Application for Fish Pass Approval (Form FP 002)

1 Site Details

1.1 What is the name of the site?
Gas Works Weir

1.2 National Grid Reference of the site (10 figure)?
SO 21874 03649 (E321730 N203747)

Refer to Drawing No: 202165/GW/101: Location Plan

1.3 Natural Resources Wales region and area (If known)
Region: Wales
Area: South East

1.4 Name of watercourse
Ebbw Fach

1.5 Watercourse Order or Hierarchy
Ebbw Fach/ Ebbw Fawr/ River Usk/ Severn Estuary/ Bristol Channel / Celtic Sea

2 Obstruction details

2.1 What is the nature of the obstruction to fish passage that the pass is designed to overcome?
At this site the Ebbw Fach is constrained within a 7m wide channel by various masonry/ concrete vertical walls of varying height (2m and 5m respectively upstream and downstream of the weir). A 1m high, 7m long stone pitched weir, see Plate 2.1, presents an obstacle to upstream passage along the Ebbw Fach for the majority of fish species, only 'athlete' fish are able to pass upstream during periods of high flow.

Plate 2.1 Gas Works weir

Downstream of the weir, see Plate 2,2, along the left bank is a 2.4m wide, 97m long concrete apron, the adjacent 4.5m wide low flow channel along the right bank is some 0.8m lower. Downstream along the right bank is a 10m long concrete apron which drops by approximately 0.8m into the low flow channel.

Plate 2.2 Apron downstream of Gas Works weir

2.2 What is the purpose of the obstruction?

The purpose of the weir is unknown and it has not be possible to obtain any historic information on this site or as-built drawings. However, it is 150m upstream of the Six Bells Minewater Pumping and Treatment Site and presumably was used to retain water levels in the river to provide a water supply to this (or another adjacent) site.

2.3 What is the configuration of the obstruction?

The alignment and levels of the existing weir are shown on the topographical survey drawings and Drawing 202165/GW/201 General Arrangement which also shows the proposed fish pass solution. Existing services are shown on Drawing 202165/GW/102 Services.

2.4 What is the overall crest length(s) of the obstruction that the pass is located in or beside (m) and what is its (their) invert level (mAOD)

The existing weir is 7m long and 7m wide with a crest level of +189.3mAOD and a toe level of 188.3mAOD. Downstream of the weir along the left bank is a 2.4m wide, 97m long concrete apron, the adjacent 4.5m wide low flow channel along the right bank is some 0.8m lower. Downstream along the right bank is a 10m long concrete apron which drops by approximately 0.8m into the low flow channel.

2.5 What is the maximum head difference across the structure (m)?

The existing head differences between the upstream and downstream extents of the proposed fish pass (entrance to the Larinier fish pass and immediately downstream of the final blockstone pre-barrage respectively) are shown on Table 2.1. The upstream water levels have been calculated using the equation Q=kbh^1.5, where b is the width of the weir, h is the head of water at the weir and coefficient k has been taken as 1.44 which is the coefficients value used for a rectangular profile weir.

The existing downstream water levels have been computed using the Q=VA equation, where; Cross-sectional area of flow A=b*h, b is the channel width, h is the head of water head in the channel.

Cross-sectional average velocity V=(1/n)*(Rh^2/3)*(S^1/2), n is the Manning roughness coefficient, assumed as 0.03, Rh is the hydraulic radius, the wetted perimeter divided by the cross-sectional area of flow, and S is the channel slope.
The existing maximum head difference across the extent of the proposed solution for the range of flows shown in Table 2.1 below is 2.12m.

Table 2.1. Existing head difference (across the extent of the proposed solution).

Flow Event	**Flows over Gas Works weir, (m^3/s)**	**Head, relative to weir crest (m)**	**Water level upstream of weir (mAOD)**	**Existing water level downstream of proposed pre-barrage (mAOD)**	**Total head difference (m)**
Q95	0.106	0.048	189.318	187.266	2.052
Q90	0.126	0.054	189.324	187.271	2.053
Q50	0.358	0.109	189.379	187.317	2.062
Q10	1.414	0.273	189.543	187.445	2.098
Q5	2.115	0.357	189.627	187.510	2.117

The head differences between the upstream and downstream extents of the proposed fish pass (as described above) are shown in Table 2.2 below. The upstream water level was computed using the 'modified crump weir' equation Q=Cd*√g*b*h^1.5 equation where Cd is a dimensionless coefficient of discharge to determine the flow within the Larinier fish pass. Q=VA was used to determine the flow within the eel pass (same method as above except n value of 0.2) and the weir equation Q=kbh^1.5 (k=1.44) was used to determine the flow over the existing weir.

The downstream water level was computed using the same method for the downstream water levels calculated for Table 2.1.

The proposed maximum head difference across the extent of the proposed solution for the known percentile flows is at Q5 and is 2.13m.

Table 2.2. Proposed head difference (across the extent of the proposed solution)

Flow Event	**Flows over Gas Works weir, (m^3/s)**	**Head, relative to invert of fish pass(m)**	**Water level at upstream entrance of Larinier pass (mAOD)**	**Tail water level (mAOD)**	**Total head difference (m)**
Q95	0.106	0.097	189.297	187.266	2.031
Q90	0.126	0.104	189.304	187.271	2.033
Q50	0.358	0.167	189.367	187.317	2.050
Q10	1.414	0.350	189.550	187.445	2.105
Q5	2.115	0.442	189.642	187.510	2.132

Who owns the obstruction and river banks?

Weir and River Channel Walls

Title:	Unknown
Forename:	
Surname:	
Position:	
Street:	
Town:	
County:	
Postcode:	
Country:	
Phone:	
Mobile:	
Fax:	
Email:	

Land along right bank (proposed site compound)

Title:	Mr
Forename:	Derek
Surname:	Bawn
Position:	Formaction Ltd
Street:	Glandwr Industrial Estate
Town:	Aberbeeg, Abertillery
County:	Gwent,
Postcode:	NP13 2LN
Country:	UK
Phone:	07970 441758
Mobile:	
Fax:	
Email:	

Land along left bank

Title:	Unknown
Forename:	
Surname:	
Position:	
Street:	
Town:	
County:	
Postcode:	
Country:	
Phone:	
Mobile:	
Fax:	
Email:	

3 Fish pass design & ownership details

3.1 Who has designed the fish pass?

Title:	Mr
Forename:	Marcus
Surname:	Phillips
Position:	Project Manager, CH2M Hill Halcrow
Street:	One Kingsway
Town:	Cardiff
County:	Cardiff
Postcode:	CF10 3AN
Country:	Wales
Phone:	029 2072 0920
Mobile:	
Fax:	029 2072 0880
Email:	Marcus.Phillips@ch2m.com

3.2 Who will own the fish pass?

Title:	Mr
Forename:	Michael
Surname:	Clyde
Position:	Natural Resources Wales Sustainable Fisheries Project Officer South East Wales Area
Street:	Rivers House, St Mellons Business Park
Town:	Cardiff
County:	
Postcode:	CF3 0EY
Country:	UK
Phone:	029 20245224
Mobile:	07795 333840
Fax:	
Email:	Michael.Clyde@cyfoethnaturiolcymru.gov.uk

3.3 Name of the lead Natural Resources Wales officer involved with this pass, if applicable?

Michael Clyde.

4 Fish species

4.1 Provide details of species for which the pass is designed. Indicate a size range for each fish species.

Species	Designed For Range (cms)
Salmon	Y
Sea Trout	Y
Brown Trout	Y
Eels	Y
Shad	N
Lamprey*	N
Grayling	Y
Coarse Fish*	Y
Others*	N

*List Species in each group

4.2 Identify any other species present at this site (for which passage would be desirable) and include the size of the fish?

N/A

4.3 Is there a need for the pass to operate 12 months of the year?

Yes

5 River discharge data and water level information

5.1 Please provide the annual river discharge hydrograph as a graph and/or table showing flow as cubic metres per second (m3s –1) against percentile exceedance value. Identify the gauging site from which the data originates, and if not at the structure itself state distance removed up or downstream and describe any interpolation used. If not gauged, state how it was estimated such as "generated from hydrometric software 'Low Flow 2000`" Annual discharge summary for river given as m3s-1 to two decimal places:

%tile exceedence	Annual Discharge (m^3s^{-1})
95	0.106
90	0.126
50	0.358
10	1.414
5	2.114

Flow estimates provided by Natural Resources Wales Hydrologist (Leah Simonds).

5.2 Range of river discharge over which pass is expected to operate

The proposed design involves constructing the Larinier pass to have an upstream invert level 0.07m below the crest level of the existing weir. A water depth of this value will have to be achieved within the Larinier fish pass before flow starts to overtop the retained weir. By ensuring all of the rivers flow will be diverted into the Larinier/Eel pass until a water head of 0.07m is achieved on the Larinier baffles reduces the required flow to achieve the lower operating limit of the Larinier pass, therefore widening the flow range in which fish will be able to successfully use the pass.

Table 5.1 provides a summary of the quantity of flow entering the Larinier/Eel pass and overtopping the retained weir at the percentile exceedance flows provided by Natural Resources Wales.

Table 5.1. Summary of the flows within the Larinier pass, eel pass and over the retained weir

%tile exceedance	Annual Discharge (m^3s^{-1})	Flow within the Larinier/eel pass (m^3s^{-1})	Flow overtopping existing retained weir (m^3s^{-1})
Q5	2.114	0.677	1.438
Q10	1.414	0.475	0.939
Q50	0.358	0.166	0.191
Q90	0.126	0.086	0.040
Q95	0.106	0.078	0.028

A summary of the upper and lower operating limits of the Larinier/eel pass is provided in Table 5.2. The EA Fish Pass Manual, page 121, states that the lower operating limit of the Larinier fish pass is when the mean water depth over the baffles in the pass (h) divided by the baffle height (a) is equal to 1.15. The baffle height in the proposed design is 0.1m, therefore h/a=1.15 is satisfied when the h is equal to 0.115m. This occurs when the river is subject to a flow of 0.160m³/s (0.095m³/s within the Larinier pass channel, 0.004m³/s within the Eel pass channel and 0.060m³/s overtopping the retained weir) which has an approximate percentile flow exceedance of Q84.

The upper operating limit of the Larinier fish pass is achieved when a water head on the most upstream baffle is equal to 0.6m. This occurs when the river is subject to a flow of 3.520m³/s which results in a flow of 1.058m³/s being present within the Larinier fish pass and a flow of 0.017m³/s within the eel pass. The flow of 3.520m³/s exceeds the Q5 flow of 2.114m³/s.

Table 5.2. Operating limits of the Larinier fish pass.

	Percentile	Total flow within the Ebbw Fach m^3s^{-1}
Lowest Flow	≈Q84	0.160
Highest Flow	>Q5	3.520

A summary of the upper and lower operating limits of the two downstream resting pools which will be created following the installation of the pre-barrages is provided in Table 5.3. The upper operating limits of the pools is where the power dissipation within the pools has a value of 200W/m³. The power dissipation (PV) has been calculated using the following equation, PV = (9810*Q*DH)/(L*W*Dm), where DH is the drop between pools and Dm is the mean depth of the pool. The PV value of 200W/m³ is exceeded in pool 2 at a Q10 flow (1.41.m³/s), this causes a PV value of 209.46W/m³. The PV value at the Q50 flow in this pool is 100.27W/m³, using interpolation between the two values the upper operating limit of the pool pass is estimated to be a flow of 1.32m³/s (Q13).

The lower operating limit is defined when the water depth within the pre-barrages low flow notch is equal to 0.2m. Both pre-barrages contain a 0.3m wide x 0.3m deep low flow notch. For a water depth of 0.2m within the low flow notch, the low flow notch must be subject to a flow of 0.04m³/s and this occurs at a flow of less than Q95.

Table 5.3. Pools downstream of weir - operating limits

	Percentile	**Total flow within the Ebbw Fach m^3s^{-1}**
Lowest Flow	<Q95	0.04
Highest Flow	≈Q13	1.32

Table 5.4 provides a summary of the operating limits of the proposed solution. The lower operating limit is equal to Q84, since this is the lower operating limit of the Larinier fish pass. The upper operating limit is the Q13 flow, when the power dissipation values within the most downstream pool exceeds 200W/m³.

Table 5.4. Operating limits of the proposed solution

	Percentile	**Flow within Larinier/eel pass m^3s^{-1}**	**Total river flow m^3s^{-1}**
Lowest Flow	≈Q84	0.099	0.160
Highest Flow	≈Q13	0.449	1.32

5.3 River water levels above ordnance datum (mAOD) corresponding with the flows identified in the previous question.

Table 5.5. Proposed water levels over the proposed extent of works at the solutions operating limits.

	Upstream Level	Tailwater Level	Estimated or measured*****
Lowest Flow (Q84)	189.315	187.279	Estimated/ calculated
Highest Flow (Q13)	189.537	187.436	Estimated/ calculated

These water levels have been obtained in accordance with the methods summarised in Section 2.5.

5.4 Is the fish pass for eel only?

No (please go to question 6)

6 Description of fish pass, operating flows, and intended operating periods

Plans and sectional elevations of all relevant parts of the pass and adjacent structures.

Drawing ref	Title
202165/GW/101	Location Plan
202165/GW/102	Services Drawing
202165/GW/201	General Arrangement
202165/GW/202	Long Section C-C
202165/GW/203	Section A-A
202165/GW/205	Details
202165/GW/210	Reinforced Concrete Channel Unit 1
202165/GW/211	Reinforced Concrete Channel Unit 2

Topographical Survey plan, long section and cross-sections

6.1 Type of fish pass

Larinier (Super-active Baffles) and pre-barrage easement.

6.2 Description of fish pass

A single flight Larinier pass is proposed to be constructed at the rivers right bank to provide fish passage upstream of the existing weir. The pass is to be set to have an average gradient of 12.9% (i.e. 1 in 7.74 gradient), with 100mm high, 10mm thick steel baffles. The reason for a varying gradient is that where possible the Larinier baffles will be fixed to the slope of the existing concrete weir, this reducing the amount of excavation and demolition work required. The fish pass is 1200mm wide with a further 70mm wide section to enable the installation of Eel bristles on the inner right bank face of the pass. The pass will be constructed within a reinforced concrete channel with side walls at least 500mm above the Larinier baffles.

At the upstream end of the pass, existing blockstones are to be lowered to create a rest pool to allow fish to rest at low flows. In order to ensure fish passage at low flows, the invert level of the Larinier pass is 189.20mAOD, 0.07m below the existing crest level of the weir, 189.27mAOD. Flow will only start to overtop the existing weir when the water depth within the Larinier pass is greater than 0.07m which is approximately 0.048m³/s.

To ensure a sufficient depth of water at the downstream entrance of the Larinier fish pass, two blockstone pre-barrages will be installed across the width of the low flow channel. The first pre-barrage will have a crest level of 187.84mAOD and will be installed 8m downstream of the first baffle in the Larinier fish pass. The second pre-barrage will be installed 9.76m downstream of the first pre-barrage with a crest level of 187.54mAOD. Both pre-barrages will contain a 0.3m wide x 0.3m deep low flow notch to maximise water depth to enable upstream fish passage.

At low flows downstream migration will be improved by providing a formal route (through the Larinier fish pass) for fish to migrate in. This will reduce potential injury to fish passing over the weir crest.

6.3 Describe why the pass was positioned at its proposed location and identify any constraints restricting the choice of location?

The proposed solution has been proposed at the right bank to:

- provide easier access for construction/ inspection/ maintenance from the proposed site compound on the right bank;
- tie in with the existing low flow channel along the right bank downstream of the weir;
- avoid the concrete apron along the left bank downstream of the weir;
- avoid services within the left bank; and
- avoid the inlets upstream of the weir along the left bank.

6.4 How is the pass location and operation designed to ensure that fish are attracted to the fish pass across the intended river discharge operating range.

The invert level of the Larinier fish pass is designed to be constructed 0.07m below the existing weir crest level. This will significantly reduce the flow required within the Ebbw Fach to satisfy the lower operating limit of the Larinier fish pass, therefore increasing the operating flow range of the proposed Larinier fish pass.

At the lower operating limit (Q84), the combined flow within Larinier/Eel pass is 0.099m³/s which is greater than the amount of flow overtopping the existing weir, therefore causing a greater attraction flow. At the upper operating limit the combined flow within the Larinier/Eel pass is equal to 0.449m³/s, the amount of flow overtopping the weir is equal to 0.874m³/s. However, the retained weir is 4.20m wide while the combined width of the Larinier/Eel pass is 1.27m (1.2m wide Larinier baffle, 0.07m wide Eel pass). The flow through the Larinier/Eel pass is more concentrated therefore causing fish to be attracted to the fish pass entrance rather than the flow overtopping the existing weir.

The pre-barrages are located downstream of the weir within the low flow channel along the right bank, during the known percentile flows all of the rivers flow will discharge via this channel and will be the only route for upstream fish migration. The pre-barrages will ensure fish are able to reach the downstream entrance to the Larinier/eel pass at low flows as they will ensure there is a sufficient depth of water for fish passage.

Table 6.1. The flows at the lower and upper operating limit within the proposed solution.

River discharge (m^3s^{-1})	Exceedance value (percentile)	Larinier pass discharge (m^3s^{-1})	Augmentation flow (if any) (m^3s^{-1})	Total attraction flow as % of river discharge
0.160	≈Q84	0.095	0.064	59
1.323	≈Q13	0.439	0.884	33

6.5 Describe any operating regime(s) or protocols for those nearby water control structures that may in any way affect operation of the pass.

Within the rivers left bank, inlets exist both upstream and downstream of the weir, however the proposed works will have no impact on the working condition of these structures whose purpose is unknown, they are however likely to be derelict.

6.6 Does the fish pass include a pool pass?

A pool pass is not proposed however two pre-barrages with intermediate resting pools will be constructed downstream of the Larinier/eel pass.

6.7 Describe how it is intended that the pool pass will operate to pass fish efficiently and effectively including the changing hydraulic conditions that will exist within it over the range of river discharge (window of fish migration) when is the pass is expected to operate.

The proposed pre-barrages downstream of the Larinier/Eeel pass will ensure there is a sufficient depth of water at the downstream entrance to the pass. The water level at the downstream entrance of the pass at Q95, 187.87mAOD, is 80mm higher than the invert level of the first baffle.

The pre-barrages will include 0.3m wide x 0.3m deep low flow notches, the most downstream pre-barrage will have a crest level of 187.54mAOD, thus the invert level of the low flow notch will be only 0.02m above the existing river bed level providing fish with an almost free passage to next resting pool. The other pre-barrage is 9.76m upstream with a crest level of 187.84mAOD, the invert level of the low flow notch is equal to the crest level of the downstream pre-barrage which will provide fish with the opportunity to swim into the next pool. The low flow notches will concentrate low flows, maximise water depth and increase the opportunity for upstream fish passage. The lower operating limit of the pre-barrage is when there is a water depth of less than 0.2m within the low flow notch, which occurs at a flow of 0.04m³/s which is less than the Q95 flow.

The resting pools are of sufficient size to adequately dissipate energy up to a flow of 1.32m³/s (Q13). At this flow the most downstream pool will contain a PV value of 200W/m³.

6.8 Summarise the operating conditions at the limits of operation in the following table;

Table 6.2. Summary of the pools at operating conditions.

	Pool 1	Pool 2	Tailwater
Length and width (m)	29.25m²	26.14m²	N/A
Min water level (mAOD) (Q84)	187.891	187.571	187.279
Max water level (mAOD) (Q13)	188.102	187.845	187.436
Min mean depth[b] (m) (Q84)	0.641	0.351	0.059
Max Mean Depth[c] (m) (Q13)	0.852	0.625	0.216
Head Difference Q84 (m)	0.000	0.320	0.292
Head Difference Q13 (m)	0.000	0.257	0.409
P/V Min (W/m³) (Q84)	0.000	54.732	N/A
P/V Max (W/m³) (Q13)	0.000	200	N/A

Numbered from upstream to downstream
[b] Occurring at lowest discharge – Minimum flow is taken as Q84 (0.160m³/s)
[c] Occurring at highest discharge – Maximum flow is taken as Q13 (1.323m³/s)

Head difference from the Larinier/eel pass is 0.00m as the proposed water level from pool 1 is higher than the calculated water level at the downstream end of the Larinier/Eel pass.

6.9 Does the fish pass include a baffle pass?
Yes

6.10 Describe how it is intended that the baffle pass will operate to pass fish efficiently and effectively including the changing hydraulic conditions that will exist within it over the range of river discharge (window of fish migration) when is the pass is expected to operate.
Refer to Drawing Nos: 202165/GW/201, 202, 203 and 205.

The single flight Larinier/eel pass will be constructed within a reinforced concrete channel. The pass is to be set to have an average gradient of 12.9% (i.e. 1 in 7.74 gradient) and is 12.16m long. The upper operating limit of the pass is when a flow of 3.520m³/s (>Q5) is present within the Larinier/eel pass, this is when the water head on the Larinier baffles equals 0.6m and becomes unsuitable for trout, coarse fish and large migratory salmonids. The lower operating limit of the Larinier fish pass is when h/a = 1.15 (h = mean depth over the baffles in the pass, a = the height of the baffle), this is achieved at a flow of 0.160m³/s which is approximately equal to a flow percentile exceedance of Q84.

The baffles will be 100mm high, 12mm thick galvanised mild steel baffles and will have a width of 1.2m wide section, along the length of the pass. The width of one baffle unit is equivalent to 0.6m, and the spacing between baffles is 0.26m.

6.11 Give details of the operating conditions at the limits of operation in the following table:

Table 6.3. Water levels at the upstream and downstream entrance to the Larinier/eel pass.

	Flow within Larinier pass (m^3/s)	Upstream Level (mAOD)	Tailwater Level (mAOD)	Estimated or measured*
Lowest Flow (Q84)	0.095	189.315	187.891	Estimated/ Calculated
Highest Flow (Q13)	0.439	189.537	188.102	Estimated/ Calculated

The tailwater levels are taken at the downstream end of the fish pass. At this location the downstream pre-barrages create a greater calculated tailwater depth than water depth of the flow passing through the Larinier pass, therefore the levels in table 6.3 correspond with the water levels of pool 1 in table 6.2.

Table 6.4. Larinier fish pass – operating conditions summary

Parameter	**Flight 1**
Upstream Pass Slope Invert Elevation (mAOD)	+189.13
Upstream Pass Hydraulic Invert Elevation (mAOD)	+189.20
Downstream Pass Slope Invert Elevation (mAOD)	+187.55
Downstream Pass Hydraulic Invert Elevation (mAOD)	+187.65
Head Difference of slope (m)	1.58
Length slope (m)	12.16
Slope (%)	Max 15, Min 9
Minimum hydraulic head, Ha, on **top** baffle (m)	0.115
Minimum hydraulic head, Ha on **tail** baffle (m)	0.241
Maximum hydraulic head, Ha, on **top** baffle (m)	0.337
Maximum hydraulic head, Ha on **tail** baffle (m)	0.452
Mean velocity at minimum pass flow (m/s)	1.05
Mean velocity at maximum pass flow (m/s)	1.4

*Ha is the hydraulic head over the invert of the baffle
Maximum heads are for Q13, which is the upper operating limit of the proposed solution.
Minimum heads are for Q84, which is the lower operating limit of the proposed solution.
Velocity calculated using EA Fish Pass Manual figure 31.
Slope of the fish pass varies as the profile of the existing weir will be retained in places.

6.12 Where resting pools are required please summarise details of the operating conditions in the table below.

No resting pools are proposed.

6.13 For combined passes and passes other than pool passes or baffle passes, please follow the principles outlined above in 7.7 – 7.12 to provide details of the proposal. See guidance notes for description of application requirements.

N/A

7 Eel passes

This section is only to be used for passes specifically designed to pass eels and elvers

7.1 Type of eel pass?

An open side channel with bristle substrate.

7.2 Description of eel pass?

Refer to drawing numbers 202165/GW/201, 202165/GW/202 and 202165/GW/203 and 202165/GW/205 for more details.

The eel pass will be located along the right bank of the reinforced concrete channel which includes the Larinier fish pass, separated by a 12mm galvanised steel dividing plate. The eel pass will consist of 1mm diameter gauge green polyester bristles mounted in tufts in 5mm holes spaced at 20mm centre to centre. The bristles will be mounted into a 10mm thick polypropylene board, the bristles will span 70mm from the face of the board. The board will be fixed to the base of the weir and the vertical wall of the concrete channel to create vertical bristles.

7.3 For pump feed passes only. Give details of the pump and associated infrastructure?

N/A

7.4 Describe why the proposed pass is planned to be installed at the location indicated and identify any constraints restricting the choice of location?

As described in Section 6.3 the weir is impassable for most fish species, including European eels. To provide access to breeding grounds upstream, the proposed eel pass will facilitate access to this upstream spawning area.

To ensure the least amount of possible work is carried out in this high risk setting as described in Section 6.3 and to maximise flows within the fish pass, the eel pass and larinier fish pass are proposed to be within the same concrete channel on the right bank edge.

7.5 Describe any operating regime(s) or protocols for nearby water control structures that may in any way affect operation of the pass.

N/A

7.6 Provide a summary of the operating conditions at the limits of operation in the table below.

Parameter	Flight 1
Upstream Pass Invert elevation (mAOD)	+189.13
Downstream pass invert elevation (mAOD)	+187.55
Head difference (m)	1.58
Length (m)	14.25
Slope %	15 Max

8 Monitoring and maintenance

This section to be filled in for all types of pass and intended species

8.1 Outline any proposals for monitoring the hydraulic and biological performance of the pass after construction.

Future monitoring of the pass and catchment is to be undertaken by Natural Resources Wales Fisheries Ops Delivery team. No formal monitoring equipment will be installed.
Natural Resources Wales Fisheries will monitor the pass effectiveness by reviewing fish data and records for the catchment.

8.2 Outline the procedures that will be put in place to ensure the structural and operational maintenance of the pass.

The pass will be operated and maintained by Natural Resources Wales Fisheries, supported by the Natural Resources Wales Operations Delivery team. A programme of maintenance and inspection will be determined by local management.

As recommended by Natural Resources Wales no provision has been made for access to the fish pass from the right bank (steps or ladder down onto the fish pass). The pass will be accessed during inspection, maintenance and clearing from the river upstream.

The location of the pass will make it difficult for the public to access, hence no covers or additional fencing will be provided to the fish and eel pass. No debris shield is to be installed as debris would accumulate without being readily able to shed downstream. Stop logs are to be installed at the upstream end of the pass to enable maintenance teams to control flow during maintenance of the pass.