

# Plean um Bainistiú Priacal Tuile

# Flood Risk Management Plan

An Leamhain – An Mhaing – Bá an Daingin  
**Laune – Maine – Dingle Bay**

# Plean um Bainistiú Priacal Tuile

## Flood Risk Management Plan

### Amhantrach (22) An Leamhain - An Mhaing - Bá an Daingin

### River Basin (22) Laune - Maine - Dingle Bay

*Limistéir um Measúnú Breise a chuimsítear sa phlean seo:*  
*Areas for Further Assessment included in this Plan:*

<i>Cill Airne</i>	<i>Killarney</i>
<i>Oileán Ciarraí</i>	<i>Castleisland</i>
<i>Daingean Uí Chúis</i>	<i>Dingle</i>
<i>Gleann Fleisce</i>	<i>Glenflesk</i>
<i>Baile an Mhuilinn</i>	<i>Milltown</i>
<i>An Caladh</i>	<i>Portmagee</i>
<i>An Tulaigh</i>	<i>Tullig</i>

Ullmhaithe ag Oifig na nOibreacha Poiblí 2018  
Prepared by the Office of Public Works 2018

*De réir In accordance with*

*Rialacháin na gComhphobal Eorpach (Measúnú agus Bainistiú Priacal Tuile) 2010 agus 2015*  
*European Communities (Assessment and Management of Flood Risks) Regulations 2010 and 2015*

## **Séanadh Dlíthiúil**

Tugadh na Pleananna um Bainistiú Priacal Tuile chun cinn mar bhonn eolais le céimeanna indéanta agus molta chun priacal tuile in Éirinn a fhreagairt agus le gníomhaíochtaí eile pleanála a bhaineann leis an rialtas. Ní ceart iad a úsáid ná brath orthu chun críche ar bith eile ná um próiseas cinnteoireachta ar bith eile.

## **Legal Disclaimer**

The Flood Risk Management Plans have been developed for the purpose of informing feasible and proposed measures to address flood risk in Ireland and other government related planning activities. They should not be used or relied upon for any other purpose or decision-making process.

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# ACHOIMRE FHEIDHMEACH

## RÉAMHRÁ

Is é seo an Plean um Bainistiú Priacal Tuile (an 'Plean') d'Abhantrach An Leamhain - An Mhaing - Bá an Daingin. Tá cur síos ar an Abhantrach i Rannán 2 den Phlean.

Is cuspóir don Phlean straitéis, ar a n-áirítear sraith céimeanna molta, um bainistiú costéifeachtach inbhuanaithe fadtéarnmach an phriacail tuile ins an Abhantrach a leagan amach, ar a n-áirítear limistéir inar cinneadh go bhfuil an priacal tuile dóchúil suntasach.

Tá an Plean seo, don tréimhse 2018-2021, ar cheann de 29 bPlean atá dá bhfoilsiú; leagann gach ceann acu amach an réimse indéanta de chéimeanna um bainistiú priacal tuile atá molta dá nAbhantracha ar leith. Céim shuntasach chun tosaigh is ea ullmhú na bPleananna seo maidir le feidhmiú pholasaí an Rialtais um bainistiú priacal tuile, mar atá leagtha amach i dTuarascáil an Ghrúpa um Athbhreithniú ar Pholasaí Tuile (OPW, 2004<sup>1</sup>), agus freagraíonn sé oibleagáidí na hÉireann faoi Threoir 'Tuilte' an AE 2007 (EU, 2007<sup>2</sup>).

Cuimsíonn an Plean céimeanna indéanta a tugadh chun cinn trí réimse clár agus tionscnamh polasaí ar a n-áirítear:

- Céimeanna neamhstruchtúrtha um chosc agus ullmhacht priacal tuile atá infheidhme ar bhonn náisiúnta, dírithe ar thionchair thuilte a laghdú, a tugadh agus atá á dtabhairt chun cinn chun polasaí Rialtais um bainistiú priacal tuile a fheidhmiú (OPW, 2004).
- Céimeanna struchtúrtha um chosaint tuile atá molta do phobail atá ar phriacal suntasach tuile, dírithe ar dhóchúlacht agus/nó céim thuilte a laghdú, a léiríodh tríd an Chlár Náisiúnta um Measúnú agus Bainistiú Priacal Tuile Abhantraí (MBPTA).

Scrúdaigh an Clár MBPTA an priacal tuile, agus céimeanna féideartha um an priacal a fhreagairt, in 300 pobal ar fud na tíre atá ar phriacal dóchúil suntasach tuile. Léiríodh na pobail seo ins an Réamh-Mheasúnú um Priacal Tuile (RPT); measúnú náisiúnta scagtha a bhí anseo. I dTábla ES-1 thíos tugtar liosta na bpobal atá léirithe tríd an phróiseas RPT mar phobail atá faoi phriacal dóchúil suntasach tuile in Abhantrach An Leamhain - An Mhaing - Bá an Daingin chomh maith leis na foinsí tuile a cinneadh a bheith suntasach maidir le gach pobal. Tugadh chun cinn agus foilsíodh sraith mapaí tuile le haghaidh gach pobal díobh, ag léiriú na limistéir atá ar phriacal tuile.

Tógann an Plean ar an chlár náisiúnta oibreacha cosanta tuile a críochnaíodh roimhe seo, orthu san atá faoi dhearadh agus faoi thógáil um an dtaca seo nó atá leagtha amach trí thionscadail nó pleananna eile, agus ar chothabháil leanúnach ar scéimeanna dhraenála agus faoiseamh tuile.

Rinneadh Measúnú Straitéiseach Comhshaoil, agus Measúnú Cuí faoin Treoir um Ghnáthóga mar ba chúil, mar chuid den ullmhú, agus tá siad folisithe i dteannta leis an Phlean.

<sup>1</sup> Tuarascáil an Ghrúpa um Athbhreithniú ar Pholasaí Tuile, OPW, 2004 ([www.floodinfo.ie](http://www.floodinfo.ie))

<sup>2</sup> Treoir faoi mheasúnú agus bainistiú priacal tuile, 2007/60/EC

**Táble ES-1 Pobail atá ar Phriacal Dóchúil Suntasach Tuile taobh istigh d'Abhantrach An Leamhain - An Mhaing - Bá an Daingin**

CONTAE	AINM an PHOBAIL	FOINSÍ PRIACAL TUILE
Ciarraí	Oileán Ciarraí	Abhann
Ciarraí	Daingean Uí Chúis	Abhann / Cósta
Ciarraí	Gleann Fleisce	Abhann
Ciarraí	Cill Airne	Abhann
Ciarraí	Baile an Mhuilinn	Abhann
Ciarraí	An Caladh	Cósta
Ciarraí	An Tulaigh	Abhann

## CUSPÓIRÍ AN PHLEAN

Is é cuspóir foriomlán an Phlean ná tionchair tuilte a bhainistiú agus a laghdú, agus aird ar shochair agus éifeachtaí eile, ar fud réimse leathan earnála, ar a n-áirítear sláinte daoine, an comhshaoil, an oidhreacht chultúrtha agus gníomhaíocht eacnamaíoch, trí scéimeanna inmharthana cosanta tuile agus céimeanna eile, bunaithe ar thuiscint chruinn ar phriacal tuile mar atá léirithe in ullmhú mapáí tuile.

Maidir le gach ceann ar leith de na hearnála seo tugadh chun cinn sraith cuspóirí a bhí comhsheasmhach ar bhonn náisiúnta. Tugtar liosta de na cuspóirí ar leith seo agus an tábhacht a bhaineann le gach ceann díobh i Rannán 1.4 den Phlean.

## RAON AN PHLEAN

Leagtar amach raon an Phlean thíos:

- **Raon Spásúil:** Leagann an Plean amach céimeanna inmharthana, scéimeanna cosanta tuile go hiondúil, atá molta chun priacal tuile a bhainistiú agus a laghdú ins na pobail sin a léiríodh tríd an RPT a bheith faoi phriacal dóchúil suntasach tuile. Leagtar amach freisin réimse polasaí agus céimeanna neamhstruchtúrtha, atá in áit nó faoi fhorbairt, a thacaíonn le laghdú agus bainistiú priacal tuile ar fud na hAbhantraí.
- **Foinsí Priacal Tuile:** Freagraíonn na céimeanna cosanta tuile atá leagtha amach sa Phlean priacal tuile ó na foinsí tuile mar a léiríodh i dTábla ES-1 i bpobal amháin nó níos mó, mar cinneadh tríd an RPT go raibh na foinsí seo dóchúil suntasach ins na pobail seo. Féadfaidh an réimse polasaí agus céimeanna neamhstruchtúrtha tacú le laghdú agus le bainistiú priacal tuile ó fhoinsí uile priacal tuile.
- **Leibhéal Sonraí:** Leagtar amach sa Phlean na céimeanna atá léirithe mar na céimeanna is cuí ag an phointe seo measúnaithe. Is dearadh imlíneach iad na céimeanna cosanta tuile a leagtar amach sa Phlean; níl siad réidh um thógáil ag an am seo. Beidh gá le dearadh breise mionsonraithe, ar a n-áirítear athbhreithniú ar chostais agus tairbhí, measúnú comhshaoil agus comhairliúchán roimh a bhfeidhmiú.

## COMHAIRLIÚCHÁN AGUS PLÉ LE POBAL AGUS LE PÁIRTITHE LEASMHARA

Rinneadh comhairliúchán poiblí ar scála leathan le linn do na mapáí tuile agus na Pleananna a bheith dá n-ullmhú. Cuireadh suíomhanna gréasáin don Chlár MBPTA agus do na Tionscadail ar fáil chun eolas faoin phróiseas iomlán agus faoi na tionscadail bhainteacha a

sholáthar agus chun torthaí na dtionscadal a fhoilsiú (tá an t-eolas a bhí ar fáil ar na suíomhanna gréasáin sin ar fáil anois ag [www.floodinfo.ie](http://www.floodinfo.ie)).

Thionól an OPW breis agus 200 Lá Comhairliúcháin Phoiblí maidir leis na mapaí tuile ins na pobail bhainteacha; bhí deis ag daoine tuithe staitiúla agus cruinneas na mapaí a phlé leis na hinnealtóirí ón OPW agus a gcuid comhairleoirí. Tharla comhairliúchán reachtúil phoiblí faoi na mapaí tuile go déanach sa bhliain 2015. In ullmhú na mapaí críochnaithe tugadh aird ar na tráchtas, tuairimí agus agóidí ó na Laethanta Comhairliúcháin Phoiblí agus ón chomhairliúchán foirmiúil chun eolas áitiúil ar thuilte agus tuairimí an phobail a chuimsiú ins na mapaí.

Tionóladh dhá bhabhta de Laethanta breise Comhairliúcháin Phoiblí ins na pobail maidir leis na roghanna dóchúla agus ansin maidir leis na Dréacht-Phleananna um bainistiú an phriacail tuile. Tionóladh comhairliúchán reachtúil phoiblí eile maidir leis na Dréacht-Phleananna. Breathnaíodh an réimse leathan tuairimí agus aighneachtaí a tháinig trí na comhairliúcháin seo agus tugadh san áireamh iad de réir mar ba chuí nuair a bhí na Pleananna dá gcríochnú.

Tiomsaíodh Grúpaí Náisiúnta agus Réigiúnacha Páirtithe Leasmhara chun deis a thabhairt do pháirtithe leasmhara páirt a ghlacadh in ullmhú na mapaí tuile agus na bPleananna. Bhí cruinnithe comhordaithe leis na húdaráis atá freagrach as an Creat-Treoir Uisce a fheidhmiú agus, maidir le habhantracha a roinntear i bpáirt le Tuisceart Éireann, leis na húdaráis chuí ansin.

Tá cur síos ar na gníomhaíochtaí maidir le comhairliúchán leis an bpobal agus le páirtithe leasmhara i Rannán 4 den Phlean.

## MEASÚNÚ TEICNIÚIL

In ullmhú an Phlean bhí anailís agus measúnú forleathan teicniúil chun an priacal tuile a léiriú tríd an PBT a chinneadh agus ansin chun céimeanna roghnaithe inmharthana um fhreagairt an phriacail a léiriú. Ar an measúnú teicniúil seo bhí:

- **Suirbhé ón Aer:** Suirbhé ón aer ar thopagrafaíocht na dtuilemhánna, chun anailís a dhéanamh ar chonas a scaipeann uiscí tuile trasna na dtuilemhánna.
- **Suirbhé Topagrafaíoch:** Suirbhé de thalamh ar leagan amach na n-aibhneacha agus na sruthán a ritheann trí na limistéir agus ansin anuas chun na farraige, ar a n-áirítear suirbhéanna ar chruth ghrinill abhann, na bruacha agus na struchtúir atá in aice leis na cainéil nó os a gcionn nó iontu.
- **Anailís Hidreolaíoch:** Anailís chun sruthanna tuile isteach agus trí na haibhneacha agus na sruthán a chinneadh, chomh maith leis na géirleibhéil farraige is cúis le tuilte. Bhí tuairisc ar leibhéil agus srutha stairiúla abhann mar bhonn eolais leis seo, maraon le meastachán ar thionchair dhóchúla athrú aeráide ar shrutha tuile agus géirleibhéil farraige.
- **Samhaltú Hiodrálach:** Tugadh chun cinn samhaltuithe ríomhaire de na haibhneacha, srutháin agus tuilemhánna chun leibhéil tuile um shrutha tugtha tuile a mheas agus a fhiosrú conas a rithfeadh agus a leathnódh tuilte ar fud na dtuilemhánna, ag tabhairt aird ar chosanta tuile atá ann cheana. Bhí na samhaltuithe mar bhonn eolais um éifeacht céimeanna dóchúla chun an priacal tuile a bhainistiú agus a laghdú.
- **Mapáil Tuile:** Maidir leis na limistéir shamhaltaithe, ullmhaíodh mapaí tuile chun réimse, doimhneacht agus luas srutha na n-uiscí tuile a thaispeáint, chomh maith le réimse mapaí guaise (chun baol agus tionchair dhóchúla tuilte a thaispeáint) agus mapaí Creasa Tuile mar bhonn eolais ar phleanáil agus forbairt inbhuanaithe. Don chás reatha agus don chás amach anseo, ullmhaíodh mapaí ócáidí tuile le réimse dóchúlachtaí

tarlaithe (ó ócáidí le seans 1 as 2 in aon bhliain ar leith, chuig ócáidí le seans 1 as 1000 in aon bhliain ar leith), ag tabhairt aird ar thionchair dhóchúla ón athrú aeráide.

- **Measúnú Priacail:** Measúnú ar thionchair dhóchúla tuilte ins na pobail, ag tabhairt san áireamh an díobháil a fhéadfadh tuilte a dhéanamh maidir le tithe cónaithe, sócmhainní pobail agus sochaí, gnóthais, talmhaíocht, bonneagar, an comhshaoil agus an oidhreacht chultúrtha áitiúil. Rinneadh measúnú priacail eacnamaíoch (díobháil) chun impleachtaí eacnamaíocha tuilte ins na pobail a chinneadh.
- **Measúnú agus Breithmheas ar Chéimeanna Dóchúla um Bainistiú Priacal Tuile:** Rinneadh réimse leathan céimeanna dóchúla um bainistiú priacal tuile ins na pobail a bhí ar phriacal suntasach tuile a fhorbairt, a mheasúnú agus a bhreithmheas chun céim dóchuil roghnaithe a léiriú um a mholadh sa Phlean. Bhí roinnt ceimeanna i gceist anseo:
  - o **Scagadh:** Measúnú ar mhodhanna dóchúla um bainistiú priacal tuile chun iad san a fhéadfadh bheith éifeachtach agus inmharthana a léiriú.
  - o **Céimeanna Dóchúla Inmharthana a Fhorbairt:** Cumadh modhanna dóchúla éifeachtacha i gcéimeanna dóchúla; rinneadh iad san a fhorbairt chuig dearadh imlíneach agus ríomhadh an costas dóchuil ar an chéim sin a fheidhmiú agus a chothabháil.
  - o **Breithmheas faoi ‘Anailís Ilchritéir’ (AI):** Rinneadh measúnú agus breithmheas ar na céimeanna indéanta trí AI chun a n-éifeacht um bainistiú priacal tuile agus na sochair agis tionchair dhóchúla faoi réimse aidhmeanna ar leith a chinneadh.
  - o **Breithmheas Eacnamaíoch:** Rinneadh anailís eacnamaíoch costais tairbhe ar na céimeanna indéanta chun inmharthanacht aon chéimeanna molta a chinntiú.
  - o **Plé le Pobail agus le Páirtithe Leasmhara:** Chuathas i gcomhairle leis na pobail áitiúla, ionadaithe tofa agus páirtithe leasmhara eile san áireamh, chun tuairimí ar aon chéim mholta a ghlacadh ar bord.
  - o **Céimeanna Roghnaithe a Léiriú:** Ceim roghnaithe do na pobail a chinneadh, ag tabhairt aird ar shochair agus ar thionchair eacnamaíocha, comhshaoil agus foriomlána, tuairimí an phobail áitiúil agus páirtithe leasmhara agus costais tuartha na céime.

Maidir le cuid de na pobail, chinn an anailís mionsonraithe teicniúil go bhfuil leibhéal íseal priacal tuile don phobal ó aibhneacha agus/nó an fharraige. Ins na cásanna sin, níorbh fhiú céimeanna um bainistiú priacal tuile (i.e. scéimeanna áitiúla um fhaoiseamh tuile) a fhorbairt dírithe ar na pobail sin ar leith a chosaint. Le haghaidh pobail eile, fuarthas amach nach mbeadh sé indéanta scéimeanna um chosaint tuile a chur chun cinn. Ach féadfaidh polasaithe agus céimeanna neamhstruchtúrtha atá infheidhme ins na limistéir uile an priacal reatha agus dóchuil a bhainistiú agus a laghdú ins na pobail seo.

Tá cur síos ar na measúnaithe teicniúla i Rannáin 5 agus 7 den Phlean.

## MEASÚNAITHE COMHSHAOIL

Rinneadh Measúnú Straitéiseach Comhshaoil (MSC) agus, nuair ba ghá, Measúnú Cuí (MC) ar Phleanleibhéal faoin Treoir um Ghnáthóga, chun sochair agus tionchair dhóchúla na bPleananna ar an chomhshaoil a chinneadh, agus chun céimeanna maolaithe agus monatóireachta a léiriú um thionchair dá leithéid a sheachaint nó a íoslaghdú.

Ba chóir a thabhairt faoi deara nach ionann faomhadh an Phlean agus cead a thabhairt um oibreacha fisiciúla ar bith a thógáil. Ní foláir Measúnú Tionchair Chomhshaoil agus Measúnú Cuí ar leibhéal tionscadail a dhéanamh, de réir na reachtaíochta bainteach mar is cuí, mar chuid de chur chun cinn céimeanna molta lena mbaineann oibreacha fisiciúla.

Tá cur síos ar na ceisteanna agus measúnaithe comhshaoil a ndearnadh i Rannán 6 den Phlean.

## CÉIMEANNA MOLTA

Tá achoimre ar na céimeanna atá molta sa Phlean, agus na scéimeanna agus oibreacha um bainistiú priacal tuile atá curthe chun cinn nó á moladh trí thionscadail nó pleananna eile, leagtha amach anseo thíos.

Is ar dhearadh imlíneach, nach bhfuil réidh ag an bpointe seo um thógáil, atá na hoibreacha fisiciúla um fhaoiseamh tuile nó ‘Scéimeanna’ a tugadh chun cinn tríd an Chlár MBPTA. Roimh a bhfeidhmiú, is gá dearadh breise mionsonraithe trí mheasúnú ar leibhéal tionscadail le haghaidh oibreacha dóchúla dá leithéid, ar a n-áirítear suirbhéanna áitiúla, comhairliúcháin breise poiblí agus le páirtithe leasmhara agus measúnú comhshaoil.

## CÉIMEANNA ATÁ MOLTA SA PHLEAN

### *Céimeanna is Infheidhmithe do gach Limistéar*

**Bainistiú Pleanála agus Forbartha Inbhuanaithe:** Tá feidhmiú cóir na dTreoirínte ar an Chóras Pleanála agus Bainistiú Priacal Tuile (RTPRA/OPW, 2009) ag na húdarais phleanála fíor-riachtanach chun forbairt mhí-oiriúnach i limistéir atá ar phriacal tuile a sheachaint, agus mar sin méadú nach gá ar phriacal tuile a sheachaint amach anseo. Soláthróidh an mhapáil tuile a tháinig tríd an Chlár MBPTA bonn fianaise níos mó um chinntí inbhuanaithe pleanála.

**Córais Inbhuanaithe um Dhraenáil Uirbeach (CIDU):** De réir na dTreoirínte ar an Chóras Pleanála agus Bainistiú Priacal Tuile (RTPRA/OPW, 2009), ba cheart do na húdarais phleanála féachaint chuig cruadhromchlú agus cruaphábháil a laghdú agus teicnící inbhuanaithe draenála a fheidhmiú chun tionchar dóchúil forbartha ar phriacal tuile le sruth anuas a laghdú.

**Pleanáil um Oiriúnú:** Tar éis don Rialtas an Creat Náisiúnta um Oiriúnú d’Athrú Aeráide a fhaomhadh, is gá do phríomhearnálacha agus do na húdarais Áitiúla pleananna earnála agus áitiúla um oiriúnú a thabhairt chun cinn. Mar sin is gá don OPW plean athchóirithe earnála a ullmhú, a chlúdaíonn an earnáil um bainistiú priacal tuile. Caithfidh earnálacha eile a léiriú sa Chreat agus Údarais Áitiúla aird a thabhairt ar phriacal tuile nuair atá a gcuid pleananna earnála agus áitiúla um oiriúnú á n-ullmhú acu.

**Bainistiú Talamhúsáide agus Bainistiú Nádúrtha Priacal Tuile:** Oibreoidh an OPW leis an Ghníomhaireacht um Chaomhnú Comhshaoil, leis na húdarais Áitiúla agus le gníomhaireachtaí eile le linn measúnaithe ar leibhéal tionscadail ar oibreacha fisiciúla agus níos leithne ar leibhéal abhantraí, chun céimeanna ar bith mar chéimeanna nádúrtha um choinneáil uisce a léiriú, a thairbheoidh aidhmeanna faoin Treoir um Chreat Uisce, bainistiú priacal tuile agus bithéagsúlacht.

**Scéimeanna um Dhraenáil Artaireach:** Tá dualgas reachtúil ar an OPW faoin Acht um Dhraenáil Artaireach 1945, agus Leasú 1995 an Achta sin, cothabháil a dhéanamh ar na Scéimeanna um Dhraenáil Artaireach agus um Fhaoiseamh Tuile a thóg an OPW faoi na hAchtanna sin.

**Ceantair Dhraenála:** Is ar na húdarais Áitiúla cuí a luíonn an dualgas reachtúil cothabhála maidir leis an 4,600 km de chainéil abhann a thairbhíonn ó na Scéimeanna Ceantair Dhraenála.

**Cothabháil Cainéal nach cuid de Scéim iad:** Taobh amuigh de na Scéimeanna um Dhraenáil Artaireach agus na Scéimeanna Ceantair Dhraenála, is ar úinéirí talún a bhfuil

cúrsaí uisce ar a gcuid tailte a luíonn cúram a gcothabhála. Tá treoir faoi chearta agus dualgais úinéirí talún, maidir le cothabháil cúrsaí uisce ar a gcuid tailte nó ina gcóngar, ar fáil ag [www.flooding.ie](http://www.flooding.ie).

**Réamhaisnéis agus Foláireamh Tuile:** Ar 5 Eanáir 2016 chinn an Rialtas ar Sheirbhís Náisiúnta um Réamhaisnéis agus Foláireamh Tuile a bhunú. Pléifidh an seirbhís le réamhaisnéis tuile ó thuille abhann agus cósta; nuair a bheidh sé ag feidhmiú ina iomlán eiseofar réamhaisnéisí agus foláirimh ginearálta ar scálaí náisiúnta agus abhantraí araon. Tá clár cúig bliana aontaithe chun an seirbhís seo a bhunú.

**Pleanáil um Fhreagairt Éigeandála:** Tá doiciméad *Bainistiú Straitéiseach Éigeandála (BSE): Struchtúir agus Creat Náisiúnta* á dhréachtadh faoi láthair ag Tascfhórsa Rialtais um Pleanáil Éigeandála. Beidh Caibidil ann maidir le Téarnamh, a chuimseoidh conas a phléifear le cistiú um éigeandálacha, agus um chostais téarnaimh ach go háirithe, amach anseo.

**Díonacht Aonair agus Phobail a Chothú:** Tá taighde ar bun ag an Roinn Tithíochta, Pleanála agus Rialtais Áitiúil (RTPRA) maidir le conas is féidir Díonacht Phobail a chur chun cinn mar chuid den athbhreithniú foriomlán ar an Chreat um Bhainistiú Móréigeandála.

**Cosaint Mhaoine Aonair:** Tá dhá scéim phíolótach um Chosaint Mhaoine Aonair (CMA) ar bun faoi láthair agus beidh a dtorthaí seo mar bhonn eolais don Rialtas maidir le tacú indéanta ar bith a fhéadfaí a sholáthar do mhaojne atá ar phriacal.

**Bailiú Sonraí maidir le Tuille:** Tá bailiú sonraí ar thuille agus, nuair is cuí, a bhfoilsíú, ar siúl ar bhonn leanúnach; is céim í seo a chuideoidh um ullmhú agus um fhreagairt ar thuiliú.

**Athlonnú Deonach Tí Cónaithe:** Ins na cúinsí is géire, féadfaidh an priacal tuile do theach cónaithe a bheith chomh mór sin go gceapfadh úinéir an tí nach bhfuil sé inbhuanaithe fanacht ann agus go gcinneadh sé ar athlonnú. Ar 11 Aibreán 2017 d'aontaigh an Rialtas na socruithe riaracháin do Scéim aonuaire um Athlonnú Deonach d'Úinéirí Tí Cónaithe, maidir leis na príomhthithe cónaithe sin a bhí faoi thuille le linn na tréimhse ó 4 Nollaig 2015 go 13 Eanáir 2016.

### **Céimeanna ar Leibhéal Abhantraí / Fo-Abhantraí**

Ní bhfuarthas aon chéimeanna indéanta ar leibhéal abhantraí / fo-abhantraí don Abhantrach seo.

### **Céimeanna ar Leibhéal Pobail**

Do na pobail seo a leanas, moltar sa Phlean go dtabharfar scéim um fhaoiseamh tuile chun cinn chuig forbairt agus measúnú ar leibhéal tionscadail, ar a n-áirítear measúnú comhshaoil mar is gá agus tuilleadh comhairliúcháin phoiblí, um mionchoigeartú agus ullmhú um a phleanáil agus a thaispeáint agus, más agus nuair is cuí, um fheidhmiú:

- Oileán Ciarraí & An Tulaigh
- Daingean Uí Chúis
- Cill Airne

Do Gleann Fleisce rinneadh scrúdú ar chéimeanna struchtúrtha dóchúla indéanta um fhaoiseamh tuile dar léiríodh scéim um fhaoiseamh tuile atá inmharthana ar bhonn teicniúil. Ach beidh gá le measúnú níos mionsonraithe ar chostais agus ar thairbhí a chríochnú um a chinneadh an bhfuil an Scéim atá molta indéanta.



## **Scéimeanna agus Oibreacha um Fhaoiseamh Tuile atá Tugtha Chun Cinn nó Molta trí Thionscadail nó trí Phleananna Eile**

Níl aon scéimeanna nó oibreacha eile um Fhaoiseamh Tuile tugtha chun cinn nó molta trí thionscadail nó trí phleananna eile.

## **FEIDHMIÚ, MONATÓIREACHT AGUS ATHBHREITHNIÚ AN PHLEAN**

Is gá infheistíocht chaipitiúil suntasach chun na céimeanna uile, mar atá leagtha amach sa Phlean seo agus ins na Pleananna uile, a fheidhmiú. Mar sin is gá tosaíocht a thabhairt don infheistíocht is gá chun an sraith náisiúnta de chéimeanna molta a fheidhmiú.

I dteannta le foilsiú an Phlean seo agus na bPleananna eile, fógraíodh an chéad sraith d'oibreacha cosanta tuile dar tugadh tosaíocht dóibh atá leagtha amach sa Phlean seo agus san 28 bPlean eile. Oibreoidh an OPW agus na hÚdaráis Áitiúla go dlúth lena chéile chun feidhmiú éifeachtach na dtionscadail tosaigh seo a thabhairt chun críche agus ina dhiaidh sin ar na tionscadail eile.

Léirítear sa Phlean an dream/na dreamanna atá freagrach as feidhmiú na gcéimeanna molta um bainistiú priacal tuile ar bhonn tosaíochta mar atá leagtha amach thuas.

Is é an tAire Stáit le cúram speisialta um Oifig na nOibreacha Poiblí agus Faoiseamh Tuile atá ina Chathaoirleach ar an An Ghrúpa Idir-Rannach um Chomhordú Pholasaí Tuile. Is é an Grúpa seo a chomhordaíonn agus a dhéanann monatóireacht ar dhul chun cinn maidir le feidhmiú na moltaí atá leagtha amach in Athbhreithniú Pholasaí Tuile an Rialtais 2004, ar a n-áirítear na céimeanna atá leagtha amach ins na Pleananna.

Is don tréimhse 2018-2021 na Pleananna seo. Athbhreithneoidh an OPW agus páirtithe leasmhara eile iad, maidir leis an dul chun cinn atá déanta, agus déanfar iad a uasdhátú in 2021.



# EXECUTIVE SUMMARY

## INTRODUCTION

This is the Flood Risk Management Plan (the 'Plan') for the Laune - Maine - Dingle Bay River Basin. A description of the River Basin is provided in Section 2 of the Plan.

The purpose of the Plan is to set out the strategy, including a set of proposed measures, for the cost-effective and sustainable, long-term management of flood risk in the River Basin, including the areas where the flood risk has been determined as being potentially significant.

This Plan, which is for the period of 2018-2021, is one of 29 Plans being published; each setting out the feasible range of flood risk management measures proposed for their respective River Basins. The preparation of these Plans represents a significant milestone in the implementation of Government policy on flood risk management, as set out in the Report of the Flood Policy Review Group (OPW, 2004<sup>3</sup>), and addresses Ireland's obligations under the 2007 EU 'Floods' Directive (EU, 2007<sup>4</sup>).

The Plan includes feasible measures developed through a range of programmes and policy initiatives including:

- Non-structural flood risk prevention and preparedness measures that are applicable nationally, aimed at reducing the impacts of flooding, that have been and are being developed to implement Government policy on flood risk management (OPW, 2004).
- Structural flood protection measures proposed for communities at significant flood risk, aimed at reducing the likelihood and/or degree of flooding, identified through the National Catchment Flood Risk Assessment and Management (CFRAM) Programme.

The CFRAM Programme has examined the flood risk, and possible measures to address the risk, in 300 communities throughout the country at potentially significant flood risk. These communities were identified through the Preliminary Flood Risk Assessment (PFRA - See Section 3 of the Plan), which was a national screening assessment of flood risk. The communities identified through the PFRA process as being at potentially significant flood risk in the Laune - Maine - Dingle Bay River Basin are listed in Table ES-1 below, along with the sources of flood risk that were deemed to be significant for each community. A set of flood maps, indicating the areas prone to flooding, has been developed and published for each of the communities.

The Plan builds on and supplements the national programme of flood protection works completed previously, that are under design and construction at this time or that have been set out through other projects or plans, and the ongoing maintenance of existing drainage and flood relief schemes.

A Strategic Environmental Assessment, and an Appropriate Assessment under the Habitats Directive where appropriate, have been undertaken as part of the preparation of, and have been published with, the Plan.

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<sup>3</sup> Report of the Flood Policy Review Group, OPW, 2004 ([www.floodinfo.ie](http://www.floodinfo.ie))

<sup>4</sup> Directive on the assessment and management of flood risks, 2007/60/EC

**Table ES-1**      **Communities at Potentially Significant Flood Risk within the Laune - Maine - Dingle Bay River Basin**

COUNTY	COMMUNITY NAME	SOURCE(S) OF FLOOD RISK
Kerry	Castleisland	Fluvial
Kerry	Dingle	Fluvial / Coastal
Kerry	Glenflesk	Fluvial
Kerry	Killarney	Fluvial
Kerry	Milltown	Fluvial
Kerry	Portmagee	Coastal
Kerry	Tullig	Fluvial

## OBJECTIVES OF THE PLAN

The overall objective of the Plan is to manage and reduce the potential consequences of flooding, recognising other benefits and effects across a broad range of sectors including human health, the environment, cultural heritage and economic activity, through viable flood protection schemes and other measures informed by a sound understanding of the flood risk established through the preparation of flood maps.

A nationally consistent set of specific objectives relating to each of these sectors was developed for the preparation of the Plans. These specific objectives and the importance given to each are listed in Section 1.4 of the Plan.

## SCOPE OF THE PLAN

The scope of the Plan is set out below:

- **Spatial Scope:** The Plan sets out viable measures, typically flood protection schemes, proposed to manage and reduce flood risk in the communities that were identified through the PRFA as being at potentially significant flood risk. The Plan also sets out a range of non-structural policies and measures, which are in place or under development, that contribute to the reduction and management of flood risk throughout the River Basin.
- **Sources of Flood Risk:** The flood protection measures that are set out in the Plan address flood risk from the sources of flooding as identified in Table ES-1 in one or more communities, as these sources were determined through the PFRA to be potentially significant in these communities. The range of non-structural policies and measures set out in the Plan can contribute to the reduction and management of flood risk from all sources of flood risk.
- **Level of Detail:** The Plan sets out the measures that have been identified as the most appropriate at this stage of assessment. The flood protection measures set out in the Plan are to an outline design, and are not at this point ready for construction. Further detailed design, including a review of costs and benefits, environmental assessment, and consultation will be required for such works before implementation.

## PUBLIC AND STAKEHOLDER CONSULTATION AND ENGAGEMENT

Extensive public consultation has been undertaken throughout the preparation of the flood maps and the Plans. Websites for the CFRAM Programme and Projects were also maintained throughout the process to provide information on the overall process and the relevant projects

and to provide access to project outputs (the information that was available from these websites is now available through [www.floodinfo.ie](http://www.floodinfo.ie)).

Over 200 Public Consultation Days were held by the OPW in or near the relevant communities in relation to the flood maps, where residents and the engineers of the OPW and its consultants could discuss past floods and the accuracy of the maps. A statutory public consultation on the draft maps was also undertaken late in 2015. The preparation of the final maps have taken the comments, observations and objections from the Public Consultation Days and formal consultation on board to reflect the local knowledge of flooding and people's views of the maps.

Two rounds of further Public Consultation Days were held in or near the communities in relation to potential options and then the Draft Plans for managing the flood risk. A further statutory public consultation was held in relation to the Draft Plans. The extensive comments and submissions made through these consultations have all been considered and taken into account as appropriate in finalising the Plans.

National and Regional Stakeholder Groups were formed to provide an opportunity for input by stakeholders to participate in the preparation of the flood maps and the Plans. Coordination and engagement meetings were held with the authorities responsible for implementing the Water Framework Directive and, for river basins that are shared with Northern Ireland, with the relevant authorities in the North.

The public and stakeholder consultation and engagement activities are described in Section 4 of the Plan.

## TECHNICAL ASSESSMENT

The preparation of the Plan has involved extensive technical analysis and assessment to determine the flood risk in the communities identified through the PFRA, and then to identify preferred, viable measures to address the risk. This technical assessment has included:

- **Aerial Survey:** Airborne survey of the physical topography of the floodplains to facilitate an analysis of how flood waters spread across the floodplains.
- **Topographical Survey:** Ground-based survey of the geometry of the rivers and streams running through the communities, between the communities and then down to the sea, including surveys of the shape of the river bed and banks and of structures in, over or alongside the channels.
- **Hydrological Analysis:** An analysis to determine flood flows into and through the rivers and streams, and extreme sea levels that can cause flooding. This analysis has been informed by records of past river levels and flows and an estimation of the potential impacts of climate change on flood flows and extreme sea levels.
- **Hydraulic Modelling:** The development of computer models of the rivers, streams and floodplains to determine the flood levels for given flood flows and how floods would flow and spread over the floodplains, taking into account existing flood defences. The models informed the assessment of the effectiveness of possible measures to manage and reduce the flood risk.
- **Flood Mapping:** The preparation of flood maps to indicate the extent, depth, flow velocity (speed) of flood-waters and a range of risk maps (showing the potential dangers and impacts of flooding) for the modelled areas, along with Flood Zone maps to inform sustainable planning and development. Maps of flood events with a range of likelihoods of occurrence (from events with a 1 in 2 chance of occurring in any year, to those with a

- 1 in a 1000 chance in any year) have been developed for the current scenario and for future scenarios taking into account the potential impacts of climate change.
- **Risk Assessment:** An assessment of the potential impacts of flooding in the communities, taking account of the homes, community and society assets, businesses, agriculture, infrastructure, the environment and the local cultural heritage that could be damaged by flooding. An economic risk (damage) assessment was undertaken to determine the economic implications of floods in the communities.
  - **Assessment and Appraisal of Possible Flood Risk Management Measures:** The development, assessment and appraisal of a wide range of possible measures to manage flood risk in the communities at significant flood risk to identify a potentially preferred measure to be proposed in the Plan. This involved a number of steps:
    - o **Screening:** The assessment of possible methods to manage flood risk to identify those that might be effective and potentially viable.
    - o **Development of Potentially Viable Measures:** Potentially effective methods were formed into possible measures, which were then developed to outline design, and the likely cost of implementing and maintaining the measure calculated.
    - o **Appraisal by 'Multi-Criteria Analysis' (MCA):** The possible measures were assessed and appraised through a MCA to determine their effectiveness in reducing flood risk and their potential benefits and impacts across the range of specific objectives.
    - o **Economic Appraisal:** The possible measures were also subject to an economic cost-benefit analysis to ensure the viability of any proposed measures.
    - o **Public and Stakeholder Engagement:** The local communities, including elected representatives and other stakeholders, were consulted with to take on board views and opinions on any proposed measure for the community it would protect.
    - o **Identification of Preferred Measures:** Determination of a preferred measure for the communities, taking account of the economic, environmental and overall benefits and impacts, the observations of the local community and stakeholders and the foreseen costs of the measure.

For some communities, the detailed technical analysis has determined that there is currently a low level of flood risk to the community from rivers and/or the sea. In such cases, the development of flood risk management measures aimed specifically at protecting such communities (i.e. local flood relief schemes) was not merited. For some other communities, it was found that it would not be feasible to progress flood protection schemes. However, the non-structural policies and measures applicable across all areas can reduce and manage the existing and potential future risk in these communities.

The technical assessments are described in Sections 5 and 7 of the Plan.

## ENVIRONMENTAL ASSESSMENTS

The Plans have been subject to Strategic Environmental Assessment (SEA), and, where necessary, Plan-level Appropriate Assessment (AA) under the Habitats Directive, to determine the potential benefits and impacts of the Plans on the environment, and to identify mitigation and monitoring measures necessary to avoid or minimise such impacts.

It should be noted that approval of the Plan does not confer consent to the construction of any physical works. Environmental Impact Assessment and Project-level Appropriate Assessment must be undertaken in accordance with the relevant legislation where relevant as part of the progression of proposed measures that involve physical works.

The environmental issues and assessments undertaken are described in Section 6 of the Plan.

## PROPOSED MEASURES

A summary of the measures proposed in the Plan and the flood relief schemes and works that have been progressed or proposed through other projects or plans are set out below.

The proposed physical flood relief works or 'Schemes' set out in the Plans that have been developed through the CFRAM Programme are to an outline design, and are not at this point ready for construction. Further detailed design through a project-level of assessment will be required for such potential works before implementation, including local surveys, further public and stakeholder consultation and environmental assessment.

### MEASURES PROPOSED IN THE PLAN

#### Measures Applicable for all Areas

**Sustainable Planning and Development Management:** The proper application of the Guidelines on the Planning System and Flood Risk Management (DHPLG/OPW, 2009) by the planning authorities is essential to avoid inappropriate development in flood prone areas, and hence avoid unnecessary increases in flood risk into the future. The flood mapping produced through the CFRAM Programme will provide an even greater evidential basis for sustainable planning decisions.

**Sustainable Urban Drainage Systems (SUDS):** In accordance with the Guidelines on the Planning System and Flood Risk Management (DHPLG/OPW, 2009), planning authorities should seek to reduce the extent of hard surfacing and paving and require the use of sustainable drainage techniques to reduce the potential impact of development on flood risk downstream.

**Adaptation Planning:** Following approval by Government of the National Climate Change Adaptation Framework key sectors and Local Authorities are required to develop sectoral and local adaptation plans. This will require a revised sectoral plan to be prepared by the OPW, covering the flood risk management sector. Other sectors identified in the Framework and Local Authorities will also be required to take account of flood risk when preparing their own sectoral and local adaptation plans.

**Land Use Management and Natural Flood Risk Management:** The OPW will work with the Environment Protection Agency, Local Authorities and other agencies during the project-level assessments of physical works and more broadly at a catchment-level to identify any measures, such as natural water retention measures, that can have benefits for Water Framework Directive, flood risk management and biodiversity objectives.

**Arterial Drainage Schemes:** The OPW has a statutory duty under the Arterial Drainage Act, 1945, and the Amendment of the Act, 1995, to maintain the Arterial Drainage and Flood Relief Schemes constructed by it under those Acts.

**Drainage Districts:** The statutory duty of maintenance for 4,600 km of river channel benefitting from Drainage District Schemes rests with the relevant Local Authorities.

**Maintenance of Channels not part of a Scheme:** Outside of the Arterial Drainage and Drainage District Schemes, landowners who have watercourses on their lands have a responsibility for their maintenance. Guidance to clarify the rights and responsibilities of landowners in relation to the maintenance of watercourses on or near their lands is available at [www.flooding.ie](http://www.flooding.ie).

**Flood Forecasting and Warning:** A Government decision was taken on 5 January 2016 to establish a National Flood Forecasting and Warning Service. The service will deal with flood forecasting from fluvial (river) and coastal sources and when fully operational will involve the issuing of flood forecasts and general alerts at both national and catchment scales. A 5-year programme has been agreed to oversee the establishment of this new service.

**Emergency Response Planning:** A Government Task Force on Emergency Planning is currently drafting a *Strategic Emergency Management (SEM): National Structures and Framework* document. This is to include a Chapter on Recovery to include how funding for emergencies, particularly recovery costs, may be handled in the future.

**Promotion of Individual and Community Resilience:** The Department of Housing, Planning & Local Government (DHPLG) is researching how Community Resilience may be advanced as part of the overall review of the Framework of Major Emergency Management.

**Individual Property Protection:** The outcomes of two Individual Property Protection (IPP) pilots currently underway will inform the Government on any feasible support it could provide to at risk properties.

**Flood-Related Data Collection:** The ongoing collection and, where appropriate, publication of flood-related data is a measure that will help to continually improve preparation for, and response to, flooding.

**Voluntary Home Relocation:** In extreme circumstances, the flood risk to a home may be such that the homeowner may consider that continuing to live in the property is not sustainable and would choose to relocate. On 11 April 2017, the Government agreed the administrative arrangements for a once-off Homeowners Voluntary Relocation Scheme for those primary residential properties that flooded during 4 December 2015 to 13 January 2016.

### Catchment / Sub-Catchment-Level Measures

No catchment / sub-catchment-level measures were found to be feasible for this River Basin.

### Community-Level Measures

For the following communities, it is proposed in the Plan that a flood relief scheme is progressed to project-level development and assessment, including environmental assessment as necessary and further public consultation, for refinement and preparation for planning / exhibition and, if and as appropriate, implementation:

- Castleisland & Tullig
- Dingle
- Killarney

Potentially viable structural flood relief measures have been investigated for Glenflesk for which a technically viable flood relief scheme has been identified. However, a more detailed assessment of the costs and benefits will need to be completed to determine if the proposed Scheme is feasible.

### Flood Relief Schemes and Works Progressed or Proposed through Other Projects or Plans

There are no other flood relief schemes or works progressed or proposed through other projects or plans.



## **IMPLEMENTATION, MONITORING AND REVIEW OF THE PLAN**

Implementing all of the measures, set out in this and all Plans, requires a significant capital investment. It has therefore been necessary to prioritise the investment required to implement the national set of proposed measures.

A prioritised initial tranche of flood protection works set out within this and the 28 other Plans to be advanced to the more detailed project level of assessment has been announced in conjunction with the publication of this and the other Plans. The OPW and Local Authorities will work closely to bring about the effective implementation of these initial projects and then subsequent projects.

The Plan identifies the body/bodies responsible for implementing the proposed flood risk management measures in a prioritised manner as above.

The Minister of State with special responsibility for the Office of Public Works and Flood Relief chairs the Interdepartmental Flood Policy Co-ordination Group. This Group co-ordinates and monitors progress in the implementation of the recommendations set out in the Government's 2004 Flood Policy Review, including the measures set out in the Plans.

These Plans are for the period 2018 - 2021. They will be reviewed in terms of progress made and be updated by the OPW and other stakeholders in 2021.

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# 1 INTRODUCTION AND BACKGROUND

## 1.1 OVERVIEW

This is the Flood Risk Management Plan (the 'Plan') for the Laune-Maine-Dingle Bay River basin.

The purpose of the Plan is to set out the strategy, including a set of measures, for the cost-effective and sustainable, long-term management of flood risk in the Laune-Maine-Dingle Bay River Basin, including the areas where the flood risk has been determined as being potentially significant. The Plan includes feasible measures developed through a range of programmes or policy initiatives including:

- Non-structural flood risk prevention and preparedness measures that are applicable nationally, aimed at reducing the impacts of flooding, to implement the recommendations of the Report of the Flood Policy Review Group, 2004<sup>1</sup>
- Structural flood protection measures for communities at significant flood risk, aimed at reducing the likelihood and/or degree of flooding, identified through the National Catchment Flood Risk Assessment and Management (CFRAM) Programme

The Plan builds on and supplements the programme of flood protection works completed previously, that are under design and construction at this time or that have been set out through other projects or plans, and the ongoing maintenance of existing drainage and flood relief schemes.

The Objectives and scope of the Plan are set out in Sections 1.4 and 1.5 respectively.

This Plan is one of 29 Plans being published; each setting out the feasible range of flood risk management measures for their respective River Basins. The preparation of these Plans is a central part of the implementation of Government policy on flood risk management (OPW, 2004), and meets Ireland's obligations under the 2007 EU 'Floods' Directive (EU, 2007<sup>2</sup>). A Strategic Environmental Assessment, and an Appropriate Assessment under the Habitats Directive, have been undertaken as part of the preparation of the Plan.

The Government's National Development Plan 2018-2027 has provided the capital envelope for a prioritised programme of investment for the advancement and implementation of ongoing flood relief projects and the flood protection measures set out within this and the 28 other Plans.

### 1.1.1 FLOODING AND FLOOD RISK

Flooding is a natural event that can happen at any time in a wide variety of locations.

Flood **hazard** is the potential threat posed by flooding to people, property, the environment and our cultural heritage. Flooding only presents a **risk** however when people, property, businesses, farms, infrastructure, the environment or our cultural heritage can be potentially impacted or damaged by floods.

Flood risk is the combination of the probability of flood events of different magnitudes and the degree of the potential impact or damage arising from a flood.

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<sup>1</sup> Report of the Flood Policy Review Group, OPW, 2004 ([www.floodinfo.ie](http://www.floodinfo.ie))

<sup>2</sup> Directive on the assessment and management of flood risks, 2007/60/EC

### **1.1.2 Types and Causes of Flooding**

Flooding can occur from a range of sources, individually or in combination, including:

- Coastal flooding (from the sea or estuaries)
- Fluvial flooding (from rivers or streams)
- Pluvial flooding (from intense rainfall events and overland flow)
- Groundwater flooding (typically from turloughs in Ireland)
- Other sources, such as from water-bearing infrastructure

A description of each of these sources of flooding is provided in Appendix A.

### **1.1.3 Impacts of Flooding**

Flooding can cause damage, loss or harm in a number of ways, including:

- Impacts of people and society, including physical injury, illness, stress and even loss of life
- Damage to property, such as homes and businesses
- Damage to, and loss of service from, Infrastructure (such as water supply or roads)
- Impacts on the environment, such as damage or pollution of habitats
- Damage to our cultural heritage, such as monuments and historic buildings

A description of each of these potential impacts of flooding is provided in Appendix A.

### **1.1.4 Potential Impacts of Future Change**

Climate change is likely to have a considerable impact on flood risk in Ireland, such as through rising mean sea levels, increased wave action and the potential increases in winter rainfall and intense rainfall events. Land use change, for example through new housing and other developments, can also increase potential future flood risk.

## **1.2 BACKGROUND**

### **1.2.1 Flood Policy and Legislative Background**

Flood risk to urban areas in Ireland has been addressed, since the 1995 Amendment to the Arterial Drainage Act (1945), through the use of structural or engineered solutions (flood relief schemes). In line with internationally changing perspectives, the Government adopted a new policy in 2004 that shifted the emphasis in addressing flood risk towards:

- A catchment-based context for managing risk and the identification of solutions to manage existing and potential risks
- More pro-active flood hazard and risk assessment and management, with a view to avoiding or minimising future increases in risk, e.g., from development on floodplains,
- Increased use of non-structural and flood impact mitigation measures

Notwithstanding this shift, engineered solutions to manage existing and potential future risks will continue to form a key component of the overall national flood risk management programme and strategy.

Specific recommendations arising from the policy review included:

- the preparation of flood maps, and,
- the preparation of flood risk management plans.

A further influence on the management of flood risk in Ireland is the EU 'Floods' Directive [2007/60/EC]. The aim of this Directive is to reduce the adverse consequences of flooding on human health, the environment, cultural heritage and economic activity. The 'Floods' Directive was transposed into Irish law by Statutory Instrument SI No. 122 of 2010<sup>3</sup> and amended by SI No. 495 of 2015<sup>4</sup>.

Under the 'Floods' Directive, Ireland, along with all other Member States, are required to undertake a Preliminary Flood Risk Assessment (PFRA) to identify areas of potentially significant flood risk (referred to in Ireland as Areas for Further Assessment, or 'AFAs'), and then for these areas to prepare flood maps in relation to the sources of flood risk deemed to be significant. Ireland is then required to prepare Plans for each River Basin, focussed on managing and reducing the risk within the AFAs. The PFRA, flood maps and the Plans need to be reviewed on a 6-yearly cycle.

### 1.2.2 Competent and Responsible Authorities for the 'Floods' Directive

The Office of Public Works (OPW) was designated following the Government approval of the Report of the Flood Policy Review Group (OPW, 2004) as the lead agency for flood risk management in Ireland. As lead agency, the OPW was designated as the Competent Authority under SI No. 122 of 2010 for the implementation of the Directive.

The following authorities may be designated by the OPW under SI Nos. 122 of 2010 and 495 of 2015 as being responsible for the implementation of key requirements of the EU 'Floods' Directive (Preliminary Flood Risk Assessment, preparation of flood maps, and identification of flood risk management measures) with respect to infrastructure for which they have responsibility:

- All local authorities
- Electricity Supply Board (ESB)
- Waterways Ireland
- Irish Water

### 1.2.3 The 'CFRAM' Programme

The purpose of the CFRAM Programme is to assess the existing fluvial and coastal flood risk, and the potential increase in risk due to climate change, ongoing development and other pressures that may arise in the future, and develop a Plan setting out a sustainable, long-term strategy to manage this risk. The OPW in conjunction with the CFRAM Study Consultants (the 'Consultants', being *Mott MacDonald Ireland* for the Laune-Maine-Dingle Bay River Basin), are undertaking the National Catchment-based Flood Risk Assessment and Management (CFRAM) Programme.

The objectives of the CFRAM Programme are to:

- Identify and map the existing and potential future fluvial and coastal flood hazard and flood risk in the Areas for Further Assessment (AFAs),
- Identify viable structural and non-structural options and measures for the effective and sustainable management of flood risk in the AFAs,

<sup>3</sup> SI No. 122 of 2010 (<http://www.irishstatutebook.ie/eli/2010/si/122/made/en/pdf>)

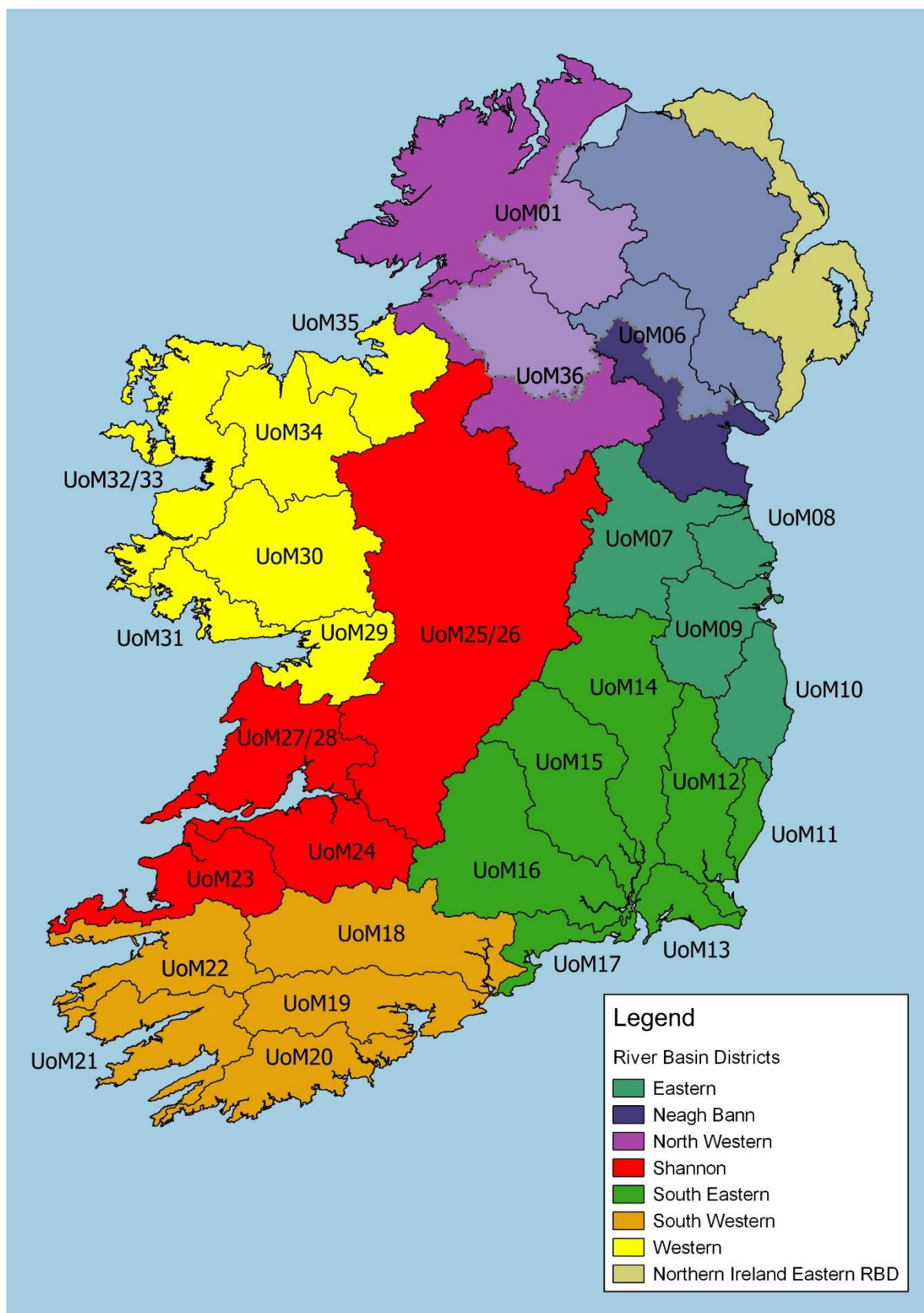
<sup>4</sup> SI No. 495 of 2015 (<http://www.irishstatutebook.ie/eli/2015/si/495/made/en/pdf>)

- Prepare a set of Plans, and associated Strategic Environmental and Habitats Directive (Appropriate) Assessments, that sets out the proposed strategies, measures and actions that should be pursued by the relevant bodies, including the OPW, local authorities and other Stakeholders, to achieve the most cost-effective and sustainable management of existing and potential future flood risk, taking account of environmental plans, objectives and legislative requirements and other statutory plans and requirements.

The CFRAM Programme has been implemented for seven large areas called River Basin Districts (RBDs) that cover the whole country. Each RBD is then divided into a number of River Basins (Units of Management, or 'UoMs'), where one Plan has been prepared for each River Basin. A map of the RBDs and the UoMs is provided in Figure 1.1.

The CFRAM Programme is focused on a number of areas where the risk has been determined through the PFRA to be potentially significant, which are referred to as Areas for Further Assessment, or 'AFAs', and on the sources of flooding within these areas that were determined to be the cause of significant risk.

Further details on the CFRAM Programme can be found on the OPW website: [www.floodinfo.ie](http://www.floodinfo.ie).



**Figure 1.1: River Basin Districts (RBDs) and Units of Management (UoMs) in Ireland**

#### 1.2.4 Other Relevant Policies and Plans

The 2004 Report of the Flood Policy Review Group and SI Nos. 122 and 495 of 2010 and 2015 respectively are the policy and legislation that directly relate to the preparation of this



Plan. However, a wide range of legislation, policies and plans are relevant to, or may be impacted by, this Plan. The relevant legislation, policies and plans (as of June 2017) are listed in Table 1.1.

**Table 1.1**      *Legislation, Policies and Plans Relevant to the Plan*

<b>Legislation / Policy / Plan</b>	<b>Description</b>
<b>Legislation</b>	
Arterial Drainage Act, 1945, and Amendment Act, 1995	Acts empowering the Commissioners of Public Works to implement Arterial Drainage Schemes (1945) and Flood Relief Schemes (1995), which must then be maintained.
Commissioners of Public Works (Functions and Powers) Act, 1996	Act to make further provision in relation to the functions and powers of the Commissioners of Public Works including in relation to flooding. The Minor Works Programme (to fund local authorities to implement local flood relief schemes) is an administrative scheme operated by the OPW under its general powers and functions to make schemes to address flood risk.
Coast Protection Act, 1963	Act to provide for the making and execution of coast protection schemes and to provide for other matters connected with the matters aforesaid.
Local Government (Works) Act, 1949	Enables local authorities to execute works affording relief or protection from flooding
SI Nos. 122 and 495 of 2010 and 2015	Transposing Instruments for the EU 'Floods' Directive - European Communities (Assessment and Management of Flood Risks) Regulations 2010 & 2015
SI Nos. 722 and 350 of 2003 and 2014,	Transposing Instruments for the EU Water Framework Directive: - European Communities (Water Policy) Regulations, 2003 & 2014
SI Nos. 435 and 200 of 2004 and 2011	Transposing Instruments for the EU Strategic Environmental Assessment Directive: - European Communities (Environmental Assessment of Certain Plans and Programmes) (Amendment) Regulations 2004 & 2011
SI No. 477 of 2011	Transposing Instruments for the EU Birds and Habitats Directives: - European Communities (Birds and Natural Habitats) Regulations 2011
Planning and Development Act, 2000 (No. 30 of 2000) and associated regulations	Principal Planning Act (and amendments) - Planning and Development Regulations 2001 to 2015 Provides for the adoption of Guidelines under Section 28 Sets out planning requirements for certain flood relief works by local authorities
Climate Action and Low Carbon Development Act, 2015	Provides for the making of a National Adaptation Framework to specify the national strategy for the application of adaptation measures in different sectors and by local authorities to reduce the vulnerability of the State to the negative effects of climate change, including potential increases in flood risk.
<b>Policies</b>	



Report of the Flood Policy Review Group, 2004	Report, approved by Government in September 2004, that sets out recommendations for flood risk management policy in Ireland, including roles and responsibilities.
Guidelines on the Planning System and Flood Risk Management, 2009	Guidelines published under Section 28 of the Planning and Development Acts that provide a transparent and robust framework for the consideration of flood risk in planning and development management.
Major Emergency Management Framework, 2006	Sets out common arrangements and structures for front line public sector emergency management in Ireland to facilitate the co-ordination of the individual response efforts of the Principal Response Agencies to major emergencies.
National Adaptation Framework, 2012 & 2018	Set out Government policy for addressing climate change adaptation in Ireland, focusing on key climate sensitive sectors and mandating certain Government Departments, other public sector bodies and Local Authorities to prepare sectoral and local climate change adaptation plans.  A new statutory Framework was introduced in January 2018 under the Climate Action and Low Carbon Development Act, 2015.
<b>Plans</b>	
Climate Change Sectoral Adaptation Plan for Flood Risk Management, 2015	Sets out the policy on climate change adaptation of the OPW, the lead agency for flood risk management in Ireland, based on a current understanding of the potential consequences of climate change for flooding and flood risk in Ireland, and the adaptation actions to be implemented by the OPW and other responsible Departments and agencies in the flood risk management sector.  A revised statutory Sectoral Adaptation Plan will be prepared under the 2018 National Adaptation Framework.
National Spatial Strategy, 2002 - 2020	A 20-year coherent national planning framework for Ireland that aims to achieve a better balance of social, economic and physical development across Ireland, supported by more effective and integrated planning.
South Western River Basin District, River Basin Management Plan, 2010	Plans (RBMPs) prepared under the Water Framework Directive (2000/60/EC) that summarise the waterbodies that may not meet the environmental objectives of the WFD and identify which pressures are contributing to the environmental objectives not being achieved. The plans describe the classification results and identified measures that can be introduced in order to safeguard waters and meet the environmental objectives of the WFD. New RBMPs are to be adopted by the end of 2017.
Second Cycle of River Basin Management Plans: 2018 - 2021	River Basin Management Planning takes an integrated approach to the protection, improvement and sustainable management of the water environment.
Regional Planning Guidelines	Planning strategies at the regional level to provide the link between the national and local planning frameworks, which work within the overall approach taken in the NSS, while providing more detail and establishing a development and spatial framework that can be used to strengthen local authority development plans and other planning strategies at county, city and local level.  The South-West Regional Planning Guidelines 2010-2022 were adopted by the South-West Regional Authority in 2010 to cover counties Cork and Kerry. The South-West Regional Authority was subsequently dissolved in 2014 and its functions and responsibilities have been transferred to the Southern Regional

	Assembly. The South-West Regional Planning Guidelines 2010-2022 shall continue to have effect until a Regional Spatial and Economic Strategy is prepared and adopted by the Southern Regional Assembly.
Development Plans	<p>The development plan sets the agenda for the development of the local authority's area over its six year lifespan. Development, whether it be residential, industrial, commercial or amenity, must generally take place in accordance with the development plan. The plan is therefore a blueprint for the economic and social development of the city, town or county for which it has been made.</p> <ul style="list-style-type: none"> <li>• Kerry County Development Plan 2015-2021</li> </ul>
Local Areas Plans	<p>Local Area Plans provide more detailed planning policies at a local level for either urban areas or wider urban and rural areas where significant development and change is anticipated.</p> <ul style="list-style-type: none"> <li>• Tralee Killarney Hub Functional Areas LAP 2013-2019</li> <li>• Listowel/Ballybunion Functional Areas LAP 2013-2019</li> <li>• Cahersiveen/Waterville/Sneem Functional Area LAP 2013-19</li> <li>• Dingle FA LAP 2012 -2018</li> <li>• Killorglin Functional Area LAP 2010-2016</li> <li>• Kenmare Functional Area LAP 2010-2016</li> <li>• Castleisland Functional Area LAP 2009-2015</li> <li>• East Dingle Peninsula Settlements LAP 2008-2014</li> <li>• South East Kerry Settlements LAP 2008-2014</li> </ul>
Ireland's Offshore Oil and Gas Exploration Plan (IOSEA5)	in the context of marine baseline information, and potential relationship with offshore and foreshore related infrastructure
National Peatlands Strategy	This Strategy guides the Government's approach to peatlands management and conservation in the future, taking into account current and potential uses of this key resource.
Food Wise 2025, Agri-Food Strategy	Outlines the key actions required to ensure that the agri-food sector (primary agriculture, the food and beverage industry, fisheries and fish processing, forestry and forestry processing) maximises its contribution to overall economic growth, job creation and environmental sustainability over the coming decade
Second Cycle of River Basin Management Plans: 2015 - 2021	River Basin Management Planning takes an integrated approach to the protection, improvement and sustainable management of the water environment.
Southern Region Waste Management Plan 2015-2021	The Waste Management Plan for the Southern Region is the framework for the prevention and management (including generation, collection and treatment) of wastes in a safe and sustainable manner.
Ireland's forest policy – a renewed vision	The strategic goal is to develop an internationally competitive and sustainable forest sector that provides a full range of economic, environmental and social benefits to society and which accords with the Forest Europe definition of sustainable forest management.
The National Climate Change Adaptation Framework (2012)	The National Climate Change Adaptation Framework provides the policy context for a strategic national adaptation response to climate change in Ireland.
The Wild Atlantic Way	A tourism trail on the west coast, and on parts of the north and south coasts, of the Republic of Ireland.

Draft National Landscape Strategy 2014 – 2024	This draft National Landscape Strategy is the means by which the State, working in co-operation with public authorities, stakeholders, communities and individuals, will provide a framework for the protection of the many cultural, social, economic and environmental values embedded in the landscape.
Planning Policy Statement 2015	This statement sets out: <ul style="list-style-type: none"> <li>• Key principles that it expects planning authorities, other public bodies and those that engage with the planning process will observe; and</li> <li>• High level priorities for the continued enhancement of the planning system in Ireland.</li> </ul>
Irish Water Strategic Services Plan, when published	Ireland's first integrated national plan for the delivery of water services.
Local Economic and Community Plans 2016 - 2021, when published	These plans set out the objectives and actions which will guide the economic and community development of local areas over the 2016 – 2021 period.

## 1.3 FLOOD RISK MANAGEMENT OBJECTIVES

### 1.3.1 Overview

The Flood Risk Management Objectives set out the goals the Plan is aiming to achieve. They have a key role in the preparation of the Plan, and the identification of appropriate measures, as the options that are available to manage flood risk within a given area are appraised against these Objectives to determine how well each option contributes towards meeting the defined goals. Establishing such Objectives is also a requirement of the EU 'Floods' Directive [Art. 7(2)].

The Flood Risk Management Objectives are aimed at considering potential benefits and impacts across a broad range of sectors including human health, the environment, cultural heritage and economic activity. The Flood Risk Management Objectives are well aligned with the objectives defined for the Strategic Environmental Assessment (see Section 6.3), as both are aimed at defining sustainable measures providing benefits to a wide range of sectors.

### 1.3.2 Definition of the Flood Risk Management Objectives

A set of Flood Risk Management Objectives was developed and applied through the Pilot CFRAM Studies, with stakeholder consultation to ensure the Objectives set were appropriate. In commencing the National CFRAM Programme, the Objectives developed for the Pilot Studies were reviewed and refined. The OPW considered it appropriate to publicly consult on the proposed Objectives, and launched a public consultation in October 2014. Seventy one submissions were received which informed amendments then made to define the final Objectives. The final set of Objectives are set out in Table 1.2.

Sets of Objectives, similar to those adopted for the National CFRAM Programme, have also been adopted for other flood relief scheme projects undertaken in parallel to the CFRAM Programme. Details of these are set out in the relevant project reports (Section 1.3.5).

The purpose of the Global Weightings referred to in Table 1.2 is set out in Section 7.3.4.

**Table 1.2** *Flood Risk Management Objectives and Global Weightings for the National CFRAM Programme*

CRITERIA		OBJECTIVE		SUB-OBJECTIVE		GLOBAL WEIGHTING
1	Social	a	Minimise risk to human health and life	i)	Minimise risk to human health and life of residents	27
				ii)	Minimise risk to high vulnerability properties	17
		b	Minimise risk to community	i)	Minimise risk to social infrastructure and amenity	9
				ii)	Minimise risk to local employment	7
2	Economic	a	Minimise economic risk	i)	Minimise economic risk	24
		b	Minimise risk to transport infrastructure	i)	Minimise risk to transport infrastructure	10
		c	Minimise risk to utility infrastructure	i)	Minimise risk to utility infrastructure	14
		d	Minimise risk to agriculture	i)	Minimise risk to agriculture	12
3	Environmental	a	Support the objectives of the WFD	i)	Provide no impediment to the achievement of water body objectives and, if possible, contribute to the achievement of water body objectives.	16
		b	Support the objectives of the Habitats Directive	i)	Avoid detrimental effects to, and where possible enhance, Natura 2000 network, protected species and their key habitats, recognising relevant landscape features and stepping stones.	10
		c	Avoid damage to, and where possible enhance, the flora and fauna of the catchment	i)	Avoid damage to or loss of, and where possible enhance, nature conservation sites and protected species or other known species of conservation concern.	5
		d	Protect, and where possible enhance, fisheries resource within the catchment	i)	Maintain existing, and where possible create new, fisheries habitat including the maintenance or improvement of conditions that allow upstream migration for fish species.	13

CRITERIA		OBJECTIVE		SUB-OBJECTIVE		GLOBAL WEIGHTING
3	Environmental (Continued)	e	Protect, and where possible enhance, landscape character and visual amenity within the river corridor	i)	Protect, and where possible enhance, visual amenity, landscape protection zones and views into / from designated scenic areas within the river corridor.	8
		f	Avoid damage to or loss of features, institutions and collections of cultural heritage importance and their setting	i)	Avoid damage to or loss of features, institutions and collections of architectural value and their setting.	4
				ii)	Avoid damage to or loss of features, institutions and collections of archaeological value and their setting.	4
4	Technical	a	Ensure flood risk management options are operationally robust	i)	Ensure flood risk management options are operationally robust	20
		b	Minimise health and safety risks associated with the construction, operation and maintenance of flood risk management options	i)	Minimise health and safety risks associated with the construction, operation and maintenance of flood risk management options	20
		c	Ensure flood risk management options are adaptable to future flood risk, and the potential impacts of climate change	i)	Ensure flood risk management options are adaptable to future flood risk, and the potential impacts of climate change	20

## 1.4 SCOPE OF THE PLAN

This Plan sets out a sustainable, long-term strategy to manage the flood risk within the Laune-Maine-Dingle Bay River Basin, focused on the areas of potentially significant flood risk (AFAs), and the sources of flooding giving rise to that risk.

### 1.4.1 Spatial Scope of the Plan

The Plan is focussed on the areas, the 'AFAs', where the risk was determined through the PFRA as being potentially significant. There are 300 AFAs, which are typically communities (villages, towns and cities) where the flood risk is concentrated, throughout the country. The areas covered by this Plan are set out in Section 3.2 (Table 3.1).

Some flood risk mitigation measures developed for the AFAs will have benefits for other areas, and so areas outside of the AFAs may also benefit from the proposed specific measures set out in the Plan.

While the Plan does not include locally specific flood protection measures to address the flood risk in areas outside of the AFAs, it does set out the range of policies and measures, which are in place or under development, that can contribute to the reduction and management of flood risk throughout the River Basin, including areas outside of the AFAs, such as spatial planning, emergency response planning and maintenance of drainage schemes.

### 1.4.2 Sources of Flooding Addressed in the Plan

The Plan for the Laune-Maine-Dingle Bay River Basin addresses *fluvial and coastal flooding* in one or more communities (AFAs), as these sources were determined through the Preliminary Flood Risk Assessment to be potentially significant in one or more communities within the area covered by the Laune-Maine-Dingle Bay River Basin Plan. The sources of flooding addressed for each of the AFAs is indicated in Table 3.1.

Other sources of flood risk within these communities, which were not deemed to have been significant for those communities within the scope of the PFRA, have not been specifically addressed (i.e., through locally specific flood protection measures). The Plan does however set out a range of policies and measures that can contribute to the reduction and management of flood risk for all sources of flood risk throughout the River Basin, including areas outside of these communities, such as spatial planning, emergency response planning and maintenance of drainage schemes.

### 1.4.3 Level of Detail of the Plan

The Plan sets out the strategy, actions and measures that are considered to be the most appropriate at this stage of assessment, which has involved detailed modelling and appraisal of possible options for managing and reducing flood risk, including environmental assessment to the degree of detail appropriate for the Plan.

The observations and views submitted as part of the consultation on the Draft Plan (See Section 4.4.6) have been reviewed and taken into account in the preparation of this Plan.

It should be noted that the flood relief works or 'Schemes' set out in the Plans that have been developed through the CFRAM Programme are to an outline design, and are not at this point ready for construction. Further detailed design through a project-level of assessment will be required for such works before implementation, along with project-level environmental assessment and appraisal (including the consideration of alternatives), further public and stakeholder consultation and engagement and a statutory planning process such as

planning permission or Public Exhibition and confirmation (Ministerial approval), where relevant. Local information that cannot be captured at the Plan-level of assessment, such as ground investigation results and project-level environmental assessments, may give rise at that stage to some amendment of the proposed works to ensure that they are fully adapted, developed and appropriate within the local context, and that they are compliant with environmental legislation.

The works set out in the Plan may therefore be subject to some amendment prior to implementation.

## 1.5 STRUCTURE OF THE DRAFT PLAN

The structure of the Plan is set out below.

### **Flood Risk Management Plan**

<b>Section 1</b>	Provides an introduction and background to the Plan, including the flood risk management Objectives the Plan is aiming to achieve, and sets out the scope of the Plan
<b>Section 2</b>	Provides an overview of the catchment and coastal areas covered by the Plan, including a summary of the flood history and existing flood risk management measures
<b>Section 3</b>	Describes the PFRA undertaken to identify the AFAs that are the focus of this Plan
<b>Section 4</b>	Outlines the public and stakeholder consultation and engagement undertaken throughout the National CFRAM Programme and other relevant projects.
<b>Section 5</b>	Details the existing and potential future flood hazard and risk in areas covered by the Plan
<b>Section 6</b>	Describes the environmental assessments undertaken to ensure that the Plan complies with relevant environmental legislation and inform the process of identifying the suitable strategies that will, where possible, enhance the environment
<b>Section 7</b>	Sets out the measures to manage the flood risk in the area covered by the Plan, and how these were developed and assessed, and provides a summary of the measures proposed in the Plan
<b>Section 8</b>	Outlines how the implementation of the Plan will be monitored and reported, and then reviewed and updated at regular intervals
<b>APPENDIX A</b>	Provides an overview of flooding and flood risk
<b>APPENDIX B</b>	Describes in more detail a physical overview of the River Basin
<b>APPENDIX C</b>	Summarises the process in undertaking the Preliminary Flood Risk Assessment
<b>APPENDIX D</b>	Provides details on certain aspects of the stakeholder and public engagement and consultation
<b>APPENDIX E</b>	Sets out the flood risk in each AFA
<b>APPENDIX F</b>	Provides a summary of the different methods of flood risk management
<b>APPENDIX G</b>	Describes the potential flood risk management works

### **Strategic Environmental Assessment Statement**

### **Natura Impact Statement**

The flood maps that have informed and form part of this Plan are available from the OPW website: [www.floodinfo.ie](http://www.floodinfo.ie).



## 2 OVERVIEW OF THE RIVER BASIN

### 2.1 THE LAUNE-MAINE-DINGLE BAY RIVER BASIN

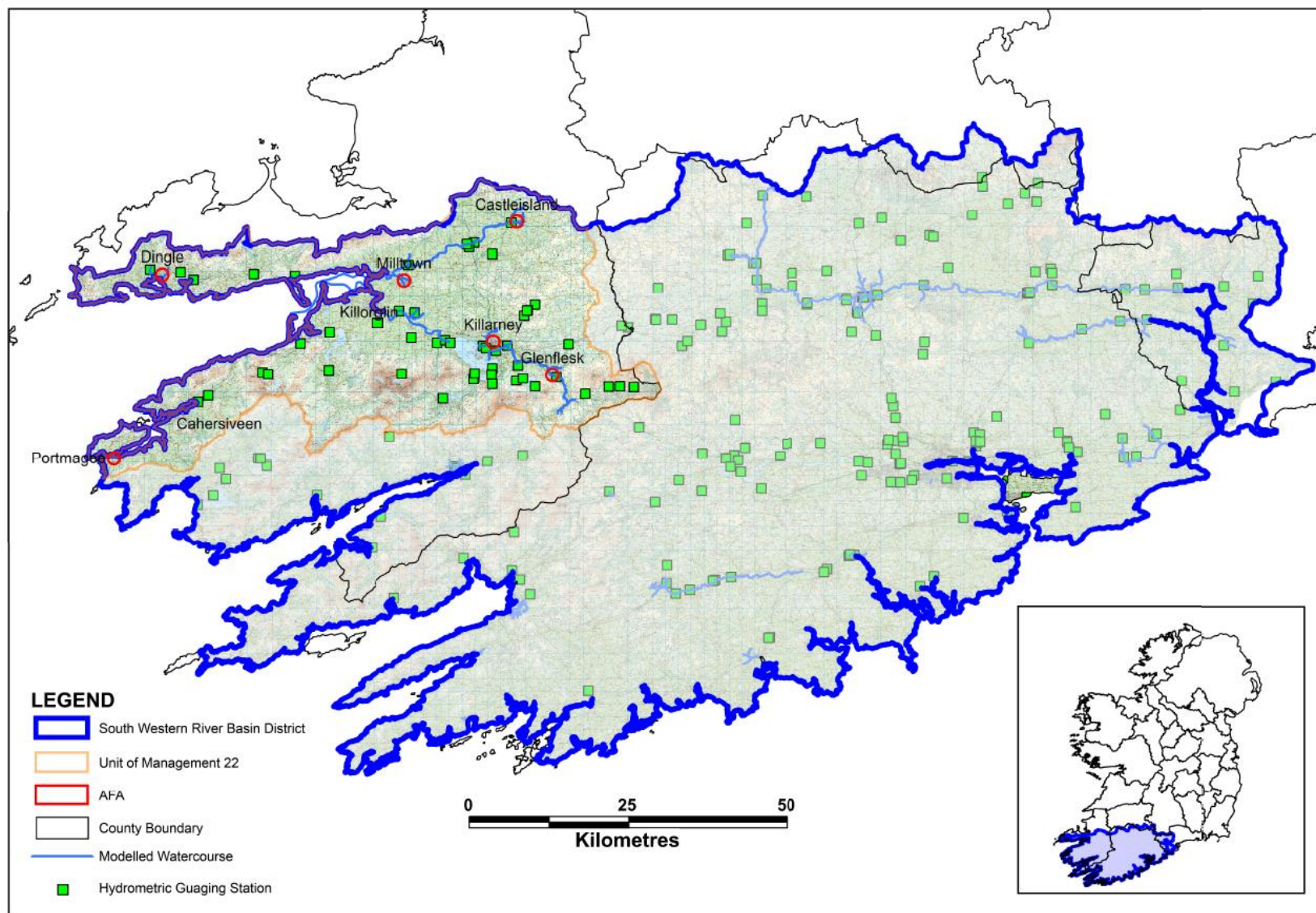
The Laune-Maine-Dingle Bay River Basin covers an area of approximately 2,031km<sup>2</sup>. The large majority of the area is in County Kerry with parts in County Cork. The main rivers are the Maine, the Flesk and the Laune. The River Basin also includes a number of large lakes including Lough Leane and Muckross Lake.

As part of this study, there are six Areas for Further Assessment (AFAs) within Laune-Maine-Dingle Bay River Basin. Associated with the AFA's is over 134km of high and medium priority watercourse. High priority watercourses are any modelled watercourse within an AFA. Medium priority watercourses are all other modelled watercourses.

**Table 2.1: AFAs within the Laune-Maine-Dingle Bay River Basin**

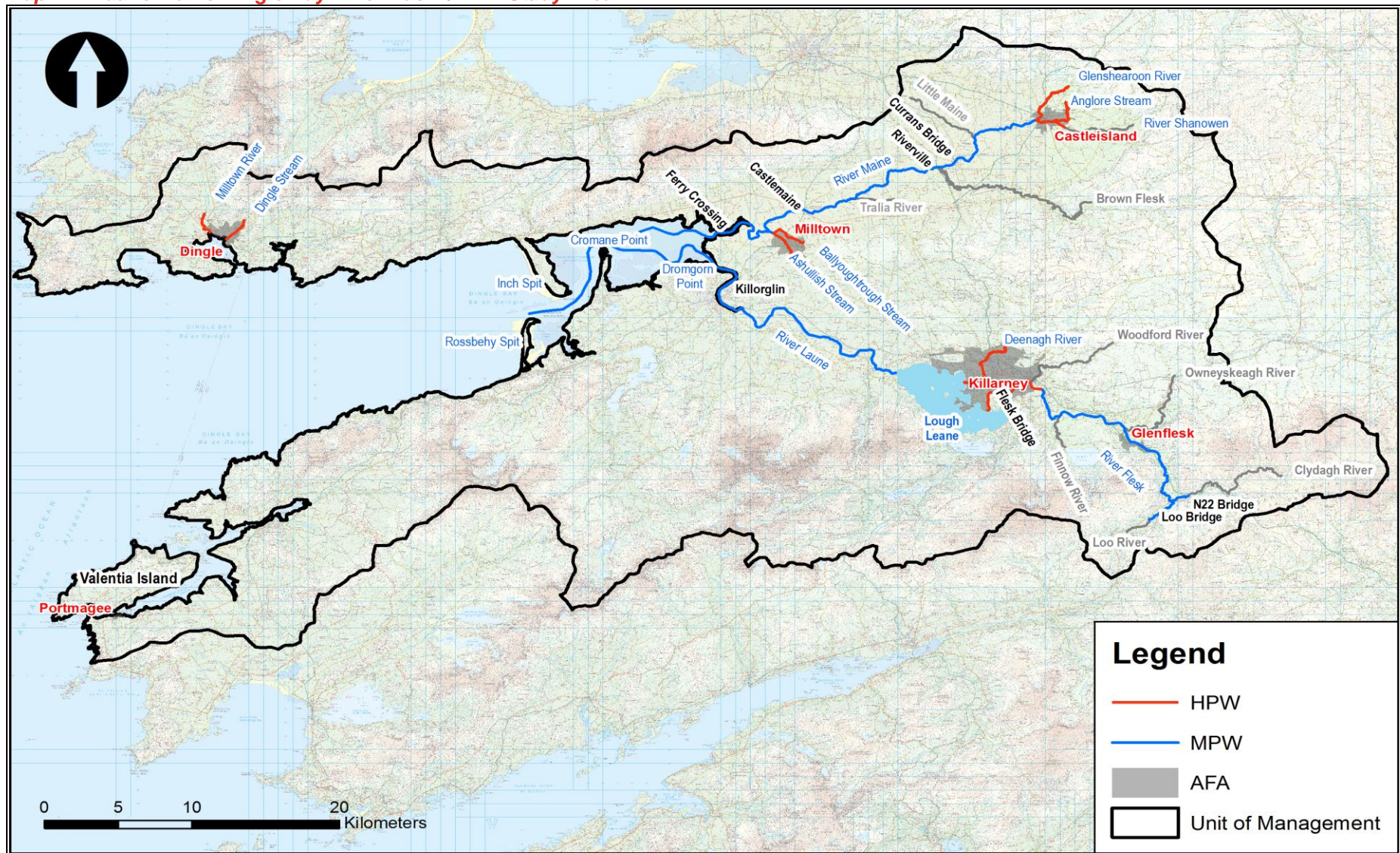
UoM	Name	Unique ID	Fluvial	Coastal	County	Easting	Northing
22	Castleisland	220323	Yes	No	Kerry	97750	110000
22	Dingle	220327	Yes	Yes	Kerry	44500	101000
22	Glenflesk	225502	Yes	No	Kerry	106621	85316
22	Killarney	220337	Yes	No	Kerry	97000	90500
22	Milltown	220339	Yes	No	Kerry	82500	101000
22	Portmagee	220340	No	Yes	Kerry	36500	73000

**Map 2.1: South Western Study Area**





Map 2.2: Laune-Maine-Dingle Bay River Basin / AFA Study Area





## 2.2 TOPOGRAPHY, GEOLOGY AND SOILS

The River Maine has elevations ranging from <1mAOD at the tidal outfall to over 400mAOD in the headwaters of the River Shanowen upstream of Castleisland. The river flattens out into the embanked reaches downstream of Currans Bridge and Riverville where Castlemaine and a number of smaller settlements lie below the flood embankments. The surrounding hills including the Dingle catchment and the tributaries of the lower Maine are typically very steep as the rivers flow through the steep valley sides of the Dingle Peninsula Mountains. However, the gradient of these tributaries flattens out significantly as these tributaries enter the sea or enter the Maine floodplain.

The River Flesk upstream of Glenflesk is relatively flat until Glenflesk (1 in 3600) and is underlain by Devonian Old Red Sandstones which forms the relatively flat valley floodplain surrounded by basalt which forms the steep valley sides. Downstream of Glenflesk, the underlying geology changes to karstified Dinantian limestones with the joining of the Owenskeagh River which increases the river gradient and narrows the valley. The land immediately next to Lough Leane is formed of fluvial and lacustrine deposits from the Lough and tributaries. Lough Leane outfalls into the River Laune which has a relatively constant 1 in 100 gradient to its outfall into Castlemaine Harbour downstream of Killorglin. The Laune valley is relatively narrow and surrounded by steep mountainous terrain to the North and South. The outfalls of Lough Leane and the River Laune floodplain are underlain by Dinantian limestone but surrounded by Dinantian shales, sandstones and limestones forming the steeper valley sides.

Further details on the topography, geology, soils and groundwater in the Laune-Maine-Dingle Bay River Basin is provided in Appendix B.

## 2.3 LAND USE AND LAND MANAGEMENT

Land use comprises pastoral and agriculture, with pastoral focussed on the steep relief along the valley sides. Farmland along the lower Maine is heavily drained in these flat low lying areas to maintain agricultural production. There are areas of coniferous plantation around Milltown and along the lower Maine in the flat floodplain. There are also a number of Natura 2000 classified boglands along the lower Maine, particularly Inchinveema bog by the Brown Flesk confluence which naturally attenuate and store flood flows. The delta area downstream of Killarney forms part of the Killarney National Park and is an important recreational and tourism attraction.

The major urban areas are located at Killarney (population 37250 including Castleisland), Killorglin (population 24750) and Dingle areas (population 15600). The remaining smaller settlements tend to be located at the edge of the floodplains or along the coast, away from the main rivers considered in this study.

The way in which the land is used can significantly impact the flow routes across the catchment, how much rainfall is stored, how much infiltrates into the ground, and how much evaporates.

The majority of the River Basin is currently rural and dedicated to agricultural or pastoral use. Changes to agriculture can lead to intensification of activities and associated increased land drainage and runoff. Increased irrigation and drainage for the commercial forests can route more water to the rivers thus reducing the time to peak.

Future urban development within the River Basin is also likely to cause more water to reach the river channels quicker and affect more people, property and environments.

Further details on land use and land use management in Laune-Maine-Dingle Bay River Basin is provided in Appendix B.

## 2.4 HYDROLOGY

### 2.4.1 Sub-Catchments & Coastlines

The Laune-Maine-Dingle Bay River Basin can be split into sub-catchments covering the AFAs.

#### 2.4.1.1 Castleisland Sub-Catchment

The River Shanowen rises near Mount Eagle and flows westwards towards Castleisland where it joins with the Anglore Stream to form the River Maine at Castleisland. The River Maine then continues to flow westwards joining with the Glanshearoon Stream and the Little Maine River before flowing south-westwards to Currans Bridge. The major tributary of the Brown Flesk joins the River Maine near the N22 crossing at Riverville gauge. Downstream of the Tralia River, the River Maine becomes increasingly tidally-influenced and is tidally-dominated downstream of Castlemaine. As the Maine continues towards Castlemaine Harbour it is joined by a number of embanked tributaries notably Ashullish Stream from Milltown.

#### 2.4.1.2 Milltown Sub-Catchment

Ashullish Stream is a steep watercourse which flows north-westwards through the centre of Milltown, under the N70 to outfall via a penstock into the River Maine. The main tributary Sruhaun Ballyoughtragh Stream (henceforth referred to as Ballyoughtrough) flows in a north-westerly direction to Chapel Bridge, flowing past the GAA grounds and alongside Old Station Road before turning west into embanked sections to join Ashullish Stream.

#### 2.4.1.3 Dingle Sub-Catchment

Dingle Stream flows in a south-westerly direction into central Dingle along Spa Road, under Bridge Street and along the Mall to outfall at the eastern end of the marina. Milltown River flows southwards to Ballinabooly where the Ballyeabought River joins from the east. Milltown River then becomes increasingly tidally influence as it continues southwards where a minor tributary joins under the R559 and then outfalls into Dingle Harbour at Milltown Bridge.

#### 2.4.1.4 The Flesk / Laune Sub-Catchment (Glenflesk / Killarney)

The River Clydagh rises near Mullaghanish and joins with the Loo River downstream of Loo Bridge to form the River Flesk. The River Flesk flows in a north-westerly direction to Glenflesk and joins with the Owenyskeagh River 2km downstream of the town before flowing towards Killarney and outfalling into Lough Leane. The River Deenagh flows along the North of Killarney before turning southwards along Port Road, and then westwards through the Killarney National Park to outfall into Lough Leane. A number of other rivers flow into Lough Leane including Owenreagh River and Muckross Lake outfall. These inflows combine with River Flesk and Deenagh to form the River Laune at the outfall. The River Laune then flows in a north-westerly direction to Killorglin where it outfalls into Castlemaine Harbour at Dromgorn Point.

#### 2.4.1.5 Coastal Features

Castlemaine Harbour is a complex estuary that extends west from the Maine and Laune into Dingle Bay. A series of complex sand bars and key spit features at the estuary outfall divert the tidal currents and protect the harbour from extreme storm waves.

The key features include:

- Cromane Point
- Inch Point
- Rossbehy Point

These large expanses of sand dunes, sand bars and shallow water are essential habitats designated under Natura 2000 and protected under EU legislation. The Maine and Laune low-tide channels are between 300m to 400m wide, combining into one channel near Aughill's Bridge which is 1.7km wide at low tide.

#### 2.4.2 Rainfall Distribution

The River Laune catchment has some of the highest standard average rainfall values in Ireland due to the relatively high relief of the upper catchment and location on the west coast. Rainfall tends to be greater in the west of the Maine catchment than the east. The Maine catchment as a whole tends to have less rainfall than the Laune catchment due to the lower elevations in the Maine.

Prolonged frontal Atlantic storm events dominate the rainfall events in both the River Laune and Maine catchments, tracking from west to east. This can mitigate peak flows as rain falls and drains from the lower reaches before the peak flows from the upper reaches. However, intense summer storm rainfall events can also occur, causing overland flow and flooding issues in the steep small catchments that have a fast time to peak.

#### 2.4.3 Hydrometric Data Availability

A range of different data sources have been used to undertake the hydrological data analysis for the Laune-Maine-Dingle Bay River Basin. The use of local hydrometric data can greatly improve and validate flood flows for historic events and design flood events. The following table highlights the sources of data that have been reviewed.

**Table 2.2 Summary of Available Data**

Type	Details	Owner	Period of Available Date
River Flows	15 minute interval data series at 12 gauges with flow converted from water level	OPW EPA	Various up to 2012
River Levels	15 minute interval data series at 15 gauges	OPW EPA	Various up to 2012
Rainfall Gauges	Daily rainfall values at 36 gauges Hourly rainfall series at Valentia Observatory	Met Eireann	Various up to 2012
Extreme sea level	Irish Coastal Protection Strategy Study Total tide +surge design levels at 11 points within Dingle Bay	OPW	Calculated for 2012
Wave conditions	Water levels, wave heights and wave periods at Dingle Harbour.	OPW	Calculated for 2013
Tidal Prediction Points	Admiralty Tide Tables Volume 1	UKHO Admiralty	Calculated for 2013

Further details on the hydrology of the Laune-Maine-Dingle Bay River Basin is provided in Appendix B.

## 2.5 FLOOD HISTORY

### 2.5.1 Historic Flood Events

Historic flood events within the River Basin were identified from the floods database ([www.floodinfo.ie](http://www.floodinfo.ie)), previous reports, and drawing on interviews with Local Authority personnel and residents during the Flood Risk Review. There were limited details available for historic flood events, as detailed records of impacts for events more than 20 years ago were scarce.

#### **Flood events in November and December 2015**

Flooding occurred in the River Basin after the completion of the hydraulic modelling for the study. This flooding occurred following prolonged rainfall during November and December 2015. During December flooding occurred in Portmagee. This flooding was pluvial in nature as it came from the higher ground around Coomanaspig. Several landslides were noted during this event in this area also. Flooding also occurred in Castlemaine and Glenflesk during this period.

#### **Flood Event 11 September 2015**

Following intense rainfall 2 properties upstream of Glenflesk flooded from the River Flesk. The N22 at this location was also impassable for a period of time.

#### **Flood Event 24 January 2014, Castleisland**

After a period of intense prolonged rainfall 22 properties flooded from the Glensheroon, the Anglore and the Maine rivers in Castleisland and Tullig.

#### **Flood Event 2 January 2014**

A combination of high tides, low pressure, storm surges and heavy rain gave rise to flood damage all over the West Coast of Ireland. Winds of up to 130km/h were recorded and members of the public on the Dingle peninsula were instructed to stay indoors. During this event flooding occurred in Killorglin, Cromane, Rossbeigh and Glenbeigh.

#### **Flood Event of 15th January 2011**

Intense rainfall over a few hours caused river levels in the Flesk to rise and flood the adjoining floodplain in Killarney and Killarney National Park. However, flooding was restricted to open fields and recreation grounds next to the river and no properties in the southern side of Killarney were affected.

#### **Flood Event of 19th November 2009**

After a month of prolonged rainfall, over 80mm of rain fell within 48 hours, flooding parts of Killarney along the River Deenagh as well the River Flesk. The saturated antecedent conditions meant that Lough Leane levels were already high prior to the event and significant inflows from the other rivers entering the lake. The intense rainfall on the 19th November 2011 further raised levels which caused significant flooding to the Killarney National Park area, parts of the N70 and the local road network. The tourist area around Muckross and the Lake Hotel were extensively flooded to depths of over 0.5m in some areas. This was the first recorded flooding of the Lake Hotel in the past 190 years.

#### **Flood Event of 4th October 2008**

Flooding at Tullig, Castleisland resulted from a complex interaction of river flooding and subterranean flow paths. Initially, river levels in the Glanshearoon River overtopped the left bank whereupon the flood water entered the Crag Cave complex to flood areas downstream on the Anglore Stream. Several properties were flooded along Anglore Stream at Cordal Road. An additional commercial property was also affected by the flooding. However, interviews with local residents indicated that the River Maine was in bank through the town.

**Flood Event of 4th January 2008**

Anecdotal reports of flooding from the Kerry County Council Engineer and informal discussions with residents of Milltown during the previous study suggest that heavy rainfall on the 4th January 2008 caused water levels to rise and spill out of Ballyoughtrough Stream along Old Station Road due to potentially undersized culverts under access bridges along this reach. Additional flooding was also experienced around the N70 Bridge on Ashullish Stream where water bypassed the bridge, possibly due to siltation reducing the capacity of this reach

**Flood Event of 1st February 2002**

A combination of high tidal level on the River Maine and flood flows on the adjoining tributary downstream of Castlemaine caused river levels to overtop the raised embankments and flood the surrounding farmland at Castlemaine. Fields were flooded for several days, and the flood waters were unable to return to the river because the floodplain is below the embankments.

**Flood Event of 17th February 1997**

Similar to the 2011 event, intense rainfall caused the River Flesk levels to rise and flood the adjoining floodplain in Killarney and Killarney National Park. However no properties were affected. High flows were recorded downstream at Laune Bridge but no flooding issues were reported on the River Laune.

**Flood Event of January 1988**

From what limited data there is available for this event, it is believed that a combination of a tidal surge and intense rainfall resulted in significant flooding along Dingle Stream. Flood waters spilled out-of-bank at Bridge Street and Hudson's Bridge and flowed rapidly down the Mall and Dykegate Street flooding properties adjacent to the road. Furthermore, the extreme sea level and intense rainfall overwhelmed the urban drainage network, causing surcharging of the sewers which added to the flooding along the streets.

**Flood Event of August 1986**

An intense summer rainfall event on 5th and 6th August 1986 resulted in 87mm of rain within 15 hours at nearby Valentia Observatory. This resulted in a rapid rise in the River Flesk levels causing flooding of the recreational grounds along the River Flesk in Killarney, but no properties were reported as being affected.

**Flood Event of November 1980**

The November 1980 event was the largest flow on record at Flesk Bridge. There was over 90mm of rain over 48 hours on the 1st and 2nd November 1980 causing Lough Leane levels to rise and limiting discharge of the prolonged fluvial flood along the River Flesk. There was no gauge data for this event at White Bridge on the River Deenagh. However, it is likely that the flood on the Deenagh was a similar %AEP to the Flesk as the rainfall amount is between the catchments. The River Flesk levels spilled out-of-bank to flood Killarney National Park as well as fields and recreational grounds adjacent to the river in Killarney. The River Deenagh was also reported as flooding but no precise locations were provided. However, no properties were reported as being affected.

There was also flooding upstream along the N22 between Loo Bridge and Glenflesk by the River Loo and River Flesk as reported by Kerry County Council which resulted in the flooding of 23 houses, 3009 acres, the loss of 209 livestock, and 322 road access disruptions.

**Other Events**



There are a number of anecdotal reports of flooding in the River Basin. These provide useful insight into the locations of flooding issues and the relative frequency of flooding when combined with the formally reported events above. These include:

- Laune Catchment
  - Regular flooding of the N71 from Lough Leane between Killarney and Molls Gap as reported on floodmaps.ie
- Maine Catchment
  - Local engineers at Castleisland reported flooding in August 2008 of similar magnitude to the event on 4th October 2008, but the flooding mechanism and extent was not provided.
- Dingle and Coastal Catchments
  - Recurring flooding at Mill Bridge in Dingle from Milltown Stream once or twice a year due to high tidal levels as reported by Kerry County Council.
  - Recurring flooding along The Mall in Dingle from Dingle Stream caused by heavy rainfall combined with high tide occurs once every 5 years on average. However, Kerry County Council reported that no properties were affected by the most recent event.
  - Flooding at Stealroe (2km downstream of Killorglin) from the River Laune due to high tides once every 10 years on average as reported by Kerry County Council.
  - Recurring flooding of the R565 road east of Portmagee from high tides on average twice a year as reported in floodmaps.ie. However, there are no records of flooding within Portmagee itself.

Information on the above past floods, such as flood flows, levels, depths, extents and mechanisms, has been used as appropriate in the CFRAM Programme to inform the preparation of the flood maps and Plans, where such information has been available at the relevant stage of the Programme and has been considered adequately reliable.

## **2.6 EXISTING FLOOD RISK MANAGEMENT MEASURES**

### **2.6.1 Arterial Drainage Schemes and Drainage Districts**

The following Arterial Drainage Schemes have been completed, and are maintained by the OPW, in the Laune-Maine-Dingle Bay River Basin.

- River Maine Catchment Drainage Scheme: Completed 1963, 228.5km of channel and 95.8km of embankment, 44.6km<sup>2</sup> benefitting lands

### **2.6.2 Minor Works**

The Minor Flood Mitigation Works and Coastal Protection Scheme (the 'Minor Works Scheme') is an administrative scheme introduced in 2009 and operated by the OPW under its general powers and functions to provide funding to local authorities to enable the local authorities, to address qualifying local flood problems with local solutions.

Under the scheme, applications from local authorities are considered for projects that are estimated to cost up to €750,000 in each instance. Funding of up to 90% of the cost is available for approved projects, with the balance being funded by the local authority concerned. Local authorities submit funding applications in the prescribed format, which are then assessed by the OPW having regard to the specific technical, economic, social and environmental criteria of the scheme, including a cost benefit assessment. With regard to the latter, proposals must meet a minimum benefit to cost ratio of 1.35 or 1.5 : 1 (depending on cost) in order to qualify. Full details are available on [www.opw.ie](http://www.opw.ie)

By the end of 2017, over 650 applications for flood relief works under the Minor Works Scheme have been approved since the inception of the Scheme in 2009. Details of the Scheme and works for which funding under the Scheme have been approved are available from the OPW Website:

- <http://www.opw.ie/en/floodriskmanagement/operations/minorfloodworkscoastalprotectionscheme/>

## 3 PRELIMINARY FLOOD RISK ASSESSMENT

### 3.1 INTRODUCTION

The Preliminary Flood Risk Assessment (PFRA) was a national screening exercise, based on available and readily-derivable information, to identify areas where there may be a significant risk associated with flooding.

The PFRA in Ireland was finalised in December 2011, following public consultation. A summary of how the PFRA was undertaken is provided in Appendix C.

### 3.2 OUTCOMES OF THE PFRA

The OPW designated 300 AFAs around Ireland, informed by the PFRA, the public consultation outcomes and the Flood Risk Reviews (further details available in Appendix C of this Plan and from the OPW website: [www.floodinfo.ie](http://www.floodinfo.ie)). The AFAs were the focus of the CFRAM Studies and parallel detailed studies.

A list of all AFAs is provided in Appendix A of the Report on the Designation of the Areas for Further Assessment (OPW, 2012). Table 3.1 identifies the AFAs that are within the area covered by this Plan, and the sources of flood risk that were deemed to be significant for each AFA, which are also shown in Figure 3.1.

**Table 3.1** *List of the AFAs within the Laune-Maine-Dingle Bay River Basin*

ID No.	COUNTY	NAME	SOURCE(S) OF FLOOD RISK
220323	Kerry	Castleisland	Fluvial
220327	Kerry	Dingle	Fluvial / Coastal
225502	Kerry	Glenflesk	Fluvial
220337	Kerry	Killarney	Fluvial
220339	Kerry	Milltown	Fluvial
220340	Kerry	Portmagee	Coastal
220999	Kerry	Tullig <sup>5</sup>	Fluvial

<sup>5</sup> Incorporated into the Castleisland AFA

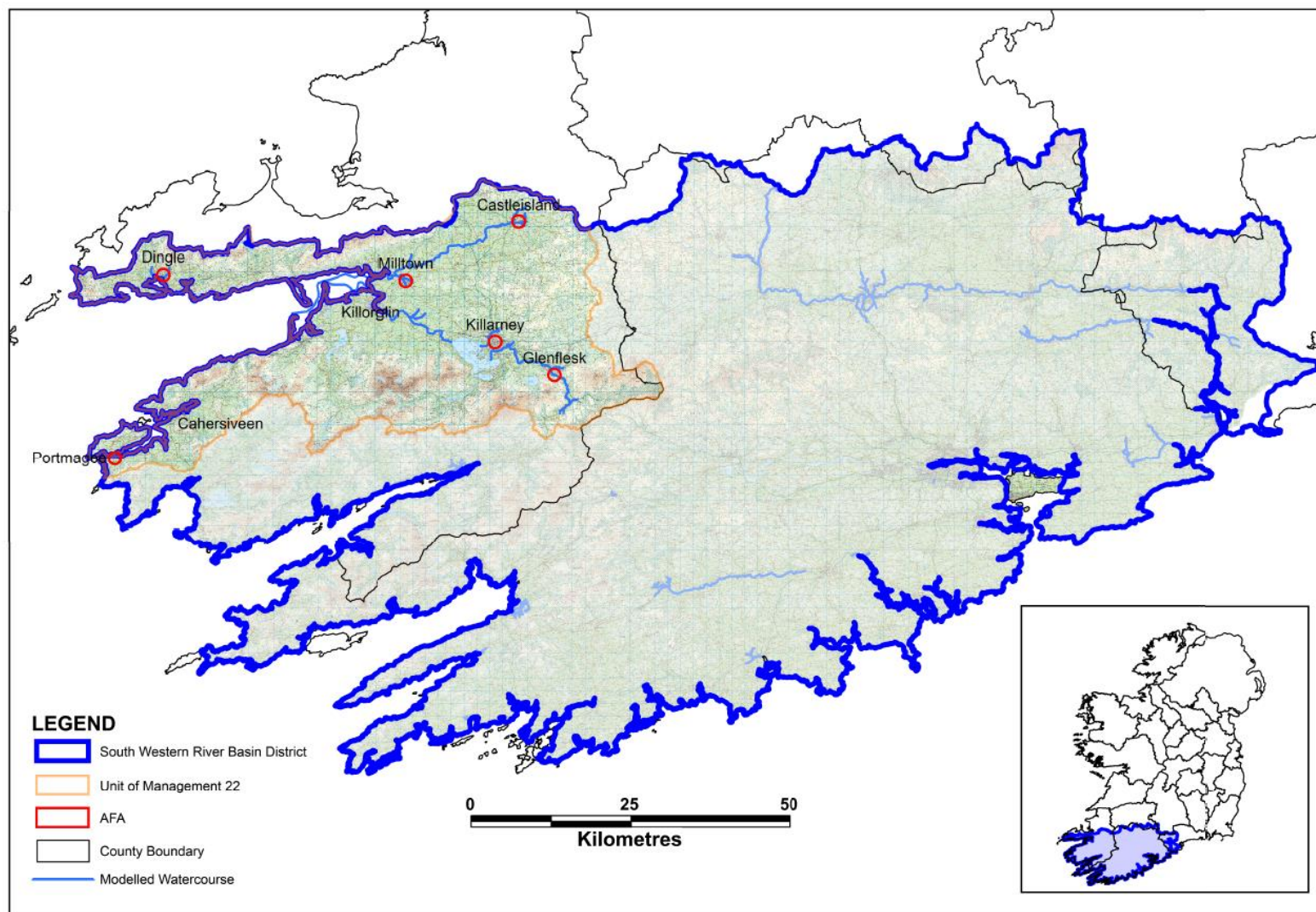
### 3.3 FURTHER INFORMATION

The Main Report on the PFRA, the Report on the Designation of the Areas for Further Assessment and a number of technical reports are available from the OPW website ([www.floodinfo.ie](http://www.floodinfo.ie)). These reports describe the process followed in the first cycle of the PFRA, describe how the AFAs were designated and provide a full national list of the AFAs.

The PFRA will be reviewed as required under the relevant legislation. It is anticipated that the review of the PFRA will consider and support a range of issues in more detail than in the first cycle of the implementation of the 'Floods' Directive, and other issues that were not possible to consider in the first cycle given the information that was available or readily-derivable at the time. Such issues may include:

- Rural and dispersed flood risk: The CFRAM Programme has focused on communities at potentially significant flood risk (the AFAs) where the risk was understood to be concentrated and where it is more likely that viable measures could be identified. In the second cycle, it is foreseen that there will be a greater level of assessment of rural and dispersed risk.
- The potential impacts of climate change: The OPW has supported research commissioned by the EPA to investigate potential impacts of climate change on extreme rainfall patterns and hence on flood flows. This should support future assessments of potential future changes in flood risk.
- Critical Infrastructure: Assets that are critical to normal societal function and that may be at risk from flood events need to be identified. This will enable assessments of the potential 'knock-on' effects for other assets and services, such that appropriate risk management measures can be implemented to help ensure Ireland's resilience to severe flood events.

The outcomes of the PFRA undertaken in the second cycle of the 'Floods' Directive implementation, which will include environmental screening / assessments as appropriate, will inform the need for further detailed assessment and flood mapping and the review of the Plans.



*Figure 3.1. Map of the AFAs within the Laune-Maine-Dingle Bay River Basin*

## **4 PUBLIC AND STAKEHOLDER CONSULTATION AND ENGAGEMENT**

### **4.1 OVERVIEW**

Public and stakeholder engagement is a critical component to the process of developing a sustainable, long-term strategy for flood risk management. This engagement is necessary to ensure that flood risk management measures are suitable and appropriate, as well as technically effective.

This section describes the public and stakeholder consultation and engagement that has been undertaken under the CFRAM Study for the Laune-Maine-Dingle Bay in the development of this Plan. An overview of the CFRAM consultation stages and structures is provided diagrammatically in Figure 4.1.

### **4.2 AVAILABILITY OF PROJECT INFORMATION**

A website for the National CFRAM Programme and the PFRA was established in 2011, and a Project-specific website was developed upon inception of the South Western CFRAM Project. Relevant information from these websites is now available from the OPW website ([www.floodinfo.ie](http://www.floodinfo.ie)), which provides information on the 'Floods' Directive and SI Nos. 122 of 2010 and 495 of 2015, the PFRA and the CFRAM Programme, and provides access to view and download reports, the Plans and other project outputs.

Information on OPW flood relief schemes and other, parallel projects is provided through the OPW Website, [www.opw.ie](http://www.opw.ie).

Flood maps prepared through the CFRAM Programme and through other projects are available through the OPW website ([www.floodinfo.ie](http://www.floodinfo.ie)).

### **4.3 STAKEHOLDER ENGAGEMENT**

#### **4.3.1 The CFRAM Steering and Progress Groups**

##### *4.3.1.1 The National CFRAM Steering Group*

The National CFRAM Steering Group was established in 2009, and met on nine occasions to the date of publication of this Plan. It was established to provide for the engagement of key Government Departments and other state stakeholders in guiding the direction and the process of the implementation of the 'Floods' Directive, including the National CFRAM Programme. The membership of this Group is provided in Appendix D.1.

The National CFRAM Steering Group reported, through the OPW, to the Interdepartmental Co-ordination Group (now the Interdepartmental Flood Policy Co-ordination Group).

**Figure 4.1: Overview of the CFRAM Consultation Stages and Structures**





#### *4.3.1.2 South Western CFRAM Project Steering Group*

A Project Steering Group was established for the South Western CFRAM Project, that includes the Laune-Maine-Dingle Bay River Basin, in 2012. This Group, which included senior representatives of the members, provided for the input of the members to guide the CFRAM Programme and act as a forum for communication between the CFRAM Programme and senior management of key stakeholders. The Project Steering Group typically met twice a year.

The membership of this Group is provided in Appendix D2.

#### *4.3.1.3 South Western CFRAM Project Progress Group*

A Project Progress Group was established for the South Western CFRAM Project in 2012. This group is a working group that supports the Project Steering Group and meets approximately every six weeks. The Group was established to ensure regular communication between key stakeholders and the CFRAM Project and to support the successful implementation of the Project.

The membership of this Group was the same as for the South Western CFRAM Project Steering Group.

### **4.3.2 Stakeholder Consultation Groups**

Stakeholder Groups were formed at national and regional level to provide an opportunity for input by non-governmental stakeholder groups to participate in the 'Floods' Directive and CFRAM processes.

#### *4.3.2.1 National CFRAM Stakeholder Group*

The National CFRAM Stakeholder Group was established in 2014, and has met twice up to the date of publication of this Plan. It was established to provide for the engagement of key national non-governmental stakeholder organisations at key stages in the process of the implementation of the National CFRAM Programme. Members of the organisations listed in Appendix D.3 have invited to meetings of this Group.

#### *4.3.2.2 Project (Regional) CFRAM Stakeholder Group*

The South Western CFRAM Stakeholder Group was established in 2011, and has met on 3 occasions up to the date of publication of this Plan. It was established to provide for the engagement of local non-governmental stakeholder organisations at key stages in the process of the implementation of the South Western CFRAM Project. Members of the organisations listed in Appendix D.4 have attended meetings of this Group, although many other organisations were also invited to attend.

### **4.3.3 Coordination with the Implementation of the Water Framework Directive**

The Water Framework Directive (WFD) is concerned with the protection of the ecological quality of our waters. While the 'Floods' Directive is concerned with the protection of people and society from our waters, both Directives are concerned with water and river basin management, and hence coordination is required between the two processes to promote integrated river basin management, achieve joint benefits where possible and address potential conflicts.



There has been, and will continue to be, coordination with the authorities responsible for the implementation of the WFD through a range of mechanisms, including bi-lateral meetings and cross-representation on various management groups, as set out in Section 6.5.

## **4.4 PUBLIC CONSULTATION AND ENGAGEMENT**

In addition to the structured engagement with relevant stakeholders through the Steering, Progress and Stakeholder Groups, the public have also been given the opportunity and encouraged to engage with the implementation of the 'Floods' Directive and the CFRAM process. These engagement and consultation steps are set out in Figure 4.1, and are described in the sub-sections below.

### **4.4.1 Consultation on Preliminary Flood Risk Assessment**

The public and stakeholder consultation and engagement in the Preliminary Flood Risk Assessment (PFRA) is described in Section 3.

### **4.4.2 Consultation on Flood Maps**

The preparation of the flood maps, which serve a range of functions (see Section 5.3) is the second key requirement of the 'Floods' Directive. The initial preparation of the flood maps involved extensive consultation with the South Western CFRAM Progress Group and planners within the various relevant local authorities. This led to the development of draft flood maps that were then consulted upon with the public through local Public Consultation Days and a national, statutory consultation.

#### **4.4.2.1 Public Consultation Days**

The OPW identified that effective consultation and public engagement would require local engagement at a community level, and hence determined that Public Consultation Days (PCDs) would be held in each AFA (where possible and appropriate) to engage with the communities at various stages of the Projects, including during the production of the flood maps.

The PCDs were advertised locally in advance, and were held at a local venue in the community during the afternoon and early evening. OPW, Local Authority and Mott MacDonald Ireland staff were present to explain the maps that were displayed in the venue and answer any questions on the maps and the CFRAM process, and to collate local information to refine or confirm the maps. The PCDs in the Laune-Maine-Dingle Bay River Basin were held for consultation on the flood maps at the venues listed in Appendix D.5.

#### **4.4.2.2 National Flood Map Consultation**

The Government considered it appropriate to stipulate in SI No. 122 of 2010 that a national consultation exercise should be undertaken<sup>6</sup>. The consultation on the flood maps for all areas was launched in November 2015. Observations and Objections submitted through the consultation process have been assessed and the flood maps amended accordingly, where appropriate.

### **4.4.3 Consultation on Flood Risk Management Objectives**

The Flood Risk Management Objectives of the National CFRAM Programme define what the process is trying to achieve in terms of reduction of flood risk, and where possible provide wider benefits, to human health, the environment, cultural heritage and economic activity. The Objectives are described further in Section 1.4.

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<sup>6</sup>

Sections 12, 13 and 14, SI No. 122 of 2010

The OPW considered it appropriate to publicly consult on the proposed flood risk management Objectives, and launched a public consultation in October 2014. Submissions received were duly considered and amendments made to the Objectives where appropriate. The Objectives were finalised in March 2015.

A Multi-Criteria Assessment (MCA) is used as part of the process for assessing potential options for reducing or managing flood risk for each AFA. The MCA and this process are described in Section 7 herein. The MCA makes use of weightings to rank the importance of the Objectives. The OPW considered it appropriate to consult on the weightings that would be assigned to each Objective, and commissioned an independent poll of over 1000 members of the public on the weightings through a structured questionnaire. The results of this poll were analysed by UCD<sup>7</sup>, and the weightings for each of the Objectives then set.

#### **4.4.4 Consultation on Options**

Based on the flood hazard and risk identified in the flood maps, options for reducing or managing flood risk in each AFA were developed and assessed. This process is described in Section 7 herein.

PCDs, similar to those held for the consultation on the flood maps were held during the development and assessment of options. These were an opportunity to engage with the community and for the community to set out what local issues were particularly important and what measures they considered would be most suitable and comment on which identified options might be effective and appropriate, or otherwise. The PCDs in the Laune-Maine-Dingle Bay River Basin were held during the option development stage at the venues listed in Appendix D.6.

#### **4.4.5 Consultation on Draft Plans**

The Draft Plan for the Laune-Maine-Dingle Bay River Basin as published for the purposes of public consultation on 15 July 2016. Observations from the public and from relevant Councils were to be submitted to the OPW by 23 September and 17 October 2016 respectively. Presentations were made to Councils during the public consultation period.

In parallel and complementary to the formal public consultation process, a series of PCDs, similar to those held for the consultation on the flood maps (Section 4.4.3 above), were held to engage locally and directly with the community and provide people with opportunity to discuss and fully understand the Draft Plans. The PCDs in the Laune-Maine-Dingle Bay River Basin were held in relation to the draft Plans at the venues listed in Appendix D.7.

The observations submitted to the OPW through the public consultation processes were considered and the Plans amended accordingly where appropriate. A synopsis of the observations submitted and amendments made to the Plan arising from the observations is available from the OPW website ([www.floodinfo.ie](http://www.floodinfo.ie)).

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<sup>7</sup> (UCD, 2015): Weighting the Perceived Importance of Minimising Economic, Social and Environmental/ Cultural Risks in Flood Risk Management, University College Dublin, 2015

## 5 FLOOD HAZARD AND RISK ASSESSMENT

A general description of flooding and flood risk has been provided in Section 1.2 of this Plan. This Section describes the assessment processes followed under the CFRAM Programme to determine the extent and nature of flooding in the AFAs within the Laune-Maine-Dingle River Basin, and the resultant flood risk. A description of these processes and outcomes for other projects is provided in the relevant project reports (see Section 1.3.5).

To ensure consistency in approach where required, a National Technical Coordination Group was established under the National CFRAM Programme to bring together all of the Consultants with the OPW, and other organisations as necessary, to determine common standards and methodologies.

### 5.1 HYDROLOGICAL ANALYSIS

For AFAs where fluvial flooding is a potentially significant risk, the hydrological assessment under the CFRAM Programme has been limited to rivers and streams with a catchment area of more than 1km<sup>2</sup>. Smaller streams may also give rise to some flood risk, and such risk would need to be considered where relevant at the project-level of assessment (see Section 8.1), when the interaction between urban storm water drainage systems, fluvial flooding and proposed measures would also need to be considered in detail.

A review and analysis of historical flood events, hydrometric data and hydrogeomorphological processes highlighted flooding issues to urban areas and nationally important infrastructure from the River Flesk, Lough Leane, River Maine and a number of smaller tributaries. The Flood Studies Update (FSU) methodologies were used to determine the existing design peak flows, lough levels and characteristic flood hydrographs for eight specified flood probabilities across the sub-catchments. Corresponding coastal conditions have been developed for those areas at coastal flood risk. A number of calibration events were identified in the Laune and Maine catchments where there was sufficient historical flood data.

Potential future catchment changes relevant to the Laune, Maine and Dingle catchments were assessed, including changes in urban development, land use and hydrology related to global climate change. Two future scenarios were developed from this analysis, a Mid-Range Future Scenario and High-End Future Scenario, which were used to develop potential future flows and extreme sea levels.

The resultant design flood hydrographs and coastal conditions were used as input into the hydraulic models. The knowledge of the hydrological processes and the historical flooding issues in the Laune, Maine and Dingle catchments was used to support the development of sustainable and appropriate flood risk management options in those areas at greatest flood risk

Full details of the hydrological analysis are provided in the South Western CFRAM Hydrology Report, UoM 22, which can be accessed through the OPW website ([www.floodinfo.ie](http://www.floodinfo.ie)).

### 5.2 HYDRAULIC MODELLING

For AFAs where fluvial flooding is a potentially significant risk, the hydraulic assessment and modelling under the CFRAM Programme has been limited to rivers and streams with a catchment area of more than 1km<sup>2</sup>. Smaller streams may also give rise to some flood risk, and such risk would need to be considered where relevant at the project-level of assessment

(see Section 8.1), when the interaction between urban storm water drainage systems, fluvial flooding and proposed measures would also need to be considered in detail.

A total of eight hydraulic models were developed for the six Areas for Further Assessment (AFAs) and Medium Priority Watercourse downstream (MPW) to assess fluvial and coastal flood risk for various flood probabilities.

The majority of models used a 1D/2D hydrodynamically linked approach such that water can flow between the river and floodplain during the event to simulate the observed flood mechanisms within AFAs. The river channels were modelled using 1D software to calculate water levels, flows and head loss at hydraulic structures. The 2D software was used to simulate the multi-directional flows across the complex urban floodplains. However, Portmagee was developed with a 2D only approach to assess coastal flood risk as it was not deemed to be at risk from fluvial flooding.

The Castleisland and Killarney models were calibrated to flood events of 4th October 2008, 2nd November 1980 and 19th November 2009 where sufficient data enabled full calibration of the hydraulic parameters. The Maine model was also calibrated for high flow in-bank events on the 4th October 2008 and 12th January 2010 events. The Milltown, Glenflesk and Dingle models were validated against reports of recurring flooding to ensure representation for historic flooding. Sensitivity tests were undertaken on flow, downstream level and Manning's 'n' for all models. An additional sensitivity test was undertaken on the culvert coefficient at Milltown following comments from the local area engineers.

The calibrated and tested models were then run for eight flood probabilities under the current design scenario, eight flood probabilities under the mid-range future scenario, and three flood probabilities under the high-end future scenario from both fluvial and coastal sources. The flood extent, flood zone, flood depth, flood velocity and flood hazard were all mapped for the specified scenarios.

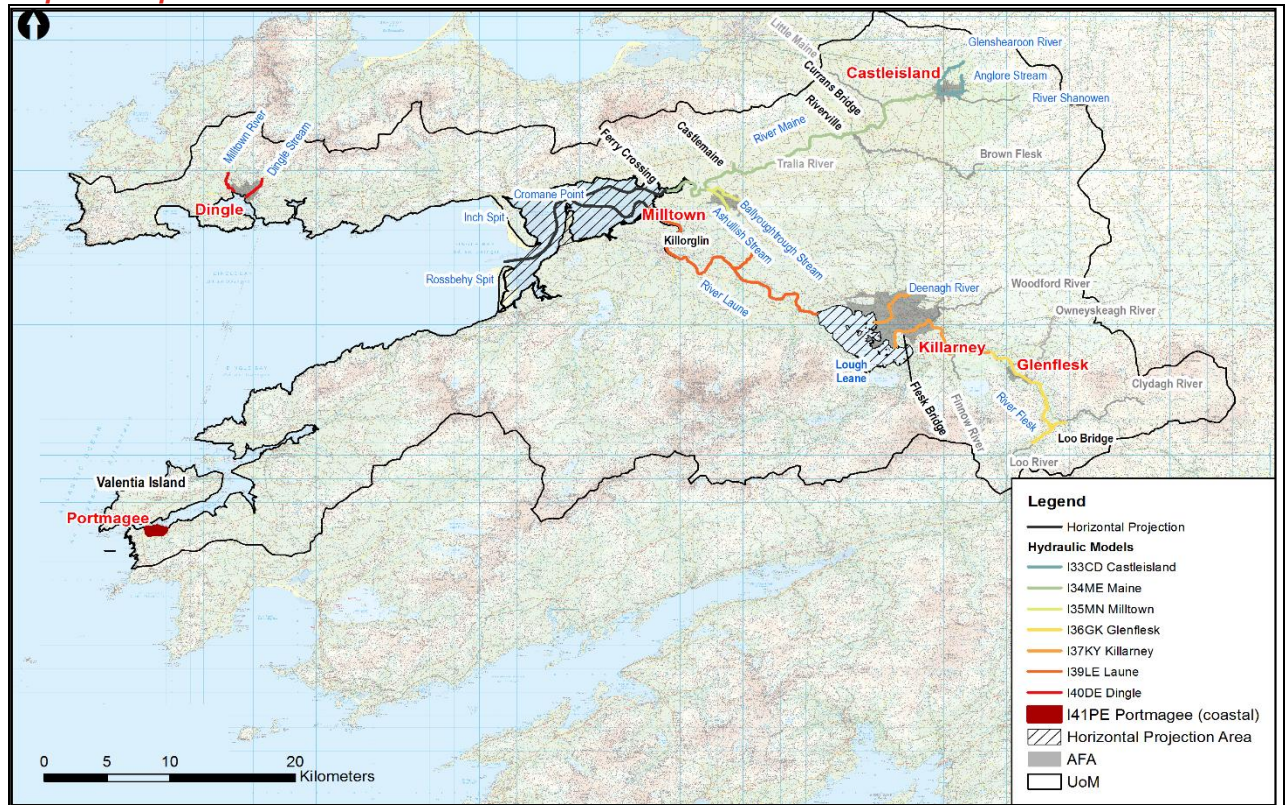
The findings from the modelling results and flood maps were used as inputs to the flood risk review. The knowledge of the flood mechanisms, critical structures and impact of flooding established supported the development of sustainable and appropriate flood risk management options in the flood risk areas.

The flood frequency analysis for extreme sea levels was taken from the Irish Coastal Protection Strategy Study (ICPSS), 2012.

Full details of the hydraulic analysis are provided in the South Western CFRAM Hydraulics Report, UoM 22, which can be accessed through the OPW website ([www.floodinfo.ie](http://www.floodinfo.ie)).



**Map 5.1: Map of Modelled Areas**



Link to relevant hydraulics and mapping report - [www.floodinfo.ie](http://www.floodinfo.ie)

### 5.3 FLOOD HAZARD MAPPING

The flood maps serve a range of functions:

#### **Public Awareness:**

Flood maps, and in particular flood extent maps and flood depth maps, inform the public, home owners, business owners, landowners and farmers, landlords and tenants about the likely risk of flooding in their areas, including the likely frequency of occurrence and depth. This knowledge can help people make decisions and prepare for flood events to reduce the potential impacts of flooding.

#### **Planning & Development Management:**

The flood maps should inform the Spatial Planning processes and support Planning Development decisions to avoid unnecessary development in flood-prone areas, in line with the 2009 Guidelines on The Planning System and Flood Risk Management<sup>8</sup>.

#### **Emergency Response Management:**

The flood maps should aid in the preparation and implementation of flood event emergency response plans, by providing information on areas prone to flooding, the potential depths of flooding and what might be at risk in the event of a flood.

#### **Flood Risk Management Decision Support:**

Flood maps, and in particular various flood risk maps, are intended to be used as a decision support tool in the identification, planning, development, costing, assessment and

<sup>8</sup> DCHPLG/OPW 2009: Guidelines on The Planning System and Flood Risk Management

prioritisation of flood risk management options, such as Flood Defence schemes, flood warning systems, public awareness campaigns etc.

The results of the 1D/2D hydraulic models were used to produce the following mapped outputs:

- Maps of maximum flood extent maps for each AFA and MPW reach
- Maps of maximum flood depth, in ranges / classifications for each AFA and MPW reach
- Maps of maximum velocities of floodplain flow, in ranges / classifications for each AFA
- Maps of maximum flood hazard (risk to people) which is a function of depth and velocity for each AFA
- Maps of Flood Zones which show three flood extents as zones A, B and C, to facilitate implementation of the Guidelines on the Planning System and Flood Risk Management for each AFA and MPW reach

As highlighted in Section 4.4.2, the flood maps were presented to the public at consultation events held in each of the AFAs. The feedback received on the flood maps for the Laune-Maine-Dingle Bay River Basin was positive and no observations were received during the public consultation days.

The flood maps can be accessed through the OPW website – ([www.floodinfo.ie](http://www.floodinfo.ie)).

The flood maps will be reviewed on an ongoing basis as new information becomes available (e.g., in relation to future or recent floods), with a formal review to be completed by the end of 2019 (see Section 8.4).

*Flood maps represent the current understanding of areas prone to flooding and the nature of the flood in a given area for a flood event of a given probability. The maps therefore need to be updated on an ongoing basis to reflect changes in the physical environment, the availability of new information (e.g., after a major flood has occurred, new calibration data is captured or where improved hydrological / flood flow estimates are available), or for other reasons that could indicate that improvements in map accuracy can be achieved. The flood maps, including the risk maps (see below), for Castleisland are currently under review and will be updated following this review. In the event that any changes are made to the maps, the measures for Castleisland will also be reviewed (see Section 7).*

## **5.4 FLOOD RISK ASSESSMENT AND MAPPING**

Using the flood hazard mapping described in Section 5.3, the potential adverse consequences (risk) associated with flooding to the following four risk receptor groups were assessed and mapped (General Flood Risk Maps) for each AFA:

- Society
- The Environment
- Cultural Heritage
- The Economy

The number of properties within a flood extent was calculated by counting the number of receptors that had any part of their footprint located within a location that had a positive depth of flooding (flood extent).

In addition, specific flood risk maps were prepared to assess the following:

- Number of Inhabitants: maps which present the indicative number of inhabitants at risk of flooding within each AEP event
- Types of Economic Activity: maps which present the types of property use and type of economic activity at risk of flooding within each AEP event
- Specific Risk Density: maps which present the annual average damage.

An assessment of each AFA's vulnerability to climate change was also carried out. An AFA is deemed as being significantly vulnerable to climate change if the increase in damages in the Mid-Range Future Scenario is significantly different to the current scenario. According to this definition Dingle and Milltown were identified as being significantly vulnerable to climate change.

The flood maps can be accessed through the OPW website – ([www.floodinfo.ie](http://www.floodinfo.ie)).

Table 5.1 presents a summary of the current risk within the Laune-Maine-Dingle Bay River Basin, including the number of residential and non-residential properties at risk in each AFA and in the floodplains of other river reaches modelled outside of the AFA.

Further details of properties and assets (receptors) at risk in each AFA are given in Appendix E.

**Table 5.1: Summary of Flood Risk in the Laune-Maine-Dingle Bay River basin**

AFA / Area / MPW	No. of Residential Properties at Risk		No. of Non-Residential Properties at Risk		NPVd <sup>2</sup> (€ millions)
	1% / 0.5% AEP <sup>1</sup>	0.1% AEP	1% / 0.5% AEP <sup>1</sup>	0.1% AEP	
Castleisland Fluvial	76	199	20	57	€11.23M
Dingle	35	68	9	10	€10.67M
	12	21	30	40	€2.40M
Glenflesk Fluvial	7	30	8	18	€0.52M
Killarney Fluvial	10	236	4	30	€4.03M
Milltown Fluvial	6	9	9	9	€0.25M
Portmagee Tidal	1	1	0	0	€0.21M
Flesk Reach (exclusive of AFA's) <sup>3</sup> Fluvial	3	17	3	11	N/A
Laune Reach (exclusive of AFA's) <sup>3</sup>	11	21	9	24	N/A
	10	14	19	22	N/A
Maine Reach (exclusive of AFA's) <sup>3</sup>	32	57	16	37	N/A
	6	8	9	9	N/A

Notes: 1: AEP Flood Event Probabilities: 1% (or 100-year flood) for Fluvial Flooding, 0.5% (or 200-year flood) for Coastal / Tidal Flooding

2: NPVd = Net Present Value Damages (accumulated, discounted damages over 50 years)

3: These figures are for reaches outside of AFA's as per Figure 3.1.

The numbers of properties at risk in Table 5.1 above are determined independently for each source (fluvial and coastal). For AFA's / MPW's where both sources of flooding occur, some properties may be at risk from both sources, and such properties have been included in the numbers for both sources.

The numbers of properties at risk and the damage values set out in Table 5.1 are as determined at this stage of assessment under current conditions. The numbers and values may change when the risk is assessed in more detail at the project-level of development of measures and/or due to the potential impacts climate change, future development and price inflation.



## 5.5 CONSIDERATION OF FUTURE CHANGES

It is likely that climate change will have a considerable impact on flood risk in Ireland.

- Sea level rise is already being observed and is projected to continue to rise into the future, increasing risk to our coastal communities and assets, and threatening damage to, or elimination of, inter-tidal habitats where hard defences exist (referred to as 'coastal squeeze').
- It is projected that the number of heavy rainfall days per year may increase, which could lead to an increase in both fluvial and pluvial (urban storm water) flood risk, although there is considerable uncertainty associated with projections of short-duration, intense rainfall changes due to climate model scale and temporal and spatial down-scaling issues.
- The projected wetter winters could give rise to increased fluvial flood risk and groundwater flood risk associated with turloughs.

These potential impacts could be significant for Ireland, where most of the main cities are on the coast and many of the main towns are on large rivers.

While there is considerable uncertainty associated with most aspects of the potential impacts of climate change on flood risk, it is prudent to take the potential for change into account in the development of Flood Risk Management policies and strategies and the design of Flood Risk Management measures.

Other changes, such as in land use, farming practices and future development could also have an impact on future flood risk through increased runoff and a greater number of people and number and value of assets within flood prone areas.

The National CFRAM Programme and parallel projects include the assessment of risk for two potential future scenarios; the Mid-Range Future Scenario (MRFS) and the High-End Future Scenario (HEFS). These scenarios include for changes as set out in Table 5.2.

**Table 5.2: Allowances in Flood Parameters for the Mid-Range and High-End Future Scenarios**

Parameter	MRFS	HEFS
Extreme Rainfall Depths	+ 20%	+ 30%
Peak Flood Flows	+ 20%	+ 30%
Mean Sea Level Rise	+ 500 mm	+ 1000 mm
Land Movement	- 0.5 mm / year <sup>1</sup>	- 0.5 mm / year <sup>1</sup>
Urbanisation	No General Allowance – Review on Case-by-Case Basis	No General Allowance – Review on Case-by-Case Basis
Forestation	- 1/6 Tp <sup>2</sup>	- 1/3 Tp <sup>2</sup> + 10% SPR <sup>3</sup>

Note 1: Applicable to the southern part of the country only (Dublin – Galway and south of this)

Note 2: Reduction in the time to peak (Tp) to allow for potential accelerated runoff that may arise as a result of drainage of afforested land

Note 3: Add 10% to the Standard Percentage Runoff (SPR) rate: This allows for temporary increased runoff rates that may arise following felling of forestry.

The impacts on flooding and flood risk under the MRFS and HEFS for the AFAs within the Laune-Maine-Dingle Bay River Basin are outlined in Appendix E.

Section 7.3.3 briefly describes how climate change was taken into account in the assessment of flood risk management options, which is detailed further in the relevant project reports.

## **5.6 COMMUNITIES (AFAS) OF LOW RISK**

The AFAs were determined through the PFRA, as described in Section 3. The flood hazard and risk analysis undertaken through the Laune-Maine-Dingle Bay River Basin CFRAM Project has been significantly more detailed than the analysis undertaken for the PFRA.

For certain AFAs, this more detailed analysis has determined that there is in fact currently a low level of flood risk to the community from rivers and/or the sea. In such cases, the development of flood risk management measures aimed specifically at reducing the risk in such AFAs (i.e., local flood protection schemes) has not been pursued. Some of the River Basin-level measures will however still be relevant and applicable as some infrastructure, such as roads, may nonetheless be prone to flooding, and land around the AFA may be prone to flooding.

In the Laune-Maine-Dingle Bay River Basin, the level of risk has been determined as being low in the following AFA:

- Portmagee AFA

The level of risk in the AFAs where the CFRAM process has determined that there is currently a low level of flood risk will be reviewed, along with all areas, as part of the review of the PFRA (see Section 3.3). This includes AFAs where the current level of risk may be low, but where the level of risk may increase in the future due to the potential impacts of climate change and so action in the future may be required to manage such impacts.

It is important to note that a low level of existing risk does not infer that undeveloped lands around the community are not prone to flooding, only that a limited number of existing properties are prone to flooding. When considering planning and development management, the potential for flooding in undeveloped areas needs to be fully considered for the AFAs where the risk to the existing community is low, as well as for all other communities, in accordance with the Guidelines on the Planning System and Flood Risk Management (see Section 7.4.1.1).

## 6 ENVIRONMENTAL CONSIDERATIONS

### 6.1 OVERVIEW

The Plan for the Laune-Maine-Dingle Bay River Basin has been the subject of a Strategic Environmental Assessment (SEA) and an Appropriate Assessment (AA) to meet the requirements of the Irish Regulations transposing the EU SEA and Habitats Directive respectively<sup>9</sup>. This Section provides a description of the process used to ensure that the environmental considerations within the Laune-Maine-Dingle Bay River Basin were addressed appropriately in the preparation of this Plan. The considerations with respect to each AFA, and the overall Plan, are summarised below and are detailed in the accompanying environmental documents.

The Draft Plan issued for consultation was accompanied by an SEA Environmental Report (Vol. III), which documented the SEA process. The Environmental Report identified, evaluated and described the likely significant effects on the environment of implementing the potential measures set out in the Draft Plan, with a view to avoiding adverse effects, and also, where appropriate, to set out recommendations as to how any identified adverse effects can be mitigated, communicated and monitored.

A Natura Impact Statement (Vol. III) also accompanied the Draft Plan, to set out the potential impacts of possible measures on Natura 2000 sites (core breeding and resting sites for rare and threatened species, or sites for some rare natural habitat types)<sup>10</sup>.

Following consideration of observations made in response to the public consultation on the Draft Plan, including comments received on the SEA Environmental Report and the Natura Impact Statement, the final Plan has been prepared. The Plan has been published with a SEA Conclusion Statement, which documents changes made to the Plan and its overall effects, and an Appropriate Assessment Conclusion Statement.

It is emphasised that the Plan sets out the strategy, actions and measures that are considered to be the most appropriate at this stage of assessment.

It should be noted that potential flood relief works or 'Schemes' set out herein will need to be further developed at a local, project level before Public Exhibition or submission for planning approval. Local information that cannot be captured at the Plan-level of assessment, such as ground investigation results and project-level environmental assessments, may give rise at that stage to some amendment of the proposed works to ensure that it is viable and fully adapted, developed and appropriate within the local context, and that it is compliant with environmental legislation.

While the degree of detail of the assessment undertaken to date would give confidence that any amendments should generally not be significant, the potential works set out in the Plan may be subject to amendment prior to implementation.

In this context, it should be noted that the SEA and AA undertaken in relation to the Plan are plan-level assessments. The Plan will inform the progression of the proposed measures, but project-level assessments will need to be undertaken as appropriate under the relevant legislation for consenting to a Scheme or works that involves physical works and that may progress in the future. The approval / adoption of the Plan has not and does not confer approval or permission for the installation or construction of any physical works. EIA and/or

<sup>9</sup> SI No. 435 of 2004 (SEA Directive) and SI No. 477 of 2011 (Habitats Directive)

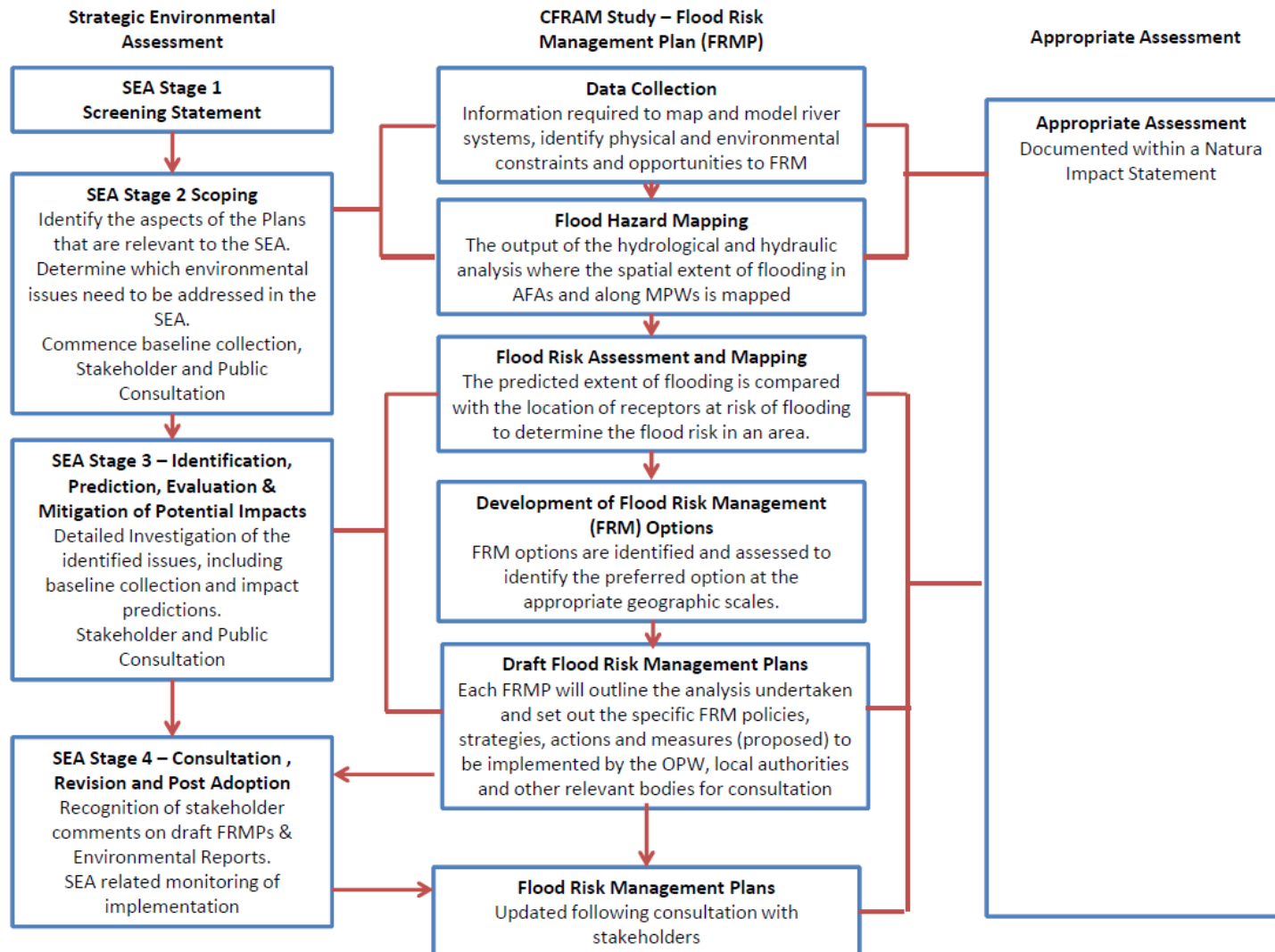
<sup>10</sup> [http://ec.europa.eu/environment/nature/natura2000/index\\_en.htm](http://ec.europa.eu/environment/nature/natura2000/index_en.htm)

AA Screening, and, where so concluded from the screening, Environmental Impact Assessment and / or Appropriate Assessment, must be undertaken in accordance with the relevant legislation where relevant as part of the progression of measures that involve physical works. The body responsible for implementation of such measures (see Section 7) is required to ensure that these requirements will be complied with.

The environmental assessments set out herein relate to the Plan, and measures set out and proposed under the Plan (see Table 7.1). Flood relief schemes and works proposed or progressed through other projects and plans (see Table 7.2) are not the focus of the environmental assessments of the Plan, but are considered in terms of their in-combination or cumulative effects with the measures set out within the Plan.

Particular issues such as knowledge gaps or mitigation measures that are expected to be necessary, are set out in Section 6.6.3 and Sections 7.4 for each preferred measure

Figure 6.1 shows the interaction and stages of the optioneering, SEA and AA processes.



**Figure 6.1: Interaction and Stages of Optioneering, SEA and AA Process**

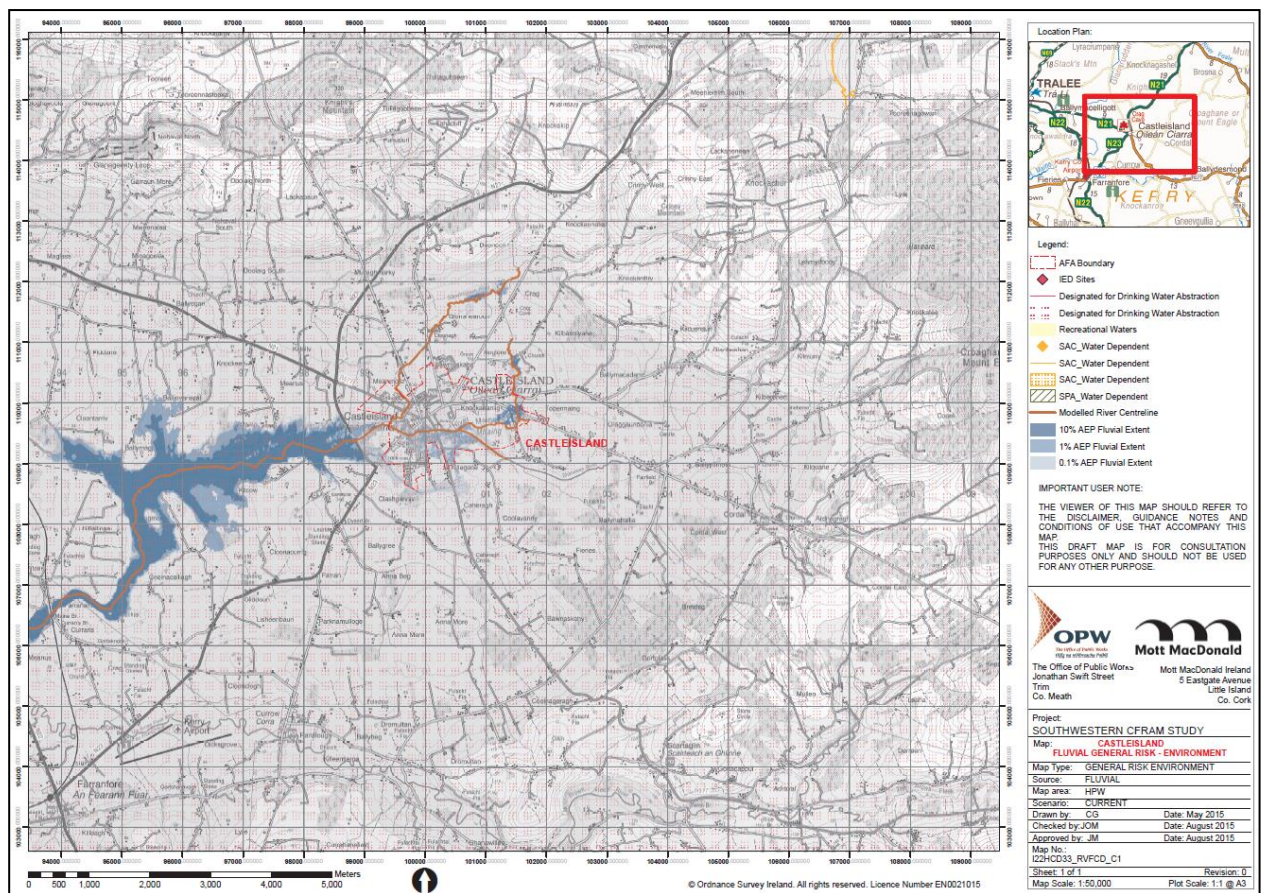
## **6.2 ENVIRONMENTAL CONSTRAINTS AND OPPORTUNITIES IN THE LAUNE-MAINE-DINGLE BAY RIVER BASIN**

### **6.2.1 Castleisland**

The key environmental sensitivities in Castleisland are summarised as follows:

- Castleisland is at risk of fluvial flooding.
- River Maine is classified as having a moderate/ good status under the Water Framework Directive (WFD). River Shanowen is classified as having a poor water status under the WFD. The rivers have been afforded an extended timescale to 2021 to achieve good status as it is recognised that time is necessary to allow for recovery from point source pressures and agricultural nutrient losses in the catchment.
- There are no significant point sources at risk within the 1% AEP fluvial extent. Castleisland WWTP is located on the west side of the town but it is not identified within the 1% AEP extent.
- The Castleisland AFA boundary does not overlap with any Natura 2000 site boundary. There are no habitats of conservation importance noted within the AFA.
- According to the Kerry County Development Plan (2015), there are no landscape or amenity designations within the town. The River Maine Riverwalk is a walk that goes from the park at An Ríocht at the east of the town to the treatment works at the west of the town.
- Receptors at risk 1% AEP fluvial flooding extent within the AFA:
  - 76 No. Residential Properties
  - 26 No. Non Residential Properties
  - 1 No. Social Amenity Site
  - 7 No. Roads at risk
- There are no high vulnerability properties at risk from fluvial flooding within the AFA. There are no Record of Monuments and Places (RMP's) or National Inventory of Architectural Heritage (NIAH) sites at risk from fluvial flooding within the AFA.





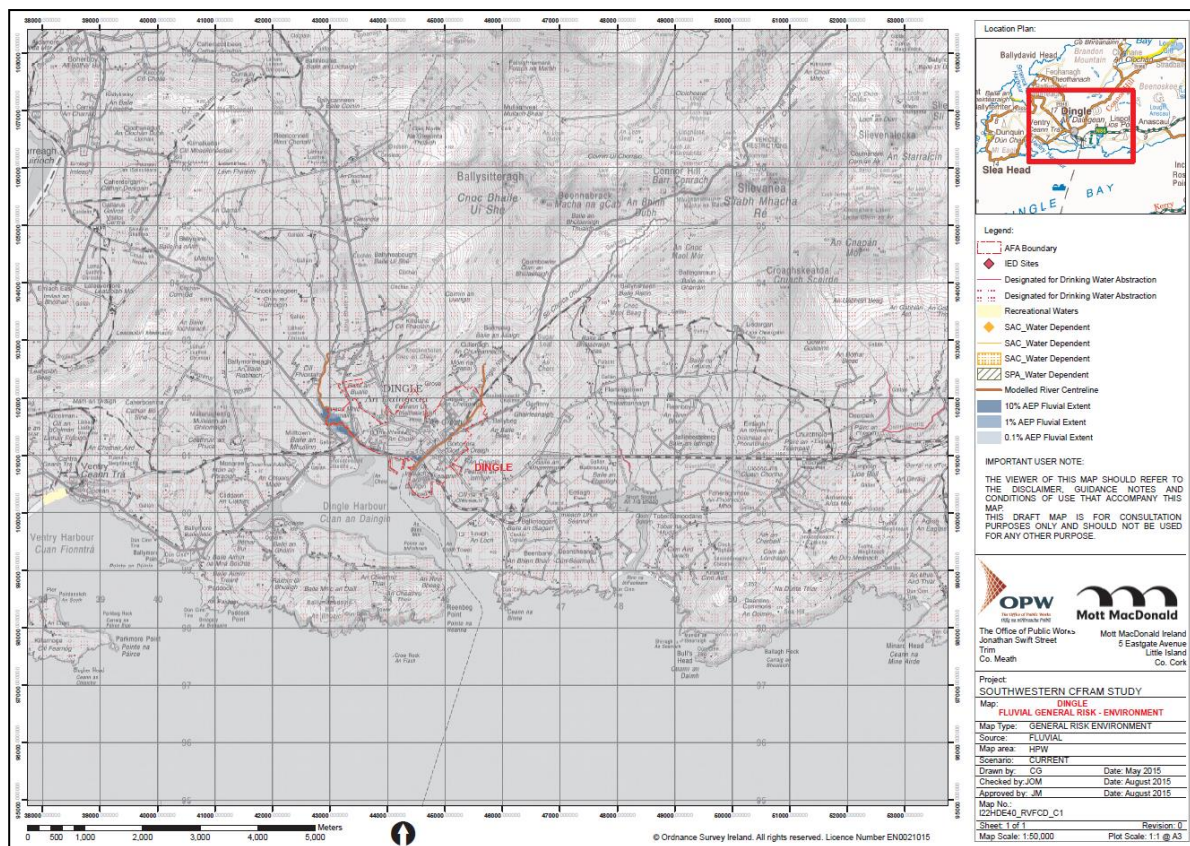
**Figure 6.2: Castleisland – Environmental Sites / Features (Fluvial Risk)**

### 6.2.2 Dingle

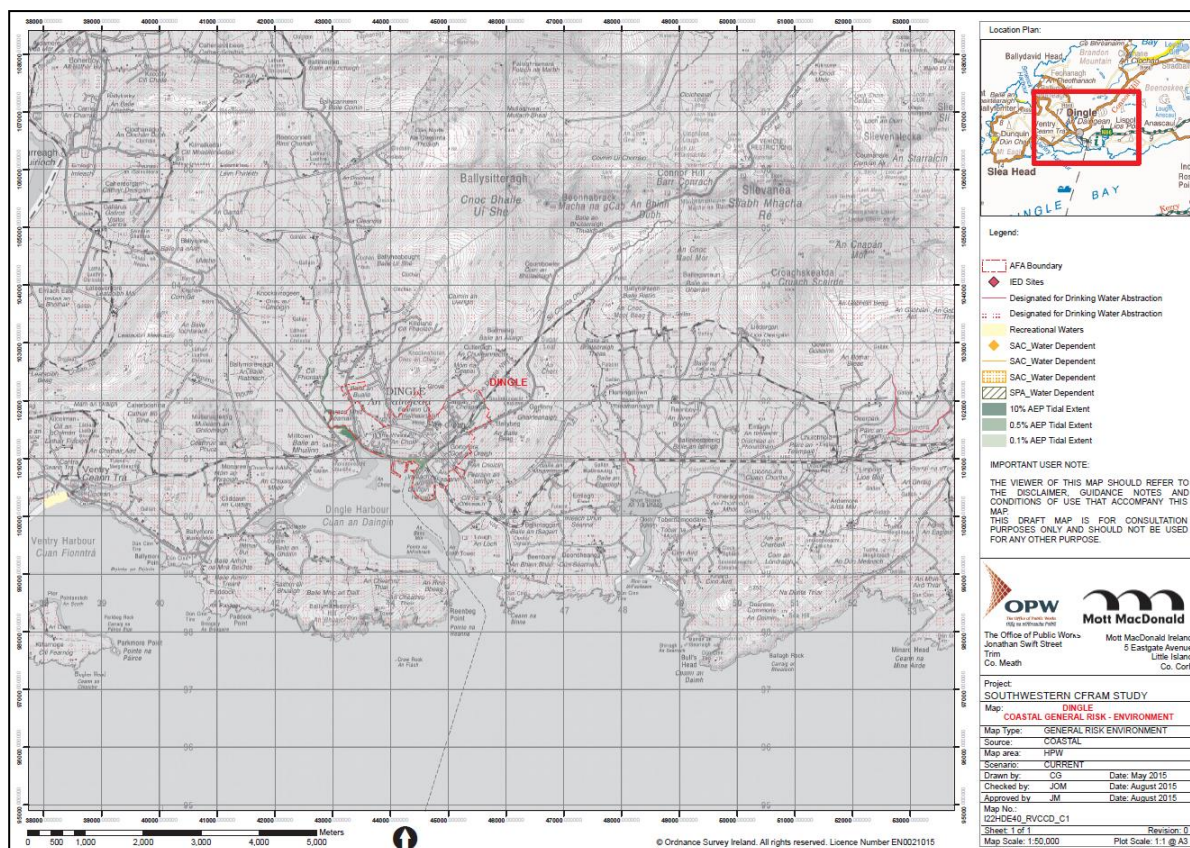
The key environmental sensitivities in Dingle are summarised as follows:

- Dingle is at risk of both fluvial and tidal flooding.
- There are two watercourses within the Dingle AFA; Dingle Stream and Milltown River. Dingle flows in a south-westerly direction into central Dingle along Spa Road, under Bridge Street and along the Mall to outfall at the eastern end of the marina. Milltown River flows southwards to Ballinabooly where the Ballyeabought River joins from the east. Milltown River then becomes increasingly tidally influenced as it continues southwards where a minor tributary joins under the R559 and then outfalls into Dingle Harbour at Milltown Bridge.
- There are no significant polluting sources within the 1% AEP fluvial and 0.5% AEP tidal extents.
- The Milltown River for much of its length has a poor water body status under the Water Framework Directive, and has no assigned status for the last 1.5km before it terminates in Dingle Harbour. Dingle stream has no assigned WFD river water body status.
- It is noted that there are no Natura 2000 sites within the AFA. Mount Brandon Special Area of Conservation SAC (000375) is located immediately north of Dingle AFA. The Dingle Peninsula Special Protection Area (SPA) is approximately 2.5km south of Dingle AFA.
- According to the Kerry County Development Plan, part of the town has been designated as an Architectural Conservation Area (ACA).
- Receptors at risk 1% AEP fluvial flooding extent within the AFA:
  - 35 No. Residential Properties
  - 54 No. Non Residential Properties
  - 3 No. Social Amenity Site
  - 3 No. NIAH
  - 1 No. RMP
  - 9 No. Roads at risk
- Receptors at risk 0.5% AEP tidal flooding extent;
  - 12 No. Residential Properties
  - 1 No. Architectural site
  - 30 No. Roads at risk





**Figure 6.3: Dingle – Environmental Sites / Features (Fluvial Risk)**



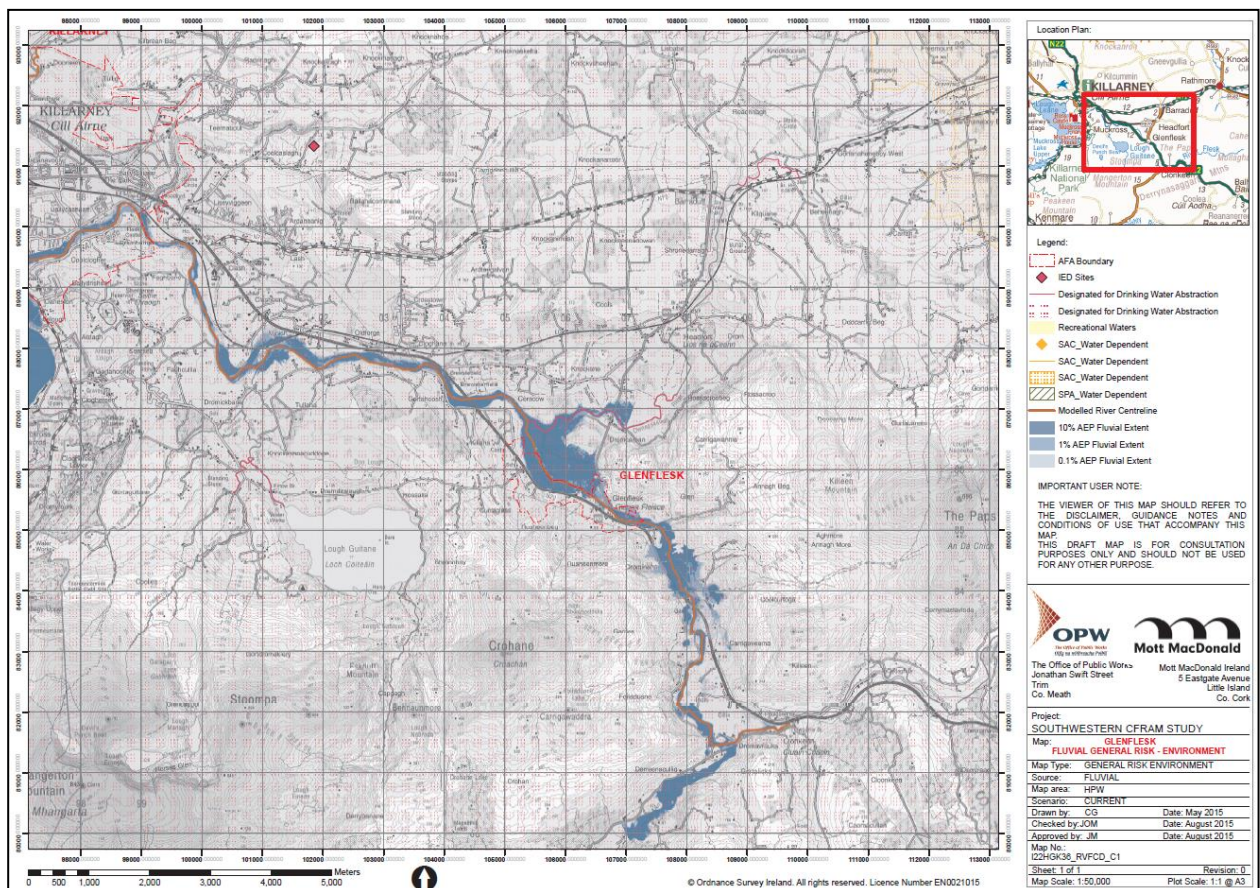
**Figure 6.4: Dingle – Environmental Sites / Features (Coastal Risk)**



### 6.2.3 Glenflesk

The key environmental sensitivities in Glenflesk are summarised as follows:

- Glenflesk is at risk of fluvial flooding.
- The River Flesk is part of the Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC.
- The River Flesk is considered a Margaritifera sensitive area (Freshwater Pearl Mussels). Freshwater Pearl Mussels (FPM) are identified as an Annex II species under the Habitats Directive.
- There are no significant polluting sources within the 1% AEP Fluvial flooding extent.
- Receptors at risk from fluvial flooding 1% AEP within the AFA:
  - 7 No. Residential properties
  - 8 No. Non-Residential properties
  - 1 No. Society Amenity Sites



**Figure 6.5: Glenflesk – Environmental Sites / Features (Fluvial Risk)**



## 6.2.4 Killarney

The key environmental sensitivities in Killarney are summarised as follows:

- Killarney is at risk of fluvial flooding.
- Killarney is located along River Flesk. The river is classified as having moderate water status under the Water Framework Directive (WFD). Lough Leane is classified as having good water status under the WFD.
- There is one significant polluting source (Waste Water Treatment Plant) within the 0.1% AEP fluvial flood extent.
- The Flesk flows into Lough Leane which is part of the Killarney National Park Special Area of Conservation SAC and Special Protection Areas. The River Flesk is also part of the SAC. There are a number of species of conservation importance within the AFA, these include otters, badgers, and lamprey and salmon.
- Killarney and Flesk Rivers are designated for Lesser Horseshoe Bat. There are a number of confirmed roosts for this species within a 6km radius of Killarney (NPWS Data).
- River Flesk is considered a Margaritifera sensitive area (Freshwater Pearl Mussel).
- Receptors at risk from fluvial flooding 1% AEP within the AFA:
  - 10 No. Residential properties
  - 4 No. Non-Residential properties
  - 1 No. Society Amenity Sites
  - 1 No. NIAH sites
  - 5 No. RMP sites
  - 2 No. Roads.

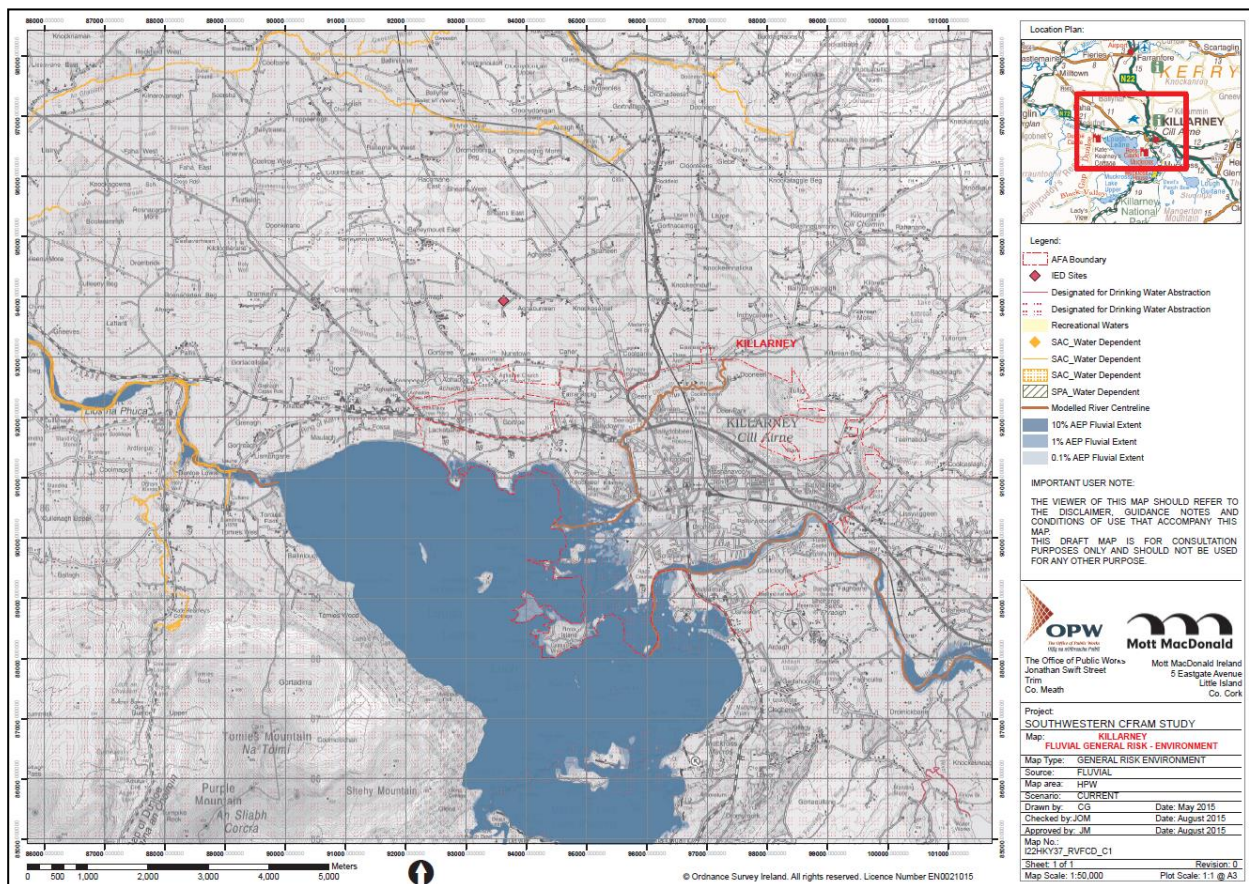


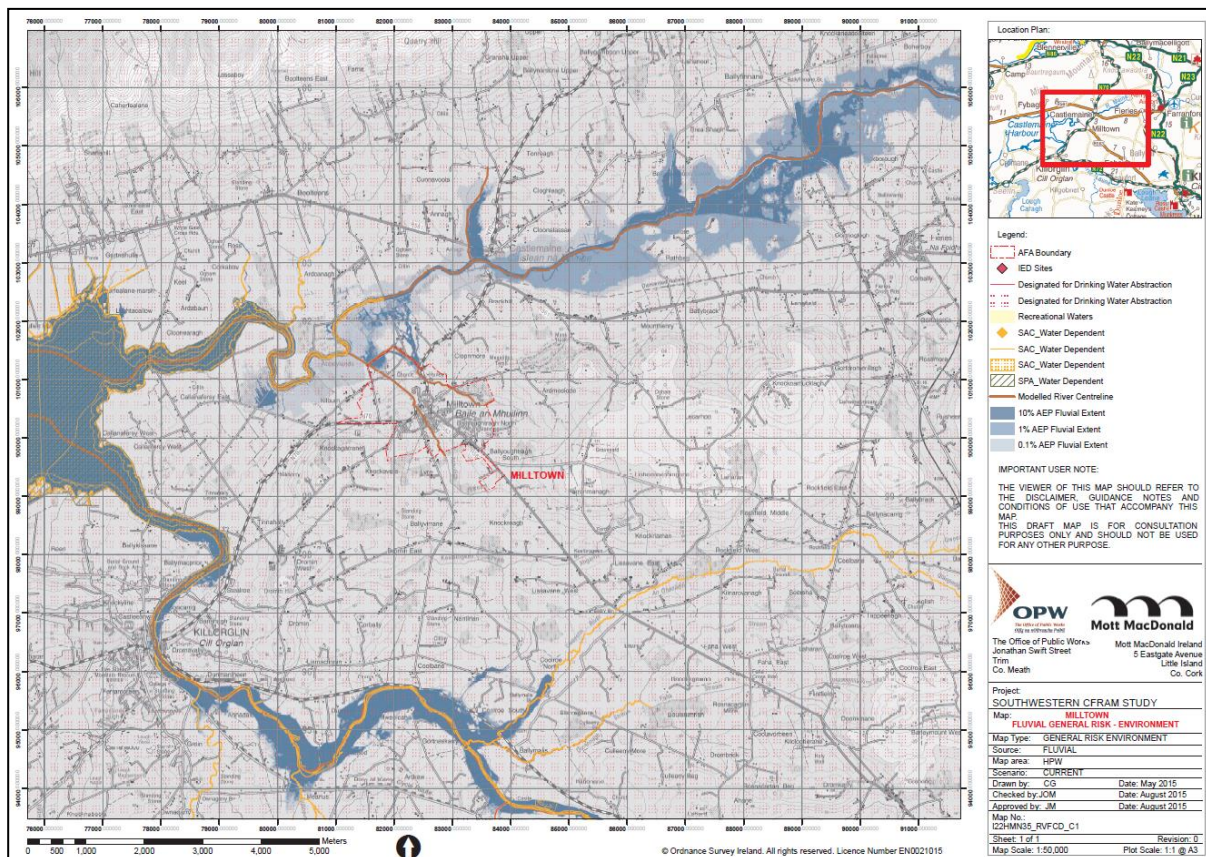
Figure 6.6: Killarney – Environmental Sites / Features (Fluvial Risk)



## 6.2.5 Milltown

The key environmental sensitivities in Milltown are summarised as follows:

- Milltown is at risk of fluvial flooding
- Milltown is located along a number of tributaries of the River Maine. The river is not classified under the Water Framework Directive. However Castlemaine Harbour which is located c. 1km downstream is a transitional waterbody classified as being of good water status.
- There are no significant polluting sources (Waste Water Treatment Plant) within the 0.1% AEP fluvial flood extent.
- The River Maine flows into Castlemaine Harbour which is a designated Area of Conservation SAC and a Special Protection Areas. The River Flesk is also part of the SAC. There are a number of species of conservation importance within the AFA, these include otters, badgers, and lamprey and salmon.
- The Southern Slieve Mish Mountains and Milltown Pastures Landscape Character area is classified as being of high value.
- Receptors at risk from fluvial flooding 1% AEP within the AFA:
  - 6 No. Residential properties
  - 3 No. Roads.



**Figure 6.7: Milltown – Environmental Sites / Features (Fluvial Risk)**

The SEA Environmental Report for the Laune-Maine-Dingle Bay River Basin can be found at: [www.floodinfo.ie](http://www.floodinfo.ie)

The Appropriate Assessment the Laune-Maine-Dingle Bay River Basin can be found at: [www.floodinfo.ie](http://www.floodinfo.ie)

## 6.3 STRATEGIC ENVIRONMENTAL ASSESSMENT

The SEA process involves six key stages as follows:

- Screening - the process of deciding whether the flood risk management plans would be likely to have significant environmental effects and as such would warrant a full SEA. The OPW conducted a screening assessment for the CFRAM studies in September 2011 which concluded that a full SEA is required.
- Scoping – Scoping determines the key environmental issues which are to be addressed in the Strategic Environmental Assessment. The scoping process set out a framework for the assessment of environmental effects resulting from a plan or programme and the generation of alternatives to ensure minimal environmental impact. The SEA process was completed in April 2015 following a consultation process with stakeholders.
- Environmental Assessment and Environmental Report – this is a key document in the SEA process as it outlines the likely significant effects on the environment of the Flood Risk Management Plan and recommends mitigation to address the significant adverse effects. The determination of the likely significant effects on the environment is based on a qualitative assessment under a series of Environmental Objectives. These environmental objectives are based on Environmental headings in Annex 2(f) of the European Communities (Environmental Assessment of Certain Plans and Programmes) Regulations, 2004 (S.I. 435 of 2004) as amended, and include the following aspects;
  - Biodiversity;
  - Population;
  - Human health;
  - Fauna;
  - Flora;
  - Soil;
  - Water;
  - Air;
  - Climatic factors;
  - Material assets;
  - Cultural heritage including architectural and archaeological heritage;
  - Landscape; and
  - The inter-relationship of the above factors.

This document also contains a history of the SEA process and how it was conducted with particular emphasis on stakeholder and public involvement;

- Consultation on the Plan and SEA Environmental Report – Consultations were conducted with the relevant Environmental Authorities and also with the public. Both groups were invited to make submissions in relation to the Plan and Environmental Report. Submissions were considered and the Environmental Report was amended appropriately where deemed necessary;
- SEA Statement – From a legal and process perspective the production of the SEA Statement was the most important phase in the process. The function of the SEA Statement was to identify how the SEA process influenced the plan. This required careful scripting, particularly in the context of how differing opinions from consultees were managed throughout the process. Another requirement of the SEA Statement

was the inclusion of reasons for choosing the plan as adopted in light of the other reasonable alternatives considered.

- **Monitoring** - Monitoring requirements refer to the need to monitor the significant effects on the environment as a result of the implementation of the Flood Risk Management Plans. Monitoring begins with the adoption of the plan and continues for the duration of the plan.

Relevant mitigation measures are discussed in Section 6.6

The SEA Environmental Report for the Laune-Maine-Dingle Bay River Basin can be found at: [www.floodinfo.ie](http://www.floodinfo.ie)

The Appropriate Assessment for the Laune-Maine-Dingle Bay River Basin can be found at: [www.floodinfo.ie](http://www.floodinfo.ie)

## 6.4 APPROPRIATE ASSESSMENT

The European Commission in 2002 published guidance on the assessment of plans and projects significantly affecting Natura 2000 sites. This guidance provides details of the general approach to Appropriate Assessment. The guidance sets out a tiered/staged approach as summarised below:

**Stage 1 - Screening for a likely significant effect:** An initial assessment of the project or plan's effect on a European site(s). A description of the plan/project and the elements that have the potential to impact on Natura 2000 sites must be provided. The potential impacts and their significance must be assessed. If it cannot be concluded that there will be no significant effect upon a European site, an Appropriate Assessment is required;

**Stage 2 - Appropriate Assessment:** The consideration of the impact on the integrity of the Natura 2000 site of the project or plan, either alone or in combination with other projects or plans, with respect to the site's structure and function and its conservation objectives. Additionally, where there are adverse impacts, an assessment of the potential mitigation of those impacts. The output of this stage of Appropriate Assessment is a Natura Impact Statement (NIS) report;

**Stage 3 – Assessment of alternative solutions:** The process which examines alternative ways of achieving the objectives of the project or plan that avoid adverse impacts on the integrity of the Natura 2000 site (where mitigation cannot be achieved); and

**Stage 4 – Assessment where no alternative solutions exist and where adverse impacts remain:** Development of compensatory measures where, in the light of imperative reasons of overriding public interest (IROPI), it is deemed that the project or plan should proceed.

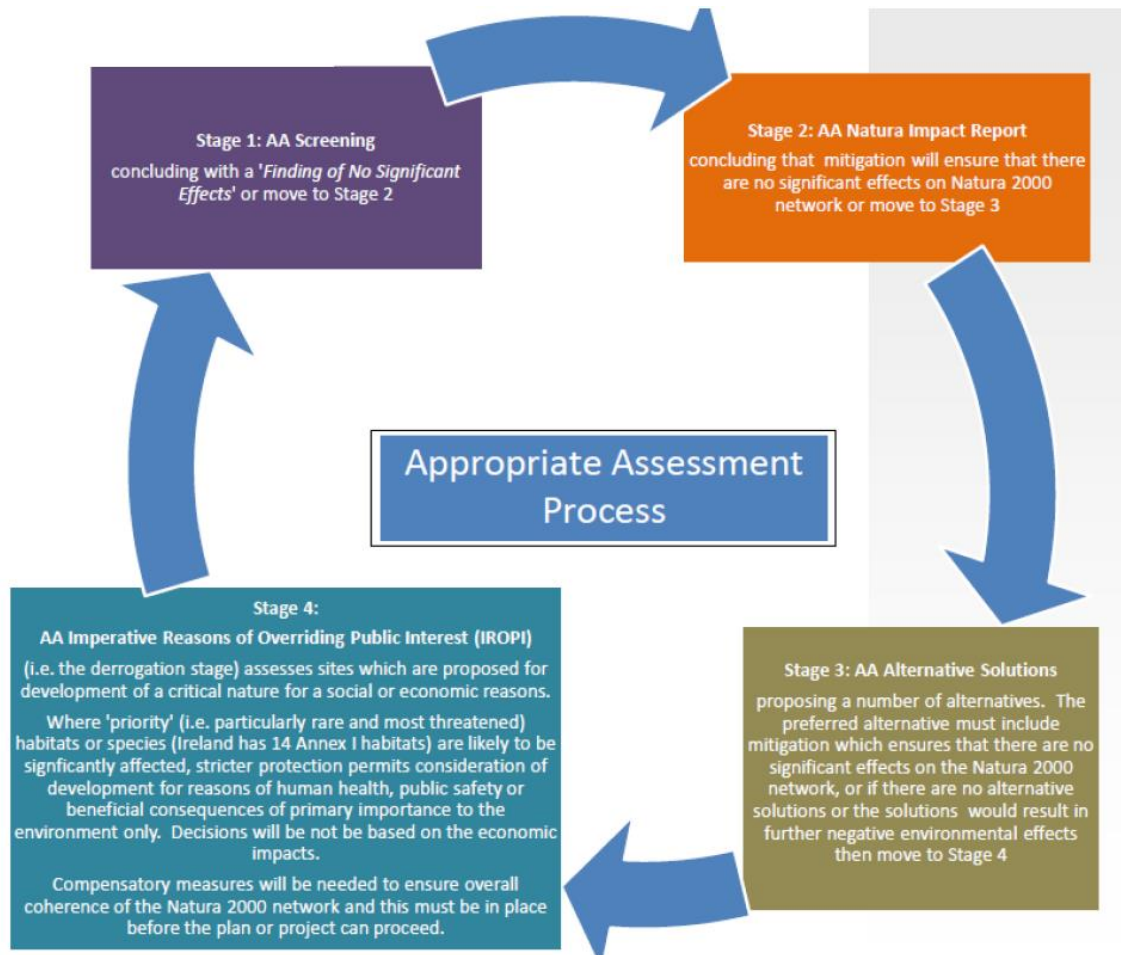
Each stage in the process determines whether a further stage is required. If, for example, the conclusions at the end of Stage 1 are that there will be no significant impacts on the Natura 2000 site, there is no requirement to carry out an Appropriate Assessment (Stage 2). The approach to Appropriate Assessment screening must however apply the precautionary principle i.e. where it cannot be definitively determined that a plan/project will not adversely impact the integrity of the Natura 2000 site then it must be assumed that there is potential for impact and a full Appropriate Assessment must be carried out.

The objective of the process is to provide adequate information, based on the best available scientific information, to inform the Competent Authority to enable them to conduct an assessment of whether the plan or project is likely to have a significant effect on the



conservation objectives of the relevant Natura 2000 sites within the zone of influence. Where adverse impacts are identified mitigation measures necessary to avoid, reduce or offset such impacts must be prescribed.

The AA and NIS carried out as part of the Laune-Maine-Dingle Bay River Basin can be found at: [www.floodinfo.ie](http://www.floodinfo.ie)



Source: West Regional Authority (WRA) in association with the Environmental Protection Agency (EPA) (2013) Draft 'SEA Resource Manual for Local and Regional Authorities'

**Figure 6.8: Appropriate Assessment Process**

#### 6.4.1 Screening for Appropriate Assessment for the Laune-Maine-Dingle Bay River Basin

The assessment of impacts of flood risk management options in the Laune-Maine-Dingle Bay on Natura 2000 sites has determined that significant impacts are likely or uncertain for the Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC.

#### 6.4.2 Proposed Mitigation Measures

The strategic environmental assessment has as part of the plan development identified the preferred flood risk management options for each of the AFAs in the Laune-Maine-Dingle Bay River Basin. The proposed structural measures were developed through the multi-criteria analysis (MCA) of a number of alternative options for each AFA.

The preferred structural flood risk management options could give rise to a number of environmental impacts, both positive and negative of short term and long term duration. For each of the proposed measures that have a potential negative impact mitigation measures have been developed to minimise the potential negative impacts arising from the options to be adopted. The SEA assessment identified that the non-structural measures proposed for the Laune-Maine-Dingle Bay River Basin have either positive or neutral impacts and as a result do not require the implementation of mitigation measures.

The proposed mitigation measures should be considered further during the next stage of option development, when detailed design of the option progresses. This will allow the proposed option to be optimised through detailed design in order to limit the potential negative impacts on the receiving environment.

Furthermore Habitats Directive Assessment was undertaken for the Laune-Maine-Dingle Bay River Basin, whereby potentially significant effects on the Natura 2000 sites (i.e. SACs and SPAs) were identified. A Natura Impact Statement (NIS) was prepared for the Laune-Maine-Dingle Bay River Basin and the proposed mitigation measures and conclusions of this assessment have been incorporated into the SEA mitigation measures. The proposed mitigation measures are specified in the SEA Environmental Report for the Laune-Maine-Dingle Bay River Basin.

## **6.5 COORDINATION WITH WATER FRAMEWORK DIRECTIVE**

The Water Framework Directive (WFD) is concerned with the protection of the ecological quality of our waters. While the 'Floods' Directive is concerned with the protection of people and society from our waters, both Directives are concerned with water and river basin management, and hence coordination is required between the two processes to promote integrated river basin management, achieve joint benefits where possible and address potential conflicts.

### **6.5.1 Bi-Lateral Meetings**

The Department of Housing, Planning and Local Government (DHPLG) is the lead Government Department for the WFD, and the nominated Competent Authority for establishing the environmental objectives and preparing a programme of measures and the River Basin Management Plans. The OPW has held bi-lateral meetings with senior representatives in DHPLG to establish the appropriate methods and approaches to coordination, which were agreed to be primarily through cross-representation on management / governance groups.

For the second cycle of implementation of the WFD, the Environmental Protection Agency (EPA) has been defined as the Competent Authority for undertaking the characterisation and reporting of same to the Commission, and is also required to assist the DHPLG in its assigned duties. The OPW has held bi-lateral meetings with the EPA since 2013 to determine the suitable approaches to the practical aspects of implementation, which were agreed to be through cross-representation on management / governance groups, and ongoing bi-lateral meetings. These meetings have included workshops to share relevant data.

### **6.5.2 Cross-Representation on Management Groups**

The governance structure for the WFD in Ireland was restructured for the second cycle under SI No. 350 of 2014, with a number of groups subsequently set up in 2014 and 2015.

#### *6.5.2.1 WFD: Water Policy Advisory Committee*

The Water Policy Advisory Committee (WPAC) was formally established in 2014 as the 'Tier 1' management committee. Its role is to provide strategic direction and advise the Minister for Housing, Planning and Local Government on the implementation of the WFD.

The OPW is represented on the WPAC to help ensure coordination in the implementation of the WFD and the 'Floods' Directive at a strategic level.

#### *6.5.2.2 WFD: The National Implementation Group*

The 'Tier 2' management committee is the National Implementation Group (NIG), which was established in March 2015. The purpose of the NIG is to assist the EPA and DHPLG with the technical and scientific implementation aspects of the WFD to ensure effectiveness, consistency and efficiency. The Group has also been established to provide a mechanism for coordination with the implementation of the 'Floods' Directive.

Working Groups have been established by the NIG to assist with the implementation of certain aspects of the WFD, including characterisation and hydromorphology. A working group on the programme of measures has also been established under the WPAC.

The OPW is represented on the NIG, and also on the characterisation and hydromorphology working groups, to promote coordination on the technical and scientific aspects of mutual relevance in implementation.

#### *6.5.2.3 WFD: Catchment Management Network*

The Catchment Management Network was convened to provide a forum for the organisations involved in implementation of the WFD, and other key stakeholders, at the regional and local level, including the local authorities. The Network first met at a launch event and workshop in November 2014, which the OPW attended. The OPW has since continued to engage with the Network to consider the coordination issues in implementation at a local level.

#### **Local Authorities Water and Communities Office**

The Local Authority Water and Communities Office (LAWCO) was established in 2015 and is led jointly by Kilkenny and Tipperary County Councils on behalf of the local authority sector. LAWCO's functions include supporting communities to take action to improve their local water environment and provision of coordination at a regional level across public bodies involved in water management. The OPW has been kept aware of the development of the LAWCO through the WPAC and NIG. This local level of activity may provide a suitable point of coordination for local flood risk management activities such as flood protection works being implemented under the Minor Works Scheme or the promotion of natural water retention measures.

#### *6.5.2.4 'Floods' Directive: Steering and Progress Groups*

The EPA are represented on the National CFRAM Steering Group, as described in Section 4.3.1.1 above, and have advised on coordination matters, such as defining Objectives relevant to the WFD (see Section 1.4). EPA representatives and the WFD Project Coordinators (appointed in the first cycle of WFD implementation, and to be replaced by LAWCO officers) are also represented on the Project Steering and Progress Groups as described.

### **6.5.3 Exchange of Information**

Relevant information was exchanged between the Competent Authorities relating the 'Floods' Directive and the WFD as necessary.

#### **6.5.4 Coordination on Measures**

One of the Flood Risk Management Objectives (Objective 3.a, Table 1.2) is to support the objectives of the WFD. This required an assessment of potential flood risk management measures against the objectives and requirements of the WFD to determine which measures might have a benefit or cause an impact in terms of the objectives of the WFD, varying in scale and duration. In this way, the potential contribution of flood risk management measures towards, or potential impacts on, the objectives of the WFD are embedded into the process for the identification of proposed measures.

Following approval of the Plans, the next stage to progress the proposed flood risk management measures will be to undertake more detailed assessment and design at a project-level, before submitting the proposals for Public Exhibition (under the Arterial Drainage Acts) or planning permission. This assessment will normally include an Environmental Impact Assessment (EIA) and, where necessary, a project-level Appropriate Assessment (AA) in line with the Birds and Habitats Directives.

The assessment at the project-level will also enable a detailed appraisal of the potential impacts of the final measure on the water body hydromorphology, hydrological regime and status to be undertaken including, where necessary (if impacts can not be avoided or mitigated), a detailed appraisal under Article 4(7) of the WFD (derogation related to deterioration caused by new modifications). This will build on the initial work done during the preparation of the Plans.

The work planned by EPA to improve assessment methods for river morphology has the potential to assist in:

- assessing the potential impact of flood management measures on WFD objectives,
- identifying the most appropriate mitigation measures, and,
- supporting decisions on the application of Article 4(7) derogations.

The EPA and OPW will work together to develop technical methods to assist in the assessment of impacts from flood protection schemes.

The OPW is also liaising with the EPA on the potential impact of WFD measures on flood risk, which are typically neutral (no impact), or may have some benefit in reducing runoff rates and volumes (e.g., through agricultural measures such as minimising soil compaction, contour farming or planting, or the installation of field drain interception ponds).

The OPW will continue to work with the EPA and other agencies implementing the WFD to identify, where possible, measures that will have benefits for both WFD and flood risk management objectives, such as natural water retention measures. It is anticipated that this is most likely to be achieved in areas where phosphorous loading is a pressure on ecological status in a sub-catchment where there is also an identified potentially significant flood risk (i.e., an AFA). This coordination will also address measures that may otherwise cause potential conflict between the objectives of the two Directives.

## **6.6 PROGRESSION OF MEASURES AND ASSESSMENT OF FUTURE WORKS**

### **6.6.1 Approval of the Plan**

As set out in Section 6.1 above, the approval / adoption of the Plan has not and does not confer approval or permission for the installation or construction of any physical works.

The progression of any measure towards the implementation of flood relief works or a 'Scheme' must, where applicable, include EIA and/or AA Screening, and, where so concluded from the screening, Environmental Impact Assessment and / or Appropriate Assessment, in accordance with the relevant legislation, and taking into account new information available at that time (e.g., as available from the Environmental Monitoring Framework and from the [www.catchments.ie](http://www.catchments.ie) website).

As part of the EIA, alternatives to the potential works set out in the Plan must be considered. It is emphasised that the Plan sets out the strategy, actions and measures that are considered to be the most appropriate at this stage of assessment. Potential flood relief works or 'Schemes' set out herein will need to be further developed at a local, project level before Exhibition under the Arterial Drainage Acts 1945 and 1995 (OPW managed schemes) or submission for planning approval under the Planning and Development legislation/regulations (Local Authority managed schemes). The project-level assessment will include the consideration of alternatives, taking into account local information that can not be captured at the Plan-level of assessment, such as ground investigation results and project-level environmental assessments. The project-level assessment may give rise at that stage to amendment of the proposed works to ensure that the works:

- are viable and fully adapted, developed and appropriate within the local context,
- comply with environmental legislation,
- consider at a project-level of detail the potential impacts and benefits related to the objectives of the Water Framework Directive (see Section 6.5.4)
- provide benefits with regards to other objectives (e.g., water quality, biodiversity) where reasonably possible and viable, such as through the use of natural water retention measures, removing barriers to fish migration or the creation of habitat features.

No measure in the Plan has been considered for, or been subject to an assessment under, the 'Imperative Reasons of Over-riding Public Interest (IROPI)' procedure under the Birds and Habitats Directive (Article 6[4]).

In addition to planning or confirmation, licences may be required by the implementing body to progress certain physical works, such as those that may cause damage or disturbance to protected species or their habitats, and the granting of such licences during or following the project-level assessment would be required before such works could proceed.

The body responsible for the implementation of such measures (typically the OPW or a local authority - see Section 8) is required to ensure that the requirements above, and the requirements of all relevant environmental legislation (such as the Environmental Liability and Water Framework Directives), are complied with.

## **6.6.2 Implementation Routes for Physical Works**

### **6.6.2.1 Works Requiring Planning Consent or Confirmation**

As set out above, the body responsible for the implementation of measures that will involve physical works, such as a flood relief scheme, will typically be either the OPW or the relevant local authority. There are three primary legislative routes by which such works may progress to construction stage, as set out in Figure 8.1, are:

- Project led by OPW (or by a Local Authority on behalf of the OPW), under the Arterial Drainage Acts.



- Project led by the relevant Local Authority under the Planning and Development Regulations.
- Project led by the relevant Local Authority under the Strategic Infrastructure Act.

As noted above, while the Plans have conducted a Strategic Environmental Assessment and Appropriate Assessment, the progression of any measure by either the OPW or a local authority will include all applicable 'project level' assessments, such as:

- Environmental Impact Assessment: For a project above the thresholds specified under Article 24 of the European Communities (Environmental Impact Assessment) Regulations, 1989 as amended or a project likely to have significant effects on the environment, having regard to the criteria specified for under Article 27 of the same EIA Regulations 1989 as amended.
- Appropriate Assessment: All projects will be screened for Appropriate Assessment and, where there is a potential for a significant effect on a European (Natura 2000) site, an Appropriate Assessment will be undertaken in accordance the European Communities (Birds and Natural Habitats) Regulations 2011.

#### **6.6.2.2 Exempted Development**

For some measures, the physical works involved are of limited scale and scope. These will typically be works that would be progressed by the local authority, with funding provided by the OPW through the Minor Flood Mitigation Works and Coastal Protection Scheme (the 'Minor Works Scheme' - see Section 2.6.5), that are deemed as exempted development in accordance with the Planning and Development Act 2000 (as amended).

As public bodies, the local authorities are required to comply with all relevant legislation, and hence must undertake EIA and/or AA screening for physical works where relevant (i.e., where the works are not exempt or below relevant thresholds) and as required by legislation. As a condition of the provision of funding for such works, the OPW requires written confirmation from the local authority of compliance with all relevant environmental legislation.

### **6.6.3 Mitigation Measures**

Projects stemming from the Plans will apply a range of standard processes and measures that will mitigate potential environmental impacts. While the applicability of processes and particular measures will be dependent on the nature and scale of each project, examples of typical processes and measures that will be implemented where applicable at the different stages of project implementation are set out below.

#### **6.6.3.1 Project Mitigation: Consenting Process**

As set out in Section 6.6.2 above, the consenting process for the progression of measures involving physical works will require the applicable environmental assessments. Also, the consenting authorities may set out specific environmental conditions as part of the project approval.

#### **6.6.3.2 Project Mitigation: Pre-Construction / Detailed Design**

For the detailed design of projects, where options are available, the design uses a hierarchy to mitigation measures along the following principles:

- Avoidance: avoid creating the potential impact where feasible.
- Mitigation: minimise the potential impact through mitigating measures



- Enhancement: Enhance the environment to better than pre-project conditions, where reasonably possible

The progression of a flood management project through the detailed design phase can entail a series of surveys to inform the design, where the scale of surveys would be proportionate to the complexity and potential impacts of the project. These can include:

- engineering structure surveys,
- topographical surveys,
- habitat & species surveys<sup>11</sup>
- ornithological surveys,
- bat surveys,
- fish surveys,
- water quality surveys,
- archaeological surveys,
- landscape and visual assessments,
- land valuation surveys and
- other surveys as deemed necessary to prepare a project.

Where necessary, Wildlife Derogation Licences and archaeological licences will be sought from Dept. of Culture, Heritage and the Gaeltacht.

The scope of the EIS will include a hydro-morphological assessment to more clearly consider and support the Water Framework Directive (WFD) objectives (see Section 6.5.4).

The potential role for non-structural measures for each flood risk area, including natural type flood management measures will be examined in more detail and incorporated into the scheme design if deemed appropriate.

#### *6.6.3.3 Project Mitigation: Construction Stage*

For large and complex projects and sites, where environmental management may entail multiple aspects, a project specific Construction Environmental Management Plan (CEMP) may be developed. This will form a framework for all environmental management processes, mitigation measures and monitoring and will include other environmental requirements such as invasive species management measures, if applicable.<sup>12</sup>

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<sup>11</sup> In the context of ecological mitigation, the habitat and species surveys are conducted as required to assess the various aspects for the project, such as ecological surveys for:

- protected or notable habitats and species, including Annex 1 habitats, Annex II and Annex IV species,
- species protected under the Wildlife Acts,
- species protected under the Flora Protection Order,
- the resting and breeding places of relevant species and,
- invasive species, both plant and animal.

<sup>12</sup> There are a range standard type mitigation measures consisting of good construction practices and good planning of works, that are used within flood management projects such as for example: Refuelling of plant and vehicles away from watercourses, Installation of wheel-wash and plant washing facilities, working only within environmental windows e.g. in-stream works in salmonid channels from May to September, Integrate fisheries in-stream enhancement through the Environmental River Enhancement Programme

A designated environmental officer, project ecologist and project archaeologist will be appointed, as appropriate for the project.

#### *6.6.3.4 Project Monitoring*

The Plan, with its associated SEA and plan-level AA, sets out a series of monitoring requirements, in connection with the SEA objectives and the predicted effects of the Plan. For measures involving physical works, the project-level EIA and AA, where conducted, will set out the specific monitoring required for each measure.

## **7 MANAGING FLOOD RISK**

### **7.1 OVERVIEW**

The purpose of the Plan is to set out a proposed strategy for the sustainable, long-term management of flood risk in the Laune-Maine-Dingle Bay River Basin, focussed on the AFAs. The strategy comprises a set of potential measures, that may be actions, physical works or 'Schemes', further assessments or data collection. For each area or location, a number of options would typically have been available as to what measures could be brought forward and proposed as part of the Plan.

This Section describes the process pursued under the National CFRAM Programme and other policies, projects or initiatives for identifying what flood risk management measures might be suitable for a given area or location, and then how the options for such measures were appraised to determine which options would be most effective and appropriate for each area or location. This process makes use of the flood mapping (Section 5), information provided through public consultation events and processes, and a range of other data and information, as appropriate. Similar processes were followed for the Pilot CFRAM Projects and other projects undertaken in parallel with the CFRAM Programme. The Section concludes with a summary of the measures proposed under this Plan.

Further information on the process set out within this Section on the identification and appraisal of measures for managing flood risk within the Laune-Maine-Dingle Bay River Basin are set out in the Preliminary Options Report for the South Western CFRAM Project, and in similar reports for parallel studies. These reports are available from the OPW website; [www.floodinfo.ie](http://www.floodinfo.ie).

### **7.2 METHODS OF FLOOD RISK MANAGEMENT**

There are a wide range of different approaches, or methods, that can be taken to reduce or manage flood risk. These can range from non-structural methods, that do not involve any physical works to prevent flooding but rather comprise actions typically aimed at reducing the impacts of flooding, to structural works that reduce flood flows or levels in the area at risk or that protect the area against flooding. The range of methods for managing flood risk that are considered include those outlined below.

#### **7.2.1 Flood Risk Prevention Methods**

Flood risk prevention measures are aimed at avoiding or eliminating a flood risk. This can be done by not creating new assets that could be vulnerable to flood damage in areas prone to flooding, or removing such assets that already exist. Alternatively, prevention can be achieved by completely removing the potential for flooding in a given area, although in practice this is rarely possible (the frequency or magnitude of flooding can be reduced by flood protection measures, but it is generally not possible to remove the risk of flooding entirely).

Flood prevention is hence generally focussed on sustainable planning and / or the re-location of existing assets, such as properties or infrastructure, and includes:

- Sustainable Planning and Development Management
- Sustainable Urban Drainage Systems (SUDS)
- Voluntary Home Relocation

- Preparation of Local Adaptation Planning
- Land Use Management and Natural Flood Risk Management Measures

### **7.2.2 Flood Protection Methods**

Flood protection measures are aimed at reducing the likelihood and/or the severity of flood events. These measures, typically requiring physical works, can reduce risk in a range of ways, such as by reducing or diverting the peak flood flows, reducing flood levels or holding back flood waters.

Protection measures typically considered include:

- Enhance Existing Protection Works
- Flood Defences
- Increasing Channel Conveyance
- Diverting Flood Flows
- Storing Flood Waters
- Implementing Channel Maintenance Programmes
- Maintenance of Drainage Schemes
- Land Commission Embankments

The preferred Standard of Protection offered by flood protection measures in Ireland is the current scenario 1% Annual Exceedance Probability (AEP) flood for fluvial flooding and 0.5 % AEP flood for tidal flooding (also referred to as the 100-year and 200-year floods respectively), although these standards can increase or decrease depending on local circumstances.

### **7.2.3 Flood Preparedness (Resilience) Methods**

In some instances, it may not be possible to reduce the likelihood or severity of flooding to an area at risk. However, actions and measures can be taken to reduce the consequences of flooding, i.e., reduce the risk to people and of damage to properties and other assets, and make sure that people and communities are resilient to flood events. This can be achieved by being aware of and preparing for the risk of flooding, knowing when floods are going to occur, taking actions immediately before, during and after a flood. The actions and measures of this type include:

- Flood Forecasting and Warning
- Emergency Response Planning
- Promotion of Individual and Community Resilience
- Individual Property Protection
- Flood-Related Data Collection

### **7.2.4 Continue Existing Regime / Do Nothing / Minor Measures**

In some circumstances the existing programme of works may be sufficient to effectively manage the existing flood risk. For instance, the OPW Arterial Drainage Maintenance Programme ensures that some towns and villages around the country have already been afforded a significantly reduced level of flood risk, and in some communities, the 1% AEP flood is contained within the river channel and so there is

very little flood risk. In such circumstances, there may be no need to implement additional measures, and so continuing the existing regime of works may be sufficient to adequately meet the flood risk management Objectives.

In other areas, the level of risk may be relatively low and the cost of implementing any substantial additional measures may be significant. Where the costs of implementing new measures are higher than the benefits of such measures, in terms of risk reduction, then it will not be possible to justify such works. In this case, it may not be possible to undertake any new measures, or only implement low-cost actions such as local maintenance of a channel or minor repairs / alterations to existing structures to reduce the risk and/or avoid a future increase in risk.

#### *7.2.4.1 Maintain Existing Flood Risk Management Works*

Flood protection works require maintenance to keep them in good order and able to offer the Standard of Protection they were designed to provide (subject to further works that may be necessary arising from the impacts of climate change). If the level of maintenance is inadequate, the condition can deteriorate and the likelihood of failure of the measure during flood events, including those below the standard of protection, can increase. Maintenance of existing flood risk management works, such as flood relief schemes, should therefore be undertaken by the owner of the works to ensure their performance as designed.

### **7.3 DEVELOPMENT AND APPRAISAL OF FLOOD RISK MANAGEMENT OPTIONS**

This Section describes the process pursued under the National CFRAM Programme for identifying the measures that would be most effective and appropriate for each area and location. Section 7.3.8 describes how other measures were identified through other policies, projects and initiatives.

#### **7.3.1 Spatial Scales of Assessment**

Measures to manage flood risk can be applied at a range of spatial scales, namely the whole River Basin, at a catchment- or sub-catchment level, or at an AFA or local level. The assessment of possible flood risk management measures has been undertaken at each of these spatial scales of assessment under the CFRAM Programme, to ensure that a catchment-based approach is taken. This is to ensure that a measure that may benefit multiple areas or AFAs is fully considered, and that potential impacts of measures elsewhere in the catchment (e.g., up- and down-stream) are assessed and understood.

Within the Laune-Maine-Dingle Bay River Basin, Glenflesk and Killarney form a sub-catchment along the River Flesk. Flood risk between the AFA's is not linked due to the scale of the sub-catchment. Also, as demonstrated through hydraulic modelling, the proposed structural flood risk management options at Glenflesk and Killarney do not impact upon each other. However, non-structural measures will be considered to mitigate future increases in risk and to provide flood warning.

No IRRs have been identified within the South Western RBD and as such are not considered.

Based on the above, the Laune-Maine-Dingle Bay River Basin is split into 3 Spatial Scales of Assessment (SSAs).

These are:

- The River Basin
- The Flesk Sub-Catchment (Glenflesk to Killarney)

- Areas for Further Assessment (AFAs)
  - Castleisland
  - Dingle
  - Glenflesk
  - Killarney
  - Milltown
  - Portmagee

The process for developing and appraising potential flood risk management options as described herein was hence undertaken at the catchment- or sub-catchment level, as well as the AFA or local level.

Flood risk management measures applicable at the River Basin level are generally non-structural measures already in-place or mandated under existing legislation or policy (as set out in Table 1.1 or determined through Government Decisions). These measures are set out in the Plan for clarity, and are being kept under review.

### 7.3.2 Step 1: Screening of Flood Risk Management Methods

Not all of the available methods for flood risk management will be applicable in all areas or locations. Some may, for example, not be socially or environmentally acceptable, be excessively expensive or may not be effective in managing or reducing flood risk in a particular community.

Screening is a process that is undertaken for the catchment and AFA spatial scale to filter out flood risk management methods that are not going to provide applicable, acceptable or viable measures for managing flood risk, either alone or in combination with other methods, for a given area or location. The methods were screened, based on an initial assessment, against the following criteria:

- **Applicability:** Effectiveness in managing or reducing flood risk
- **Economic:** Indicative costs relative to economic benefits
- **Environmental:** Potential impacts for the environment
- **Social:** Potential impacts for people, the community and society
- **Cultural:** Potential impacts for assets and collections of cultural importance

The outcome of the screening process is a set of flood risk management methods that might form, alone or in combination, potentially viable options for flood risk management measures.

For some communities (AFAs), typically those where the risk is relatively low, no local flood risk protection methods were found to be applicable, acceptable and viable, based on the screening process. In such cases, the process does not move to the next steps described below. However, the River Basin-level prevention and preparedness measures will generally be applicable or available to manage the flood risk that does exist in the community. These cases are described along with other AFAs under Section 7.4.

### 7.3.3 Step 2: Development of Options for Flood Risk Management Measures

The set of flood risk management methods identified through the screening process as being potentially effective or appropriate for each area or location were considered as to how they might be used to form potential measures aimed at achieving the flood risk management Objectives. This process involved professional experience and judgement, informed and



guided by local knowledge and suggestions, to develop potentially viable options that incorporate one, or more often a combination of, the screened methods.

The options for possible measures were then developed to outline design, typically to the target Standards of Protection (see Section 7.2.2), based on the information available at the time of development. This permitted an estimation of the cost of the option, and also an appraisal of the option to determine how well it would achieve the flood risk management Objectives, the potential negative impacts arising, and whether it would be economically viable.

The development of options under the CFRAM Programme, while focused primarily on existing risk, included consideration of potential future flood extents, depths and risks based on the flood mapping undertaken for the Mid-Range and High-End Future Scenarios (see Section 5.5). This was completed to identify what flood protection or other measures might be required in the future, and how adaptable measures aimed at addressing existing risks would be to meet future needs.

The development of options typically included the modelling of the measures where these include physical works. This was to determine the effectiveness of the option in reducing risk, and also to assess any impacts up- or down-stream with the objective of ensuring that any proposed measure does not increase risk up- or down-stream. Where a possible increase in risk elsewhere has been identified as being significant then the option would have been rejected or amended. Where a minor increase in risk was identified, then this will be addressed and mitigated at the project-level of assessment (see Section 8.1) to ensure that the measure would not increase risk elsewhere.

The options considered include 'No Change', which means continuing only the current flood risk management activities.

### **7.3.4 Step 3: Appraisal by Multi-Criteria Analysis**

A range of possible options for measures are typically available to manage and reduce flood risk in a given area or location, and so a method of analysis was needed to determine which of the options might be the most effective and appropriate. This analysis needed to take account of the goals of the Plan, i.e., the flood risk management Objectives (see Section 1.4), and also the general importance of each Objective (the 'Global Weighting' - see below) and the local importance or relevance of each Objective (the 'Local Weighting' - see below).

The method of analysis used to appraise the options is called a 'Multi-Criteria Analysis', or 'MCA'. This is a method for appraising an option against a weighted range of diverse Objectives, to produce a mark or score of performance, referred to as the 'MCA-Benefit Score'. To produce the overall MCA-Benefit Score, a number of steps were followed, as below:

1. Each option was scored on how it performed against each Objective in turn (i.e., its benefits in reducing risk or contributing to other objectives, or its negative impact in terms of increasing risk or causing harm or detrimental impacts)
2. This score was then multiplied by both the Global and Local Weightings (see below)
3. The weighted scores for each Objective were then added up to give the overall MCA-Benefit Score for the option.

The MCA-Benefit Score permitted the comparison of one option against another to identify which option would perform best on balance across all of the Objectives, whereby the higher the score, the better the option would perform. The MCA-Benefit Score reflects the balance of benefits and impacts across all sectors and Objectives.

A critical consideration in selecting a preferred, or best-performing, option is cost. One option may perform marginally better than another, but cost considerably more, and it would be in the best interest of the tax-payer to achieve the best performance per Euro invested. The preferred option, based on the MCA Appraisal, was hence initially determined as that which had the highest MCA-Benefit Score relative to cost.

A detailed description of the MCA Appraisal process is set out in the CFRAM Technical Methodology Note on Option Appraisal and the Multi-Criteria Analysis (MCA) Framework, which is available from the OPW website ([www.floodinfo.ie](http://www.floodinfo.ie)).

#### *7.3.4.1 Assigning Global Weightings for Each Objective*

The MCA makes use of 'Global Weightings' to rank the general importance, or level of 'societal value', for each of the Objectives. The more important the Objective, the higher the Global Weighting, and hence the more influence the Objective has in determining the overall MCA-Benefit Score and the choice of preferred flood risk management measure.

Given the key role the Objectives and their Global Weightings have in selecting preferred measures for managing flood risk, the OPW considered it appropriate to consult on the Global Weightings that would be assigned to each Objective (see Section 4.4.4).

The final Global Weightings adopted for each Objective, which are consistent nationally (i.e., do not vary between River Basins or AFAs), are included in Table 1.2.

#### *7.3.4.2 Assigning Local Weightings for Each Objective*

Local Weightings are intended to reflect the relevance of each Objective within the context of each catchment or AFA for which flood risk management measures are being considered. For example, in a given AFA there may be no Utility Infrastructural assets, or no Environmentally Protected Areas, and hence the Local Weighting for the relevant Objectives should be reduced as they are not relevant for that AFA. A Local Weighting value from 0 up to 5 was assigned for each Objective for each catchment and AFA, depending on the relevance of the Objective in the given area.

The Local Weightings were determined by the Project Consultants in consultation with the OPW and the Project Steering and Progress Groups, and informed by:

- public and stakeholder consultation through questionnaires that were available from the Project Website and issued at the PCDs and through the Project Stakeholder Group, and,
- guidance issued by the OPW to ensure a consistent approach nationally (see [www.floodinfo.ie](http://www.floodinfo.ie), CFRAM Technical Methodology Note - Option Appraisal and the Multi-Criteria Analysis (MCA) Framework).

The Local Weightings for the AFAs for the Laune-Maine-Dingle Bay River Basin are set out in the Preliminary Options Report available from the OPW website ([www.floodinfo.ie](http://www.floodinfo.ie)).

### **7.3.5 Step 4: Economic Appraisal**

As well as an MCA, flood risk management investments must be economically viable, i.e., the economic benefits of a measure (reduction in flood damages) must outweigh the cost of the measure, to ensure value for money. This equation is called the Benefit - Cost Ratio (or 'BCR'), where the BCR should be equal to or greater than one.

The appraisal to determine whether options meet this requirement, is called a cost-benefit analysis. This analysis was undertaken to determine the economic viability of each option

for each area or location. A more detailed description of the cost-benefit analysis is set out in the CFRAM Technical Methodology Note on Cost-Benefit Analysis (CBA), which is available from the OPW website, [www.floodinfo.ie](http://www.floodinfo.ie).

### **7.3.6 Step 5: Public and Stakeholder Engagement**

Public and stakeholder engagement and participation in the process to develop effective and appropriate flood risk management measures is critical. The local community typically have a wealth of knowledge about flooding in their area that can help identify possible solutions and ensure that any proposed measures are effective. Community participation is also essential to make sure that any proposed measure is locally-acceptable, addressing key areas of concern and ensuring that the measure, if structural, will fit into the community environment in a way that local people will welcome.

The engagement process with the public and stakeholders to identify potentially suitable measures began at the Public Consultation Days (PCDs) held for the flood mapping (see Section 4.4.3), where people were asked to identify what they saw as potential solutions for the flood problems in their area, and also what was locally important to guide the identification of the Local Weightings for the MCA Appraisal (see Section 7.3.4).

As options were being considered and appraised, following the processes set out above, a further set of PCDs were held in relevant communities. Members of the local community and other stakeholders attending were presented at these events with the possible options and the findings of the appraisal processes to that time, and were asked for their opinions and input to help guide the process of identifying a preferred measure. The list of PCDs that were held at this stage of the Project is provided in Appendix D.6.

A further series of PCDs were held to engage locally and directly with the community and provide people with opportunity to discuss and fully understand the Draft Plans (see Section 4.4.6). The PCDs in the Laune-Maine-Dingle Bay River Basin were held during the option development stage at the venues listed in Appendix D.7.

### **7.3.7 Step 6: Identification of Preferred Options**

The preferred measures set out in this Plan have been determined based on a range of considerations, namely:

- The MCA Benefit - Cost Ratio (BCR)
- The economic viability (the economic BCR)
- The environmental considerations and assessments
- The adaptability to possible future changes, such as the potential impacts of climate change
- Professional experience and judgement of the OPW, local authorities and Mott MacDonald Ireland
- Public and stakeholder input and opinion.

A further series of PCDs were held to engage locally and directly with the community and provide people with opportunity to discuss and fully understand the Draft Plans (see Section 4.4.6). The PCDs in the Laune-Maine-Dingle Bay River Basin were held during the option development stage at the venues listed in Appendix D.7.

The measures to be taken forward to project-level development through the implementation of this Plan are described in Section 7.4 below, and are summarised in Section 7.7.

### 7.3.8 Measures Identified from Other Policies, Projects and Initiatives

In addition to the measures identified through the CFRAM Programme, a number of other measures and actions are required or have been deemed to be of benefit in managing flood risk through other policies, projects and initiatives. A range of policy and legal requirements, as identified in Table 1.1, mandate that certain measures be implemented, such as the ongoing maintenance of Flood Relief Schemes and Arterial Drainage and Drainage District Schemes, or the consideration of flood risk in planning and development management. Other measures and actions have been identified through past or ongoing projects, such as certain flood relief schemes in AFAs not addressed by the CFRAM Programme, or through other initiatives, such as policy recommendations from the Interdepartmental Flood Policy Co-ordination Group. These measures are identified within the Plan along with those developed through the CFRAM Programme.

## 7.4 OUTCOMES

The application of the process and the resultant outcomes for the Laune-Maine-Dingle Bay River Basin, and for the catchments, sub-catchments and AFAs within the River Basin are set out in the sub-sections below.

### 7.4.1 Measures Applicable for All Areas

There are certain prevention and preparedness measures related to flood risk management, as described in Section 7.2 above and in Appendix F, that form part of wider Government policy. These measures, set out below under the themes of prevention, protection and preparedness, should be applied as appropriate and as applicable across all areas of the River Basin, including properties and areas outside of the AFAs, as well as within.

#### 7.4.1.1 Prevention: Sustainable Planning and Development Management

The application of the Guidelines on the Planning System and Flood Risk Management by the planning authorities is essential to avoid inappropriate development in flood prone areas, and hence avoid unnecessary increases in flood risk into the future. The flood mapping produced through the CFRAM Programme and parallel projects will facilitate the continued application of the Guidelines.

<b>Measure Name:</b>	Application of the Guidelines on the Planning System and Flood Risk Management (DHPLG/OPW, 2009)
<b>Code:</b>	IE22-UoM-9011-M21
<b>Measure:</b>	The Planning Authorities will ensure proper application of the Guidelines on the Planning System and Flood Risk Management (DHPLG/OPW, 2009) in all planning and development management processes and decisions, including where appropriate a review of existing land use zoning and the potential for blue/green infrastructure, in order to support sustainable development, taking account of the flood maps produced through the CFRAM Programme and parallel projects.
<b>Implementation:</b>	Planning Authorities
<b>Funding:</b>	Existing duties (Planning Authorities)

#### 7.4.1.2 Prevention: Sustainable Urban Drainage Systems

Sustainable Urban Drainage Systems (SUDS) can play a role in reducing and managing run-off from new developments to surface water drainage systems, reducing the impact of such developments on flood risk downstream, as well as improving water quality and contributing to local amenity.

<b>Measure Name:</b>	Implementation of Sustainable Urban Drainage Systems (SUDS)
<b>Code:</b>	IE22-UoM-9012-M34
<b>Measure:</b>	In accordance with the Guidelines on the Planning System and Flood Risk Management (DHPLG/OPW, 2009), planning authorities should seek to reduce the extent of hard surfacing and paving and require, subject to the outcomes of environmental assessment, the use of sustainable drainage techniques.
<b>Implementation:</b>	Planning Authorities
<b>Funding:</b>	Existing duties (Planning Authorities)

#### 7.4.1.3 Prevention: Voluntary Home Relocation

In extreme circumstances, the flood risk to a home may be such that the homeowner may consider that continuing to live in the property is not sustainable and would choose to relocate.

In response to the floods of Winter 2015/2016, the Government has agreed to the administrative arrangements for a voluntary homeowner relocation scheme, to provide humanitarian assistance for those primary residences worst affected by these floods. At present, there is no Scheme to provide financial assistance to other home-owners choosing to relocate due to their flood risk.

The Interdepartmental Flood Policy Co-ordination Group is considering the future policy options for voluntary home relocation for consideration by Government.

<b>Measure Name:</b>	Voluntary Home Relocation Scheme
<b>Code:</b>	IE22-UoM-9052-M22
<b>Measure:</b>	Implementation of the once-off Voluntary Homeowner Relocation Scheme that has been put in place by Government in 2017. The Interdepartmental Flood Policy Co-ordination Group is considering the policy options around voluntary home relocation for consideration by Government.
<b>Implementation:</b>	Home-Owners with humanitarian assistance to those qualifying under the Voluntary Homeowners Relocation Scheme, 2017
<b>Funding:</b>	Homeowners and the OPW, under the 2017 Scheme

#### 7.4.1.4 Prevention: Local Adaptation Planning

The National Climate Change Adaptation Framework recognises that local authorities also have an important role to play in Ireland's response to climate

adaptation. Given the potential impacts of climate change on flooding and flood risk, the local authorities should take fully into account these potential impacts in the performance of their functions, in particular in the consideration of spatial planning and the planning and design of infrastructure, in line with the Local Authority Adaptation Strategy Development Guidelines (EPA, 2016).

<b>Measure Name:</b>	Consideration of Flood Risk in local adaptation planning
<b>Code:</b>	IE22-UoM-9013-M21
<b>Measure:</b>	Local authorities should take into account the potential impacts of climate change on flooding and flood risk in their planning for local adaptation, in particular in the areas of spatial planning and the planning and design of infrastructure.
<b>Implementation:</b>	Local Authorities
<b>Funding:</b>	Existing duties (Local Authorities)

#### *7.4.1.5 Prevention: Land Use Management and Natural Flood Risk Management Measures*

The OPW has been liaising with the EPA on the potential impact of WFD measures on flood risk, which are typically neutral (no impact), or may have some benefit in reducing runoff rates and volumes (e.g., through agricultural measures).

The OPW will work with the EPA, local authorities and other agencies to identify, where possible, measures that will have benefits for both WFD and flood risk management objectives, such as natural water retention measures, and also for biodiversity and potentially other objectives. This will form part of the project-level assessment required to progress physical works and flood relief schemes towards planning or Exhibition and confirmation (see Section 8.1), where potential works may be amended or enhanced by the introduction of natural water retention and similar measures. The work will include seeking, and where possible implementing, pilot studies in coordination with the Local Authority WFD Offices and other relevant agencies. It is anticipated that this is most likely to be achieved in areas where there are pressures on the ecological status of a water body in a sub-catchment where there is also an identified potentially significant flood risk (i.e., an AFA). This coordination will also facilitate the resolution of issues for measures that may otherwise cause potential conflict between the objectives of the two Directives in certain water bodies.

<b>Measure Name:</b>	Assessment of Land Use and Natural Flood Risk Management Measures
<b>Code:</b>	IE22-UoM-9021-M31
<b>Measure:</b>	The OPW will work with the EPA, local authorities and other agencies during the project-level assessments of physical works and more broadly at a catchment-level to identify, where possible, measures that will have benefits for both WFD and flood risk management objectives, such as natural water retention measures, and also for biodiversity and potentially other objectives, including the use of pilot studies and applications, where possible.
<b>Implementation:</b>	Local Authority WFD Offices, OPW, EPA, Others



<b>Funding:</b>	Existing Duties (OPW, Others)
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#### *7.4.1.6 Protection: Minor Works Scheme*

The Minor Flood Mitigation Works and Coastal Protection Scheme (the 'Minor Works Scheme') is an administrative scheme operated by the OPW under its general powers and functions to support the local authorities through funding of up to €750k to address qualifying local flood problems with local solutions.

<b>Measure Name:</b>	Minor Works Scheme
<b>Code:</b>	IE22-UoM-9051-M61
<b>Measure:</b>	The OPW will continue the Minor Works Scheme subject to the availability of funding and will keep its operation under review to assess its continued effectiveness and relevance.
<b>Implementation:</b>	OPW, Local Authorities
<b>Funding:</b>	OPW, Local Authorities

#### *7.4.1.7 Protection: Maintenance of Arterial Drainage Schemes and Existing Flood Relief Schemes*

There is 1 Arterial Drainage Scheme within the Laune-Maine-Dingle Bay River Basin, namely the River Maine Catchment Drainage Scheme. The OPW has a statutory duty under the Arterial Drainage Act, 1945, and the Amendment of the Act, 1995, to maintain the Arterial Drainage and the flood relief Schemes. The local authorities should also maintain those flood relief schemes for which they have maintenance responsibility. This Plan does not amend these responsibilities to provide additional flood relief. The Plan therefore does not set out additional measures in this regard.

The Arterial Drainage Maintenance service has developed and adheres to a suite of Environmental Management Protocols and Standard Operating Procedures which minimise the potential environmental impact of operations. A Strategic Environmental Assessment (SEA) was conducted for the national Arterial Drainage Maintenance activities for the period 2011-2015 and a further SEA process was again carried out for the national Arterial Drainage Maintenance activities for the period 2016-2021. Appropriate Assessments are also carried out on an ongoing basis for Arterial Drainage Maintenance operations. Operations outside the scope of the SEA or AA processes are subject to Ecological Assessment to consider environmental sensitivities around Arterial Drainage Maintenance.

#### *7.4.1.8 Maintenance of Channels Not Part of a Scheme*

Outside of the Arterial Drainage and Drainage District Schemes, landowners who have watercourses on their lands have a responsibility for their maintenance. Guidance to clarify the rights and responsibilities of landowners in relation to the maintenance of watercourses on or near their lands is available at [www.flooding.ie](http://www.flooding.ie).

#### *7.4.1.9 Preparedness: Flood Forecasting*

The Government decided in January 2016 to establish a National Flood Forecasting and Warning Service. When fully operational, this will be of significant benefit to communities and individuals to prepare for and lessen the impact of flooding. The Government decision

has provided the opportunity to proceed with a first stage implementation of the service and will involve the following elements:

- establishment of a National Flood Forecasting Service as a new operational unit within Met Éireann, and
- establishment of an independent Oversight Unit within the Office of Public Works (OPW).

The service will deal with flood forecasting from fluvial (river) and coastal sources and when established it will involve the issuing of flood forecasts and general alerts at both national and catchment scales.

A Steering Group, including representatives from the OPW, the Department of Housing, Planning and Local Government (DHPLG), Met Éireann and the Local Authorities has been established to steer, support and oversee the establishment of the new service. A number of meetings have taken place to progress this complex project.

Given the complexities involved in establishing, designing, developing and testing this new service, it is anticipated that the first stage of the service will take at least 5 years before it is fully operational. In the interim period, existing flood forecasting and warning systems and arrangements will continue to be maintained.

<b>Measure Name:</b>	Establishment of a National Flood Forecasting and Warning Service
<b>Code:</b>	IE22-UoM-9031-M41
<b>Measure:</b>	The establishment of a new operational unit in Met Éireann to provide, in the medium term, a national flood forecasting service and the establishment of an independent Oversight Unit in the OPW.
<b>Implementation:</b>	OPW, DHPLG, Met Éireann and Local Authorities
<b>Funding:</b>	OPW, DHPLG

#### *7.4.1.10 Preparedness: Review of Emergency Response Plans for Severe Weather*

Section 4.7 of the Major Emergency Management (MEM) Framework introduces the concept of self-appraisal as part of the systems approach to emergency management. The purpose of the appraisal process is to assist agencies and regions to review, monitor and assess their activities and to identify issues which may need to be addressed and consider what measures they could adopt to improve preparedness, as part of the major emergency development programmes.

The regional appraisal, which is undertaken annually, is based on a self-assessment questionnaire, for which the answers are evidence-based and supported with references to documentary support (e.g. document dates, exercise reports, etc.). The process is supported by meetings of the National Steering Group project team with Regional Steering Group Chairs (2 per annum) to shape future MEM developments and identify challenging issues and areas for improvement. It is the task of the National Steering Group to review and validate these appraisals and provide appropriate feedback.

Flood planning and inter-agency co-ordination are included in appraisals and remains a key objective for National Steering Group and Regional Steering Groups.

The local authorities should, in particular, review their flood event emergency response plans, making use of the information on flood hazards and risks provided through the CFRAM Programme and this Plan.

<b>Measure Name:</b>	Ongoing Appraisal of Flood Event Emergency Response Plans and Management Activities
<b>Code:</b>	IE22-UoM-9032-M42
<b>Measure:</b>	Ongoing, regular appraisal of emergency management activities to improve preparedness and inter-agency coordination and to shape future MEM developments as part of the major emergency development programmes, taking into account in particular the information developed through the CFRAM Programme and this Plan.
<b>Implementation:</b>	Principal Response Agencies, Regional Steering Groups, National Steering Group
<b>Funding:</b>	Existing duties (Implementation Bodies)

#### 7.4.1.11 *Preparedness: Individual and Community Resilience*

While the State, through the OPW, local authorities and other public bodies can take certain actions (subject to environmental assessment, where relevant) to reduce and manage the risk of flooding, individual home-owners, businesses and farmers also have a responsibility to manage the flood risk to themselves and their property and other assets to reduce damages and the risk to personal health in the event of a flood.

Research by the DHPLG is informing a review of the national emergency framework and the supports that can be provided to communities to help them respond to all emergencies, including flooding emergencies. This will build on past initiatives and existing support, such as that provided through the 'Plan, Prepare, Protect' programme (<http://www.flooding.ie/>) and the 'Be Winter Ready' Campaigns (<http://winterready.ie/>).

<b>Measure Name:</b>	Individual and Community Action to Build Resilience
<b>Code:</b>	IE22-UoM-9033-M43
<b>Measure:</b>	All people at flood risk should make themselves aware of the potential for flooding in their area, and take long-term and short-term preparatory actions (subject to environmental assessment, where relevant) to manage and reduce the risk to themselves and their properties and other assets.
<b>Implementation:</b>	Public, business owners, farmers and other stakeholders
<b>Funding:</b>	N/A

#### 7.4.1.12 *Preparedness: Individual Property Protection*

Individual Property Protection can be effective in reducing the damage to the contents, furniture and fittings in a house or business, but are not applicable in all situations (for example, they may not be suitable in areas of deep or prolonged flooding, or for some types of property with pervious foundations and flooring). Property owners considering the use of such methods should seek the advice of an appropriately qualified expert on the suitability

of the measures for their property, and consider the possible requirements for environmental assessment.

While there may be some existing tax relief for some homeowners works on their homes which are aimed at preventing the risk of flooding, the Interdepartmental Flood Policy Co-ordination Group is considering the administrative arrangements, for consideration by Government, of any appropriate assistance to home owners, where it is suitable, to install Individual Property Protection measures for their property.

<b>Measure Name:</b>	Individual Property Protection
<b>Code:</b>	IE22-UoM-9053-M43
<b>Measure:</b>	Property owners may consider the installation of Individual Property Protection measures. The Interdepartmental Flood Policy Co-ordination Group is considering the policy options around installation of Individual Property Protection measures for consideration by Government.
<b>Implementation:</b>	Home owners, Interdepartmental Flood Policy Co-ordination Group
<b>Funding:</b>	Home owners, N/A

#### 7.4.1.13 *Preparedness: Flood-Related Data Collection*

Ongoing collection and, where appropriate, publication of hydrometric and meteorological data, and data on flood events as they occur, will help us to continually improve our preparation for, and response, to flooding.

<b>Measure Name:</b>	Flood-Related Data Collection
<b>Code:</b>	IE22-UoM-9041-M61
<b>Measure:</b>	The OPW, Local Authorities / EPA and other organisations collecting and, where appropriate, publishing hydro-meteorological data and post-event event flood data should continue to do so to improve future flood risk management.
<b>Implementation:</b>	OPW, Local Authorities / EPA and other hydro-meteorological agencies
<b>Funding:</b>	Existing duties (Implementation Bodies)

AFAs which are presently ungauged but are considered to have significant flood risk and would significantly benefit from the installation of new gauge stations are as follows:

- Glenflesk (river gauge located just downstream of Loo Bridge)
- Dingle (tide and river gauges)

## 7.4.2 Castleisland AFA Measures

### Potentially Viable Flood Relief Works

Potentially viable flood relief works for Castleisland that may be implemented after project level assessment and planning or Exhibition and confirmation might include Flow Diversion and Western Flood Defences.

The potentially viable flood relief works consist of the construction of an open channel to divert the Anglore Stream around Tullig and Fluvial Flood Defences comprising of walls and embankments. This measure does not provide protection downstream of the Church Street Bridge.

Section 8.1 sets out the routes for the progression of measures and future assessments, including environmental assessments, of any potential future physical works.

### Public Consultation Outcomes

During the Public Consultation Day at Optioneering stage, Flood Defences were supported but there was also opposition to certain elements of the works by landowners. As a result, the Flow Diversion & Western Flood Defences measure was developed after the Public Consultation Day. During the statutory consultation on the Draft Plan feedback received expressed opposition to measures proposed on the school playing field and to the flow diversion at Tullig. Other feedback expressed the opinion that the Maine and the Glensheroon should be dredged. The point was also made that flood waters could go around the proposed defences. The Details of when the PCD's occurred are provided in Appendix D.

### Appraisal of the Flood Risk Management Measure

Table 7.1 summarises the appraisal of the Flood Risk Management Measure considered in Castleisland.

**Table 7.1 Appraisal of the Flood Risk Management Measure**

Measure	MCA Appraisal Scores				TOTAL - MCA Benefit Score	Cost (€millions)	MCA Score / Cost	BCR
	Technical	Social	Economic	Environ / Cultural				
Flow Diversion & Western Flood Defences	925.00	530.85	402.53	-436.00	497.38	€5.20M	95.57	1.32

Under the technical criteria it was found that the proposed measure was operationally robust and that there were few potential health and safety risks involved in the construction of the works. It was determined that some elements of the measure could be adapted to address future flood risk as the heights of flood walls could be increased to cater for future flows but it would be difficult to increase the size of the culvert and channel on the flow diversion. Details of the climate change adaptability assessment are included in Appendix G.

Under the Social criteria it was found that the proposed measure reduced the number of people, social infrastructure and workplaces at risk from flooding. However no high vulnerability properties are protected by the proposed measure in Castleisland.

Under the Economic criteria it was found that the proposed measure significantly reduced the potential flood damages and risk to transport infrastructure in Castleisland. However, as no utility infrastructure or agricultural activities were protected from flooding by the measure no score was achieved under the economic heading for these receptors.

Under the Environmental / Cultural criteria it was found that the construction of this measure will result in significant negative impacts on the water body status in the absence of appropriate mitigation. Japanese Knotweed and Giant Rhubarb occur along the bank of the river. There is potential that works may spread these species.

### **Conclusions and Other Issues**

These potentially viable flood relief works are expected to provide protection to the defended areas against a 100-Year fluvial flood (1% Annual Exceedance Probability). This option does not increase flood risk downstream in the undefended areas.

<b>Measure Name:</b>	Castleisland Flood Relief Scheme
<b>Code:</b>	IE22-IE-AFA-220323-CD01-M33
<b>Measure:</b>	Progress the Castleisland Flood Relief Scheme to project-level development and assessment for refinement and preparation for planning / Exhibition and, as appropriate, implementation.
<b>Implementation:</b>	OPW and/or local authority - To be confirmed
<b>Funding:</b>	OPW

Further details of the potentially viable flood relief works, their appraisal, and the public consultation outcomes are set out in Appendix G.



### 7.4.3 Dingle AFA Measures

#### **Potentially Viable Flood Relief Works**

Potentially viable flood relief works for Dingle that may be implemented after project level assessment and planning or Exhibition and confirmation might include Storage and Flood Defences.

The potentially viable flood relief works consist of the provision of a storage area on the Dingle Stream upstream of the town and Tidal Flood Defences comprising of sea walls and embankments.

Section 8.1 sets out the routes for the progression of measures and future assessments, including environmental assessments, of any potential future physical works.

#### **Public Consultation Outcomes**

The feedback at the Public Consultation Day at Optioneering stage was in support of Storage & Flood Defences. During the statutory consultation on the Draft Plans feedback was received expressing opposition to the flood storage element of the measure. The point was made that the proposed location of the storage area includes a well and a former landfill site. Some of the residents believe the river should be dredged. The Details of when the PCD's occurred are provided in Appendix D.

#### **Appraisal of the Flood Risk Management Measure**

Table 7.2 summarises the appraisal of the Flood Risk Management Measure considered in Dingle.

**Table 7.2      *Appraisal of the Flood Risk Management Measure***

Measure	MCA Appraisal Scores				TOTAL - MCA Benefit Score	Cost (€millions)	MCA Score / Cost	BCR
	Technical	Social	Economic	Environ / Cultural				
Storage & Flood Defences	900.00	730.81	882.38	-245.00	1368.18	€4.21M	324.77	2.04

Under the technical criteria it was found that the proposed measure was operationally robust and that there were very few potential health and safety risks involved in the construction of the works. It was determined that the measure could be easily adapted to address future flood risk as the heights of flood walls and storage area could be increased to cater for future flows. Details of the climate change adaptability assessment are included in Appendix G.

Under the Social criteria it was found that the proposed measure significantly reduced the number of people, social infrastructure and workplaces at risk from flooding. However no high vulnerability properties are protected by the proposed measure in Dingle.

Under the Economic criteria it was found that the proposed measure significantly reduced the potential flood damages and risk to transport infrastructure in Dingle. However, as no utility infrastructure or agricultural activities were protected from flooding by the measure no score was achieved under the economic heading for these receptors.

Under the Environmental / Cultural criteria it was found that the construction of in-stream works would result in significant emissions of sediment to the waterbody and downstream in the absence of appropriate mitigation. The construction of this measure is likely to cause a permanent change to the landscape character of the AFA both along Spa Road and at the harbour.

### **Conclusions and Other Issues**

These potentially viable flood relief works are expected to provide protection to the defended areas against a 100-Year fluvial flood (1% Annual Exceedance Probability) or a 200-Year tidal flood (0.5% Annual Exceedance Probability).

<b>Measure Name:</b>	Dingle Flood Relief Scheme
<b>Code:</b>	IE22-IE-AFA-220327-DE01-M33
<b>Measure:</b>	Progress the Dingle Flood Relief Scheme to project-level development and assessment for refinement and preparation for planning / Exhibition and, as appropriate, implementation.
<b>Implementation:</b>	OPW and/or local authority - To be confirmed
<b>Funding:</b>	OPW

Further details of the potentially viable flood relief works, their appraisal, and the public consultation outcomes are set out in Appendix G.

## 7.4.4 Killarney AFA Measures

### **Potentially Viable Flood Relief Works**

Potentially viable flood relief works for Killarney that may be implemented after project-level assessment and planning or Exhibition and confirmation might include Flood Defences.

The potentially viable flood relief works consist of Fluvial Flood Defences comprising of walls and embankments along with flood resilience of some properties.

Section 8.1 sets out the routes for the progression of measures and future assessments, including environmental assessments, of any potential future physical works.

### **Public Consultation Outcomes**

The feedback at the Public Consultation Day at Optioneering stage was in support of Flood Defences. Some feedback indicated that the proposed defences would not protect properties that had come close to flooding in the recent past. Further assessment of the hydrology and hydraulics of the Flesk is required at Project Stage to address the matters raised. During the statutory consultation on the draft FRMP feedback was received indicating that some residents wanted the access to their properties to be protected. Other residents were concerned that the proposed measure would increase flood risk and requested that the location of defences be revised. The Details of when the PCD's occurred are provided in Appendix D.

### **Appraisal of the Flood Risk Management Measure**

Table 7.3 summarises the appraisal of the Flood Risk Management Measure considered in Killarney.

**Table 7.3 Appraisal of the Flood Risk Management Measure**

Measure	MCA Appraisal Scores				TOTAL - MCA Benefit Score	Cost (€millions)	MCA Score / Cost	BCR
	Technical	Social	Economic	Environ / Cultural				
Flood Defences	850.00	436.22	248.28	-265.00	419.50	€1.32M	318.96	1.26

Under the technical criteria it was found that the proposed measure was operationally robust and that there were few potential health and safety risks involved in the construction of the works. It was determined that the measure could be easily adapted to address future flood risk as the heights of flood walls could be increased to cater for future flows. Details of the climate change adaptability assessment are included in Appendix G.

Under the Social criteria it was found that the proposed measure reduced the number of people, social infrastructure and workplaces at risk from flooding. However no high vulnerability properties social infrastructure are protected by the proposed measure in Killarney.

Under the Economic criteria it was found that the proposed measure significantly reduced the potential flood damages and risk to transport infrastructure in Killarney. However, as no utility infrastructure or agricultural activities were protected from flooding by the measure no score was achieved under the economic heading for these receptors.

Under the Environmental / Cultural criteria it was found that Freshwater Pearl Mussels located downstream of the proposed embankments and flood walls could be impacted by the construction of this measure without appropriate mitigation.

Killarney has a number of NIAHs throughout the town, however only one site is at risk within the 1% AEP fluvial extent. The provision of a flood wall along the river will provide protection to a number of RMPs against flooding. However there is potential for permanent long term negative impacts arising from their setting within the visual envelope of the town resulting from the measures.

### **Conclusions and Other Issues**

These potentially viable flood relief works are expected to provide protection against a 100-Year flood (1% Annual Exceedance Probability).

<b>Measure Name:</b>	Killarney Flood Relief Scheme
<b>Code:</b>	IE22-IE-AFA-220337-KY01-M33
<b>Measure:</b>	Progress the Killarney Flood Relief Scheme to project-level development and assessment for refinement and preparation for planning / Exhibition and, as appropriate, implementation.
<b>Implementation:</b>	OPW and/or local authority - To be confirmed
<b>Funding:</b>	OPW

Feedback provided at public consultations indicated that the flood extents for the River Flesk may be underestimated. Further assessment of the hydrology and hydraulics of the Flesk is required at Project Stage to ensure that the standard of protection is achieved and that flood risk is not increased as a result of the flood risk management measures.

Further details of the potentially viable flood relief works, their appraisal, and the public consultation outcomes are set out in Appendix G.

#### **7.4.5 Milltown AFA**

Potentially viable flood relief works have been investigated for Milltown. The assessment of these works are detailed in the Preliminary Options Report. None of the methods were found to be economically viable. This is because the flood risk in the Milltown AFA is relatively low. There are only 6 no. residential properties and 9 no non-residential properties at risk in Milltown from the 1% AEP event. The assessment found that the cost of protecting those properties was over four times the value of the potential flood damage to those same properties.

#### 7.4.6 Measures with a Benefit - Cost Ratio below Unity

For some AFAs, no economically viable measure (i.e., a measure with a benefit - cost ratio of greater than 1.0) has been found through the analysis undertaken to date, but a technically viable measure has been identified with a benefit - cost ratio of between 0.5 and 1.0. A more detailed assessment of the costs of such measures may indicate that the measure could be implemented at a cost below that determined through the analysis undertaken to date.

While it would not be prudent to progress such measures to full project-level assessment towards planning / Public Exhibition based on the information available at present, a more detailed assessment of the costs can be progressed to determine if an economically viable measure may in fact exist that could justify the progression to full project-level assessment.

##### 7.4.6.1 Glenflesk AFA Measures

#### **Potentially Viable Flood Relief Works**

Potentially viable flood relief works for Glenflesk that may be implemented after project-level assessment and planning or Exhibition and confirmation might include Flood Defences.

The potentially viable flood relief works consist of Fluvial Flood Defences comprising of walls, embankments and road raising along the Flesk River.

Section 8.1 sets out the routes for the progression of measures and future assessments, including environmental assessments, of any potential future physical works.

#### **Public Consultation Outcomes**

Prior to the Public Consultation Day held at the Flood Risk Management Optioneering Stage it was clear that the proposed structural flood risk management option would not be economically viable. As a result, the Public Consultation Day focused on viable non-structural measures. During the statutory consultation on the draft FRMP feedback was received that suggested that the extent of flooding predicted in Glenflesk was underestimated and that the preferred solution should include the removal of obstructions to flow from the river bed and banks. The Details of when the PCD's occurred are provided in Appendix D.

#### **Appraisal of the Flood Risk Management Measure**

Table 7.4 summarises the appraisal of the Flood Risk Management Measure considered in Glenflesk.

**Table 7.4 Appraisal of the Flood Risk Management Measure**

Measure	MCA Appraisal Scores				TOTAL - MCA Benefit Score	Cost (€millions)	MCA Score / Cost	BCR
	Technical	Social	Economic	Environ / Cultural				
Flood Defences	1250.00	241.39	68.18	-571.00	-261.44	€0.25M	-1038.60	0.87

Under the technical criteria it was found that the proposed measure was operationally robust and that there were few potential health and safety risks involved in the construction of the works. It was determined that the measure could be easily adapted to address future flood risk as the heights of flood walls could be increased to cater for future flows. Details of the climate change adaptability assessment are included in Appendix G.

Under the Social criteria it was found that the proposed measure reduced the number of people, social infrastructure and workplaces at risk from flooding. However, no high vulnerability properties are protected by the proposed measure in Glenflesk.

Under the Economic criteria it was found that the proposed measure reduced the potential flood damages and risk to transport infrastructure in Glenflesk. However, as no utility infrastructure or agricultural activities were protected from flooding by the measure no score was achieved under the economic heading for these receptors.

Under the Environmental / Cultural criteria it was found that this measure has an associated risk of elevated sediment runoff to the watercourse in the absence of appropriate mitigation. The proposed works including the removal of bankside vegetation and the construction of earth mounds occur within or adjacent to the SAC Boundary. There are a number of species of conservation importance within the AFA, these include otters, badgers, bats. This measure has the potential to cause disturbance to these species during the construction phase.

### **Conclusions and Other Issues**

These potentially viable flood relief works are expected to provide protection against a 100-Year flood (1% Annual Exceedance Probability). However, this option is not economically viable.

<b>Measure Name:</b>	Undertake a Detailed Assessment of the Costs of the Potential Measure for Glenflesk
<b>Code:</b>	IE22-IE-AFA-225502-GK01-M33
<b>Measure:</b>	Undertake a detailed assessment of the costs to determine if an economically viable measure may exist that could justify the progression to full project-level assessment
<b>Implementation:</b>	OPW and/or local authority - To be confirmed
<b>Funding:</b>	OPW

Further details of the potentially viable flood relief works, their appraisal, and the public consultation outcomes are set out in Appendix G.



## 7.5 PRIORITISATION OF PROPOSED PROTECTION MEASURES

Implementing all of the proposed measures as set out in this, and all, Plans would require a significant capital investment as well as substantial resources to manage the implementation process. The Government's National Development Plan 2018 to 2027 has committed up to €1 billion over the lifetime of the Plan for flood relief measures. This will enable the OPW to continue with the implementation of its existing flood relief capital works programme and will also facilitate the phased implementation of the proposed measures within the Plans. Within this period, it is necessary to prioritise the investment of resources in the delivery of the flood relief capital investment programme.

The basis on which measures in the Plans have been prioritised for implementation is a key consideration in planning the investment of the significant public resources made available for flood relief over the next 10 years. The prioritisation primarily relates to the protection measures to be implemented by the OPW or funded by the OPW but implemented by a local authority.

For the purposes of prioritisation, the measures have been divided into three streams as follows:

1. Large Schemes: Measures costing in excess of €15m
2. Medium and Small Schemes: Measures costing in between €750k/€1m and €15m
3. Minor Schemes: Measures costing less than €750k/€1m

There are only a small number of Large Schemes, all of which will be advanced at an early stage due to their scale and their long lead in period.

It is anticipated that the Minor Schemes will be brought forward by the local authorities, with OPW funding, and so may be advanced at an early stage.

The measures in the remaining stream (Medium and Small Schemes) will be prioritised on a regional basis, by reference to the six CFRAM study areas. The management objective for this €1 billion ten year programme of flood relief works is to efficiently utilise available capacity to plan progression and completion of schemes that deliver greatest protection and maximise return.

## 7.6 FLOOD RISK MANAGEMENT IN OTHER AREAS

This Plan identifies a series of flood risk management measures for the entire River Basin and also viable, locally-specific flood protection measures for the AFAs identified through the PFRA.

While it is considered that the PFRA identified the areas of significant flood risk throughout Ireland, the PFRA will be reviewed in line with legislation, and other areas can be considered for detailed assessment at that stage.

In the interim, local authorities may avail of the OPW Minor Flood Mitigation Works and Coastal Protection Scheme (Section 2.6.5 and 7.4.1.6), where the relevant criteria are met, to implement local solutions to local flood problems, including in areas outside of the AFAs.

## **7.7 SUMMARY OF PROPOSED MEASURES**

Table 7.5 provides a summary of the measures that are to be progressed through the implementation of the Plan for the Laune-Maine-Dingle Bay River Basin.

**Table 7.5: Summary of Flood Risk Management Measures**

Measure	Implementation	Funding
<b>River Basin Measures (Applicable for All Areas)</b>		
Application of the Guidelines on the Planning System and Flood Risk Management (DHPLG/OPW, 2009)	Planning Authorities	Planning Authorities
Implementation of Sustainable Urban Drainage Systems (SUDS)	Planning Authorities	Planning Authorities
Voluntary Home Relocation	Interdepartmental Flood Policy Co-ordination Group	OPW (2017 Scheme)
Consideration of Flood Risk in Local Adaptation Planning	Local Authorities	Local Authorities
Assessment of Land Use and Natural Flood Risk Management Measures	EPA, OPW, Others	OPW, Others
Minor Works Scheme	OPW, Local Authorities	OPW, Local Authorities
Establishment of a National Flood Forecasting and Warning Service	OPW, DHPLG, Met Éireann and local authorities	OPW, DHPLG
Ongoing Appraisal of Flood Event Emergency Response Plans and Management Activities	Principal Response Agencies, Regional Steering Groups, National Steering Group	Implementation Bodies
Individual and Community Action to Build Resilience	Public, business owners, farmers and other stakeholders	N/A
Individual Property Protection	Home Owners, Interdepartmental Flood Policy Co-ordination Group	Homeowners
Flood-Related Data Collection	OPW, Local Authorities / EPA, and other hydro-meteorological agencies	Implementation Bodies

<b>Catchment / Sub-Catchment Measures</b>		
None		
<b>Community-Level (AFA) Measures</b>		
Progress the project-level development and assessment of a Flood Relief Scheme, including environmental assessment as necessary and further public consultation, for refinement and preparation for planning / Exhibition and, if and as appropriate, implementation, for the Communities set out below.		
<i>Castleisland &amp; Tullig</i>	<i>OPW and/or Kerry County Council</i>	<i>OPW</i>
<i>Dingle</i>	<i>OPW and/or Kerry County Council</i>	<i>OPW</i>
<i>Killarney</i>	<i>OPW and/or Kerry County Council</i>	<i>OPW</i>
Undertake a Detailed Assessment of the Costs of the Potential Measure for the Communities set out below.		
Glenflesk	<i>OPW and/or Kerry County Council</i>	<i>OPW</i>

## **8 IMPLEMENTATION, MONITORING AND REVIEW OF THE PLAN**

### **8.1 IMPLEMENTATION OF THE PLAN**

The Plan sets out the strategy, actions and measures that are considered to be the most appropriate at this stage of assessment, including a programme of structural and non-structural measures to be implemented and has identified the responsible body/bodies for implementing those measures.

#### **8.1.1 River Basin Level Measures**

The River Basin level measures, i.e., those applicable in all areas (Section 7.4.1), typically do not involve physical works, and represent the implementation of existing policy and/or the development of new policies or Schemes.

Many prevention and preparedness measures are already in-hand with the relevant implementing bodies or are being proactively progressed by the Interdepartmental Flood Policy Co-ordination Group. Other such measures requiring new action should be pro-actively and urgently progressed and implemented by the relevant implementing bodies, subject to any licences and/or environmental assessments required, through normal business practices.

#### **8.1.2 Catchment and AFA-Level Physical Measures**

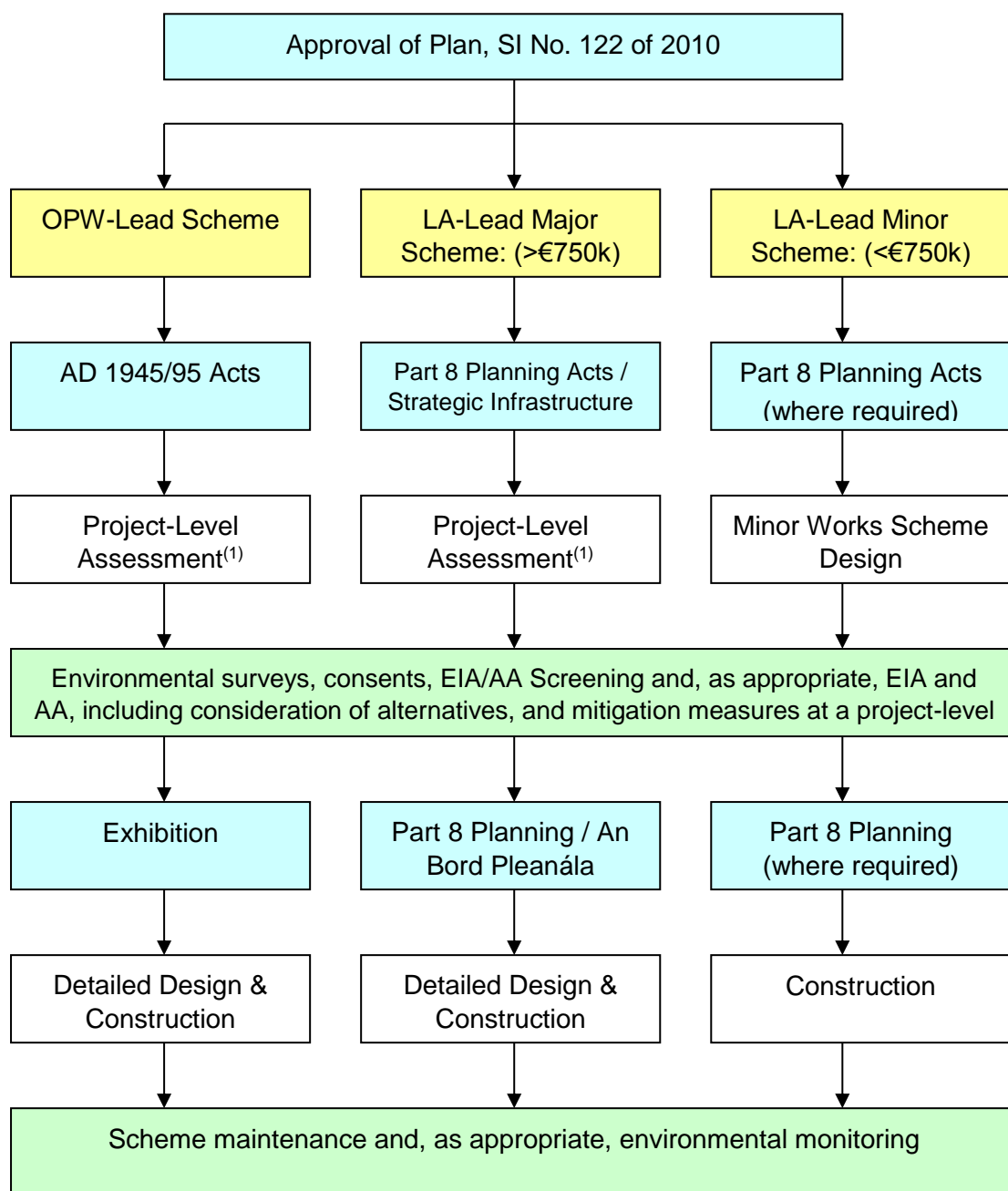
Most of the measures at the catchment and/or AFA-level involve physical works. The body responsible for the implementation of measures that will involve physical works, such as a flood relief scheme, will typically be either the OPW or the relevant local authority (see Table 7.1).

The potential physical flood relief works or 'Schemes' set out in the Plans that have been developed through the CFRAM Programme are to an outline design, and are not at this point ready for construction. Further detailed design through a project-level of assessment will be required for such works before implementation, including more detailed adaptation planning for the potential impacts of climate change along with:

- Project-level environmental assessment and appraisal (e.g., EIA and Appropriate Assessment where relevant)
- Further public and stakeholder consultation and engagement (see Section 8.1.4)
- Statutory planning processes, such as planning permission or Public Exhibition and confirmation (Ministerial approval), where relevant.

Local information that cannot be captured at the Plan-level of assessment, such as ground investigation results, project-level environmental assessments and interactions with local urban storm water drainage systems, may give rise at that stage to some amendment of the proposed works to ensure that they are viable, fully adapted, developed and appropriate within the local context, and that they are compliant with environmental legislation. The works set out in the Plan may therefore be subject to some amendment.

There are three routes by which such works may progress to construction stage, as set out in Figure 8.1.



**Figure 8.1: Options for Progression of Measures Involving Physical Flood Relief Works**

Note (1): Project-level assessment will take account of the potentially viable measures identified in the Plan, but will involve the consideration of alternatives at the project-level and, as appropriate, EIA and AA, including the definition of necessary mitigation measures at the project-level. Only schemes/measures confirmed to be viable following project level assessment will be brought forward for Exhibition/Planning and detailed design

Where measures require further assessment or hydrometric monitoring before progression to further development at a local, project level, such assessments or monitoring will be implemented and progressed as soon as possible.



### **8.1.3 Other Catchment and AFA-Level Measures**

Measures may have been identified at the catchment or AFA-level in the Laune-Maine-Dingle Bay River Basin that do not involve physical works. Such measures might include:

- The need for further hydrometric monitoring / data gathering
- Further study or analysis (for example, in areas of high technical uncertainty)
- The operation of existing structures to manage water levels or flows

Measures relating to the operation of existing structures would typically be the responsibility of the ESB or Waterways Ireland, and represent ongoing practice or the enhancement of same.

For the remaining measures under this category, the OPW will advance these, subject to any licences and/or environmental assessments that may be required, as a matter of priority within available resources.

### **8.1.4 Public and Stakeholder Consultation and Engagement**

The project development stage will involve a significant level of further public consultation on the proposed measures in the Plan at key points in the progress of the design work required to bring those measures to a state of readiness to submit for planning approval (in the case of projects being implemented by local authorities under the Planning and Development Acts) or for Public Exhibition (in the case of projects being implemented by the OPW under the Arterial Drainage Acts ADA). Public Information Days will be organised to inform the communities affected of the progress with the design of the proposed scheme.

In the case of schemes being implemented by the OPW under the ADA, the main public consultation event is the formal Public Exhibition stage. This involves the preparation of the scheme documentation (schedules setting out details and benefits of the scheme, including names of the proprietors, owners and occupiers of the lands with which the proposed scheme will interfere; maps, drawings, plans, sections setting out the technical detail; Environmental Impact Statement, if required; and Interference Notices sent to each affected person detailing the extent of works proposed on their respective lands or property and any proposed compulsory interference with, or acquisition of, these lands and property). All of the Scheme Documents are forwarded to the relevant Local Authority and they are also placed on formal Public Exhibition in a public building(s) in the area typically over a period of 4 weeks when interested parties and the public have the opportunity to study the proposals and make comments, observations, objections, etc. OPW staff and/or consultancy staff are available at Public Exhibition to answer queries and offer clarification. Interference Notices are also forwarded to affected parties in advance of the Exhibition period. All observations received are responded to and, if necessary, the scheme may be revised as a result of them. Following Public Exhibition, the scheme is submitted to the Minister for Finance and Public Expenditure and Reform for Confirmation (approval) of the Scheme.

The OPW is also considering suitable mechanisms at a national level to provide for consultation and engagement for the national flood risk management programme with stakeholders that have a national remit.

## **8.2 MONITORING OF PROGRESS IN IMPLEMENTATION OF THE PLAN**

The OPW will monitor progress in the implementation of measures for which the OPW has responsibility on an ongoing basis as part of its normal business management processes.

The OPW will coordinate and monitor progress in the implementation of the Plans through an Interdepartmental Co-ordination Group.

On a six-yearly cycle, the OPW will undertake a full review of the progress in the implementation of the Plan and the level of flood risk, and will report this progress publicly and to the European Commission as part of obligations of Ireland under the 'Floods' Directive.

In addition to monitoring of implementation of the measures set out in the Plan, monitoring will also be undertaken in relation to:

- Continued collection and analysis of hydro-meteorological data for improved flood flow and sea level frequency analysis and for observation of the potential impacts of climate change
- Ongoing recording of flood events through established systems, with photographs, peak water levels, duration, etc., for recording and publication on the National Flood Event Data Archive ([www.floodinfo.ie](http://www.floodinfo.ie))
- Monitoring of compliance with the Guidelines on the Planning System and Flood Risk Management through ongoing review of development plans, local area plans and other forward planning documents
- Changes that may affect the areas prone to flooding as shown on the flood maps, with the flood maps updated on an ongoing basis as necessary

## **8.3 ENVIRONMENTAL MONITORING**

### **8.3.1 Monitoring of the Plan**

A mitigation monitoring programme has been formulated for each AFA within the Plan based on the SEA objectives, sub objectives and the associated indicators. The monitoring programme is required for the following reasons:

- To monitor the predicted significant negative effects of the Plan; and to
- Monitor the baseline environmental conditions for all SEA objectives.

The monitoring programme will also help to identify any unforeseen negative effects of the plan and ensure that action can be taken to mitigate them. This monitoring will be carried out at various stages of scheme implementation e.g. before, during and after scheme development, such that the success of measures to protect or enhance environmental, social and cultural receptors can be assessed.

As part of the monitoring programme, relevant and appropriate thresholds will be agreed in consultation with the competent authorities to determine when remedial action is required for the particular aspect of the environment being monitored. Existing environmental monitoring is currently undertaken throughout Ireland by the OPW and other organisations like the EPA, IFI, and NPWS, for a number of environmental elements in accordance with environmental legislation, these sources will be used as baseline data or reference.

The proposed monitoring programme is specified in the SEA Environmental Report for the Laune-Maine-Dingle Bay River Basin.

## 8.4 REVIEW OF THE PFRA, FLOOD MAPS AND THE PLANS

In accordance with the requirements of the EU 'Floods' Directive, the PFRA, flood maps and Plans will be reviewed on a six-yearly cycle, with the first reviews of the PFRA, maps and final Plans due by the end of 2018, 2019 and 2021 respectively.

The review of the PFRA is described in Section 3.3.

The review of the flood maps, on an ongoing basis and formally by the end of 2019, will take account of additional information received and/or physical amendments such as the construction of new infrastructure, and, where appropriate, the amendment of the flood maps.

It is anticipated that this review of the Plans will include any changes or updates since the publication of the Plans, including:

- A summary of the review of the PFRA and the flood maps, taking into account the potential impacts of climate change, including where appropriate the addition or removal of AFAs
- An assessment of the progress made towards the achievement of the flood risk management Objectives
- A description of, and an explanation for, any measures foreseen in the final version of the Plan which were planned to be undertaken and have not been taken forward
- A description of any additional measures developed and/or progressed since the publication of the Plan

The Review of the Plan, which will include assessments under SEA and Habitats Directives as appropriate, taking into account new information available at that time (e.g., as available from the Environmental Monitoring Framework and from the [www.catchments.ie](http://www.catchments.ie) website), will be published in line with relevant legislation, following public and stakeholder engagement and consultation.

## GLOSSARY AND ACRONYMS

Annual Exceedance Probability Or AEP	The probability, typically expressed as a percentage, of a flood event of a given magnitude being equalled or exceeded in any given year. For example, a 1% AEP flood event has a 1%, or 1 in a 100, chance of occurring or being exceeded in any given year.
Appropriate Assessment	An assessment of the potential impacts of a plan or project on the integrity of a site designated as a Natura 2000 Site, as required under the Habitats Directive.
Area for Further Assessment Or AFA	Areas where, based on the Preliminary Flood Risk Assessment, the risks associated with flooding are considered to be potentially significant. For these areas further, more detailed assessment was required to determine the degree of flood risk, and develop measures to manage and reduce the flood risk. The AFAs were the focus of the CFRAM Studies.
Arterial Drainage Scheme	Works undertaken under the Arterial Drainage Act (1945) to improve the drainage of land. Such works were undertaken, and are maintained on an ongoing basis, by the OPW.
Benefiting Lands	Lands benefiting from an Arterial Drainage Scheme.
Catchment	The area of land draining to a particular point on a river or drainage system, such as an Area for Further Assessment (AFA) or the outfall of a river to the sea.
Catchment Flood Risk Assessment and Management Study Or CFRAM Study	A study to assess and map the existing and potential future flood hazard and risk from fluvial and coastal waters, and to define objectives for the management of the identified risks and prepare a Plan setting out a prioritised set of measures aimed at meeting the defined objectives.
Communities	Cities, towns, villages or townlands where there are a collection of homes, businesses and other properties.
Consequences	The impacts of flooding, which may be direct (e.g., physical injury or damage to a property or monument), a disruption (e.g., loss of electricity supply or blockage of a road) or indirect (e.g., stress for affected people or loss of business for affected commerce)
Drainage	Works to remove or facilitate the removal of surface or sub-surface water, e.g., from roads and urban areas through urban storm-water drainage systems, or from land through

	drainage channels or watercourses that have been deepened or increased in capacity.
Drainage District	Works across a specified area undertaken under the Drainage Acts to facilitate land drainage
Flood	The temporary covering by water of land that is not normally covered by water.
'Floods' Directive	The EU 'Floods' Directive [2007/60/EC] is the Directive that came into force in November 2007 requiring Member States to undertake a PFRA to identify Areas for Further Assessment (AFAs), and then to prepare flood maps and Plans for these areas.
Flood Extent	The extent of land that has been, or might be, flooded. Flood extent is often represented on a flood map.
Flood Hazard Map	A map indicating areas of land that may be prone to flooding, referred to as a flood extent map, or a map indicating the depth, velocity or other aspect of flooding or flood waters for a given flood event. Flood hazard maps are typically prepared for either a past event or for (a) potential future flood event(s) of a given probability.
Flood Risk Map	A map showing the potential risks associated with flooding. These maps may indicate a particular aspect of risk, taking into account the probability of flooding (e.g., annual average economic damages), but can also show the various receptors that could be affected by floods of different probabilities.
Flood Risk Management Plan (Plan)	A Plan setting out a prioritised set of measures within a long-term sustainable strategy aimed at achieving defined flood risk management objectives. The Plan is developed at a River Basin (Unit of Management) scale, but is focused on managing risk within the AFAs.
Floodplain	The area of land adjacent to a river or coastal reach that is prone to periodic flooding from that river or the sea.
Fluvial	Riverine, often used in the context of fluvial flooding, i.e., flooding from rivers, streams, etc.
Habitats Directive	The Habitats Directive [92/43/EEC] aims at securing biodiversity through the provision of protection for animal and plant species and habitat types of European importance.
Hazard	Something that can cause harm or detrimental consequences. In this context, the hazard referred to is flooding.

Hydraulics	The science of the behaviour of fluids, often used in this context in relation to estimating the conveyance of flood water in river channels or structures (such as culverts) or overland to determine flood levels or extents.
Hydrology	The science of the natural water cycle, often used in this context in relation to estimating the rate and volume of rainfall flowing off the land and of flood flows in rivers.
Hydrometric Area	Hydrological divisions of land, generally large catchments or a conglomeration of small catchments, and associated coastal areas. There are 40 Hydrometric Areas in the island of Ireland.
Indicative	This term is typically used to refer to the flood maps developed under the PFRA. The maps developed are approximate, rather than highly detailed, with some local anomalies.
Individual Risk Receptor Or IRR	A single receptor (see below) that has been determined to represent a potentially significant flood risk (as opposed to a community or other area at potentially significant flood risk, known as an Area for Further Assessment, or 'AFA').
Inundation	Another word for flooding or a flood (see 'Flood')
Measure	A measure (when used in the context of a flood risk management measure) is a set of works, structural and / or non-structural, aimed at reducing or managing flood risk.
National CFRAM Programme	The programme developed by the OPW to implement key aspects of the EU 'Floods' Directive in Ireland, which included the CFRAM Studies, and built on the findings of the PFRA.
Pluvial	Refers to rainfall, often used in the context of pluvial flooding, i.e., flooding caused directly from heavy rainfall events (rather than over-flowing rivers).
Point Receptor	Something that might suffer harm or damage as a result of a flood, that is at a particular location that does not cover a large area, such as a house, office, monument, hospital, etc.
Preliminary Flood Risk Assessment	An initial, high-level screening of flood risk at the national level to determine where the risks associated with flooding



Or PFRA	are potentially significant, to identify the AFAs. The PFRA is the first step required under the EU 'Floods' Directive.
Public Consultation Day Or PCD	A public and stakeholder consultation and engagement event advertised in advance, where the project team displayed and presented material (e.g., flood maps, flood risk management options) at a venue within a community, with staff available to explain and discuss the material, and where members of the community and other interested parties could provide local information and put forward their views.
Receptor	Something that might suffer harm or damage as a result of a flood, such as a house, office, monument, hospital, agricultural land or environmentally designated sites.
Return Period	A term that was used to describe the probability of a flood event, expressed as the interval in the number of years that, on average over a long period of time, a certain magnitude of flood would be expected to occur. This term has been replaced by 'Annual Exceedance Probability, as Return Period can be misleading.
Riparian	River bank. Often used to describe the area on or near a river bank that supports certain vegetation suited to that environment (Riparian Zone).
Risk	The combination of the probability of flooding, and the consequences of a flood.
River Basin	An area of land (catchment) draining to a particular estuary or reach of coastline.
River Basin District Or RBD	A regional division of land defined for the purposes of the Water Framework Directive. There are eight RBDs in the island of Ireland; each comprising a group of River Basins.
Riverine	Related to a river
Runoff	The flow of water over or through the land to a waterbody (e.g., stream, river or lake) resulting from rainfall events. This may be overland, or through the soil where water infiltrates into the ground.
Standard Annual Average Rainfall Or SAAR	The average rainfall in an area per annum

Sedimentation	The accumulation of particles (of soil, sand, clay, peat, etc.) in the river channel
Significant Risk	Flood risk that is of particular concern nationally. The PFRA Main Report (see <a href="http://www.floodinfo.ie">www.floodinfo.ie</a> ) sets out how significant risk is determined for the PFRA, and hence how Areas for Further Assessment have been identified.
Strategic Environmental Assessment Or SEA	An SEA is an environmental assessment of plans and programmes to ensure a high level consideration of environmental issues in the plan preparation and adoption, and is a requirement provided for under the SEA directive [2001/42/EC]
Standard of Protection	The magnitude of flood, often defined by the annual probability of that flood occurring being exceeded (the Annual Exceedance Probability, or 'AEP'), that a measure / works is designed to protect the area at risk against.
Surface Water	Water on the surface of the land. Often used to refer to ponding of rainfall unable to drain away or infiltrate into the soil.
Surge	The phenomenon of high sea levels due to meteorological conditions, such as low pressure or high winds, as opposed to the normal tidal cycles
Survey Management Project	A project commissioned by the OPW in advance of the CFRAM Studies to specify and manage a large proportion of the survey work.
Sustainability	The capacity to endure. Often used in an environmental context or in relation to climate change, but with reference to actions people and society may take.
Tidal	Related to the tides of the sea / oceans, often used in the context of tidal flooding, i.e., flooding caused from high sea or estuarine levels.
Topography	The shape of the land, e.g., where land rises or is flat.
Transitional Water	The estuarine or inter-tidal reach of a river, where the water is influenced by both freshwater river flow and saltwater from the sea.
Unit of Management Or UoM	A hydrological division of land defined for the purposes of the Floods Directive. One Plan has been prepared for each Unit of Management, which is referred to within the Plan as a River Basin.

Vulnerability	The potential degree of damage to a receptor (see above), and/or the degree of consequences that could arise in the event of a flood.
Waterbody	A term used in the Water Framework Directive (see below) to describe discrete section of rivers, lakes, estuaries, the sea, groundwater and other bodies of water.
Water Framework Directive	The Water Framework Directive [2000/60/EC] aims to protect surface, transitional, coastal and ground waters to protect and enhance the aquatic environment and ecosystems and promote sustainable use of water resources

## LIST OF ACRONYMS

<b>AA</b>	Appropriate Assessment
<b>AEP</b>	Annual Exceedance Probability
<b>AFA</b>	Area for Further Assessment
<b>AR5</b>	5th Assessment Report (IPCC)
<b>BCR</b>	Benefit - Cost Ratio
<b>CFRAM</b>	Catchment-Based Flood Risk Assessment and Management
<b>DHPLG</b>	Department of Housing, Planning and Local Government
<b>EIA</b>	Environmental Impact Assessment
<b>EPA</b>	Environmental Protection Agency
<b>ESB</b>	Electricity Supply Board
<b>EU</b>	European Union
<b>FRMP</b>	Flood Risk Management Plan
<b>FRR</b>	Flood Risk Review
<b>HEFS</b>	High-End Future Scenario
<b>HPW</b>	High Priority Watercourse
<b>INFF</b>	Irish National Flood Forum
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>IROPI</b>	Imperative Reasons of over-riding Public Interest
<b>MCA</b>	Multi-Criteria Analysis
<b>MPW</b>	Medium Priority Watercourse
<b>MRFS</b>	Mid-Range Future Scenario
<b>NCCAF</b>	National Climate Change Adaptation Framework
<b>NIAH</b>	National Inventory of Architectural Heritage
<b>OPW</b>	Office of Public Works
<b>PCD</b>	Public Consultation day
<b>PFRA</b>	Preliminary Flood Risk Assessment
<b>RBD</b>	River Basin District
<b>RBMP</b>	River Basin Management Plan
<b>RMP</b>	Record of Monuments and Places
<b>SAAR</b>	Standard Annual Average Rainfall
<b>SAC</b>	Special Area of Conservation
<b>SEA</b>	Strategic Environmental Assessment
<b>SFRA</b>	Strategic Flood Risk Assessment
<b>SI</b>	Statutory Instrument

<b>SPA</b>	Special Protection Area
<b>SUDS</b>	Sustainable Urban Drainage Systems
<b>UoM</b>	Unit of Management
<b>WFD</b>	Water Framework Directive

## REFERENCES

**Dwyer, N., and Devoy, R., 2012.** 'Sea Level' In: Dwyer, N. ed. The Status of Irelands Climate, 2012.

**EU, 2007.** Directive 2007/60/EC on the Assessment and Management of Flood Risk. Official Journal of the European Communities L288 of 6<sup>th</sup> November 2007, p.27.

**EU, 2014.** EU policy document on Natural Water Retention Measures, CIS Technical Report - 2014 - 082, 2014

**IPCC, 2014.** Summary for policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

**Jevrejeva, S., Grinsted, A., and Moore, J.C., 2014.** Upper limit for sea level projections by 2100, Environmental Research Letters, 9 104008

**OPW, 2004.** Report of the National Flood Policy Review Group ([www.floodinfo.ie](http://www.floodinfo.ie)).

**OPW, 2011.** Main Overview Report - Preliminary Flood Risk Assessment.

**OPW, 2012.** Designation of the Areas for Further Assessment

**UCD, 2015.** Weighting the Perceived Importance of Minimising Economic, Social and Environmental/ Cultural Risks in Flood Risk Management, O'Sullivan, J. and Bedri, Z., University College Dublin, 2015 ([www.floodinfo.ie](http://www.floodinfo.ie))

**Flood Studies Update (FSU) Programme.**

<http://www.opw.ie/en/floodriskmanagement/hydrometrichydrologicaldata/floodstudiesupdate/>

**Wallingford, NERC, 1975.** Flood Studies Report.

**OPW and RPS, 2012.** Irish Coastal Protection Strategy Study (ICPSS)



## APPENDICES

## **APPENDIX A**

### **FLOODING AND FLOOD RISK**

#### **A.1 INTRODUCTION**

A flood is defined in the 'Floods' Directive as a "temporary covering by water of land not normally covered by water", i.e., the temporary inundation of land that is normally dry. Flooding is a natural process that can happen at any time in a wide variety of locations.

Flood **hazard** is the potential threat posed by flooding to people, property, the environment and our cultural heritage. The degree of hazard is dependent on a variety of factors that can vary from location to location and from one flood event to another. These factors include the extent and depth of flooding, the speed of the flow over the floodplains, the rate of onset and the duration of the flood.

Flooding only presents a **risk** however when people, property, businesses, farms, infrastructure, the environment or our cultural heritage can be potentially impacted or damaged by floods. Flood risk is the combination of the probability of flood events of different magnitudes and the degree of the potential impact or damage that can be caused by a flood. The actual damage that can be caused depends on the vulnerability of society, infrastructure and our environment to damage or loss in the event of a flood, i.e., how sensitive something is to being damaged by a flood.

#### **A.2 Types and Causes of Flooding**

Flooding can occur from a range of sources, individually or in combination, as described below.

##### **A.2.1 Coastal Flooding**

Coastal flooding occurs when sea levels along the coast or in estuaries exceed neighbouring land levels, or overcome coastal defences where these exist, or when waves overtop the coastline or coastal defences. Mean sea levels around Ireland are rising (Dwyer and Devoy, 2012), and are expected to continue to rise due to climate change in the range of 0.52 to 0.98m (IPCC, 2014) by 2100, with an associated increase in flood risk from the sea over the coming decades.

Coastal flooding can also occur in the form of tsunami, and Ireland has suffered from tsunami flooding in the past<sup>1</sup>. It was determined during the Preliminary Flood Risk Assessment (PFRA, see Section 3) however that this cause of flooding is not, on the basis of our current understanding, a significant cause of flood risk in Ireland, although further investigation is required on this matter. As a result, tsunami risk is not addressed in this Plan.

##### **A.2.2 Fluvial Flooding**

Fluvial flooding occurs when rivers and streams break their banks and water flows out onto the adjacent low-lying areas (the natural floodplains). This can arise where the runoff from heavy rain exceeds the natural capacity of the river channel, and can be exacerbated where a channel is blocked or constrained or, in estuarine areas, where high tide levels impede the flow of the river out into the sea. While there is a lot of uncertainty on the

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<sup>1</sup> The tsunami that devastated Lisbon, Portugal in 1755 also hit the south coast of Ireland according to records of that time, and there are reports of tsunami-like flood events around the South coast from 1761 and 1854 (Pers comm., GSI)

impacts of climate change on rainfall patterns, there is a clear potential that fluvial flood risk could increase into the future.

### **A.2.3 Pluvial Flooding**

Pluvial flooding occurs when the amount of rainfall exceeds the capacity of urban storm water drainage systems or the infiltration capacity of the ground to absorb it. This excess water flows overland, ponding in natural or man-made hollows and low-lying areas or behind obstructions. This occurs as a rapid response to intense rainfall before the flood waters eventually enter a piped or natural drainage system. This type of flooding is driven in particular by short, intense rain storms.

### **A.2.4 Groundwater Flooding**

Groundwater flooding occurs when the level of water stored in the ground rises as a result of prolonged rainfall, to meet the ground surface and flows out over it, i.e. when the capacity of this underground reservoir is exceeded. Groundwater flooding results from the interaction of site-specific factors such as local geology, rainfall infiltration routes and tidal variations. While the water level may rise slowly, it may cause flooding for extended periods of time. Hence, such flooding may often result in significant damage to property or disruption to transport. In Ireland, groundwater flooding is most commonly related to turloughs in the karstic limestone areas prevalent in particular in the west of Ireland.

### **A.2.5 Other Causes of Flooding**

The above causes of flooding are all natural; caused by either extreme sea levels or heavy or intense rainfall. Floods can also be caused by the failure or exceedance of capacity of built or man-made infrastructure, such as bridge collapses, from blocked piped sewerage networks, or the failure or over-topping of reservoirs or other water-retaining embankments (such as raised canals). While it is recognised that some of these other sources may cause local problems, it was determined during the PFRA (see Section 3) however that these causes of flooding are not, in the context of the national flood risk and on the basis of our current understanding, causes of significant flood risk, or can not always be foreseen, and hence are not addressed in the Plan.

## **A.3 IMPACTS OF FLOODING**

### **A.3.1 Impacts on people and society**

Flooding can cause physical injury, illness and loss of life. Deep, fast flowing or rapidly rising flood waters can be particularly dangerous. For example, even shallow water flowing at 2 metres per second (m/sec) can knock children and many adults off their feet, and vehicles can be moved by flowing water of only 300mm depth. The risks increase if the floodwater is carrying debris. Some of these impacts may be immediate, the most significant being drowning or physical injury due to being swept away by floods. Floodwater contaminated by sewage or other pollutants (e.g. chemicals stored in garages or commercial properties) can also cause illnesses, either directly as a result of contact with the polluted floodwater or indirectly, as a result of sediments left behind. Those most likely to be at risk are people living in a single-storey bungalow or below ground in a basement, those outdoors on foot or in a vehicle, or people staying in a tent or caravan.

As well as the immediate dangers, the impact on people and communities as a result of the stress and trauma of being flooded or having access to their property cut-off by floodwaters, or even of being under the threat of flooding, can be immense. Long-term impacts can arise due to chronic illnesses and the stress associated with being flooded and the lengthy recovery process.

The ability of people to respond and recover from a flood can vary. Vulnerable people, such as the elderly, people with mobility difficulties or those who have a long-term illness, are potentially less able to respond to a flood emergency. Some people may have difficulty in replacing household items damaged in a flood and may lack the financial means to recover and maintain acceptable living conditions after a flood.

Floods can also cause impacts on communities as well as individuals through the temporary, but sometimes prolonged, loss of community services or infrastructure, such as schools, health services, community centres or amenity assets.

### **A.3.2 Impacts on property**

Flooding can cause severe damage to properties. Floodwater is likely to damage internal finishes, contents and electrical and other services and possibly cause structural damage. The physical effects can have severe long-term impacts, with re-occupation sometimes not being possible for over a year. The costs of flooding are increasing, partly due to increasing amounts of electrical and other equipment within developments. The degree of damage generally increases with the depth of flooding, and sea-water flooding may cause additional damage due to corrosion.

Flooding can also cause significant impacts to agriculture. A certain level of flooding is intrinsic in certain areas, and agricultural management takes this into account, however extreme or summer flooding can have detrimental impacts through loss of production, as well as damage to land and equipment.

### **A.3.3 Impacts on Infrastructure**

The damage flooding can cause to businesses and infrastructure, such as transport or utilities like electricity, gas and water supply, can have significant detrimental impacts on individuals and businesses and also local and regional economies. Flooding of primary roads or railways can deny access to large areas beyond those directly affected by the flooding for the duration of the flood event, as well as causing damage to the road or railway itself. Flooding of water distribution infrastructure such as pumping stations or of electricity sub-stations can result in loss of water or power supply over large areas. This can magnify the impact of flooding well beyond the immediate community. The long-term closure of businesses, for example, can lead to job losses and other economic impacts.

### **A.3.4 Impacts on the Environment**

Detrimental environmental effects of flooding can include soil and bank erosion, bed erosion or siltation, land slides and damage to vegetation and species that are not resilient against flooding, as well as the impacts on water quality, habitats and flora and fauna caused by pollutants carried by flood water. Flooding can however be a necessary element of natural and semi-natural habitats. Many wetland habitats are dependent on continual or periodic flooding for their sustainability and can contribute to the storage of flood waters to reduce flood risk elsewhere.

### **A.3.5 Impacts on our Cultural Heritage**

In the same way as flooding can damage properties, flood events can damage or destroy assets or sites of cultural heritage value. Particularly vulnerable are monuments, structures or assets (including building contents) made of wood or other soft materials, such as works of art and old paper-based items such as archive records, manuscripts or books. Soil erosion during flood events could also destroy buried heritage and archaeological sites.

#### **A.4 Potential Impacts of Future Change**

It is likely that climate change will have a considerable impact on flood risk in Ireland, such as through rising mean sea levels, increased wave action and the potential increases in winter rainfall and intense rainfall events. Land use change, for example through new housing and other developments, can also increase potential future flood risk.

## **APPENDIX B**

### **PHYSICAL OVERVIEW OF THE RIVER BASIN**

#### **B.1 TOPOGRAPHY, GEOLOGY, SOILS AND GROUNDWATER**

The River Maine catchment is relatively low lying with elevations ranging from <1mAOD at the tidal outfall to over 400mAOD in the headwaters of the River Shanowen upstream of Castleisland. The River Maine has a typical gradient of approximately 1 in 770 until Currans Bridge and Riverville. The major tributaries of the Little Maine River and Brown Flesk River have similar gradients and meander planforms.

The River Maine then flattens out into the embanked reaches downstream where Castlemaine and a number of smaller settlements lie below the flood embankments. Therefore, these populations are vulnerable to prolonged river and coastal flooding if water overtops the embankments as the flood waters become trapped on the floodplain. The surrounding hills including the Dingle catchment and the tributaries of the lower Maine are typically very steep as the rivers flow through the steep valley sides of the Dingle Peninsula Mountains. However, the gradient of these tributaries flattens out significantly as these tributaries enter the sea or enter the Maine floodplain.

The River Laune catchment and tributaries' elevations range from sea level at Killorglin to over 1000m at Carrantoohil, the highest peak in Ireland. However, the upper Flesk is relatively flat until Glenflesk (1 in 3600) before the gradient increases towards Killarney and Lough Leane. Lough Leane itself is surrounded by mountainous terrain which reaches over 1000mAOD.

Lough Leane outfalls into the River Laune which has a relatively constant 1 in 100 gradient to its outfall into Castlemaine Harbour downstream of Killorglin. The Laune valley is relatively narrow and surrounded by steep mountainous terrain to the North and South.

The upper catchment of the River Maine is dominated by underlying nationally important karst features which can increase infiltration and therefore reduce peak flow when the ground is not saturated. However, the karst geology can also amplify flooding when the karst is saturated from preceding rainfall by providing subterranean flow routes and or groundwater flooding in addition to the river flooding.

The River Flesk upstream of Glenflesk is underlain by Devonian Old Red Sandstones which forms the relatively flat valley floodplain surrounded by basalt which forms the steep valley sides. Downstream of Glenflesk, the underlying geology changes to karstified Dinantian limestones with the joining of the Owenskeagh River which increases the river gradient and narrows the valley. The land immediately next to Lough Leane is formed of fluvial and lacustrine deposits from the Lough and tributaries. The outfalls of Lough Leane and the River Laune floodplain are underlain by Dinantian limestone but surrounded by Dinantian shales, sandstones and limestones forming the steeper valley sides.



## **B.2 LAND USE AND LAND MANAGEMENT**

Land use comprises pastoral and agriculture, with pastoral focussed on the steep relief along the valley sides. Farmland along the lower Maine is heavily drained in these flat low lying areas to maintain agricultural production.

There are areas of coniferous plantation around Milltown and along the lower Maine in the flat floodplain. There are also a number of Natura 2000 classified boglands along the lower Maine, particularly Inchinveema bog by the Brown Flesk confluence which naturally attenuate and store flood flows. The delta area downstream of Killarney forms part of the Killarney National Park and is an important recreational and tourism attraction.

The major urban areas are located at Killarney (population 37250 including Castleisland), Killorglin (population 24750) and Dingle areas (population 15600). The remaining smaller settlements tend to be located at the edge of the floodplains or along the coast, away from the main rivers considered in this study.

The way in which the land is used can significantly impact the flow routes across the catchment, how much rainfall is stored, how much infiltrates into the ground, and how much evaporates.

The majority of the River Basin is currently rural and dedicated to agricultural or pastoral use. Changes to agriculture can lead to intensification of activities and associated increased land drainage and runoff. Increased irrigation and drainage for the commercial forests can route more water to the rivers thus reducing the time to peak.

Future urban development within the River Basin is also likely to cause more water to reach the river channels quicker and affect more people, property and environments.

## **B.3 HYDROLOGY**

### **B 3.1 Sub-Catchments & Coastlines**

The Laune-Maine-Dingle Bay River Basin can be split into sub-catchments covering the AFAs as shown in Maps 2.1 and 2.2.

#### **B 3.1.1 Castleisland Sub-Catchment**

The Study considers 32km of the River Maine from Castleisland to its tidal outfall into Castlemaine Harbour. The River Shanowen rises near Mount Eagle and flows westwards towards Castleisland where it joins with the Anglore Stream to form the River Maine at Castleisland. The River Maine then continues to flow westwards joining with the Glanshearoon Stream downstream of Castleisland and the Little Maine River at Springmount before flowing south-westwards to Currans Bridge.

Downstream of Currans Bridge, the River Maine becomes increasingly embanked above the surrounding floodplain. The major tributary of the Brown Flesk joins the River Maine near the N22 crossing at Riverville gauge. A portion of the Brown Flesk is diverted through a bypass channel to join the River Maine downstream of the old Maine Bridge. Downstream of the Tralia River, the River Maine becomes increasingly tidally-influenced and is tidally-dominated downstream of Castlemaine. The River Maine continues to meander across the tidal floodplain where it is joined by a number of embanked tributaries notably Ashullish Stream from Milltown. The River Maine outfalls into the Castlemaine natural harbour at the ferry crossing, before flowing out into Dingle Bay.

### **B 3.1.2 Milltown Sub-Catchment**

Ashullish Stream is a steep watercourse which flows north-westwards through the centre of Milltown, under the N70 to outfall via a penstock into the River Maine. The main tributary Sruhaun Ballyoughtragh Stream (henceforth referred to as Ballyoughtrough) flows in a north-westerly direction to Chapel Bridge, flowing past the GAA grounds and alongside Old Station Road before turning west into embanked sections to join Ashullish Stream.

### **B 3.1.3 Dingle Sub-Catchment**

There are two watercourses within the Dingle AFA; Dingle Stream and Milltown River. Dingle Stream flows in a south-westerly direction into central Dingle along Spa Road, under Bridge Street and along the Mall to outfall at the eastern end of the marina. Milltown River flows southwards to Ballinabooly where the Ballyeabought River joins from the east. Milltown River then becomes increasingly tidally influence as it continues southwards where a minor tributary joins under the R559 and then outfalls into Dingle Harbour at Milltown Bridge.

### **B 3.1.4 The Flesk / Laune Sub-Catchment (Glenflesk / Killarney)**

The Study also considers 73km of river in the River Laune catchment from the N22 Bridge to the tidal outfall downstream of Killorglin. The River Clydagh rises near Mullaghanish and flows over steep ground to join with the Loo River downstream of Loo Bridge to form the River Flesk. The River Flesk flows in a north-westerly direction across shallow gradients to Glenflesk and joins with the Owenyskeagh River 2km downstream of the town. Downstream of Flesk Bridge, the River Flesk has a steeper gradient until it reaches Mill Road Bridge and flows west along the southern edge of Killarney before outfalling into Lough Leane. The River Deenagh flows along the North of Killarney before turning southwards along Port Road, and then westwards through the Killarney National Park to outfall into Lough Leane. A number of other rivers flow into Lough Leane including Owenreagh River and Muckross Lake outfall. These inflows combine with River Flesk and Deenagh to form the River Laune at the outfall. The River Laune then flows in a north-westerly direction to Killorglin where it outfalls into Castlemaine Harbour at Dromgorn Point.

### **B 3.1.5 Coastal Features**

The River Maine and River Laune both outfall into the naturally formed Castlemaine Harbour. Castlemaine Harbour is a complex estuary that extends west from the Maine and Laune into Dingle Bay. A series of complex sand bars and key spit features at the estuary outfall divert the tidal currents and protect the harbour from extreme storm waves.

The key features include:

- Cromane Point
- Inch Point
- Rossbehy Point

These large expanses of sand dunes, sand bars and shallow water are essential habitats designated under Natura 2000 and protected under EU legislation. The Maine and Laune low-tide channels are between 300m to 400m wide, combining into one channel near Aughill's Bridge which is 1.7km wide at low tide.

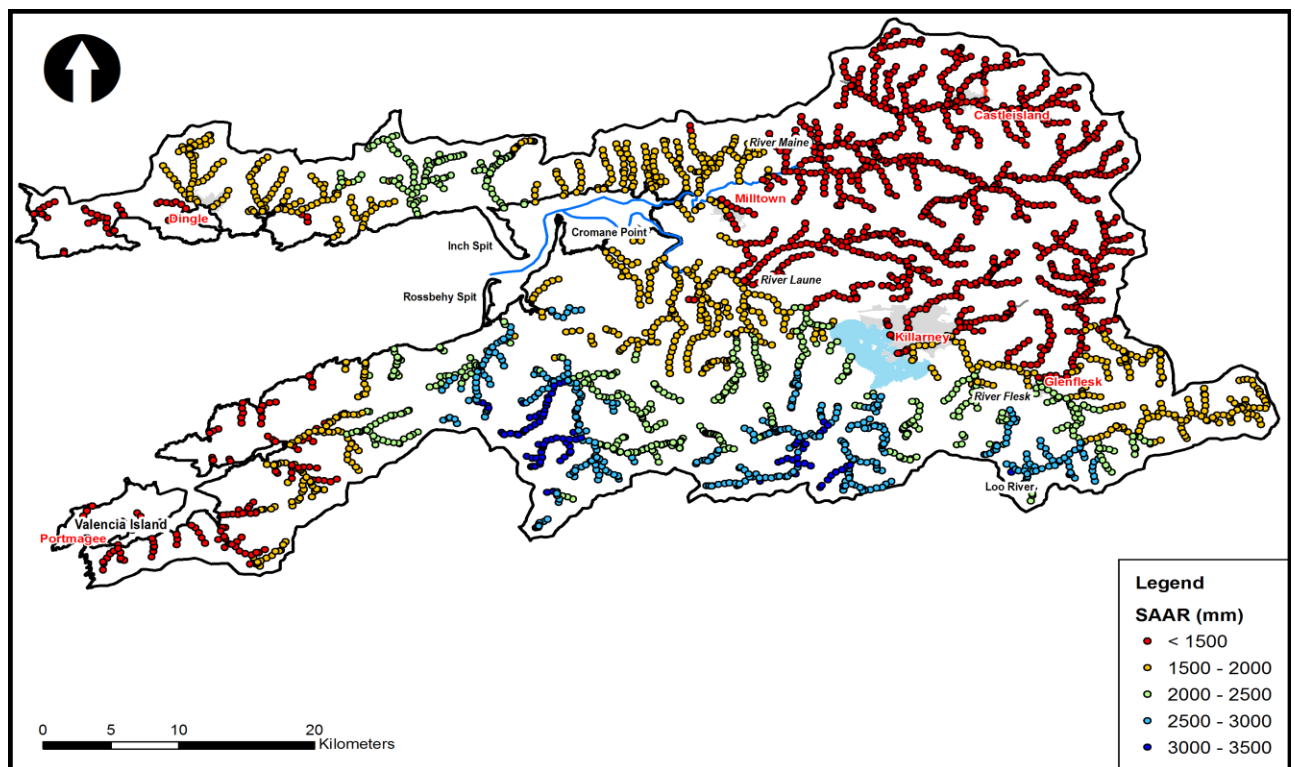
### B 3.2.1 Rainfall Distribution

The River Laune catchment has some of the highest standard average rainfall values in Ireland due to the relatively high relief of the upper catchment and location on the west coast. Rainfall tends to be greater in the west of the Maine catchment than the east. The Maine catchment as a whole tends to have less rainfall than the Laune catchment due to the lower elevations in the Maine.

Prolonged frontal Atlantic storm events dominate the rainfall events in both the River Laune and Maine catchments, tracking from west to east. This can mitigate peak flows as rain falls and drains from the lower reaches before the peak flows from the upper reaches. However, intense summer storm rainfall events can also occur, causing overland flow and flooding issues in the steep small catchments that have a fast time to peak.

The variation in Standard Average Annual Rainfall across the River Basin is shown in the map below.

**Map B.1: Standard Annual Average Rainfall**



### B 3.2.2 Hydrometric Data Availability

A range of different data sources have been used to undertake the hydrological data analysis for the Laune-Maine-Dingle Bay River Basin. The use of local hydrometric data can greatly improve and validate flood flows for historic events and design flood events. The following table highlights the sources of data that have been reviewed.

*Table 2.2 Summary of Available Data*

Type	Details	Owner	Period of Available Date
River Flows	15 minute interval data series at 12 gauges with flow converted from water level	OPW EPA	Various up to 2012
River Levels	15 minute interval data series at 15 gauges	OPW EPA	Various up to 2012
Rainfall Gauges	Daily rainfall values at 36 gauges Hourly rainfall series at Valentia Observatory	Met Eireann	Various up to 2012
Extreme sea level	Irish Coastal Protection Strategy Study Total tide +surge design levels at 11 points within Dingle Bay	OPW	Calculated for 2012
Wave conditions	Water levels, wave heights and wave periods at Dingle Harbour.	OPW	Calculated for 2013
Tidal Prediction Points	Admiralty Tide Tables Volume 1	UKHO Admiralty	Calculated for 2013

Full details of all the available and reviewed data for the River Basin is available in the River Basin Hydrology Report.

## **APPENDIX C**

# **SUMMARY OF THE PRELIMINARY FLOOD RISK ASSESSMENT**

### **C.1 INTRODUCTION**

The Preliminary Flood Risk Assessment (PFRA) is a national screening exercise, based on available and readily-derivable information, to identify areas where there may be a significant risk associated with flooding.

The PFRA in Ireland was finalised in December 2011, following public consultation.

### **C.2 OVERVIEW OF THE PFRA**

The objective of the PFRA is to identify areas where the risks associated with flooding might be significant. These areas (referred to as Areas for Further Assessment, or 'AFAs') are where more detailed assessment will then be undertaken to more accurately assess the extent and degree of flood risk, and, where the risk is significant, to develop where possible measures to manage and reduce the risk. The more detailed assessment, that focussed on the AFAs, was undertaken through the National CFRAM Programme or parallel studies.

It is important to note that the PFRA is not a detailed assessment of flood risk. It is rather a broad-scale assessment, based on available or readily-derivable information, to identify where there is a genuine cause for concern that may require national intervention and assessment, rather than locally developed and implemented solutions.

Three key approaches have been used in undertaking the PFRA to identify the AFAs. These are:

- Historic Analysis: The use of information and records on floods that have happened in the past
- Predictive Analysis: Undertaking analysis to determine which areas might flood in the future, as determined by predictive techniques such as modelling, analysis or other calculations, and of the potential damage that could be caused by such flooding
- Consultation: The use of local and expert knowledge of the local authorities and other Government departments and agencies to identify areas prone to flooding and the potential consequences that could arise

The assessment considered all types of flooding, including natural sources, such as that which can occur from rivers, the sea and estuaries, heavy rain and groundwater, and the failure of built infrastructure. It has also considered the impacts flooding can have on people, property, businesses, the environment and cultural heritage.

Other EU Member States have used similar approaches to undertaking the PFRA as that undertaken in Ireland.

The 'Floods' Directive does not provide a definition for 'significant' flood risk. A highly prescriptive definition is not suitable given the preliminary nature of the PFRA, and so a set of guiding principles were defined. It should however be remembered that, while flooding of one home will be traumatic to the owner or residents of that home, the PFRA needs to consider what is nationally or regionally significant flood risk.

The provisional identification of the AFAs has involved interpretation of information from all three of the above approaches. The final designation of the AFAs also took into account information and views provided through the public consultation and arising from on-site inspections that were undertaken in parallel with the consultation.

### **C.3 PUBLIC CONSULTATION ON THE PFRA**

The 'Floods' Directive requires Member States to publish the PFRA once completed. However, the OPW has also publicly consulted on a draft of the PFRA before it was finalised, published and reported to the European Commission.

Consultation with various bodies has been undertaken during the preparation of the draft PFRA, which has included two rounds of workshops (Summer 2010 and Winter 2010-2011) involving all local authorities. During these workshops, the local authorities provided information on areas known or suspected to be at risk from flooding, and reviewed provisional Areas for Further Assessment (AFAs) identified by the OPW in relation to fluvial and coastal flood risk.

Consultation was also held with the following organisations to inform the process and draft outcomes of the PFRA:

- Dept. Agriculture, Food and the Marine
- Dept. of Culture, Heritage and the Gaeltacht
  - *National Monuments*
  - *National Parks and Wildlife Service*
- Environmental Protection Agency
- ESB
- Geological Survey of Ireland
- Health Service Executive
- Transport Infrastructure Ireland (formerly National Roads Authority)
- Waterways Ireland

Discussions were also held with utility operators in relation to the location and potential vulnerability of utility infrastructure.

The OPW published the Draft PFRA for consultation on the National CFRAM Programme website (now closed) in August 2011, and placed it on public exhibition in the principal offices of all city and county councils on the same date. While not a requirement of the Directive, SI No. 122 of 2010 set out a requirement for public consultation on the PFRA. The public consultation period began upon publication of the PFRA and extended to 1<sup>st</sup> November 2011. Submissions were invited in writing, by email, or via the website.

A total of 52 submissions were received under the public consultation process. A breakdown of the source of submissions is set out below:

County and City Councils	18
Councillors	4
Members of the Public	15
Community Groups / Associations	5
Other	10



The principal issues raised in the submissions include the following:

- Recommendations for the inclusion of locations for designation as AFAs, and / or expressions of concern related to past flooding, or the potential for flooding, of a particular location
- Comments that certain bodies, and / or their past or ongoing actions, were responsible for causing or aggravating flooding or flood problems
- Requests for inclusion in the consultation / engagement process for the CFRAM Studies
- Comments relating to past planning decisions and / or recommendations for changes to planning law
- Queries on the accuracy of, or suggested correction to, the PFRA maps
- Recommendations as to how flood risk in a location / region could be managed, or concerns as to how future flood risk management could have detrimental impacts

Only a very small number of submissions (7) included comments (positive or negative) on the PFRA process and / or the PFRA consultation process. These were carefully considered by the OPW and it was concluded that there was no basis to amend the PFRA process given nature of the exercise.

All submissions were also considered, in parallel with the findings of the Flood Risk Review (see below), in the final designation of the AFAs.

## **C.4 FLOOD RISK REVIEWS**

To assist in the final designation of AFAs, it was deemed appropriate that the probable and possible AFAs be inspected on-site, informed by the PFRA data and findings, by suitably qualified professionals.

The on-site inspections, referred to as Flood Risk Reviews (FRRs), were undertaken by the Consultants. The inspections included a prior review of available relevant information (such as the PFRA data and findings), interviews with local residents and / or local authority staff (where possible), and an on-site inspection of the AFA to confirm, through duly informed professional opinion, the likely flood extents and potential receptors.

Following the FRR, the consultants submitted to the OPW FRR reports that set out the FRR process, described their findings and made recommendations as to whether or not a location should be designated as an AFA. The final FRR reports are available from the OPW website ([www.floodinfo.ie](http://www.floodinfo.ie)).

The CFRAM Steering and Progress Groups (comprising representatives of the local authorities, regional authorities and the EPA as well as of the OPW <sup>1</sup>) considered the FRR reports and their recommendations, and expressed their opinions on the designation of AFAs to the OPW. The OPW has taken these opinions into consideration in the final designation of AFAs.

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<sup>1</sup> Representatives of the Rivers Agency of Northern Ireland are also members of the Steering and Progress Groups for CFRAM Studies that cover cross-border catchments.

## **C.5 OUTCOMES OF THE PFRA**

The communities designated as AFAs are set out in Section 3 herein.

Full information on the PFRA, including the outcomes nationally, are set out in the Main Report of the PFRA and the Report on the Designation of the Areas for Further Assessment, which are both available from the OPW website ([www.floodinfo.ie](http://www.floodinfo.ie)).



## **APPENDIX D**

### **STAKEHOLDER AND PUBLIC ENGAGEMENT AND CONSULTATION**

#### **APPENDIX D.1**

##### **Membership of the National CFRAM Steering Group**

- Office of Public Works
- County and City Managers Association
- Dept. Housing, Planning and Local Government
- Dept. Agriculture, Food and the Marine
- Dept. of Culture, Heritage and the Gaeltacht
- Environmental Protection Agency
- Electricity Supply Board
- Geological Survey of Ireland (Dept. of Communications, Climate Action and Environment)
- Irish Water
- Met Éireann
- Office of Emergency Planning
- Rivers Agency (Northern Ireland)
- Waterways Ireland

#### **APPENDIX D.2**

##### **Membership of the South Western CFRAM Steering Group**

- Office of Public Works
- Mott MacDonald Ireland
- Environmental Protection Agency
- Cork City Council
- WFD Co-ordinator
- Cork County Council
- Kerry County Council
- Limerick City and County Council
- Tipperary County Council
- Waterford City & County Council
- Southern Regional Assembly

## APPENDIX D.3

### Organisations Invited to Meetings of the National Stakeholder Group

**Table D.3.1 Organisations Invited to Meetings of the National Stakeholder Group**

An Bord Pleanála	Iarnród Éireann	Irish Small and Medium Enterprises Association
An Taisce	Industrial Development Agency	Irish Water
Association of Consulting Engineers of Ireland (ACEI)	Inland Fisheries Ireland	Irish Water and Fish Preservation Society
Badgerwatch	Inland Waterways Association of Ireland	Irish Wildlife Trust
Bat Conservation Ireland	Institute of Professional Auctioneers and Valuers	IRLOGI
BirdWatch Ireland	Insurance Ireland	Landscape Alliance Ireland
Bord Gáis Networks	Irish Academy of Engineering	Macra na Feirme
Bord na Mona	Irish Angling Development Alliance	Marine Institute
Canoeing Ireland	Irish Business and Employers Confederation (IBEC)	National Anglers Representative Association
Chambers Ireland	Irish Co-Operative Organisation Society	Transport Infrastructure Ireland (formerly National Roads Authority)
CIWEM Ireland	Irish Countrywomen's Association	Native Woodland Trust
Coarse Angling Federation of Ireland	Irish Creamery Milk Suppliers Association (ICMSA)	Recreational Angling Ireland
Coastal and Marine Resources Centre	Irish Farmers Association (IFA)	Rivers Agency (NI)
Coastwatch Ireland	Irish Federation of Pike Angling Clubs	Rowing Ireland
Coillte	Irish Federation of Sea Anglers	Royal Town and Planning Institute (RTPI)
Construction Industry Federation (CIF)	Irish Marine Federation / Irish Boat Rental Association	Society of Chartered Surveyors of Ireland (SCSI)
Council of Cultural Institutes	Irish National Committee of Blue Shield	St. Vincent de Paul
Dublin City Council / Dublin Flood Forum	Irish National Flood Forum	Sustainable Water Network (SWAN)
Eircom	Irish Natural Forestry Foundation	Teagasc
EirGrid	Irish Peatland Conservation Council	The Heritage Council
Engineers Ireland	Irish Planning Institute (IPI)	Trout Anglers Federation of Ireland
Health Services Executive (HSE)	Irish Red Cross	

## APPENDIX D.4

### Organisations Represented at Meetings of the South Western CFRAM Stakeholder Group

*Table D.4 Organisations Represented at Meetings of the South Western CFRAM Stakeholder Group*

Office of Public Works	Teagasc
Mott MacDonald Ireland	Inland Fisheries Ireland
Cork City Council	Southern Assembly
Cork County Council	Irish Farmers Association
Environmental Protection Agency	
Kerry County Council	
Limerick County Council	
Tipperary County Council	
Waterford City and County Council	

## APPENDIX D.5

### Public Consultation Days Held at the Flood Mapping Stage in the Laune-Maine-Dingle Bay River Basin

*Table D.5 Flood Mapping PCDs Held in the Laune-Maine-Dingle Bay River Basin*

AFA	Date	Venue	No. Attendees
Castleisland	29/10/2014	KCC Area Office, Castleisland	14
Dingle	06/11/2014	Dingle Library	14
Glenflesk	21/10/2014	Glenflesk GAA Club	36
Killarney	23/10/2014	KCC Area Office, Killarney	11
Milltown	16/10/2014	Milltown Community Centre	16
Portmagee	30/10/2014	Portmagee Community Centre	7



## APPENDIX D.6

### Public Consultation Days Held at the Flood Risk Management Optioneering Stage in the Laune-Maine-Dingle Bay River Basin

*Table D.6 Flood Risk Management Optioneering PCDs Held in the Laune-Maine-Dingle Bay River Basin*

AFA	Date	Venue	No. Attendees
Castleisland	09/12/2015	KCC Area Office, Castleisland	22
Dingle	09/12/2015	Dingle Library	12
Glenflesk	08/12/2015	Glenflesk GAA Club	32
Killarney	08/12/2015	Avenue Hotel, Killarney	20
Milltown	10/12/2015	Milltown Community Centre	12

## APPENDIX D.7

### Public Consultation Days Held at the Draft Flood Risk Management Plan Stage in the Laune-Maine-Dingle Bay River Basin

*Table D.7 Draft Flood Risk Management Plan PCDs Held in the Laune-Maine-Dingle Bay River Basin*

Date	Venue	No. Attendees
2/9/2016	Kerry County Council Offices, Castleisland	30
5/9/2016	The Plaza Hotel, Killarney	25

## **APPENDIX E**

### **DESCRIPTION OF FLOOD RISK IN EACH AFA**

The numbers of properties at risk are determined independently for each source (fluvial and coastal). For AFA's where both sources of flooding occur, some properties may be at risk from both sources, and such properties have been included in the numbers for both sources.

The numbers of properties at risk and the damage values set out herein are as understood under current conditions and at this stage of assessment. The numbers and values may change when the risk is assessed in more detail at the project-level of development of measures and/or due to the potential impacts climate change, future development and inflation.

The greatest risk to residential properties is in Castleisland. The greatest risk to non-residential properties is in Dingle.

## **Castleisland AFA**

Within the Castleisland AFA, 76 residential and 20 non-residential / business properties are affected for the 1.0% AEP fluvial event. The flooding also impacts on 7 transport assets and 1 social infrastructure asset. The greatest risk to life is associated with deep and fast flowing water flooding on the left bank downstream of Church Street, and along the R577 from the Maine and across Glebe House Road from Anglore Stream. However, the risk to life at Tullig is Low to Moderate because the flooding is shallow.

The areas flooded are consistent with the recorded flooded areas in 2008 and the more recent event in January 2014. The subterranean flow path between Glanshearoon and Anglore was highlighted by local authority staff during the flood risk review and confirmed by site visits during this study. The exact route, capacity of the cave system, and travel time of these subterranean flows, are not easily quantified. However, the model was calibrated well with the flood extent in the 2008 event. Therefore, there is reasonable confidence in the flood mapping in Castleisland based on the information available at the time of this study.

The key flow routes and flooding mechanisms are:

- Overtopping of the Glanshearoon right bank at Crag Cottages into a swallow hole and connected to increased flows and flooding along Anglore Stream.
- Overtopping of the left bank of Anglore Stream at Glebe House Road Bridge and flowing across the road to flood properties.
- Backwater from the downstream culvert on Anglore Stream flooding properties in Tullig – This corresponds with regular flooding along Cordal Road. However, the flooding is shallow and the extent may be reduced by local urban drainage not considered in this model.
- Backwater from Herbert's and Barrack Lane Bridge cause overtopping of the Maine downstream of Church Street bridge to flood properties on the left bank.
- Backwater from Church Street Bridge causes overtopping of the Maine upstream of the bridge to flood properties on the right bank.
- In the most extreme events, flood waters flow across the road at Castleisland Community College and into the neighbouring catchment towards Killfinnaun Bridge.

The key thresholds and areas affected by flooding in Castleisland are:

- 50% AEP fluvial event overtops the river bank at Crag Cottages and enters the Crag Cave.
- 50% AEP fluvial event exceeds the downstream culvert on Anglore road to flood Tullig.
- 2% AEP fluvial event overtops the left bank downstream of Church Street but no properties are affected.
- 1% AEP fluvial event overtops the left bank downstream of Church Street and causes limited flooding to less than ten properties.
- 0.1% AEP fluvial event overtops the right bank upstream of Church Street and causes extensive property flooding (> 200 properties).
- 0.1% AEP fluvial event floods across the Community College and into the Killfannaun catchment.

The critical structures in determining fluvial flood risk include:

- Herbert's, Barrack Lane and Church Street Bridges on the River Maine including the utility crossing below the soffit on Hebert's and Barrack Lane Bridge.
- The raised river bank at Crag Cottages which determines the threshold at which the Glanshearoon floods into the swallow hole, thereby increasing flows through the cave system to Anglore Stream.
- Glebe House Road Bridge and the downstream culvert on Anglore Stream.

### E1. Castleisland Flood Risk Table

Type of Risk	Flood Risk for Design AEP (%) Event		
	10% AEP	1% / 0.5% AEP	0.1% AEP
<b>Current Scenario (Present Day)</b>			
Event Damage (€)	1,283,651.17	4,210,876.76	17,215,081.29
No. Residential Properties at Risk	28	76	199
No. Business Properties at Risk	5	20	57
No. Utilities at Risk	0	0	1
No. Major Transport Assets at Risk	2	7	8
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	1	3
No. Environmental Assets at Risk	0	0	0
No. Potential Pollution Sources at Risk	0	0	0
<b>Mid-Range Future Scenario</b>			
Event Damage (€)	4,046,057.59	10,876,052.84	26,134,343.65
No. Residential Properties at Risk	37	132	237
No. Business Properties at Risk	7	33	86
No. Utilities at Risk	0	0	1
No. Major Transport Assets at Risk	2	8	8
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	1	3
No. Environmental Assets at Risk	0	0	0
No. Potential Pollution Sources at Risk	0	0	0
<b>High-End Future Scenario</b>			
Event Damage (€)	5,459,330.56	16,125,933.67	28,958,596.13
No. Residential Properties at Risk	60	170	253
No. Business Properties at Risk	14	42	91
No. Utilities at Risk	0	0	1
No. Major Transport Assets at Risk	6	8	9
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	1	2	3
No. Environmental Assets at Risk	0	0	0
No. Potential Pollution Sources at Risk	0	0	0

## **Dingle AFA**

Dingle is at risk from both fluvial and tidal flooding. Within the Dingle AFA, 35 residential and 54 non-residential / business properties are affected for the 1% AEP fluvial event. For the 0.5% AEP tidal event, 12 residential and 30 non-residential / business properties are affected. Both sources of flooding also impact on transport and social assets. The greatest risk to life is associated with deep water at Bridge Street and fast flowing water down Spa Road and The Mall, which is classed as Significant in the 10% AEP event and greater magnitude events.

The areas flooded are consistent with those photographed in the January 1988 event and the recurring flood reports on floodmaps.ie. Therefore, there is reasonable confidence in the flood mapping.

The key flow routes and fluvial flood mechanisms are:

- Overtopping of the right bank along Spa Road due to flows exceeding the capacity of bridges and culverts although flooding is very shallow (< 0.1m) for smaller events.
- Overtopping of both banks at the low spots of Lana na h'Abhann and Hudson's Bridge causing flooding of The Mall and Bridge Street
- Backing up from Milltown Bridge to overtop the bridge on the right bank and the R459 on the left bank near the junction.

The key fluvial thresholds and areas affected by flooding are:

- 10% AEP Fluvial Current Scenario exceeds the capacity of Dingle Stream to cause very shallow flooding (< 0.1m) along Spa Road and the Mall.
- 2% AEP Fluvial Current Scenario on Milltown Stream overtops Milltown Bridge on the right bank and the R459 on the left bank but does not affect properties.
- 1% - 0.5% AEP Fluvial Current Scenario floods the Library site on Milltown Stream.

The key flow routes and coastal flood mechanisms are:

- Dingle Stream is tidally influenced downstream of the weir near Hudson's Bridge.
- Milltown Stream is tidally influenced downstream of the Ballymoretreagh confluence.
- Overtopping of the road at The Woods but does not affect properties.
- Overtopping of the left bank downstream of the roundabout on Dingle Stream, but does not affect properties.
- Overtopping of Milltown Bridge and the quayside at Strand Street in more extreme events.

The key coastal thresholds and areas affected by flooding are:

- 20% AEP Coastal Current Scenario overtops the road at The Woods, but does not affect properties.
- 10% AEP Coastal Current Scenario overtops the left bank of Dingle Stream downstream of the roundabout but does not affect properties.

- 2% AEP Coastal Current Scenario overtops around Milltown Bridge and the quayside at Strand Street, but does not affect properties.
- 1% AEP Coastal Current Scenario affects properties on Strand Street from overtopping of the quay and flooding upstream of Bridge Street.
- Approximately 40 properties are affected by the 0.5%AEP Coastal Current Scenario.

The critical structures in determining fluvial flood risk include:

- On Dingle Stream:
  - Access Bridge and river bend downstream of Sruthean Beag estate
  - Brewery Access Bridges
  - Spa Road culvert
  - Lana na hAbhann
  - Hudson's Bridge
  - Bridge Street culvert
- On Milltown Stream:
  - Milltown Bridge



## E.2 Dingle Flood Risk Table

Type of Risk		Flood Risk for Design AEP (%) Event		
		10% AEP	1% / 0.5% AEP	0.1% AEP
<b>Current Scenario (Present Day)</b>				
Event Damage (€)	Fluvial	1,528,159.42	3,021,372.14	8,290,587.65
	Tidal	178,530.51	1,429,970.77	3,224,628.61
No. Residential Properties at Risk	Fluvial	25	35	68
	Tidal	4	12	21
No. Business Properties at Risk	Fluvial	41	54	83
	Tidal	4	30	40
No. Utilities at Risk	Fluvial	0	0	0
	Tidal	0	0	0
No. Major Transport Assets at Risk	Fluvial	7	9	10
	Tidal	0	3	3
No. Highly Vulnerable Properties at Risk	Fluvial	0	0	0
	Tidal	0	0	0
No. of Social Infrastructure Assets at Risk	Fluvial	1	3	4
	Tidal	0	1	1
No. Environmental Assets at Risk	Fluvial	0	0	0
	Tidal	0	0	0
No. Potential Pollution Sources at Risk	Fluvial	0	0	0
	Tidal	0	0	0
<b>Mid-Range Future Scenario</b>				
Event Damage (€)	Fluvial	3,843,944.88	8,188,704.50	13,345,959.50
	Tidal	5,382,346.51	10,336,429.95	11,492,440.09
No. Residential Properties at Risk	Fluvial	34	62	87
	Tidal	23	46	50
No. Business Properties at Risk	Fluvial	55	81	92
	Tidal	43	61	63
No. Utilities at Risk	Fluvial	0	0	0
	Tidal	0	0	0
No. Major Transport Assets at Risk	Fluvial	8	10	10
	Tidal	4	5	6

No. Highly Vulnerable Properties at Risk			
Fluvial	0	0	0
Tidal	0	0	0
No. of Social Infrastructure Assets at Risk			
Fluvial	3	3	4
Tidal	1	3	3
No. Environmental Assets at Risk			
Fluvial	0	0	0
Tidal	0	0	0
No. Potential Pollution Sources at Risk			
Fluvial	0	0	0
Tidal	0	0	0
<b>High-End Future Scenario</b>			
Event Damage (€)			
Fluvial	3,812,725.19	11,701,877.15	14,950,364.69
Tidal	11,969,307.21	20,000,122.40	23,710,272.05
No. Residential Properties at Risk			
Fluvial	36	75	96
Tidal	50	71	77
No. Business Properties at Risk			
Fluvial	6	9	10
Tidal	64	78	83
No. Utilities at Risk			
Fluvial	0	0	0
Tidal	0	0	0
No. Major Transport Assets at Risk			
Fluvial	6	9	10
Tidal	6	6	6
No. Highly Vulnerable Properties at Risk			
Fluvial	0	0	0
Tidal	0	0	0
No. of Social Infrastructure Assets at Risk			
Fluvial	3	4	4
Tidal	3	3	3
No. Environmental Assets at Risk			
Fluvial	0	0	0
Tidal	0	0	0
No. Potential Pollution Sources at Risk			
Fluvial	0	0	0
Tidal	0	0	0

## **Glenflesk AFA**

Within the Glenflesk AFA, 7 residential and 8 non-residential / business properties are affected for the 1.0% AEP fluvial event. The flooding also impacts on 2 transport assets along with 1 social and 2 environmental assets. The greatest risk to life is associated with deep water flooding between the Flesk and Owneyskeagh Rivers

The areas flooded are consistent with the recurring flooding along the N22, which is reported almost every year. The sensitivity test demonstrated that changes in flow estimates and roughness, within uncertainty bounds, increased water levels but did not significantly increase flood extent and hazard, as the narrow valley is largely flooded in the 50% AEP event. Therefore, there is reasonable confidence in the flood mapping.

The key flow routes and flooding mechanisms are:

- Flooding of the N22 raised road embankment between Garries Bridge and Annagh Beg Bridge due to the limited floodplain capacity between the N22 and Islandmore road parallel to the channel.
- Overtopping of the N22 raised road embankment at Loo Bridge due to backing up from the bridge and flood relief structures.
- Backing up from the rapids and the confluence to overtop the right bank of the Flesk at Glenflesk and left bank of the Owneyskeagh, largely flooding fields but limited property flooding upstream of Curreal Bridge.

The key thresholds and areas affected by flooding are:

- 50% AEP inundates the floodplain and encroaches onto the N22. Surface water runoff onto the road is not considered in the CFRAMS model.
- 10% AEP event overtops the N22 downstream of Garries Bridge and 5% AEP floods the N22 from Glenflesk to Garries Bridge.
- 0.1% AEP causes significant flooding along all modelled watercourses. There is extensive inundation in Glenflesk and Islandmore. The N22 and property along its path are completely flooded upstream of the confluence of the River Flesk and Annagh Beg Stream.
- Limited property flooding along the right bank in the 2% AEP and larger fluvial events.

The critical structures in determining fluvial flood risk include:

- The rapids which determine water levels in Glenflesk AFA.
- The raised road embankments of the N22 and Islandmore Road.
- Loo Bridge and the flood relief culvert limiting the flow passing under the N22.

### E3. Glenflesk Flood Risk Table

Type of Risk	Flood Risk for Design AEP (%) Event		
	10% AEP	1% / 0.5% AEP	0.1% AEP
<b>Current Scenario (Present Day)</b>			
Event Damage (€)	0.00	520,048.30	3,201,617.62
No. Residential Properties at Risk	0	7	30
No. Business Properties at Risk	0	8	18
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	2	2	2
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	1	1
No. Environmental Assets at Risk	2	2	2
No. Potential Pollution Sources at Risk	0	0	0
<b>Mid-Range Future Scenario</b>			
Event Damage (€)	238,242.62	1,639,197.70	4,523,461.11
No. Residential Properties at Risk	3	19	36
No. Business Properties at Risk	5	16	23
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	2	2	3
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	1	1
No. Environmental Assets at Risk	2	2	2
No. Potential Pollution Sources at Risk	0	0	0
<b>High-End Future Scenario</b>			
Event Damage (€)	335,756.48	2,181,556.43	5,125,255.19
No. Residential Properties at Risk	5	26	37
No. Business Properties at Risk	5	17	24
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	2	2	3
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	1	1
No. Environmental Assets at Risk	2	2	2
No. Potential Pollution Sources at Risk	0	0	0

## **Killarney AFA**

Within the Killarney AFA, 10 residential and 4 non-residential / business properties are affected for the 1.0% AEP fluvial event. The flooding also impacts on utilities, transport, social and environmental assets. The greatest risk to life is associated with deep and fast flowing water on the right bank between White Bridge (Flesk) and Flesk Bridge, but this does not affect properties or roads in the 1% AEP event. In the 0.1% AEP event, risk to life is classed as significant to flooded properties along Muckcross Road and Ballycasheen Road due to the velocity of water.

The areas flooded are consistent with the lakeside property flooding reported in 2009 and limited property flooding upstream of Flesk Bridge and Deenagh Lodge. Therefore, there is reasonable confidence in the flood mapping.

The key flow routes and flooding mechanisms are:

- Backing up from Lough Leane inundating the alluvial forests in the National Park.
- Backing up from White Bridge (Flesk) to bypass on the left and right banks, flooding Ballycasheen and Mill Road.
- Backing up from Flesk Bridge to flood the right bank at Muckcross Grove before flowing along Muckcross Road and towards the Deenagh in extreme events only.
- Backing up from the roundabout and Deenagh Lodge Bridge to overtop the right bank and the N22 in extreme events.

The key thresholds and areas affected by flooding are:

- 50% AEP fluvial event floods the National Park downstream of the town on both the Deenagh and Flesk.
- 1% AEP fluvial event bypasses White Bridge (Flesk) to flood Ballycasheen and Mill Road. Properties affected in the 0.1%AEP event only.
- 0.1% AEP fluvial event overtops the right bank upstream of Flesk Bridge.
- 2% AEP fluvial event overtops left bank upstream of the roundabout and Deenagh Lodge Bridge.

The critical structures in determining fluvial flood risk include:

- The culvert under the Ballydowney roundabout and old bridge crossing immediately downstream on the Deenagh.
- Deenagh Lodge Bridge for flooding to Port Road.
- White Bridge on the Flesk for properties along Mill Road and Ballycasheen Road in extreme events.
- Flesk Bridge and the weir downstream but only in the most extreme events.

#### E4. Killarney Flood Risk Table

Type of Risk	Flood Risk for Design AEP (%) Event		
	10% AEP	1% / 0.5% AEP	0.1% AEP
<b>Current Scenario (Present Day)</b>			
Event Damage (€)	318,116.75	979,522.81	18,457,442.02
No. Residential Properties at Risk	0	10	236
No. Business Properties at Risk	3	4	30
No. Utilities at Risk	0	1	1
No. Major Transport Assets at Risk	1	2	10
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	1	1	1
No. Environmental Assets at Risk	2	2	2
No. Potential Pollution Sources at Risk	0	0	0
<b>Mid-Range Future Scenario</b>			
Event Damage (€)	486,511.76	6,917,081.81	41,647,356.99
No. Residential Properties at Risk	2	99	389
No. Business Properties at Risk	4	43	106
No. Utilities at Risk	1	1	1
No. Major Transport Assets at Risk	3	7	15
No. Highly Vulnerable Properties at Risk	0	1	3
No. of Social Infrastructure Assets at Risk	1	3	9
No. Environmental Assets at Risk	2	2	2
No. Potential Pollution Sources at Risk	0	0	0
<b>High-End Future Scenario</b>			
Event Damage (€)	598,373.47	15,666,219.42	55,441,502.30
No. Residential Properties at Risk	2	229	444
No. Business Properties at Risk	4	75	125
No. Utilities at Risk	1	1	1
No. Major Transport Assets at Risk	11	15	17
No. Highly Vulnerable Properties at Risk	0	2	3
No. of Social Infrastructure Assets at Risk	1	7	9
No. Environmental Assets at Risk	2	2	2
No. Potential Pollution Sources at Risk	0	0	0

## Milltown AFA

Within the Milltown AFA, 6 residential and 9 non-residential / business properties are affected for the 1.0% AEP fluvial event. The flooding also impacts on 3 transport and 1 social asset. The greatest risk to life is associated with deep water on the left bank of Ballyoughtrough Stream upstream of the confluence with Ashullish Stream. However, no properties are affected by flooding in this area. Flooding along Old Station Road is classified as Low to Moderate risk to life because the flooding is shallow up to the 1% AEP. However, risk to life along Old Station Road increases to Significant in the 0.1% AEP fluvial event.

The areas flooded are consistent with the recorded flooded areas in January 2008 and the comments by local authority staff and local residents during the flood risk review. The sensitivity test demonstrated the uncertainty in flow estimates, roughness and culvert coefficients did not significantly increase levels in the upper reaches. Therefore, there is reasonable confidence in the flood mapping in the upstream reaches. However, the uncertainty in flow estimates did significantly affect flood risk near the outfall. Therefore, the flood mapping in this area should be carefully considered with the limitations of the ungauged hydrology methodology.

It should be noted that the drainage system and tributaries towards Cloonmore and Kilburn has not been modelled as part of the CFRAM study as these are not MPW or HPWs.

The key flow routes and flooding mechanisms predicted by the model are as follows:

- Overtopping of Ballyoughtrough along Old Station Road due to the capacity of the culverts and flooding towards Rathpoge East. Less than 10 houses are affected by flooding.
- Overtopping of Ballyoughtrough along Old Station Road due to the capacity of the twin culvert and flooding towards Ashullish Stream.
- Backing up from the N70 bridge and bypassing of the footbridge upstream in Milltown.
- Overtopping of the right bank and bypassing of the N70 bridge on Bridge Street in predicted climate change conditions.
- Backing up of water in the raised embankment reach during periods of high tide in the Maine, combined with high fluvial flows overtopping the raised embankments at the confluence of Ballyoughtrough and Ashullish Streams.
- The raised embankments at the outfall protect 0.425km<sup>2</sup> from flooding up to and including the 2% AEP fluvial event.

The key thresholds and areas affected by flooding are:

- 50% AEP event exceeds the capacity of the Ballyoughtragh Stream downstream of the N70 causing water to spill over the right bank in two locations.
- 50% AEP overtops at the confluence of the Ballyoughtragh an Ashusliish Streams at low points in the embankments to flood fields.
- 10% AEP causes shallow flooding by the N70 at Hurley's Bridge.
- 2% AEP event causes additional sections of the Ballyoughtragh Stream downstream of the N70 to spill, impacting additional properties.
- 1% AEP event floods the N70 at Town Bridge on the Ashullish Stream
- 0.5% AEP event bypasses town bridge



The critical structures in determining fluvial flood risk include:

- The culverts on Ballyoughtrough stream along Old Station road.
- The raised embankments and flapped outfall at the outfall to the Maine for flood risk to the surrounding low-lying ground.
- The N70 road bridge for flood risk near Bridge Street in Milltown.

### E5. Milltown Flood Risk Table

Type of Risk	Flood Risk for Design AEP (%) Event		
	10% AEP	1% / 0.5% AEP	0.1% AEP
<b>Current Scenario (Present Day)</b>			
Event Damage (€)	28,443.37	229,793.76	698,560.12
No. Residential Properties at Risk	2	6	9
No. Business Properties at Risk	1	9	9
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	2	3	3
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	1	1
No. Environmental Assets at Risk	0	0	0
No. Potential Pollution Sources at Risk	0	0	0
<b>Mid-Range Future Scenario</b>			
Event Damage (€)	172,889.96	668,222.59	1,112,600.25
No. Residential Properties at Risk	5	9	10
No. Business Properties at Risk	9	9	11
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	3	4	4
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	1	1	2
No. Environmental Assets at Risk	0	0	0
No. Potential Pollution Sources at Risk	0	0	0
<b>High-End Future Scenario</b>			
Event Damage (€)	322,200.65	925,310.68	1,236,872.40
No. Residential Properties at Risk	6	9	11
No. Business Properties at Risk	9	10	12
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	3	6	6
No. Highly Vulnerable Properties at Risk	0	0	1
No. of Social Infrastructure Assets at Risk	1	2	2
No. Environmental Assets at Risk	0	0	0
No. Potential Pollution Sources at Risk	0	0	0

## **Portmagee AFA**

Within the Portmagee AFA 1 residential property and 1 environmental asset are affected for the 0.5% AEP tidal event. There is very low coastal flood risk to receptors within the AFA under current conditions. This risk could increase marginally to affect less than 5 quayside properties under the HEFS scenario.

It should be noted that the R565 levels are based on IFSAR data rather than LIDAR, so the road level is only accurate to +/- 0.7m. However, levels in the AFA are based on LIDAR data and are deemed to be accurate to +/- 0.2m. There are no reports of tidal flooding at this AFA. Therefore, there is reasonable confidence in the flood mapping within the AFA.

The key flow routes and flooding mechanisms are:

- Overtopping of the quayside at the Car Park and behind the Restaurant, but no property flooding under current conditions.
- Minor overtopping at The Old School spillway but no property flooding under current conditions.
- Overtopping of the R565 to the east but this does not affect flood risk in the AFA.

The key thresholds and areas affected by flooding are:

- 10% AEP overtops the R565 to the east of the AFA.
- 10% AEP overtops The Old School slipway but no property flooding under current conditions.
- 0.5% AEP overtops the quayside but no property flooding under current conditions.
- Risk to life is classified as low within the AFA for the 0.5% AEP coastal event, increasing to moderate in the 0.1% AEP coastal event under current and future climate conditions.

The critical structures in determining tidal flood risk include:

- The quayside wall / car park level.

## E6. Portmagee Flood Risk Table

Type of Risk	Flood Risk for Design AEP (%) Event		
	10% AEP	1% / 0.5% AEP	0.1% AEP
<b>Current Scenario (Present Day)</b>			
Event Damage (€)	34,967.10	76,454.53	82,156.90
No. Residential Properties at Risk	1	1	1
No. Business Properties at Risk	0	0	0
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	0	0
No. Environmental Assets at Risk	1	1	1
No. Potential Pollution Sources at Risk	0	0	0
<b>Mid-Range Future Scenario</b>			
Event Damage (€)	161,857.88	547,305.88	1,097,421.10
No. Residential Properties at Risk	2	4	8
No. Business Properties at Risk	1	3	6
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	0	1	2
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	1	2	3
No. Environmental Assets at Risk	1	1	1
No. Potential Pollution Sources at Risk	0	0	0
<b>High-End Future Scenario</b>			
Event Damage (€)	1,380,137.93	1,582,084.06	2,689,525.19
No. Residential Properties at Risk	11	15	20
No. Business Properties at Risk	7	7	8
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	2	3	3
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	1	2	3
No. Environmental Assets at Risk	1	1	1
No. Potential Pollution Sources at Risk	0	0	0

## **APPENDIX F**

### **METHODS OF FLOOD RISK MANAGEMENT**

There are a wide range of different approaches, or methods, that can be taken to reduce or manage flood risk. These can range from non-structural methods, that do not involve any physical works to prevent flooding but rather comprise actions typically aimed at reducing the impacts of flooding, to structural works that reduce flood flows or levels in the area at risk or that protect the area against flooding.

The range of methods for managing flood risk that are considered include those outlined below.

#### **F.1 FLOOD RISK PREVENTION METHODS**

Flood risk prevention measures are aimed at avoiding or eliminating a flood risk. This can be done by not creating new assets that could be vulnerable to flood damage in areas prone to flooding, or removing such assets that already exist. Alternatively, prevention can be achieved by completely removing the potential for flooding in a given area, although in practice this is rarely possible (the frequency or magnitude of flooding can be reduced by flood protection measures, but it is generally not possible to remove the risk of flooding entirely).

Flood prevention is hence generally focussed on sustainable planning and / or the re-location of existing assets, such as properties or infrastructure.

##### **F.1.1 Sustainable Planning and Development Management**

In November 2009, the Guidelines on the Planning System and Flood Risk Management, jointly developed by DHPLG and the OPW, were published under Section 28 of the Planning Acts. These Guidelines provide a systematic and transparent framework for the consideration of flood risk in the planning and development management processes, whereby:

- A sequential approach should be adopted to planning and development based on avoidance, reduction and mitigation of flood risk.
- A flood risk assessment should be undertaken that should inform the process of decision-making within the planning and development management processes at an early stage.
- Development should be avoided in floodplains unless there are demonstrable, wider sustainability and proper planning objectives that justify appropriate development and where the flood risk to such development can be reduced and managed to an acceptable level without increasing flood risk elsewhere (as set out through the Justification test).

The proper application of the Guidelines by the planning authorities is essential to avoid inappropriate development in flood prone areas, and hence avoid unnecessary increases in flood risk into the future, and to take a precautionary approach in regards to the potential impacts of climate change on flood risk that should be addressed in spatial plans, planning decisions and through Local Adaptation Plans. The flood mapping produced through the CFRAM Programme and parallel projects provided as part of the Plan will facilitate the application of the Guidelines.

In flood-prone areas where development can be justified (i.e., re-development, infill development or new development that has passed the Justification Test), the planning authorities can manage the risk by setting suitable objectives or conditions, such as minimum floor levels or flood resistant or resilient building methods.

### **F.1.2 Sustainable Urban Drainage Systems (SUDS)**

Development of previously 'green', or permeable, land within an urban area increases the impermeable area, reducing infiltration and increasing runoff rates and volumes. Traditional urban storm water drainage systems are effective at transferring surface water quickly, but they provide only limited attenuation causing the volume of water in the receiving watercourse to increase more rapidly and increasing flood risk. Sustainable Drainage Systems (SUDS) can play a role in reducing and managing run-off to surface water drainage systems as well as improving water quality and contributing to local amenity. SUDS comprise a wide range of techniques, including swales, basins, ponds and infiltration systems.

In accordance with the Guidelines (see Section 7.2.1.1), planning authorities should seek to reduce the extent of hard surfacing and paving and require the use of sustainable drainage techniques to reduce the potential impact of development on flood risk downstream.

### **F.1.3 Voluntary Home Relocation**

In extreme circumstances, the flood risk to a home may be such that the home owner may consider that continuing to live in the property is not sustainable and would choose to relocate.

### **F.1.4 Preparation of Local Adaptation Planning**

It is likely that climate change will have a considerable impact on flood risk in Ireland, such as through rising mean sea levels and the potential increases in winter rainfall and intense rainfall events. For example, it is known that sea levels are rising at a rate of more than 3mm/yr at present, and the Fifth Assessment Report (AR5) of the Inter-Governmental Panel on Climate Change (IPCC) projects that mean sea level is likely to rise between 0.52m and 0.98m by the end of the century. The flood risk assessment for the future scenarios, described in Section 5 herein, highlight the potential impacts of such changes. More recent research (Jevrejeva et al. 2014) indicates that it is plausible that mean sea level may rise by up to approximately 2m by the end of the century.

The Climate Action and Low Carbon Development Act, 2015, required that the Minister for Communications, Climate Action and Environment prepare a National Climate Change Adaptation Framework (NCCAF) that shall specify the national strategy for the application of adaptation measures in different sectors and by a local authority in its administrative area in order to reduce the vulnerability of the State to the negative effects of climate change. The consultation document on the NCCAF (DCCAE, March 2016) noted that as the impacts of climate change vary by region, adaptation requires locally specific, place-based responses, and that Building resilience to the impacts of the climate change at local level for communities and businesses can be achieved in an effective manner if it is integrated into existing planning frameworks and policies under the remit of the local government sector. The NCCAF was published in January 2018 and sets out that local level adaptation measures will be identified in Local Adaptation Strategies prepared by the relevant local authority and implemented through inclusion in relevant plans and policies under the local authority's remit. To this end, local authorities should take into account the potential impacts of climate change on flooding and flood risk in their planning for local adaptation, in particular in the areas of spatial planning and the planning and design of infrastructure.

### **F.1.5 Land Use Management and Natural Flood Risk Management Measures**

Flood flows depend on how much rain falls in the catchment and the pattern of rainfall, and also on how much and how rapidly the rain runs off the land into the river. The volume and rate of runoff can be reduced by changing land use practices, such as by reducing stocking rates, changing the way ploughing is undertaken (e.g., along contours rather than perpendicular to contours), the retention, protection and/or rewetting of peatlands and bogs and by planting hedgerows across hillsides.

Similarly, excess runoff can be stored in wetlands, micro-detention basins, or be attenuated in small streams and channels through the use of obstructions to flow, such as large woody-debris dams. While such measures have been shown to reduce flood peaks in small catchments and frequent, less severe flood events, they may be less effective for more severe floods and in larger catchments and often require very significant land owner engagement for implementation (EU, 2014).

These types of measures will often not be able to solve severe flood problems on their own, but they have the potential to form part of the solution and can also help to achieve the goals in a range of areas, including water quality, nature conservation / biodiversity, agriculture and forestry, green growth and climate change mitigation and adaptation (EU, 2014), and as such would be best addressed on a multi-sectoral level in partnership with all relevant agencies, to promote integrated catchment management.

## **F.2 FLOOD PROTECTION METHODS**

Flood protection measures are aimed at reducing the likelihood and/or the severity of flood events. These measures, typically requiring physical works, can reduce risk in a range of ways, such as by reducing or diverting the peak flood flows, reducing flood levels or holding back flood waters. The preferred Standard of Protection offered by such measures in Ireland is the current scenario 1% Annual Exceedance Probability (AEP) flood for fluvial flooding and 0.5 % AEP flood for tidal flooding (also referred to as the 100-year and 200-year floods respectively), although these standards can increase or decrease depending on local circumstances.

A description of the protection measures typically considered is provided below.

### **F.2.1 Enhance Existing Protection Works**

Flood protection works will provide flood protection up to a certain 'Standard of Protection' and, depending on the type of protection measure, may reduce the severity of flooding above this Standard. The Standard of Protection is the magnitude of flood, often defined by the annual probability of that flood occurring being exceeded (the Annual Exceedance Probability, or 'AEP'), that the measure is designed to protect the area at risk against.

In some locations where existing flood protection works exist, measures can be taken, in addition to the necessary ongoing maintenance, to improve the condition of the works to reduce the likelihood of failure, and/or increase the Standard of Protection to further reduce the risk in, and extend, the protected area. This can apply to both structures that were deliberately built as flood protection works, and also other structures (e.g., quay walls, road embankments) that provide some flood protection as a secondary function.

Some natural features can provide defences against floods, or form part of a defence in depth. For example sand dunes and flood marshes often form effective barriers against flooding in coastal areas. These features may be vulnerable to rapid erosion and some enhancement may be useful to retain the feature and their effectiveness in providing a defence function.



### **F.2.2. Flood Defences**

Solid structures built between the source of flood waters (rivers, estuaries or the sea) and an area vulnerable to flooding (people, properties, land and other assets) can prevent flooding up to the Standard of Protection of the structure, hence reducing the flood risk in the area being protected by the structure. Such structures typically include walls (generally in urban areas with limited space) or embankments (generally in rural areas and in urban areas where space is available, such as parks), but can also include other built or natural structures, such as sand dunes. However, the residual risk of flooding which remains after a defence is constructed, which arises as a flood in excess of the design standard of the defence may occur, also needs to be carefully considered during design.



*Figure F.1: Flood Defence Wall*



*Figure F.2: Flood Defence Embankment (During Construction / Maintenance)*

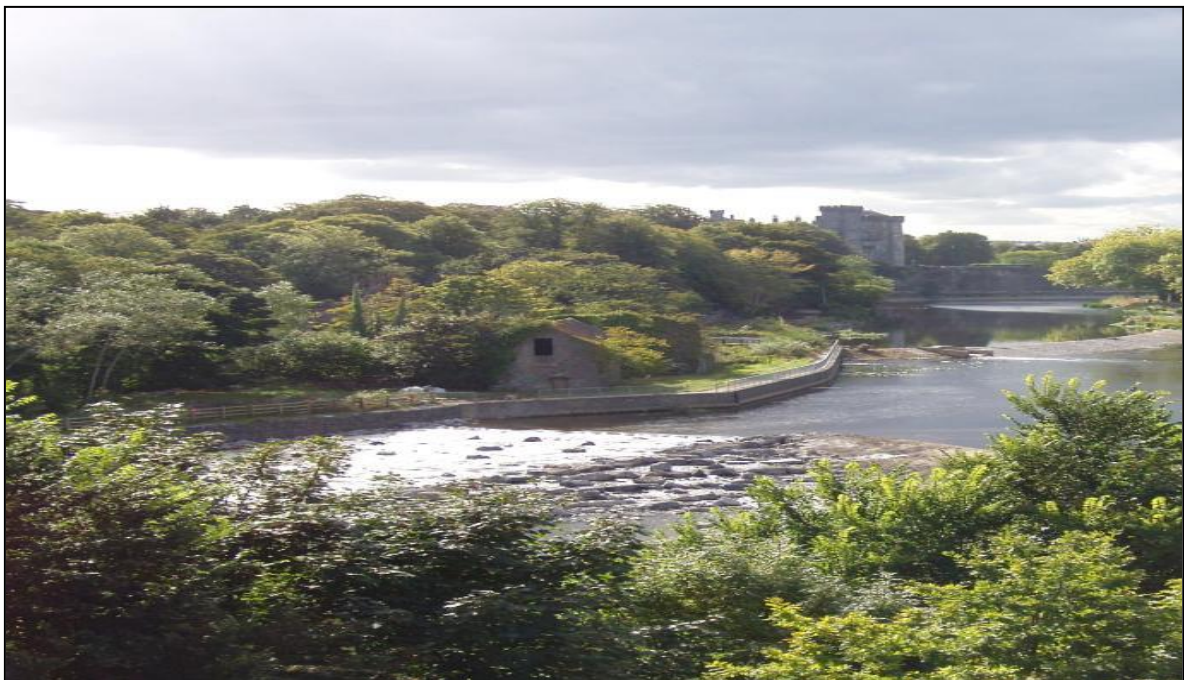


### **F.2.3 Increasing Channel Conveyance**

The water level of a river is determined by the flow and the hydraulic characteristics of the river, any structures (e.g., bridges, weirs, walls) in, alongside and over the river and, when in flood, of the floodplain. The hydraulic characteristics determine the conveyance of the river, and changing these characteristics can reduce the water level for a given flow. This can be achieved by works such as dredging to deepen and/or widen the river, reducing the roughness of the rivers, its banks and floodplain to allow more flow to pass, or removing or altering structures to reduce the build up of water upstream of the structure.



*Figure F.3: River Widening (During Construction)*



*Figure F.4: River Widening (After Construction)*

By increasing channel (and floodplain) conveyance, river levels during a flood can be lowered, hence reducing the likelihood and severity of flooding. This can be to the point that flooding during events up to the design Standard of Protection is avoided, but this type of measure has the advantage that it also reduces the risk for floods greater than the design Standard of Protection.

This type of measure is typically only applicable for river flooding,

#### **F.2.4 Diverting Flood Flows**

Flooding of an area from a river occurs because the quantity of flow flowing through an area exceeds the conveyance capacity of the channel and so the river spills out on to its floodplain. Reducing the flow through an area in the event of a flood can reduce the likelihood of flooding for that area, and this can be achieved by diverting some of the flows around the area of risk through a flood diversion channel or across a designated area of land.

#### **F.2.5 Storing Flood Waters**

Instead of diverting excess flood waters to reduce the flow through an area at risk, the flow can also be reduced by storing flood waters upstream of the area.

This can be in large, single flood attenuation structures, in wash-lands on the floodplain or in multiple, smaller storage areas dispersed around the catchment. Storage using soft measures, such as wetlands or micro-detention basins, or through attenuation in small channels, is generally considered to be part of land use management, or natural flood risk management (see Section 7.2.2.7).

Floods can also be attenuated (i.e., the flood slowed down, the peak flow reduced and the flood volume spread over a longer period of time) by measures along the river and floodplain, e.g., increasing channel and floodplain roughness (introducing impediments to flow in the river, or on floodplains, such as by increasing riparian vegetation or planting hedgerows) or by restoring meanders.

Such measures are often referred to as natural water retention measures or natural flood management. While these have been shown to reduce flood flows in smaller, more common floods, it is understood that their impact in larger, more extreme or rare floods, is reduced. Further research is required on this matter. However, such measures can have significant benefits for environmental enhancement, such as contributing to the objectives of the Water Framework Directive or increasing biodiversity.

#### **F.2.6 Implementing Channel Maintenance Programmes**

Excess silt and gravels deposited in watercourses and vegetation in and on the banks of river channels, or the blockage of channels by discarded rubbish or bulky objects in urban areas, can reduce the conveyance of a channel, increasing flood levels in the event of a flood and hence increasing the flood risk in the surrounding area. The blockage of culvert screens by debris and rubbish can also increase flood risk.

A regular maintenance programme to remove excess inorganic material, vegetation and/or remove debris and rubbish from river channels, and ensure that culvert screens are kept clear, can help reduce flood levels during flood events.

### **F.2.7 Maintenance of Drainage Schemes**

Following the passing of the Arterial Drainage Act, 1945, the OPW began investigations to determine where Arterial Drainage Schemes would be suitable and economically viable. The implementation of the Schemes began in the late-1940s and continued into the early-1990s, and a total of 11,500kms of river channel now form part of the Arterial Drainage Schemes, that also include 800km of embankments.

The purpose of the Arterial Drainage Schemes was primarily to improve the drainage of agricultural lands to enhance production. This typically involved lowering or widening river beds and removal of weirs to facilitate the drainage and discharge of neighbouring lands and drainage channels. While not the primary focus of the Schemes, they did also provide enhanced conveyance capacity where they passed through towns, villages and dispersed rural communities that in turn has reduced the flood risk to properties in these areas.

While new Arterial Drainage Schemes are no longer being undertaken, the OPW has a statutory duty to maintain the completed schemes in proper repair and in an effective condition. The annual maintenance programme is published by the OPW on the OPW website, and typically involves some clearance of vegetation and removal of silt build-up on a five-yearly cycle.

Drainage Districts are areas where drainage schemes to improve land for agricultural purposes were constructed under a number of Acts of Parliament and Acts of the Oireachtas prior to 1945. 170 Drainage District Schemes were established, covering 4,600km of channel. The statutory duty of maintenance for these schemes lies with the local authorities concerned. The standard of this maintenance varies widely from county to county.

### **F.2.8 Land Commission Embankments**

The Land Commission was created in 1881 as a rent fixing commission by the Land Law (Ireland) Act 1881, and was reconstituted in the Irish Free State by section 2 of the Land Law (Commission) Act, 1923, backdated to the state's creation. With very few exceptions, lands acquired through the Land Commission are now in private ownership. Trusts were established in some cases for the maintenance of Flood Defences on acquired lands. The Commission was dissolved on 31 March 1999 by the Irish Land Commission (Dissolution) Act, 1992 and the trusts held by the Land Commission were transferred to the Dept. Agriculture, Food and the Marine (DAFM), with retained funds entrusted to the Public Trustee, who is an officer of the DAFM.

While the Public Trustee administers these funds that may be used for repairs of the embankments, this is applied only in very exceptional circumstances, as the amount of such funds is generally small and wholly inadequate to maintain the various embankments. The DAFM does not however have a general responsibility for the maintenance, repair or restoration of the embankments, which rests with the land owner in most cases (Section 10 of the Land Act, 1965).

## **F.3 FLOOD PREPAREDNESS (RESILIENCE) METHODS**

In some instances, it may not be possible to reduce the likelihood or severity of flooding to an area at risk. However, actions and measures can be taken to reduce the consequences of flooding, i.e., reduce the risk to people and of damage to properties and other assets, and make sure that people and communities are resilient to flood events. This can be achieved by being aware of and preparing for the risk of flooding, knowing when floods are going to occur, taking actions immediately before, during and after a flood. The actions and measures of this type are described below.

### **F.3.1 Flood Forecasting and Warning**

Knowing that a flood event is imminent allows people, communities and local authorities to prepare for the flood by, for example, erecting temporary defences or moving people and assets out of harm's way.

It is possible to forecast floods under certain conditions using weather predictions, observed rainfall and river levels and flows, and with the aid of computer models. Flood forecasts based on predicted weather are generally less certain than those based on observed rainfall or river levels or flows. The forecast period achievable generally depends on the catchment size and characteristics, and, while in larger catchments it may be possible to provide a number of hours or even days of advance warning of a flood event, in small, flashy catchments this period can be extremely short and therefore of less or potentially no real benefit. Flood forecasting also involves significant uncertainty, as it entails trying to simulate very complex systems in real time with limited data.

The OPW, on behalf of Ireland, signed a partner agreement in 2010 with the European Flood Awareness System (EFAS), which was developed by the EU Joint Research Centre for use by partner organisations. EFAS was developed to help improve and increase preparedness for fluvial floods and is intended to provide early warning or notification of potential flood events under specified criteria. These EFAS flood notifications are disseminated by the OPW to local authorities and other relevant stakeholders. During the floods of winter 2015/16, EFAS provided a number of valuable flood notifications and forecasts which informed and supported the management of these floods. The OPW also provides national tidal and storm surge forecasts for local authorities and other relevant stakeholders and disseminates high tide advisory notices to local authorities when tide, weather and atmospheric conditions are such that coastal flooding may arise.

A number of other project specific flood forecasting systems are in place as part of OPW funded flood relief schemes that include demountable Flood Defence systems.

Appendix F6 of the Major Emergency Management (MEM) Framework (2006) sets out the arrangements put in place by Met Éireann to issue public service weather warnings to the local authorities. Met Éireann operates a weather warning system that aligns with the EU Meteoalarm system ([www.meteoalarm.eu](http://www.meteoalarm.eu)). Met Éireann also issues weather warnings to the public. Warnings for very heavy rainfall may indicate a threat of widespread flooding or flooding for a specific area.

Local warnings are also issued by the local authority. Warnings may be circulated to national and/or local broadcast media, as appropriate, which can be supplemented, in the case of specific local areas identified as being at risk, with emergency vehicles and personnel to deliver the warnings in very exceptional cases.

A Government decision was taken on the 5th January 2016 to establish a National Flood Forecasting and Warning Service (refer Section 7.4.1.10 for further details).

### **F.3.2 Emergency Response Planning**

Well prepared and executed emergency response plans can significantly reduce the impact of flood events, particularly for human health and welfare. The MEM Framework designates the local authority as the lead agency for co-ordinating a response to a flooding emergency. "A Guide to Flood Emergencies (2013)" sets out the sequence of steps required to prepare for and respond to flood emergencies. The Department of Housing, Planning and Local Government is designated as the Lead Government Department for co-ordinating a national response to large scale flood emergencies.

Local authorities develop and review flood plans. Flood plans detail how local authorities receive, assess and respond to weather and flood warnings that can be received from the OPW, Met Éireann, EFAS or other sources, taking into account other relevant information available to them, such as real-time gauge information (e.g., [www.waterlevel.ie](http://www.waterlevel.ie)) and local knowledge of river systems, roads, infrastructure and vulnerable communities.

Local authorities, as part of their planning for flood emergencies, appoint a Severe Weather Assessment Team. This team monitors weather alerts and provides an analysis of the flood risk before and during an event, as well as providing specialist advice to the operational services deployed to a flood event.

It is the responsibility of the Severe Weather Assessment Team to determine the scale of response that is required, i.e. further action required, the activation of an internal operational response, or the requirement for increased levels of inter-agency co-ordination, up to the declaration of a major emergency and activation of the Major Emergency Plan.

During a flood emergency, where a national response is required to support the local response, the Lead Government Department activate and chair the National Co-ordination Group. Once the National Co-ordination Group is activated, the Lead Government Department establishes links with all Regional / Local Co-ordination Groups. The National Co-ordination Group sets key response objectives, prioritising life safety and protection of property/ critical infrastructure. The National Co-ordination Group works with the Principal Response Agencies to ensure that resources are allocated where needed and can provide optimum benefits. The National Co-ordination Group also develops key public safety messages and provides a single point for information to media and public sector organisations.

### **F.3.3 Promotion of Individual and Community Resilience**

Individuals and communities that are aware of any prevalent flood risk are able to prepare for flood events such that if and when such events occur, people are able to take appropriate actions in advance of, during and after a flood to reduce the harm and damages a flood can cause. This could include short-term preparation and action such as elevating valuables to above likely flood levels, helping neighbours who may have mobility difficulties to prepare and if necessary evacuate, moving vehicles to high ground and evacuating themselves if necessary. Longer-term preparations can involve making homes and properties flood resilient or flood resistant, such as through new floor and wall coverings chosen to be durable in a flood or moving electrical sockets above likely flood levels.

In 2005, the OPW launched the Plan, Prepare, Protect campaign that provides general, practical advice to homeowners, businesses and farmers on what they can do to prepare for flood events and make themselves resilient. This advice has recently been updated and is available to view and download from: [www.flooding.ie](http://www.flooding.ie).

While the Plan, Prepare, Protect campaign provides useful information, as a national campaign it is generic. Resilience also has a strong local dimension involving consultation with the local community, the dissemination of site-specific advice, and the provision of assistance with preparedness at a local level for individuals and businesses known to be at risk. The Report of the Flood Policy Review Group (OPW, 2004) recommends that local authorities should assume responsibility for the local dimension of the flood risk education programme, including raising awareness of individuals and business interests considered to be at risk, and to assist individuals and business interests considered to be at risk with preparations for minimising damages in the event of a flood event

While the State, through the OPW, local authorities and other public bodies can take certain actions to reduce and manage the risk of flooding, individual home-owners, businesses and farmers also have a responsibility to manage the flood risk to themselves, their property and other assets to reduce damages and the risk to personal health in the event of a flood.

All people at flood risk within the Laune-Maine-Dingle Bay River Basin should:

- Make themselves aware of the potential for flooding in their area, including the likely extents, depths and risk-to-life
- Consider what long-term preparatory actions they might take to reduce the potential damage, such as implementing property resilience or resistance measures
- Prepare a flood event plan to set out the actions they should take before, during and after a flood event
- Discuss the issue of flooding and flood risk with other people in their communities, and consider forming a local Flood Action Group

Advice on what steps can be taken is provided in the Plan, Prepare, Protect booklet available through [www.flooding.ie](http://www.flooding.ie).

#### **F.3.4 Individual Property Protection**

Individual Property Protection includes generally low-cost and small-scale measures that can be applied to individual properties to help make them more resistant to flood waters. Examples might include flood-gates to go across doorways, water-proof doors, air-vent covers, non-return valves for pipe-work and sewerage, etc. These measures can be effective in reducing the damage to the contents, furniture and fittings in a house or business, but are not applicable in all situations (for example, they may not be suitable in areas of deep or prolonged flooding, or for some types of property with pervious foundations and flooring).

#### **F.3.5 Flood-Related Data Collection**

Data on flood flows and levels, as collected through the hydrometric networks of the OPW, EPA / local authorities, the Marine Institute and other organisations, are essential to understand what extreme river flows and levels and sea levels might occur, and hence to enable the appropriate design of structural and non-structural flood risk management measures. Similarly, recording details on flood events that happen are extremely useful to build up our knowledge of flood risk throughout the country and also to understand how the flooding occurs in the affected area to calibrate the computer models used to predict potential future flooding. The ongoing collection and, where appropriate, publication of such data is a measure that will help us to continually improve our preparation for, and response, to flooding.

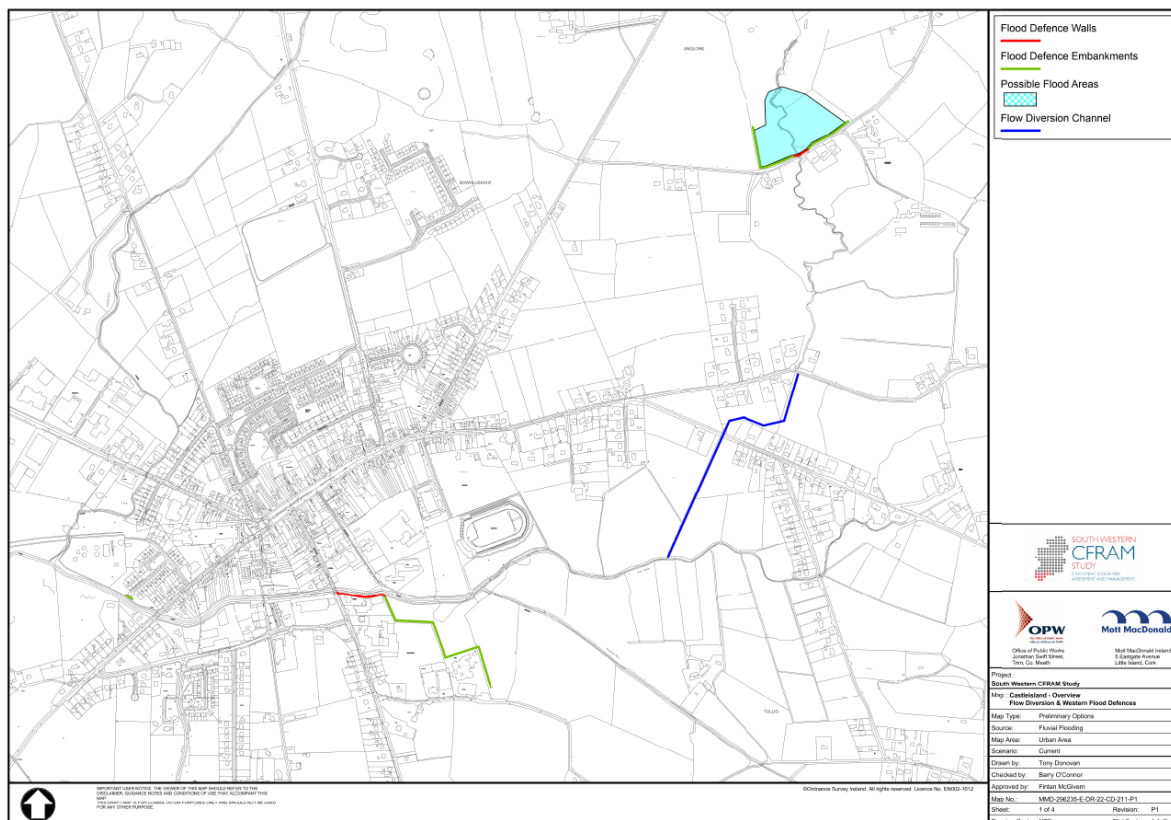


## **APPENDIX G**

### **DESCRIPTION OF POTENTIALLY VIABLE FLOOD RELIEF WORKS**

## G.1 Castleisland AFA

<b>River Basin</b>	Laune-Maine-Dingle Bay River Basin
<b>AFA</b>	Castleisland AFA
<b>Option</b>	Flow Diversion & Western Flood Defences
<b>Code</b>	IE22-IE-AFA-220323-CD01-M33
<b>Description</b>	Construction of an open channel to divert the Anglore Stream around Tullig and Fluvial Flood Defences comprising of walls and embankments. This option does not provide protection downstream of the Church Street Bridge.



**IMPORTANT NOTE:** The works presented herein are not the final and definitive works. Potentially viable flood relief works set out herein will need to be further developed at a local, project level before Exhibition or submission for planning approval.

MCA Appraisal Outcomes			
Objective	Un-weighted Score	Local Weighting	Comment
1.a.i)	1.83	5	<i>Calculation based on the number of residential properties protected</i>
1.a.ii)	0	0	<i>Calculation based on the number of high vulnerability properties protected</i>
1.b.i)	2.88	0.65	<i>Calculation based on the number of social amenity properties protected</i>
1.b.ii)	3.96	5	<i>Calculation based on the number of non-residential properties protected</i>
2.a	3.49	5	<i>Calculation based on reduction in AAD</i>
2.b	2.25	5	<i>Calculation based on transport infrastructure protected</i>
2.c	0	0.25	<i>Calculation based on utility infrastructure protected</i>
2.d	0	1.88	<i>Calculation based on agriculture protected</i>
3.a	-2	5	<i>The River Maine supports an important population of salmonid fish and is considered sensitive to potential impacts from the flood risk management measures. It has a poor to good WFD status. During the construction phase there is potential for short term impacts on sensitive waterbodies (-2).</i>
3.b	0	0	<i>The proposed works will have no impact on Natura 2000 sites as there are no designations in the area.</i>
3.c	-3	4	<i>Construction of the measures can result in temporary release of sediment and pollutants to the watercourse. The Maine supports salmonid. The proposed works require instream works. Sedimentation during spawning season could have detrimental effects on salmonid populations (-2). Otter has been recorded on the Maine in Castleisland. There is potential for temporary disturbance during construction including the removal of considerable hedgerows and treeline to facilitate the construction of earthen berms (-1). The proposed measures include for the construction of flow diversion channel at Tobermaing. There is potential localised loss or disturbance to flora / fauna however this is limited by the already modified nature of the ditch (-1). Works will involve re-engineering of the existing ditch including the installation of a culvert across the road. It is noted that invasive species such as Japanese Knotweed and Giant Rhubarb occur along the bank of the river. There is potential that works may spread these species in this option. Detailed invasive species management is required to manage the control and spreading of the species during the construction stage (-3).</i>

3.d	-4	4	<i>The Maine supports salmonid. The proposed measures includes the construction of walls within the town at the western extent of the town, this will restrict fishing access to the river in the town to a lesser extent than option 2. The construction of embankments and walls and drainage channel will require excavation of the bank of stream during the construction stage this would result in short term emissions of sediment to the waterbody and downstream without treatment (-2). The proposed measure includes the re-engineering of an existing drainage ditch in Tobinmaing, these instream works have potential for the emission of significant sedimentation downstream without treatment (-4). The potential fisheries habitat value is not known however the Maine is assigned good / moderate water body status under the WFD.</i>	
3.e	-1	1	<i>The proposed measure also includes the construction of a permanent wall along the short extent River Maine Walkway. There is currently a wall along this section of the walkway. This will restrict access in short term (-1) however it is unlikely to differ from the existing setting of the walkway at this location (0). Once constructed the drainage channel is unlikely to be discernible in the landscape.</i>	
3.f.i)	0	1	<i>There are a small number of NIAH buildings within the town including a school and church on Church Street. These are not at risk from flooding.</i>	
3.f.ii)	0	1	<i>There are a small number of RMP within the town including the castle however these are not at risk from flooding</i>	
4.a	5	5	<i>Flood walls, embankments, channels and culverts, no moving parts</i>	
4.b	2	5	<i>Risk of falling from a height, drowning and electrocution</i>	
4.c	2.25	5	<i>Adaptive Approach: increase height of existing Flood Defences by 0.2m (Score 5) Adaptive Approach: increase volume of storage area (Score 3) Adaptive Approach: increase capacity of culvert (Score 0) Adaptive Approach: increase capacity of flow diversion channel (Score 1)</i>	
Total MCA-Benefit Score		Option Cost (€millions)		MCA-Benefit Score / Cost Ratio
497.38		€5.20M		95.57
No Properties Benefitting		10% AEP Event	1%/05% AEP Event	0.1% AEP Event
Residential		28	76	0
Commercial		5	26	0

<b>Economic Appraisal (Cost-Benefit Analysis) Outcomes - All figures €millions</b>			
<b>Area NPVd (uncapped)</b>	<b>Option Cost</b>	<b>Option NPVb (capped)</b>	<b>Benefit - Cost Ratio</b>
€11.2M	€5.20M	€7.76M	1.32
<b>Environmental Assessments</b>			
<p><b>Key Conclusions:</b></p> <ul style="list-style-type: none"> <li>The construction of this option will include the re-engineering of an existing drainage ditch in Tobinmanig. The construction of measures will result in significant negative impacts on the water body status in the absence of appropriate mitigation.</li> <li>There are no significant point sources at risk within the 1% AEP fluvial extent. Castleisland WWTP is located on the west side of the town but it is not identified within the 1% AEP extent. It is noted that invasive species such as Japanese Knotweed and Giant Rhubarb occur along the bank of the river. There is potential that works may spread these species.</li> <li>The Castleisland AFA boundary does not overlap with any Natura 2000 site boundary. There are no habitats of conservation importance noted within the AFA.</li> <li>In relation to the architectural objective, there is no environmental preference between options.</li> <li>This option will have a neutral impact on archaeological and cultural heritage of the AFA</li> </ul>			
<b>Adaptability to Potential Future Changes</b>			
<p>Adaptive Approach: increase height of existing Flood Defences by 0.2m (Score 5)  Adaptive Approach: increase volume of storage area (Score 3)  Adaptive Approach: increase capacity of culvert (Score 0)  Adaptive Approach: increase capacity of flow diversion channel (Score 1)</p> <p>Option is adaptable to climate change – Score 2.25</p> <p>An assessment of each AFA's vulnerability to climate change was also carried out. An AFA is deemed as being significantly vulnerable to climate change if the increase in damages in the Mid-Range Future Scenario is significantly different to the current scenario. According to this definition Castleisland is not significantly vulnerable to climate change.</p>			
<b>Public Consultation Outcomes</b>			
<p>During the Public Consultation Day on option development, Flood Defences was supported but there was also opposition to certain elements of the works by landowners. As a result, Flood Defences &amp; Flow Diversion was developed after the Public Consultation Day. Flow Diversion &amp; Western Flood Defences was also developed after the Public Consultation Day on option development.</p> <p>During the statutory consultation on the draft FRMP the following observations were received:</p> <ul style="list-style-type: none"> <li>Some landowners were opposed to the flow diversion</li> <li>The Flood Defences should not interfere with the school playing fields</li> <li>Flood waters could go around the proposed defences</li> <li>Some landowners do not want flood flows from the Kilbanivane area to be diverted towards Tullig</li> <li>The Maine should be dredged to remove obstructions</li> <li>The Glensheroon should be dredged.</li> </ul>			

### Other Issues / Conclusions

The MCA has identified Flow Diversion & Western Flood Defences as a potentially viable Flood risk management option. This option does not provide protection downstream of the Church Street Bridge. It expected to provide protection to the defended areas against a 100-Year fluvial flood (1% Annual Exceedance Probability) while not increasing flood risk downstream in the undefended areas.

The proposed upgrade works to the existing culvert in Tullig will not provide protection against the 1% AEP event but it will reduce the impact of frequent flood events.

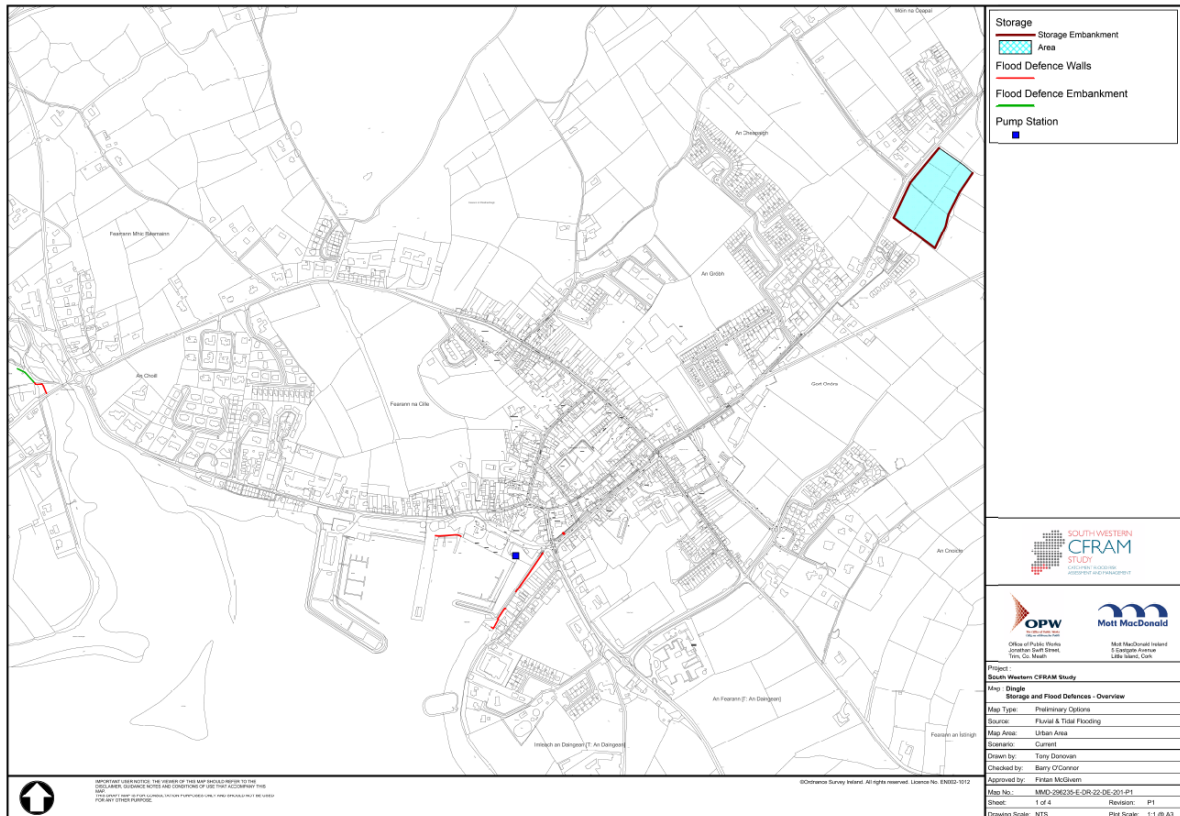
Note: All environmental issues raised during the consultation stage should be addressed at project stage.

Note: Castleisland Community School is concerned about the positioning of the embankment and they will need to be consulted further at scheme development stage.

Note: Information provided at Draft FRMP stage will be addressed at scheme development stage.

## G.2 Dingle AFA

<b>River Basin</b>	Laune-Maine-Dingle Bay River Basin
<b>AFA</b>	Dingle AFA
<b>Option</b>	Storage & Flood Defences
<b>Code</b>	IE22-IE-AFA-220327-DE01-M33
<b>Description</b>	The provision of a storage area on the Dingle Stream upstream of the town and tidal Flood Defences comprising of sea walls and embankments.



**IMPORTANT NOTE:** The works presented herein are not the final and definitive works. Potentially viable flood relief works set out herein will need to be further developed at a local, project level before Exhibition or submission for planning approval.



MCA Appraisal Outcomes			
Objective	Un-weighted Score	Local Weighting	Comment
1.a.i)	4.42	5	<i>Calculation based on the number of residential properties protected</i>
1.a.ii)	0	0	<i>Calculation based on the number of high vulnerability properties protected</i>
1.b.i)	4.53	4.28	<i>Calculation based on the number of social amenity properties protected</i>
1.b.ii)	3.18	5	<i>Calculation based on the number of non-residential properties protected</i>
2.a	4.53	5	<i>Calculation based on reduction in AAD</i>
2.b	3.75	5	<i>Calculation based on transport infrastructure protected</i>
2.c	0	0	<i>Calculation based on utility infrastructure protected</i>
2.d	0	1.88	<i>Calculation based on agriculture protected</i>
3.a	-1	5	<i>The Milltown River rises north of Dingle (town) and flows south to discharge into Dingle harbour on the west side of the town. The Dingle Stream rises north of the town and enters from the north east, before following Spa Road to terminate in Dingle Harbour. The WFD river water body status for the Milltown River is poor for most of its length, and has no assigned status for the last 1.5km before it terminates in Dingle Harbour. Dingle stream has no assigned WFD river water body status. These rivers are not considered to be sensitive waterbodies. The measure includes a combination of storage and Flood Defences within the town. There are no significant polluting sources within the 1% AEP (-1). Short term construction phase impacts of Flood Defence walls and embankments.</i>
3.b	0	2	<i>Mount Brandon SAC is primarily designated for habitats and flora. FPM are a qualifying feature but are within the Owenmore River. There will be no work within the SAC and there is no hydrological connection to the Owenmore River, therefore no potential for impact on FPM (0). The SPA is approximately 2km south of the AFA. Noise impacts are unlikely (0).</i>

3.c	-3	3	<i>Flood walls on the Dingle Stream will be along existing walls and as such there is limited potential for impact. The stream is heavily channelised within the town (0). Japanese knotweed and Giant rhubarb occur along the bank of the stream immediately north of the roundabout on the N86 and in close proximity to the proposed location of the flood wall. There is high potential for spread of these invasive species along the stream (-1). The Dingle stream at the location of the storage area flows through mosaic of wet and rough grassland. This habitat has low ecological value (0). The stream banks are engineered as it flows towards and through the housing estate to the south of the proposed storage area. The stream has low fishery value and is unlikely to be used by otter (0). Otter has been recorded at the location of the embankment and flood wall propose on the Milltown River. There is potential for localised disturbance to feeding (-3).</i>
3.d	-4	1	<i>Both the Milltown River and the Dingle Stream cross the Mount Bandon SAC. This area is not designated for fishery habitat, the stream is heavy channelised. (-1). Construction of the storage tank and Flood Defence walls would require excavation of the bank of the stream and diversion of the Dingle Stream during the construction stage. This would result in short term emissions of sediment to the waterbody and downstream without treatment (-5). The storage area would result in the permanent construction of a large embankment and likely result in the permanent loss of fisheries habitat.</i>
3.e	-4	3	<i>Dingle town is not located in an area designated as primary or secondary special amenity in the Kerry county development plan. The N86 and R560 roads entering Dingle are identified as having significant views and prospects (-2). Construction of the significant area of storage within sight of scenic viewpoints would cause short term impacts on visual amenity (-4). Flood Defence walls and embankments with a max height of 5m at the storage area and approx. 2.9m high along the Milltown stream in proximity to scenic routes and views will cause a permanent / long term impact. The existing landscape features include approximately 1m height stone walls parallel to the road. The measure will be discernible from the existing landscape and will cause a significant permanent long term visual intrusion on the views along spa road. The proposed measure also includes for the construction of approx. 2m high defence wall along the eastern extent of the harbour. This will impede views from the dwellings currently overlooking the harbour and 2.9m embankments within the estuary (-5). These measures will have significant impacts on the visual amenity of the harbour and estuary. This measure has considerably less wall structures within the town (1).</i>

3.f.i)	2	3	Parts of the town have been designated an Architectural Conservation Area (ACA). There are a number of NIAH designated sites designated (2). The proposed measures will reduce the risk of flooding downstream on the Dingle Stream on designated features along the Meal and the tracks within the town. The proposed storage area is located upstream and will not impact on the setting of these features.	
3.f.ii)	1	1	There are a number of RMP sites within the town boundary. The proposed measures will reduce the risk of fluvial flooding on one RMP.	
4.a	5	5	Flood Defences and storage, little moving parts with the exception of a sluice valve in the storage area	
4.b	2	5	Risk of electrocution, falling from a height and drowning	
4.c	2	5	Should be easily adapted for future flood events	
Total MCA-Benefit Score		Option Cost (€millions)		MCA-Benefit Score / Cost Ratio
1368.18		€4.21M		124.00
No Properties Benefitting		10% AEP Event	1%/05% AEP Event	0.1% AEP Event
Residential	Fluvial	25	35	0
	Tidal	4	12	0
Commercial	Fluvial	41	54	0
	Tidal	4	30	0
Economic Appraisal (Cost-Benefit Analysis) Outcomes - All figures €millions				
Area NPVd (uncapped)	Option Cost		Option NPVb (capped)	Benefit - Cost Ratio
€13.08M	€4.21M		€8.58M	2.04
Environmental Assessments				
Key Conclusions:				
<ul style="list-style-type: none"><li>The construction of this option could result in significant negative impacts on the water body status without appropriate mitigation. This measure includes the construction of instream works. In the absence of appropriate mitigation, this would result in significant emissions of sediment to the waterbody and downstream.</li><li>There are no Natura 2000 sites within the AFA. The Dingle Peninsula SPA is approximately 2.5km south of Dingle AFA. Potential disturbance to conservation interests of the SPA during the construction stage is extremely unlikely given distance from SPA.</li></ul>				

- of the SPA during the construction stage is extremely unlikely given distance from SPA.
- Construction of significant area of storage within sight of scenic viewpoints would cause short term impacts on visual amenity. The construction of this option is likely to cause a permanent change to the landscape character of the AFA and result in long term impact. Currently, walls within the town range around 1m in height, the construction of these proposed defence walls will be a discernible change in the town and will cause significant permanent visual intrusion on the views along Spa road. All of the options include measures for the protection of tidal flooding along the harbour and estuary. These are expected to impede views from dwellings currently overlooking the harbour and estuary and these permanent structures will change the view and prospect and character in the area.
- In relation to the architectural objective, there is no environmental preference between options.

### **Adaptability to Potential Future Changes**

Adaptive Approach: increase size and capacity of storage area by increasing the height of the storage embankments (Score 3)

Adaptive Approach: increase height of Flood Defences, note may be accommodated by freeboard (Score 3)

No physical provision: Increase length of Flood Defence walls by 1,100m (Score 0)

Option is adaptable to climate change – Score 2.0

An assessment of each AFA's vulnerability to climate change was also carried out. An AFA is deemed as being significantly vulnerable to climate change if the increase in damages in the Mid-Range Future Scenario is significantly different to the current scenario. According to this definition Dingle is significantly vulnerable to climate change.

### **Public Consultation Outcomes**

The feedback provided at the Public Consultation Day for option development was in support of Storage & Flood Defences. During the statutory consultation on the draft FRMP a number of landowners and residents indicated that they were not in favour of the proposed storage area. Other feedback indicated that the proposed location of the storage area included a well and a landfill site.

Other feedback received at the Draft Flood Risk Management Plan stage includes:

- Residents believe the river should be dredged.
- Pumping the river into the sea should be considered
- Further consultation with the local community is required
- Bat boxes in the area should be maintained in position
- Further assessment is required on the environmental impact of the proposed scheme.

### **Other Issues / Conclusions**

The MCA has identified Storage & Flood Defences as a potentially viable flood risk management option.

It should be noted that there is potential for the proposed storage area to contain an old landfill site. Further investigation should be carried out before progressing this option.

All environmental issues raised during the consultation stage should be addressed at project stage.

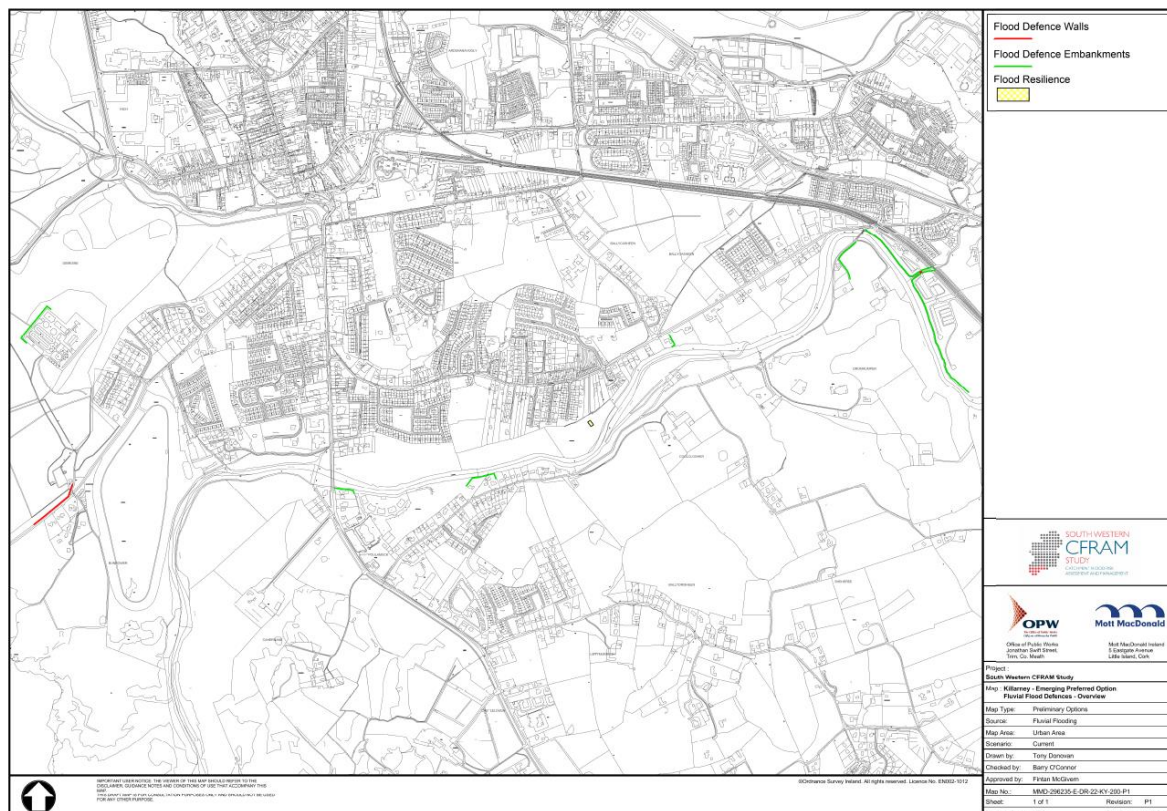
Note: Agri-environmental scheme on-going on some land and will need to be considered at detailed design stage.

Note: Impact on water supply springs must be considered at project development stage.

Note: Information provided at Draft FRMP stage will be addressed at scheme development stage.

## G.3 Killarney AFA

<b>River Basin</b>	Laune-Maine-Dingle Bay River Basin
<b>AFA</b>	Killarney AFA
<b>Option</b>	Flood Defences
<b>Code</b>	IE22-IE-AFA-220337-KY01-M33
<b>Description</b>	Fluvial Flood Defences comprising of walls, embankments along with flood resilience of some properties.



**IMPORTANT NOTE:** The works presented herein are not the final and definitive works. Potentially viable flood relief works set out herein will need to be further developed at a local, project level before Exhibition or submission for planning approval.

MCA Appraisal Outcomes			
Objective	Un-weighted Score	Local Weighting	Comment
1.a.i)	0.95	0.74	<i>Calculation based on the number of residential properties protected</i>
1.a.ii)	0	0	<i>Calculation based on the number of high vulnerability properties protected</i>
1.b.i)	4.75	2.5	<i>Calculation based on the number of social amenity properties protected</i>
1.b.ii)	4.64	3.77	<i>Calculation based on the number of non-residential properties protected</i>
2.a	3.65	3.12	<i>Calculation based on reduction in AAD</i>
2.b	3.26	5	<i>Calculation based on transport infrastructure protected</i>
2.c	0	0	<i>Calculation based on utility infrastructure protected</i>
2.d	0	2.5	<i>Calculation based on agriculture protected</i>
3.a	2	5	<i>Killarney is located along Flesk River. The river is classified as having moderate water status under the WFD. Parts of the town including the WwTP is at risk from fluvial flooding. It is considered that the provision of an embankment surrounding (in part) the WwTP will mitigate flooding at the WwTP and the impacts on the water quality in Ross Bay of Lough Leane (3). However during the construction of embankments there is potential for short term impacts on the water status of the local waterbodies due to the generation of sediment (-1).</i>
3.b	-5	5	<i>Flesk has pearl mussel populations in close proximity to proposed embankment locations. Very high risk of sediment runoff into the watercourse with significant implications for conservation objectives (-5).</i>
3.c	-3	5	<i>High potential for localised disturbance to species - otter, Lesser Horse bats and for deterioration in local habitat (high potential for translocation of Japanese Knotweed which is common throughout the area locally).</i>
3.d	0	4	<i>The reduction in flood related impacts on water quality resulting from storm water overflows at the WwTP, will ensure that fishery habitats in Lough Leane are improved. (1). However there is potential for a short term negative impact arising from the release of sediments to the Folly Stream, Lough Leane and to the River Flesk during the construction phase (-1) .</i>



3.e	-4	5	<i>The area is considered to be "very scenic" and of extreme importance for tourism and of national or county importance. In order to place adequate Flood Defences along the River Flesk there will be a requirement to remove significant stands of mature trees along the river, at the Ross Road and at the WwTP. This will have a long term negative impact on the landscape amenity of the area. (-4)</i>
3.f.i)	2	3	<i>There are 3 NIAHs that currently located within the 1% AED flood zone. A number of these will be protected from further flooding (3). However a Flood Defence wall in proximity to Reen cottage may have a negative setting impact, primarily due to the requirement to move existing vegetation to accommodate the wall. (-1). However, this can be mitigated.</i>
3.f.ii)	3	3	<i>There are 4 RMPs that currently located within the 1% AED flood zone. These are at risk of damage during flood events. Risk of damage will be reduced.</i>
4.a	5	5	<i>Walls and embankments therefore little operational risk.</i>
4.b	2	5	<i>Risk of overhead cables and drowning.</i>
4.c	1.5	5	<i>Walls and embankments can be easily adapted for future flood water rises, additional Flood Defences can be added top protects against future flood events.</i>
<b>Total MCA-Benefit Score</b>		<b>Option Cost (€millions)</b>	<b>MCA-Benefit Score / Cost Ratio</b>
419.50		€1.32M	318.96
<b>No Properties Benefitting</b>	<b>10% AEP Event</b>	<b>1%/05% AEP Event</b>	<b>0.1% AEP Event</b>
Residential	0	10	0
Commercial	3	4	0
<b>Economic Appraisal (Cost-Benefit Analysis) Outcomes - All figures €millions</b>			
<b>Area NPVd (uncapped)</b>	<b>Option Cost</b>	<b>Option NPVb (capped)</b>	<b>Benefit - Cost Ratio</b>
€4.03M	€1.32M	€1.66M	1.26
<b>Environmental Assessments</b>			
<b>Key Conclusions:</b> <ul style="list-style-type: none"> <li>The construction of this option could result in temporary negative impacts on the water body status without appropriate mitigation. There are no instream works proposed as part of this option, however it may require some excavation of the bankside of River during the construction stage. The Waste Water Treatment Plant (WWTP) is considered a significant polluting source in the AFA and this measure can contribute in achieving the objectives of the WFD by preventing recurring flooding to this significant polluting source.</li> </ul>			

- The Killarney AFA lies partly within Killarney National Park site boundary. Killarney is located along River Flesk. The river is assigned moderate water status under the Water Framework Directive (WFD).
- Freshwater Pearl Mussel populations are recorded in close proximity downstream of the proposed embankments and flood walls. Without appropriate mitigation there is a very significant possibility that FPM would be impacted by elevated levels of sediment runoff to the watercourse from the construction of the proposed flood risk management option.
- According to the Tralee/Killarney Hub Functional Local Area Plan 2013-2019, Killarney is characterised as being particularly valuable in terms of architecture and archaeological heritage. The town has a number of NIAHs throughout the town, however only one site is at risk within the 1% AEP fluvial extent. The provision of a flood wall along the river will provide protection to a number of RMPs against flooding. Generally, this measure performs well in terms of its protection to the AFA and exceeds the minimum targets to provide protection to the town, however there is potential for permanent long term negative impacts arising from their setting within the visual envelope of the town resulting from the measures.

### **Adaptability to Potential Future Changes**

Adaptive approach: increase height of Flood Defences by 0.6m (Score 3)

No physical provision: add 720m of additional Flood Defences (Score 0)

Option is adaptable to climate change – Score 1.5

An assessment of each AFA's vulnerability to climate change was also carried out. An AFA is deemed as being significantly vulnerable to climate change if the increase in damages in the Mid-Range Future Scenario is significantly different to the current scenario. According to this definition Killarney is not significantly vulnerable to climate change.

### **Public Consultation Outcomes**

The feedback received at the Public Consultation Day on options was in support of Flood Defences. During the statutory consultation on the draft FRMP the following feedback was received:

- The proposed defences will not protect some properties at risk
- The proposed defences will increase flood risk
- The location of the defences should be changed to protect roads and access to properties
- The location of the defences needs to be reviewed
- A flood warning system is required for Killarney
- The River Deenagh should be maintained to manage flood risk.
- Flood walls should be used instead of embankments at certain locations.
- Surface water flooding needs to be considered
- The impact of Flood Defences on old oak woodland needs to be assessed.
- Additional embankments are required
- River banks need to be maintained by landowners
- The flood maps are not accurate
- Residents enquired about upstream storage
- A flood warning system is required for Killarney
- Flood walls should be used instead of embankments at certain locations
- 2015 flood mechanism at White Bridge needs to be considered
- Further assessment is required on the environmental impact of the proposed scheme

### **Other Issues / Conclusions**

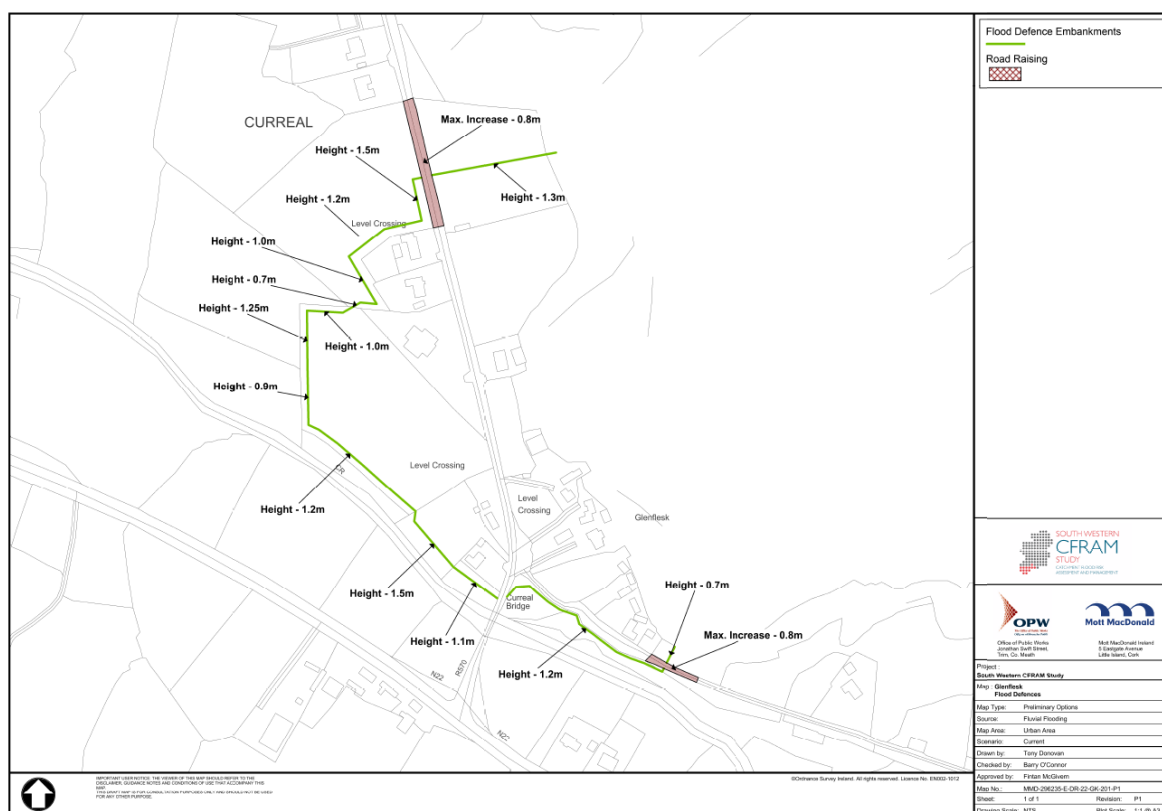
The MCA has identified Flood Defences as a potentially viable flood risk management option. Following flooding in 2015 it would appear that the hydrology and hydraulics developed as part of this study could underestimate flooding from the Flesk. These will be reviewed at the scheme development stage of the Killarney Flood Relief Scheme. The final position and height of Flood Defences will be subject to revised hydraulic modelling to ensure that the proposed defences do not give rise to an increase in flood risk.

All environmental issues raised during the consultation stage should be addressed at project stage.

Note: Information provided at Draft FRMP stage will be addressed at scheme development stage.

## G.4 Glenflesk AFA

<b>River Basin</b>	Laune-Maine-Dingle Bay River Basin
<b>AFA</b>	Glenflesk AFA
<b>Option</b>	Flood Defences
<b>Code</b>	IE22-IE-AFA-225502-GK-M33
<b>Description</b>	Fluvial Flood Defences comprising of walls, embankments and road raising along the Flesk River.



**IMPORTANT NOTE:** The works presented herein are not the final and definitive works. Potentially viable flood relief works set out herein will need to be further developed at a local, project level before Exhibition or submission for planning approval.

MCA Appraisal Outcomes			
Objective	Unweighted Score	Local Weighting	Comment
1.a.i)	2.8	0.41	<i>Calculation based on the number of residential properties protected</i>
1.a.ii)	0	0	<i>Calculation based on the number of high vulnerability properties protected</i>
1.b.i)	2.5	0.25	<i>Calculation based on the number of social amenity properties protected</i>
1.b.ii)	3.54	1.27	<i>Calculation based on the number of non-residential properties protected</i>
2.a	2.1	0.2	<i>Calculation based on reduction in AAD</i>
2.b	4.63	5	<i>Calculation based on transport infrastructure protected</i>
2.c	0	0	<i>Calculation based on utility infrastructure protected</i>
2.d	0	4.46	<i>Calculation based on agriculture protected</i>
3.a	-2	5	<i>There are no significant pollutant sources at risk from flooding. The River Flesk is considered a sensitive water body. (-2) Short term construction impacts.</i>
3.b	-5	5	<i>Flesk has pearl mussel populations in close proximity to proposed embankment locations. Very high risk of sediment runoff into the watercourse with significant implications for conservation objectives (-5).</i>
3.c	-3	5	<i>High potential for bats (particularly Daubenton's bat) at the Curreal Bridge. Otter are also likely in the area - potential for disturbance (-3).</i>
3.d	-2	3	<i>(-2) Construction impacts associated with the works and temporary restrict access to the river.</i>
3.e	-1	1	<i>The proposed embankments are low in nature with a maximum height of 1.5m. As a result it is considered unlikely that these will have a significant impact on the landscape character of the area, other than short term temporary impacts during the construction phase. No likely impacts. Temporary short term impacts on a local level prior to mitigation.</i>
3.f.i)	0	1	<i>The church is not at risk from flooding and the proposed measures are unlikely to affect the setting of the structure therefore no impacts are likely.</i>
3.f.ii)	0	0	<i>There are no designated sites at risk from flooding.</i>
4.a	5	5	<i>Embankments and road raising, very robust, no moving parts.</i>
4.b	4	5	<i>Risk of electrocution.</i>
4.c	3.5	5	<i>Easy to adapt for future flood events as heights of Flood Defences can be modified.</i>

Total MCA-Benefit Score	Option Cost (€millions)		MCA-Benefit Score / Cost Ratio
-261.44	€0.25M		-1038.60
No Properties Benefitting	10% AEP Event	1%/05% AEP Event	0.1% AEP Event
Residential	0	7	15
Commercial	0	8	18
Economic Appraisal (Cost-Benefit Analysis) Outcomes - All figures €millions			
Area NPVd (uncapped)	Option Cost	Option NPVb (capped)	Benefit - Cost Ratio
€0.52M	€0.25M	€0.22M	0.87
Environmental Assessments			
<p><b>Key Conclusions:</b></p> <ul style="list-style-type: none"> <li>This AFA occurs along the Flesk River Glenflesk is at risk of fluvial flooding.</li> <li>The Flesk River is part of the Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC. The proposed works occur within or adjacent to the SAC Boundary.</li> <li>This option requires the removal of bankside vegetation and the construction of earth mounds bank-side and has an associated risk of elevated sediment runoff to the watercourse in the absence of appropriate mitigation.</li> <li>There are a number of species of conservation importance within the AFA, these include otters, badgers, bats. This measure has the potential to cause disturbance to species of conservation concern through operation of construction plant and personnel and noise generated by the works and possibly artificial lighting that may be used in the darker evenings.</li> <li>The construction of the embankments is unlikely to have a significant impact on the landscape character of the area. The appearance of floodwalls would be designed appropriate to minimise potential visual effects within the AFA.</li> <li>This option will have a neutral impact on archaeological, cultural and architectural heritage of the AFA</li> </ul>			
Adaptability to Potential Future Changes			
<p>Adaptive Approach: increase height of Flood Defences by 0.4m (Score 4)  Adaptive Approach: raise height of roads by an additional 0.4m (Score 3)</p> <p>Option is adaptable to climate change – Score 3.5</p> <p>An assessment of each AFA's vulnerability to climate change was also carried out. An AFA is deemed as being significantly vulnerable to climate change if the increase in damages in the Mid-Range Future Scenario is significantly different to the current scenario. According to this definition Glenflesk is not significantly vulnerable to climate change.</p>			

### **Public Consultation Outcomes**

Prior to the Public Consultation Day on option development it was clear that any proposed structural flood risk management option would not be economically viable. As a result, the Public Consultation Day on option development focused on viable non-structural measures.

Feedback on received during the statutory consultation on the draft FRMP included the following observations:

- The flood maps are not accurate
- Residents are opposed to flood walls and embankments
- Clearance of trees and bushes from the river bank is required
- Flooding in Glenflesk is caused by the backing up of flow in the Flesk when it converges with flows from Curreal
- Individual property protection is required
- Sediment that has built up in the river should be removed
- More consultation is required with the local community
- Cost of scheme should be re-evaluated
- Further assessment is required on the environmental impact of the proposed scheme

### **Other Issues / Conclusions**

All environmental issues raised during the consultation stage should be addressed at project stage.

The flood depths in Glenflesk may be underestimated.

The community of Glenflesk extends far upstream of the AFA and includes the areas of Garries Bridge, Foilduane and Loo Bridge where the access to properties are cut off in times of flood.





Oifig na nOibreacha Poiblí, Ceannoifig, Sráid Jonathan Swift,  
Baile Átha Troim, Co. na Mí, C15 NX36

The Office of Public Works, Head Office, Jonathan Swift Street,  
Trim, Co. Meath, C15 NX36

Teileafón / Telephone: (0761) 106000, (046) 942 6000  
Ríomhphost / Email: [floodinfo@opw.ie](mailto:floodinfo@opw.ie)  
Suíomh Gréasáin / Website: [www.floodinfo.ie](http://www.floodinfo.ie)