FLOODING ON THE TAY

INTRODUCTION

The theme of flooding in Perth is highly and perennially relevant to pupils and their families in and around the city. It offers opportunities for investigating the local area and local issues as well as the chance to involve the wider community.

Below, we suggest some approaches for an investigation of flooding in Perth, its causes and effects over the years and what is being done to reduce the impact of flooding in the future. Particular reference is made to the floods of January 1993. If you choose to focus on these floods, it is recommended that this topic is studied in January, at the same time as the floods of '93. Not only will the weather conditions perhaps be similar, but you may like to find out about the flooding on a 'day by day' basis, imagining that you and your class are experiencing the events as they happened.

We recommend that any teachers investigating the 1993 floods get hold of the following book: The Great Flood, a chronicle of the events and people of Perth and Kinross during the flood of January 1993, Roger Smith (1993) – available cheaply online. It includes photographs, maps and eyewitness accounts and is an invaluable resource.

Other archive material may be found in the archives of the AK Bell library in Perth http://www.pkc.gov.uk/archives Contact the Local History Officer at the library for further information and assistance (01738 477069).

Following these teaching suggestions, we provide background information, a timeline of events and link to the content for pupils shown on the website.

We are extremely grateful to Perth teacher Susan MacLagan for sharing her work on this topic.

Tay Landscape Partnership

FLOODING ON THE TAY

SUGGESTIONS FOR TEACHING AND LEARNING ACTIVITES

CURRICULAR AREA	EXPERIENCES & OUTCOMES	KEY LEARNING ACTIVITIES
Introductory Activities		Look at the online pupil material together. This shows images relating to flooding in Perth. In particular, look at the image of the Old Bridge (Smeaton bridge) with the lines showing flood levels of the river at various times. Even better, if your school is local, take a walk and look at the markings on the bridge itself. Discuss what it would be like if the Tay reached those levels today. Where would the water go? What would be affected?

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SUGGESTIONS FOR TEACHING AND LEARNING ACTIVITES

CURRICULAR AREA	EXPERIENCES & OUTCOMES	KEY LEARNING ACTIVITIES
		Why does the water level of the Tay go up and down? What causes flooding?
Sciences Planet Earth: Processes of the Planet	By investigating how water can change from one form to another, I can relate my findings to everyday experiences. SCN 1-05a	Carry out experiments to investigate the volume of snow/ice/water. Bring in ice from outside or from the freezer. Look at the amount of space it takes up in a transparent container. Allow it to melt and then measure it again.
		This resource from SEPA has a short interactive explaining some of the causes of flooding http://www.sepakids.com
Mathematics: Number, money and measurement	I can estimate how long or heavy an object is, or what amount it holds, using everyday things as a guide, then measure or weigh it using appropriate instruments and units. MNU 1-11a	See also this short video showing the impact of flooding: http://www.bbc.co.uk/education/clips/zfnb9j6
		Discuss what would happen to the Tay after days of heavy rainfall, and if winter snow on the mountains all melted at once.

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SUGGESTIONS FOR TEACHING AND LEARNING ACTIVITES

CURRICULAR AREA	EXPERIENCES & OUTCOMES	KEY LEARNING ACTIVITIES
		The weather in Perth
		As an ongoing activity, set up a weather station outside your classroom and record the temperature and rainfall each day for a month. Compare these settings with the local averages – see background information.
Social Studies: People, Place and Environment	By using a range of instruments, I can measure and record the weather and can discuss how weather affects my life. SOC 1-12a	If possible, access weather records for Perth in 1993 and compare the daily weather (see http://www.metoffice.gov.uk/public/weather/climate-historic/#?tab=climateHistoric for historic data).
		Here are some simple suggestions for setting up your own weather station http://www.metoffice.gov.uk/learning/weather-for-kids/weather-station

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SUGGESTIONS FOR TEACHING AND LEARNING ACTIVITES

CURRICULAR AREA	EXPERIENCES & OUTCOMES	KEY LEARNING ACTIVITIES
Social Studies: People, Past Events and Societies	I can use evidence to recreate the story of a place or individual of local historical interest. SOC 1-03a	What happened in 1993?
		Introduce the topic of the flooding in 1993, perhaps through a drama lesson featuring a weather report for early January 1993. The timeline in the background information below provides a list of the key events.
Social studies: People, Place and Environment	I can describe the physical processes of a natural disaster and discuss its impact on people and the landscape. SOC 2-07b	Pupils investigate the events of January 1993 using books, maps, websites, photographs etc.
Expressive Arts: Drama	I have developed confidence and skills in creating and presenting drama which explores real and imaginary situations, using improvisation and script. EXA 1-14a	The extent of the flooding for each day could be plotted on a different map, so that the development and extent of the flooding can be seen. You could set up an Incident Room, or a TV studio to report on events.
		List all the impacts and repercussions of the flooding.

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SUGGESTIONS FOR TEACHING AND LEARNING ACTIVITES

CURRICULAR AREA	EXPERIENCES & OUTCOMES	KEY LEARNING ACTIVITIES
Social Studies: People, Past Events and Societies	I can use evidence to recreate the story of a place or individual of local historical interest. SOC 1-03a	What was it like to live in Perth during January 1993?
	I am learning to use my notes and other types of writing to help me understand information and ideas, explore problems, generate and develop ideas or create new text. LIT 1-25a	Invite families and neighbours to an open session (with refreshments?) to share their experiences with pupils. Pupils could prepare questions, interview people and take notes and photographs.
Literacy and English: Writing	I can convey information, describe events or processes, share my opinions or persuade my reader in different ways. LIT 1-28a / LIT 1-29a	Using drama, pupils could re-enact some of the rescue or flood stories they have heard.
	Having explored the elements which writers use in different genres, I can use what I learn to create my own stories, poems and plays with interesting structures, characters and/or settings. ENG 1-31a	Pupils could then create newspaper front pages with eyewitness accounts or write dramatic stories describing a rescue.

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SUGGESTIONS FOR TEACHING AND LEARNING ACTIVITES

CURRICULAR AREA	EXPERIENCES & OUTCOMES	KEY LEARNING ACTIVITIES
Social Studies: People, Place and Environment	I can consider ways of looking after my school or community and can encourage others to care for their environment. SOC 1-08a	How can flooding be prevented?
		Pupils investigate strategies for managing flooding, in particular flood defences.
Technologies	Through discovery and imagination, I can develop and use problem-solving strategies to construct models. TCH 1-14a / TCH 2-14a	Take a walk round Perth to look at the flood defences which are decorative as well as practical. Discuss how they work. Take photographs or sketch the defences. Mark these defences on your map.
	Having evaluated my work, I can adapt and improve, where appropriate, through trial and error or by using feedback. TCH 1-14b / TCH 2-14b	In groups pupils could build model flood prevention walls and then test them. In groups, pupils build a wall made of Lego stretching across a classroom tray. This represents the wall of a house.

FLOODING ON THE TAY

SUGGESTIONS FOR TEACHING AND LEARNING ACTIVITES

CURRICULAR AREA	EXPERIENCES & OUTCOMES	KEY LEARNING ACTIVITIES
Social Studies: People, Place and Environment	I can consider ways of looking after my school or community and can encourage others to care for their environment. SOC 1-08a	The teacher should then flood the tray, and pupils watch how the water flows around the wall. Drain the tray. Choosing from a range of materials: cloth, string, sand, paper, plasticene, pebbles etc. pupils construct defences to prevent water from getting through the wall. Then flood the tray again and pupils evaluate their flood defences. What works best? Can they improve their defences?
Technologies	Through discovery and imagination, I can develop and use problem-solving strategies to construct models. TCH 1-14a / TCH 2-14a	
	Having evaluated my work, I can adapt and improve, where appropriate, through trial and error or by using feedback. TCH 1-14b / TCH 2-14b	Invite a council representative to come and talk to the class about Perth's flood defences.

FLOODING ON THE TAY

BACKGROUND INFORMATION

- Perth is built partly on a natural flood plain. The city has suffered flooding for much of its history.
- Particularly bad floods were recorded in 1210, 1648, 1774, 1814, 1993 and 2016. Some of these flood levels are marked on the side of the Old Bridge (Smeaton's bridge) in Perth.
- Smeaton's bridge, completed in 1771 incorporates features to strengthen it against flooding. Two of its nine arches are built on dry land, in readiness for flooding.
- The flooding of 1993 is known today as the Great Flood. It was caused by heavy rain and rapid melting of snow into the rivers Tay and Isla in January 1993. This caused the Tay to rise more than 6m and burst through flood defences at three places near North Muirton.
- Around 1,500 homes were affected, along with numerous businesses, council archives, museum storage and inundated farm land.
- Rescue efforts involved 800 council workers, 500 firemen, 400 policemen and 250 army and navy personnel, as well as hundreds of individuals.
- People were evacuated by boat to the emergency centre set up at Perth Grammar School.
- After the flood, in 2001 a new flood prevention scheme for the city was opened, costing £25m. It is made up of banks of earth and a stone wall stretching more than 8km along the river from north to south of Perth.
- These defences are credited with preventing catastrophic flooding during high water levels in early 2016.

FLOODING ON THE TAY

TIMELINE OF EVENTS

DATE	EVENT
10th January	• 6pm, snow starts falling and continues all night. Snowdrifts start to form and block minor roads. • Strong winds blow from the Arctic.
11th January	• The A9 closes just outside Perth because of the snow. • Farmers try to keep roads open using tractors with ploughs attached. • By 11am the M90 (Perth to Edinburgh motorway) is closed. • Motorists are forced to leave their cars and spend the night in village halls and schools. • Perth is cut off from the rest of Scotland.
12th January	• The weather is still bad and roads are still blocked. Perth is still cut off. • The army take food, medicines and blankets to people stuck in village halls. • Many people can't get to work. • 80,000 people are without power.
13th January	• The weather conditions get a little better and people begin to clear roads and paths. • Drivers go back to their cars as the roads are cleared. They have to dig out their cars and the police help pull them back onto the main roads.

FLOODING ON THE TAY

TIMELINE OF EVENTS

DATE	EVENT
14th January	• The temperature rises and the snow begins to melt. • Rain starts to fall, but the rain gauges are covered in snow so it's not possible to measure rainfall. • Local reservoirs are opened to collect extra water. • A yellow flood warning is issued to farmers near the River Tay and Earn.
15th January	• The really serious flooding begins. • Farms, houses and telephones are affected. • The Emergency Planning Centre opens at 6am, By the end of the day they have had over 100 calls for help. • The River Earn goes to red alert at 8am. • The A9 is closed by more snow. • Craigie Burn is one of first to burst its banks. • At 8.30pm the army is sent to help in Bridge of Earn.

FLOODING ON THE TAY

TIMELINE OF EVENTS

DATE	EVENT
16th January	• As Friday became Saturday the flood gets worse. The weather is now very mild , snow is melting and it is still raining. • A railway bridge at Forgandenny collapses. • Workmen, the army and volunteers fill sandbags. • At 7pm a red alert was issued for Perth. • Everywhere near a river or burn was in danger.
17th January	• The Bridge of Earn is badly flooded by the River Earn and stays high for 27 hours. • Farmland is flooded all along the Tay tributaries. • Helicopters from Scone Aerodrome rescue people. • At 10am the North Inch and nearby homes are flooded. • Elderly people in North Muirton are evacuated to the Grammar School Community Wing. • At 3.51pm water comes over the floodbanks at North Muirton. • Bells Sports Centre and the Museum are flooded. • Both bridges across the Tay are closed. • Anyone with a boat is asked to help in the rescue. • Power is switched off to North Muirton for safety. • The water at its highest at 7.30pm.

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TIMELINE OF EVENTS

DATE	EVENT
18th January	• The water begins to go down slowly. • North Muirton families who stayed overnight in their homes are rescued by boat. • North Muirton school is under 3-4 feet of water. • The Council repairs the floodbanks to stop the flooding at North Muirton.

FLOODING ON THE TAY

TIMELINE OF EVENTS

WEATHER DATA FROM JANUARY

(from http://www.metoffice.gov.uk/pub/data/weather/uk/climate/stationdata/leucharsdata.txt)
NB This data was collected from the nearest weather station, which is at Leuchars.

	AVERAGE FOR JANUARY	JANUARY 1993
MAXIMUM TEMPERATURE	6.6°C	7.6°C
MINIMUM TEMPERATURE	0.5°C	0.7°C
RAINFALL	66.6mm	167.2mm
HOURS OF SUNSHINE	62.3 hours	50.7 hours

SEPA FLOOD MAPS

Maps produced by the Scottish Environment Protection Agency show which areas of Scotland are at most risk of flooding. They can be viewed here: http://www.sepa.org.uk/environment/water/flooding/flood-maps/

EYEWITNESS ACCOUNTS

The floods were discussed in the House of Lords. There are some vivid accounts of the week of the storm here: http://hansard.millbanksystems.com/lords/1993/jan/28/perthshire-floods
An extract from Baroness Strange's account is included in the pupil material.

FLOODING ON THE TAY

FLOOD ALERT!

In **JANUARY 1993** Perth and the surrounding area suffered terrible flooding, known today as **THE GREAT FLOOD**.

Around **1,500** homes were affected, along with shops offices, the museum and farm land.

People were evacuated by boat to the emergency centre set up at Perth Grammar School.

In early **2016 STORM DESMOND** caused terrible flooding again. Luckily the new flood defences in Perth held strong and kept the city safe.

The water level of the Tay was over **6 METRES HIGHER** than usual and burst through flood defences at three places near **NORTH MUIRTON**.

Hundreds of people were involved in rescue efforts: **800** council workers, **500** firemen, **400** policemen and **250** army and navy personnel, as well as **HUNDREDS** of individuals.

After the flood, in 2001 a **NEW FLOOD PREVENTION SCHEME** for the city was opened, costing £25m. It is made up of banks of earth and a stone wall stretching more than **8KM ALONG THE RIVER** from north to south of Perth.

THE METEOROLOGICAL OFFICE

MONTHLY WEATHER REPORT

COMPILED FROM RETURNS OF OFFICIAL AND VOLUNTARY OBSERVERS

MET. O. 1015 U.D.C. 551 506 1 (41-4)

JANUARY 1993

VOLUME 110 NUMBER 1

Mostly warm, but dull, very wet and windy

January started with a ridge over south-eastern Britain. A cold front approached the north-west on the 1st, returning northwards on the 2nd. By the 3rd, the ridge was declining and a deep Icelandic low carried fronts across Scotland and Northern Ireland. The fronts had cleared by midday on the 4th, but further systems were into western parts by midnight, crossing all areas during the 5th as the low became centred off Scotland. A secondary low formed south of Ireland delaying the clearance of the cold front. This front persisted through the Midlands and south-east England during the 6th, finally clearing by midnight. A very deep low south of Ireland rushed fronts across all areas on the 7th, but a lull ensued on the 8th as a ridge covered southern districts. By midnight, an exceptionally deep low off Northern Ireland was pushing fronts across the country; this theme continued over the next two days as the low tracked north-eastwards. Another depression raced across central areas on the 13th, clearing by 1800, followed on the 14th by further troughs after a short-lived ridge. Systems crossed during the 15th and 16th as a deep low formed off north-west Scotland. These cleared during the 17th, allowing a ridge to form on the 18th. Meanwhile a depression formed off south-west Ireland and moved across Scotland, weakening the ridge. An occlusion cleared south-eastwards by 0600 on the 19th, allowing another ridge to form, followed by troughs from the west as a low formed north-west of Scotland. Over the next four days, many systems crossed all areas, controlled by lows passing to the north of Scotland, but by midnight on the 24th, pressure was rising over the Atlantic. On the 25th, south-west Britain was under the influence of high pressure, although troughs still affected north-western Scotland. The high slipped south-westwards during the 26th, allowing fronts to swing south-eastwards across most areas. A new low formed west of Ireland on the 27th, and further troughs crossed all areas, becoming virtually stationary over southern Scotland and northern England on the 28th. On the 29th, a front moved south-westwards to affect eastern Britain, whilst a cold front affected Scotland. By the 30th, a Scandinavian high had moved to central Europe, and another high was building in the Atlantic. A slow-moving front over central parts was the boundary between the highs.

Weather

It was an extremely unsettled month, one of the stormiest ever in Scotland, which was attacked by twenty depressions. After a cold foggy start in England and Wales, things soon became very disturbed as successive depressions sent bands of heavy rain and gales across the whole country. One low, on the 10th, had a central pressure of 914 mb, believed to be the lowest this century. Snow and freezing conditions on the 11th, especially in Scotland, were followed quickly by much higher temperatures melting the snow and causing floods. Over the last few days the weather tempered as pressure rose. Thunder was heard around western Scottish coasts on the 11th, 12th, 14th, 15th and 17th, at Tiree on the 20th and 21st, and over Ulster and western Scotland on the 22nd.

Wind

Gusts to 70 knots or higher were reported from Scotland every day up to the 25th. On the 5th, south-westerly gales drove the oil-tanker ***Braer*** onto rocks in the Shetlands, and subsequent gales destroyed the vessel, causing widespread pollution. On the 10th, high tides and gales caused serious flooding and the death of a canoeist in Strathclyde Region. Severe gales hit England and Wales that day and the 13th, causing many fallen trees and power losses. The 13th claimed six lives - two in a plane crash in Cumbria, one drowning off The Scillies, one following an accident in Northumberland, and two in an accident in Surrey. Six people died on the 15th in accidents in Cumbria, Shropshire, Oxfordshire and Edinburgh. Power lines were brought down in the Highlands on the 18th, and extensive property damage occurred in north Wales and County Durham. On the 17th and 21st, gusts of 125 and 147 knots respectively were recorded at Cairngorm summit, the latter almost a British record. That day, the gusts of 77 and 72 knots at Glasgow and Edinburgh Airports respectively were the highest for 25 years, causing three deaths. On the 24th, a man died in Portland Harbour, Dorset, when his dinghy capsized in gales, and further property damage occurred, especially in Shropshire, Merseyside, the Isle of Wight and Yorkshire. An 82 knot gust was recorded at Leeds Weather Centre, and many of these areas had had their second successive day with these conditions.

Temperature

In the 5th equal warmest January this century, only extreme north-west Scotland was colder than average. Much of England and Wales was over 2.0 ° C above average, with the greatest anomaly of 3.0 ° C above average recorded at three stations :- Christchurch, Dorset, Marlborough, Wiltshire and Nettlecombe, Somerset. Scotland was generally 1 to 2 ° above average, but Cape Wrath, Highland Region, was 0.4 ° below average. The highest temperature was 15.2 ° C at Boulmer, Northumberland, on the 16th, whilst the lowest was -11.0 °C at Moel Cynydd, Powys, on the 3rd, and at Writtle, Essex, on the 11th.

Rainfall

Much of England and Wales had above average rainfall, whilst parts of Scotland had over twice, and in some cases, three times the average. The highest percentage was 324% of average at Strathallan School, Tayside Region, whilst the lowest was 64% of average at L'Ancresse, Guernsey. The highest daily total was 87 mm at Cwmystwyth, Dyfed, on the 26th, and other significant falls were 74 mm at Kinlochewe, Highland Region, on the 16th, and 66 mm at Tyndrum, Central Region, on the 14th and the 21st. Glasgow had its wettest January for 65 years, and stations as distant as Leuchars and Stornoway reported records. On the 10th, torrential rain , gales and high tides led to serious flooding at many southern resorts. Flooding also occurred in Merseyside, Cumbria, Lancashire, Surrey, Berkshire and parts of Wales. Heavy rain plus snowmelt on the 17th led to Perth's highest flood since 1814; large areas of Tayside and also Fife and Central Regions were flooded.

Snow

Snow fell in eastern Scotland on the 3rd, and a band of rain, sleet and snow moved eastwards over Britain on the 4th, with some 30 cm reported from parts of the Pennines. Snow and hail showers affected Scotland on the 8th and 9th, and blustery wintry showers were widespread in Northern Ireland and Scotland on the 10th, bringing power cables down in Lothian Region. The 11th was one of the most wintry days in Scotland for twenty years. Heavy wintry showers brought severe conditions to many regions, including low-lying areas. Many roads were blocked, marooning drivers, rail travel was impossible, and there were similar problems in Northern Ireland. This weather later moved southwards to affect the Pennines, and blizzard conditions continued into the 12th. By then, 40 cm of snow were lying in places, and snow was reported as far south as the Cotswolds and Chilterns. Further snow fell in Scotland over the next few days, but by the 17th, snowmelt was causing major flooding problems in Tayside Region. Wintry showers continued over high ground in Scotland over the next few days, and the 23rd saw widespread snow showers in the Northern Isles. Blustery wintry showers broke out north of the Midlands on the 24th, spreading to many southern parts on the 25th. Sleet or snow occurred over the next few days in northern areas.

Sunshine

January was dull, few places reaching their average. The England & Wales general value of 1.25 hours represents 76% of the 1961-1990 average, the dullest January since 1975. Anomalies ranged from 124% of average at Buxton, Derbyshire, to 22% of average at Poolewe, Highland Region. The highest daily total was 7.7 hours at Drummond Castle, Tayside, on the 31st, whilst the highest monthly total was 67.6 hours at Sunderland Polytechnic, Tyne & Wear.

Fog

Dense freezing fog was widespread over central and southern parts on the 1st and 2nd, and a woman died in Kent on the 1st in one of numerous accidents. The fog persisted in some areas until the morning of the 3rd, returning widely on the afternoon of the 4th. During the next few days, many coastal and some hilly inland areas were affected by fog. Further fog formed over central and southern England early on the 7th, but no further fog was reported until a few coastal patches in Kent on the morning of the 20th. Hill or coastal patches formed in central England, East Anglia, the south-east and Wales on the 27th, lingering into the 28th. Patches formed in the Scottish Highlands on the 29th, as they did in a few other places. Dense fog affected the south-west, parts of the West Midlands and the north early on the 30th, and also the Suffolk coast that evening, spreading to Norfolk on the 31st.

Miscellaneous phenomena

Whirlwinds were reported at Congresbury, Avon, on the 12th, and Kirton, Lincolnshire, on the 13th.

Additional to Monthly Parts, each Annual Volume of the Weather Report includes an explanatory introduction and a summary for the year.

Not just flooding…

Here is an account from a woman who lived in the area:

> “On Friday 15th January we were wakened by the sound of a huge oak tree crashing down at the back-door, removing half of our driveway. In the Carse we had gale force winds all day, with hurricane gusts up to 140 miles per hour. These combined with the heavy flooding (from Balmyre Hill the Carse, which is all about sea level, looked like a river) loosened the roots of the trees, so that large trees were crashing everywhere like ninepins. With us, three trees fell, bringing down electricity lines, two blocked a side road and another three had to be cleared from blocking access to people's houses. Slates whizzed off the roof and embedded six inches deep in the grass. It was simply awful. Three hundred year-old oaks and lime trees crashed to the ground or split in half 50 feet up. Parts of the dome in the centre of our house fell in, spraying the carpet with rain and broken glass. At Bridge of Earn the river began to rise and started to burst its banks.”
>
> - Baroness Strange, speaking in the House of Lords