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Southern Water's Water for Life: Hampshire

Technical Report 1: Review of Pipeline Watercourse Crossings for Water Recycling and Bulk Supplies

Report for Southern Water

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4	17/12/2021	Fourth draft	Claire Pitcher			Updated to take account of Southern Water Legal comments

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1 Introduction

1.1 Background

Water companies in England and Wales are required to produce a Water Resources Management Plan (WRMP) every five years. The Plan sets out how the company intends to maintain the balance between supply and demand for water over the selected planning horizon (minimum 25 years) in order to ensure security of supply in each of the water resource zones making up its supply area.

Following submission of WRMPs in 2019, Ofwat through the Price Review 2019 (PR19) Final Determination, has identified the potential for companies to jointly deliver strategic regional water resources solutions to secure long-term resilience on behalf of customers while protecting the environment and benefiting wider society. As part of the assessment of companies' PR19 business plans, Ofwat introduced proposals to support the delivery of Strategic Regional Water Resource Options (SROs) over the next 5 to 15 years with solutions considered to be 'construction ready' for the 2025-2030 period. Ofwat's Final Determination in December 2019 set out a gated process for the co-ordination and development of a consistent set of SROs.

This gated process provides a mechanism for the industry, regulators, stakeholders and customers to input into the development and scheduling of these strategic solutions, through a combined set of statutory and regulatory processes. These include the National Framework, Drinking Water Safety Plans, Business Plans and WRMPs

1.2 Southern Water's Strategic Challenge

The River Itchen, the River Test, and the Candover Stream are the three primary surface water resources utilised in Southern Water's Western Operating Area. In March 2019, the Environment Agency (EA) enacted sustainability reductions on all three sources, imposing new abstraction limitations to protect biodiversity in periods of drought. These reductions have fundamentally changed the water resources position in Hampshire and Isle of Wight (IOW) water resource zones (WRZs), and there is uncertainty regarding the potential for further changes in the future. The scale of the sustainability reductions is expected to generate sizeable supply-deficits during periods of severe drought.

Water supply modelling completed in development of Southern Water's WRMP, published in 2019, identified a 167 Ml/d supply-demand deficit across Southern Water's Western Operating Area during a 1-in-200-year drought scenario, accounting for the sustainability reductions referenced above. The WRMP19 preferred strategy included a 75Ml/d desalination plant in the Hampshire Southampton West (HSW) Water Resource Zone (WRZ). This was confirmed as the Base Case for the Gate 1 submission.

As part of the RAPID Gated process, Southern Water have been investigating a number of alternative Strategic Resource Options (SROs) to the Base Case including water recycling and alternative use of Portsmouth Water's Havant Thicket Reservoir. The Gate 1 work included a gap analysis and look ahead to activities required prior to the Gate 2 submission to further understand the environmental risks of progressing with the base case or alternatives.

As part of the RAPID Gate 2 submission, Southern Water is progressing the 'base case' (Fawley desalination) as well as eight potential alternatives, which are being considered in case the Base Case is not deliverable. These can be broken down into the following options, and are summarised in **Table 1.1**:

- Desalination alternatives
- Water recycling
- Water transfer

Table 1.1 Water for Life-Hampshire Strategic Solution Review

Solution	Configuration	Description
Desalination	**Base Case**	75Ml/d of drinking water produced by desalination plant in Fawley area supplying Hampshire Southampton West (HSW) Water Resources Zone with the interface between the new and existing distribution system located at Testwood WSW.

	A.2	61Ml/d of drinking water produced by desalination plant in vicinity of Fawley supplying HSW WRZ (as in Strategy A.1).
	A.3	75Ml/d or 61Ml/d of drinking wate produced by desalination plant at land parcel D55 supplying HSW WRZ with interface between the new and existing distribution system located at Otterbourne WSW.
Water Recycling	**B.2**	61 Ml/d recycled water from Water Recycling Plant (fed from [redacted] transferred to Lake Otterbourne environmental buffer and treated at Otterbourne WSW
	B.4	15 Ml/d recycled water from Water Recycling Plant (fed from [redacted] transferred to Havant Thicket Reservoir environmental buffer, with bulk supply to 61Ml/d, treated at Otterbourne WSW
	B.5	75 Ml/d recycled water from Water Recycling Plant (fed from [redacted] and [redacted] transferred to Lake Otterbourne environmental buffer and treated at Otterbourne WSW
Water Transfer Alternatives	**D.2**	75 Ml/d Alternative direct raw water transfer from Havant Thicket Impounding Reservoir to Otterbourne WSW

1.2.1 Risks identified at Gate 1

One of the key issues raised in the Gate 1 assessments, relating to the water recycling options (B.2, B.4 and B.5) and alternative use of Havant Thicket Reservoir (D.2) was the number of watercourse crossings potentially required for the pipeline connection infrastructure, and the resulting risk of impacts to priority chalk stream habitat and Special Areas of Conservation (SAC). The proposed pipeline connections extend from the Havant area to Otterbourne Water Supply Works (WSW), requiring the crossing of four main rivers (tributaries may also need to be crossed depending on final route selection). Extending east to west these watercourses are: River Wallington, River Meon, River Hamble and River Itchen. Two of these watercourses are, or will be, designated as SAC for their chalk stream habitat and species which they support: River Meon (compensatory habitat for Southern Water Drought Plan) and River Itchen. All four watercourses discharge into the Solent European Marine Site and a number of estuaries for which an attribute to support favourable conservation status is to maintain freshwater input ("*Structure: freshwater sources – maintain the natural freshwater flow/volume into the estuary*").

Natural England highlighted in the response to consultation on WRMP19 and during the preparation of Gate 1 material concerns with demonstrating that the pipeline crossings of watercourses will not alter flows not only to the watercourse itself, but also downstream into the estuaries, and will not cause disturbance of localised flows within adjacent wetland habitat, should these be crossed. Natural England also indicated that there is a cumulative issue to be addressed in terms of the requirement for numerous crossings of chalk stream priority habitat and associated floodplains.

1.2.2 The Strategic Resource Options

The remit of this document (described in **Section 1.4**) is to support pipeline route selection and refinement, and look at the potential water crossing locations for the various pipelines associated with each SRO. The SROs being considered within this report are:

- A3 Meon desalination (alternative location to Base Case).
- B2 Water recycling [redacted] to Otterbourne Water Supply Works (WSW) via Lake Otterbourne environmental buffer.
- B4 Water recycling [redacted] to Otterbourne WSW via Havant Thicket Reservoir environmental buffer.
- B5 Water recycling [redacted] to Otterbourne WSW via Lake Otterbourne environmental buffer.

- D2 Havant Thicket Reservoir alternative bulk supply.

The pipeline routes being considered are shown in **Figure 2.1, Section 2**.

[redacted] east, to avoid the New Forest SAC, Special Protection Area (SPA) and Ramsar. The WFD and HRA of the WRMP19 had looked at the surface flow vectors in the crossing locations to provide an initial assessment.

1.3 Other Bulk Supplies

Within Southern Water's WRMP19 and the wider Water for Life Hampshire (WfLH) programme, two other pipeline routes are identified in a similar area and have therefore been considered further within this report:

- Southampton Link Main: [redacted].
- Gater's Mill pipeline: from Portsmouth Water's [redacted]

Both pipelines are required to transfer water resources across Southern Water's Western Water Resource Zone (WRZ).

The Southampton Link Main is an option to transfer water between Testwood WSW and Otterbourne WSW, with no new abstractions or discharges required. A detailed pipeline route for a similar link between the two WSWs was designed to a level suitable for submission as part of a planning application in c.2016, although this wasn't progressed. A key issue was the extension of the pipeline from Testwood WSW through the lower River Test flood meadows which is functionally linked to the Lower Test Valley Site of Special Scientific Interest (SSSI), and through a section of the Solent and Southampton Water SPA and Ramsar, close to Weston Corner. Although the River Test is currently only designated a Site of Special Scientific Interest (SSSI), consultation with Natural England for the Strategic Resource Options, confirmed that the watercourse could be designated a SAC, if used as part of compensation package for Southern Water's Drought Plan 2019.

The Gater's Mill pipeline is required to transfer 23Ml/d additional water from a bulk supply provided by Portsmouth Water, using the Havant Thicket Reservoir. The existing pipeline between [redacted] has insufficient capacity to transport this water, and therefore a new pipeline is required. A route was developed at WRMP19, however this required the River Itchen SAC to be crossed multiple times, and as such significant concerns were raised by Natural England as to whether this could be constructed without affecting the integrity of the SAC. As part of an ongoing route refinement process, Southern Water have identified an alternative route, which extends further east, and therefore avoids crossing the River Itchen SAC multiple times.

The wider Western Grid bulk supply pipeline routes are represented in **Figure 1.1** below. The pipeline routes being considered in this report are shown in **Figure 2.1, Section 2**.

A number of other strategic bulk supply routes are included in the Water for Life: Hampshire (WfLH) programme and wider Western Grid, such as the Candover Drought Order and Hampshire Grid Main. These pipeline routes have not been considered within this report as they are at different stages in their optioneering, design and confirmation of construction techniques. For example, the Candover Drought Order is being prepared for a planning application, with supporting Environmental Statement, for autumn 2021 and will utilise pipe bridges for the majority of the route. On the other hand, the Hampshire Grid Main is not in a similar locality to the other bulk supplies, although it will require crossings of the River Test. This pipeline extends north west from Otterbourne WSW, and therefore there is no opportunity to combine the crossing locations with the Southampton Link Main.

The Gater's Mill and Southampton Link Main were included in the report to provide data early on in the design process for these schemes. The Gater's Mill routing demonstrates the change in routing proposed since WRMP19. The Southampton Link Main uses the previously proposed route to assess risk, however this scheme is undergoing further optioneering, which could ultimately change the start and end points of the pipeline route.

Figure 1.1 Water for Life Hampshire bulk supply pipeline routes

1.4 Purpose of this Report

This report documents a desk-based exercise undertaken to determine the environmental sensitivity of the watercourse crossings for both the RAPID SROs (water recycling and bulk supply) and also other bulk supply pipelines identified as part of Southern Water's WfLH programme.

To support the Gate 2 process for the SROs, the results of the work have been shared with [redacted] and Southern Water to assist in the completion of the Stage 4 site selection and route optioneering work. The need for further pipeline route refinement, survey work and investigations was highlighted. Following completion of Stage 4, and confirmation of the pipeline routes selected as part of the configuration of each option for the purposes of option appraisal being completed for Gate 2, detailed mapping of the crossing points has been provided to inform further pipeline route refinement. These are shown in **Appendix A4**.

A cumulative assessment of all the pipeline routes within the WfLH programme has not been completed at this stage, as it cannot be undertaken accurately, and will therefore be completed for Gate 3. As discussed in Section 1.2 and 1.3, further optioneering of the routes is ongoing, including hydraulic modelling and initial survey work, and the final SRO has yet to be selected. Construction and operation of the pipelines in the WfLH programme have very similar timescales. The design principles being used by the WfLH Engineering team, and the principles of the methodology provided in this report, will inform the in combination assessment, once pipeline route corridors are more accurately defined.

This report comprises the following sections:

- Section 1: Introduction (this section)
- Section 2: Approach and Methodology
- Section 3: Assumptions and Limitations
- Section 4: Review of Watercourse Crossings
- Section 5: Route Optimisation to Reduce 'Red' Watercourse Crossings
- Section 6: Review of SRO Stage 4 Site Selection Routes
- Section 7: Conclusions

2 Approach and Methodology

2.1 Approach

The study area has been defined based on the extents of the eastern, western and northern pipeline buffer boundaries and the location of the coast to the south. The study area has been extended outside the remit of the RAPID SROs under consideration, to include the components to and from the Havant Thicket Reservoir, and the [redacted] pipeline route required for WRMP19 options (B1 Lower Itchen having been discounted from the Gated process).

The study area for the Southampton Link Main has been identified using the pipeline route previously assessed in WRMP19, extended upstream along the River Test to Romsey. Further upstream from here, the river is split into numerous channels, therefore requiring multiple crossings and increasing the potential impacts. The railway line and other infrastructure constraints are likely to prohibit crossing the River Test further north than Romsey.

The potential pipeline routes that have been assessed[1] are shown in **Figure 2.1**.

The desk-based assessment has been undertaken as follows:

- Watercourses have been located using OS Open Data, specifically OS Open Rivers and OS Open Zoomstack.
- In-river features and habitats and their potential sensitivity to change from a pipeline crossing have been characterised using a range of existing survey data including River Habitat Surveys (RHS), River Corridor Surveys (RCS) and Fluvial Audits where available. Also, existing aerial imagery and ground imagery (e.g., as provided by Google Earth and Google Street View) has been used to augment the data.
- Riparian habitats have been characterised using a combination of existing survey data (e.g., RHS, RCS) and other information, e.g., GIS data, extant aerial imagery etc. Riparian flood zones have been considered using existing Environment Agency GIS flood zone data.
- The bedrock and superficial geology of the study area has been defined using British Geological Survey (BGS) 1:50,000 digital mapping served as WMS through GIS. Faulting and folding have been also been identified using these data. Other structural data, namely bedrock dips, which have been used to help develop an understanding of localised groundwater flow directions, have been taken from scans of BGS 1:50,000 geological maps which are freely available online by the BGS.
- An understanding of the surface gradients, and therefore likely runoff directions, around river pipeline crossings has been constructed using available digital elevation model (DEM) data. In this case 1m LiDAR data was used. OS Terrain 50 (50m resolution DEM) was used to understand wider catchment hydrology and derive understanding of Stream Power Index for each watercourse.
- Hydrogeological information within the study area was developed using existing BGS 1:625,000 hydrological mapping information served as WMS layers and supported by analysis of existing BGS scanned maps on hydrogeology (e.g., 1:100,000 Hydrogeological map of Hampshire and Isle of Wight).
- Information on the groundwater head and flow directions, both generally along the pipeline routes and where pipeline crossings are located, was derived from the analysis of a combination of existing BGS borehole logs for boreholes drilled adjacent to pipeline crossings and the collated hydrogeological information. Such data will allow optimal siting of the pipeline so as not to disrupt groundwater flows to or around a watercourse or habitat and also to ensure the pipeline is located as far above the groundwater surface as possible.
- Habitat information has been gained from various freely available GIS boundary sources, including statutory and non-statutory designated sites, AONB and National Parks and the

[1] Indicative corridor designs from Southern Water WfLH [redacted]. Gater's Mill and Southampton Link Main taken from WRMP19 shapefiles.

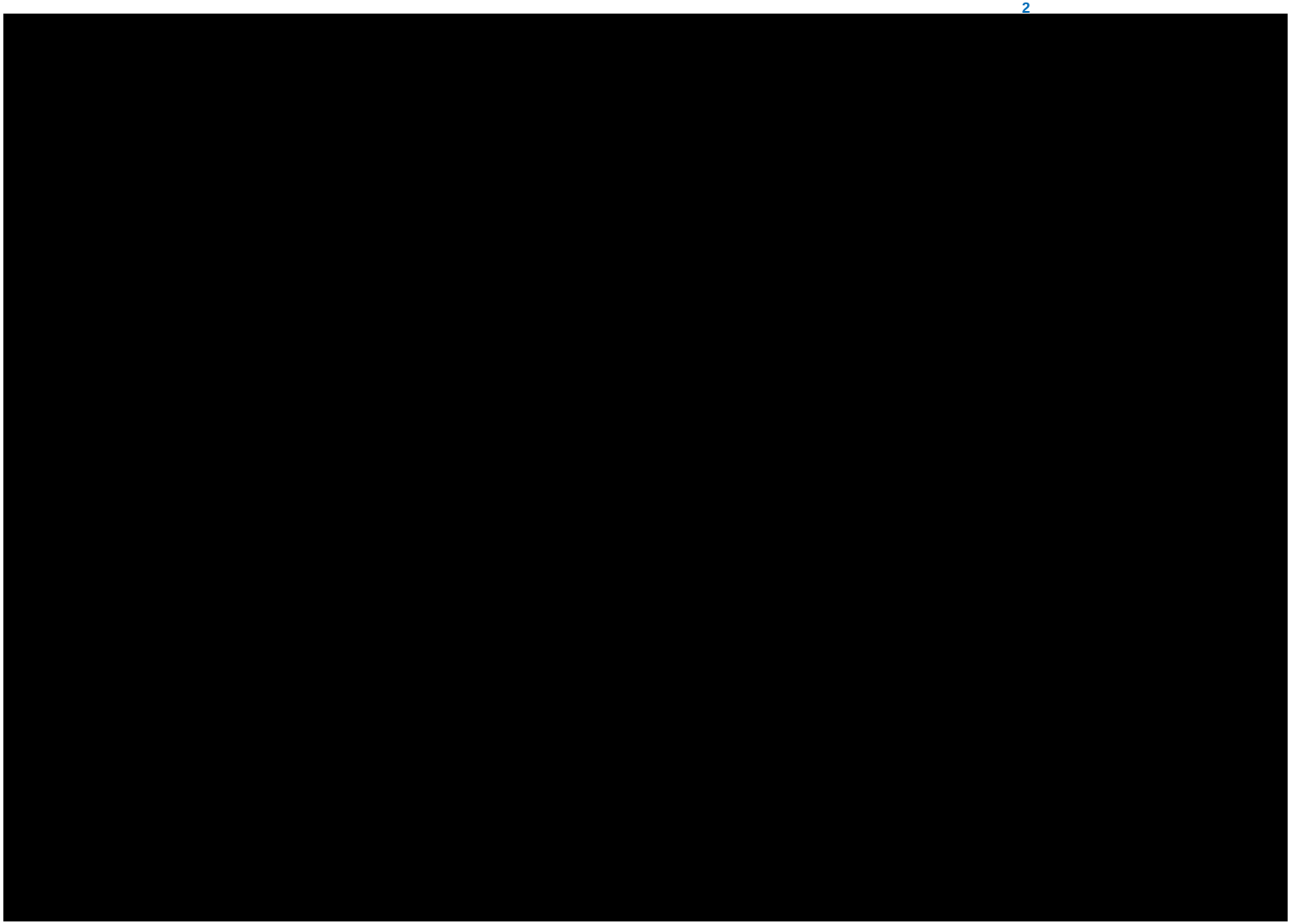
Priority Habitat Inventory for England, Groundwater Dependant Terrestrial Ecosystems, ancient woodland etc and the APEM aerial survey work.

Using the aforementioned data, the key aim has been to assess whether the river crossings for each pipeline route are positioned in a location which leads to the least impact on the watercourse, its riparian areas and the habitats supported in these areas at the crossing location, as well as downstream in the estuarine and coastal zone of these watercourses. Additionally, the hydrogeological information, where available, has been used to ensure that impacts to subsurface flows to the rivers or habitats are not impacted by the crossing.

Finally, where a crossing is shown to have an impact, the collated data has been used to suggest an alternative crossing location with a lower impact.

This assessment does not negate the need to undertake field studies and surveys, including hydrological and geomorphological assessment alongside a suite of ecological surveys, to establish a robust baseline against which impacts can be assessed. It is rather trying to identify areas of significant risk and inform the ongoing route selection and refinement process. Further route optimisation will be required during scheme development of the Selected Option at Gate 3, not only for the watercourse crossings, but along other lengths of the pipeline where priority habitats and locally designated sites may be crossed. This further work will then inform the need for mitigation and/or compensation for habitat losses.

Figure 2.1 [2]



[2] Multiple pipeline routes follow the same path at some point along their route. These are overlaid on the map as it is very difficult to show these overlaps clearly. Individual routes are mapped in Section 4.

2.2 Methodology

The methodology used covered three specific areas; analysing data over the pipeline route, creation of an exclusion map and categorising pipeline crossings into risk classes. These are discussed separately below.

Geospatial analyses were undertaken using QGIS[3] (v3.18.1), SAGA GIS[4] (v7.8.1) and Whitebox GAT[5] (v3.4.0).

2.2.1 Pipeline Route Data

Multiple geospatial datasets were used to understand surface and subsurface features in order to characterise the potential impact of pipeline watercourse crossings. These data, their sources, associated licence attributions and general use are presented in **Table 2.1**.

Table 2.1 Pipeline route data used in the pipeline crossing assessment

Data set	Source	Attribution	Use
OS Open Zoomstack	Ordnance Survey OS OpenData, (2020).	Contains OS data © Crown Copyright [and database right] (2021).	Geographical feature location and identification and watercourse identification.
OS Terrain 50 50m resolution digital elevation model	Ordnance Survey, (2020).	Contains OS data © Crown Copyright [and database right] (2021).	Understand surface elevation and general catchment characteristics.
National LiDAR 1m digital terrain model	Environment Agency, (2021).	© Environment Agency copyright and/or database right 2015. All rights reserved.	Characterise surface elevation and derive surface slope vectors to understand surface water flow directions adjacent to pipeline watercourse crossings.
Groundwater Source Protection Zones	Environment Agency, (2016).	© Environment Agency copyright and/or database right 2016. All rights reserved.	Understand the location and extent of existing groundwater Source Protection Zones.
1:625,000 hydrogeological map of the UK	BGS, (2021).	Contains British Geological Survey materials © UKRI [2021]	Characterise the gross hydrogeology of the area and the aquifer potential of the geology.
1:50,000 scale bedrock, superficial and structural geology mapping	BGS, (2021) (as WMS).	Contains British Geological Survey materials © UKRI [2021]	Understand geological makeup and structure of the area. Also used in combination with hydrogeological data to understand groundwater potential.
Borehole records	BGS, (2021).	Contains British Geological Survey materials © UKRI [2021]	Interpretation of ~50 borehole logs to understand superficial geology thickness, depth to bedrock and presence and depth of groundwater in order to define any groundwater flow directions.

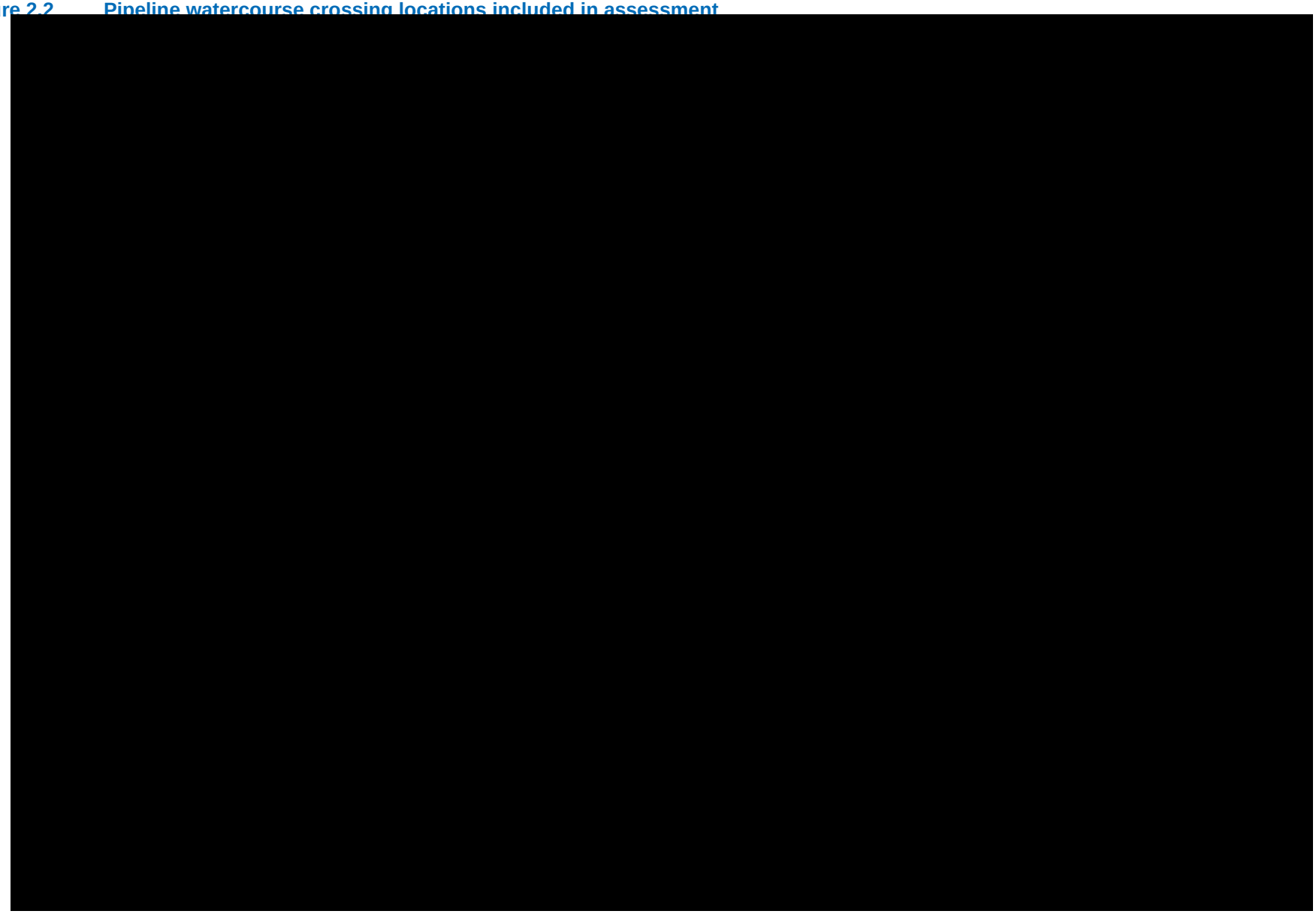
[3] QGIS Development Team. (2021). QGIS Geographic Information System. Open Source Geospatial Foundation Project. Retrieved from http://qgis.osgeo.org
[4] Conrad, O., Bechtel, B., Bock, M., Dietrich, H., Fischer, E., Gerlitz, L., Wehberg, J., Wichmann, V., and Bohner, J. (2015): System for Automated Geoscientific Analyses (SAGA) v. 2.1.4, Geosci. Model Dev., 8, 1991-2007, doi:10.5194/gmd-8-1991-2015.
[5] Lindsay, J.B. (2017). Whitebox Geospatial Analysis Tools.

Data set	Source	Attribution	Use
Hydrogeological Map of Hampshire and the Isle of Wight (1979)	BGS, (2021).	Contains British Geological Survey materials © UKRI [2021]	Characterisation of hydrogeology of the study area.
River Habitat Survey summary data	Environment Agency, (2019).	© Environment Agency copyright and/or database right 2019. All rights reserved.	Limited summary dataset, used to understand general features of watercourses adjacent to pipeline watercourse crossing points.
WFD RBMP2 waterbodies	Environment Agency, (2019).	© Environment Agency copyright and/or database right 2016. All rights reserved.	Used to understand current WFD classification and which waterbodies crossings lay within.

These data were used to contribute towards defining the final risk for each pipeline watercourse crossing as well as to understand potential areas for relocation of high risk pipeline watercourse crossings in order to reduce the overall risk to the fluvial and estuarine environment.

The location of pipeline crossings was determined by using OS Open Rivers data and undertaking a line intersection of all current proposed pipeline routes. Where these two datasets intersected, a pipeline crossing was taken to occur. Each crossing was given a unique identifier based on the name of the main watercourse it was crossing and an incrementing number starting at one (see **Appendix A1** for full list of watercourse crossings by pipeline route). In total there are 117 pipeline watercourse crossings (**Figure 2.2**) for all of the pipeline routes currently under consideration. However, this reflects the multiple route options currently being considered in respect of multiple alternative SRO options, and will be reduced significantly once a single preferred option. Although most pipeline routes will therefore be mutually exclusive, a cumulative assessment will be required once the routes are refined, as the Gater's Mill and Southampton Link Main will be required, alongside the final chosen SRO route.

Figure 2.2 Pipeline watercourse crossing locations included in assessment



2.2.2 Exclusion Map

The exclusion map provides a collation of all key information within the pipeline route and adjacent area into a single raster layer which provides information on the presence of key features which could be impacted by pipeline construction. Of key interest are habitat features with dependency on surface or groundwater and within which pipeline construction could have significant negative impacts for current and future habitat quality. The steps in creating this exclusion map were:

- Creation of a zero-filled 1m resolution raster over the pipeline route area.
- Scoring of all key features for inclusion in the exclusion map followed by rasterisation of each key feature.
- Cumulative summation of each key feature raster (initially to the zero-filled 1m raster and then to the subsequent output raster from each summation step) to produce the final exclusion map.

The key features used in the exclusion map are outlined below:

- **Designated sites –** these include Local Nature Reserves (LNR), National Nature Reserves (NNR), Sites of Special Scientific Interest (SSSI), Special Areas of Conservation (SAC), Special Protection Areas (SPA) and Ramsar sites. They represent areas where negative potential ecological impacts from pipeline construction are extremely high and therefore should be avoided.
- **Priority Habitat Inventory –** these cover priority habitats which fall within the study area based on the Natural England Priority Habitat Inventory (PHI) data and where pipeline construction could lead to potential impacts on these habitats, particularly those associated with surface water and groundwater dependant features. which are categories which fall within study area. For the "*No main habitat but additional habitats present*" category these were reclassified using dominant habitat identified within the PHI dataset.
- **BGS superficial deposit thickness –** these data are derived from the BGS and represent the average superficial deposit thickness as a 1km resolution cell. They provide an understanding of the general thickness of superficial geology across the site. For thinner superficial geology beneath a watercourse this could mean a greater risk for bed destabilisation and subsequent negative impacts to a watercourse due to the construction of the pipeline. The data is only applied around watercourses and is determined based on a 250m buffer.
- **Ancient Woodland** – identifies the location of ancient woodland.
- **Stream Power Index** – the Stream Power Index was calculated by geoprocessing using the OS Terrain 50 DEM. It is used to identify areas of high stream power which may have higher erosion potential which could have increase energy to erode the bed and banks (especially if destabilised by pipeline construction activities) and therefore may not represent a sensible option to cross a watercourse. The data applies to watercourses only and is clipped to watercourses using a 100m buffer. The entire catchment area of all watercourses which are crossed by pipelines were included in the analysis.
- **National Forestry Inventory 2018** – provides the location of woodland (area over 0.5ha with minimum 20% canopy cover or the ability to achieve this and a minimum width of 20m). Data overlays on Ancient Woodland to further emphasise the importance of ancient woodland.
- **Surface waterbodies** – based on OS Open Zoomstack surface water data and encompasses lakes and ponds.

A list of the sources and required licence attributions for each of these datasets are presented in **Table 2.2**.

Table 2.2 Exclusion map data sources and licence attributions

Data set	Source	Attribution
Priority Habitat Inventory	Natural England (2020).	© Natural England copyright. Contains Ordnance Survey data © Crown copyright and database right [2021].
Superficial deposit thickness (1Km Hex-Grid) dataset	British Geological Survey, (2016).	Contains British Geological Survey materials © UKRI [2021].
Ancient Woodland (England)	Natural England (2020).	© Natural England copyright. Contains Ordnance Survey data © Crown copyright and database right [2021].
Ordnance Survey: Terrain 50 50m resolution digital elevation model	Ordnance Survey, (2020).	Contains OS data © Crown Copyright [and database right] (2021).
National Forestry Inventory 2018	Forestry Commission, (2020).	Contains, or is based on, information supplied by the Forestry Commission. © Crown copyright and database right 2019 Ordnance Survey [100021242]
OS Open Zoomstack	Ordnance Survey OS OpenData, (2020).	Contains OS data © Crown Copyright [and database right] (2021).

The scores applied to each key feature are outlined in **Table 2.3**. The scores were selected in order to ensure that key features were rapidly excluded due to the cumulative effects of summing the scores.

Table 2.3 Exclusion map feature scoring

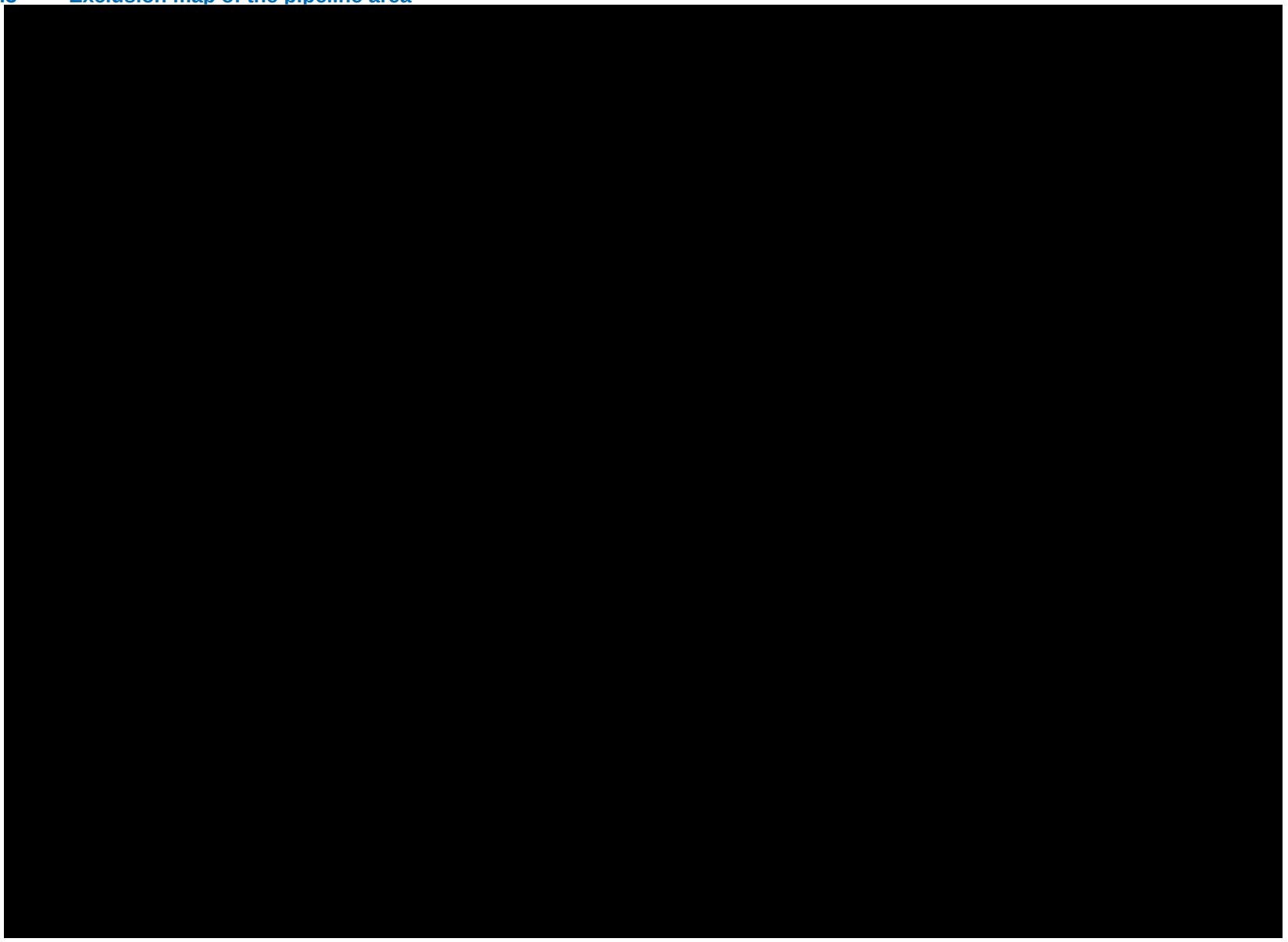
Feature	Individual categories	Score	Reasons for score
Designations	LNR, NNR, SSSI, SAC, SPA and Ramsar[6]	1000	Score is based on the ecological and habitat importance of these sites and the need to avoid these during pipeline construction to prevent negative impacts.
Priority Habitat Inventory	Coastal and floodplain grazing marsh[7]	100	Scores based on importance of the habitat and its potential sensitivity to disturbance and changes in surface or groundwater. Higher the score the greater the sensitivity and the more it should be avoided.
	Coastal saltmarsh	500	
	Coastal vegetated shingle	50	
	Deciduous woodland	100	
	Good quality semi-improved grassland	50	
	Lowland calcareous grassland	100	
	Lowland dry acid grassland	100	
	Lowland fens	500	
	Lowland heathland	100	
	Lowland meadows	100	
	Maritime cliff and slope	50	
	Mudflats	500	
	Purple moor grass and rush pastures	500	
	Reedbeds	500	
	Saline lagoons	500	
	Traditional orchard	100	
BGS superficial	0-1m thickness	100	Scores based on thickness of superficial material. The thicker the material the lower the score which
	1-2m thickness	50	

[6] Including potential and candidate sites where identified in publicly available datasets.
[7] Coastal floodplain and grazing marsh was scored slightly lower (second highest category in the scoring) because it's very difficult to define any groundwater and surface water connectivity with confidence without further baseline evidence. The hydrological connectivity at this stage is uncertain. Further information is required to determine the relation between these habitats and groundwater and watercourses (established through local geology, elevation and distance from surface waters) to better refine the scores.

Feature	Individual categories	Score	Reasons for score
deposit thickness	2-4m thickness	25	represents a decreasing risk for destabilisation of the subsurface beneath and adjacent to a watercourse from construction of a pipeline crossing.
	4-9m thickness	10	
	9-21m thickness	5	
Ancient Woodland (England)	Presence	1000	Score is based on the importance of the habitat and so is set high to maintain exclusion at all times. Also cumulative with National Forestry Inventory data to further highlight importance and need to exclude the area from any construction.
Stream Power Index	0-104	2	Scores based on analysis of percentile data distribution across the calculated Stream Power Index raster grid. Higher score means higher stream power and therefore higher potential for erosion by the river.
	104-900	20	
	>900	100	
National Forestry Inventory 2018	Presence	500	Scored based on importance of woodland and need to maintain woodland integrity.
Surface waterbodies	Presence	500	Scored based on importance of habitats and fact that constructing pipeline through these would be extremely difficult and likely destroy habitat.

The resulting exclusion map is shown in **Figure 2.3**. Some of the smaller tributary watercourses on which there are pipe crossings are excluded to make the map clearer.

Figure 2.3 Exclusion map of the pipeline area



For **Figure 2.3**, the higher the score means a greater the need to avoid a site due to the presence of important habitats or features which could lead to degradation or could be unsuitable for pipeline construction.

The exclusion map forms a key data set to understand the current potential impacts of each watercourse crossing, with scores in the exclusion map being used to represent the risk of the watercourse crossing.

2.3 Pipeline Crossing Impact Categorisation

For each pipeline crossing a series of key data were identified:

- Pipeline crossing ID.
- Watercourse being crossed.
- BGS hydrogeology and aquifer potential.
- BGS superficial deposit depth.
- Surface gradient vectors.
- BGS borehole data showing superficial thickness, depth to bedrock and presence and depth to any groundwater.
- Exclusion map score at pipeline crossing point and maximum score within 25m of pipeline crossing.

These data have been combined to categorise the potential impacts of various pipeline crossings as either green (low impact), amber (moderate impact) or red (high impact). The categorisation is based on a hierarchy, using the exclusion map scores within 25m of the pipeline watercourse crossing as the key impact metric and weighting these scores with the hydrogeological information and the surface gradient vectors. The 25m score has been selected to allow for the potential working easement of a pipeline crossing and it also provides an understanding of the potential for relocating the pipeline several tens of meters upstream or downstream from the selected crossing point.

For the purposes of the assessment the exclusion map scores have been categorised to represent these three impact categories. The break-down of the exclusion map into these categories is defined with reference to the scoring system (**Table 2.3**) and is also visualised in **Figure 2.4**:

- **≤120** = Green (low potential impact).
- **>120 - ≤300** = Amber (moderate potential impact).
- **>300** = Red (high potential impact).

Weighting based on the hydrogeology information and surface gradient vectors will be applied to green and amber category crossings. Where these weights indicate that there is an increased potential for impacts, for example both groundwater flow directions and surface flow directions indicate potential impacts to a watercourse, then the rating will be increased by a category. Any crossings identified as Red based on the exclusion map score will not be weighted and will remain unchanged.

A full list of the individual data and their associated impact scores for all watercourse crossings is provided in **Appendix A2**.

The findings of the impact scoring are presented in **Section 4.**

2.4 Consultation

A draft of this report was provided to Natural England and the Environment Agency at the beginning of June 2021. Full regard has been given to feedback and comments provided and where appropriate, the report has been updated to reflect the comments and provide greater clarity on the assessment. A comments log is provided in **Appendix A3** documenting how the comments have been addressed.

Figure 2.4 RAG rated exclusion map

3 Assumptions and Limitations

There are a number of assumptions and limitations to the approach which should be considered alongside the conclusions derived from the investigation. Briefly these are:

- The pipeline routes that have been assessed are indicative only, and generally straight lined in nature, such that at the scale of mapping and with the definition available, there is still a level of uncertainty as to whether habitats will be intersected or not.
- The assessment is desk based only. Site specific survey work (ecological, geomorphological and hydrological) will be required to refine the routes and confirm impacts. Survey work is due to commence in late 2021/2022.
- Scoring information used to classify potential impacts across the pipeline route and crossings is semi-quantitative and is based, for the most part, on the perceived importance of a habitat, e.g., importance of a habitat type or designation. For more numerical data, e.g., superficial depth, Stream Power Index, the scores are based on statistical analysis of the distribution of the data through the pipeline area.
- Analysis of the BGS borehole logs located along the pipeline route adjacent to the watercourse crossings indicated that information on groundwater water levels during coring, the thickness of the superficial deposits and depth to the bedrock rockhead were relatively limited. It could not be ascertained if this lack of information was due to the presence of no groundwater or this information not being recorded (however coupled with BGS 1:625,000 scale information suggests it could be a combination of both). This meant that there is only limited information to characterise geology and groundwater presence and flow direction at the scale of the watercourse crossings.
- BGS hydrogeological maps of the area provided limited information on groundwater flow directions due to the low to no productivity of most of the aquifers along the pipeline route. Where information was available these data were coarse due to the spatial scale of the mapping.
- Depth to superficial deposit data is based on 1km grid cell data derived by the BGS. While a coarse resolution this is a suitable dataset, specifically as many of the BGS boreholes did not contain sufficient information to accurately measure the depth to the bedrock and the thickness of any overlying superficial material.
- Data on the geomorphology, hydrology, ecology and dimensions of each indicated pipeline crossing is not available, specifically as this is a high level overview. However, for each crossing aerial imagery and surface and subsurface features have been used alongside other available information, such as RHS, to integrate an understanding of these features at each crossing. Regardless, these individual features will need to be considered in significantly greater detail in the field prior to finalisation of a pipeline crossing for the Selected Option, to fully understand the per site risk both now, during construction and in the future when pipelines are in place.

4 Review of Watercourse Crossings

As noted above, impacts have been categorised for each of the 117 pipeline watercourse crossings. The full table of impacts for all crossings is presented in **Appendix A2**. Summary counts for the watercourse impact scores indicate there are:

- **Green** impact = 34 crossings.
- **Amber** impact = 30 crossings.
- **Red** impact = 53 crossings.

While these scores are indicative and even if a site is classed as a low impact, good construction and pollution prevention practices and utmost consideration for the river, its supporting habitats and surrounding habitats, should be undertaken at each and every watercourse crossing.

The crossings with the highest red impacts are presented below for each pipeline route (**Table 4.1** – **4.13**). The impact score ratio is the ratio between the maximum impact score at 25m from the crossing point with the impact score at the site of the crossing point. Impact score ratios of greater than 5 have been highlighted in grey in **Table 4.1** – **Table 4.13** below, indicating crossings which are likely not to require any significant route modification but would likely require other processes to be implemented (e.g., good construction practices) to protect the high quality habitats adjacent to these sites.

Where the crossings are identified as having greater impacts, Section 5 provides potential alternative routing to be considered during route refinement once a preferred SRO has been selected.

4.1 Alternative Desalination SRO Location: A3 Meon Desalination to Otterbourne WSW

4.1.1 Route 1

The watercourse crossings identified for Meon to Otterbourne Route 1 are presented in **Figure 4.1**.

Figure 4.1 A3 Meon Desalination to Otterbourne WSW: Route 1 pipeline watercourse crossing potential impacts

There are a total of 16 watercourse crossings associated with the Meon desalination to Otterbourne WSW Route 1 pipeline. Of these, eight are green, one is amber and seven are red impact rating. The crossings with the red (highest) impacts are presented below in **Table 4.1** (information on the amber crossing points provided in the appendices).

Table 4.1 Red impact watercourse crossings for A3 Meon Desalination to Otterbourne WSW: Route 1

Pipeline crossing ID	Crossed watercourse	WFD WB name and ID	Aquifer hydrogeology and flow mechanism	Surface water gradient vectors at crossing	Impact score at crossing point	Max impact score within 25m of crossing point	Impact score ratio
Ham_01	River Hamble	Main River Hamble (GB107042016250)	Essentially no groundwater	Towards	100	600	6.0
Itc_08	River Itchen	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2625	2625	1.0
Itc_09	Rosemary Leet	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2025	2525	1.2
Itc_10	The Itchen Navigation	Itchen (GB107042022580)	Highly productive (fracture)	Away	2625	2625	1.0
Itc_39	Kingfisher Stream	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2625	2625	1.0
Itc_40	Ditch (Rosmary Leet)	Itchen (GB107042022580)	Highly productive (fracture)	Towards	625	2625	4.2
Itc_41	Ditch (The Itchen Navigation)	Itchen (GB107042022580)	Highly productive (fracture)	Towards	2645	2645	1.0

4.1.2 Route 2

The watercourse crossings identified for Meon to Otterbourne Route 2 are presented in **Figure 4.2**.

Figure 4.2 A3 Meon Desalination to Otterbourne WSW: Route 2 pipeline watercourse crossing potential impacts

There are a total of 16 watercourse crossings associated with the Meon desalination to Otterbourne WSW Route 2 pipeline. Of these, eight are green, one is amber and seven are red impact rating. The crossings with the red (highest) impacts are presented below in **Table 4.2**.

Table 4.2 Red impact watercourse crossings for A3 Meon Desalination to Otterbourne WSW: Route 2

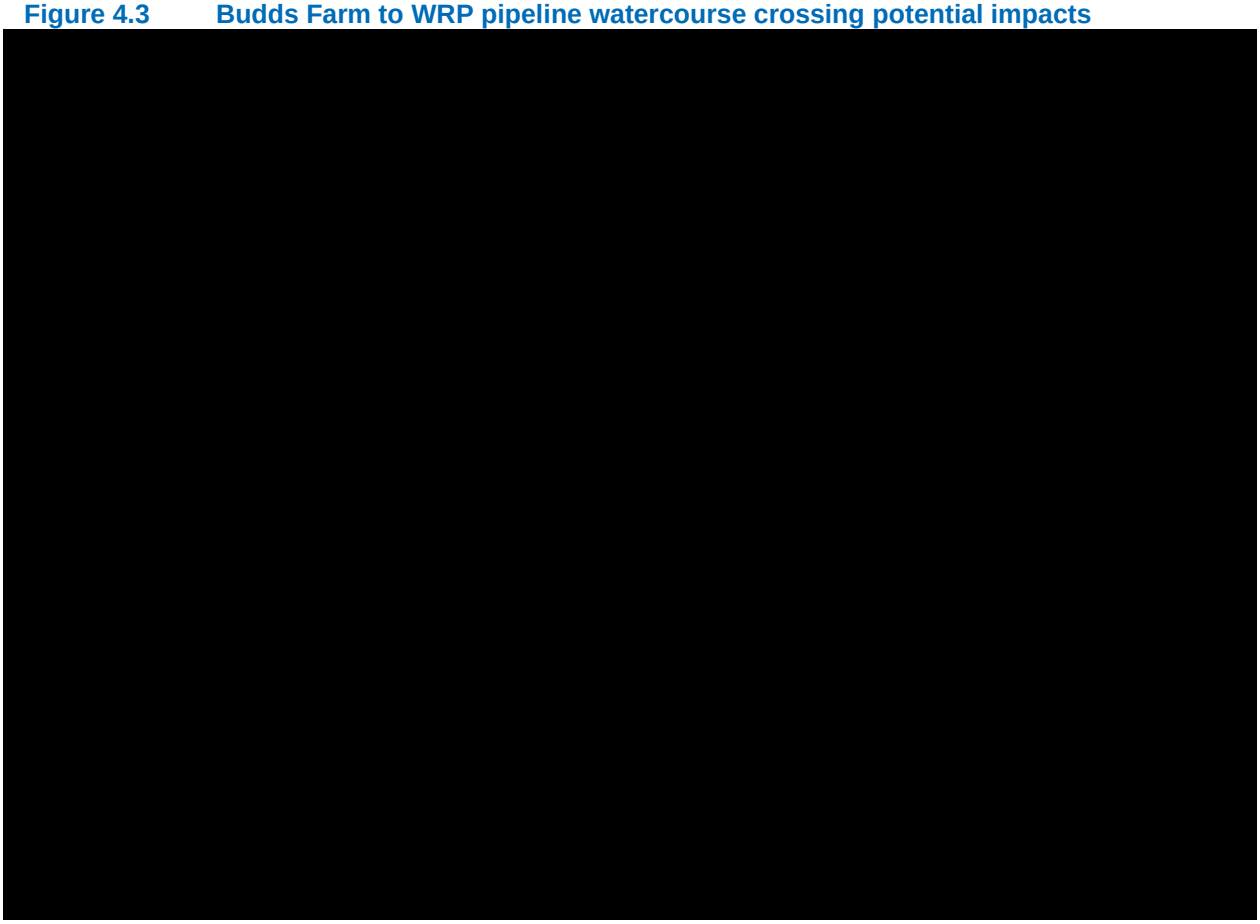
Pipeline crossing ID	Crossed watercourse	WFD WB name and ID	Aquifer hydrogeology and flow mechanism	Surface water gradient vectors at crossing	Impact score at crossing point	Max impact score within 25m of crossing point	Impact score ratio
Ham_01	River Hamble	Main River Hamble (GB107042016250)	Essentially no groundwater	Towards	100	600	6.0
Itc_08	River Itchen	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2625	2625	1.0
Itc_09	Rosemary Leet	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2025	2525	1.2
Itc_10	The Itchen Navigation	Itchen (GB107042022580)	Highly productive (fracture)	Away	2625	2625	1.0
Itc_39	Kingfisher Stream	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2625	2625	1.0
Itc_40	Ditch (Rosmary Leet)	Itchen (GB107042022580)	Highly productive (fracture)	Towards	625	2625	4.2
Itc_41	Ditch (The Itchen Navigation)	Itchen (GB107042022580)	Highly productive (fracture)	Towards	2645	2645	1.0

4.2 Water Recycling SRO Pipeline Routes

4.2.1 B2, B4 and B5 [redacted]

The watercourse crossings identified for Budds Farm WTW to WRP are presented in **Figure 4.3**.

Figure 4.3 Budds Farm to WRP pipeline watercourse crossing potential impacts



There is a total of one watercourse crossings associated with the [redacted] pipeline. Of these, none are green or amber and one is red impact rating. The highest impact red crossing is detailed below in **Table 4.3**.

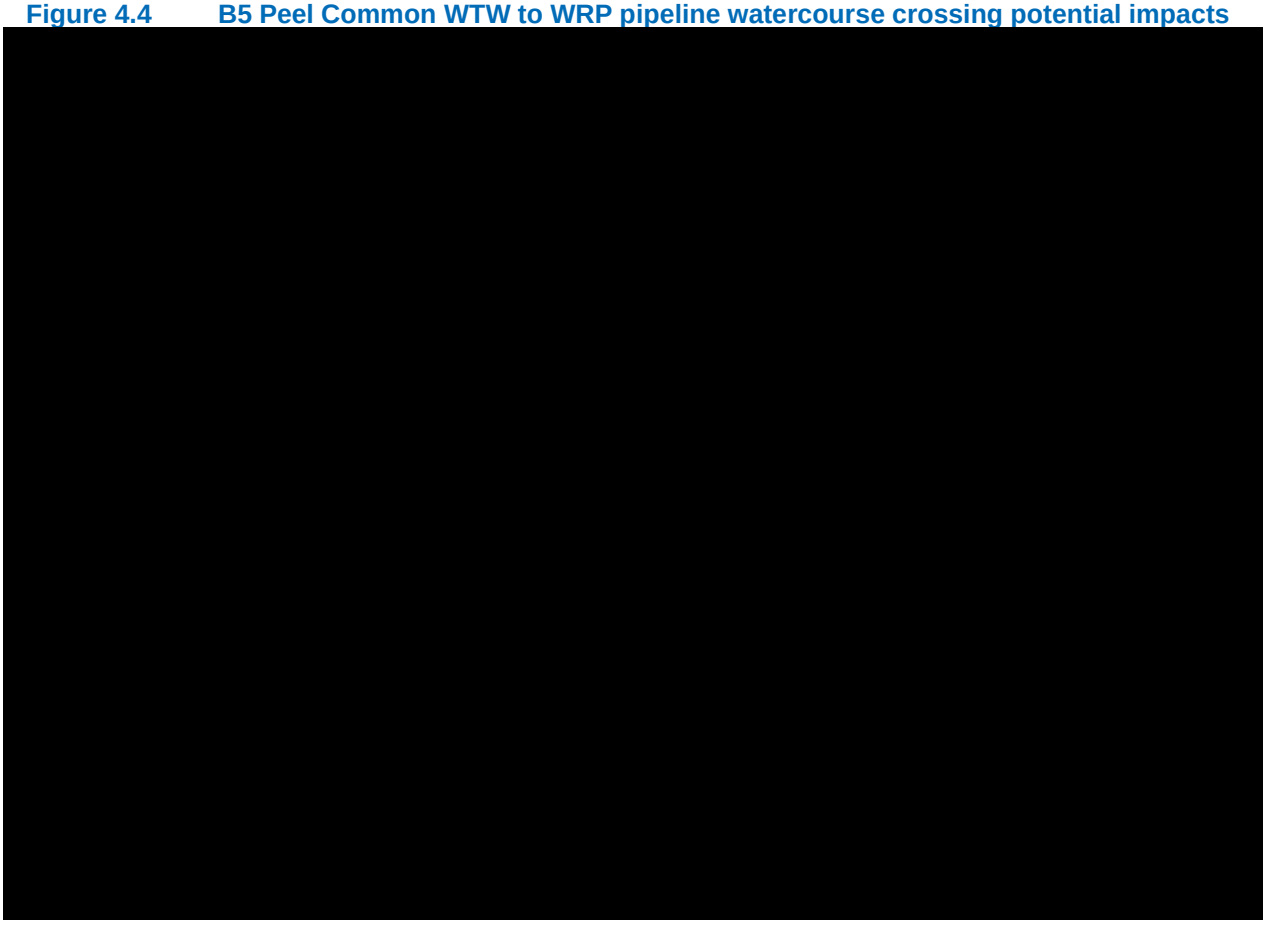
Table 4.3 Red impact watercourse crossings for [redacted]

Pipeline crossing ID	Crossed watercourse	WFD WB name and ID	Aquifer hydrogeology and flow mechanism	Surface water gradient vectors at crossing	Impact score at crossing point	Max impact score within 25m of crossing point	Impact score ratio
Est_01	Brockhampton Mill Lake	Langstone Harbour (GB580705130000)	Highly productive (fracture)	Towards	10	610	61.0

4.2.2 B5 [redacted]

The watercourse crossings identified for [redacted] are presented in **Figure 4.4**.

Figure 4.4 B5 Peel Common WTW to WRP pipeline watercourse crossing potential impacts



There is a total of one watercourse crossing associated with the [redacted] pipeline. Of these, none are green, one is amber and none are red impact rating.

4.2.3 B2 and B5 Water Recycling Plant to Otterbourne WSW

4.2.3.1 Route 1

The watercourse crossings identified for WRP to Otterbourne WSW Route 1 are presented in **Figure 4.5**.

Figure 4.5 WRP to Otterbourne WSW: Route 1 pipeline watercourse crossing potential impacts

There are a total of 24 watercourse crossings associated with the WRP to Otterbourne Route 1 pipeline. Of these, nine are green, three are amber and 12 are red impact rating. The crossings with the red (highest) impacts are presented below in **Table 4.4**.

Table 4.4 Red impact watercourse crossings for WRP to Otterbourne WSW: Route 1

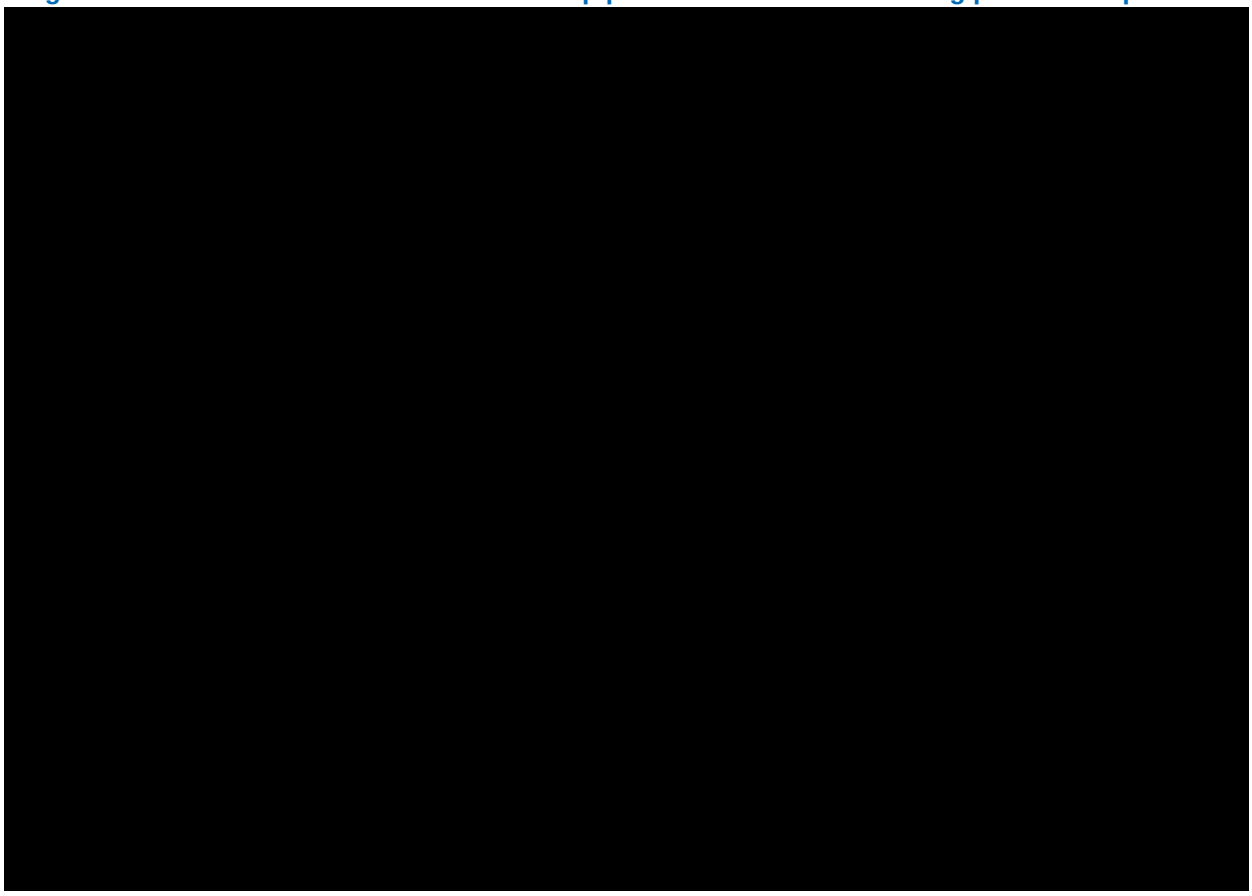
Pipeline crossing ID	Crossed watercourse	WFD WB name and ID	Aquifer hydrogeology and flow mechanism	Surface water gradient vectors at crossing	Impact score at crossing point	Max impact score within 25m of crossing point	Impact score ratio
Ham_01	River Hamble	Main River Hamble (GB107042016250)	Essentially no groundwater	Towards	100	600	6.0
Itc_08	River Itchen	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2625	2625	1.0
Itc_09	Rosemary Leet	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2025	2525	1.2
Itc_10	The Itchen Navigation	Itchen (GB107042022580)	Highly productive (fracture)	Away	2625	2625	1.0
Itc_39	Kingfisher Stream	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2625	2625	1.0
Itc_40	Ditch (Rosmary Leet)	Itchen (GB107042022580)	Highly productive (fracture)	Towards	625	2625	4.2
Itc_41	Ditch (The Itchen Navigation)	Itchen (GB107042022580)	Highly productive (fracture)	Towards	2645	2645	1.0
Meon_03	River Meon	Meon (GB107042016640)	Essentially no groundwater	Towards	720	720	1.0
Wal_01	Trib of Wallington River	Potwell Trib (GB107042016400)	Essentially no groundwater	Towards	202	702	3.5

Pipeline crossing ID	Crossed watercourse	WFD WB name and ID	Aquifer hydrogeology and flow mechanism	Surface water gradient vectors at crossing	Impact score at crossing point	Max impact score within 25m of crossing point	Impact score ratio
Wal_03	Wallington River	Potwell Trib (GB107042016400)	Essentially no groundwater	Towards	702	702	1.0
Wal_12	Trib of Wallington River	Wallington below Southwick (GB107042016360)	Essentially no groundwater	Towards	100	702	7.0
Wal_13	Trib of Wallington River	Wallington below Southwick (GB107042016360)	Essentially no groundwater	Towards	1602	1602	1.0

4.2.3.2 Route 2

The watercourse crossings identified for WRP to Otterbourne WSW Route 2 are presented in **Figure 4.6**.

Figure 4.6 WRP to Otterbourne Route 2 pipeline watercourse crossing potential impacts



There are a total of 24 watercourse crossings associated with the WRP to Otterbourne WSW Route 2 pipeline. Of these, eight are green, five are amber and 11 are red impact rating. The crossings with the red (highest) impacts are presented below in **Table 4.5**.

Table 4.5 Red impact watercourse crossings for WRP to Otterbourne WSW: Route 2

Pipeline crossing ID	Crossed watercourse	WFD WB name and ID	Aquifer hydrogeology and flow mechanism	Surface water gradient vectors at crossing	Impact score at crossing point	Max impact score within 25m of crossing point	Impact score ratio
Ham_03	Trib of River Hamble	Moors Stream (GB107042016260)	Low productivity (intergranular)	Towards (LB) / Parallel (RB)	100	700	7.0

Pipeline crossing ID	Crossed watercourse	WFD WB name and ID	Aquifer hydrogeology and flow mechanism	Surface water gradient vectors at crossing	Impact score at crossing point	Max impact score within 25m of crossing point	Impact score ratio
Itc_11	River Itchen	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2025	2627	1.3
Itc_12	Rosemary Leet	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	45	2645	58.8
Itc_13	The Itchen Navigation	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2645	2645	1.0
Itc_38	Kingfisher Stream	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2625	2625	1.0
Itc_42	The Itchen Navigation	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	645	2645	4.1
Itc_43	The Itchen Navigation	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	645	2645	4.1
Itc_44	Ditch (The Itchen Navigation)	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	645	2645	4.1
Itc_45	Ditch (The Itchen Navigation)	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	125	645	5.2
Wal_01	Trib of Wallington River	Potwell Trib (GB107042016400)	Essentially no groundwater	Towards	202	702	3.5
Wal_03	Wallington River	Potwell Trib (GB107042016400)	Essentially no groundwater	Towards	702	702	1.0

4.2.3.3 SIA Route ([redacted] Impact Assessment Route)

The watercourse crossings identified for WRP to Otterbourne (SIA route) are presented in **Figure 4.7**.

Figure 4.7 WRP to Otterbourne WSW (SIA route) pipeline watercourse crossing potential impacts

There are a total of 21 watercourse crossings associated with the WRP to Otterbourne SIA pipeline. Of these, five are green, six are amber and ten are red impact rating. The crossings with the red (highest) impacts are presented below in **Table 4.6**.

Table 4.6 Red impact watercourse crossings for WRP to Otterbourne WSW (SIA route)

Pipeline crossing ID	Crossed watercourse	WFD WB name and ID	Aquifer hydrogeology and flow mechanism	Surface water gradient vectors at crossing	Impact score at crossing point	Max impact score within 25m of crossing point	Impact score ratio
Itc_11	River Itchen	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2025	2627	1.3
Itc_12	Rosemary Leet	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	45	2645	58.8
Itc_13	The Itchen Navigation	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2645	2645	1.0
Itc_38	Kingfisher Stream	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2625	2625	1.0
Itc_42	The Itchen Navigation	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	645	2645	4.1
Itc_43	The Itchen Navigation	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	645	2645	4.1
Itc_44	Ditch (The Itchen Navigation)	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	645	2645	4.1
Itc_45	Ditch (The Itchen Navigation)	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	125	645	5.2
Wal_06	Trib of Wallington River	Potwell Trib (GB107042016400)	Essentially no groundwater	Towards	100	602	6.0
Wal_16	Wallington River	Potwell Trib (GB107042016400)	Essentially no groundwater	Towards	202	702	3.5

4.2.4 B4 WRP to Havant Thicket Reservoir

4.2.4.1 Route 1

The watercourse crossings identified for WRP to Havant Thicket Reservoir Route 1 are presented in **Figure 4.8**.

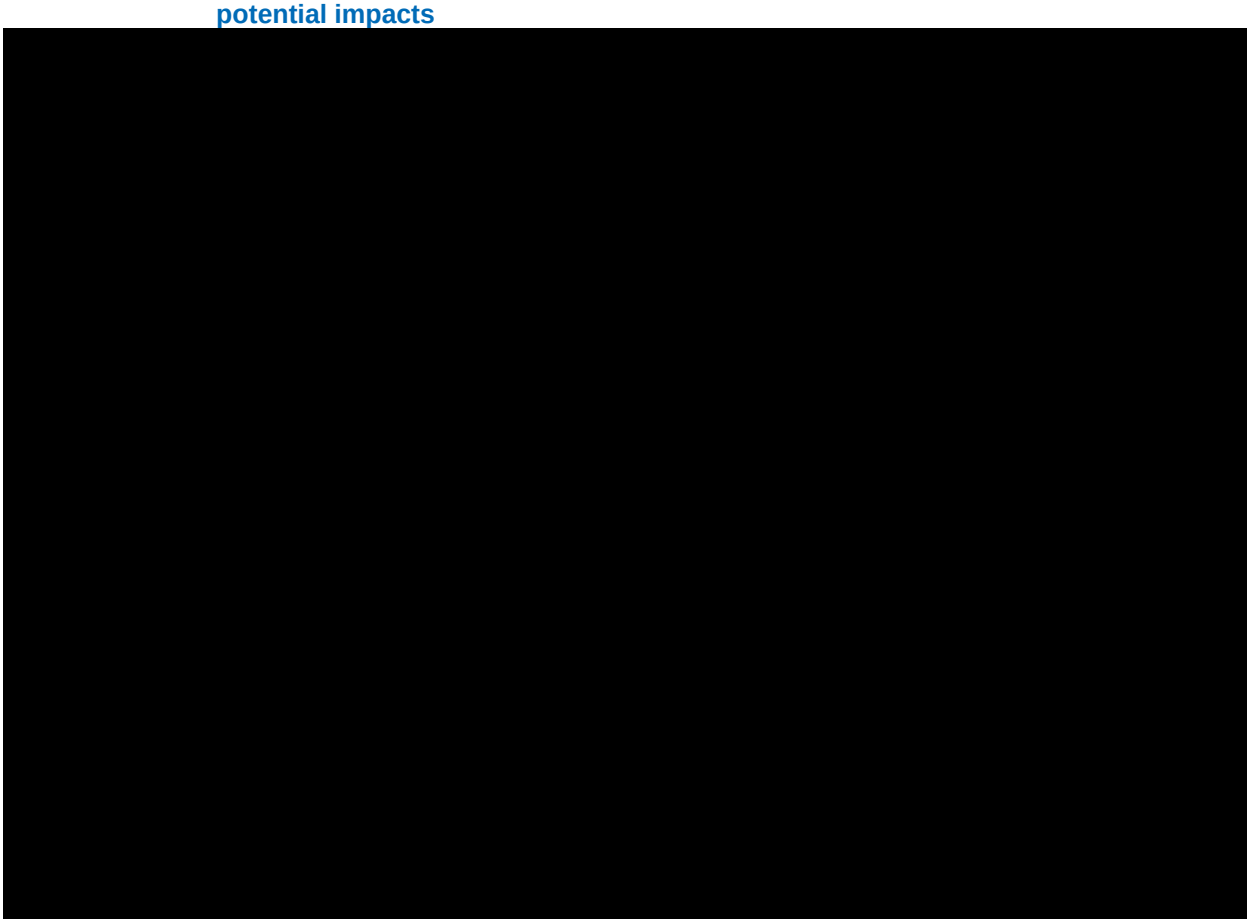
Figure 4.8 WRP to Havant Thicket Reservoir: Route 1 pipeline watercourse crossing potential impacts

There are a total of 4 watercourse crossings associated with the WRP to Havant Thicket Reservoir Route 1 pipeline. Of these, two are green, two are amber and none are red impact rating.

4.2.4.2 Route 2

The watercourse crossings identified for WRP to Havant Thicket Reservoir Route 2 are presented in **Figure 4.9**.

Figure 4.9 WRP to Havant Thicket Reservoir: Route 2 pipeline watercourse crossing potential impacts



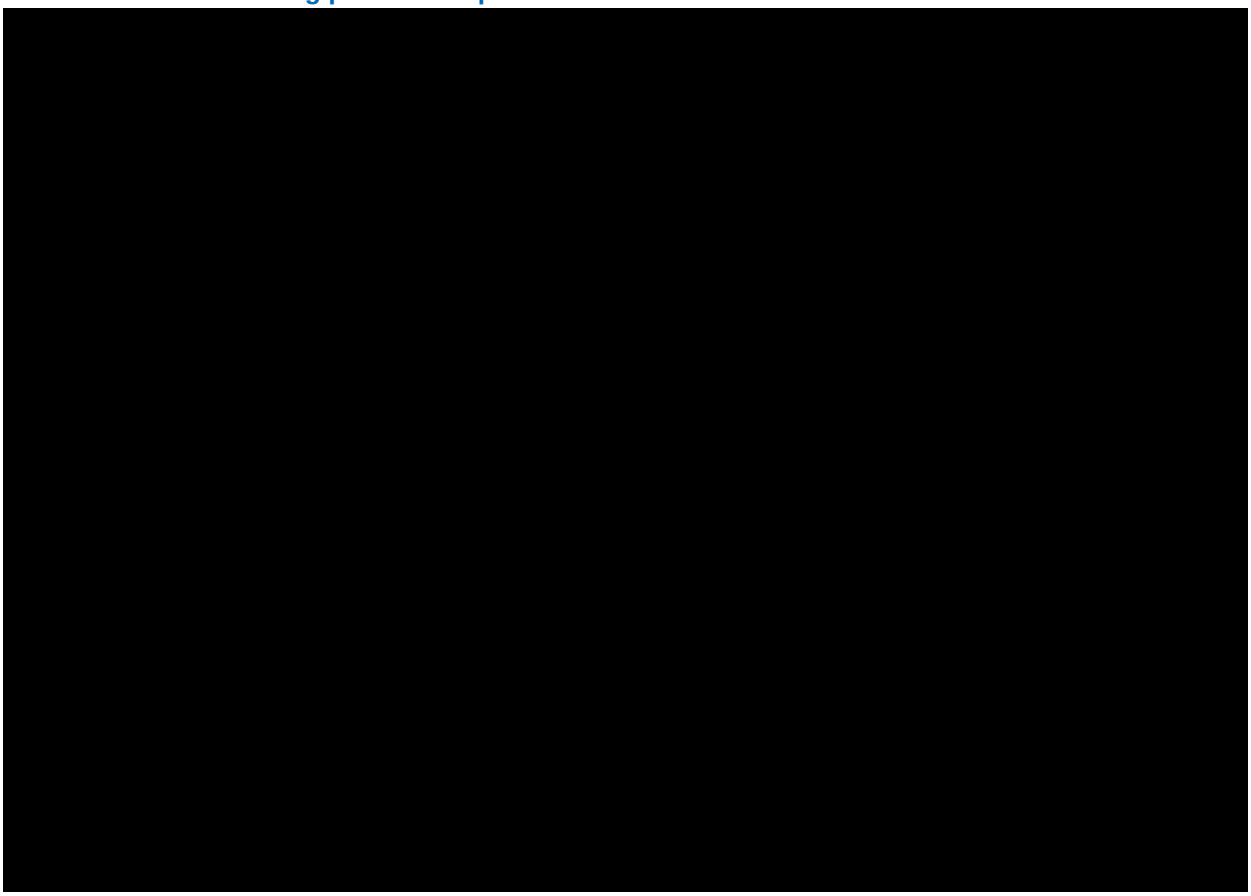
There are a total of 3 watercourse crossings associated with the WRP to Havant Thicket Route 2 pipeline. Of these, one is green, two are amber and none are red impact rating.

4.2.5 B4 Water Recycling and D2 Bulk Supply: Havant Thicket Reservoir to Otterbourne WSW

4.2.5.1 Route 1

The watercourse crossings identified for Havant Thicket Reservoir to Otterbourne WSW Route 1 are presented in **Figure 4.10**.

Figure 4.10 Havant Thicket Reservoir to Otterbourne WSW: Route 1 pipeline watercourse crossing potential impacts



There are a total of nine watercourse crossings associated with the Havant Thicket to Otterbourne Route 1 pipeline. Of these, none are green or amber and nine are red impact rating. The crossings with the red (highest) impacts are presented below in **Table 4.7**.

Table 4.7 Red impact watercourse crossings for Havant Thicket Reservoir to Otterbourne WSW: Route 1

Pipeline crossing ID	Crossed watercourse	WFD WB name and ID	Aquifer hydrogeology and flow mechanism	Surface water gradient vectors at crossing	Impact score at crossing point	Max impact score within 25m of crossing point	Impact score ratio
Her_01	Park Lane Stream	Hermitage Stream (GB107042016370)	Essentially no groundwater	Towards (LB) / Parallel (RB)	102	702	6.9
Itc_01	Bow Lake	Bow Lake (GB107042016650)	Low productivity (intergranular)	Towards	702	702	1.0
Itc_08	River Itchen	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2625	2625	1.0
Itc_09	Rosemary Leet	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2025	2525	1.2
Itc_10	The Itchen Navigation	Itchen (GB107042022580)	Highly productive (fracture)	Away	2625	2625	1.0
Itc_39	Kingfisher Stream	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2625	2625	1.0
Itc_40	Ditch (Rosmary Leet)	Itchen (GB107042022580)	Highly productive (fracture)	Towards	625	2625	4.2
Itc_41	Ditch (The Itchen Navigation)	Itchen (GB107042022580)	Highly productive (fracture)	Towards	2645	2645	1.0
Meon_01	River Meon	Meon (GB107042016640)	Highly productive (fracture)	Towards	100	800	8.0

4.2.5.2 Route 2

The watercourse crossings identified for Havant Thicket Reservoir to Otterbourne WSW Route 2 are presented in **Figure 4.11**.

Figure 4.11 Havant Thicket Reservoir to Otterbourne WSW: Route 2 pipeline watercourse crossing potential impacts

There are a total of 18 watercourse crossings associated with the Havant Thicket to Otterbourne Route 2 pipeline. Of these, seven are green, three are amber and eight are red impact rating. The crossings with the red (highest) impacts are presented below in **Table 4.8**.

Table 4.8 Red impact watercourse crossings for Havant Thicket Reservoir to Otterbourne WSW: Route 2

Pipeline crossing ID	Crossed watercourse	WFD WB name and ID	Aquifer hydrogeology and flow mechanism	Surface water gradient vectors at crossing	Impact score at crossing point	Max impact score within 25m of crossing point	Impact score ratio
Ham_03	Trib of River Hamble	Moors Stream (GB107042016260)	Low productivity (intergranular)	Towards (LB) / Parallel (RB)	100	700	7.0
Her_01	Park Lane Stream	Hermitage Stream (GB107042016370)	Essentially no groundwater	Towards (LB) / Parallel (RB)	102	702	6.9
Itc_08	River Itchen	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2625	2625	1.0
Itc_09	Rosemary Leet	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2025	2525	1.2
Itc_10	The Itchen Navigation	Itchen (GB107042022580)	Highly productive (fracture)	Away	2625	2625	1.0
Itc_39	Kingfisher Stream	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2625	2625	1.0

Pipeline crossing ID	Crossed watercourse	WFD WB name and ID	Aquifer hydrogeology and flow mechanism	Surface water gradient vectors at crossing	Impact score at crossing point	Max impact score within 25m of crossing point	Impact score ratio
Itc_40	Ditch (Rosmary Leet)	Itchen (GB107042022580)	Highly productive (fracture)	Towards	625	2625	4.2
Itc_41	Ditch (The Itchen Navigation)	Itchen (GB107042022580)	Highly productive (fracture)	Towards	2645	2645	1.0

4.2.5.3 Route 3

The watercourse crossings identified for Havant Thicket Reservoir to Otterbourne WSW Route 3 are presented in **Figure 4.12**.

Figure 4.12 Havant Thicket Reservoir to Otterbourne WSW: Route 3 pipeline watercourse crossing potential impacts

There are a total of 31 watercourse crossings associated with the Havant Thicket to Otterbourne Route 3 pipeline. Of these, 13 are green, five are amber and 13 are red impact rating. The crossings with the red (highest) impacts are presented below in **Table 4.9**.

Table 4.9 Red impact watercourse crossings for Havant Thicket Reservoir to Otterbourne WSW: Route 3

Pipeline crossing ID	Crossed watercourse	WFD WB name and ID	Aquifer hydrogeology and flow mechanism	Surface water gradient vectors at crossing	Impact score at crossing point	Max impact score within 25m of crossing point	Impact score ratio
Ham_01	River Hamble	Main River Hamble (GB107042016250)	Essentially no groundwater	Towards	100	600	6.0
Her_01	Park Lane Stream	Hermitage Stream (GB107042016370)	Essentially no groundwater	Towards (LB) / Parallel (RB)	102	702	6.9
Itc_08	River Itchen	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2625	2625	1.0
Itc_09	Rosemary Leet	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2025	2525	1.2
Itc_10	The Itchen Navigation	Itchen (GB107042022580)	Highly productive (fracture)	Away	2625	2625	1.0
Itc_39	Kingfisher Stream	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2625	2625	1.0
Itc_40	Ditch (Rosmary Leet)	Itchen (GB107042022580)	Highly productive (fracture)	Towards	625	2625	4.2
Itc_41	Ditch (The Itchen Navigation)	Itchen (GB107042022580)	Highly productive (fracture)	Towards	2645	2645	1.0
Meon_03	River Meon	Meon (GB107042016640)	Essentially no groundwater	Towards	720	720	1.0
Wal_01	Trib of Wallington River	Potwell Trib (GB107042016400)	Essentially no groundwater	Towards	202	702	3.5
Wal_03	Wallington River	Potwell Trib (GB107042016400)	Essentially no groundwater	Towards	702	702	1.0
Wal_12	Trib of Wallington River	Wallington below Southwick (GB107042016360)	Essentially no groundwater	Towards	100	702	7.0
Wal_13	Trib of Wallington River	Wallington below Southwick (GB107042016360)	Essentially no groundwater	Towards	1602	1602	1.0

4.2.5.4 Route 4

The watercourse crossings identified for Havant Thicket Reservoir to Otterbourne WSW Route 4 are presented in **Figure 4.13**.

Figure 4.13 Havant Thicket to Otterbourne Route 4 pipeline watercourse crossing potential impacts

There are a total of 28 watercourse crossings associated with the Havant Thicket to Otterbourne Route 4 pipeline. Of these, 13 are green, five are amber and ten are red impact rating. The crossings with the red (highest) impacts are presented below in **Table 4.10**.

Table 4.10 Red impact watercourse crossings for Havant Thicket Reservoir to Otterbourne WSW: Route 4

Pipeline crossing ID	Crossed watercourse	WFD WB name and ID	Aquifer hydrogeology and flow mechanism	Surface water gradient vectors at crossing	Impact score at crossing point	Max impact score within 25m of crossing point	Impact score ratio
Her_06	Hermitage Stream	Hermitage Stream (GB107042016370)	Essentially no groundwater	Parallel	600	702	1.2
Itc_11	River Itchen	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2025	2627	1.3
Itc_12	Rosemary Leet	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	45	2645	58.8
Itc_13	The Itchen Navigation	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2645	2645	1.0
Itc_38	Kingfisher Stream	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2625	2625	1.0
Itc_42	The Itchen Navigation	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	645	2645	4.1
Itc_43	The Itchen Navigation	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	645	2645	4.1
Itc_44	Ditch (The Itchen Navigation)	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	645	2645	4.1
Itc_45	Ditch (The Itchen Navigation)	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	125	645	5.2
Wal_06	Trib of Wallington River	Potwell Trib (GB107042016400)	Essentially no groundwater	Towards	100	602	6.0

4.3 [redacted] (WRMP19)

4.3.1 Route 1

The watercourse crossings identified for [redacted] Route 1 (original WRMP19 route) are presented in **Figure 4.14**.

Figure 4.14 [redacted]: Route 1 pipeline watercourse crossing potential impacts

There are a total of 23 watercourse crossings associated with the [redacted] Route 1 pipeline. Of these, two are green, eight are amber and 13 are red impact rating. The crossings with the red (highest) impacts are presented below in **Table 4.11**.

Table 4.11 Red impact watercourse crossings for [redacted]: Route 1

Pipeline crossing ID	Crossed watercourse	WFD WB name and ID	Aquifer hydrogeology and flow mechanism	Surface water gradient vectors at crossing	Impact score at crossing point	Max impact score within 25m of crossing point	Impact score ratio
Itc_15	Trib of River Itchen	Itchen (GB107042022580)	Moderately productive (intergranular)	Away (LB) / Towards (RB)	627	627	1.0
Itc_16	Trib of River Itchen	Itchen (GB107042022580)	Moderately productive (intergranular)	Towards	27	627	23.2
Itc_17	River Itchen	Itchen (GB107042022580)	Essentially no groundwater	Towards	2025	2025	1.0
Itc_18	River Itchen	Itchen (GB107042022580)	Essentially no groundwater	Away	2027	2127	1.0

Pipeline crossing ID	Crossed watercourse	WFD WB name and ID	Aquifer hydrogeology and flow mechanism	Surface water gradient vectors at crossing	Impact score at crossing point	Max impact score within 25m of crossing point	Impact score ratio
Itc_19	Barton River	Itchen (GB107042022580)	Moderately productive (intergranular)	Parallel	2025	2045	1.0
Itc_20	Barton River	Itchen (GB107042022580)	Moderately productive (intergranular)	Towards	2025	2127	1.1
Itc_21	River Itchen	Itchen (GB107042022580)	Essentially no groundwater	Away (LB) / Towards (RB)	2025	2145	1.1
Itc_22	River Itchen	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2625	2625	1.0
Itc_23	The Itchen Navigation	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2025	2625	1.3
Itc_47	Otter Bourne	Itchen (GB107042022580)	Low productivity (intergranular)	Away (LB) / Towards (RB)	25	1225	49.0
Itc_49	Barton River	Itchen (GB107042022580)	Essentially no groundwater	Away (LB) / Towards (RB)	2625	2625	1.0
Itc_50	Ditch (River Itchen)	Itchen (GB107042022580)	Essentially no groundwater	Towards	1125	1625	1.4
Itc_56	Trib of River Itchen	Itchen (GB107042022580)	Moderately productive (intergranular)	Towards	525	627	1.2

4.3.2 Route 2

The watercourse crossings identified for [redacted] Routes 2 and 3 are presented in **Figure 4.15**. The only difference between the two routes is the approach to the Itc27 crossing point and minimising the length within the South Downs National Park.

Figure 4.15 [redacted]: Routes 2 and 3 pipeline watercourse crossing potential impacts

There are a total of eight watercourse crossings associated with the [redacted] Routes 2 and 3 pipelines. Of these, one is green, one is amber and six are red impact rating. The crossings with the red (highest) impacts are presented below in **Table 4.12**.

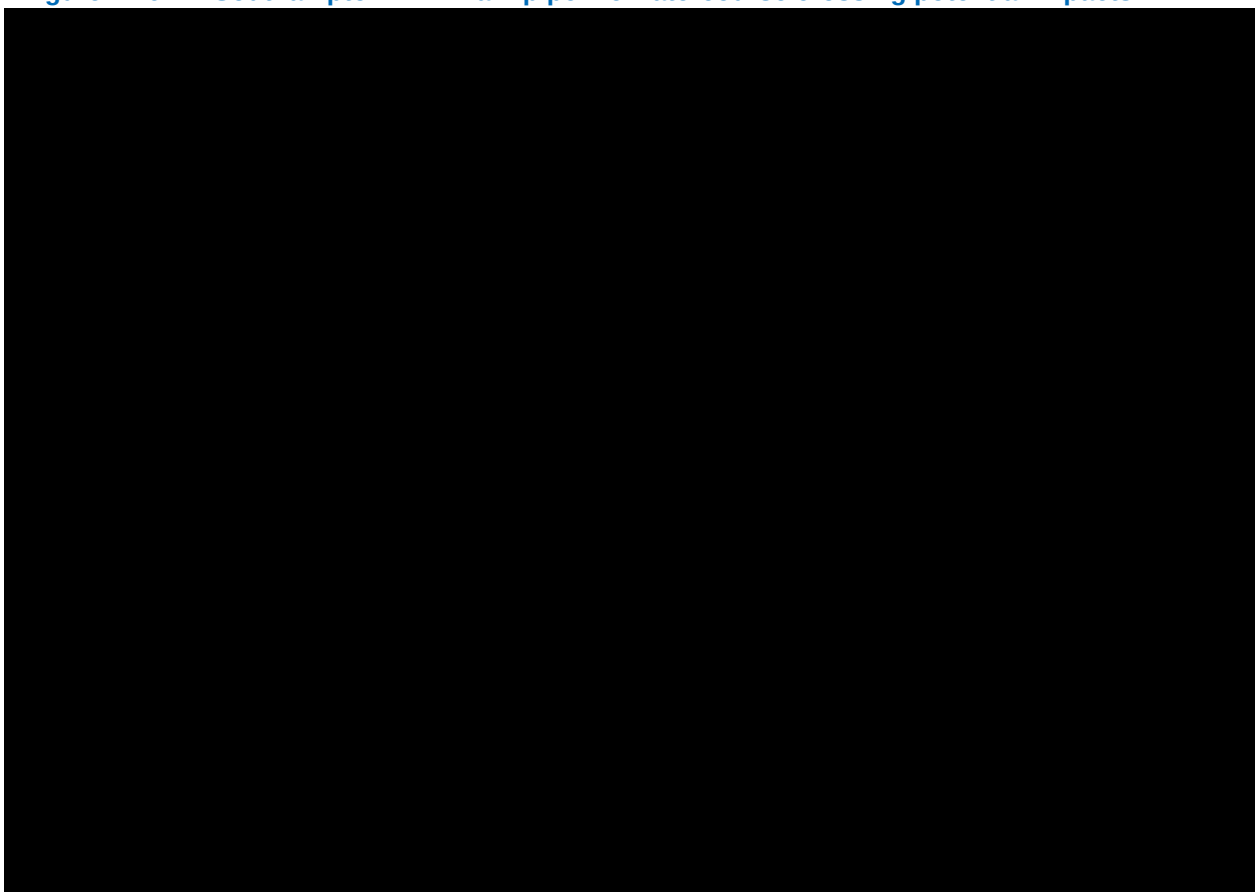
Table 4.12 Red impact watercourse crossings for [redacted]: Routes 2 and 3

Pipeline crossing ID	Crossed watercourse	WFD WB name and ID	Aquifer hydrogeology and flow mechanism	Surface water gradient vectors at crossing	Impact score at crossing point	Max impact score within 25m of crossing point	Impact score ratio
Itc_26	Trib of River Itchen	Itchen (GB107042022580)	Moderately productive (intergranular)	Towards	27	527	19.5
Itc_27	River Itchen	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2027	2627	1.3
Itc_28	The Itchen Navigation	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2645	2645	1.0
Itc_37	Kingfisher Stream	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	2625	2627	1.0
Itc_46	Ditch (The Itchen Navigation)	Itchen (GB107042022580)	Low productivity (intergranular)	Towards	125	2645	21.2
Itc_55	Trib of River Itchen	Itchen (GB107042022580)	Moderately productive (intergranular)	Away (LB) / Towards (RB)	25	627	25.1

4.4 Southampton Link Main (WRMP19)

The watercourse crossings identified for [redacted] are presented in **Figure 4.16**.

Figure 4.16 Southampton Link Main pipeline watercourse crossing potential impacts



There are a total of 19 watercourse crossings associated with the [redacted] pipeline. Of these, seven are green, six are amber and six are red impact rating. The crossings with the red (highest) impacts are presented below in **Table 4.13**.

Table 4.13 Red impact watercourse crossings for Southampton Link Main

Pipeline crossing ID	Crossed watercourse	WFD WB name and ID	Aquifer hydrogeology and flow mechanism	Surface water gradient vectors at crossing	Impact score at crossing point	Max impact score within 25m of crossing point	Impact score ratio
Itc_29	Otter Bourne	Monks Brook (GB107042016310)	Low productivity (intergranular)	Towards (LB) / Away (RB)	0	600	0.0
Test_05	Tadburn Lake	Tadburn Lake (GB107042016490)	Essentially no groundwater	Towards (LB) / Away (RB)	102	602	5.9
Test_08	Ditch (River Test)	Test (Lower) (GB107042016840)	Essentially no groundwater	Towards	3125	3125	1.0
Test_09	River Test	Test (Lower) (GB107042016840)	Essentially no groundwater	Towards (LB) / Away (RB)	77	3127	40.6
Test_10	River Test	Test (Lower) (GB107042016840)	Moderately productive (intergranular)	Towards	1045	1145	1.1
Test_11	Ditch (River Test)	Test (Lower) (GB107042016840)	Moderately productive (intergranular)	Towards	125	1145	9.2

4.5 Summary of Watercourse Crossings

A summary of the number of green, amber and red impact crossings that would occur if each pipeline route was installed is presented in **Table 4.14**.

Table 4.14 Summary of watercourse crossing impacts for each pipeline route

Pipeline	Green impact crossings	Amber impact crossings	Red impact crossings	Red crossings with impact score ratio >5	Total number of crossings
Alternative Desalination SRO Location					
A3 Meon Desalination to Otterbourne WSW Route 1	8	1	7	1	16
A3 Meon Desalination to Otterbourne WSW Route 2	8	1	7	1	16
Water Recycling SRO and Bulk Supply SRO					
B2, B4 and B5 [redacted]	0	0	1	1	1
B5 [redacted] WTW to WRP	0	1	0	0	1
B2&B5 WRP to Otterbourne WSW Route 1	9	3	12	2	24
B2&B5 WRP to Otterbourne WSW Route 2	8	5	11	3	24
B2&B5 WRP to Otterbourne WSW SIA	5	6	10	3	21
B4 WRP to HTR Route 1	2	2	0	0	4
B4 WRP to HTR Route 2	1	2	0	0	3
B4&D2 HTR to Otterbourne WSW Route 1	0	0	9	2	9
B4&D2 HTR to Otterbourne WSW Route 2	7	3	8	2	18
B4&D2 HTR to Otterbourne WSW Route 3	13	5	13	3	31
B4&D2 HTR to Otterbourne WSW Route 4	13	5	10	3	28
Water Resources Management Plan 2019 Bulk Supplies					
[redacted] Route 1 (WRMP19)	2	8	13	2	23
[redacted] Route 2	1	1	6	3	8
[redacted] Route 3	1	1	6	3	8
Southampton Link Main (WRMP19)	7	6	6	3	19

A full list of impact ratings for each crossing is presented in **Appendix A2**.

5 Route Optimisation to Reduce Red Impact Watercourse Crossings

5.1 Red Impact Watercourse Crossings

The distribution of red impact crossings indicates that the vast majority are concentrated on the River Itchen, followed by a small area of the River Test. Further analysis of the red impact crossings to understand the drivers behind the high impact scores illustrates that the primary drivers behind red scores for sites not on the River Itchen or River Test are predominantly Priority Habitat Inventory and Woodland, while for sites on the River Itchen and River Test the drivers are predominantly designations (these rivers being SSSIs and SACs). Secondary drivers are mostly due to factors such as superficial geology thickness and stream power index etc.

Clearly there are a large number of potential pipeline watercourse crossings sites which are at risk of causing impacts. However, the impact score ratio for each site (**Table 4.1** - **Table 4.13**), provides further evidence of the potential impact of each crossing (with the higher the ratio indicating that the point impact score is significantly lower than the 25m impact score due to fewer key at risk areas at the crossing point when compared out to 25m). A ratio of greater than 5 (highlighted in grey in **Table 4.1** - **Table 4.13**, indicates that an additional 18 sites (out of the 53 red impacted crossings) have relatively low impact scores at the point of the proposed crossing. Therefore, these sites are likely not to require any significant route modification but would likely require other processes to be implemented (e.g., good construction practices) to protect the high quality habitats adjacent to these sites. These 18 sites are shown in **Table 5.1**.

Appendix A1 outlines which crossing corresponds with each pipeline route. These are also outlined in **Figure 4.1** to **Figure 4.16**, **Section 4**.

Table 5.1 Red impact sites likely not requiring route modification

Pipeline crossing ID	Crossed watercourse	Impact score at crossing point	Max impact score within 25m of crossing point	Impact score ratio
Itc_26	Trib of River Itchen	27	527	19.5
Ham_01	River Hamble	100	600	6.0
Itc_29	Otter Bourne	0	600	---
Test_05	Tadburn Lake	102	602	5.9
Wal_06	Trib of Wallington River	100	602	6.0
Est_01	Brockhampton Mill Lake	10	610	61.0
Itc_16	Trib of River Itchen	27	627	23.2
Itc_55	Trib of River Itchen	25	627	25.1
Itc_45	Ditch (The Itchen Navigation)	125	645	5.2
Ham_03	Trib of River Hamble	100	700	7.0
Her_01	Park Lane Stream	102	702	6.9
Wal_12	Trib of Wallington River	100	702	7.0
Meon_01	River Meon	100	800	8.0
Test_11	Ditch (River Test)	125	1145	9.2
Itc_47	Otter Bourne	25	1225	49.0
Itc_12	Rosemary Leet	45	2645	58.8
Itc_46	Ditch (The Itchen Navigation)	125	2645	21.2
Test_09	River Test	77	3127	40.6

Once a preferred pipeline corridor route is selected, it is recommended that further investigations of identified sensitive sites are undertaken to ensure that pipeline construction activities can be undertaken safely without damaging adjacent habitats. If these investigations identify that this is not the case then it is likely that rerouting of the pipeline to an area with the potential for less impact is considered.

The remaining 35 sites have the potential to cause high impacts to watercourses, habitats and designated sites (**Table 5.2**).

Table 5.2 Red impact pipeline crossings likely requiring route modification

Pipeline crossing ID	Crossed watercourse	Impact score at crossing point	Max impact score within 25m of crossing point	Impact score ratio
Itc_15	Trib of River Itchen	627	627	1.0
Itc_56	Trib of River Itchen	525	627	1.2
Her_06	Hermitage Stream	600	702	1.2
Itc_01	Bow Lake	702	702	1.0
Wal_01	Trib of Wallington River	202	702	3.5
Wal_03	Wallington River	702	702	1.0
Meon_03	River Meon	720	720	1.0
Test_10	River Test	1045	1145	1.1
Wal_13	Trib of Wallington River	1602	1602	1.0
Itc_50	Ditch (River Itchen)	1125	1625	1.4
Itc_17	River Itchen	2025	2025	1.0
Itc_19	Barton River	2025	2045	1.0
Itc_18	River Itchen	2027	2127	1.0
Itc_20	Barton River	2025	2127	1.1
Itc_21	River Itchen	2025	2145	1.1
Itc_09	Rosemary Leet	2025	2525	1.2
Itc_08	River Itchen	2625	2625	1.0
Itc_10	The Itchen Navigation	2625	2625	1.0
Itc_22	River Itchen	2625	2625	1.0
Itc_23	The Itchen Navigation	2025	2625	1.3
Itc_38	Kingfisher Stream	2625	2625	1.0
Itc_39	Kingfisher Stream	2625	2625	1.0
Itc_40	Ditch (Rosmary Leet)	625	2625	4.2
Itc_49	Barton River	2625	2625	1.0
Itc_11	River Itchen	2025	2627	1.3
Itc_27	River Itchen	2027	2627	1.3
Itc_37	Kingfisher Stream	2625	2627	1.0
Itc_13	The Itchen Navigation	2645	2645	1.0
Itc_28	The Itchen Navigation	2645	2645	1.0
Itc_41	Ditch (The Itchen Navigation)	2645	2645	1.0
Itc_42	The Itchen Navigation	645	2645	4.1
Itc_43	The Itchen Navigation	645	2645	4.1
Itc_44	Ditch (The Itchen Navigation)	645	2645	4.1
Test_08	Ditch (River Test)	3125	3125	1.0

The majority of these sites are concentrated on the River Itchen and River Test. While good practice construction techniques etc. could be employed to mitigate any potential impacts to the watercourse and adjacent habitats the sensitivity of these sites strongly suggests that alternative routes for these crossings should be investigated or there should be an aim to select locations where “narrow corridors” of designated site or habitats exist, thereby limiting potential impacts. A review of alternative routes for these red crossings is presented in Section 5.2 below.

5.2 Suggested Alternative Routing for Red Watercourse Crossings

Alternative pipeline routes were selected using several considerations, specifically:

- Routing a pipeline so that it bypasses high risk areas, even if this means a slightly longer pipeline route.
- Where bypassing a high risk area is not possible then the pipeline is rerouted so that the smallest spatial area of high risk is crossed in order to minimise impacts.
- Utilising existing river crossings where possible.
- Utilising existing disturbed routeways, such as a road or track, in order to minimise digging in sensitive areas and habitats.
- Reducing the number of watercourse crossings to a minimum.
- Attempting to not deviate significantly from the current suggested route.

Figure 5.1 shows the potential re-routing of the Havant Thicket Reservoir to Otterbourne WSW Route 4 pipeline across the Hermitage Stream.

Figure 5.1 Hermitage Stream ([redacted] modified route: Havant Thicket Reservoir to Otterbourne WSW Route 4

This proposed re-routing involves utilising an existing road and passing beneath the [redacted] in such a way as to avoid the woodland habitats on the eastern and western side of the road.

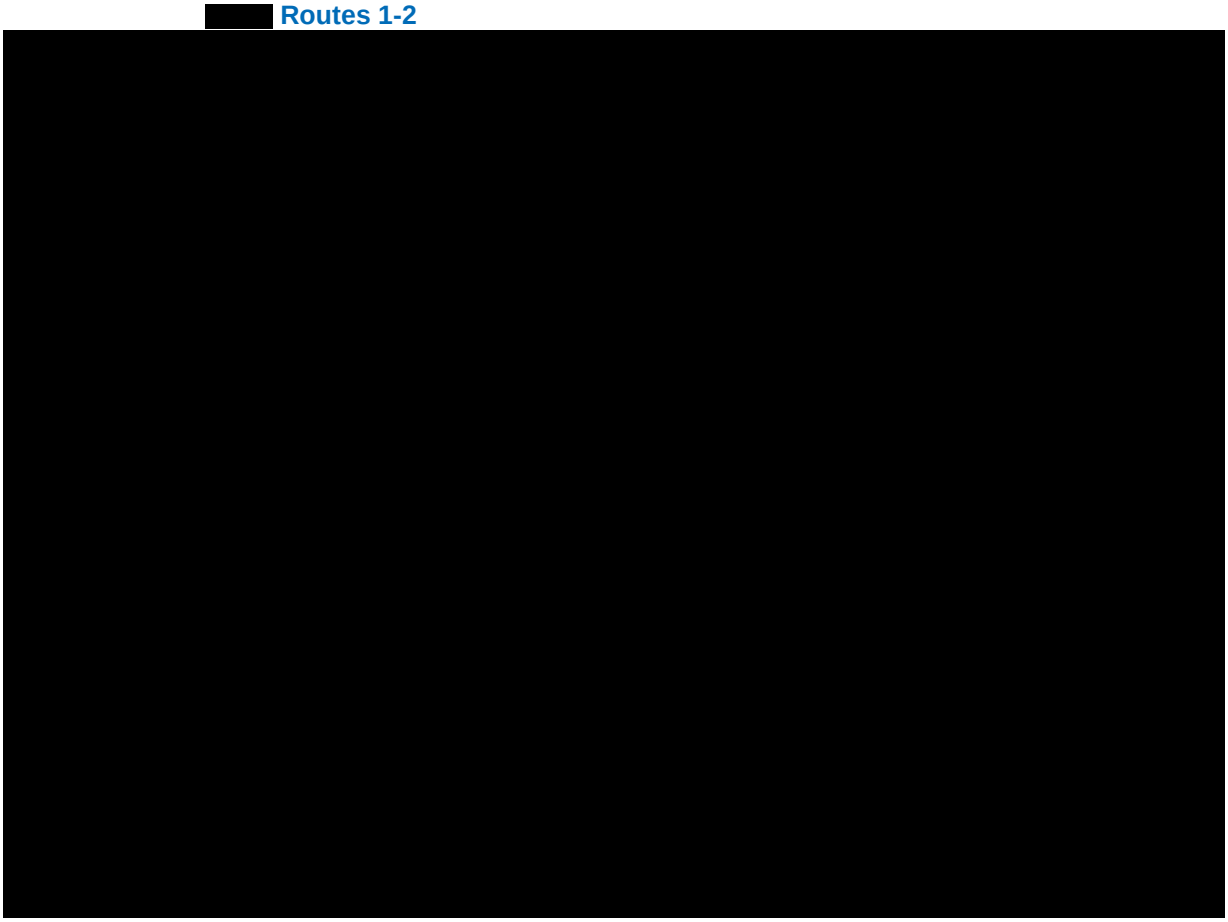
Figure 5.2 shows a potential re-route option for the [redacted] Routes 1-3, Havant Thicket Reservoir to Otterbourne WSW Routes 1-4 and A3 Meon Desalination to Otterbourne WSW Routes 1-2 pipelines. This area represents one of the most complex areas of crossings due to the large number of suggested pipeline routes (nine in total). As discussed above, the number of crossings will decline markedly when the pipeline route has been finalised for each SRO configuration and once a Selected Option SRO has been identified. However, for the current time all crossings have been considered here.

Figure 5.2 River Itchen [redacted] modified route: [redacted] Routes 1-3, Havant Thicket Reservoir to Otterbourne WSW Routes 1-4 and A3 Meon Desalination to Otterbourne WSW Route 1-2

[redacted] Routing along the gravel track greatly assists in avoiding moderate and high risk habitats. It should be noted that the River Itchen is a highly sensitive and important habitat and the morphology of the channel means there are potentially a large number of watercourses to cross. Therefore, any route selected needs to bear these in mind.

Figure 5.3 shows a re-route option for the [redacted] Routes 1-2 pipelines.

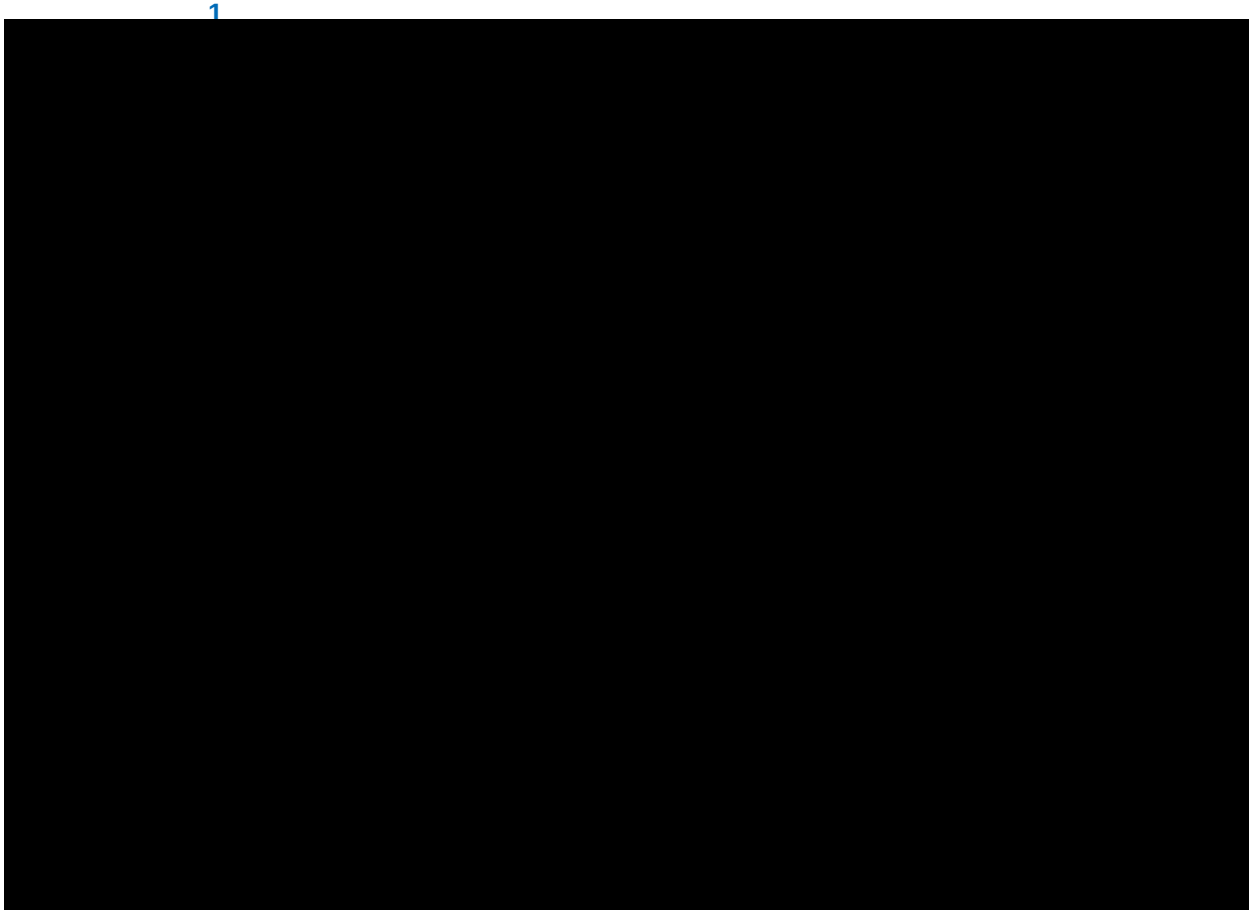
Figure 5.3 River Itchen [redacted] modified route: [redacted] Routes 1-2



This proposed reroute utilises an existing track, taking the pipeline to the west and then turns north through a field. This reduces the numbers of potential watercourse crossings and also places the pipeline away from high risk habitats.

Figure 5.4 shows a reroute option for the [redacted] Route 1 pipeline.

Figure 5.4 River Itchen [redacted] modified route: [redacted] Route 1



[redacted]

Figure 5.5 shows a re-route option for the Havant Thicket Reservoir to Otterbourne WSW Route 3 pipeline crossing on the River Meon.

Figure 5.5 River Meon [redacted] modified route – Havant Thicket Reservoir to Otterbourne WSW Route 3

Figure 5.6 shows a re-route option for the Southampton Link Main pipeline.

Figure 5.6 River Test [redacted] modified route: Southampton Link Main

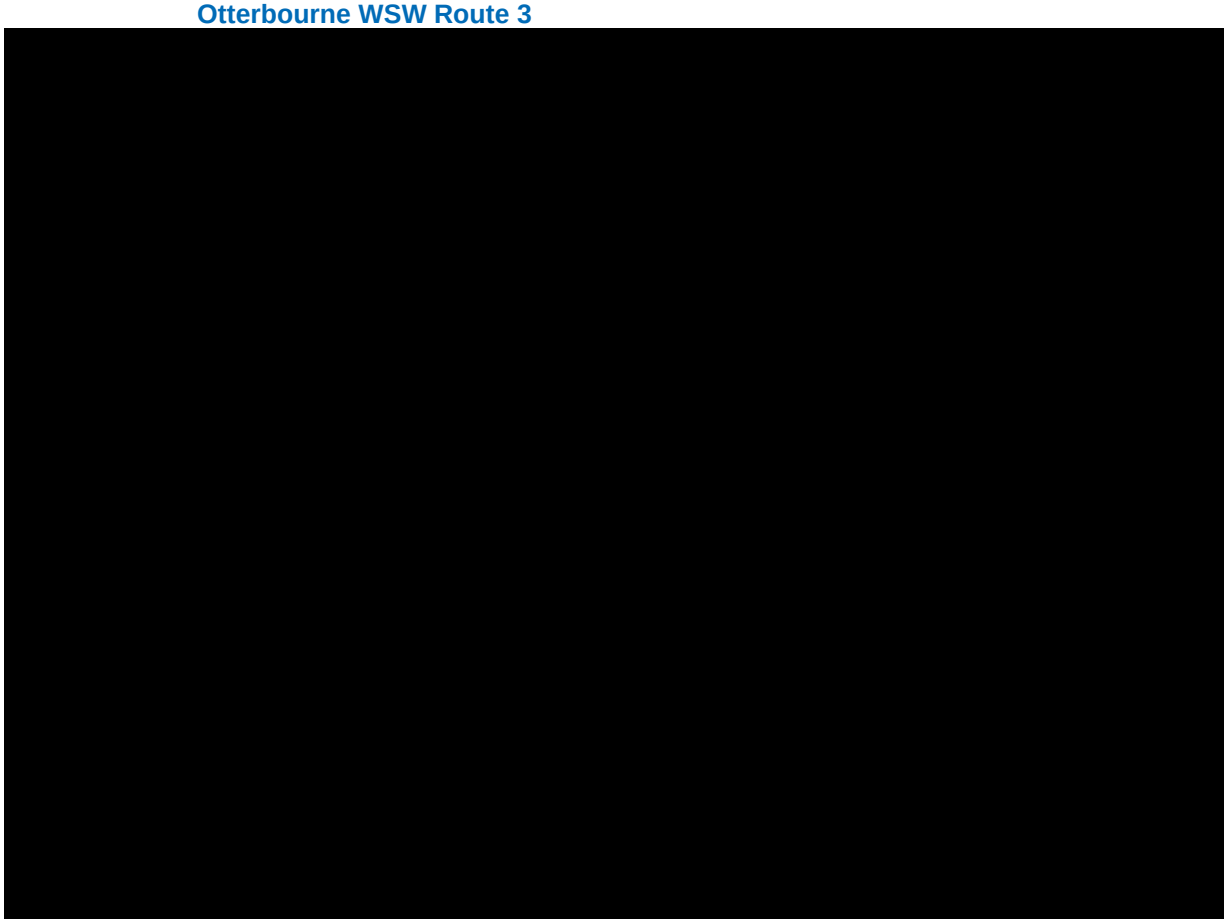
This proposed re-route is complex and some habitat impacts are likely given the distribution of habitats and watercourses in the area. However, the re-route attempted to maintain distance between the high risk red habitats as much as possible. In order to provide an optimised route, two crossings not included in the list of 35 in **Table 5.2** (but included in the red list in **Table 5.1**), crossings Test_09 and Test_11, where included in the re-routing. [redacted]

Figure 5.7 shows a reroute option for the Havant Thicket Reservoir to Otterbourne WSW Route 3 pipeline as it crosses the Wallington River.

Figure 5.7 Wallington River [redacted] modified route: Havant Thicket Reservoir to Otterbourne WSW Route 3

Figure 5.8 shows a re-route option for the Havant Thicket Reservoir to Otterbourne WSW Route 3 pipeline as it crosses the Wallington River.

Figure 5.8 Wallington River [redacted] modified route: Havant Thicket Reservoir to Otterbourne WSW Route 3



This proposed re-route moves the pipeline away from high risk habitat (woodland) as well as passing the pipeline between high risk habitat patches before linking up with the pipeline to the south of the habitat. Although this route adds an existing crossing on a ditch (centre of **Figure 5.8)** it is considered to be balanced by the rerouting of the pipeline away from the high risk habitat as well as passing the pipeline perpendicular beneath the Wallington River at the new proposed crossing rather than near parallel to the river (as the current crossing at Wal_13).

[redacted] and, given the path of the pipeline[8], it is suspected that the pipeline will actually follow this road and use the road bridge to cross the tributary of the River Itchen. Therefore, no re-routing is required here. However, the crossing has been kept in this category due to the high risk of the site.

It is acknowledged that these are only suggestions for alternative routes, however they provide crossings with significantly reduced environmental impacts. It is recommended that the results of this work inform the wider pipeline discussions to be held by the route selection and optioneering teams [redacted] and Southern Water Network Team) to understand the feasibility of using these alternative crossings such that a practical solution is identified. The type of construction method, which isn't considered in this approach, will also be important in refining the types of impacts likely to occur and how these could be mitigated.

[8] The path is slightly offset from the road to the south, possibly due to a map scale error when digitising the pipeline. Therefore, the assumption has been made that the pipeline is following the road.

6 Review of SRO Pipeline Routes

Following completion of the Stage 4 site selection work, the routes identified in **Table 6.1** were confirmed for use in the configuration of the SROs for the purposes of the options appraisal process, which is being used to identify a Selected Option to take to Gate 3.

Table 6.1 SRO Configurations – Pipeline Routes Selected

B2 WRP [redacted] to Lake Otterbourne Environmental Buffer	B4 WRP [redacted] to Havant Thicket Reservoir Environmental Buffer	B5 WRP ([redacted]) to Lake Otterbourne Environmental Buffer	D2 Havant Thicket Reservoir alternative use bulk supply
[redacted] Route 1	[redacted] Route 1	[redacted] Route 1	Havant Thicket Reservoir to Otterbourne WSW Route 3
WRP to Lake Otterbourne Environmental Buffer Route 1	WRP to Havant Thicket Reservoir Route 1	[redacted] Route 1	
	Havant Thicket Reservoir to Otterbourne WSW Route 3	WRP to Lake Otterbourne Environmental Buffer Route 1	

There remains some optionality around the routes between the WRP or Havant Thicket Reservoir and Otterbourne, with WRP to Lake Otterbourne Environmental Buffer Route 2 still being considered, as well as Havant Thicket Reservoir to Otterbourne WSW Route 4. It is likely that a pipeline corridor amalgamating the two; i.e., WRP to Lake Otterbourne Routes 1 and 2, and Havant Thicket Reservoir to Otterbourne WSW Routes 3 and 4, will be produced for further refinement.

The pipeline crossings and their impact rating for those selected are provided in **Table 6.2**. Detailed mapping of the crossings is provided in **Appendix A4**.

Table 6.2 Watercourse crossings by pipeline and impact rating

Watercourse	Crossing Code	Crossing ID	[redacted] to WRP	[redacted] to WRP	WRP to Havant Thicket Route 1	WRP to Otterbourne Route 1	WRP to Otterbourne Route 2	Havant Thicket to Otterbourne Route 3	Havant Thicket to Otterbourne Route 4	Impact Rating
Brockhampton Mill Lake	Estuary_01	Est_01		X						Red
River Hamble	Hamble_01	Ham_01				X		X		Red
Trib of River Hamble	Hamble_02	Ham_02					X			Green
Trib of River Hamble	Hamble_03	Ham_03					X			Red
Trib of River Hamble	Hamble_04	Ham_04							X	Green
Trib of River Hamble	Hamble_05	Ham_05				X		X		Green
Trib of River Hamble	Hamble_06	Ham_06				X	X	X	X	Green
Trib of River Hamble	Hamble_07	Ham_07				X	X	X	X	Green
Trib of River Hamble	Hamble_08	Ham_08				X	X	X	X	Green
Trib of River Hamble	Hamble_09	Ham_09				X	X	X	X	Green
River Hamble	Hamble_10	Ham_10					X			Green
Trib of River Hamble	Hamble_11	Ham_11				X		X		Green
River Hamble	Hamble_12	Ham_12							X	Amber
Trib of River Hamble	Hamble_13	Ham_13						X	X	Green
Park Lane Stream	Hermitage_01	Her_01						X		Red
Park Lane Stream	Hermitage_02	Her_02			X			X		Green
Hermitage Stream	Hermitage_03	Her_03			X			X		Green
Hermitage Stream	Hermitage_04	Her_04							X	Green
Hermitage Stream	Hermitage_05	Her_05							X	Green
Hermitage Stream	Hermitage_06	Her_06							X	Red
Bidbury Mead Stream	Hermitage_08	Her_08			X			X		Amber
Bidbury Mead Stream	Hermitage_11	Her_11			X			X		Amber
Ford Lake	Hor_01	Hor_01						X	X	Green
Ditch (Bow Lake)	Itchen_02	Itc_02				X	X	X		Green

Watercourse	Crossing Code	Crossing ID	[redacted] to WRP	[redacted] to WRP	WRP to Havant Thicket Route 1	WRP to Otterbourne Route 1	WRP to Otterbourne Route 2	Havant Thicket to Otterbourne Route 3	Havant Thicket to Otterbourne Route 4	Impact Rating
Bow Lake	Itchen_03	Itc_03				X	X	X		Amber
Ditch (Bow Lake)	Itchen_04	Itc_04							X	Green
Bow Lake	Itchen_05	Itc_05							X	Green
River Itchen	Itchen_08	Itc_08				X		X		Red
Rosemary Leet	Itchen_09	Itc_09				X		X		Red
The Itchen Navigation	Itchen_10	Itc_10				X		X		Red
River Itchen	Itchen_11	Itc_11					X		X	Red
Rosemary Leet	Itchen_12	Itc_12					X		X	Red
The Itchen Navigation	Itchen_13	Itc_13					X		X	Red
Ditch (Otter Bourne)	Itchen_36	Itc_36					X		X	Amber
Kingfisher Stream	Itchen_38	Itc_38					X		X	Red
Kingfisher Stream	Itchen_39	Itc_39				X		X		Red
Ditch (Rosmary Leet)	Itchen_40	Itc_40				X		X		Red
Ditch (The Itchen Navigation)	Itchen_41	Itc_41				X		X		Red
The Itchen Navigation	Itchen_42	Itc_42					X		X	Red
The Itchen Navigation	Itchen_43	Itc_43					X		X	Red
Ditch (The Itchen Navigation)	Itchen_44	Itc_44					X		X	Red
Ditch (The Itchen Navigation)	Itchen_45	Itc_45					X		X	Red
River Meon	Meon_02	Meon_02					X		X	Amber
River Meon	Meon_03	Meon_03				X		X		Red
Trib of Wallington River	Wallington_01	Wal_01				X	X	X		Red
Wallington River	Wallington_02	Wal_02				X	X	X		Green
Wallington River	Wallington_03	Wal_03				X	X	X		Red
Wallington River	Wallington_04	Wal_04							X	Amber
Ditch (Wallington River)	Wallington_05	Wal_05							X	Green

Watercourse	Crossing Code	Crossing ID	[redacted] to WRP	[redacted] to WRP	WRP to Havant Thicket Route 1	WRP to Otterbourne Route 1	WRP to Otterbourne Route 2	Havant Thicket to Otterbourne Route 3	Havant Thicket to Otterbourne Route 4	Impact Rating
Trib of Wallington River	Wallington_06	Wal_06							X	Red
Trib of Wallington River	Wallington_08	Wal_08				X	X	X		Amber
Trib of Wallington River	Wallington_09	Wal_09				X	X	X		Amber
Trib of Wallington River	Wallington_10	Wal_10							X	Amber
Trib of Wallington River	Wallington_11	Wal_11							X	Green
Trib of Wallington River	Wallington_12	Wal_12				X		X		Red
Trib of Wallington River	Wallington_13	Wal_13				X		X		Red
Trib of Wallington River	Wallington_14	Wal_14				X		X		Green
Wallington River	Wallington_15	Wal_15	X							Amber

7 Conclusions

The methodology employed has identified a total of 53 potential watercourse pipeline crossings out of 117 which have the high potential to cause impacts to watercourses and habitats during their construction and, potentially, during their operation.

However, it should be noted that the 117 crossings represent <u>all</u> the watercourse crossings of the current working list of 17 pipelines (in some cases the same crossing occurs for multiple pipelines due to the selected routes overlapping). Only one SRO will be selected, thereby reducing the number of watercourse crossings, however in-combination effects will need to be considered with the WRMP19 pipelines; [redacted] and Southampton Link Main.

The majority of crossings which have the potential to cause impacts were located on the River Itchen and River Test and the reason for the high impact is due to the presence of designated sites and key habitats. Of these 53 sites, 18 were identified as possibly not requiring significant route modification, only robust site investigation and construction practices to ensure that watercourses and adjacent habitats and designated sites are not affected. This consideration leaves a total of 35 pipeline watercourse crossings where potential impacts from the construction of the crossing are high, and potential alternative routes have been identified.

It is recommended that a collaborative approach be undertaken across the wider WfLH team to understand whether these alternatives are feasible or provide documented justification as to why the routes cannot be used (especially in relation to SAC designated watercourses). Site specific survey work to understand local groundwater levels, surface flows, geology and watercourse characteristics will be required to further understand the level of impact and where route crossings can be altered. Further scheme development and route refinement is therefore proposed as part of Gate 3.

Appendices

A1 Watercourse crossings by pipeline

Watercourse	Crossing Code	Crossing ID	[redacted] to WRP	[redacted] to WRP	WRP to Havant Thicket Route 1	WRP to Havant Thicket Route 2	WRP to Otterbourne Route 1	WRP to Otterbourne Route 2	WRP to Otterbourne SIA	Havant Thicket to Otterbourne Route 1	Havant Thicket to Otterbourne Route 2	Havant Thicket to Otterbourne Route 3	Havant Thicket to Otterbourne Route 4	Meon to Otterbourne Route 1	Meon to Otterbourne Route 2	Testwood WTW to Otterbourne	[redacted] Otterbourne Route 1	[redacted] Otterbourne Route 2	[redacted] Otterbourne Route 3
Brockhampton Mill Lake	[redacted]	[redacted]		X															
River Hamble							X					X		X	X				
Trib of River Hamble								X			X								
Trib of River Hamble								X			X								
Trib of River Hamble									X				X						
Trib of River Hamble							X					X							
Trib of River Hamble							X	X			X	X	X	X	X				
Trib of River Hamble							X	X			X	X	X	X	X				
Trib of River Hamble							X	X			X	X	X	X	X				
Trib of River Hamble							X	X			X	X	X	X	X				
River Hamble								X			X								
Trib of River Hamble							X					X		X	X				
River Hamble									X				X						
Trib of River Hamble									X			X	X	X	X				
Park Lane Stream										X	X	X							
Park Lane Stream					X							X							
Hermitage Stream					X							X							
Hermitage Stream													X						
Hermitage Stream													X						
Hermitage Stream													X						
Hermitage Stream						X													
Bidbury Mead Stream					X							X							
Bidbury Mead Stream						X													
Bidbury Mead Stream						X													

Watercourse	Crossing Code	Crossing ID	[redacted] to WRP	[redacted] to WRP	WRP to Havant Thicket Route 1	WRP to Havant Thicket Route 2	WRP to Otterbourne Route 1	WRP to Otterbourne Route 2	WRP to Otterbourne SIA	Havant Thicket to Otterbourne Route 1	Havant Thicket to Otterbourne Route 2	Havant Thicket to Otterbourne Route 3	Havant Thicket to Otterbourne Route 4	Meon to Otterbourne Route 1	Meon to Otterbourne Route 2	Testwood WTW to Otterbourne	[redacted] Otterbourne Route 1	[redacted] Otterbourne Route 2	[redacted] Otterbourne Route 3
Bidbury Mead Stream	[redacted]	[redacted]			X							X							
Ford Lake												X	X	X	X				
Ford Lake									X										
Bow Lake										X									
Ditch (Bow Lake)							X	X			X	X		X	X				
Bow Lake							X	X			X	X		X	X				
Ditch (Bow Lake)													X						
Bow Lake									X				X						
Bow Lake																	X		
Bow Lake																		X	X
River Itchen							X			X	X	X		X	X				
Rosemary Leet							X			X	X	X		X	X				
The Itchen Navigation							X			X	X	X		X	X				
River Itchen								X	X				X						
Rosemary Leet								X	X				X						
The Itchen Navigation								X	X				X						
Trib of River Itchen																	X		
Trib of River Itchen																	X		
Trib of River Itchen																	X		
River Itchen																	X		
River Itchen																	X		
Barton River																	X		
Barton River																	X		
River Itchen																	X		

Watercourse	Crossing Code	Crossing ID	[redacted] to WRP	[redacted] to WRP	WRP to Havant Thicket Route 1	WRP to Havant Thicket Route 2	WRP to Otterbourne Route 1	WRP to Otterbourne Route 2	WRP to Otterbourne SIA	Havant Thicket to Otterbourne Route 1	Havant Thicket to Otterbourne Route 2	Havant Thicket to Otterbourne Route 3	Havant Thicket to Otterbourne Route 4	Meon to Otterbourne Route 1	Meon to Otterbourne Route 2	Testwood WTW to Otterbourne	[redacted] to Otterbourne Route 1	[redacted] to Otterbourne Route 2	[redacted] to Otterbourne Route 3
River Itchen	[redacted]	[redacted]															X		
The Itchen Navigation																	X		
Otter Bourne																	X		
Otter Bourne																	X		
Trib of River Itchen																		X	X
River Itchen																		X	X
The Itchen Navigation																		X	X
Otter Bourne																X			
Otter Bourne																X			
Monk's Brook																X			
Otter Bourne																X			
Otter Bourne																X			
Ditch (Otter Bourne)																	X		
Ditch (Otter Bourne)																		X	X
Ditch (Otter Bourne)								X	X				X						
Kingfisher Stream																		X	X
Kingfisher Stream								X	X				X						
Kingfisher Stream							X			X	X	X		X	X				
Ditch (Rosmary Leet)							X			X	X	X		X	X				
Ditch (The Itchen Navigation)							X			X	X	X		X	X				
The Itchen Navigation								X	X				X						
The Itchen Navigation								X	X				X						
Ditch (The Itchen Navigation)								X	X				X						

Watercourse	Crossing Code	Crossing ID	[redacted] to WRP	[redacted] to WRP	WRP to Havant Thicket Route 1	WRP to Havant Thicket Route 2	WRP to Otterbourne Route 1	WRP to Otterbourne Route 2	WRP to Otterbourne SIA	Havant Thicket to Otterbourne Route 1	Havant Thicket to Otterbourne Route 2	Havant Thicket to Otterbourne Route 3	Havant Thicket to Otterbourne Route 4	Meon to Otterbourne Route 1	Meon to Otterbourne Route 2	Testwood WTW to Otterbourne	[redacted] to Otterbourne Route 1	[redacted] to Otterbourne Route 2	[redacted] to Otterbourne Route 3
Ditch (The Itchen Navigation)	[redacted]	[redacted]						X	X				X						
Ditch (The Itchen Navigation)																		X	X
Otter Bourne																	X		
Trib of Barton River																	X		
Barton River																	X		
Ditch (River Itchen)																	X		
Trib of River Itchen																	X		
Trib of River Itchen																	X		
Trib of River Itchen																	X		
Trib of River Itchen																	X		
Trib of River Itchen																		X	X
Trib of River Itchen																	X		
Ditch (Bow Lake)									X										
River Meon										X									
River Meon								X	X		X		X						
River Meon							X					X							
Trib of River Test																X			
Trib of River Test																X			
Trib of River Test																X			
Tadburn Lake																X			
Tadburn Lake																X			
Trib of Tadburn Lake																X			
Trib of Tadburn Lake																X			

Watercourse	Crossing Code	Crossing ID	[redacted] to WRP	[redacted] to WRP	WRP to Havant Thicket Route 1	WRP to Havant Thicket Route 2	WRP to Otterbourne Route 1	WRP to Otterbourne Route 2	WRP to Otterbourne SIA	Havant Thicket to Otterbourne Route 1	Havant Thicket to Otterbourne Route 2	Havant Thicket to Otterbourne Route 3	Havant Thicket to Otterbourne Route 4	Meon to Otterbourne Route 1	Meon to Otterbourne Route 2	Testwood WTW to Otterbourne	[redacted] to Otterbourne Route 1	[redacted] to Otterbourne Route 2	[redacted] to Otterbourne Route 3
Ditch (River Test)	[redacted]	[redacted]														X			
River Test																X			
River Test																X			
Ditch (River Test)																X			
Ditch (River Test)																X			
Ditch (River Test)																X			
Ditch (River Test)																X			
Trib of Wallington River							X	X				X							
Wallington River							X	X				X							
Wallington River							X	X				X							
Wallington River									X				X						
Ditch (Wallington River)													X						
Trib of Wallington River									X				X						
Trib of Wallington River											X								
Trib of Wallington River							X	X				X							
Trib of Wallington River							X	X				X							
Trib of Wallington River									X				X						
Trib of Wallington River									X				X						
Trib of Wallington River							X					X							
Trib of Wallington River							X					X							
Trib of Wallington River							X					X							
Wallington River			X																
Wallington River									X										

A2 Watercourse pipeline crossing impact rating

Pipeline crossing ID	Crossed watercourse	WFD WB name and ID	BGS hydrogeology bedrock unit	Aquifer hydrogeology and flow mechanism	Mean superficial deposits thickness (m)	Surface water gradient vectors at crossing	Rest water level at nearest borehole (m)	Superficial geology thickness at nearest borehole (m)	Crossing point impact score	Max impact score within 25m of crossing point	Overall impact rating
	Brockhampton Mill Lake	Langstone Harbour (GB580705130000)	White Chalk Subgroup	Highly productive (fracture)	5	Towards	n/a	n/a	10	610	Red
	River Hamble	Main River Hamble (GB107042016250)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	100	600	Red
	Trib of River Hamble	Moors Stream (GB107042016260)	Lambeth Group	Low productivity (intergranular)	1	Towards	0.3	None	102	102	Green
	Trib of River Hamble	Moors Stream (GB107042016260)	Lambeth Group	Low productivity (intergranular)	1	Towards (LB) / Parallel (RB)	0.6	>5	100	700	Red
	Trib of River Hamble	Moors Stream (GB107042016260)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	102	102	Green
	Trib of River Hamble	No waterbody	Thames Group	Essentially no groundwater	1	LB - Away / RB - Parallel	n/a	n/a	100	102	Green
	Trib of River Hamble	Upper Hamble (GB107042016280)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	102	102	Green
	Trib of River Hamble	Upper Hamble (GB107042016280)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	102	120	Green
	Trib of River Hamble	Upper Hamble (GB107042016280)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	102	120	Green
	Trib of River Hamble	Upper Hamble (GB107042016280)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	102	102	Green
	River Hamble	Upper Hamble (GB107042016280)	Thames Group	Essentially no groundwater	1	Towards (LB) / Away (RB)	0.65	3	120	120	Green
	Trib of River Hamble	Upper Hamble (GB107042016280)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	102	120	Green
	River Hamble	Upper Hamble (GB107042016280)	Thames Group	Essentially no groundwater	1	Towards (LB) / Away (RB)	n/a	n/a	120	220	Amber
	Trib of River Hamble	Upper Hamble (GB107042016280)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	100	102	Green
	Park Lane Stream	Hermitage Stream (GB107042016370)	Thames Group	Essentially no groundwater	1	Towards (LB) / Parallel (RB)	n/a	n/a	102	702	Red
	Park Lane Stream	Hermitage Stream (GB107042016370)	Thames Group	Essentially no groundwater	1	Parallel	n/a	n/a	102	102	Green

Pipeline crossing ID	Crossed watercourse	WFD WB name and ID	BGS hydrogeology bedrock unit	Aquifer hydrogeology and flow mechanism	Mean superficial deposits thickness (m)	Surface water gradient vectors at crossing	Rest water level at nearest borehole (m)	Superficial geology thickness at nearest borehole (m)	Crossing point impact score	Max impact score within 25m of crossing point	Overall impact rating
[redacted]	Hermitage Stream	Hermitage Stream (GB107042016370)	Thames Group	Essentially no groundwater	2	Parallel	n/a	n/a	52	52	Green
	Hermitage Stream	Hermitage Stream (GB107042016370)	Thames Group	Essentially no groundwater	2	Towards	n/a	n/a	52	52	Green
	Hermitage Stream	Hermitage Stream (GB107042016370)	Thames Group	Essentially no groundwater	1	Parallel	No GW	2.9	102	102	Green
	Hermitage Stream	Hermitage Stream (GB107042016370)	Thames Group	Essentially no groundwater	1	Parallel	n/a	n/a	600	702	Red
	Hermitage Stream	Hermitage Stream (GB107042016370)	Thames Group	Essentially no groundwater	2	Towards	No GW	1.1	52	52	Green
	Bidbury Mead Stream	No waterbody	White Chalk Subgroup	Highly productive (fracture)	3	Towards (LB) / Away (RB)	n/a	n/a	125	127	Amber
	Bidbury Mead Stream	No waterbody	White Chalk Subgroup	Highly productive (fracture)	3	Parallel	n/a	n/a	125	127	Amber
	Bidbury Mead Stream	No waterbody	White Chalk Subgroup	Highly productive (fracture)	3	Parallel	2.4	>4.5	127	127	**Amber**
	Bidbury Mead Stream	No waterbody	White Chalk Subgroup	Highly productive (fracture)	3	Parallel	2.4	>4.5	125	127	**Amber**
	Ford Lake	Horton Heath Stream (GB107042016270)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	0	0	Green
	Ford Lake	Horton Heath Stream (GB107042016270)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	0	0	Green
	Bow Lake	Bow Lake (GB107042016650)	Lambeth Group	Low productivity (intergranular)	1	Towards	n/a	n/a	702	702	Red
	Ditch (Bow Lake)	Bow Lake (GB107042016650)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	102	102	Green
	Bow Lake	Bow Lake (GB107042016650)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	202	202	Amber
	Ditch (Bow Lake)	Bow Lake (GB107042016650)	Thames Group	Essentially no groundwater	1	Towards (LB) / Away (RB)	n/a	n/a	102	102	Green
	Bow Lake	Bow Lake (GB107042016650)	Thames Group	Essentially no groundwater	1	Away (LB) / Towards (RB)	n/a	n/a	100	120	Green

Pipeline crossing ID	Crossed watercourse	WFD WB name and ID	BGS hydrogeology bedrock unit	Aquifer hydrogeology and flow mechanism	Mean superficial deposits thickness (m)	Surface water gradient vectors at crossing	Rest water level at nearest borehole (m)	Superficial geology thickness at nearest borehole (m)	Crossing point impact score	Max impact score within 25m of crossing point	Overall impact rating
	Bow Lake	Bow Lake (GB107042016650)	Thames Group	Essentially no groundwater	2	Towards (LB) / Away (RB)	2.4	4.5	52	70	Green
	Bow Lake	Bow Lake (GB107042016650)	Thames Group	Essentially no groundwater	1	Towards (LB) / Parallel (RB)	n/a	n/a	120	120	Green
	River Itchen	Itchen (GB107042022580)	Lambeth Group	Low productivity (intergranular)	3	Towards	n/a	n/a	2625	2625	Red
	Rosemary Leet	Itchen (GB107042022580)	Lambeth Group	Low productivity (intergranular)	3	Towards	n/a	n/a	2025	2525	Red
	The Itchen Navigation	Itchen (GB107042022580)	White Chalk Subgroup	Highly productive (fracture)	3	Away	n/a	n/a	2625	2625	Red
	River Itchen	Itchen (GB107042022580)	Lambeth Group	Low productivity (intergranular)	3	Towards	n/a	n/a	2025	2627	Red
	Rosemary Leet	Itchen (GB107042022580)	Lambeth Group	Low productivity (intergranular)	3	Towards	n/a	n/a	45	2645	Red
	The Itchen Navigation	Itchen (GB107042022580)	Lambeth Group	Low productivity (intergranular)	3	Towards	n/a	n/a	2645	2645	Red
	Trib of River Itchen	Itchen (GB107042022580)	Bracklesham Group and Barton Group (Undifferentiated)	Moderately productive (intergranular)	4	Towards (LB) / Away (RB)	1	>10	125	125	Amber
	Trib of River Itchen	Itchen (GB107042022580)	Bracklesham Group and Barton Group (Undifferentiated)	Moderately productive (intergranular)	4	Away (LB) / Towards (RB)	n/a	n/a	627	627	Red
	Trib of River Itchen	Itchen (GB107042022580)	Bracklesham Group and Barton Group (Undifferentiated)	Moderately productive (intergranular)	4	Towards	n/a	n/a	27	627	Red
	River Itchen	Itchen (GB107042022580)	Thames Group	Essentially no groundwater	3	Towards	n/a	n/a	2025	2025	Red
	River Itchen	Itchen (GB107042022580)	Thames Group	Essentially no groundwater	3	Away	6.78	>10	2027	2127	Red
	Barton River	Itchen (GB107042022580)	Bracklesham Group and Barton Group (Undifferentiated)	Moderately productive (intergranular)	3	Parallel	n/a	n/a	2025	2045	Red
	Barton River	Itchen (GB107042022580)	Bracklesham Group and Barton Group (Undifferentiated)	Moderately productive (intergranular)	3	Towards	n/a	n/a	2025	2127	Red

Pipeline crossing ID	Crossed watercourse	WFD WB name and ID	BGS hydrogeology bedrock unit	Aquifer hydrogeology and flow mechanism	Mean superficial deposits thickness (m)	Surface water gradient vectors at crossing	Rest water level at nearest borehole (m)	Superficial geology thickness at nearest borehole (m)	Crossing point impact score	Max impact score within 25m of crossing point	Overall impact rating
[redacted]	River Itchen	Itchen (GB107042022580)	Thames Group	Essentially no groundwater	3	Towards (LB) / Away (RB)	n/a	n/a	2025	2145	Red
	River Itchen	Itchen (GB107042022580)	Lambeth Group	Low productivity (intergranular)	3	Towards	n/a	n/a	2625	2625	Red
	The Itchen Navigation	Itchen (GB107042022580)	Lambeth Group	Low productivity (intergranular)	3	Towards	n/a	n/a	2025	2625	Red
	Otter Bourne	Itchen (GB107042022580)	Lambeth Group	Low productivity (intergranular)	3	Parallel (LB) / Away (RB)	n/a	n/a	25	127	Amber
	Otter Bourne	Itchen (GB107042022580)	Lambeth Group	Low productivity (intergranular)	3	Towards	n/a	>5.79	25	127	Amber
	Trib of River Itchen	Itchen (GB107042022580)	Bracklesham Group and Barton Group (Undifferentiated)	Moderately productive (intergranular)	4	Towards	n/a	n/a	27	527	Red
	River Itchen	Itchen (GB107042022580)	Lambeth Group	Low productivity (intergranular)	3	Towards	n/a	n/a	2027	2627	Red
	The Itchen Navigation	Itchen (GB107042022580)	Lambeth Group	Low productivity (intergranular)	3	Towards	n/a	n/a	2645	2645	Red
	Otter Bourne	Monks Brook (GB107042016310)	Lambeth Group	Low productivity (intergranular)	1	Towards (LB) / Away (RB)	n/a	n/a	0	600	Red
	Otter Bourne	Monks Brook (GB107042016310)	White Chalk Subgroup	Highly productive (fracture)	1	Away (LB) / Towards (RB)	n/a	n/a	0	0	Green
	Monk's Brook	Monks Brook (GB107042016310)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	202	202	Amber
	Otter Bourne	Itchen (GB107042022580)	White Chalk Subgroup	Highly productive (fracture)	1	Towards	n/a	n/a	0	0	Green
	Otter Bourne	Itchen (GB107042022580)	White Chalk Subgroup	Highly productive (fracture)	1	Towards	n/a	n/a	0	0	Green
	Ditch (Otter Bourne)	Itchen (GB107042022580)	Lambeth Group	Low productivity (intergranular)	3	Away (LB) / Towards (RB)	n/a	n/a	125	127	Amber
	Ditch (Otter Bourne)	Itchen (GB107042022580)	Lambeth Group	Low productivity (intergranular)	3	Parallel (LB) / Towards (RB)	n/a	n/a	125	125	Amber

Pipeline crossing ID	Crossed watercourse	WFD WB name and ID	BGS hydrogeology bedrock unit	Aquifer hydrogeology and flow mechanism	Mean superficial deposits thickness (m)	Surface water gradient vectors at crossing	Rest water level at nearest borehole (m)	Superficial geology thickness at nearest borehole (m)	Crossing point impact score	Max impact score within 25m of crossing point	Overall impact rating
[redacted]	Ditch (Otter Bourne)	Itchen (GB107042022580)	Lambeth Group	Low productivity (intergranular)	3	Parallel	n/a	n/a	25	125	Amber
	Kingfisher Stream	Itchen (GB107042022580)	Lambeth Group	Low productivity (intergranular)	3	Towards	n/a	n/a	2625	2627	Red
	Kingfisher Stream	Itchen (GB107042022580)	Lambeth Group	Low productivity (intergranular)	3	Towards	n/a	n/a	2625	2625	Red
	Kingfisher Stream	Itchen (GB107042022580)	Lambeth Group	Low productivity (intergranular)	3	Towards	n/a	n/a	2625	2625	Red
	Ditch (Rosmary Leet)	Itchen (GB107042022580)	White Chalk Subgroup	Highly productive (fracture)	3	Towards	n/a	n/a	625	2625	Red
	Ditch (The Itchen Navigation)	Itchen (GB107042022580)	White Chalk Subgroup	Highly productive (fracture)	3	Towards	n/a	n/a	2645	2645	Red
	The Itchen Navigation	Itchen (GB107042022580)	Lambeth Group	Low productivity (intergranular)	3	Towards	n/a	n/a	645	2645	Red
	The Itchen Navigation	Itchen (GB107042022580)	Lambeth Group	Low productivity (intergranular)	3	Towards	n/a	n/a	645	2645	Red
	Ditch (The Itchen Navigation)	Itchen (GB107042022580)	Lambeth Group	Low productivity (intergranular)	3	Towards	n/a	n/a	645	2645	Red
	Ditch (The Itchen Navigation)	Itchen (GB107042022580)	Lambeth Group	Low productivity (intergranular)	3	Towards	n/a	n/a	125	645	Red
	Ditch (The Itchen Navigation)	Itchen (GB107042022580)	Lambeth Group	Low productivity (intergranular)	3	Towards	n/a	n/a	125	2645	Red
	Otter Bourne	Itchen (GB107042022580)	Lambeth Group	Low productivity (intergranular)	3	Away (LB) / Towards (RB)	n/a	>5.79	25	1225	Red
	Trib of Barton River	Itchen (GB107042022580)	Thames Group	Essentially no groundwater	3	Towards	n/a	n/a	25	125	Amber
	Barton River	Itchen (GB107042022580)	Thames Group	Essentially no groundwater	3	Away (LB) / Towards (RB)	n/a	n/a	2625	2625	Red
	Ditch (River Itchen)	Itchen (GB107042022580)	Thames Group	Essentially no groundwater	3	Towards	0.4	>10	1125	1625	Red

Pipeline crossing ID	Crossed watercourse	WFD WB name and ID	BGS hydrogeology bedrock unit	Aquifer hydrogeology and flow mechanism	Mean superficial deposits thickness (m)	Surface water gradient vectors at crossing	Rest water level at nearest borehole (m)	Superficial geology thickness at nearest borehole (m)	Crossing point impact score	Max impact score within 25m of crossing point	Overall impact rating
	Trib of River Itchen	Itchen (GB107042022580)	Thames Group	Essentially no groundwater	4	Away	1.5	>20	0	125	Amber
	Trib of River Itchen	Itchen (GB107042022580)	Thames Group	Essentially no groundwater	4	Away	1.5	>20	0	125	Amber
	Trib of River Itchen	Itchen (GB107042022580)	Thames Group	Essentially no groundwater	4	Away	n/a	n/a	0	125	Amber
	Trib of River Itchen	Itchen (GB107042022580)	Thames Group	Essentially no groundwater	4	Away	n/a	n/a	0	100	Green
	Trib of River Itchen	Itchen (GB107042022580)	Bracklesham Group and Barton Group (Undifferentiated)	Moderately productive (intergranular)	4	Away (LB) / Towards (RB)	n/a	n/a	25	627	Red
	Trib of River Itchen	Itchen (GB107042022580)	Bracklesham Group and Barton Group (Undifferentiated)	Moderately productive (intergranular)	4	Towards	n/a	n/a	525	627	Red
	Ditch (Bow Lake)	Bow Lake (GB107042016650)	Thames Group	Essentially no groundwater	1	Towards (LB) / Away (RB)	n/a	n/a	102	102	Amber
	River Meon	Meon (GB107042016640)	White Chalk Subgroup	Highly productive (fracture)	1	Towards	n/a	n/a	100	800	Red
	River Meon	Meon (GB107042016640)	Lambeth Group	Low productivity (intergranular)	1	Towards	n/a	n/a	102	220	Amber
	River Meon	Meon (GB107042016640)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	720	720	Red
	Trib of River Test	Luzborough Lane Stream (GB107042016800)	Thames Group	Essentially no groundwater	2	Towards	No GW	8.2	52	52	Green
	Trib of River Test	Luzborough Lane Stream (GB107042016800)	Bracklesham Group and Barton Group (Undifferentiated)	Moderately productive (intergranular)	2	Towards	n/a	n/a	52	52	**Amber**
	Trib of River Test	Luzborough Lane Stream (GB107042016800)	Thames Group	Essentially no groundwater	3	Parallel	n/a	n/a	0	0	Green
	Tadburn Lake	Tadburn Lake (GB107042016490)	Bracklesham Group and Barton Group (Undifferentiated)	Moderately productive (intergranular)	1	Towards	n/a	n/a	202	202	Amber

Pipeline crossing ID	Crossed watercourse	WFD WB name and ID	BGS hydrogeology bedrock unit	Aquifer hydrogeology and flow mechanism	Mean superficial deposits thickness (m)	Surface water gradient vectors at crossing	Rest water level at nearest borehole (m)	Superficial geology thickness at nearest borehole (m)	Crossing point impact score	Max impact score within 25m of crossing point	Overall impact rating
[redacted]	Tadburn Lake	Tadburn Lake (GB107042016490)	Thames Group	Essentially no groundwater	1	Towards (LB) / Away (RB)	n/a	n/a	102	602	Red
	Trib of Tadburn Lake	Tadburn Lake (GB107042016490)	Thames Group	Essentially no groundwater	1	Parallel	n/a	n/a	0	0	Green
	Trib of Tadburn Lake	Tadburn Lake (GB107042016490)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	100	100	Green
	Ditch (River Test)	Test (Lower) (GB107042016840)	Thames Group	Essentially no groundwater	4	Towards	n/a	n/a	3125	3125	Red
	River Test	Test (Lower) (GB107042016840)	Thames Group	Essentially no groundwater	4	Towards (LB) / Away (RB)	n/a	n/a	77	3127	Red
	River Test	Test (Lower) (GB107042016840)	Bracklesham Group and Barton Group (Undifferentiated)	Moderately productive (intergranular)	4	Towards	n/a	n/a	1045	1145	Red
	Ditch (River Test)	Test (Lower) (GB107042016840)	Bracklesham Group and Barton Group (Undifferentiated)	Moderately productive (intergranular)	4	Towards	n/a	n/a	125	1145	Red
	Ditch (River Test)	Test (Lower) (GB107042016840)	Bracklesham Group and Barton Group (Undifferentiated)	Moderately productive (intergranular)	4	Towards	n/a	n/a	25	125	Amber
	Ditch (River Test)	Test (Lower) (GB107042016840)	Bracklesham Group and Barton Group (Undifferentiated)	Moderately productive (intergranular)	4	Towards	n/a	>7.5	25	125	Amber
	Ditch (River Test)	Test (Lower) (GB107042016840)	Thames Group	Essentially no groundwater	4	Towards	n/a	>7.5	125	125	Amber
	Trib of Wallington River	Potwell Trib (GB107042016400)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	202	702	Red
	Wallington River	Potwell Trib (GB107042016400)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	102	120	Green
	Wallington River	Potwell Trib (GB107042016400)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	702	702	Red
	Wallington River	Potwell Trib (GB107042016400)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	102	202	Amber

Pipeline crossing ID	Crossed watercourse	WFD WB name and ID	BGS hydrogeology bedrock unit	Aquifer hydrogeology and flow mechanism	Mean superficial deposits thickness (m)	Surface water gradient vectors at crossing	Rest water level at nearest borehole (m)	Superficial geology thickness at nearest borehole (m)	Crossing point impact score	Max impact score within 25m of crossing point	Overall impact rating
[redacted]	Ditch (Wallington River)	Potwell Trib (GB107042016400)	Thames Group	Essentially no groundwater	2	Away (LB) / Towards (RB)	n/a	n/a	52	52	Green
	Trib of Wallington River	Potwell Trib (GB107042016400)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	100	602	Red
	Trib of Wallington River	Upper Wallington (GB107042016350)	White Chalk Subgroup	Highly productive (fracture)	1	Towards	41	n/a	120	120	**Amber**
	Trib of Wallington River	Upper Wallington (GB107042016350)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	102	202	Amber
	Trib of Wallington River	Upper Wallington (GB107042016350)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	152	152	Amber
	Trib of Wallington River	Upper Wallington (GB107042016350)	Thames Group	Essentially no groundwater	1	Towards	3.65	None	102	202	Amber
	Trib of Wallington River	Upper Wallington (GB107042016350)	Thames Group	Essentially no groundwater	1	Towards	15-22	None	102	102	Green
	Trib of Wallington River	Wallington below Southwick (GB107042016360)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	100	702	Red
	Trib of Wallington River	Wallington below Southwick (GB107042016360)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	1602	1602	Red
	Trib of Wallington River	Wallington below Southwick (GB107042016360)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	102	102	Green
	Wallington River	Wallington below Southwick (GB107042016360)	White Chalk Subgroup	Highly productive (fracture)	2	Towards	n/a	n/a	50	170	**Amber**
	Wallington River	Potwell Trib (GB107042016400)	Thames Group	Essentially no groundwater	1	Towards	n/a	n/a	202	702	Red

Table notes

1 – WB = waterbody, GW = groundwater, LB = left bank, RB = right bank.

2 – Surface gradients refer to both banks of the watercourse unless explicitly specified.

3 – Where overall impact rating is emboldened this indicates the score has been weighted.

A3 Stakeholder Comment Log[9,10]

[redacted]

A4 Detailed Mapping for Options Appraisal

[redacted] ***to Water Recycling Plant***

Exclusion map:

[redacted]

Priority habitats at watercourse crossing[11]:

[redacted]

[11] The legend on each figure is automatically tailored to the figure to reflect habitats present only.

[redacted] ***to Water Recycling Plant***

Exclusion map:

[redacted]

Priority habitats at watercourse crossing[12]:

[redacted]

[12] The legend on each figure is automatically tailored to the figure to reflect habitats present only.

Water Recycling Plant to Havant Thicket Reservoir – Route 1

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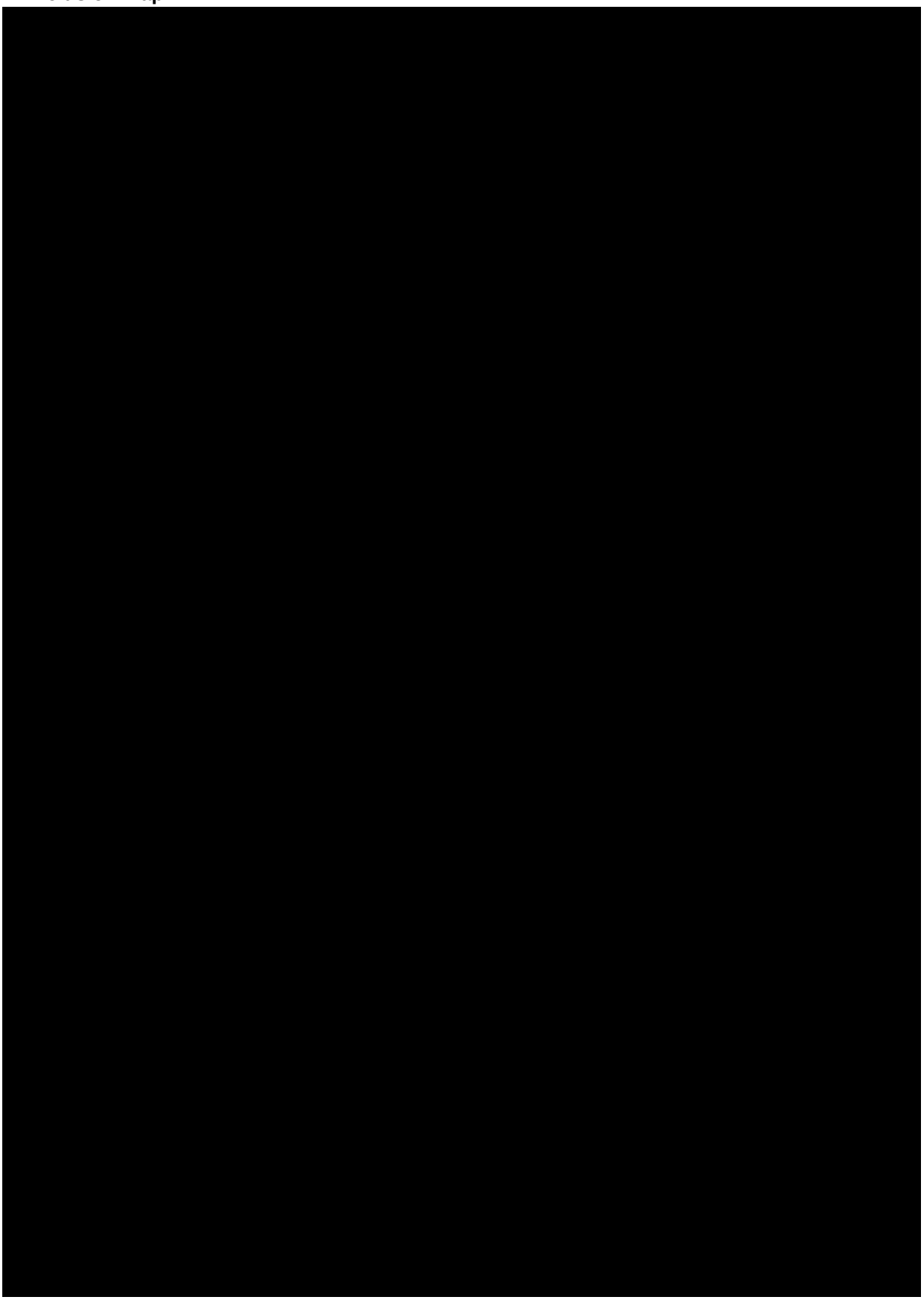
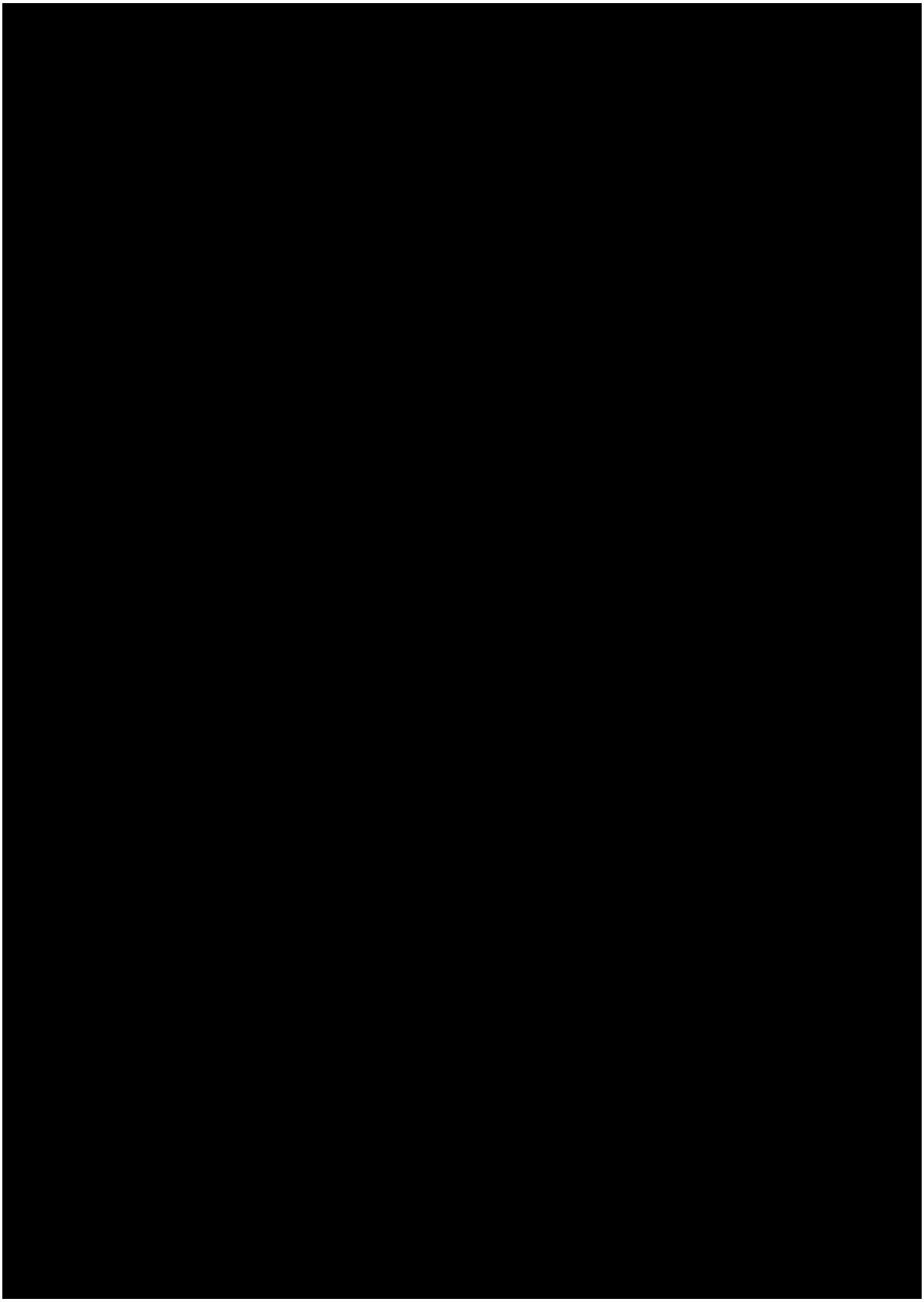


Priority habitats at watercourse crossing[13]:



[13] The legend on each figure is automatically tailored to the figure to reflect habitats present only.

Water Recycling Plant to Lake Otterbourne Environmental Buffer – Route 1

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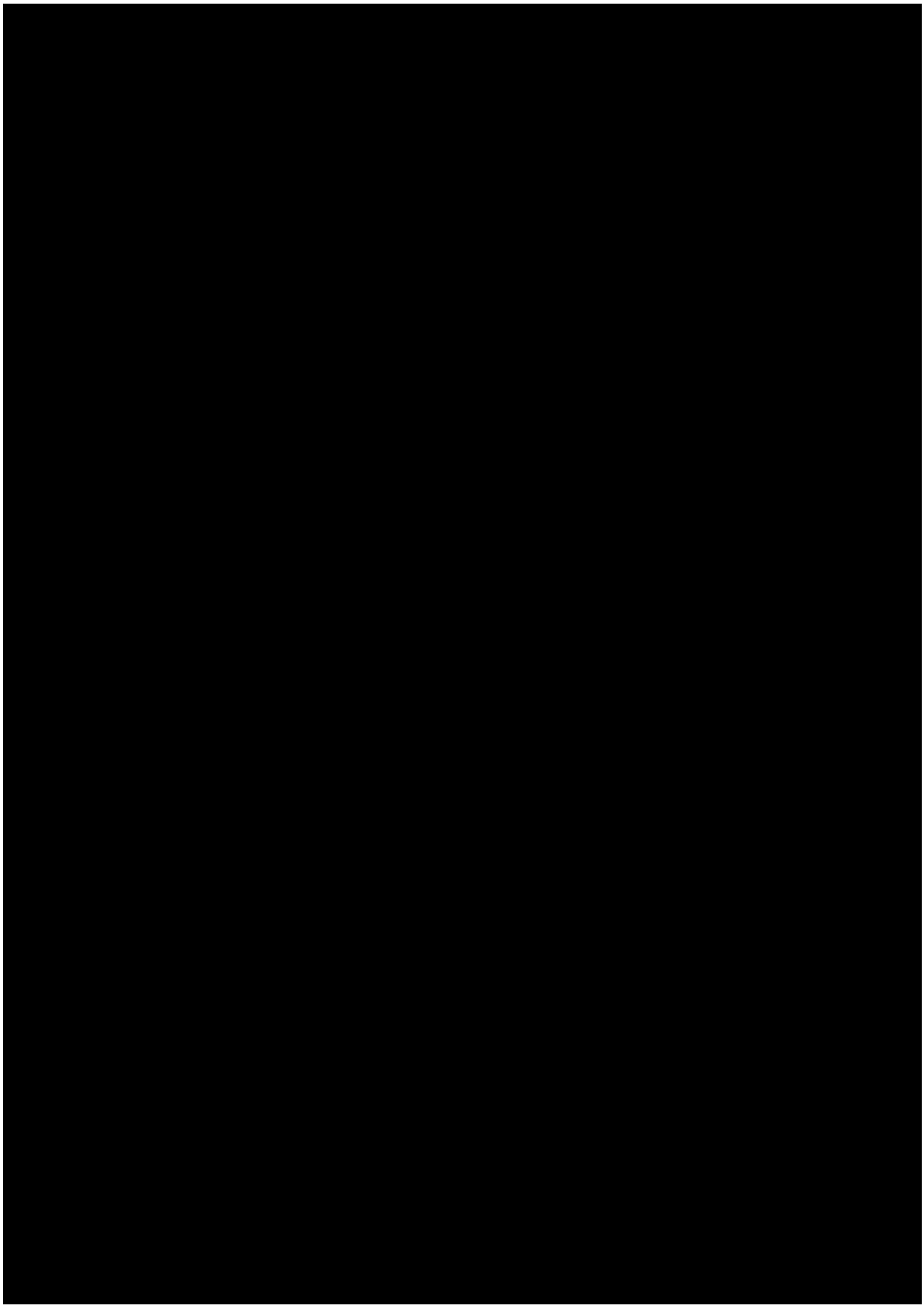
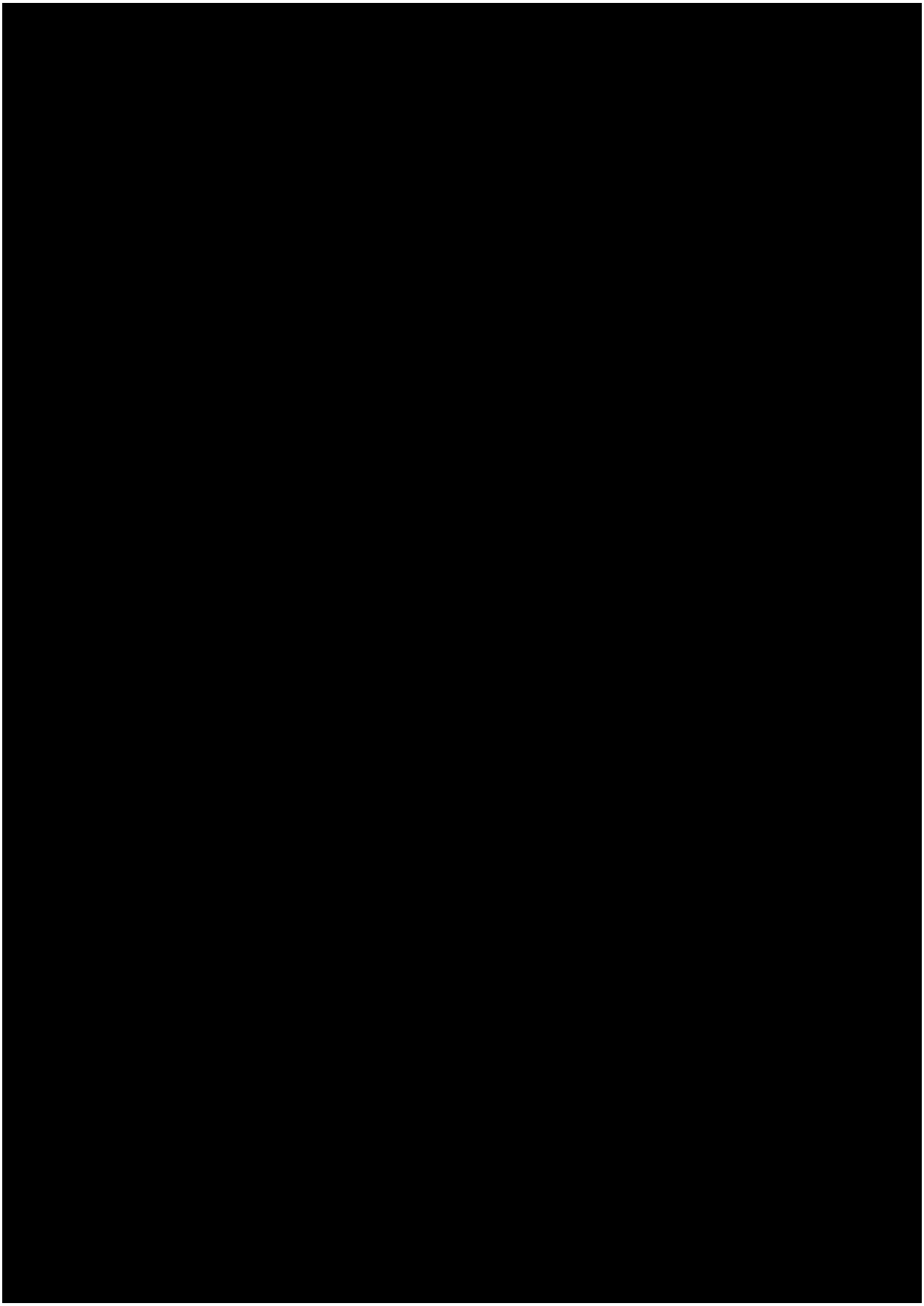
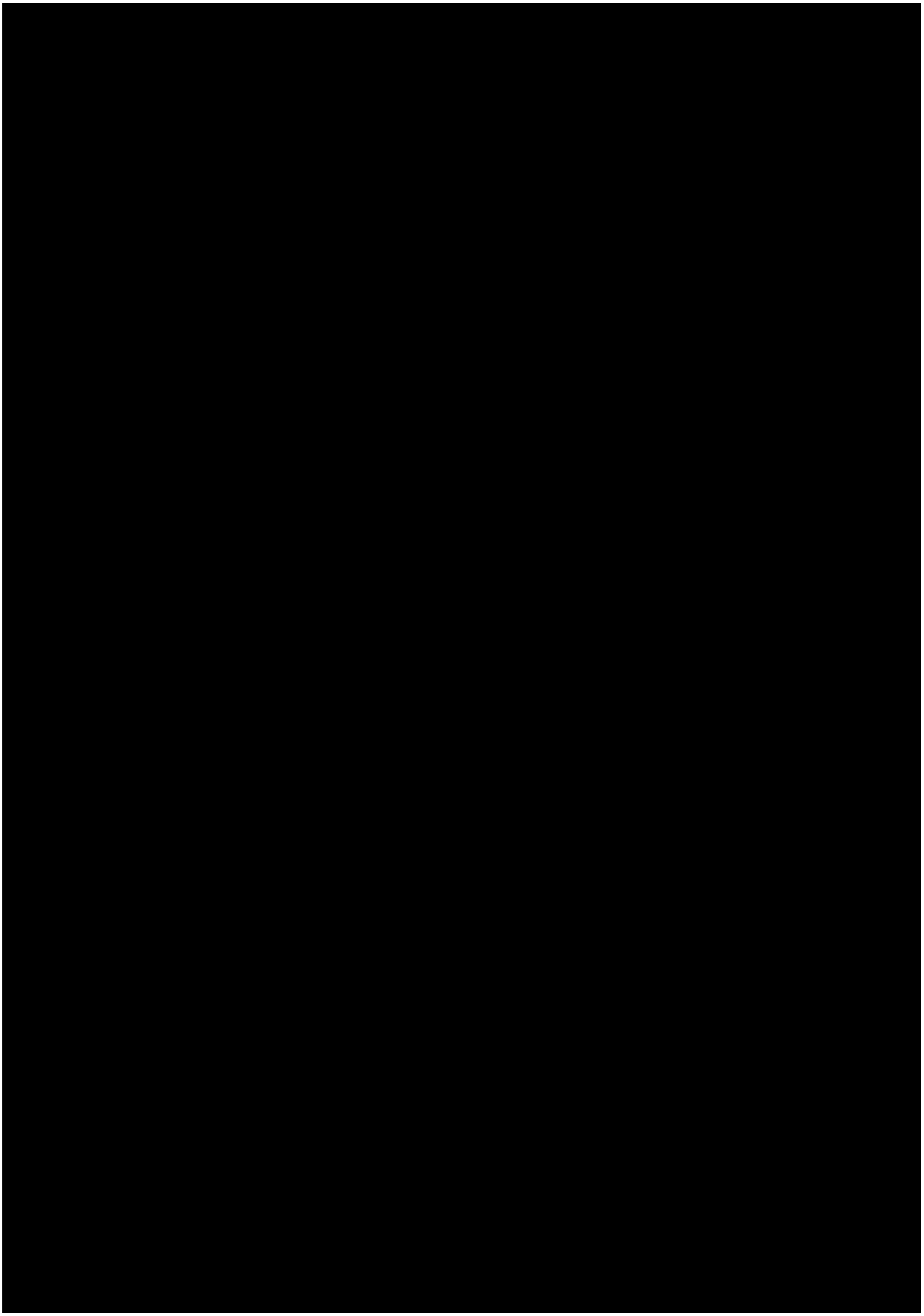
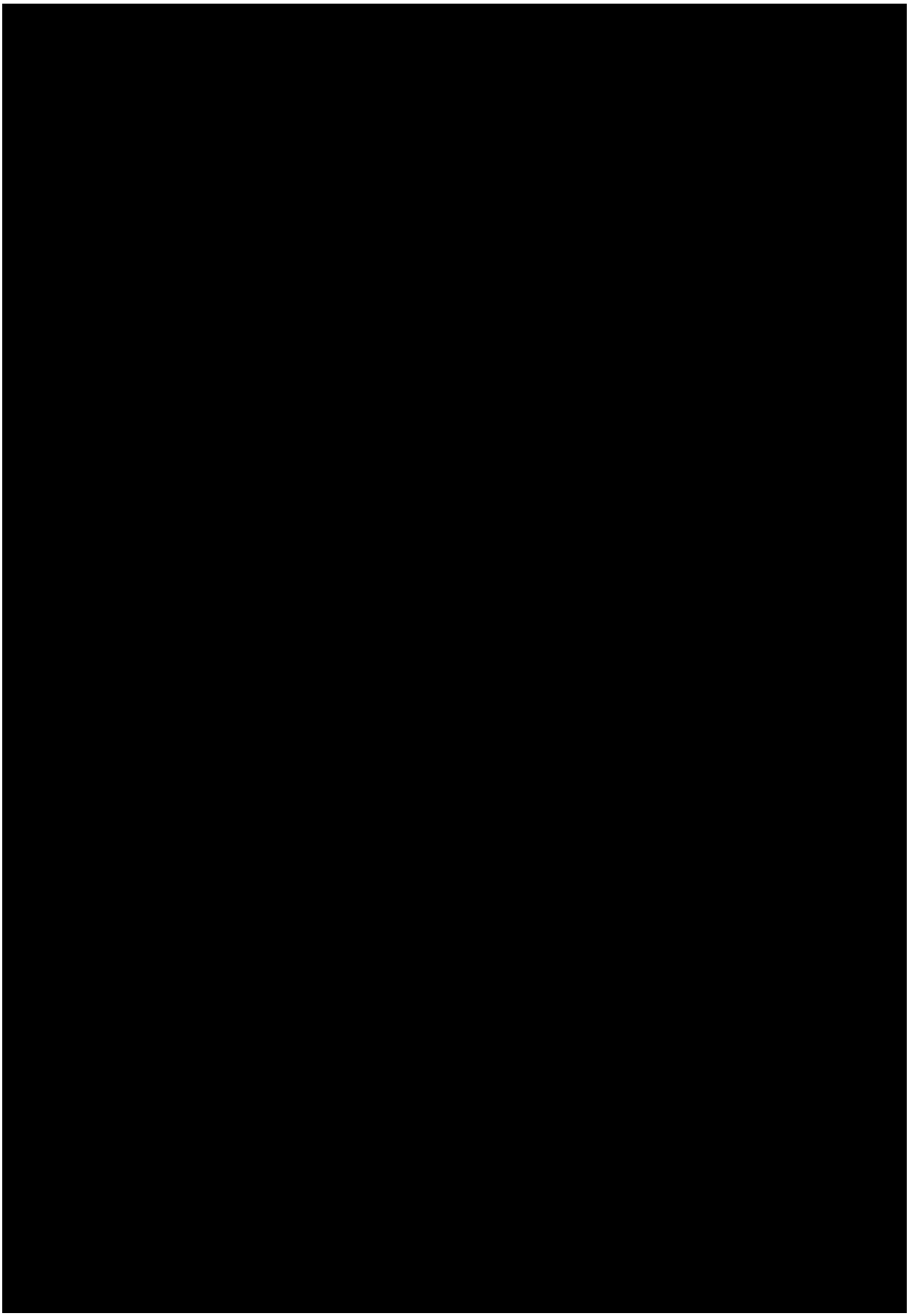
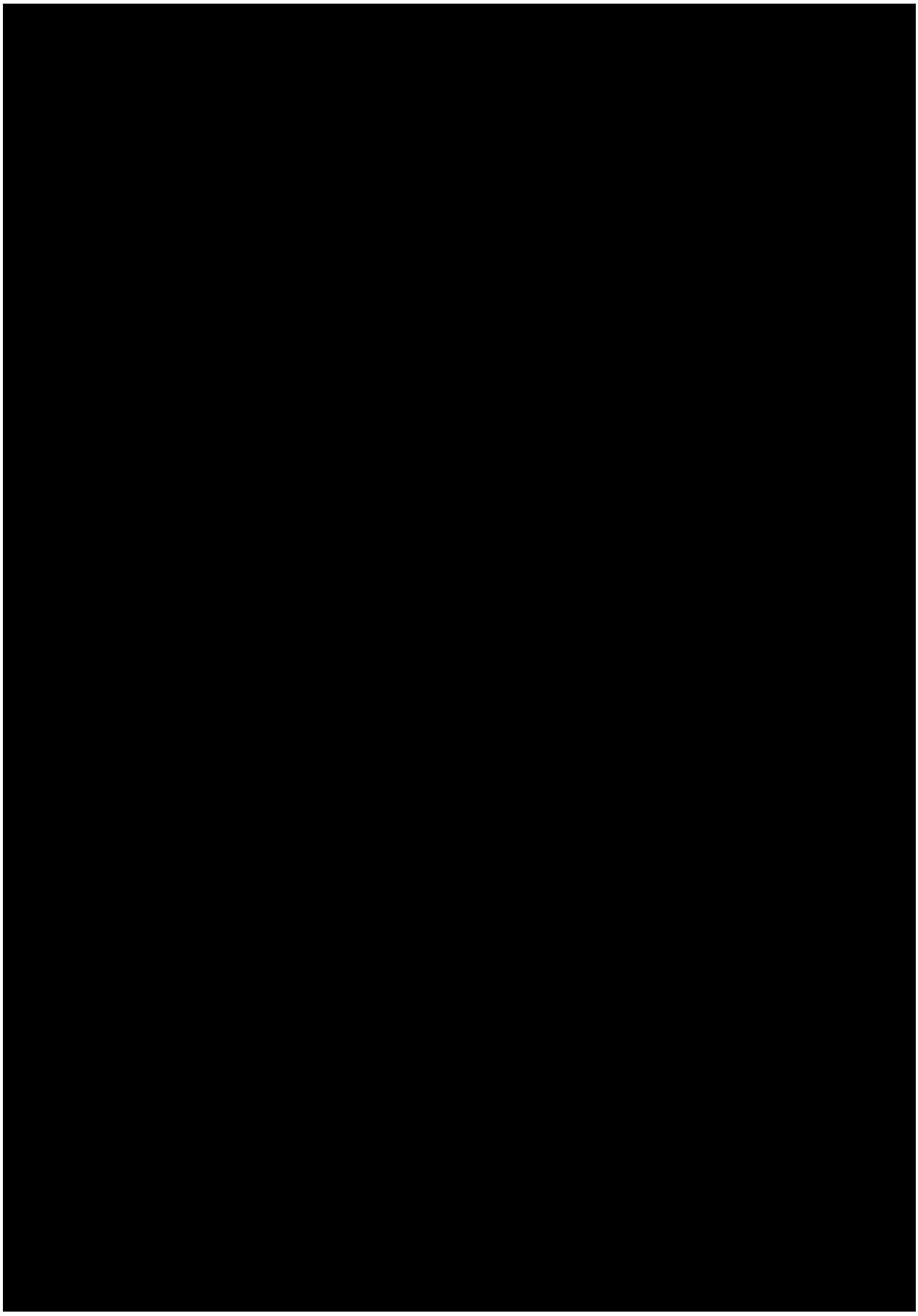
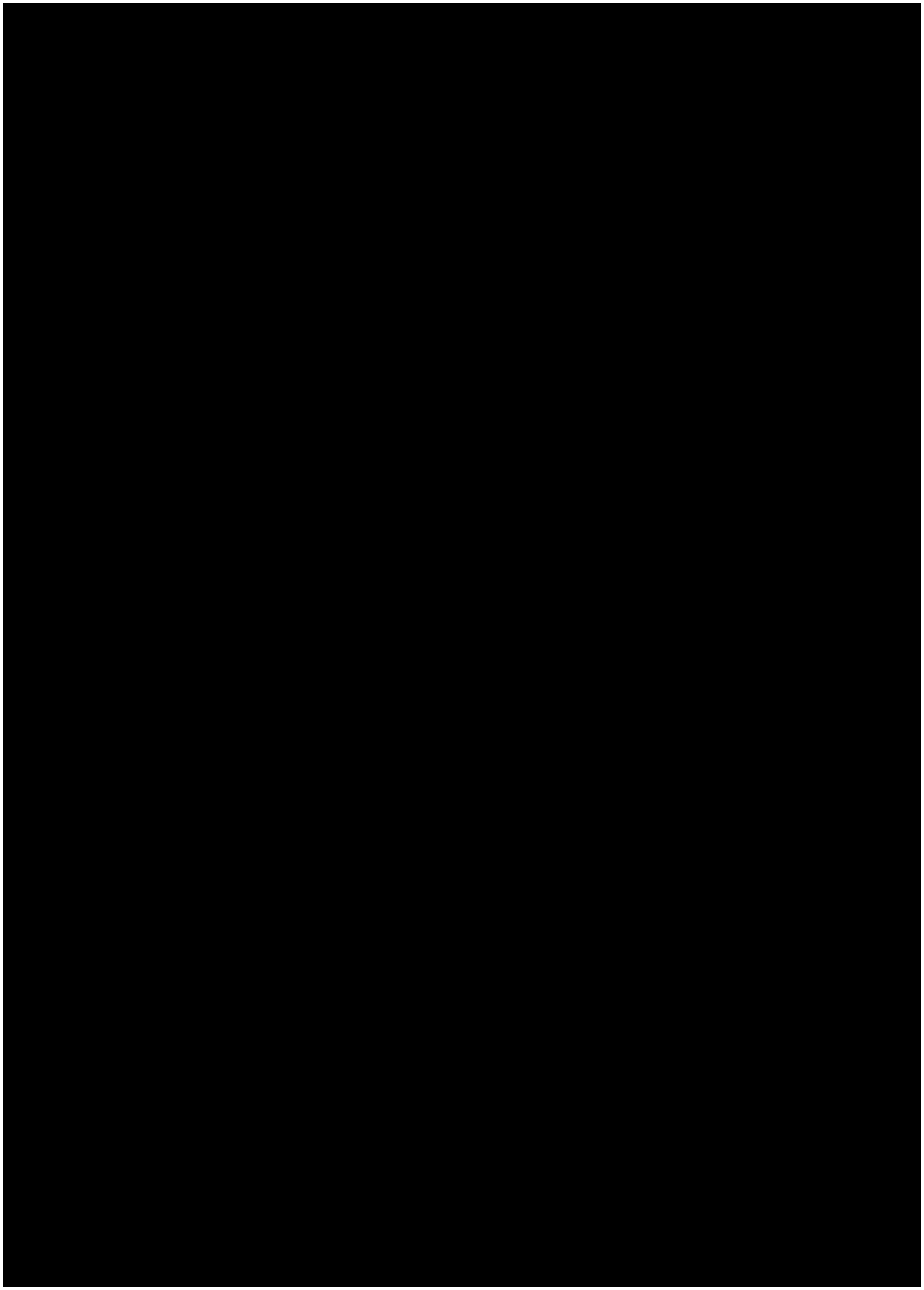




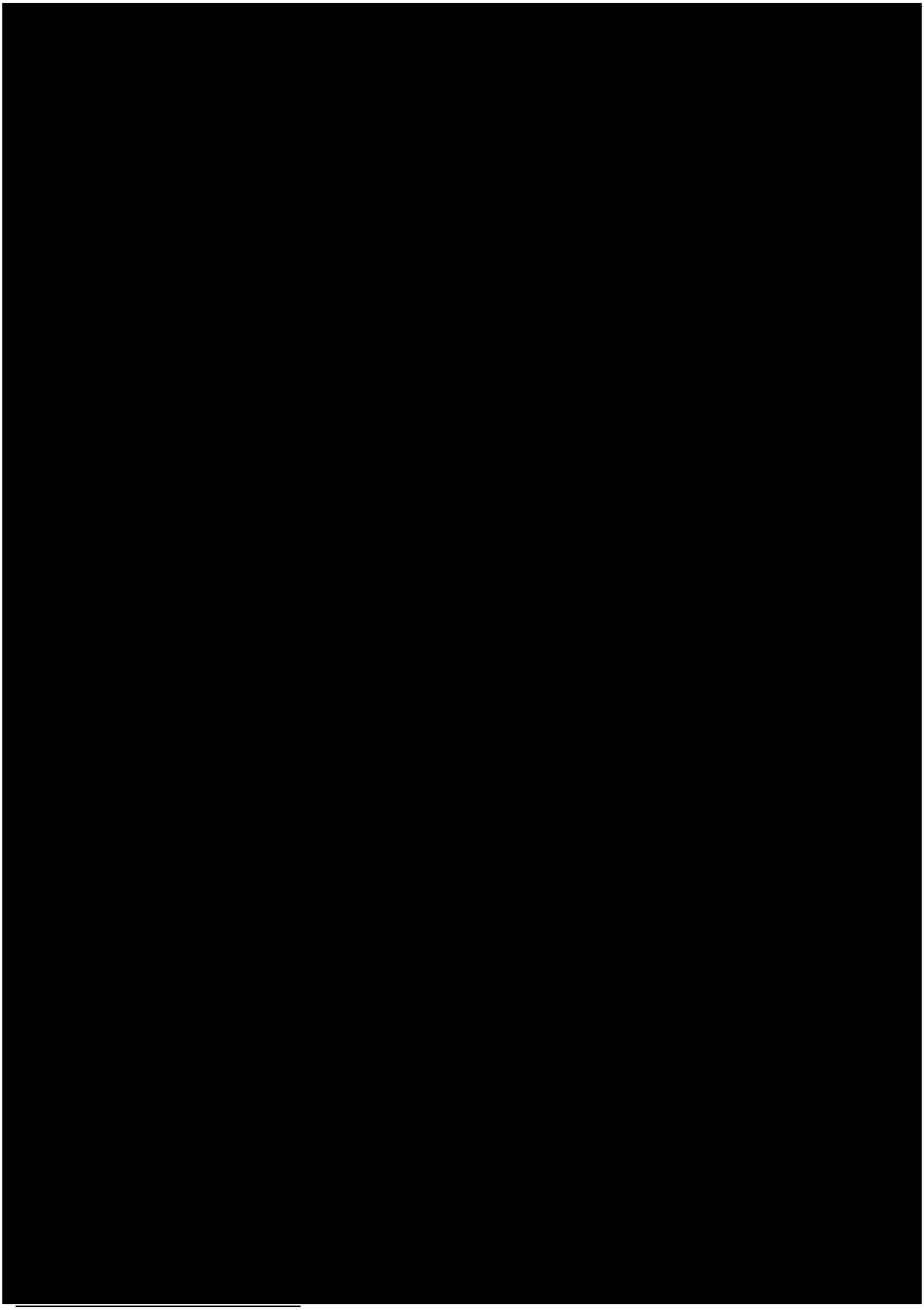




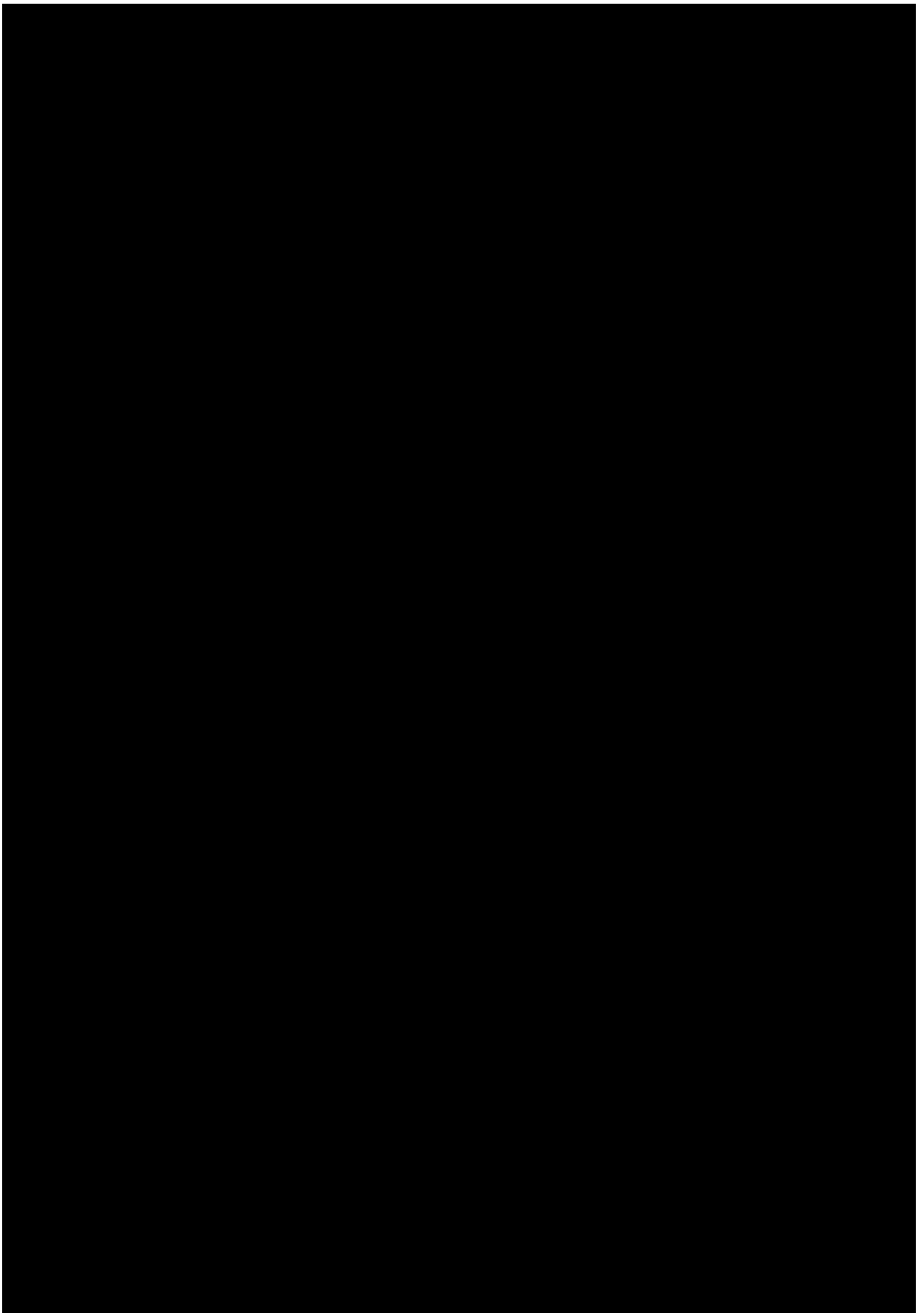


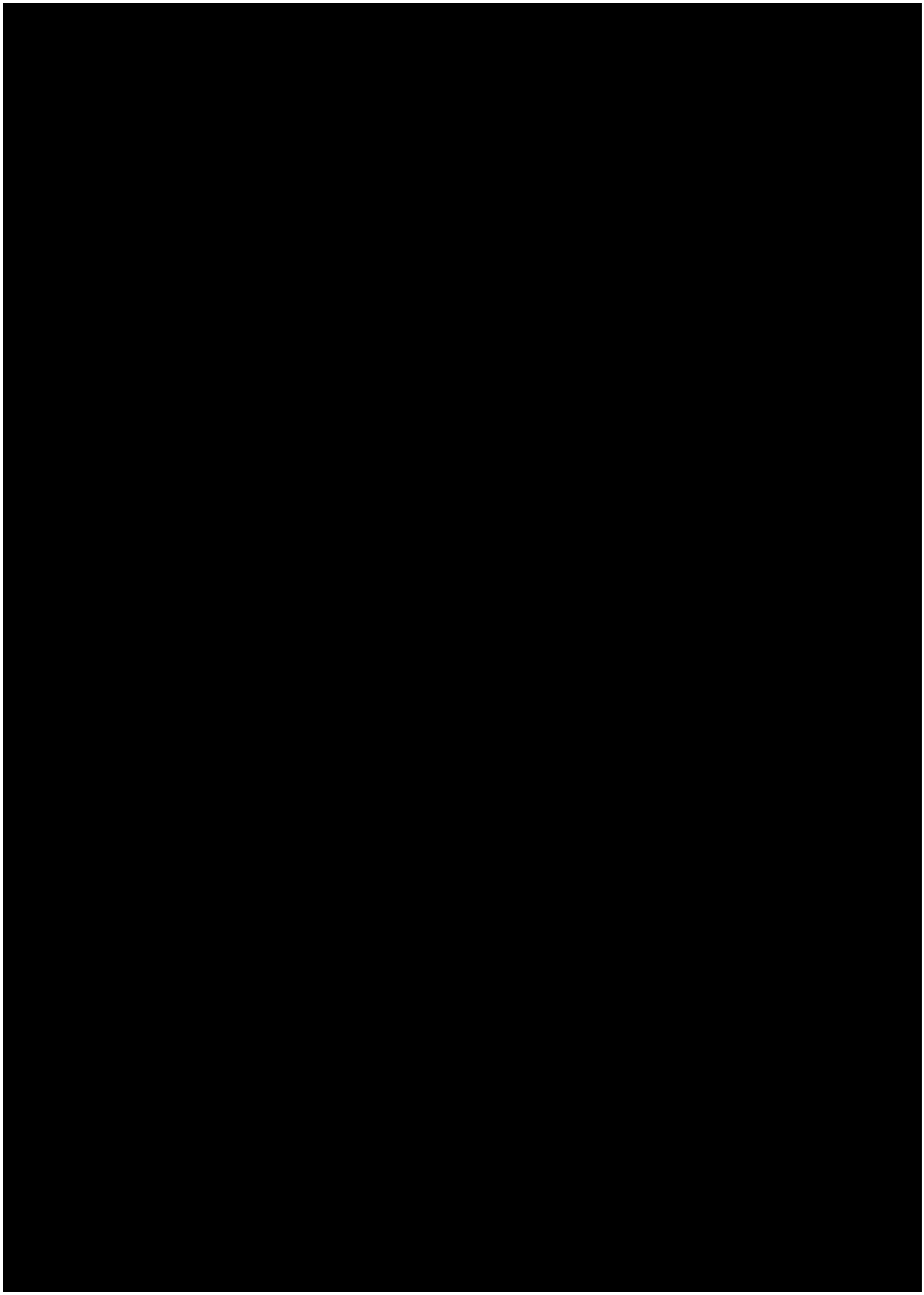


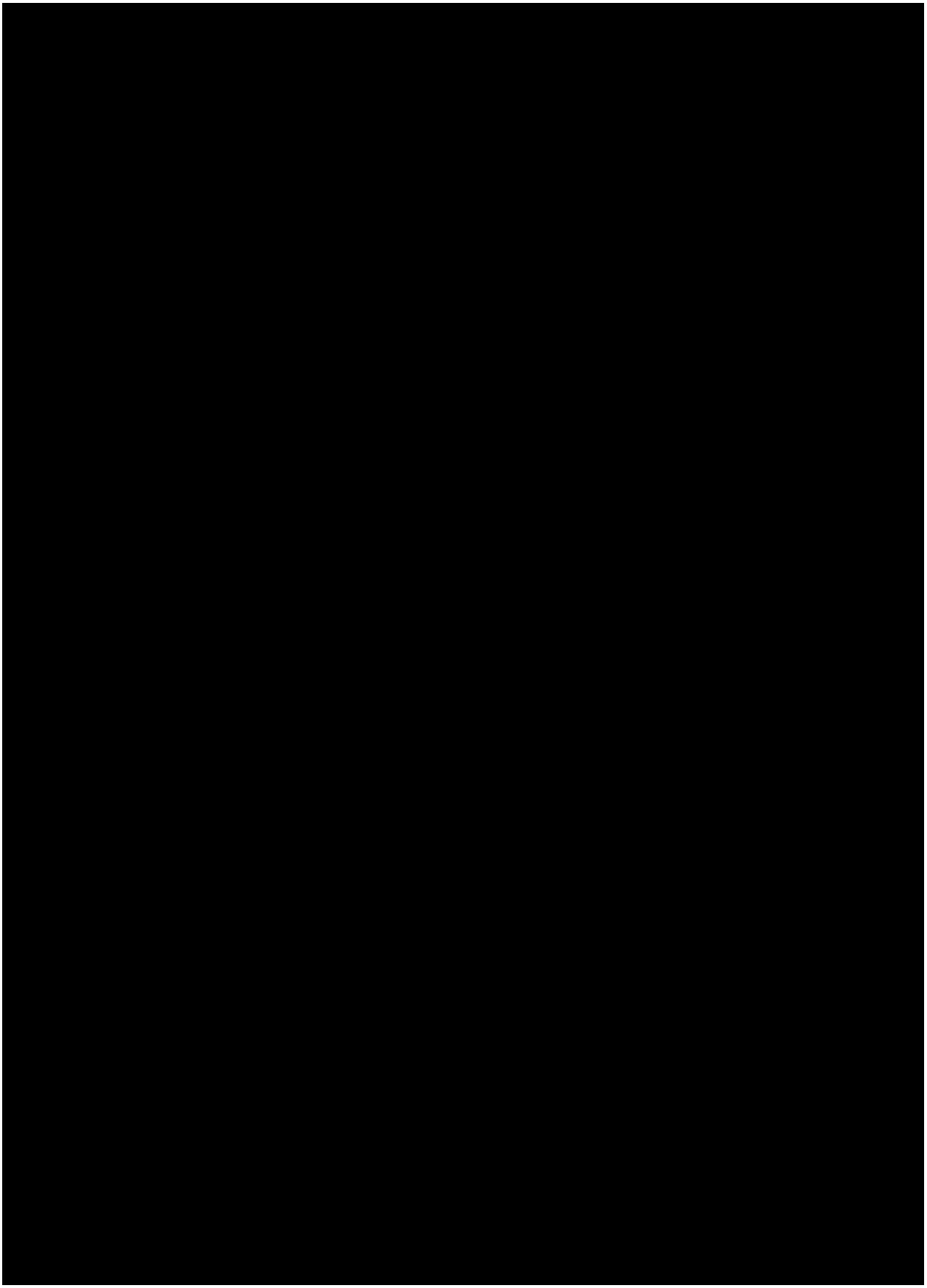
Priority habitats at watercourse crossing[14]:

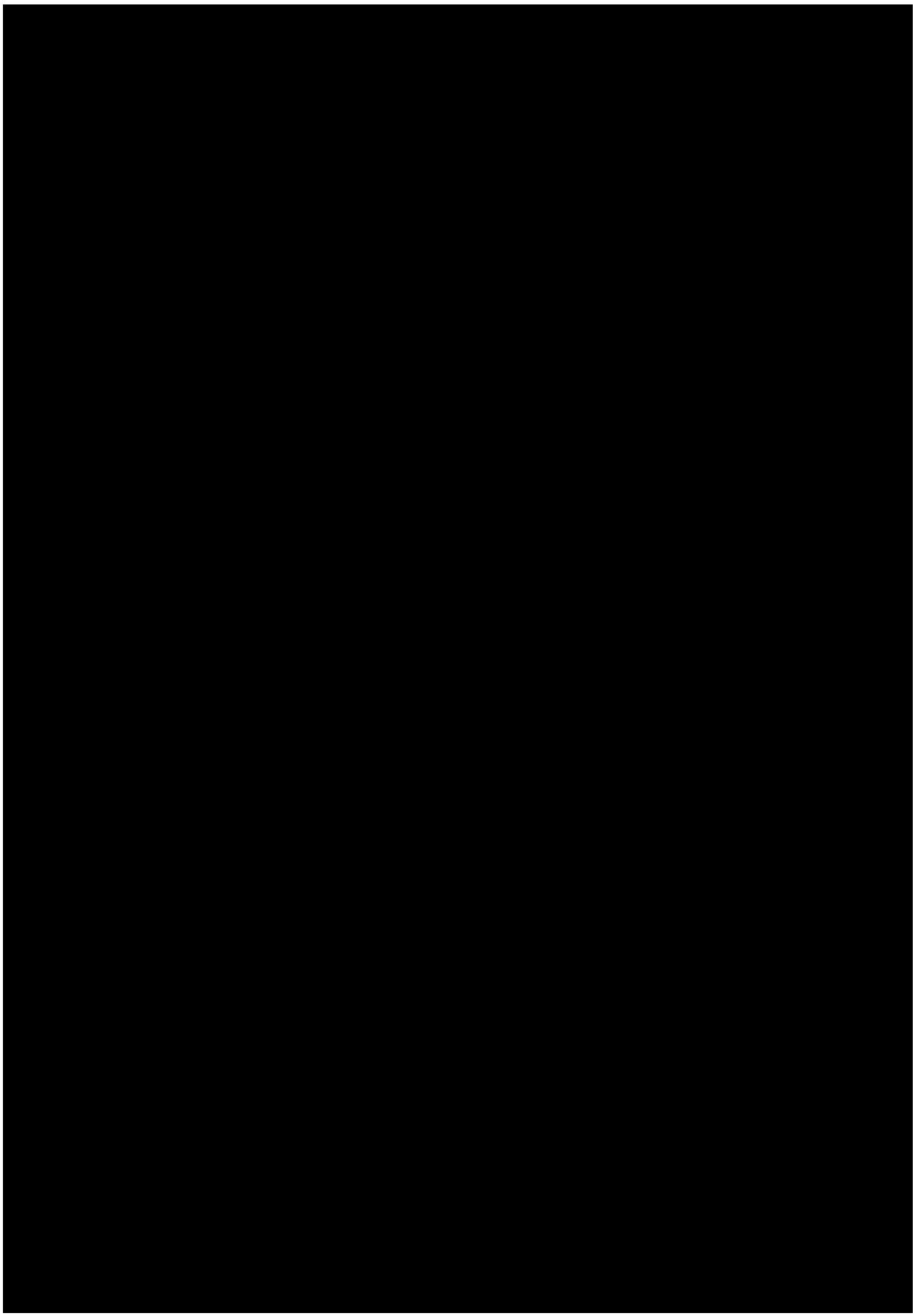


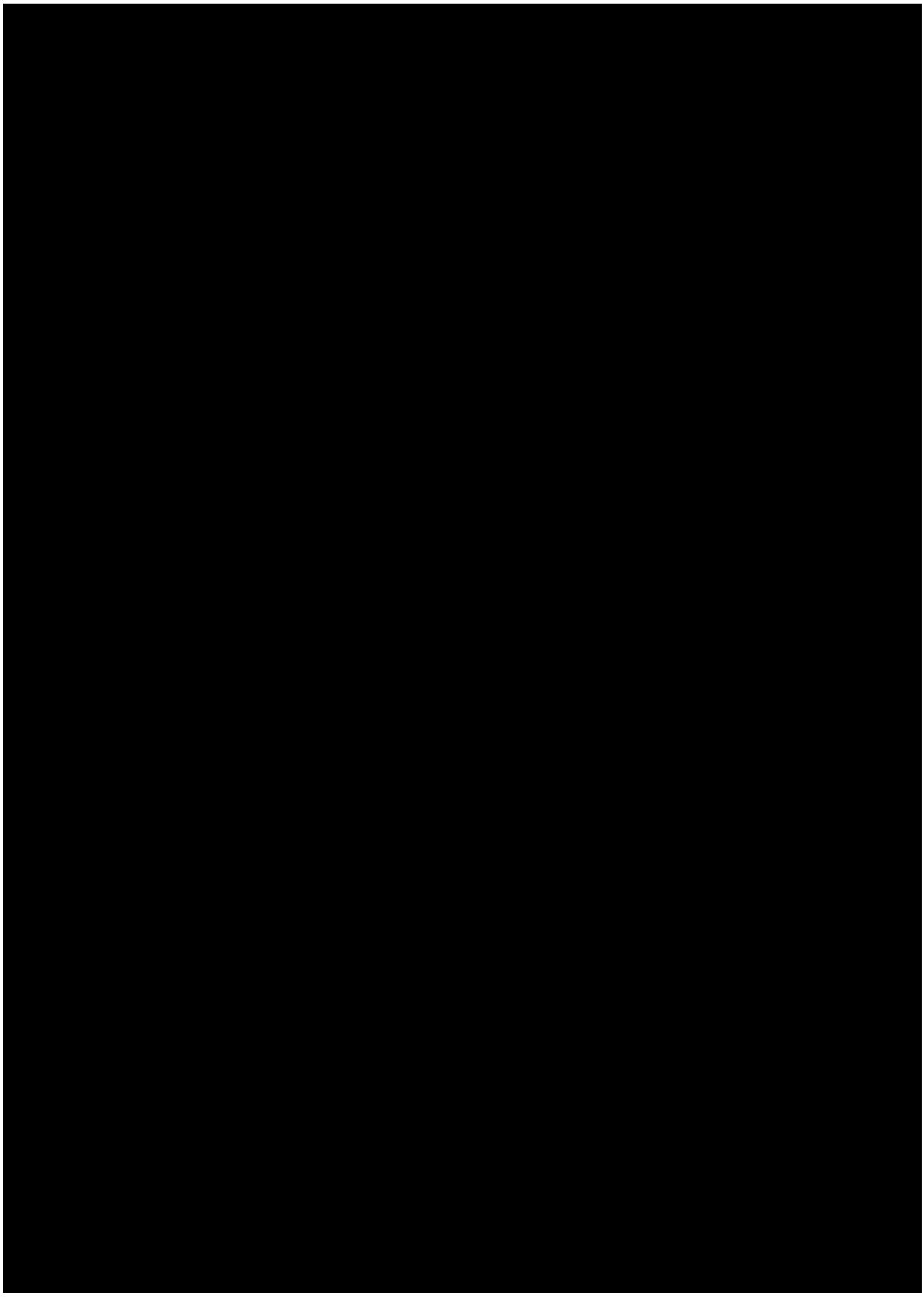
[14] The legend on each figure is automatically tailored to the figure to reflect habitats present only.

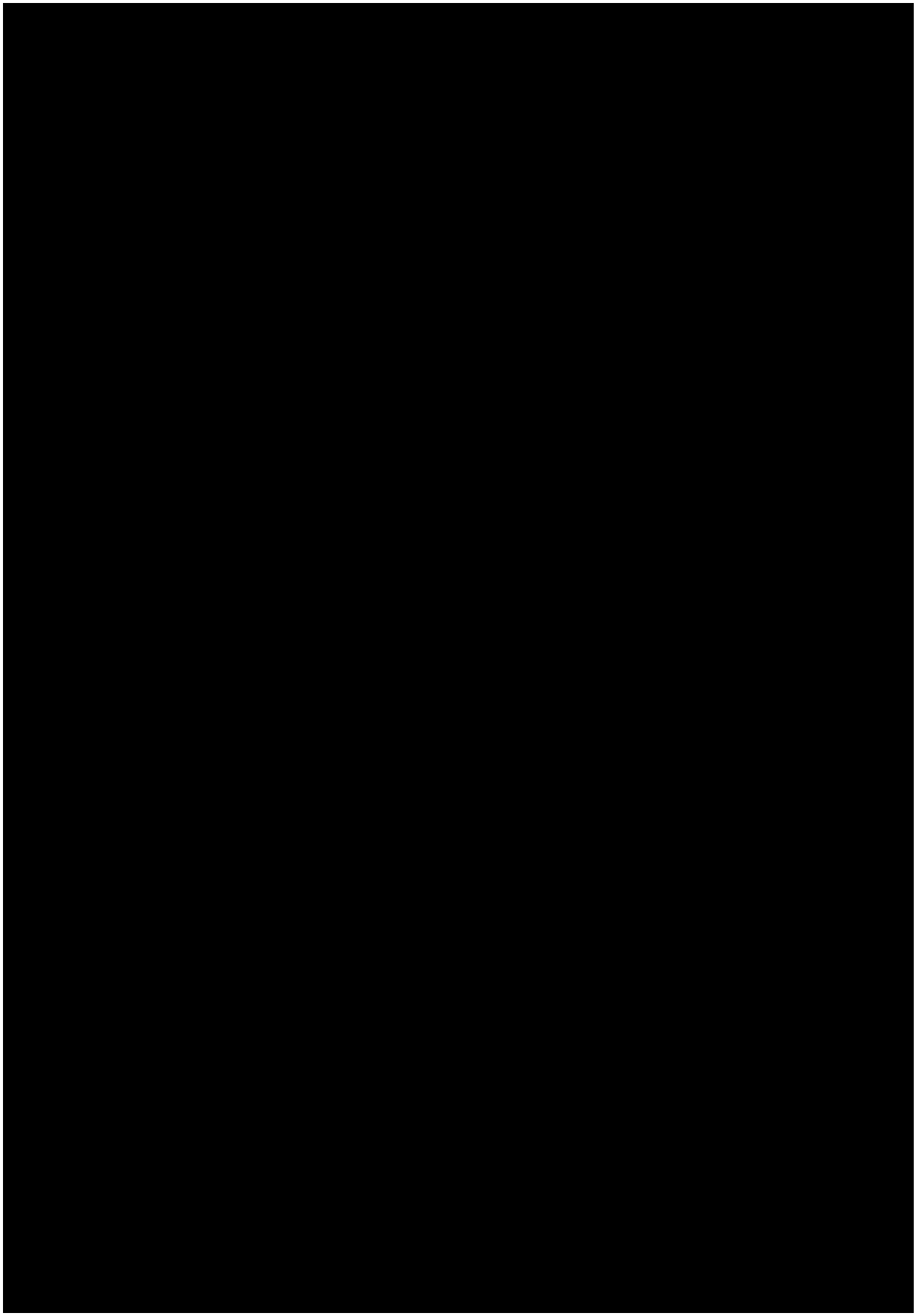


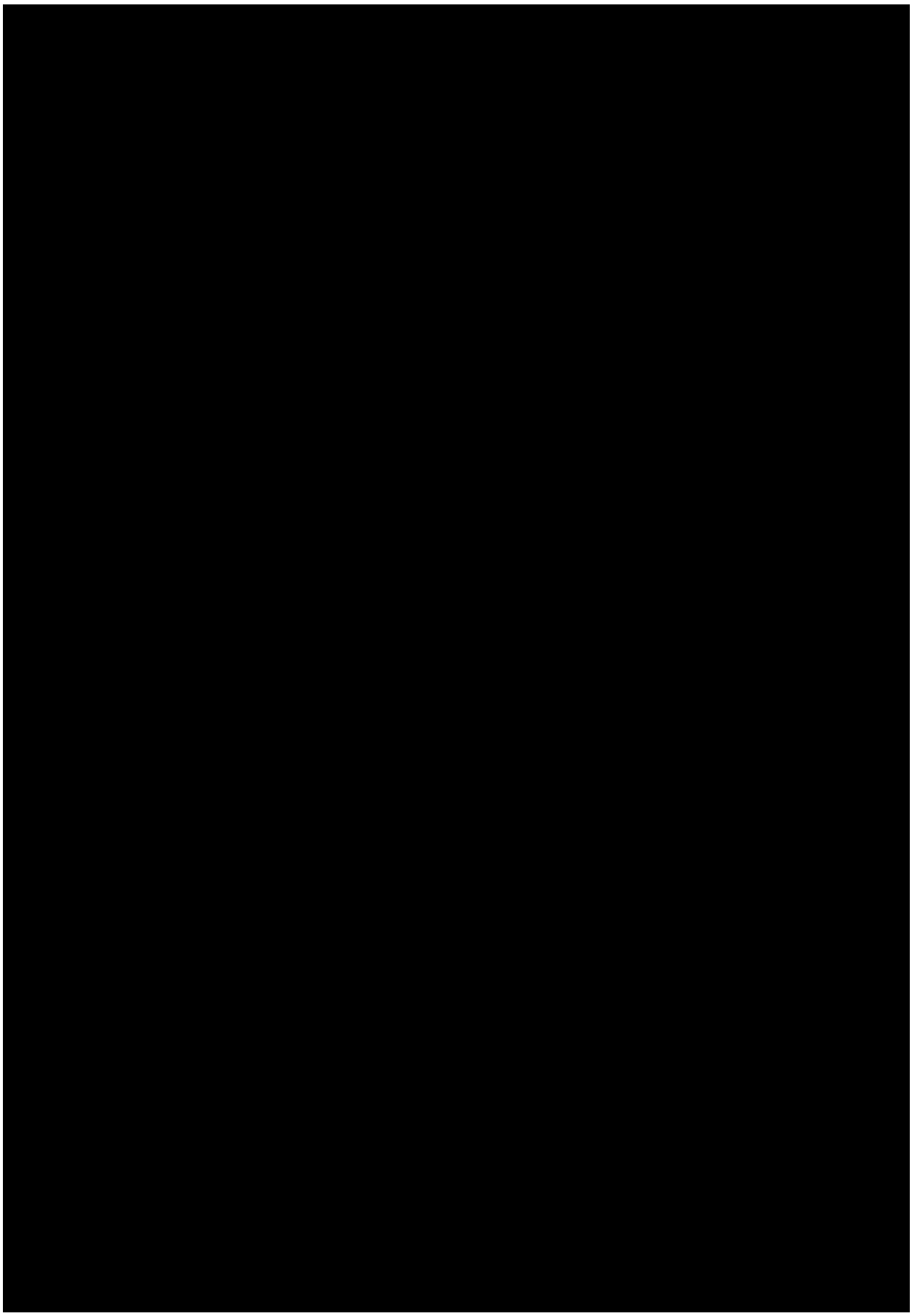


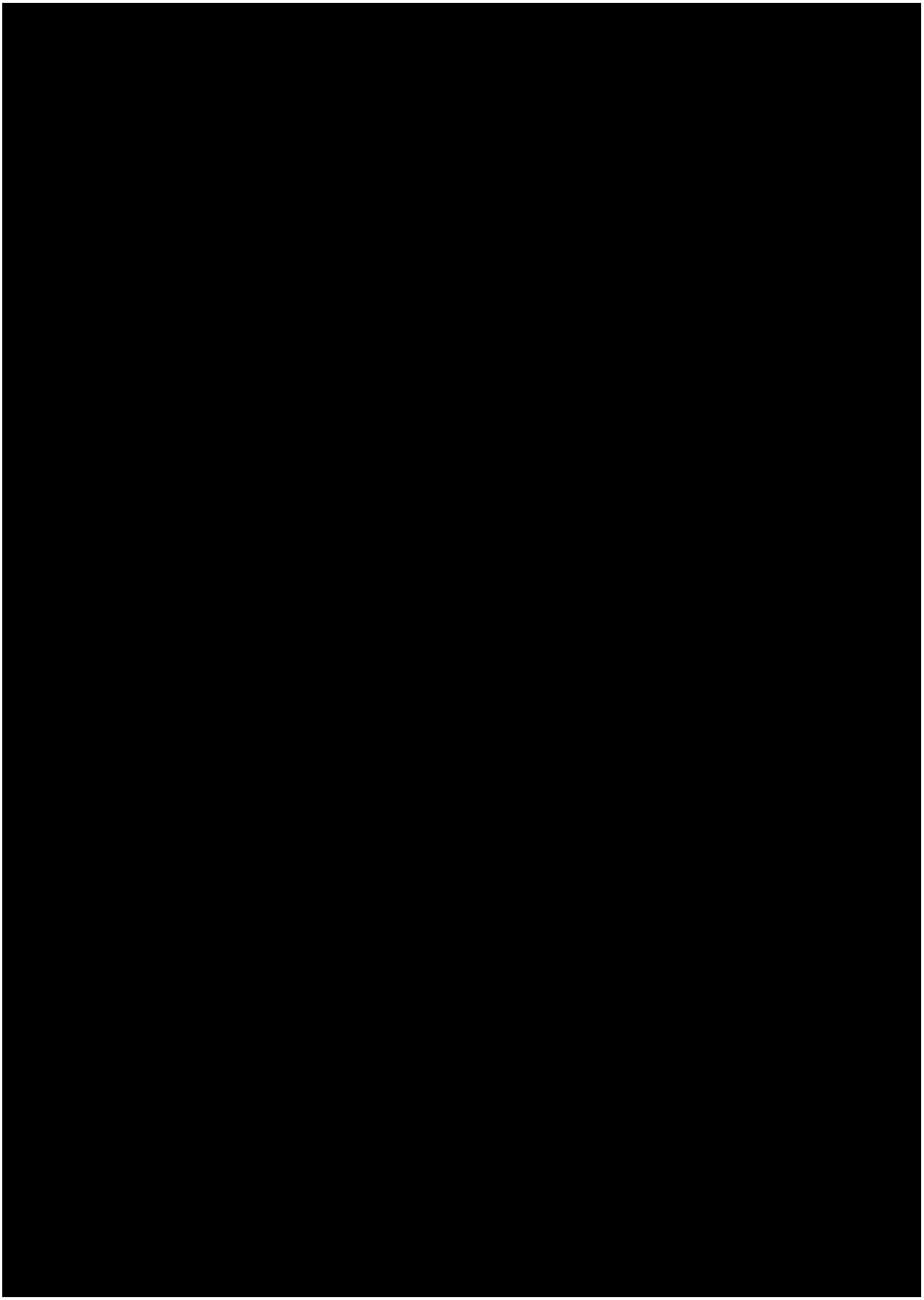


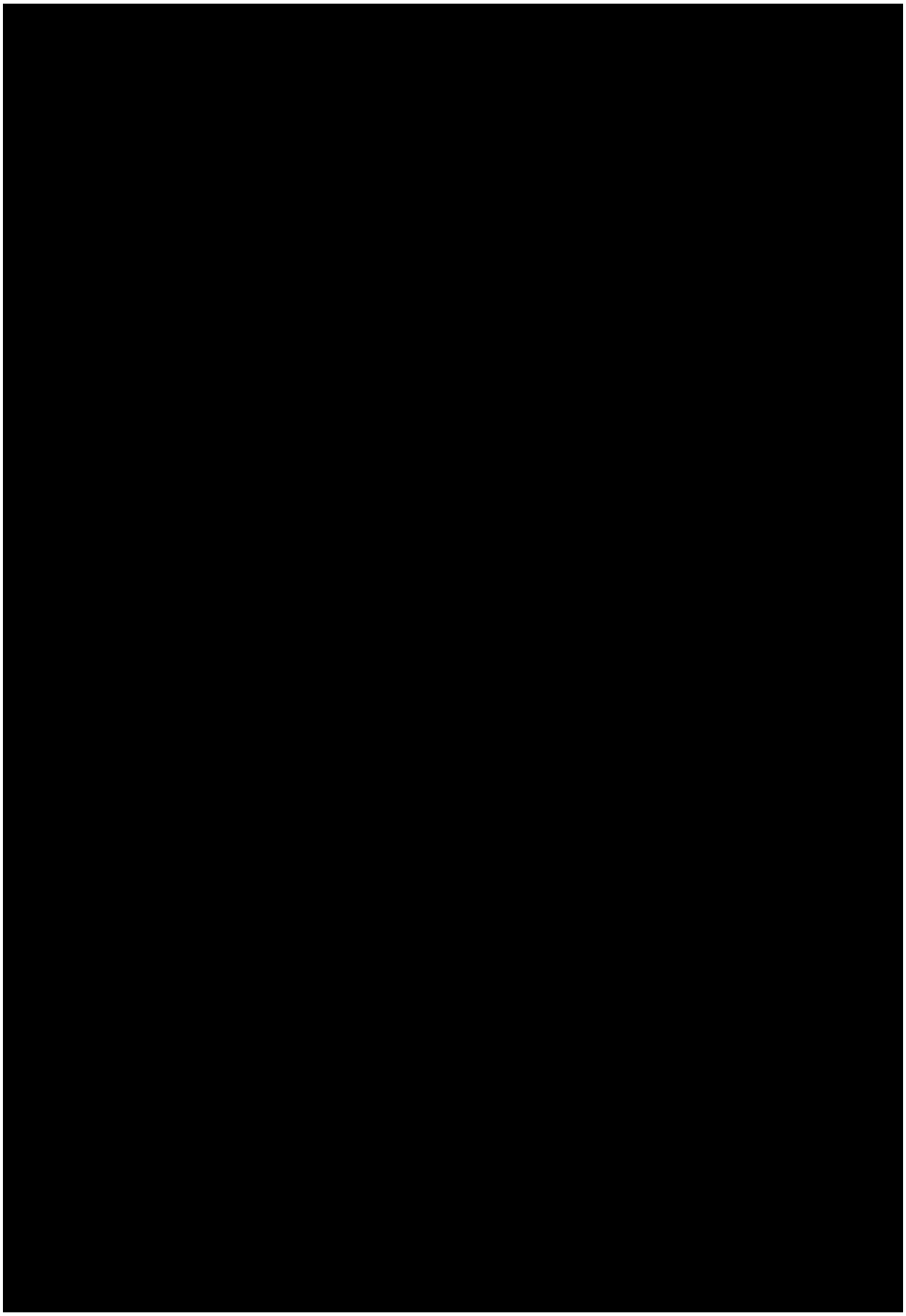


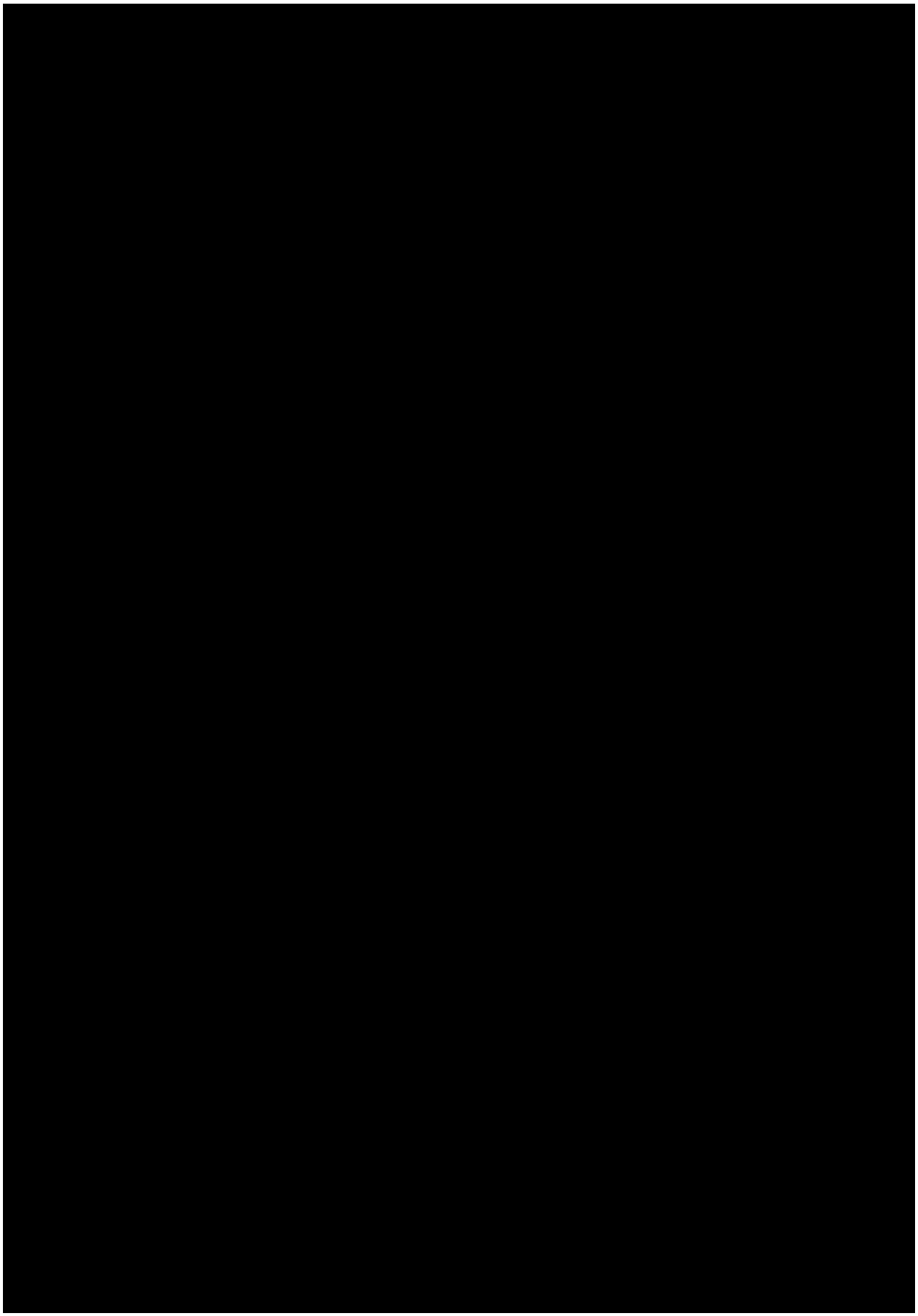


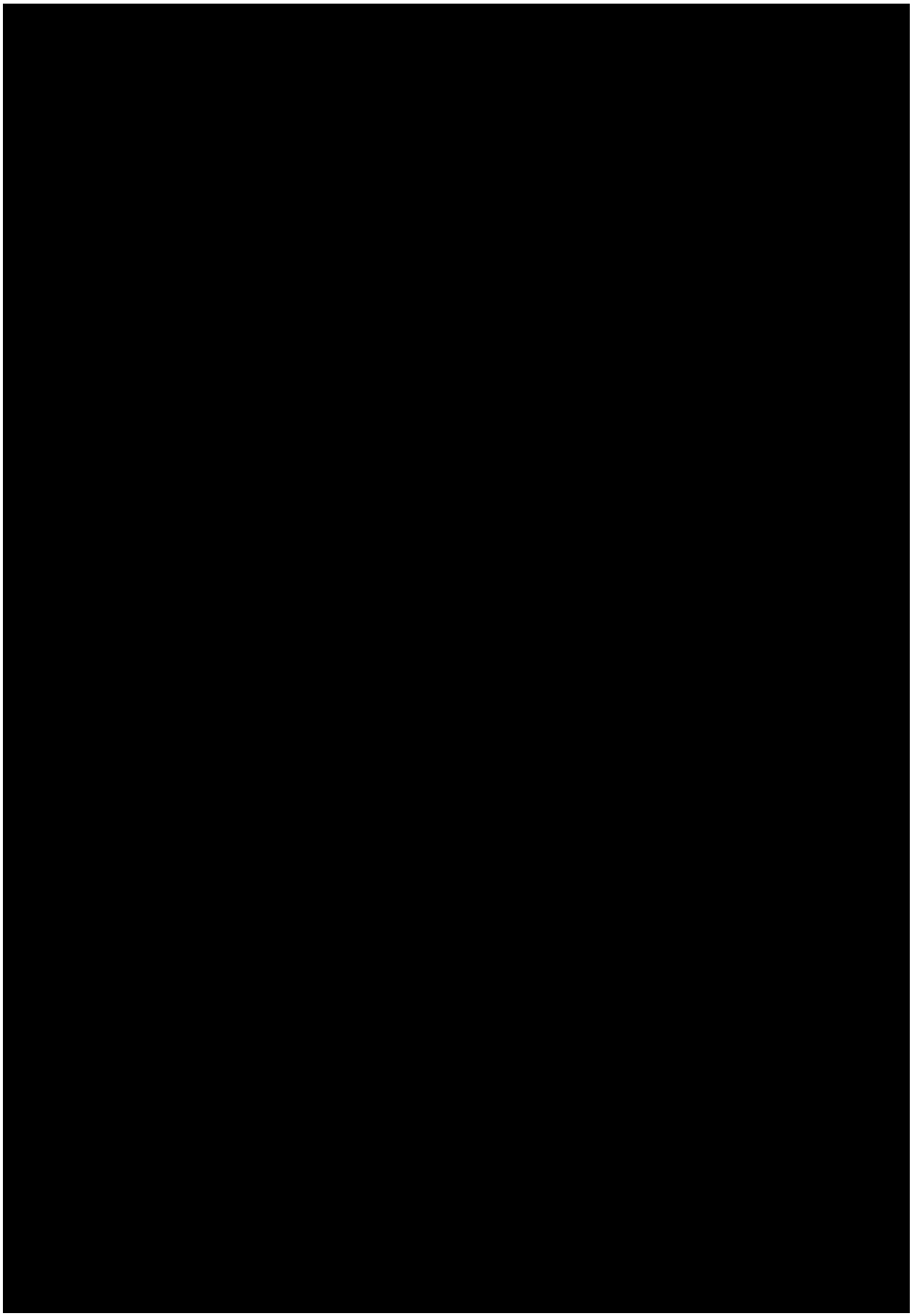






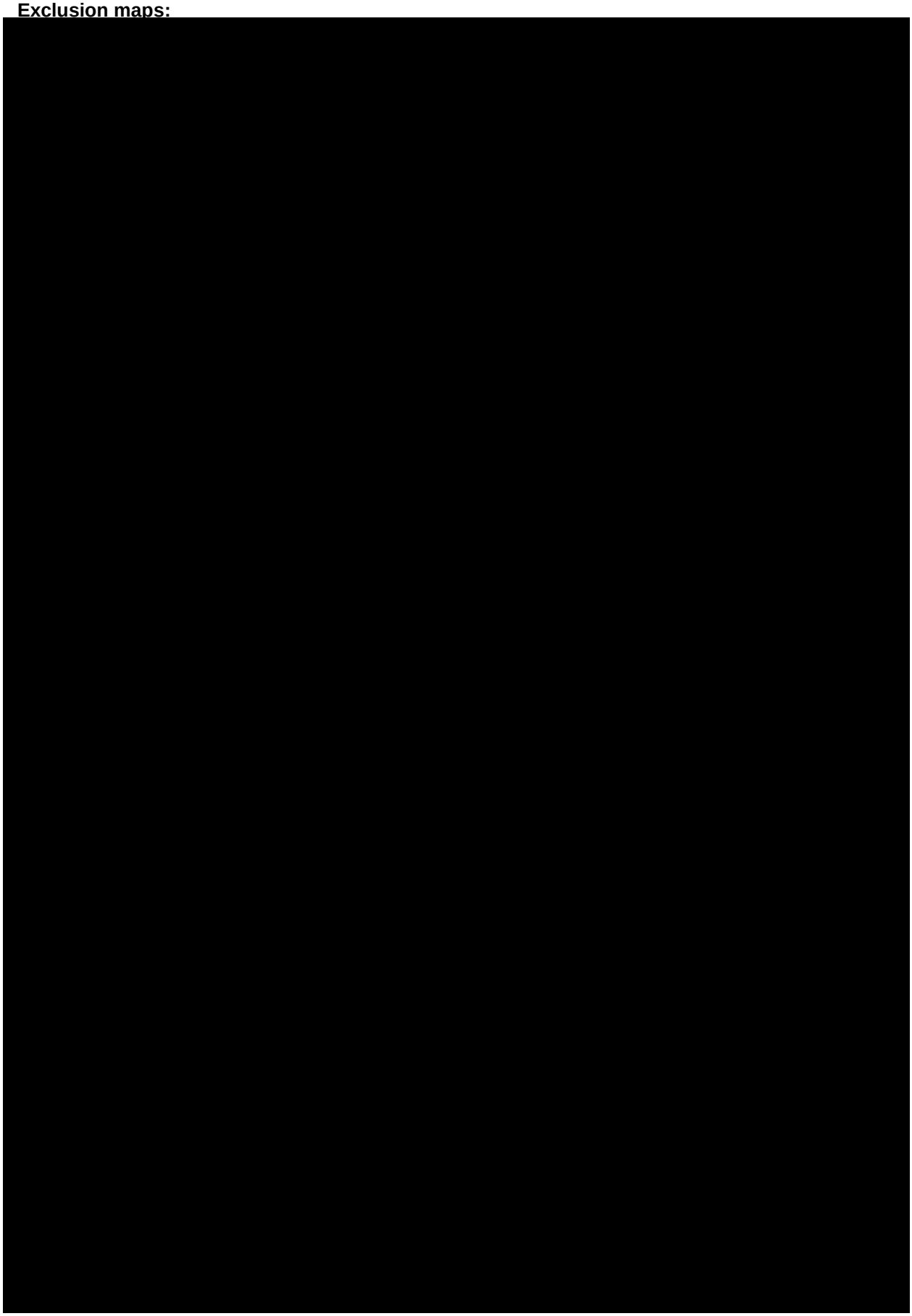


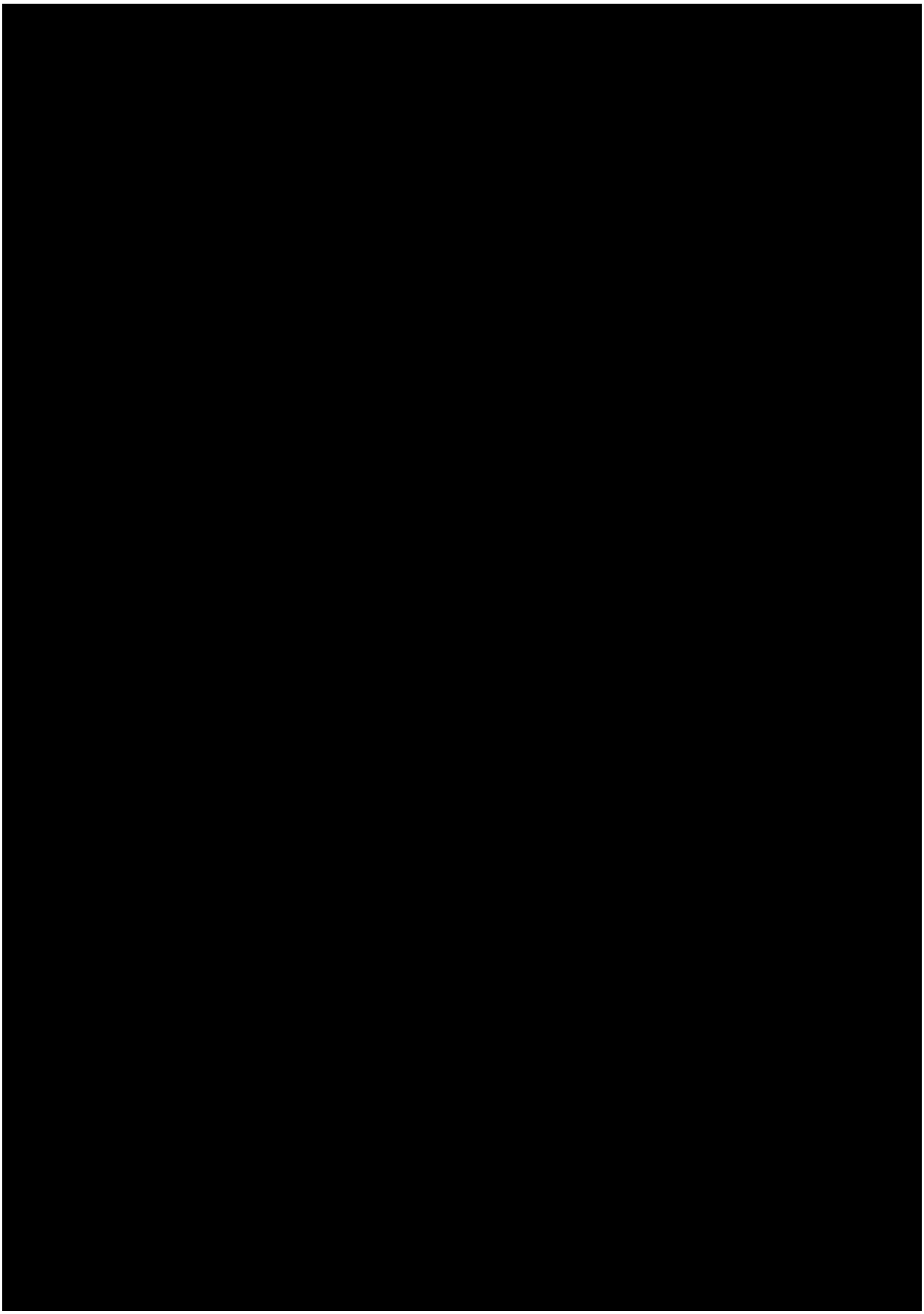


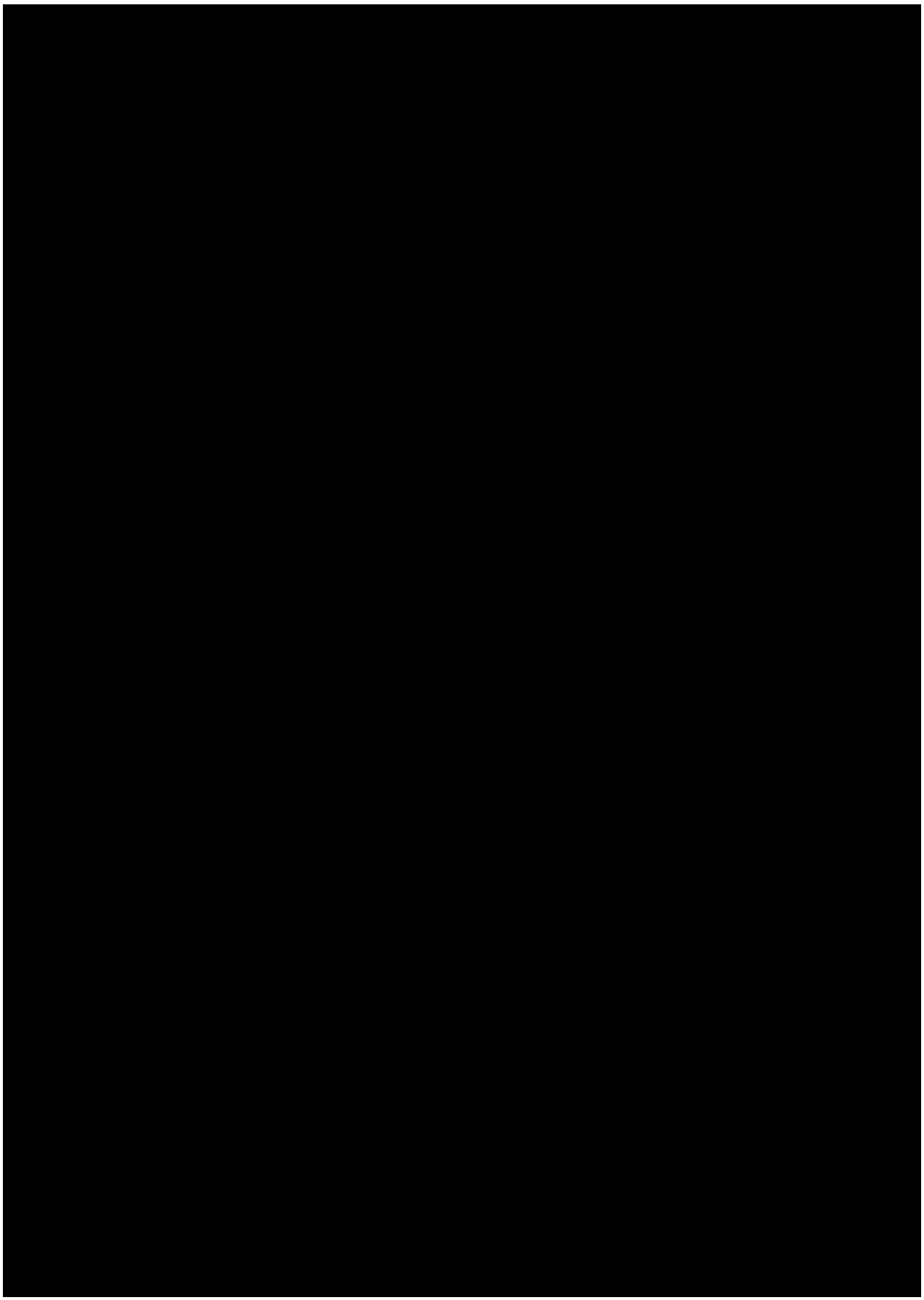


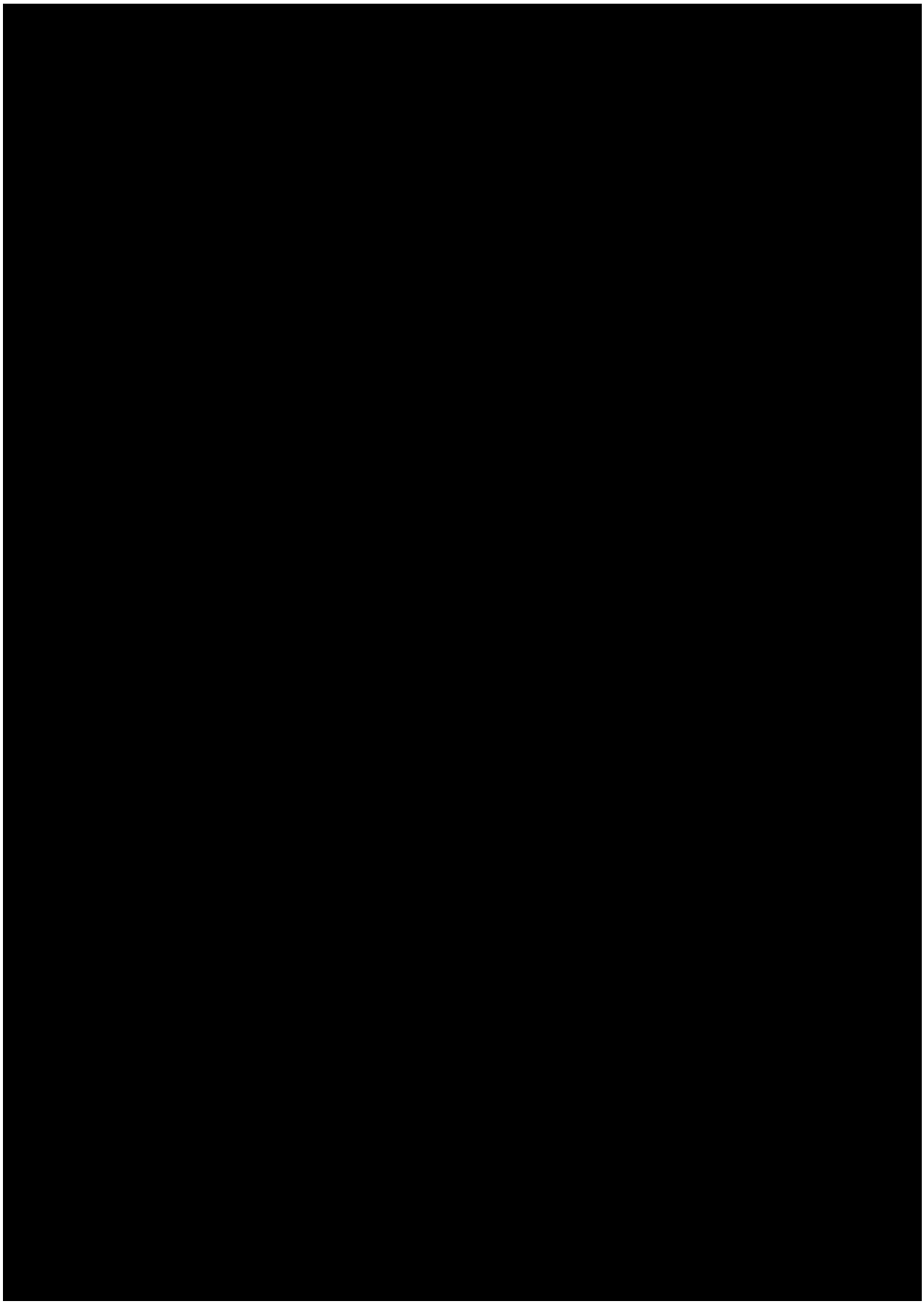
Havant Thicket Reservoir to Otterbourne WSW – Route 3

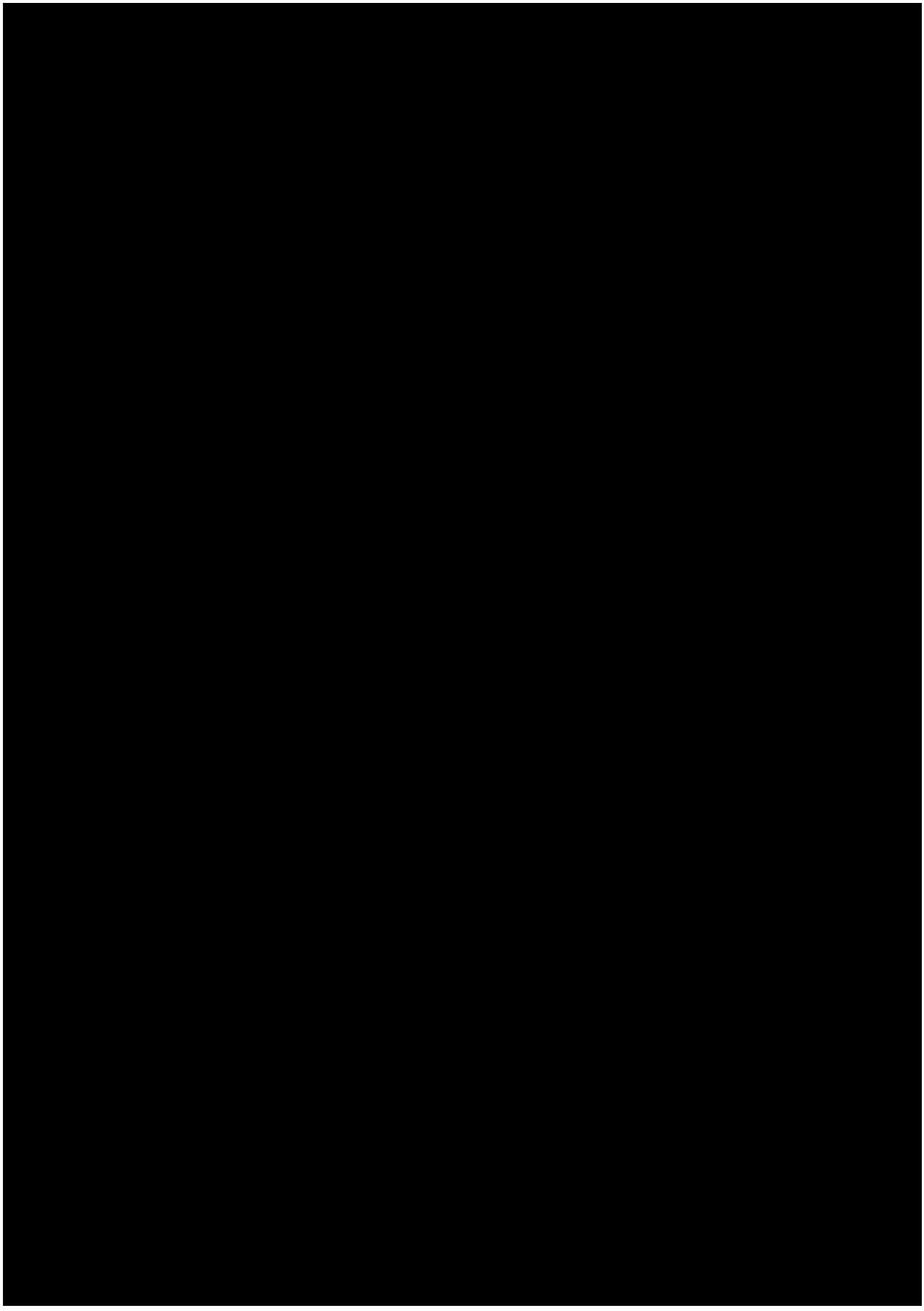
Exclusion maps:

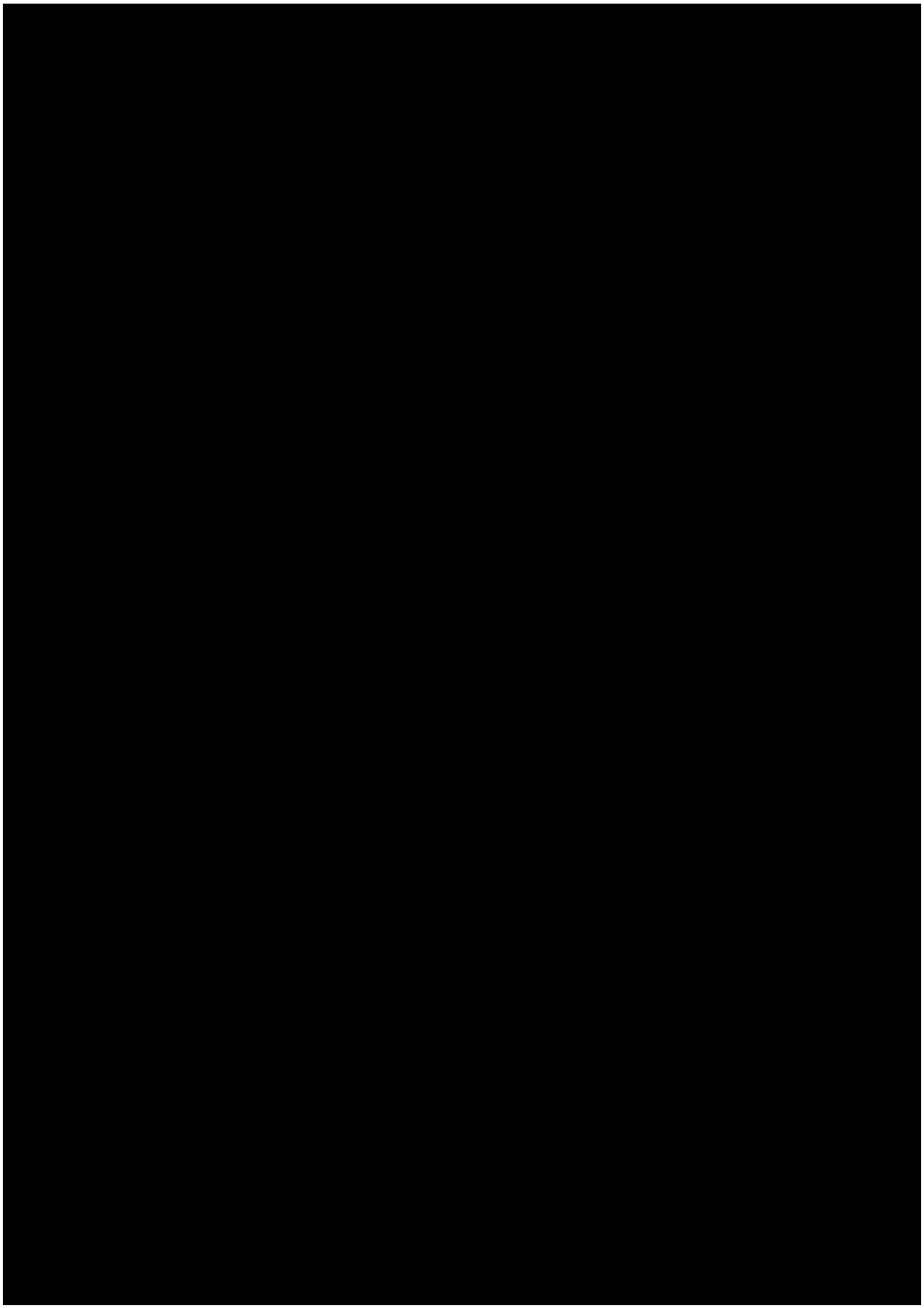


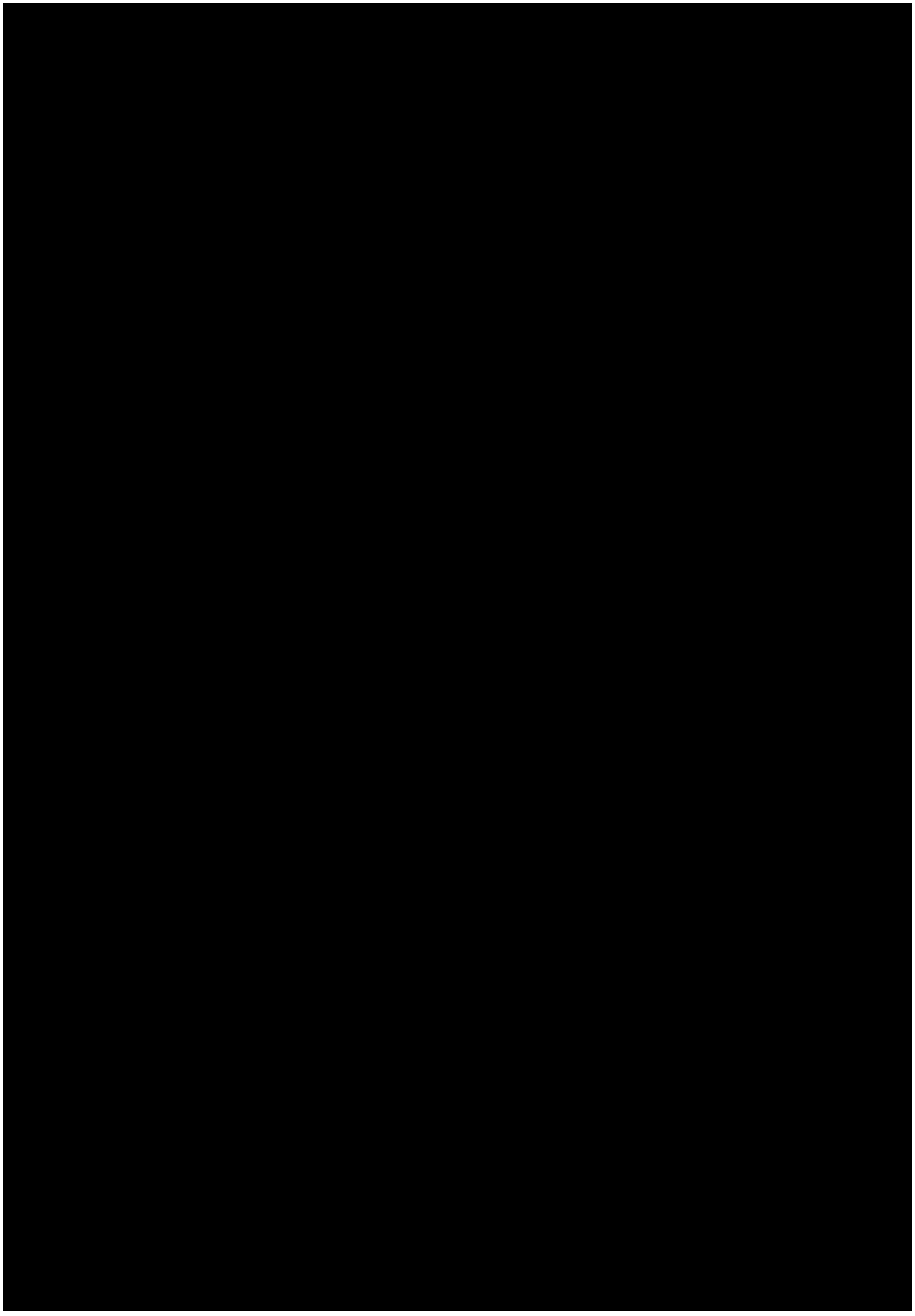


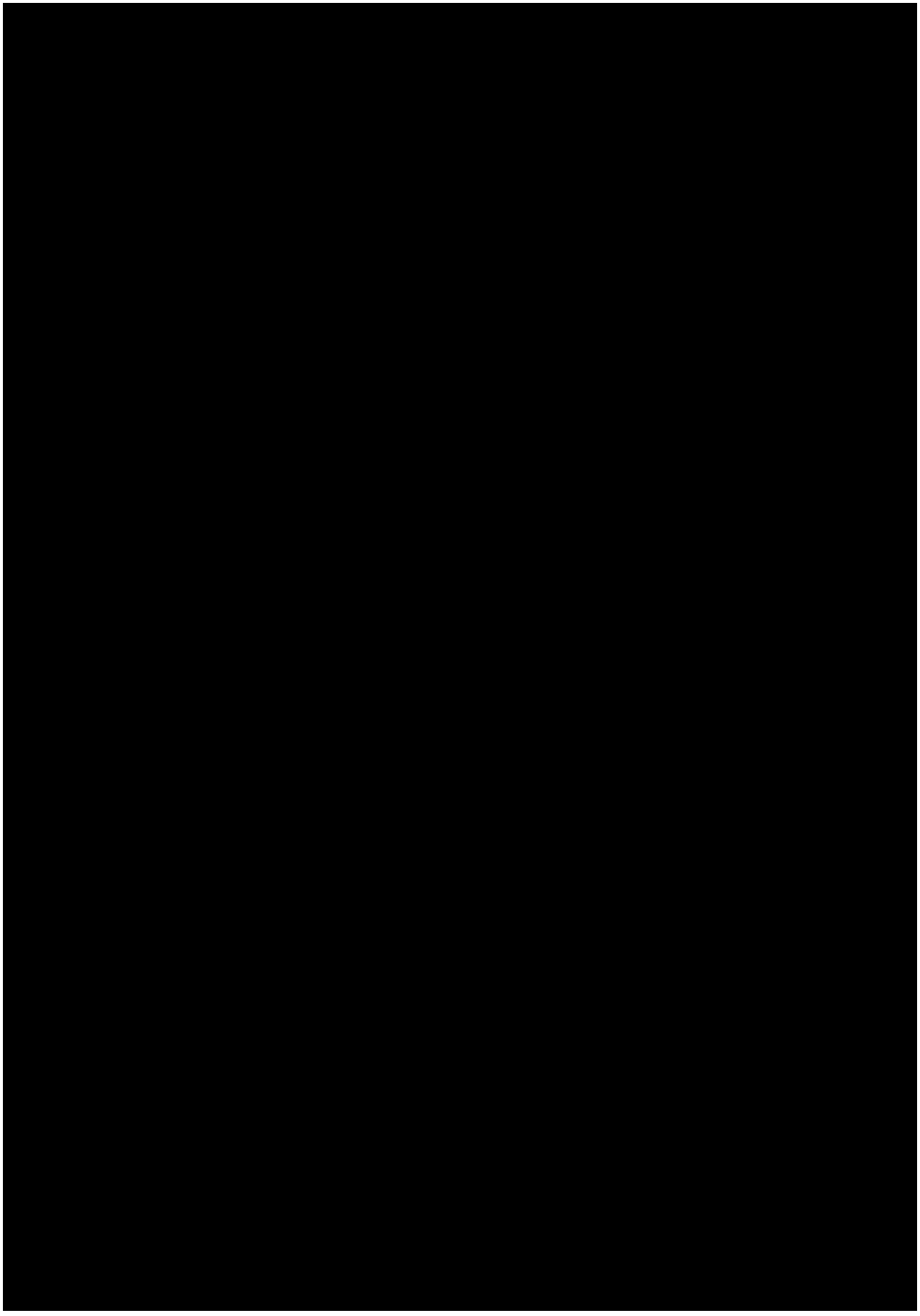




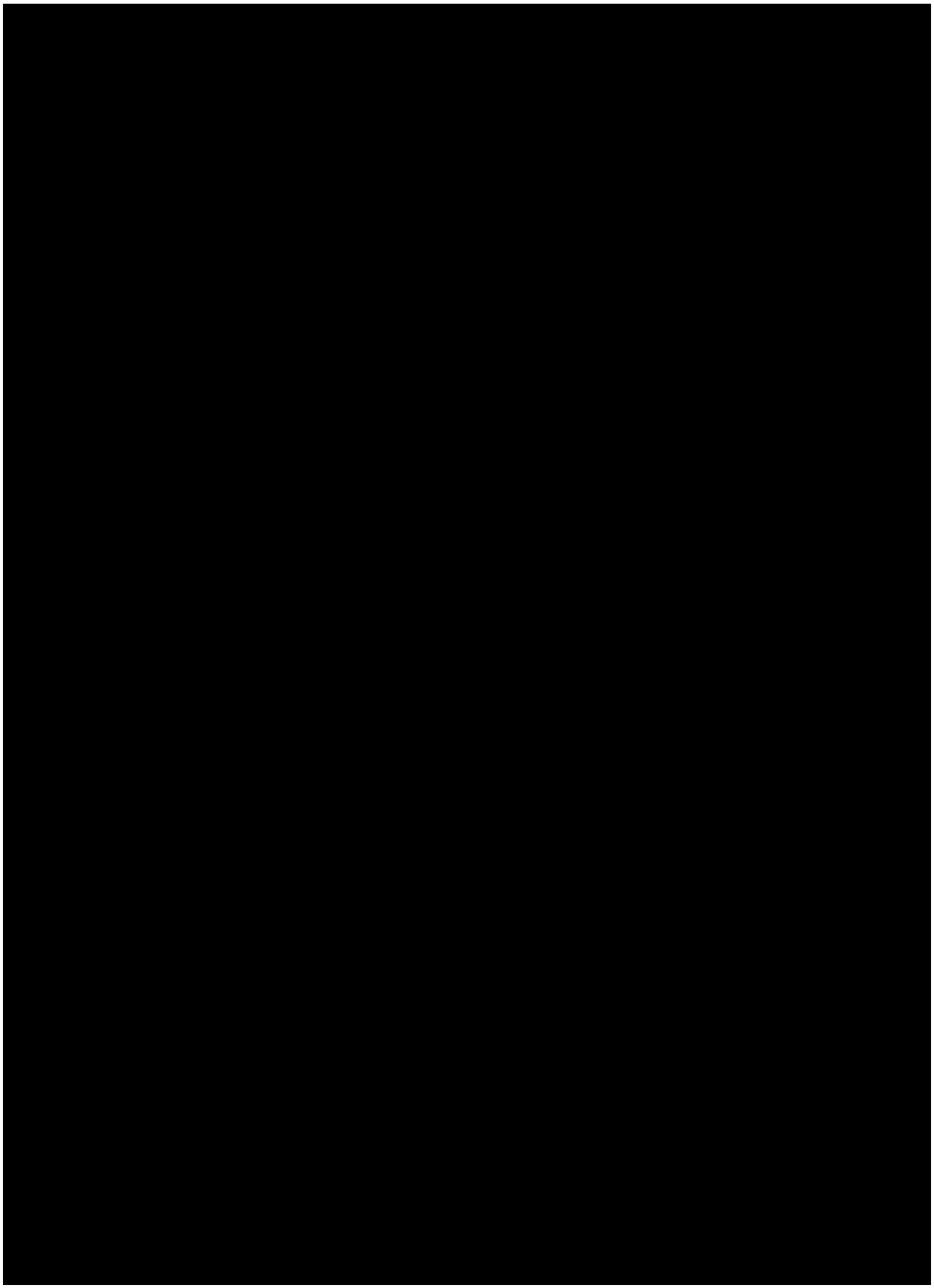




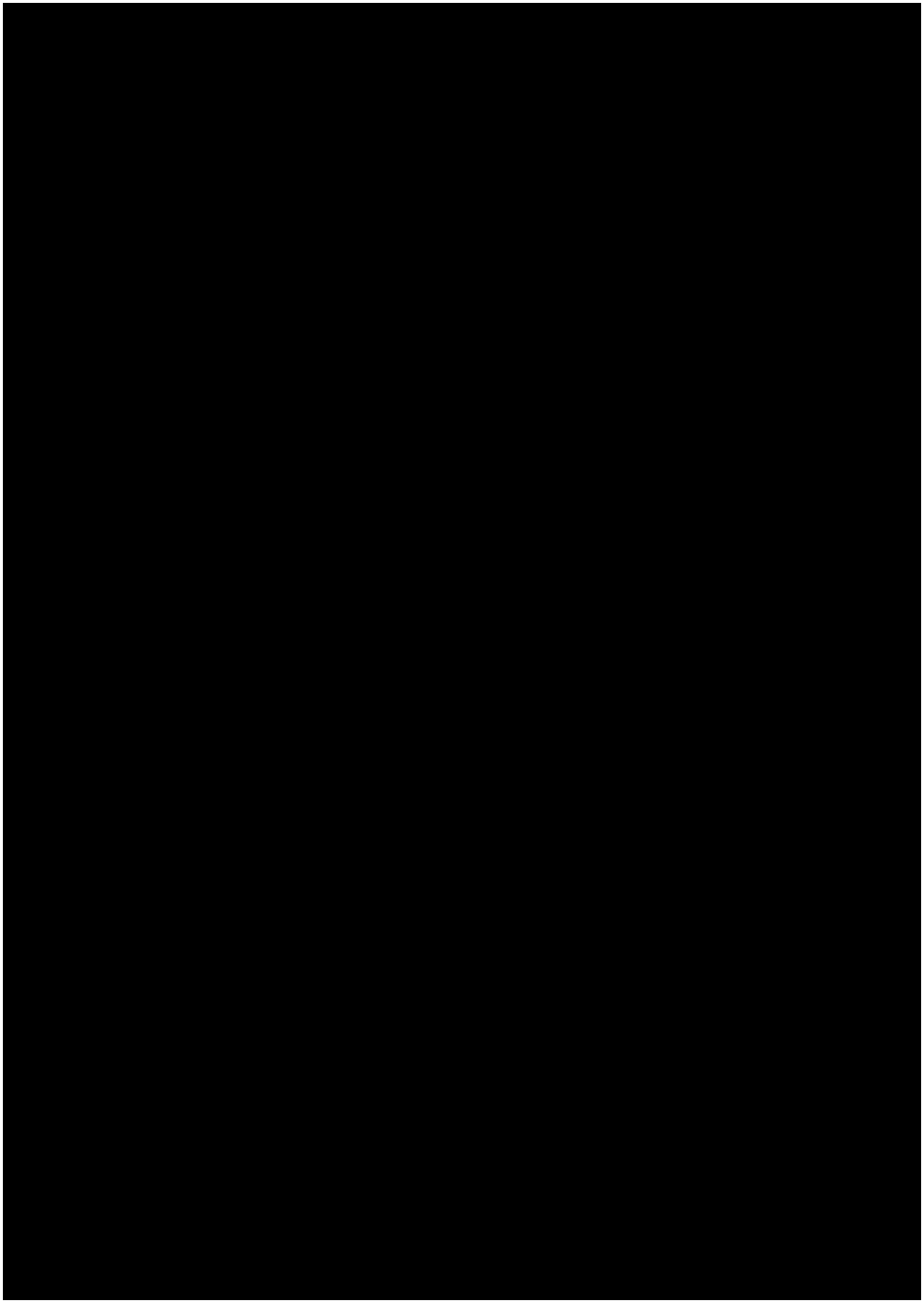


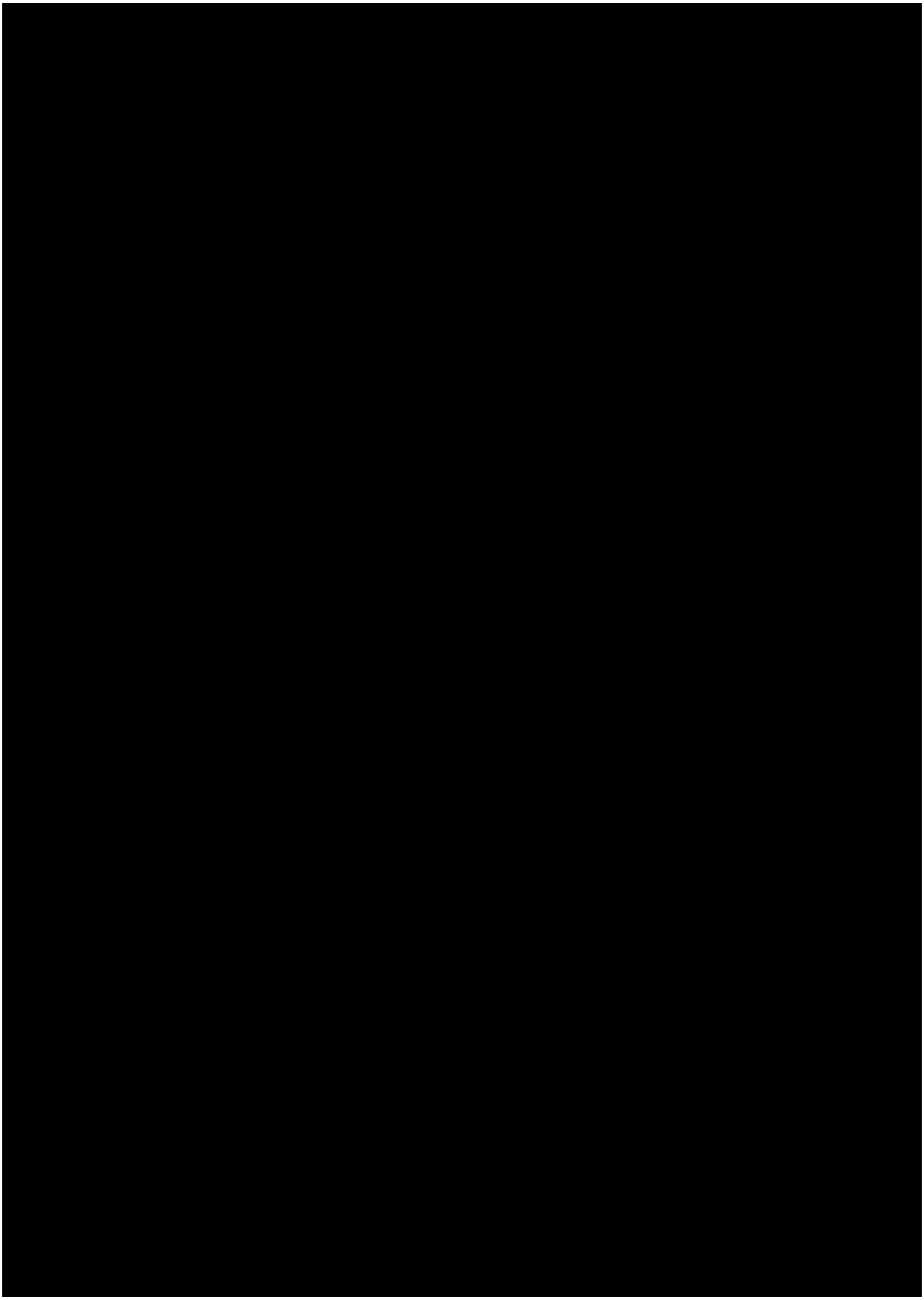


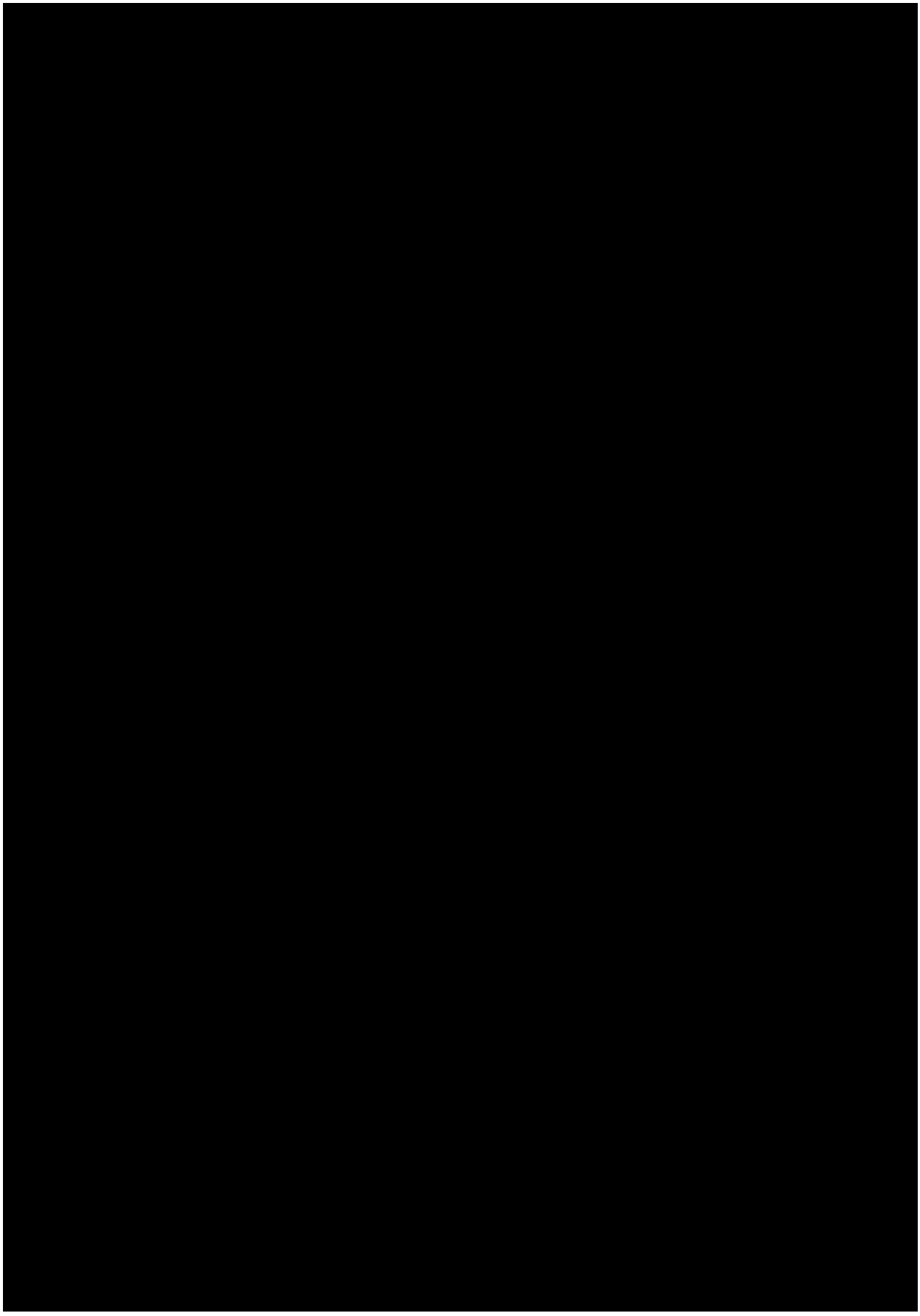
Priority habitats at watercourse crossing[15]:

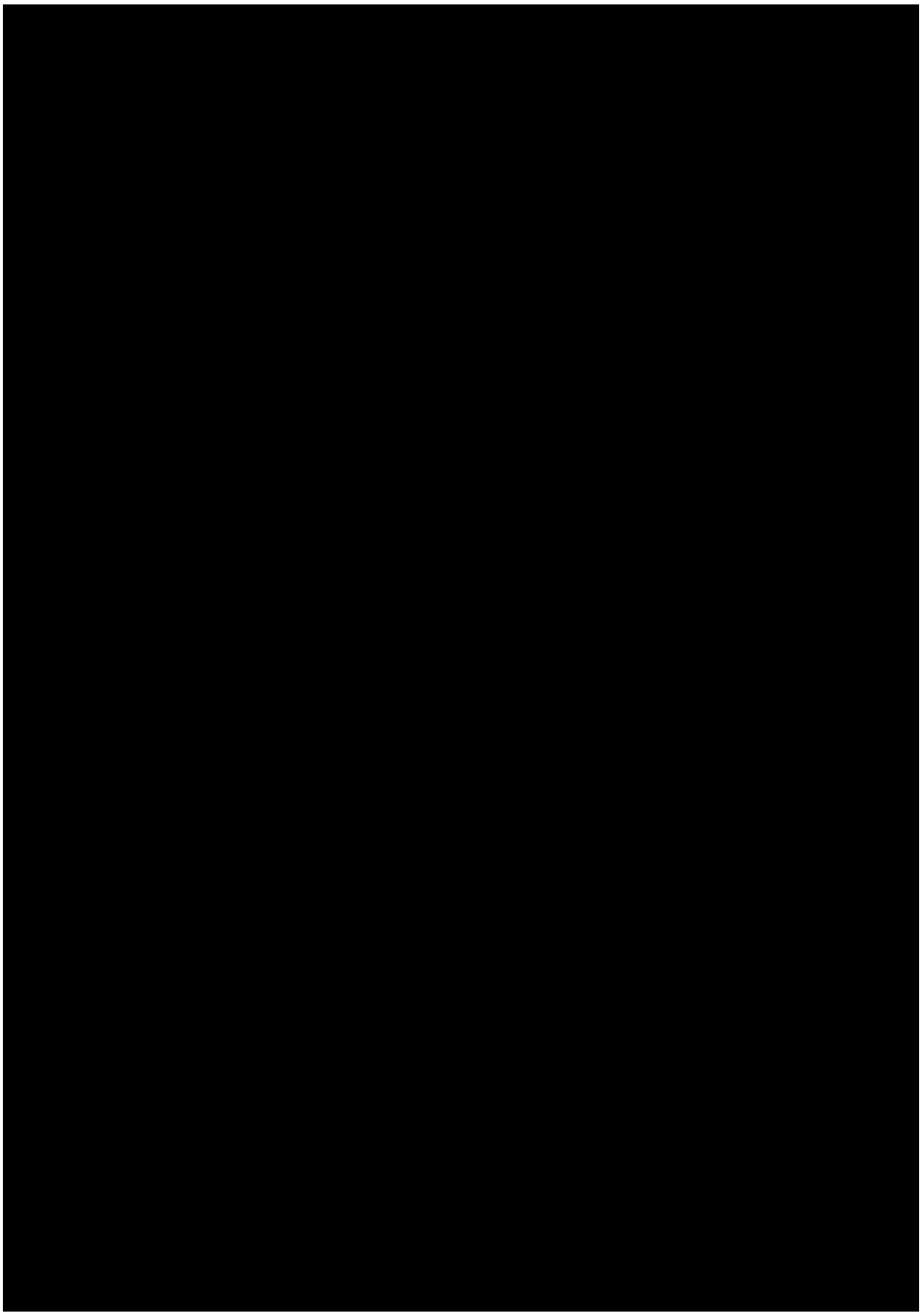


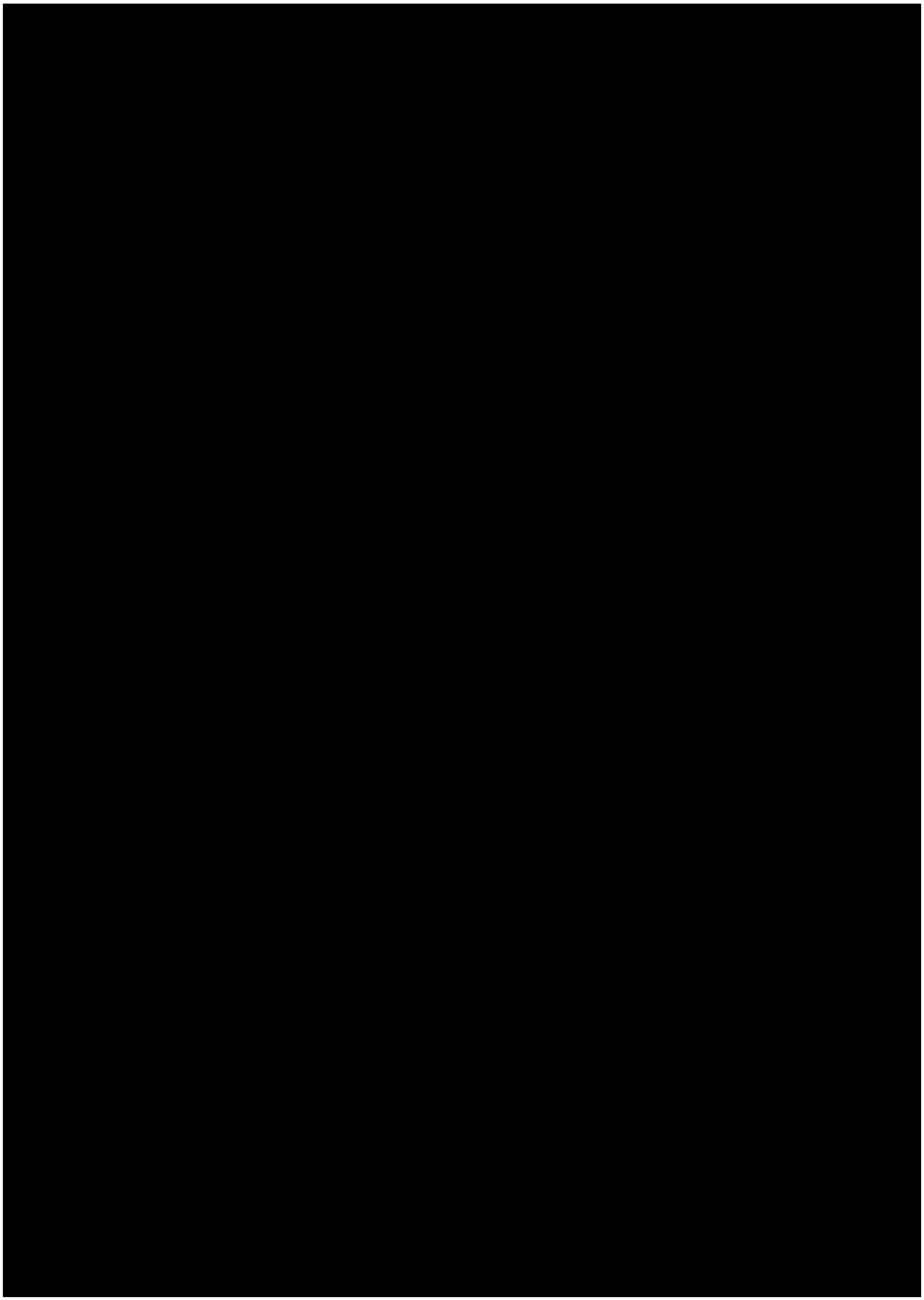
[15] The legend on each figure is automatically tailored to the figure to reflect habitats present only.

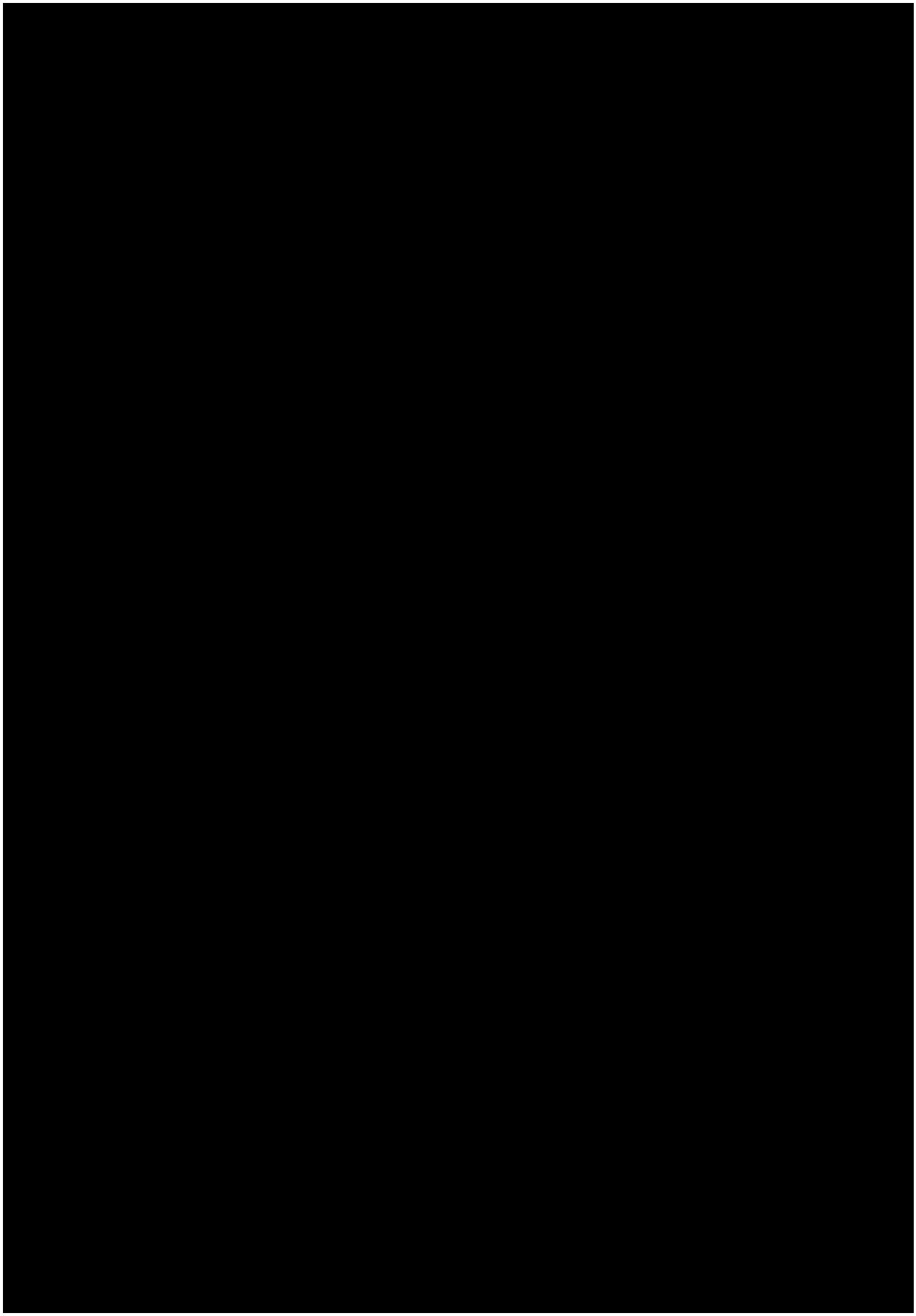


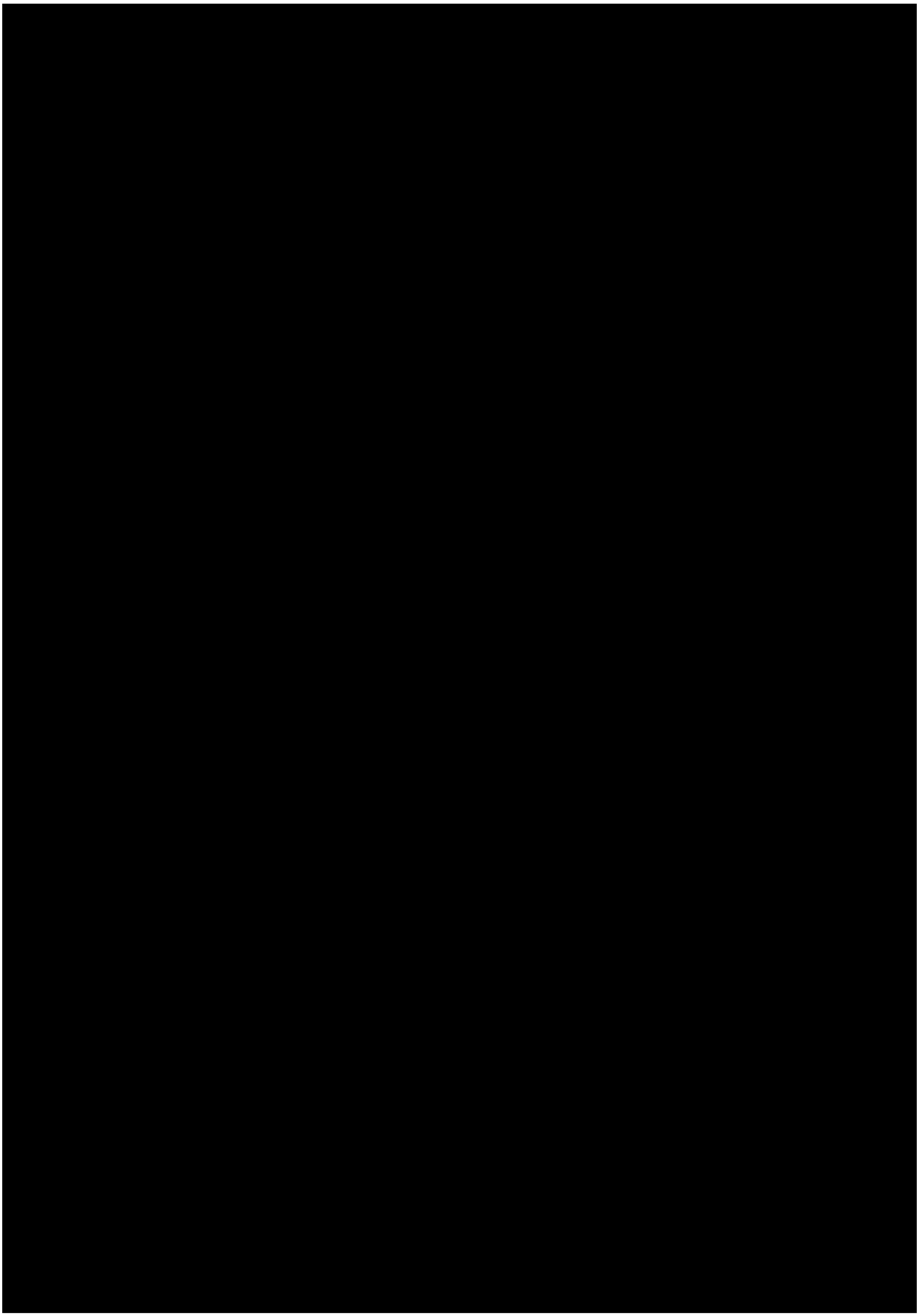












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