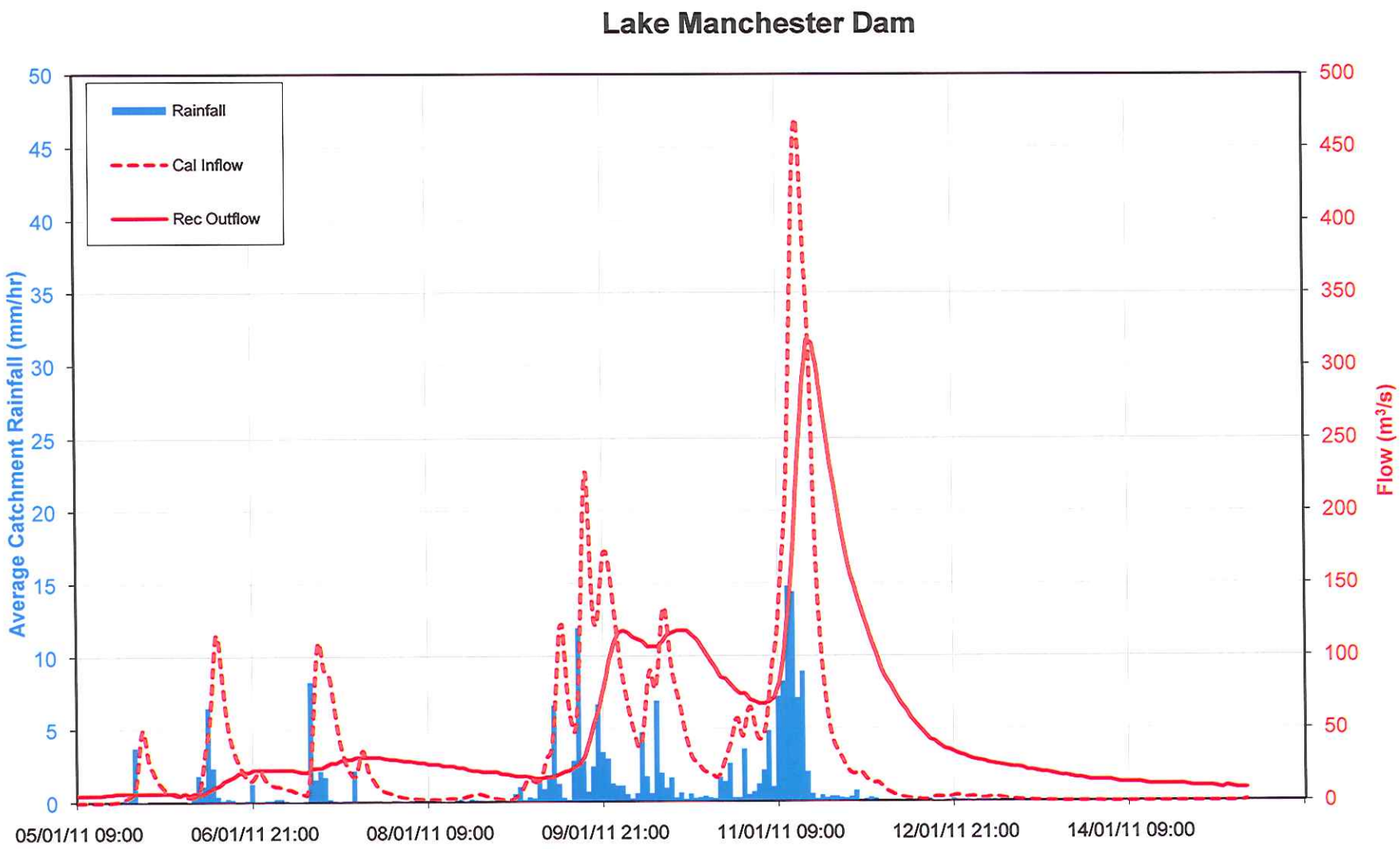
Lake Manchester Dam was extensively refurbished between 2006 and 2008. The objective of this work was to improve the stability and flood handling capacity of the dam. The dam is a mass concrete gravity/post tensioned structure with a maximum height of 44 metres and a total crest length of 230 metres (including spillway). The dam crest level is EL 59.7 metres and full supply level is EL 50.90 metres.

The non overflow section of the dam was raised in 2008 to its current levels and post tensioned anchors installed to stabilise the dam for extreme flood loads. The raising incorporated a unique pre-cast concrete "bucket" which served as permanent formwork for the 3 metre deep spreader beam on top of the existing crest. The anchor heads and required bursting reinforcement were incorporated into the spreader beam below its surface to allow vehicular access to the non-overflow section of the crest. A 3 metre high reinforced concrete cantilever parapet wall was constructed on the upstream edge of the spreader beam.

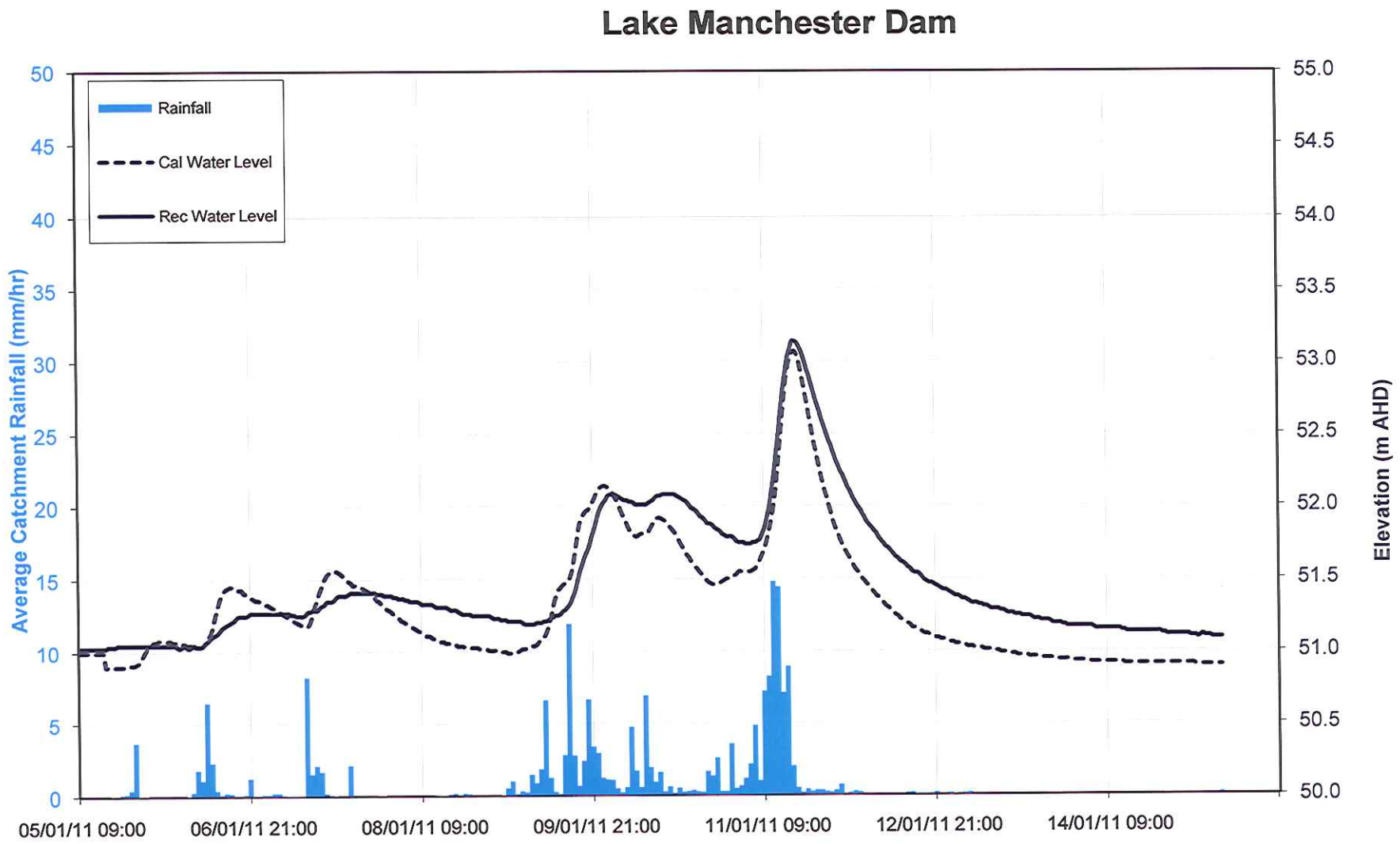
The 50 metre long spillway is located in the left abutment with crest level of EL 50.90 metre. The spillway consists of a concrete weir type structure about 4 metre high with an unlined approach channel at EL 46.9 metre, followed by a steep reinforced concrete lined chute approximately 16 metre long ending at a flip bucket. The spillway jet from the flip bucket impacts downstream on the unlined stilling basin excavated in rock with an invert level of around EL 23 metre.

An URBS catchment model is available for Lake Manchester Dam. As shown in the following graphs, the URBS catchment model performed well for the January 2011 flood event and was able to provide a useful prediction of dam outflow based on recorded rainfall. The peak outflow from the Dam during the January floods was in the order of 320 m^3/s.

January 2011 – Inflows/Outflows



January 2011 – Water Level

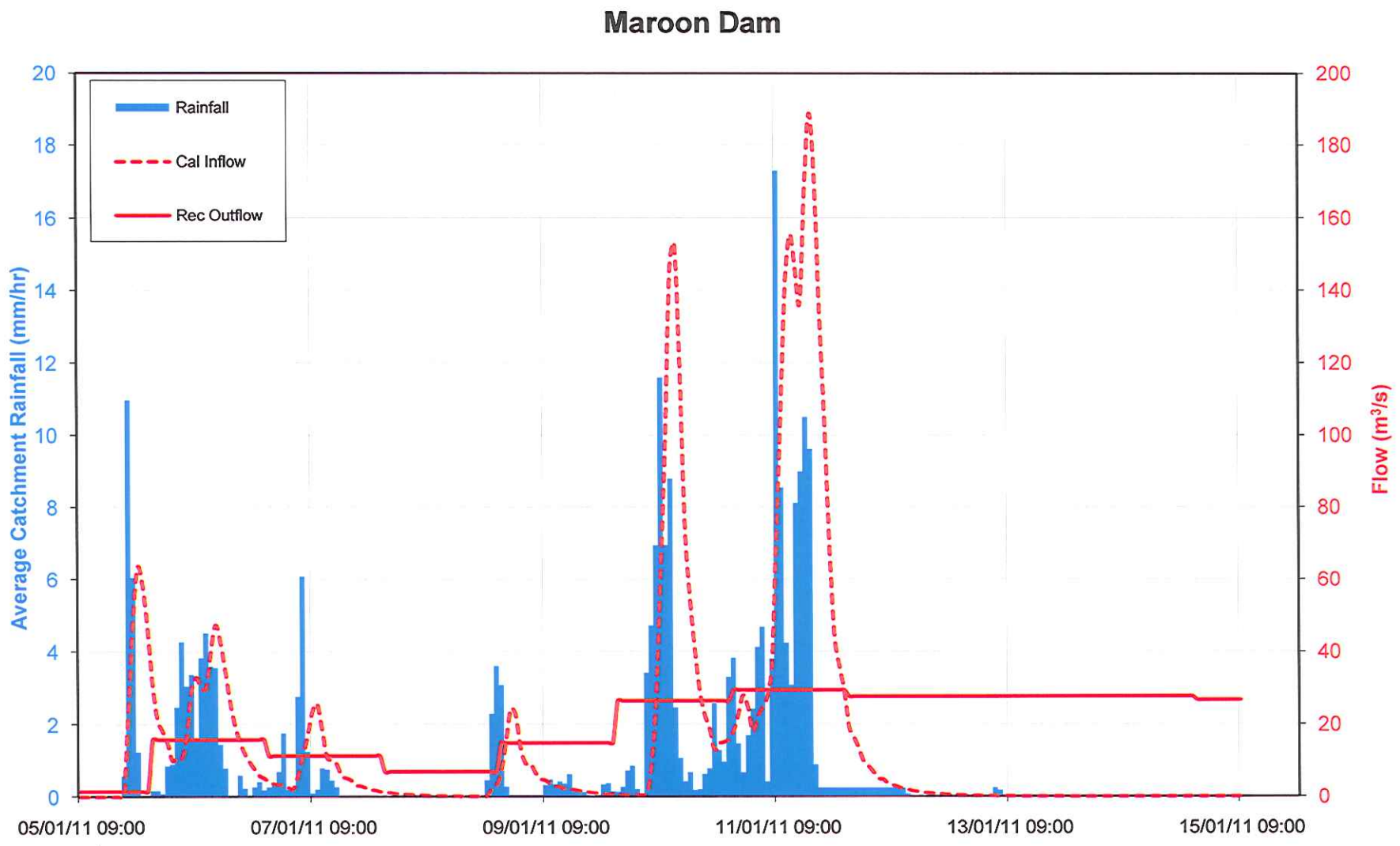


7.14 Maroon Dam

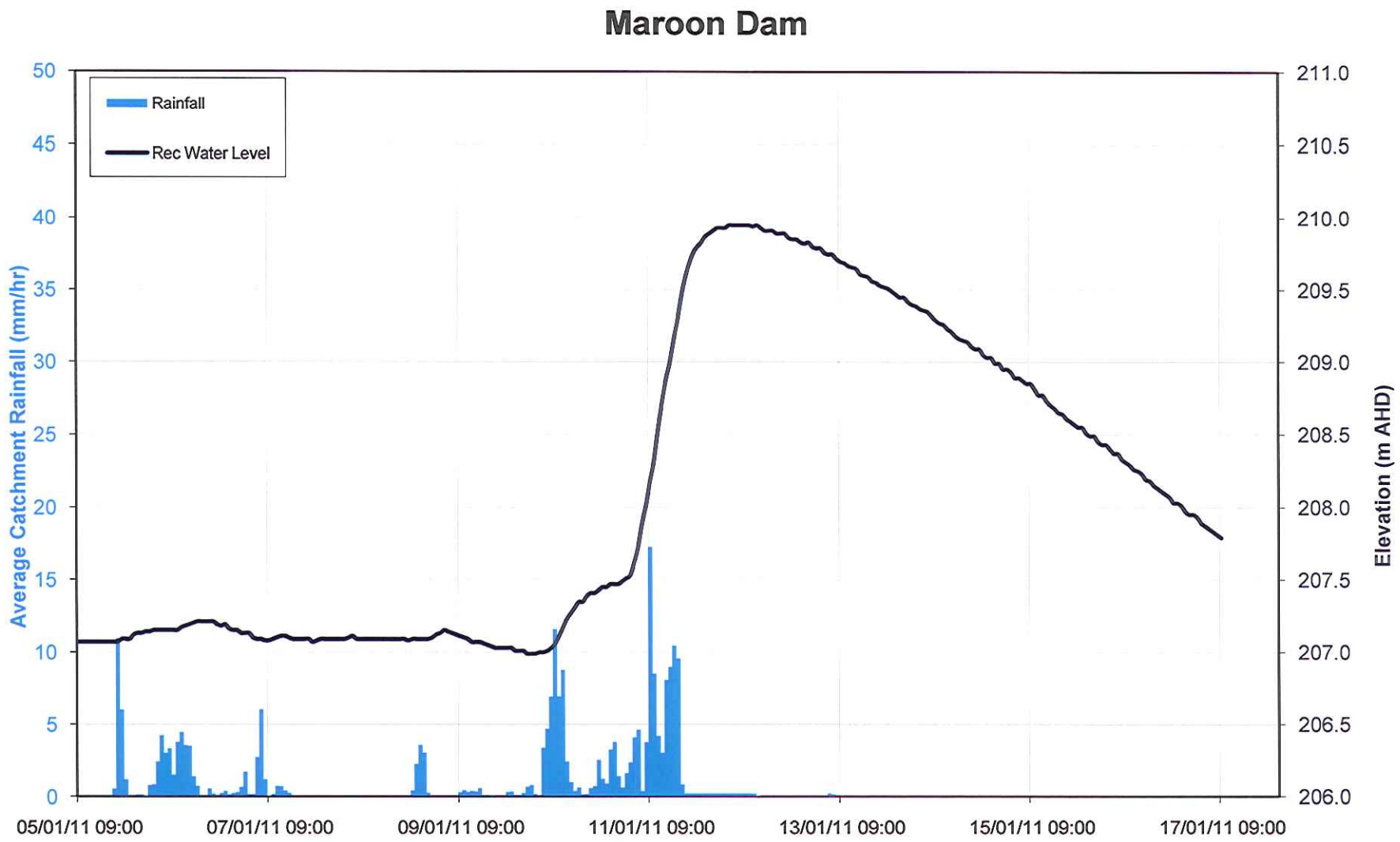
Maroon Dam has been owned by Seqwater since 1 July 2008. This central earth core and rockfill structure, situated on Burnett Creek approximately 25 km above its confluence with the Logan River, permitted expansion of irrigation along Burnett Creek and the Logan River for about 130km downstream of the dam. This more than doubled the existing area being irrigated to construction of the dam. The dam has outer gravel drains and rockfill to a maximum the height of 47 metres and a crest length of 457 metres. Maroon dam also has upstream and downstream weighting zones. The spillway comprises an unlined outlet channel excavated through the rock of the right bank. A concrete control structure is located part-way along the excavated channel. The spillway control level is 217.51 metres.

An URBS catchment model is available for Maroon Dam. As shown in the following graphs, the URBS catchment model performed well for the January 2011 flood event and was able to provide a useful prediction of dam outflow based on recorded rainfall. The peak outflow from the Dam during the January floods was in the order of 200 m^3/s.

January 2011 – Inflows/Outflows



January 2011 – Water Level

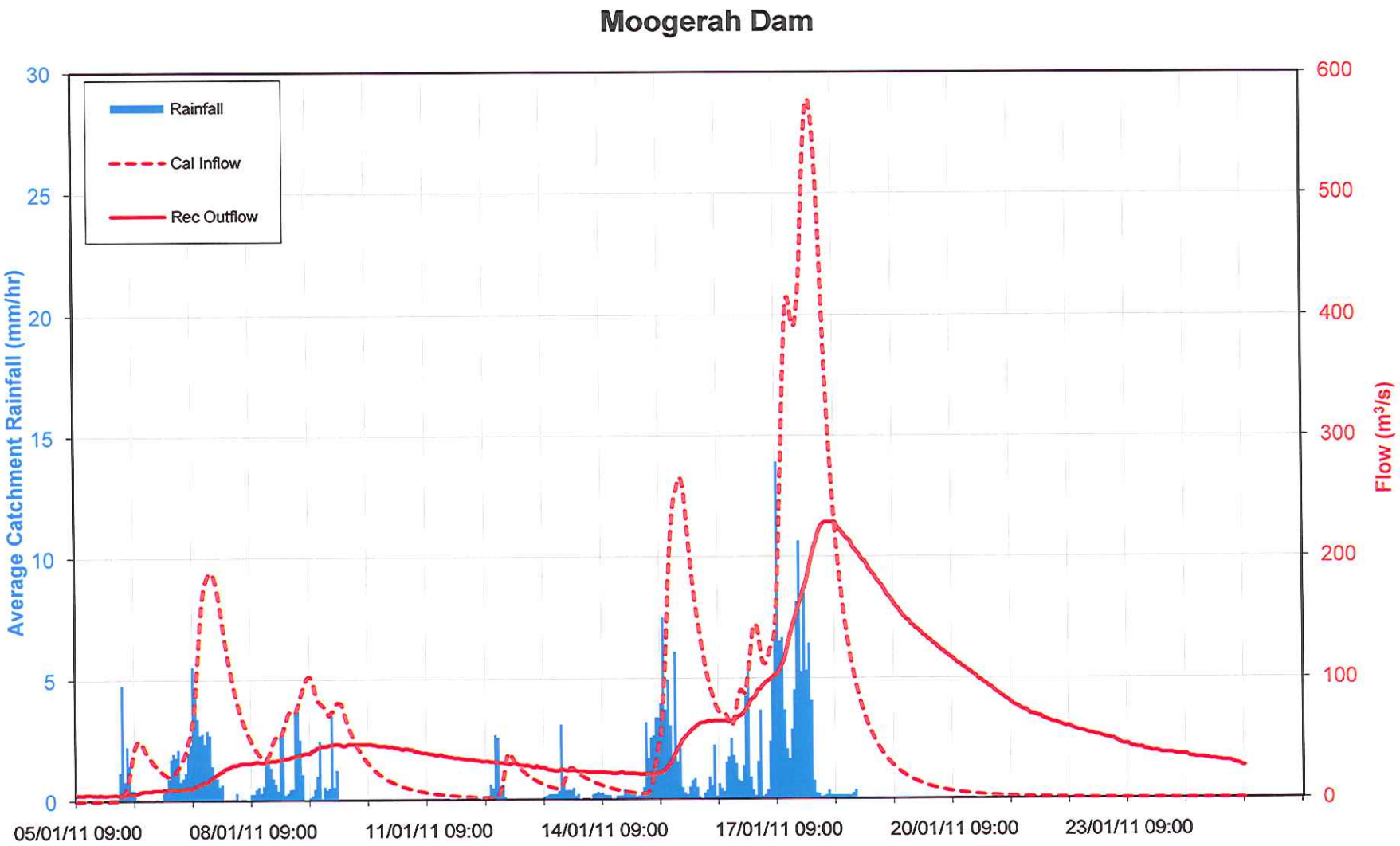


7.15 Moogerah Dam

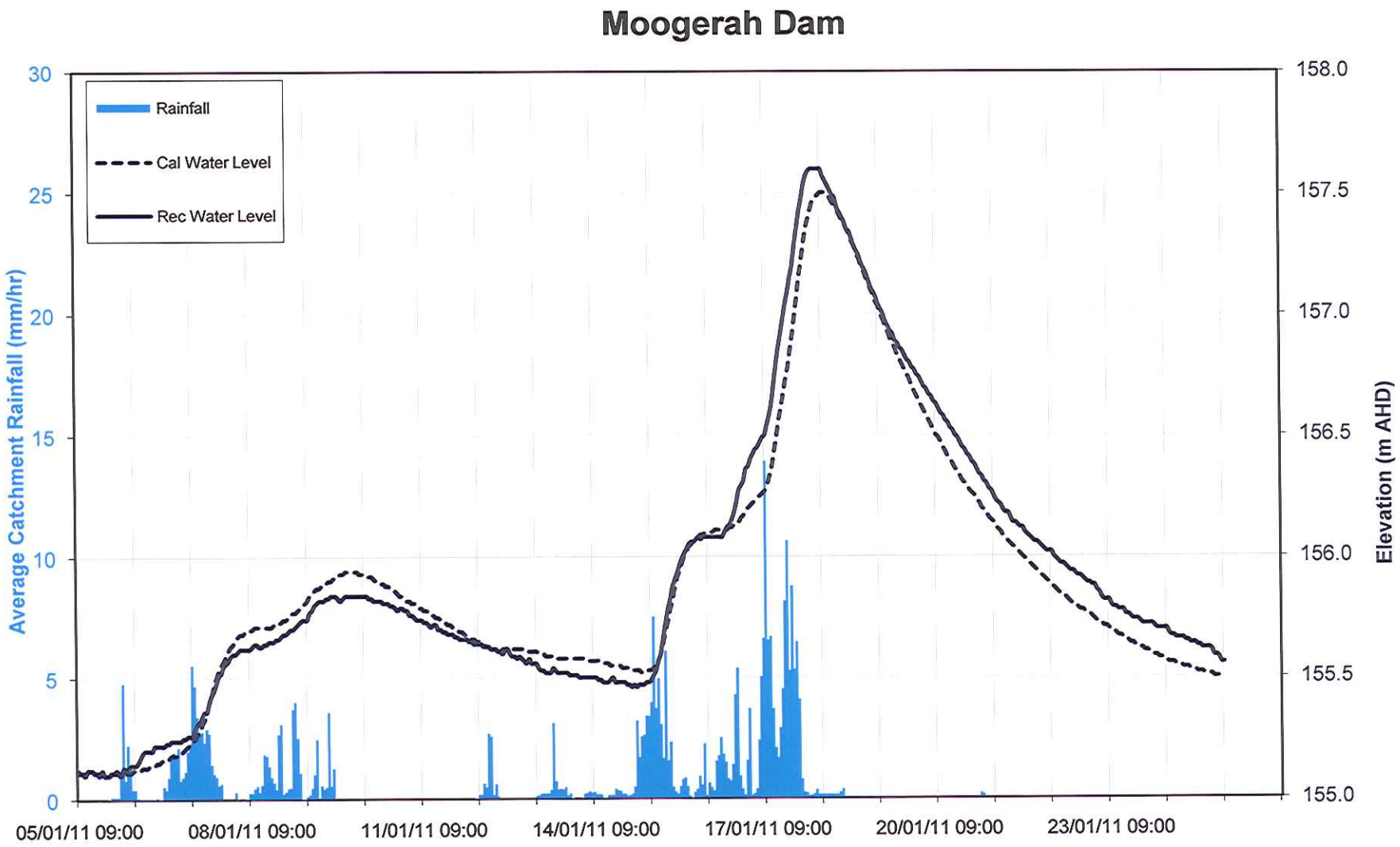
Moogerah Dam has been owned by Seqwater since 1 July 2008. Moogerah Dam provides irrigation supplies to riparian landholders along Reynolds Creek and, through a series of diversions, also supplies water to Warrill Creek and Warrill Valley farmers. Moogerah Dam is a thin double curvature concrete arch with mass gravity thrust blocks on each abutment. The dam has a maximum height of 37.8 metres above the downstream toe. The dam spillway located on the right abutment has an ogee crest and a short apron with a flip exit.

An URBS catchment model is available for Moogerah Dam. As shown in the following graphs, the URBS catchment model performed well for the January 2011 flood event and was able to provide a useful prediction of dam outflow based on recorded rainfall. The peak outflow from the Dam during the January floods was in the order of 230 m^3/s.

January 2011 – Inflows/Outflows



January 2011 – Water Level



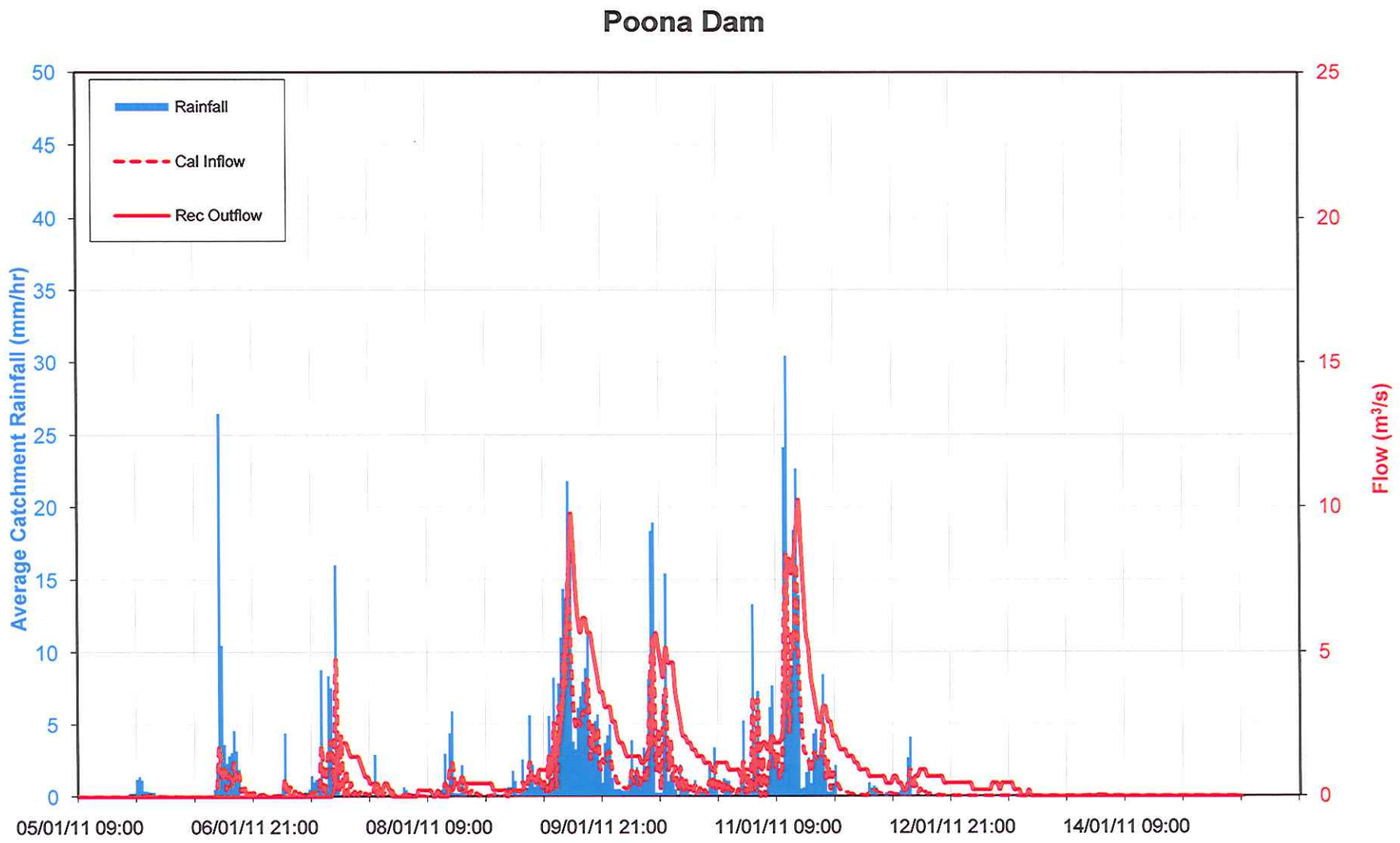
7.16 Poona

Poona Dam has been owned by Seqwater since 1 July 2008. Poona Dam is a low height earth fill structure of maximum height about 10m located in gently undulating pasture land on an unnamed tributary of the South Maroochy River. The structure is located alongside residential properties and close to the Image Flat Water Treatment Plant and forms a headpond for this plant.

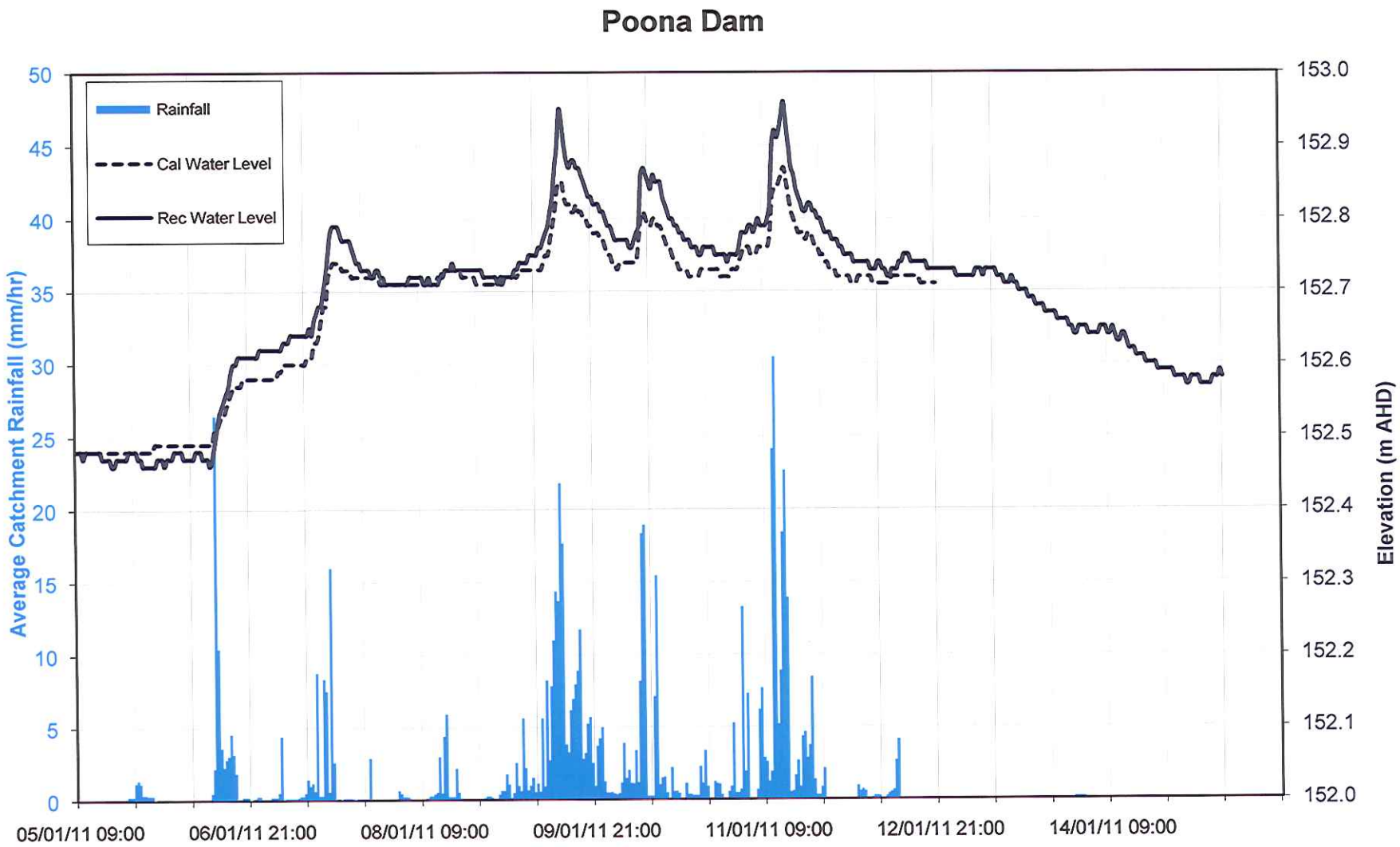
The spillway is a broad crested reinforced concrete, rock filled crib wall on slab with the spillway crest elevation at 152.7 metres. The spillway has an upstream grassed berm of about 600 mm width and upstream slope 3H on 1V constructed to just below the crest of the concrete section. The abutments of the overflow section are stone pitched up to elevation 153.3 to prevent erosion when spilling. The spillway chute is an earthfill channel protected with rock mattresses and gabions. These mattresses were repaired and additional protection was provided in 1997 after erosion occurred on the banks.

An URBS catchment model is available for Poona Dam. As shown in the following graphs, the URBS catchment model performed well for the January 2011 flood event and was able to provide a useful prediction of dam outflow based on recorded rainfall. The peak outflow from the Dam during the January floods was only in the order of 10 m^3/s.

January 2011 – Inflows/Outflows



January 2011 – Water Level

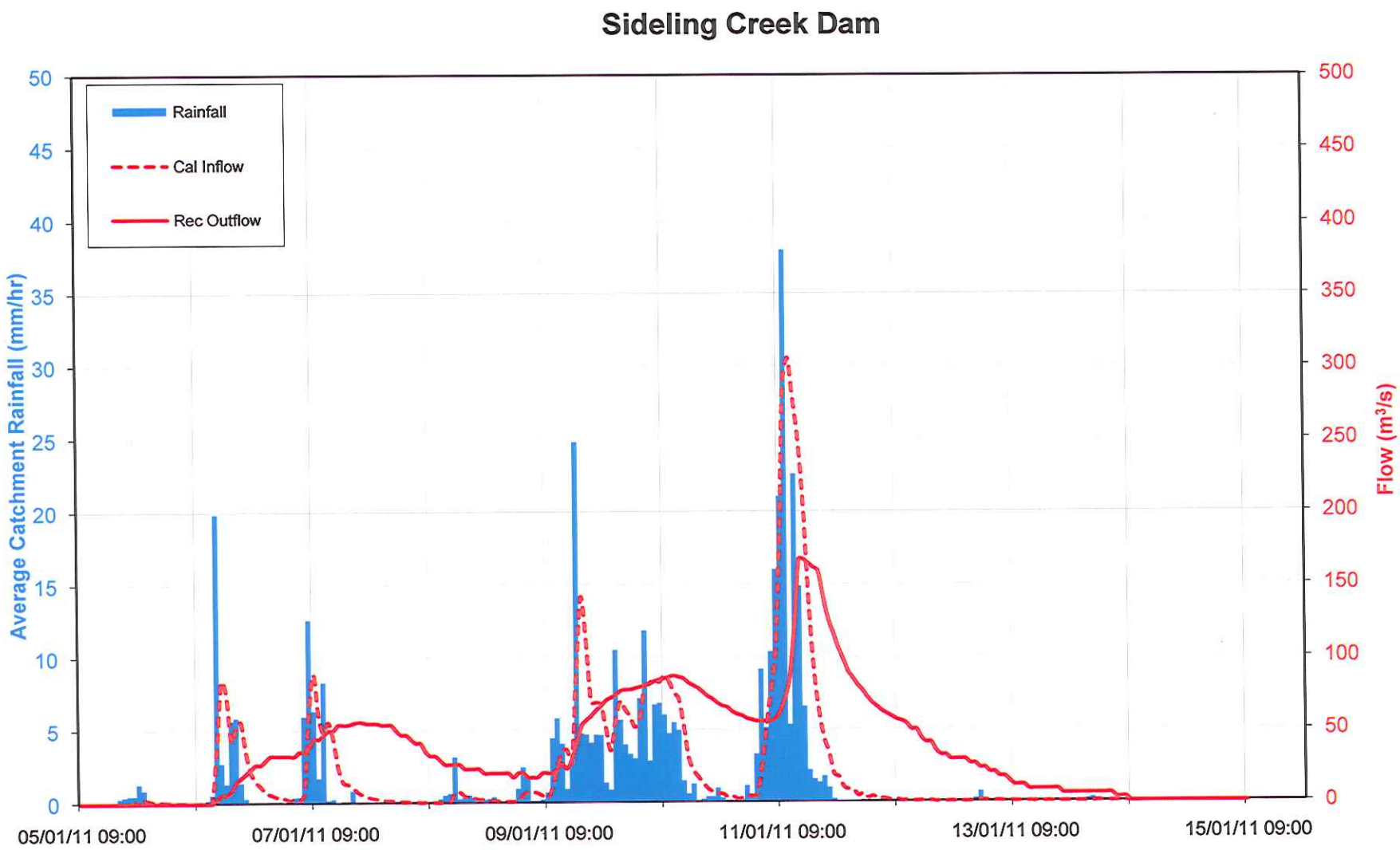


7.17 Sideling Creek Dam

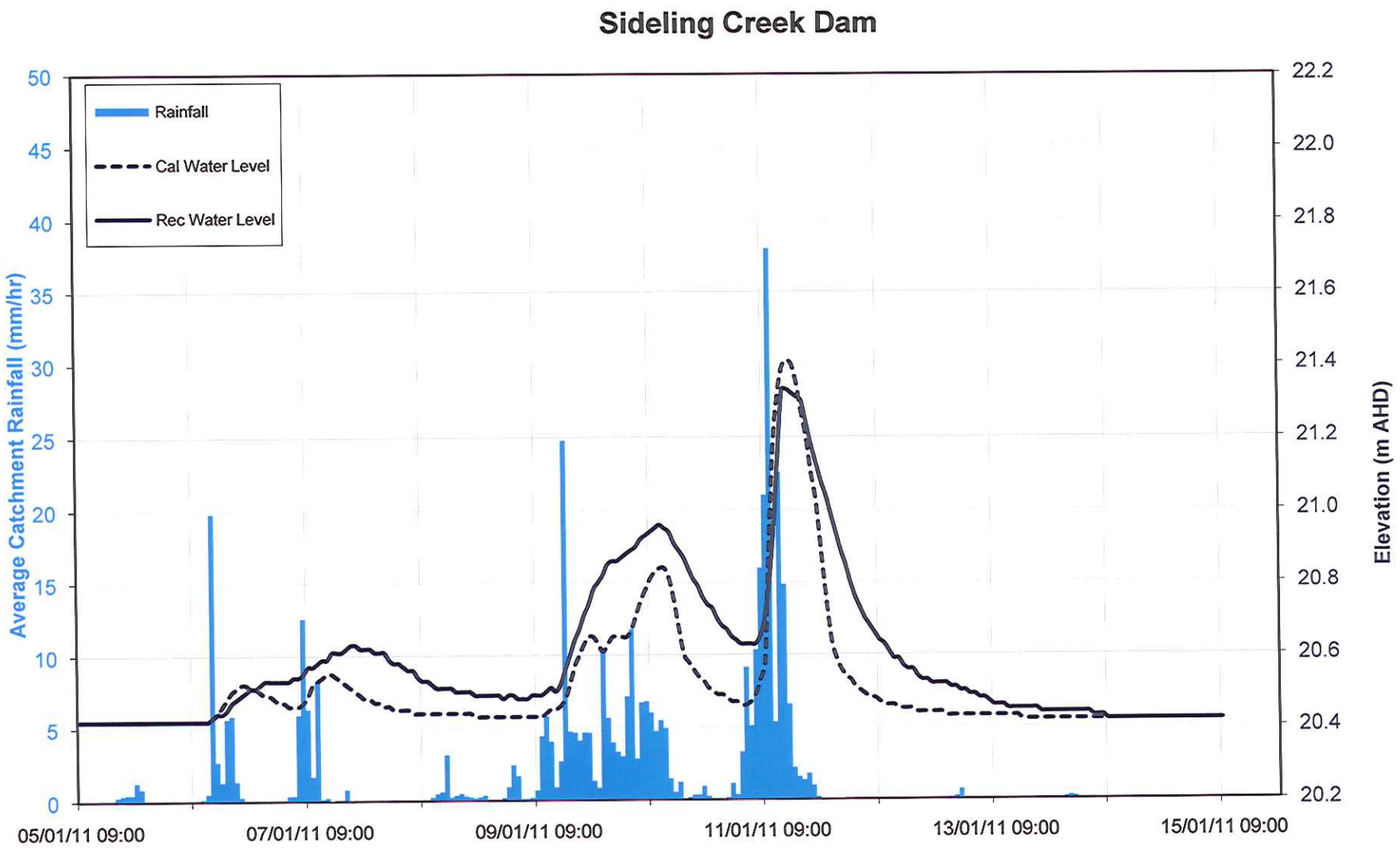
Sideling Creek Dam has been owned by Seqwater since 1 July 2008. The dam is an earthfill embankment approximately 500 metres long and about 25 metres high at maximum section with a crest level of SD 24.08 metres. When the original dam was completed in 1957, the embankment crest level was SD 22.26m and the dam had an uncontrolled spillway with crest level of SD 17.98 metres. The dam (including spillway) was raised in 1969 bringing the full supply level to SD 20.42 metres and storage to 14,400 ML. The dam spillway has a 112m long semi circular ogee type reinforced concrete crest. The crest is at EL 20.42 metres AHD.

An URBS catchment model is available for Sideling Creek Dam. As shown in the following graphs, the URBS catchment model performed reasonably well for the January 2011 flood event and was able to provide a useful prediction of dam outflow based on recorded rainfall. The peak outflow from the Dam during the January floods was in the order of 170 m^3/s.

January 2011 – Inflows/Outflows



January 2011 – Water Level

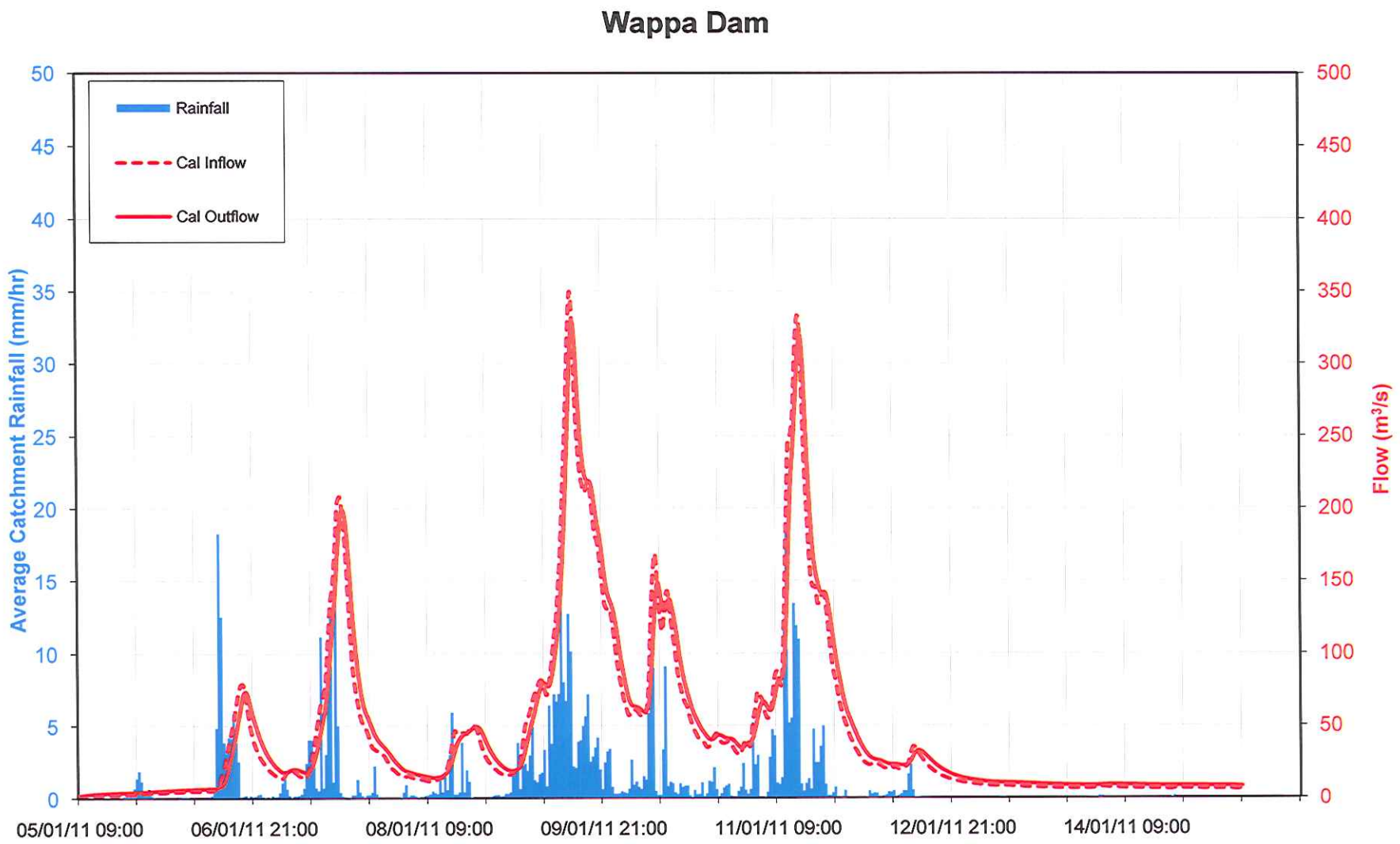


7.18 Wappa Dam

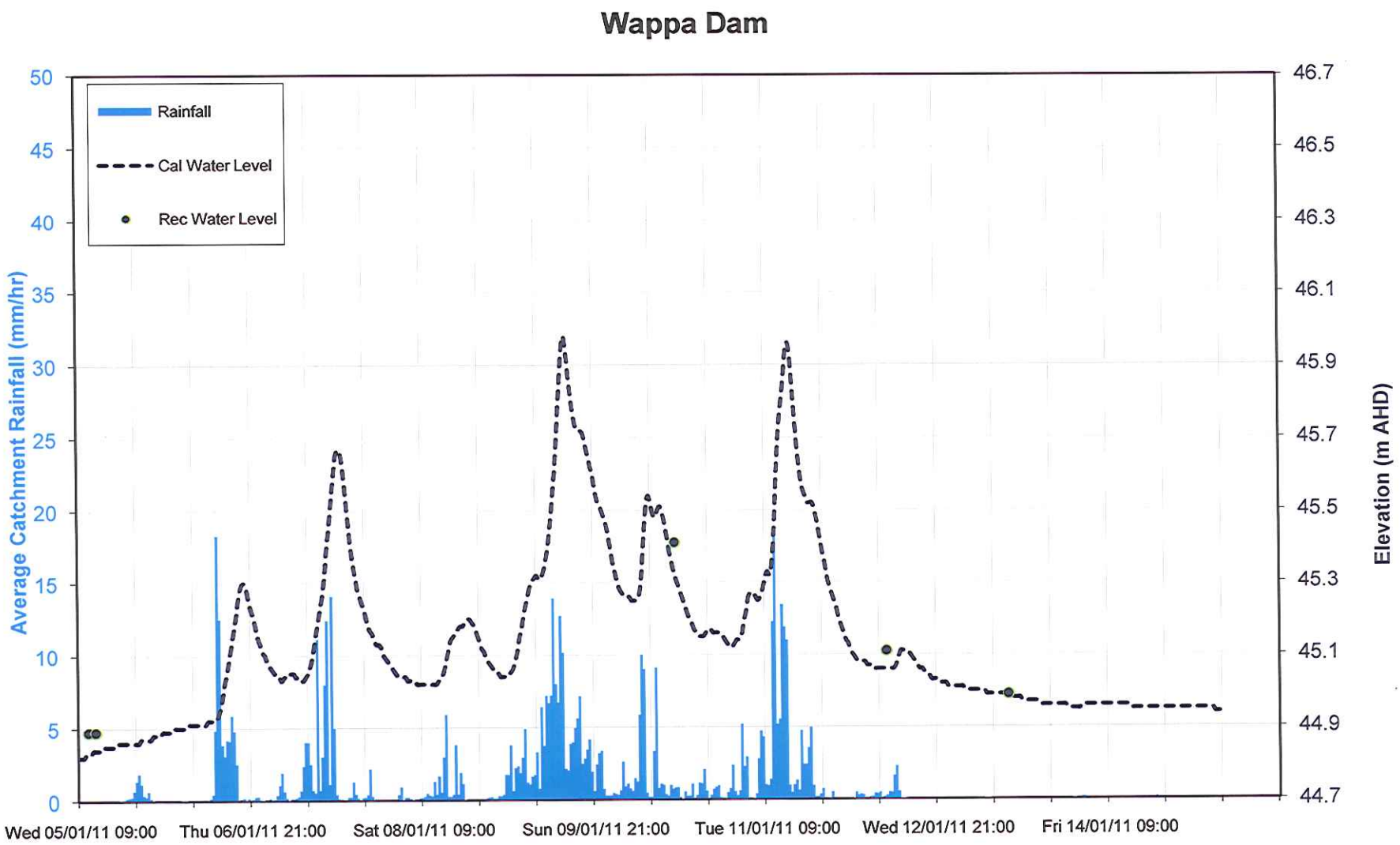
Wappa Dam has been owned by Seqwater since 1 July 2008. Wappa Dam is a composite concrete gravity arch structure with a left bank earth embankment and right bank concrete retaining wall and embankment. The maximum height of the arch section is 24 metres and the earth embankment is about 9 metres high. The dam has been constructed in stages with the first full supply level (FSL) stage to RL 38.7 metres, second stage to RL 41.8 metres and then finally to RL 44.8 metres around 1983. The dam has a concrete gravity spillway with an uncontrolled crest and dentated stilling basin in the central river bed area.

An URBS catchment model is available for Sideling Creek Dam. As shown in the following graphs, the URBS catchment model performed reasonably well for the January 2011 flood event and was able to provide a useful prediction of dam outflow based on recorded rainfall. The peak outflow from the Dam during the January floods was in the order of 340 m^3/s.

January 2011 – Inflows/Outflows

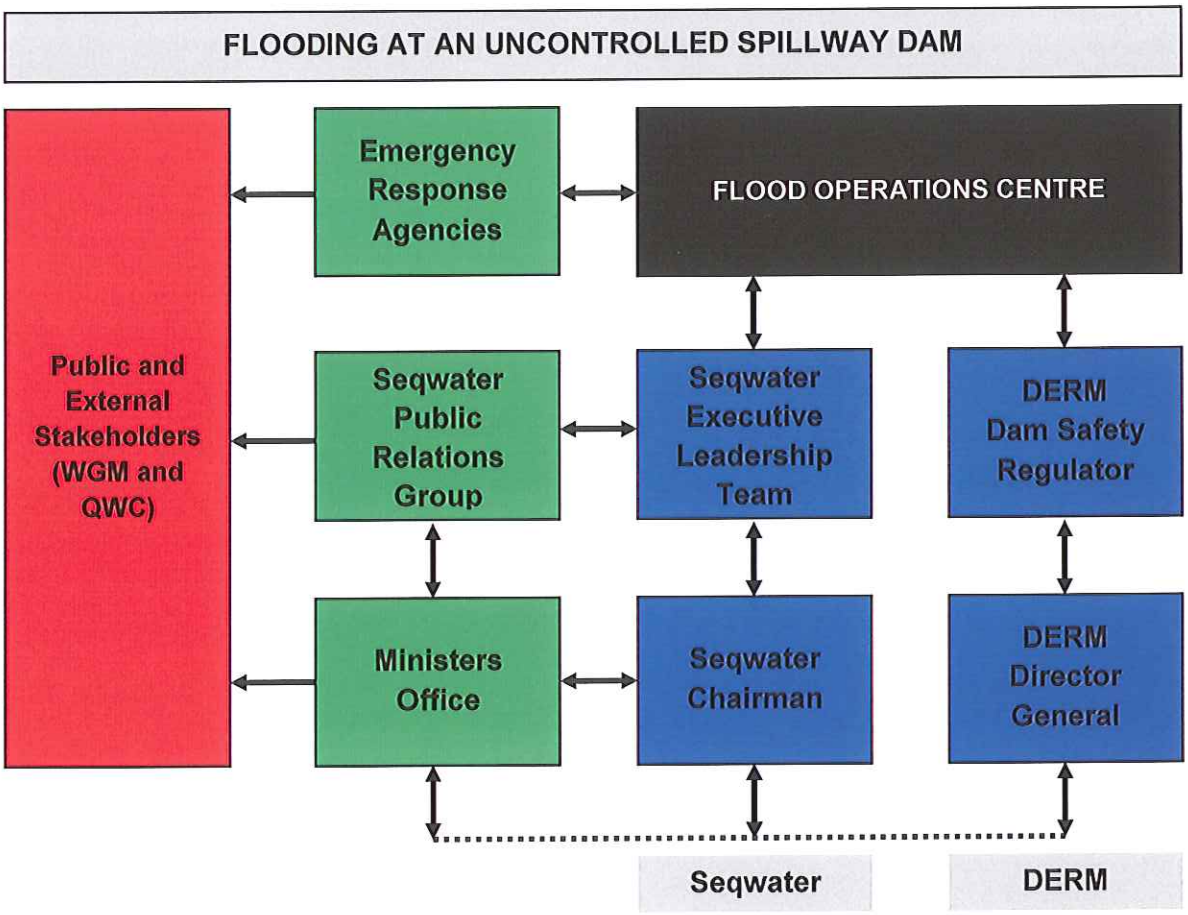


January 2011 – Water Level



8 FLOOD EVENT COMMUNICATIONS

Flood Event communication procedures within Seqwater when releases from controlled spillway dams occur are contained in the Flood Procedure Manual. Similar communication procedures are used for Seqwater's uncontrolled spillway dams. The diagram below shows likely information flows during a Flood Event.



The outflows from Seqwater's uncontrolled spillway dams generally provide a relatively low contribution to flooding within the river basins in which they are located because the catchment areas of the dams are small in relation to the total area of the basin. This is demonstrated in the following table:

DAM	DAM CATCHMENT (km^2)	BASIN NAME	BASIN CATCHMENT* (km^2)	DAM CATCHMENT / BASIN CATCHMENT*
Atkinson Dam	32.7	Brisbane River	15,000	0.22%
Baroon Pocket Dam	67	Mary River	7,333	0.91%
Bill Gunn Dam	3	Brisbane River	15,000	0.02%
Borumba Dam	465	Mary River	7,333	6.34%
Bromelton OSS	1	Logan-Albert	3,850	0.03%
Cedar Pocket	17.8	Mary River	7,333	0.24%
Clarendon Dam	3.4	Brisbane River	15,000	0.02%
Cooloolabin	8.1	Maroochy River	630	1.29%
Enoggera	33	Brisbane River	15,000	0.22%
Ewen Maddock	21	Mooloolah River	196	10.71%
Gold Creek	10.5	Brisbane River	15,000	0.07%
Lake Macdonald	49	Mary River	7,333	0.67%
Lake Manchester	74	Brisbane River	15,000	0.49%
Little Nerang	35.2	Nerang River	400	8.80%
Nindooinbah	0.55	Logan-Albert	3,850	0.01%
Maroon Dam	106	Logan-Albert	3,850	2.75%
Moogerah Dam	228	Brisbane River	15,000	1.52%
Poona Dam	0.73	Maroochy River	630	0.12%
Sideling Creek Dam	53	Pine Rivers	690	7.68%
Wappa Dam	71.5	Maroochy River	630	11.35%

* To basin outlet or closest gauging station to basin outlet.

Accordingly, because of the relatively low contribution to overall basin flooding caused by the outflows from these dams, outflow information from Seqwater's uncontrolled spillway dams is often not critical for use by Emergency Response Agencies during flood emergencies. Accordingly, Seqwater does not automatically provide output from URBS model runs from its uncontrolled spillway dams to Emergency Response Agencies during flood events unless requested. This approach is adopted to ensure that Emergency Response Agencies are not provided with information that is potentially irrelevant during flood emergencies when these Agencies are busy and their resources potentially are stretched to their limit. This process was agreed in meeting with Emergency Response Agencies that took place as shown in the table below. Notes from these meetings are contained in Appendix E.

Council	Dams	Meeting Date and Time
Brisbane City Council	Atkinson, Clarendon, Enoggera, Gold Creek, Lake Manchester, Leslie Harrison, North Pine, Sideling Creek, Somerset, Wivenhoe	17 August 2010, 9:00am
Gympie Regional Council	Borumba, Cedar Pocket	Phone Discussions
Gold Coast City Council	Hinze, Little Nerang	17 August 2010, 11:30am
Ipswich City Council	Lake Manchester, Moogerah, Somerset, Wivenhoe	16 August 2010, 1:30pm
Lockyer Valley Regional Council	Bill Gunn, Clarendon	Phone Discussions
Logan City Council	Bromelton, Maroon, Nindooinbah, Wyaralong	30 August 2010, 9:00am
Moreton Bay Regional Council	North Pine, Sideling Creek	19 August 2010, 10:00am
Redland City Council	Leslie Harrison	8 September 2010, 9:30am
Scenic Rim Regional Council	Bromelton, Maroon, Moogerah, Nindooinbah, Wyaralong	6 September 2010, 9:00am
Somerset Regional Council	Atkinson, Bill Gunn, Clarendon, Somerset, Wivenhoe	19 August 2010, 1:00pm
Sunshine Coast Regional Council	Baroon Pocket, Cooloolabin, Ewen Maddock, Lake Macdonald, Poona, Wappa	18 August 2010, 9:30am

During the January 2011 floods, no specific outflow data from URBS model runs for Seqwater's uncontrolled spillway dams was requested from Emergency Response Agencies. This was expected given the flood warnings issued by the BoM during this period. These are summarised in the following table in relation to Seqwater's uncontrolled spillway dams.

Dam	Approximate Time of January 2011 Peak	Basin	Dates of Basin Flood Warnings For January 2011
Atkinson Dam	11/01/2011 16:00	Brisbane River	6 to 21 January
Baroon Pocket Dam	11/01/2011 15:00	Mary River	6 to 14 January
Bill Gunn Dam	11/01/2011 16:00	Brisbane River	6 to 21 January
Borumba Dam	11/01/2011 05:00	Mary River	6 to 14 January
Bromelton Dam	13/01/2011 06:00	Logan-Albert	12 to 14 January
Cedar Pocket Dam	09/01/2011 23:00	Mary River	6 to 14 January
Clarendon Dam	19/01/2011 21:00	Brisbane River	6 to 21 January
Cooloolabin Dam	09/01/2011 19:00	Maroochy River	9 to 13 January
Enoggera Dam	11/01/2011 16:00	Brisbane River	6 to 21 January
Ewen Maddock Dam	11/01/2011 17:00	Mooloolah River	9 to 13 January
Gold Creek Dam	11/01/2011 14:00	Brisbane River	6 to 21 January
Lake Macdonald Dam	20/01/2011 13:00	Mary River	6 to 14 January
Lake Manchester Dam	11/01/2011 15:00	Brisbane River	6 to 21 January
Little Nerang Dam	11/01/2011 07:00	Nerang River	Nil issued.
Maroon Dam	12/01/2011 05:00	Logan-Albert	12 to 14 January
Moogerah Dam	11/01/2011 19:00	Brisbane River	6 to 21 January
Nindooinbah	11/01/2011 19:00	Logan-Albert	12 to 14 January
Poona Dam	09/01/2011 15:00	Maroochy River	9 to 13 January
Sideling Creek Dam	11/01/2011 14:00	Pine Rivers	Nil issued.
Wappa Dam	09/01/2011 15:00	Maroochy River	9 to 13 January

Overall, communication processes during the January 2011 floods in relation to Seqwater's uncontrolled spillway dams worked well. The Seqwater Executive Leadership Team monitored the situation based on advice provided from the Flood Operations Centre. The BoM issued appropriate flood warnings for the river basins as necessary and the Emergency Response Agencies remained aware that they were able to obtain dam outflow information from Seqwater should it be required.

9 REPORT CONCLUSIONS AND RECOMMENDATIONS

This report shows that Seqwater was well prepared for the 2010/11 wet season and the floods of January 2011. In particular, Seqwater's preparedness for the floods can be demonstrated by the following outcomes leading up to and during the floods:

- Seqwater's uncontrolled spillway dams are maintained in a constant state of readiness for major floods.
- Seqwater's uncontrolled spillway dams are structurally sound and were undamaged by the January 2011 floods.
- Seqwater's flood models worked well during the January 2011 floods and allowed useful outflow predictions from Seqwater's uncontrolled spillway dams to be available for use by Emergency Response Agencies if required.
- Seqwater's Emergency Incident Management performed in an excellent manner during the January 2011 floods and allowed urban water supply continuity to be provided to the communities of southeast Queensland by effectively managing the adverse impacts of the floods on Seqwater's water supply infrastructure.

It is recommended that Seqwater's continuous improvement policy in relation to these systems should remain in place to ensure appropriate response to future flood events. Although the January 2011 floods were unprecedented in Queensland's history, much larger floods are possible and Seqwater must remain prepared for such an eventuality.