

Chapter 17: Ecosystem Services

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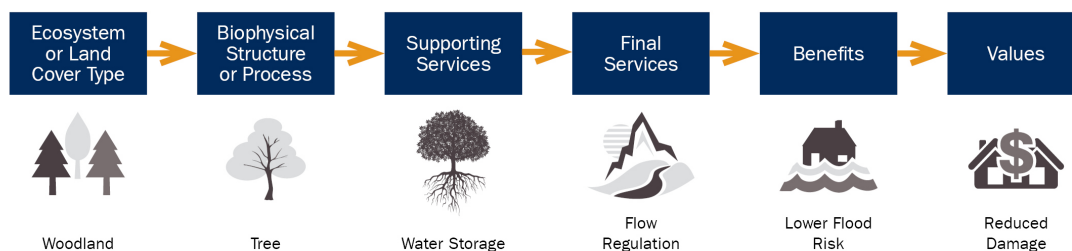
17 Ecosystem Services

17.1 Introduction

International Finance Corporation (IFC) Performance Standard (PS) 6 defines ecosystem services as "*the benefits that people, including businesses, obtain from ecosystems*" (Ref. 17.10), which accords with the definition provided by the Millennium Ecosystem Assessment (MA) (Ref. 17.1). While there is no single system for categorising ecosystem services, the MA framework is widely accepted and, as acknowledged in IFC PS Guidance Note 6 (paragraph 2), provides a useful starting point. The MA identifies four broad categories of ecosystem service:

- **Provisioning services** – the products people obtain from ecosystems. These may include *inter alia* (i) crops, livestock, seafood and game, wild foods, and ethnobotanical plants; (ii) water for drinking, irrigation, and industrial purposes; and (iii) vegetated areas which provide the basis for many biopharmaceuticals, construction materials, and biomass for renewable energy. Goods may be provided by heavily managed ecosystems, such as agricultural and aquacultural systems and plantation forests, or by natural or semi-natural ones, for example in the form of capture fisheries and the harvest of other wild foods;
- **Regulating services** – the benefits people obtain from the regulation of ecosystem processes. These may include *inter alia* (i) local climate regulation and carbon storage and sequestration; (ii) natural hazard mitigation; (iii) purification of water and air; (iv) control of pests and disease; and (v) pollination;
- **Cultural services** – the cultural, educational, and spiritual benefits people obtain from ecosystems. These may include *inter alia* (i) cultural, spiritual, or religious upliftment from cultural heritage, spiritual, or sacred sites; (ii) opportunities for recreation such as sport, hunting, fishing, ecotourism; and (iii) opportunities for scientific exploration, knowledge-building, and education; and
- **Supporting services** – the natural processes that maintain the other services such as soil formation, nutrient and water cycling, or primary production.

Supporting services differ from provisioning, regulating, and cultural services in that, unlike the other types of service from which people can directly benefit, their impacts on human well-being are indirect (Ref. 17.2 and Ref. 17.3) and mostly long-term in nature; the formation of soils, for example, takes place over decades or centuries. All other ecosystem services – regulating, provisioning, and cultural – ultimately depend on them. Supporting services are strongly interrelated to each other and are generally underpinned by a vast array of physical, chemical, and biological interactions. Supporting services are linked to particular biophysical structures or processes of an ecosystem, such as the way water storage is linked to soils, trees, plants, and other vegetation, and underpin the provision of the services which are of direct value to people, such as reduced surface water runoff, filtering of air and water quality, timber provision, and wild foods. These final ecosystem services provide benefits to people such as reduced damages from flooding, which are valued by their beneficiaries (Table 17.1).

Figure 17.1 The Relationship between Ecosystems, Services, and Benefits

The benefits of ecosystems are conferred at many scales and often to multiple different beneficiaries. At the local level, ecosystem services are frequently the basis for rural livelihoods and subsistence, particularly for the poor. Artisanal fishing of coastal waters and rivers, for example, provides both cash income and food for low-income families. Similarly, harvesting of plants for traditional medicine can provide an important substitute for more expensive commercially available pharmaceuticals. Benefits can also be regional – such as the provision of flood protection and erosion control afforded to communities and businesses by coastal mangroves – or national, such as sites that form part of a country’s cultural heritage. At a global scale, ecosystems regulate climate and support the biodiversity which underpins all biological production.

Businesses and projects may also benefit from ecosystem services through, for example, the direct use of inputs such as water or through protection from natural hazards such as flooding. Identifying and protecting such services can have further benefits such as avoiding punitive regulation and negative publicity, strengthening the organisation’s reputation and, in some cases, providing effective natural alternatives to more expensive engineering solutions.

Despite the widespread benefits of ecosystem services, a number of recent high-profile reports have revealed that a significant number of global ecosystems are in a degraded state. In 2005 for example, the MA concluded that on a global scale the majority of ecosystem services have been degraded (Ref. 17.1). More recently, The Economics of Ecosystems and Biodiversity (TEEB), a major international initiative, published a series of reports which found that many ecosystem services are so degraded they are reaching tipping points, and highlighted the growing costs of biodiversity loss and ecosystem degradation (Ref. 17.5).

This has led to a growing shift in national and international policy, away from looking at the environment in separate “*silos*” – air, water, soil, biodiversity – towards a more integrated approach based on entire ecosystems. Identifying impacts in this manner stresses the linkages and trade-offs between different services, allowing the ecosystem approach to identify areas which provide multiple benefits. Further, the emphasis placed on looking at the environment in terms of the benefits that people derive from it helps to ensure that the full value of ecosystem services and people’s preferences for these are incorporated into decision-making processes.

In 2010, the Conference of the Parties to the Convention on Biological Diversity (CBD) adopted a Strategic Plan with the aim of “*maintaining ecosystem services, sustaining a healthy planet, and delivering benefits essential for all people*” (Ref. 17.6). The EU also adopted a target to halt

the loss of biodiversity and the degradation of ecosystem services by 2020 and restore them where possible (Ref. 17.7).

In 2012, the vision for a Green Economy outlined in Rio +20 recognised that economic performance depends on effective ecosystem and biodiversity management and the continued flow of ecosystem services (Ref. 17.8). In the same year, the IFC published its revised Performance Standards on Environmental and Social Sustainability which, in addition to the requirements set out in PS 6, included reference to ecosystem services throughout many of the other Performance Standards (Table 17.1). More recently, the European Commission has put forward a proposal to amend the European EIA Directive to specifically include consideration of ecosystem services (Ref. 17.9).

IFC PS 6 recognises that sustainable development cannot be achieved if either biodiversity or ecosystem services are lost or degraded by development efforts and therefore requires that *"where a project is likely to adversely impact ecosystem services, as determined by the risks and impacts identification process, the client will conduct a systematic review to identify priority ecosystem services"* (Ref. 17.10). Since ecosystem services are, by nature, cross-cutting they apply to several of the IFC Performance Standards as shown in Table 17.1 below.

Table 17.1 Ecosystem Services in the 2012 IFC Performance Standards

Performance Standard	Summary of Requirements
PS1: Assessment and Management of Environmental and Social Risks and Impacts	Where the project involves specifically identified physical elements, aspects, and facilities that are likely to generate impacts, environmental and social risks and impacts will be identified in the context of the project's area of influence. This area of influence encompasses, as appropriate...indirect project impacts on biodiversity or on ecosystem services upon which Affected Communities' livelihoods are dependent.
PS4: Community Health, Safety, and Security	The project's direct impacts on priority ecosystem services may result in adverse health and safety risks and impacts to Affected Communities. With respect to this Performance Standard, ecosystem services are limited to provisioning and regulating services as defined in paragraph 2 of Performance Standard 6...where appropriate and feasible, the client will identify those risks and potential impacts on priority ecosystem services that may be exacerbated by climate change. Adverse impacts should be avoided, and if these impacts are unavoidable, the client will implement mitigation measures in accordance with paragraphs 24 and 25 of Performance Standard 6. With respect to the use of and loss of access to provisioning services, clients will implement mitigation measures in accordance with paragraphs 25–29 of Performance Standard 5.

Continued...

Performance Standard	Summary of Requirements
PS5: Land Acquisition and Involuntary Resettlement	This Performance Standard applies to physical and/or economic displacement resulting from the following types of land-related transactions...restriction on access to land or use of other resources including communal property and natural resources such as marine and aquatic resources, timber and non-timber forest products, freshwater, medicinal plants, hunting and gathering grounds and grazing and cropping areas (natural resource assets referred to in this Performance Standard are equivalent to ecosystem provisioning services as described in Performance Standard 6).
PS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	Where a project is likely to adversely impact ecosystem services, as determined by the risks and impacts identification process, the client will conduct a systematic review to identify priority ecosystem services...with respect to impacts on priority ecosystem services of relevance to Affected Communities and where the client has direct management control or significant influence over such ecosystem services, adverse impacts should be avoided. If these impacts are unavoidable, the client will minimise them and implement mitigation measures that aim to maintain the value and functionality of priority services. With respect to impacts on priority ecosystem services on which the project depends, clients should minimise impacts on ecosystem services and implement measures that increase resource efficiency of their operations, as described in Performance Standard 3. Additional provisions for ecosystem services are included in Performance Standards 4, 5, 7, and 8.
PS7: Indigenous Peoples	If the client proposes to locate a project on, or commercially develop natural resources on lands traditionally owned by, or under the customary use of, Indigenous Peoples, and adverse impacts can be expected, the client will take the following steps...document efforts to avoid and otherwise minimise impacts on natural resources and natural areas of importance to Indigenous People. " <i>Natural resources and natural areas of importance</i> " as referred to in this Performance Standard are equivalent to priority ecosystem services as defined in Performance Standard 6...where a project may significantly impact on critical cultural heritage that is essential to the identity and/or cultural, ceremonial, or spiritual aspects of Indigenous Peoples lives, priority will be given to the avoidance of such impacts (natural areas with cultural value are equivalent to priority ecosystem cultural services as defined in Performance Standard 6). Where significant project impacts on critical cultural heritage are unavoidable, the client will obtain the Free, Prior and Informed Consent (FPIC) of the Affected Communities of Indigenous Peoples. Includes natural areas with cultural and/or spiritual value such as sacred groves, sacred bodies of water and waterways, sacred trees, and sacred rocks.

Continued...

Performance Standard	Summary of Requirements
PS8: Cultural Heritage	Where the client has encountered tangible cultural heritage that is replicable and not critical, the client will apply mitigation measures that favour avoidance. Where avoidance is not feasible, the client will apply a mitigation hierarchy as follows...minimise adverse impacts and implement restoration measures, in situ, that ensure maintenance of the value and functionality of the cultural heritage, including maintaining or restoring any ecosystem processes needed to support it (consistent with requirements in Performance Standard 6 related to ecosystem services and conservation of biodiversity).

Complete.

The assessment in this chapter has been undertaken in accordance with the 2012 IFC Performance Standards (Ref. 17.10), drawing on the Guidance Notes that accompany the Standards (Ref. 17.11). The approach is also informed by separate on-going dialogue between URS and the IFC's Environment, Social, and Governance Department (Ref. 17.12) and the World Resources Institute (WRI) (Ref. 17.13) regarding their risk screening procedures, expectations of ecosystem services assessments, and emerging guidance on consideration of ecosystem services in ESIA's.

This chapter presents an assessment of the potential impacts and dependencies on ecosystem services resulting from the Construction and Pre-Commissioning, Operational, and Decommissioning Phases of the Project. In addition, measures to anticipate and avoid, or where avoidance is not possible, minimize, and, where residual impacts remain, compensate / offset for risks and impacts on priority ecosystem services are presented.

Specifically, the purpose of this chapter is to:

- Systematically identify and assess the likely impacts of Project activities on ecosystem services (ESS) and the nature and significance of these impacts on ESS beneficiaries¹;
- Evaluate Project dependence on ESS in order to help manage risks and take advantage of opportunities related to ecosystem change; and
- Help inform, for unavoidable impacts, the selection of appropriate mitigation measures which aim to maintain the value and functionality of priority ESS and enhance the resource efficiency of Project operations.

This chapter is not intended to be read in isolation; instead it presents and assesses the key ecosystem service considerations relevant to the topics presented in other chapters of this ESIA Report, including key inter-linkages, to ensure that the values which ecosystem service

¹ The ESS framework focuses on assessing impacts on the beneficiaries of ecosystem services. Where impacts on ecosystem services reduce the benefits to beneficiaries, then these beneficiaries are identified as Project Affected Communities (PACs). Thus, not all ESS beneficiaries will necessarily be PACs. A beneficiary only becomes a PAC when the Project reduces the level of benefits provided to an individual or group of beneficiaries.

beneficiaries attach to ecosystem goods and services are appropriately considered and addressed throughout the ESIA process.

The findings of the assessment in this chapter have also been used to inform the baseline data collection process, impact assessment, and selection of appropriate mitigation options in other relevant technical chapters. This chapter brings together the findings of the other chapters to examine the issues at an ecosystem level and to assess how impacts on one aspect of the environment can affect others. As such, the chapter is heavily informed by the other chapters of the ESIA Report and cross references these where appropriate.

There are, therefore, significant overlaps between the assessment presented in this chapter and in the other technical chapters. For example, impacts on fisheries, crops, and tourism and recreation are all covered in both this chapter and in **Chapter 14 Socio-Economics**. While the assessment of these issues is broadly similar across the two chapters and each assessment has informed the other, it is important to note that this chapter uses an ecosystem services assessment framework to assess impact significance and, as such, there may be differences between the receptor sensitivities and impact magnitudes across chapters. This is due to the fact that the ecosystem services assessment considers the impact of the Project on ecosystem functioning and ability to continue providing services, as well as the ability of all those who access or benefit from those services to continue to derive services of the same value.

17.2 Approach

The approach to, and methodology for, the ecosystem services assessment in this chapter is based the Ecosystem Services Identification, Valuation, and Integration (ESIVI) approach (Ref. 17.14). The ESIVI tool was created in order to provide a rigorous and transparent framework for ecosystem service assessments that meets the requirements set out in the 2012 IFC Performance Standards.

The development of the ESIVI tool was informed by both the conceptual framework established by the MA, which explicitly links ecosystem services and human well-being, and the WRI's conceptual framework for Ecosystem Services Review for Impact Assessment (Ref. 17.15). The WRI framework puts the Project at the centre of the interactions between human well-being, ecosystem services, ecosystems, and drivers of ecosystem change, recognising that the Project has the potential to affect all the components of the framework and is itself affected by them. It reflects the two ways the Project relates to ecosystem services in terms of:

- Potential impacts on the existing relationships between human well-being, ecosystem services, and ecosystems; and
- Project dependence on these relationships for the achievement of successful performance.

The development of the ESIVI tool was informed by expertise built up from carrying out policy and project level work on ecosystem service assessments over the past ten years as well as a number of Good International Industry Practices and guidelines, including:

- IFC Performance Standards 1, 4, 5, 6, 7, and 8 and their accompanying Guidance Notes (Ref. 17.11);

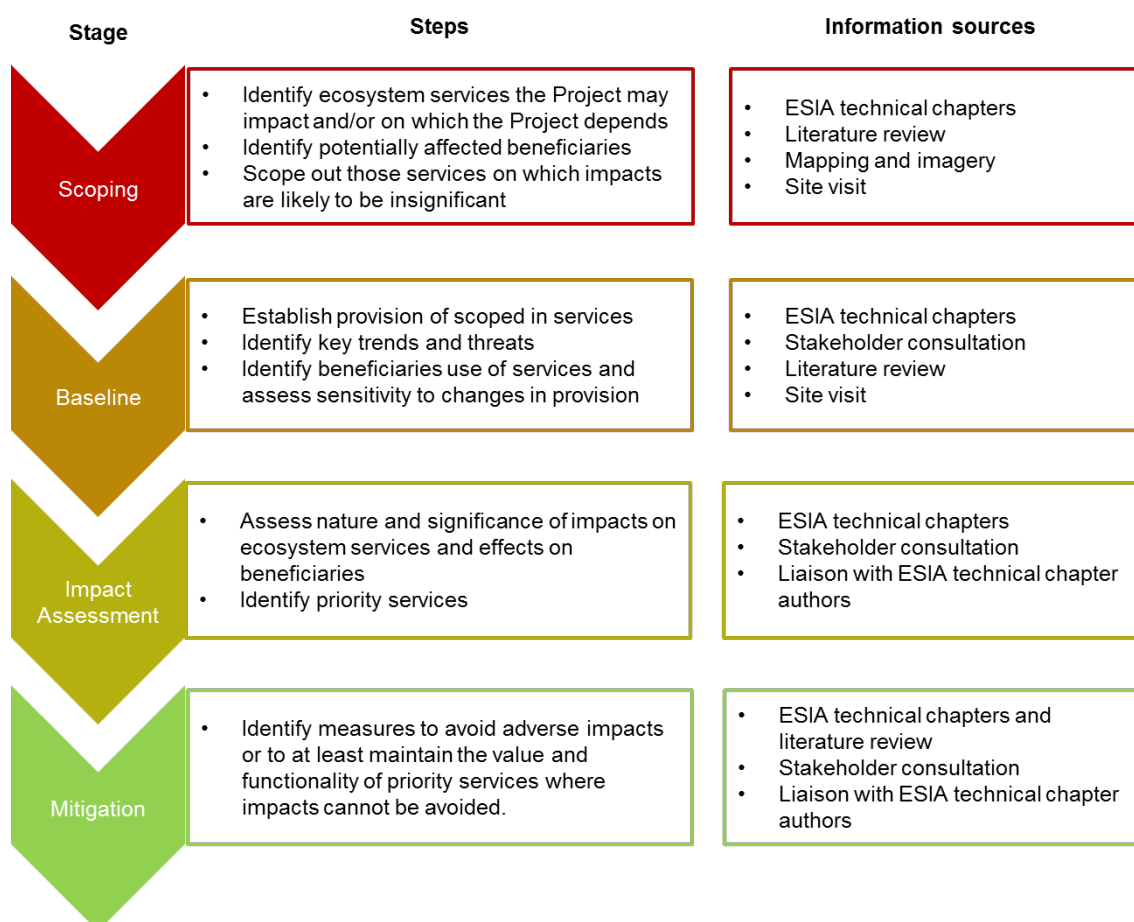
- Landsberg et al. (2011), 'Ecosystem Services Review for Impact Assessment: Introduction and Guide to Scoping' (Ref. 17.15);
- IPIECA/OGP (2011), 'Ecosystem Services Guidance: Biodiversity and Ecosystem Services Guide and Checklists' (Ref. 17.16);
- Convention on Biological Diversity (2006), 'Voluntary Guidelines on Biodiversity-Inclusive Impact Assessment' (Ref. 17.17);
- TEEB (2010), 'The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature' (Ref. 17.5);
- Bateman et al. (2010), 'Economic Analysis for Ecosystem Service Assessments' (Ref. 17.2);
- Burkhard et al. (2009), 'Landscapes' Capacities to Provide Ecosystem Services – A Concept for Land-Cover Based Assessments' (Ref. 17.3);
- Landsberg et al. (2013), 'Weaving Ecosystem Services into Impact Assessment: A Step-by-Step Method' (Ref. 17.18); and
- UNEP-WCMC (2012), 'UK National Ecosystem Services Assessment' (Ref. 17.19).

The ecosystem services assessment process comprises four stages²:

- **Scoping** – to identify the services provided by affected ecosystems that could potentially be impacted by the Project or that the Project may depend upon;
- **Baseline establishment** – to assess the status of these services within the affected ecosystems in the absence of the Project, as well as the location of ecosystem service beneficiaries and the extent to which they benefit from the services provided;
- **Impact assessment** – to identify the likely impacts of Project activities on ecosystem services and their beneficiaries, the significance of these impacts, and which services should be considered priority ecosystem services; and
- **Mitigation and residual impact assessment** – to identify the range of measures that may be implemented to anticipate and avoid, or where avoidance is not possible, minimize adverse impacts on priority ecosystem services and to determine the residual impacts once mitigation is in place.

Figure 17.2 provides a schematic overview of the assessment process and the key sources of data at each stage.

² Note that these stages of the ESIVI tool are consistent with the impact assessment methodology described in **Chapter 3 Impact Assessment Methodology** and used in other chapters.

Figure 17.2 The Ecosystem Services Assessment Process

17.3 Scoping

The objective of the initial scoping exercise is to identify those ecosystem services which could potentially be affected by Project activities or that the Project may depend upon and which therefore ought to be subject to more detailed investigation.

Due to the complexity and interconnectivity of ecosystems, together with the uncertainty surrounding how each process within an ecosystem is likely to respond to change, isolating and assessing each of the likely impacts of a project on particular ecosystem services is a difficult task. Further, the potentially wide range of people who benefit from ecosystem services and the different values they attach to such services mean that assessing the impacts and dependencies of a project on ecosystem services is an extensive undertaking.

As such, a comprehensive assessment of every impact or dependency on each ecosystem service and an economic valuation of each type of use is beyond the scope of an ESIA³. An effective ESIA should therefore focus resources on assessing the services which are likely to be of highest priority, with further, more detailed assessments being carried out where necessary to inform the development of follow up reports. For example, while it is not appropriate to undertake a full economic valuation for each ecosystem service within an ESIA, valuing certain services may be a useful exercise for informing the development of Livelihood Restoration Plans which depend on ecosystem based forms of income such as fishing and farming.

An important element of the scoping stage is therefore to identify which services can be excluded from the ESIA in order to provide a comprehensive and manageable assessment. This was done using the ESIVI tool which contains a checklist of ecosystem services that has been compiled using the guidance, checklists, and other relevant information contained in the studies listed in the previous section.

In this assessment the ESIVI checklist (Table 17.2) was used to systematically identify the services which may potentially be impacted by the Project or upon which the Project may depend. Definitions and examples of each of the ecosystem services are provided in Appendix 17.1 Ecosystem Services Checklist.

Table 17.2 Ecosystem Services Checklist

Provisioning Services	Regulating Services	Cultural Services
Crops	Local climate regulation	Tourism & recreation values
Livestock & fodder	Global climate regulation	Cultural & spiritual values
Capture fisheries	Air quality regulation	Scientific & knowledge values
Aquaculture	Hazard regulation	Wild species diversity
Wild foods	Water quality regulation	
Timber	Pollination	
Energy	Disease and pest control	
Biochemicals / medicine	Noise regulation	
Water (supply)	Soil quality regulation	

Continued...

³ Note, IFC Guidance Note 6 states that "client requirements are focused on the mitigation of impacts on ecosystem services and the benefits that ecosystem services might bring to companies rather than on the economic valuation for such services".

Provisioning Services	Regulating Services	Cultural Services
Fibres and ornamental resources		
Genetic resources		

Complete.

It is important to note that impacts on supporting services are not explicitly accounted for in the ESIVI ecosystem services assessment in order to avoid double-counting. This follows from Bateman *et al.* who draw the distinction between supporting ecosystem services (e.g. nutrient cycling), final ecosystem services (e.g. growth of trees), goods (e.g. timber), and benefits (e.g. livelihoods) (Ref. 17.2).

Final ecosystem services are the last item in the chain of ecosystem functioning which inputs to the production of goods. They are the aspects of the natural environment which most directly affect human well-being. This focus on the final item in the chain of ecosystem services is to avoid the double counting which would occur if an attempt is made to value those intermediate ecological processes or outcomes (e.g. weathering, photosynthesis, nutrient cycling, etc.) which are captured elsewhere in the provisioning, regulating, and cultural services that they support. For example, the impacts of supporting services such as photosynthesis are accounted for in terms of their support of crop growth and timber production.

An important exception is nevertheless made in the case of biodiversity. The authors of the MA argued that biodiversity underpins ecosystem function and should therefore be categorised as a supporting service. As such, biodiversity in itself would be excluded from the ecosystem service assessment in order to avoid double counting. However, a number of other studies suggest that the existence of biodiversity is itself a service, regardless of whether or not it provides a supporting role in the provision of any other services, and that people are willing to pay to preserve global biodiversity even if they do not benefit from any of the ecosystem services it supports (Ref. 17.20, 17.21 and 17.22). Excluding biodiversity from the ecosystem services assessment would fail to capture such values.

Therefore, in order to capture as wide a range of benefits as possible, and following the approach of the landmark UK National Ecosystem Assessment (Ref. 17.19), “*wild species diversity*” is included in the assessment as a distinct cultural service in its own right. To avoid double counting, the ecosystem services assessment distinguishes between biodiversity as a supporting function, and wild species diversity that is valued for its own sake (i.e. the existence value that people are willing to pay for the preservation of particular species, or local values attached to particular species which are not captured within other services). As a result, the assessment for wild species diversity focuses on any threats to populations of locally, regionally, nationally, or globally significant species.

Using the ESIVI checklist (Table 17.2), the range of ecosystem services potentially provided by the affected ecosystems, and the likely beneficiaries (direct or indirect) of each of those services were identified. As set out in PS 1, the emphasis during the initial identification stage is on covering the broadest possible scope of beneficiaries, including:

- Local beneficiaries, such as those who benefit from growing crops in a household plot close to where they live;
- Regional beneficiaries, such as those living within a watershed who benefit from flood protection;
- National beneficiaries, such as those across the country who visit an area for tourism / recreational purposes; and
- Global beneficiaries, such as those across the world who for example, benefit from carbon sequestration.

Identifying the type of beneficiary is important at this stage because different types of beneficiary are assessed differently with regards to mitigation requirements. For example, IFC PS 6 applies to ESS whose beneficiaries are at the local or regional scale, while PS 1 applies to ESS with global beneficiaries, such as carbon sequestration. Further, the type of beneficiaries also informs whether an ecosystem service is classed as a Type 1 service, where impacts on ecosystem services may adversely affect communities, or a Type 2 service, where the project directly depends on an ecosystem service for its operations. Identification of beneficiaries at this stage also informs the baseline data collection plan by identifying the particular groups or individuals who need to be consulted about the extent to which they presently benefit from (or value) each of the ecosystem services identified.

Once the broadest possible range of potential ecosystem services and their associated beneficiaries were identified, each service was systematically reviewed and scored against the inclusion criteria shown in Table 17.3 to identify which ecosystem services should be included in the more detailed impact assessment and which should be scoped out of the assessment.

Table 17.3 Criteria for Determining the Scope of the Ecosystem Services Assessment*

Inclusion Criteria	Assigned Score		
Is this service provided by affected ecosystems?	No 0	Potentially 1	Yes 2
Is the Project likely to have an impact on the ecosystem which provides this service?	No 0	Potentially 1	Yes 2
Is the Project likely to reduce any of the benefits that any people derive from this ESS? **	No 0	Potentially 1	Yes 2
Does the Project depend on this ESS for successful performance?	No 0	Potentially 1	Yes 2

Continued...

Inclusion Criteria		Assigned Score		
Does the client have direct management control or significant influence over this ESS? †		No 0	Potentially 1	Yes 2
Is the Project likely to have an overall beneficial impact on service use or provision?		No 0	Yes 15	
Ecosystem Service Relevance		Score		
Negligible	Service not present and unlikely to be affected Does not have to be assessed further	0		
Low	Project may have an insignificant impact / dependence on the service Does not have to be assessed further	1-4		
Moderate	Project likely to have a significant impact on beneficiaries of the service or likely to be dependent on the service Must be assessed further	5-8		
High	Project likely to have a significant impact on beneficiaries of the service and likely to be dependent on the service Must be assessed further	9-10		
Benefit	Project is likely to have a positive impact on service provision Does not have to be assessed further	>10		

* Note, under the scoring system set out in Table 17.3, a service can only be classed as high relevance if it is both a Type 1 and a Type 2 service i.e. the Project could reduce the benefits that people derive from the service and the Project itself depends on the service for successful performance.

** Note, this criterion specifically refers to potential impacts on users of a service while the preceding criterion refers to potential impacts on the ecosystem which provides the service. This is an important distinction because a Project may have significant impacts on an ecosystem (such as by withdrawing significant amounts of water from a river), however, whether or not people are using this service is an important factor in assessing the significance of the impact.

† Note, this criterion follows the guidelines set out in the IFC PS and identifies whether a client can be said to have control over a Project's impacts on an ecosystem service (this may exclude, for example, upstream manufacture of inputs or downstream use of a product) and whether the impacts are likely to be of significant influence (while a Project may impact on a service, for example, it may be possible to exclude these impacts from the assessment if it is known at the scoping stage that the impacts will be insignificant in terms of beneficiaries well-being).

The purpose of this initial scoping exercise was to identify any ecosystem services that may be provided by affected ecosystems, the extent of use, and how likely each of these services are to be impacted by the Project. Once the likely relevance was assessed, a shortlist of ecosystem services to be included in the baseline and impact assessment sections was compiled. Since this is a scoping exercise, the potential impact ratings shown in Table 17.4 should not be interpreted as an ultimate determination of impact significance; rather they are intended as an indication of the potential for an impact on a service to occur and the potential level of that impact.

The scoping exercise was undertaken through a review of both the information and data collected for the Russian Sector EIA and other ESIA chapters, including satellite mapping, site visits, and stakeholder consultation. A review of published literature was also carried out to supplement the existing evidence and to provide more detailed technical information where needed. As further information became available throughout the baseline and impact assessment process, the initial scoping exercise was revisited and updated where necessary in order to ensure that all relevant ecosystem services were included in the impact assessment.

The scoping exercise resulted in the identification of ten ecosystem services to be taken forward for more detailed assessment. These are:

- Crops;
- Capture fisheries;
- Water (supply);
- Hazard regulation;
- Air quality regulation;
- Water quality regulation;
- Soil quality regulation;
- Tourism and recreation values;
- Cultural and spiritual values; and
- Wild species diversity.

The full results of the scoping exercise are found in Appendix 17.2 Scoping Results while a summary of the rationale for inclusion or exclusion of each ecosystem service is provided in the following table.

Table 17.4 Scoping Exercise: Summary of the Rationale for Inclusion or Exclusion of Each Ecosystem Service

Ecosystem Service	Relevance*	Include in Impact Assessment	Justification
Crops	Moderate	Yes	Construction of the Pipeline will require some temporary and permanent loss of agricultural land. Vineyards would be the primary crop affected. The loss of agricultural production could have an impact on the current and future income from productive land which could also impact on employment opportunities.
Livestock & fodder	Negligible	No	There is no evidence of livestock farming or any grazing areas within the vicinity of the Project Area and it is unlikely that provision or use of the service will be affected by the Project.
Capture fisheries	Moderate	Yes	Fishing is undertaken along the coast in the vicinity of the marine component of the Project. At the time of scoping it was identified that the Project could limit access to fishing areas and could disturb fish habitats and fisheries productivity, which could impact livelihoods and well-being. Furthermore, several fishing organisations voiced concerns during the stakeholder consultation meetings held between 10th and 14th December 2012 and in October 2013 around the potential for the Project to restrict access to fishing grounds, to act as a barrier to fish migration, or to impact upon fisheries productivity as a result of noise and vibration (Chapter 6 Stakeholder Engagement).

Continued...

Ecosystem Service	Relevance*	Include in Impact Assessment	Justification
Aquaculture	Negligible	No	There is a mussel farm located around 3.8 km to the south of the proposed Pipeline route, near Bolshoi Utrish marina. However, the Project is not expected to impact upon mussel farming activities due to the distance from Project activities (Appendix 14.1 Fisheries Study).
Wild foods	Low	No	Hunting is prohibited in the area in which the Project is located, although information suggests that poaching of species such as rabbit, deer, wild boar, tortoise, and game birds may occur. Due to the limited amount of habitat that will be impacted by the Project relative to the surrounding area, the Project is unlikely to significantly impact the numbers or distributions of such species. Rural households may also collect wild foods from forested areas within the vicinity of the Project Area and the Project could reduce the provision of such foods due to vegetation clearance and through restricting access to land within the Project Area. Conversely, however, vegetation clearance could increase accessibility to this resource by providing a path which could be used to exploit forest resources that are not directly affected by Project activities. Overall, the scale of vegetation loss is minor and the habitat is well replicated nearby. As such, any impact on provision or use of the service is likely to be low.
Timber	Negligible	No	The Project Area covers an area of forest owned by the State Forestry Department. However, there is no timber harvesting or woodland management regime in place within this area of forest so there is unlikely to be any impact on timber provision. At the time of scoping it was identified that rural households may collect timber from other forested areas surrounding the Project Area however these areas would not be impacted by the Project. The Project could have a temporary beneficial impact on this service if the timber cleared during construction is made available for rural households.

Continued...

Ecosystem Service	Relevance*	Include in Impact Assessment	Justification
Energy	Low	No	Forested ecosystems within the vicinity of the Project Area provide a supply of wood that could be harvested as an energy resource. At the time of scoping it was identified that rural households may collect wood from forested areas potentially impacted by the Project and that the Project has the potential to reduce the availability of such fuels due to vegetation clearance. However, the scale of vegetation loss is relatively minor and habitat is well replicated nearby. Further, vegetation clearance may increase accessibility to this resource by providing a path which could be used to exploit forest resources that are not directly affected by Project activities. As such, any impact on provision or use of the service is considered to be low. As with timber provision, the Project could have a temporary beneficial impact on this service if the vegetation cleared during construction is made available for rural households. There is no use of other ecosystem-based energy such as biofuels or hydropower that could be affected by the Project.
Biochemicals / medicine	Low	No	Consultation with the local administration and government agencies revealed that there may be some collection of flora and fauna within the vicinity of the Project Area which is believed to have medicinal and/or spiritual properties. Local households (particularly elderly members) may also harvest herbs and plants growing in and around the Project Area to produce family cures and teas. These species have been extensively catalogued (Ref. 17. 23). The Project could potentially reduce the provision of such resources due to vegetation clearance and habitat loss. However, the scale of vegetation loss is relatively minor and habitat is well replicated nearby. The construction of access roads and clearance of forest could also increase the accessibility of such resources. As such, any impact on provision or use of the service is considered to be low.

Continued...

Ecosystem Service	Relevance*	Include in Impact Assessment	Justification
Water (supply)	Moderate	Yes	At the time of scoping it was identified that there are several surface and ground water resources present within the Project Area which flow to and/or are used directly by beneficiaries for drinking and industrial / agricultural uses. The Project Area crosses water courses at several points and could impact downstream surface water flows. The clearance of vegetation could also impact surface flows and groundwater recharge rates. Changes in the availability of water resources could impact the well-being of potential beneficiaries. Freshwater is required for Project activities and so this is identified as a Type 1 and a Type 2 service. Water required by the Project will be abstracted from a Ministry of Defence owned well near Sukko and tankered in to the site. The abstraction of water could draw down water levels and impact the ability of other users to access water.
Fibres and ornamental resources	Low	No	Shells are collected from the marine environment, which are sold as handicrafts in local markets (particularly a certain species of conch with a large orange shell). The Project could temporarily (during construction) impact access to areas where shells are collected although this is likely to have minimal impact on service use and provision as shells may be collected from other sites along the coast and the supply of shells is unlikely to be significantly impacted.
Genetic resources	Negligible	No	There is no evidence of any use of flora or fauna within or immediately surrounding the Project Area for the conservation or preservation of genetic resources. While it is possible that there may be as yet undiscovered genetic resources, there is no recorded scientific interest in the immediate vicinity of the Project Area and the habitat and fauna is replicated nearby, particularly in the Utrish State Nature Reserve, which is likely to provide a more important source of genetic resources.
Local climate regulation	Negligible	No	Due to the small scale of the Project Area relative to the extent of the surrounding ecosystems, it is unlikely that the area impacted by the Project plays an important role in local climate control, e.g. the regulation of precipitation, cooling, or shading etc. As such there is unlikely to be any significant change in provision or use of this service.

Continued...

Ecosystem Service	Relevance*	Include in Impact Assessment	Justification
Global climate regulation	Low	No	Vegetation and soils play a role in sequestering and storing greenhouse gases. Construction of landfill facilities and the Pipeline, clearance of vegetation, and fuel burnt in generators and transportation will generate greenhouse gases. Disturbance of the seabed could also potentially lead to the release of methane deposits. However, the impact of these activities relative to global greenhouse gas emissions and their effects on the well-being of populations affected by climate change is considered to be negligible (Chapter 9 Air Quality).
Hazard regulation	Moderate	Yes	Both the Project and local communities depend on the capacity of natural systems to regulate natural hazards such as floods, mudslides, and erosion. Several stakeholders from Varvarovka and Gai Kodzor raised the potential for increased flood risk as an issue during the initial stakeholder engagement exercise held in December 2012 (Chapter 6 Stakeholder Engagement). The Project could potentially impact local flooding events through the crossing of water courses. The clearance of vegetation (which binds soil particles) could also lead to an increase in erosion. Marine dredging could affect natural coastal processes leading to changes in coastal erosion and flooding. Since both local communities and the Project itself depend on hazard regulation, this is both a Type 1 and a Type 2 service.
Air quality regulation	Moderate	Yes	Air quality regulation is an important service within Anapa Resort Town which is renowned and marketed for its health benefits (Ref. 17.24). At the time of the scoping exercise it was identified that the Project could impact air quality regulation through the clearance of vegetation which plays a role in absorbing pollutants from the atmosphere (Ref. 17.25) as well as through emissions from construction vehicles and equipment.

Continued...

Ecosystem Service	Relevance*	Include in Impact Assessment	Justification
Water quality regulation	Moderate	Yes	Good water quality is important for fishing, human consumption, tourism, as well as for general ecosystem functioning. The Project could impact marine, surface, and ground water resources through spills, leaks, disposal of wastewater etc. during construction. Any Project contamination of groundwater is likely to be an important issue where people are abstracting directly from groundwater resources. Dredging (which could potentially expose contaminants in the sea bed) and disposal of hydrotest water could impact marine water quality with potentially significant impacts on well-being for the tourism industry, recreational water users, and fishing.
Pollination	Low	No	Several Lepidoptera (in their butterfly or moth adult life stage) and bee species feed on flower nectar and play a role in pollination within the ecosystems surrounding the Project Area. The primary habitat types which support such species are secondary and mesophilic meadows. The terrestrial land take required by the Project is likely to lead to a small loss of secondary meadow. The limited extent of this loss in respect to the surrounding habitat means that the Project is unlikely to significantly impact the distribution or population of any important natural pollinators. As such, the impact on the provision and use of the service is expected to be low.
Disease and pest control	Negligible	No	There is no evidence to suggest that the ecosystems or any particular species within the vicinity of the Project Area play a significant role in pest control. There is also no evidence of any habitats (e.g. standing water) which may influence the incidence and abundance of human pathogens (Chapter 15 Community Health, Safety and Security).
Noise regulation	Negligible	No	There is no evidence that ecosystems within the vicinity of the Project Area play an important role in noise regulation.

Continued...

Ecosystem Service	Relevance*	Include in Impact Assessment	Justification
Soil quality regulation	Moderate	Yes	Terrestrial soil quality is important for landowners, workers, human health, flora, and fauna. Healthy soil also plays an important role in flood regulation through the capacity for water absorption. The Project could impact this service through excavation of top soil, clearance of vegetation, and contamination through leaks and spills. The potential Project impact on soils was raised by several Supsekh residents during the initial stakeholder engagement exercise.
Tourism & recreation values	Moderate	Yes	Tourism is an important and growing industry in the region and potential Project impacts on this service were raised during the initial stakeholder engagement exercise. The Project could affect both terrestrial and marine tourism and recreation (e.g. through temporary loss of access or disturbance to hiking trails, beaches, and the marine environment). In particular, the well-being of the owners of, and visitors to, the Shingari and Don resort complexes could be impacted by the Project due to restricted access to areas used for water sports, by visual and noise disturbance during the construction period, or by potential impacts on marine water quality. Potential impacts on Sukko beach were raised during stakeholder consultation (Chapter 6 Stakeholder Engagement).
Cultural & spiritual values	Moderate	Yes	The natural environment plays an important role in the cultural identity and aesthetic value of the area (including Anapa, Gai-Kodzor, Sukko, Supsekh and Varvarovka). There are also a number of sites of cultural (graves / cemeteries / war memorials), scientific (archaeological remains), and spiritual (churches / sacred springs / religious and community festivals) importance. The Project could temporarily disturb such sites and permanently change elements of the natural environmental setting of the area which could impact on the well-being of any beneficiaries.

Continued...

Ecosystem Service	Relevance*	Include in Impact Assessment	Justification
Scientific & knowledge values	Benefit	No	Marine surveys for the Project collected geophysical data from Black Sea locations not previously studied. Preliminary analysis of this data suggests that the Project has facilitated the discovery of information which will be valuable to scientific knowledge. Publication of the results of this research will be explored in appropriate academic publications when available. Bacterial life which has adapted to survive in extreme anoxic environments may be present in areas of deep water offshore. While some mussel / bacterial mats were identified there was no evidence to suggest that this life is of any unique interest to science. Due to the potentially significant contribution to science that such surveys have revealed, the impact of the Project on this service is considered to be beneficial.
Wild species diversity	Moderate	Yes	A number of terrestrial and marine species of national and global conservation importance are present in the ecosystems within and surrounding the Project Area, including critically endangered sturgeon species and a critically endangered tortoise species. The Project could impact such species through collisions, disturbance, severance, loss of habitat etc. Further, the most common concern raised by stakeholders during consultation (raised 33 times) was the Project's potentially negative impact on the natural environment, including the marine environment, the coastline, onshore valuable habitat area (e.g. the mountain area of the Kilberov Canyon), juniper trees, and local wildlife around the proposed compressor station (Chapter 6 Stakeholder Engagement). As such, impacts on wild species may potentially have a direct impact on the well-being of stakeholders including local communities and NGOs.

*As calculated using the approach set out in Table 17.3, see Appendix 17.2 for full details.

Complete.

17.4 Spatial and Temporal Boundaries

Ecosystem services are the contributions that ecosystems make to human well-being and business performance. As such, the focus of the ecosystem services assessment is on assessing changes in beneficiary well-being (including both Affected Communities and the Project itself), as a result of impacts on ecosystems and their associated services (Figure 17.3).

Figure 17.3 Impact Pathway for Assessing Impacts on Ecosystem Services

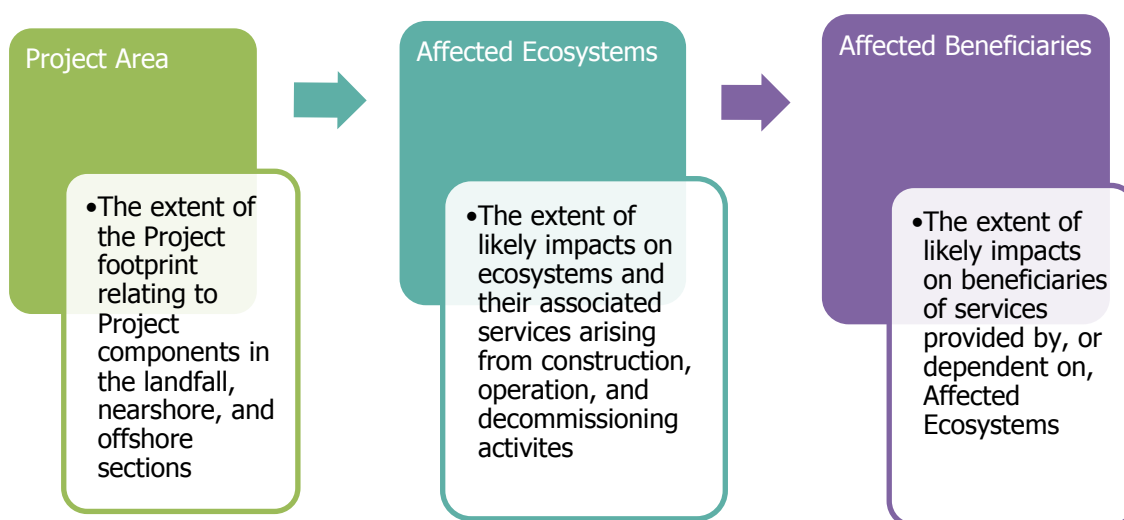


The assessment in this chapter therefore differs from other chapters in that it involves a two-stage process. First, the impacts on the ecosystem and its associated services (the physical receptor) need to be understood before the implications for ecosystem service beneficiaries (the social receptor) can be assessed.

As such, the spatial boundaries of this assessment are determined by: the Project Area and the ecosystems within it which are affected by the construction, operation, and decommissioning phases of the Project (a physically defined area); the flows of ecosystem services generated by these ecosystems; and ultimately, the locations of the ecosystem service beneficiaries (a socially defined area).

The relationship between the Project Area, the Affected Ecosystems, and the Affected Beneficiaries is illustrated in Figure 17.4 below. Further details on each of the assessment areas are provided in the following sections.

Figure 17.4 Defining Spatial Boundaries for Assessing Impacts on Ecosystem Services



17.4.1 Project Area

The Project Area includes landfall, nearshore, and offshore sections. These are described in detail in **Chapter 1 Introduction** and in **Chapter 5 Project Description**.

17.4.2 Affected Ecosystems

The Affected Ecosystems are defined by the extent of the ecosystems or land uses which are most likely to be impacted by the construction, operation, or decommissioning phases of the Project.

Since ecosystems make up interconnected areas of natural habitat they cannot be restricted to a particular spatial area on a map. However, drawing a defined spatial boundary at this stage provides a basis for identifying the ecosystems most likely to be impacted by the Project. Since the Project includes both onshore and offshore components, the potential impacts on both marine and terrestrial ecosystems (including inland freshwater bodies) are considered.

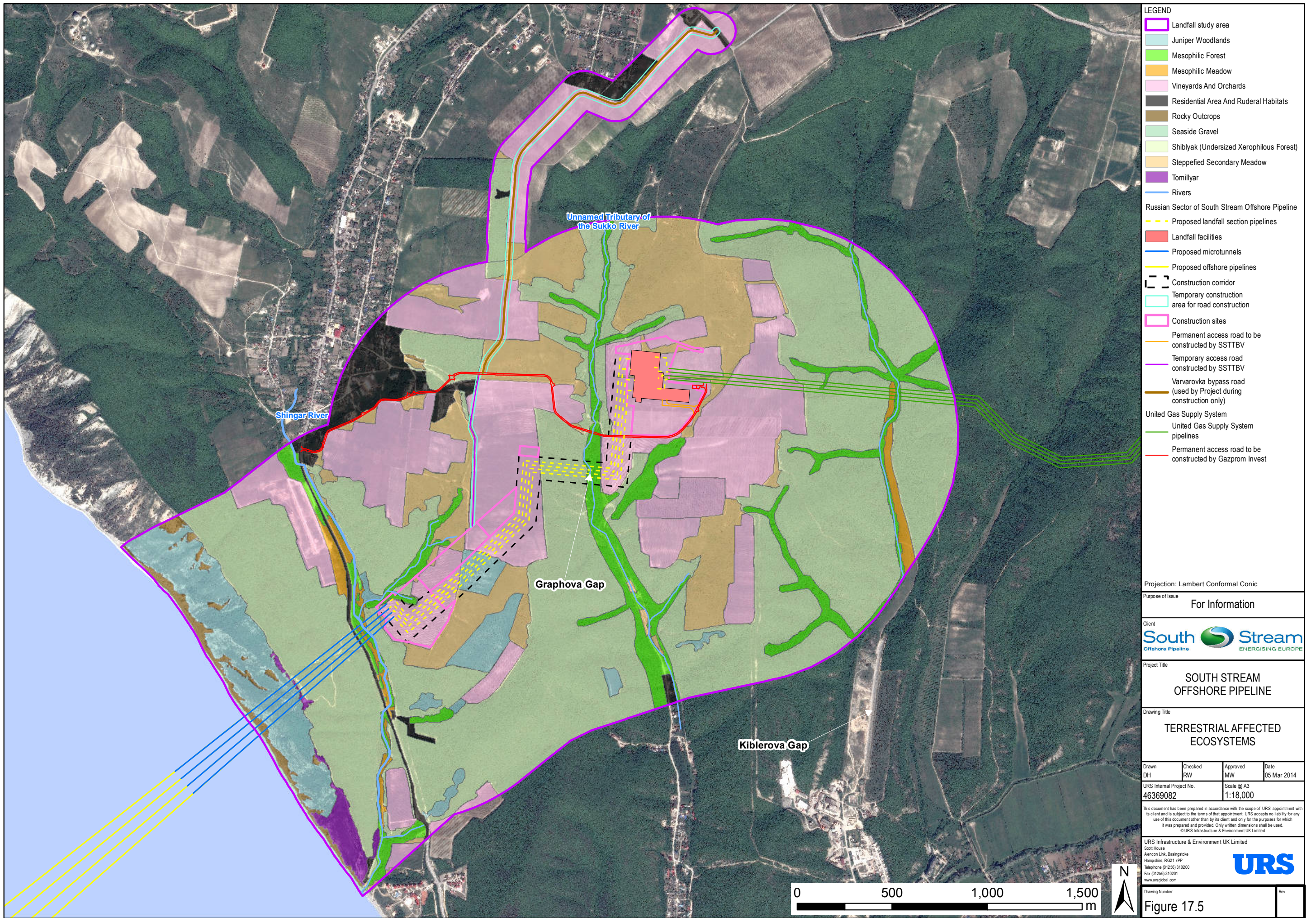
17.4.2.1 Terrestrial Affected Ecosystems

Any ecosystems which fall at least partly within the landfall section of the Project Area could potentially be impacted by the Project through habitat loss, vegetation clearance, compaction, etc., while certain activities such as leaks, spills or emissions could have physical impacts on ecosystems (or parts thereof) outside of the Project Area.

Further, while the area within the safety exclusion zone (a 410 m width surrounding the Pipeline and the landfall facilities) may not experience any direct physical impacts, there will be restrictions on land use and development within the exclusion zone which could potentially affect access to ecosystem services provided *in situ* (e.g. crops, wild foods, etc.).

For the purposes of the ecosystem services assessment, the starting point for identifying potentially Affected Ecosystems has been defined as a 1 km radius surrounding the landfall section, extending to the coastline (Figure 17.5).⁴

⁴ Note, taking this as a starting point recognises that the extent of the Affected Ecosystem could extend beyond the 1 km boundary. These wider impacts are accounted for through the assessment of impacts on beneficiaries.



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17.4.2.2 Marine Affected Ecosystems

As noted above, the Project Area is divided into landfall, nearshore and offshore sections. This division is based on technical consideration of different construction activities to be employed in each section, and has no connection to the ecosystems in which Project activities take place. For the purposes of assessing the impacts on marine ecosystem services, and following the approach taken in **Chapter 12 Marine Ecology**, the 'nearshore section' is therefore considered to also include the area between 0 to 23 m water depth, which forms part of the 'landfall section' in the Project Description. Because the nearshore and offshore sections of the Project Area are ecologically contiguous, they are considered as one in this chapter.

During the construction phase of the Project the nearshore section of the Project Area is defined by the maritime safety exclusion zones around the construction vessels, extending out 3 km either side of the outermost pipeline, encompassing:

- The area impacted by sediment dispersion, based on sediment models;
- The route of the four individual pipelines;
- The likely anchor spread and movement locations of vessels directly associated with the Pipeline installation and maintenance; and
- The proposed microtunnel exit pit and temporary dredge storage location.

The nearshore section Project Area is approximately 5.2 km².

The offshore section is approximately 225 km in length and pipelines will be laid directly on the sea bed from the maximum water depth where dredging works will take place (30 m water depth), to the boundary between the Russian and Turkish EEZs. The Project Area of the offshore section consists of a corridor of 3 km from the boundary of the nearshore section to the 600 m water depth contour, after which the corridor decreases to 2 km width either side of the outermost pipeline from the 600 m water depth contour to the EEZ boundary. The offshore section of the Project Area encompasses:

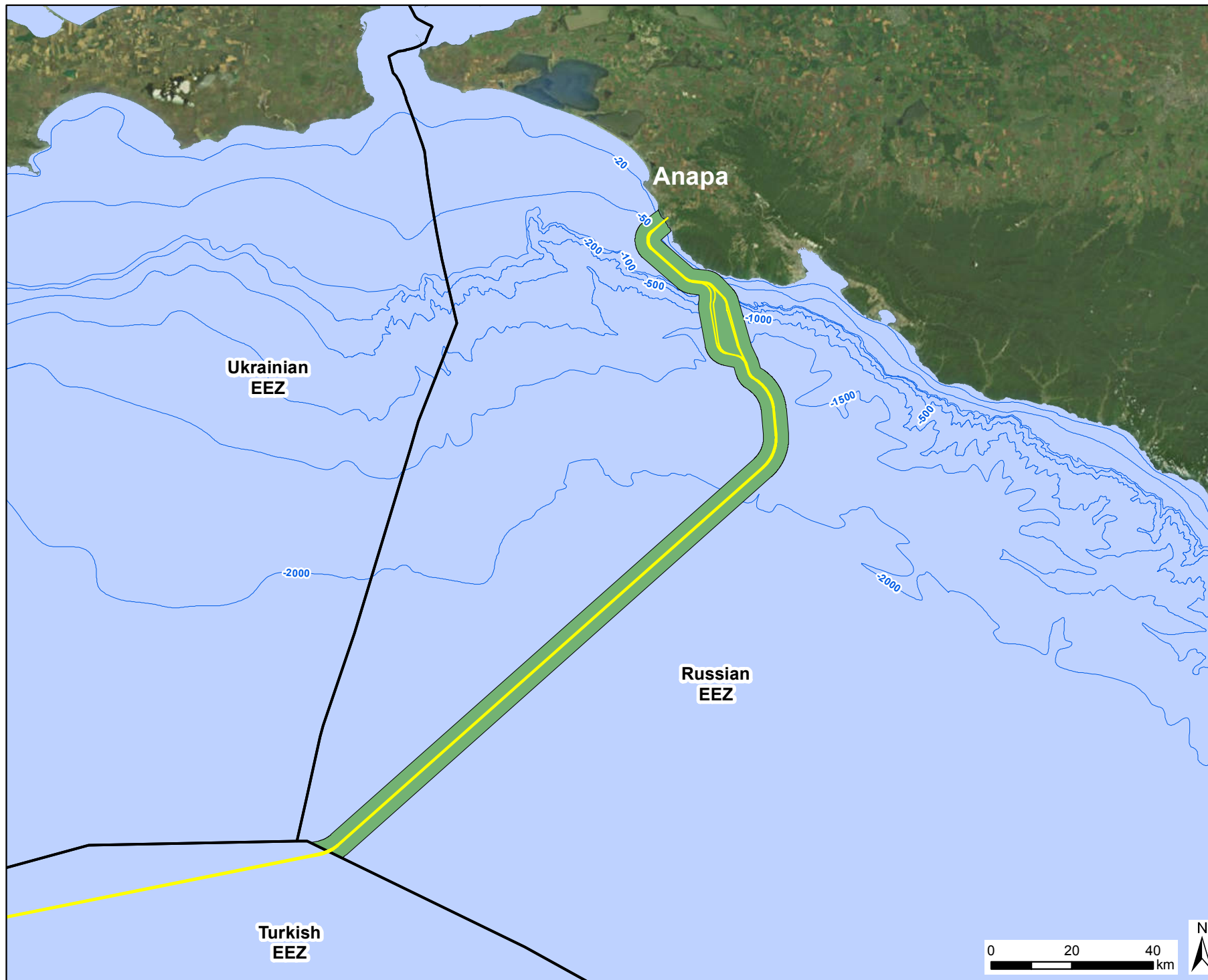
- The area impacted by sediment dispersion, based on sediment models;
- The route of the four individual pipelines; and
- The likely anchor spread and movement locations of vessels directly associated with the Pipeline installation and maintenance.

The offshore section is approximately 1,080 km² which is 206 km² from the nearshore boundary to the 600 m water depth contour and 874 km² from this to the EEZ boundary.

During the operation phase the Project Area will be smaller, defined by the operation exclusion zone of 0.5 km either side of the outside pipelines from the microtunnel exit point to the Russian / Turkish EEZ boundary (end of offshore section).

The starting point for assessing the potential impacts on ecosystem services in the marine environment has been delineated as a 3 km wide corridor following the nearshore section of the Pipeline to the 600 m water depth contour, and then a 2 km wide corridor from the 600 m water depth contour to the EEZ boundary. Again, taking this as a starting point recognises that

the potential extent of predicted impacts (e.g. noise disturbance) may extend beyond this boundary. These are captured in the assessment of impacts on beneficiaries.

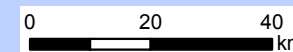


LEGEND

- Affected Ecosystems
- Russian Sector of South Stream Offshore Pipeline
- Proposed offshore pipelines
- Exclusive Economic Zone boundary
- Isobaths

Projection: Lambert Conformal Conic

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17.4.3 Affected Beneficiaries

Due to the interconnectedness of ecosystem processes and the flows of services they provide, impacts on Affected Ecosystems may also influence the ability of people to use or access particular services outside of the Affected Ecosystems.

For example, abstraction from surface waters within Affected Ecosystems, could reduce surface water flows which could impact the ability of beneficiaries to abstract water downstream. Likewise, fish species may breed at particular sites within marine Affected Ecosystems and then migrate throughout the marine environment supporting fishing industries across multiple countries.

As such, beneficiaries living outside of the Affected Ecosystems may be impacted by changes to the services provided and the assessment therefore needs to consider, *"project-related impacts across the potentially affected landscape or seascape...which does not necessarily correspond to any one pre-defined unit of geographical space"* (Ref. 17.26).

Further, the location of beneficiaries can vary depending on the type of service and, as such, beneficiaries are not restricted to a particular spatial area or landscape. For example, while the beneficiaries of the local climate regulation service may be restricted to the surrounding area, the beneficiaries of global climate regulation may be located throughout the world. As such, the extent of impacts on beneficiaries of ecosystem services can extend far beyond the Project Area or the Affected Ecosystems.

The Affected Beneficiaries are therefore defined by the location of the beneficiaries of the services provided by or dependent upon the Affected Ecosystems. While most of the beneficiaries are likely to be located within or around the ecosystems providing services, they vary across different services and can be located regionally, nationally, or even globally.

As such, the locations of Affected Beneficiaries are not restricted to a single pre-defined unit of geographical space and instead are defined for each ecosystem service depending on the beneficiaries of that service.

While the focus of the assessment in this chapter is on potential impacts on local beneficiaries living close to or within the Affected Ecosystems (defined as beneficiaries living in the Local Area⁵), impacts on regional, national, and global beneficiaries are identified and accounted for where applicable (Table 17.5 and Figure 17.7).

⁵ Note: the definition of the Local Area is in alignment with the Local Communities identified in **Chapter 14 Socio-Economics** and encompasses the towns of Anapa, Gai-Kodzor, Sukko, Supsekh, Rassvet, and Varvarovka. Defining a Local Area in this manner is used to delineate between local and regional beneficiaries in order to provide a focus for the assessment. While beneficiaries living within the Local Area provide the main focus of the assessment, impacts on regional, national, global beneficiaries are identified where relevant and included in the assessment.

Table 17.5 Ecosystem Service Beneficiaries

Location of Beneficiaries	Definition
Local Area	Residents, landowners, and companies located within the towns of Anapa, Gai-Kodzor, Sukko, Supsekh, Rassvet, and Varvarovka who directly or indirectly benefit from services provided by, or dependent upon, the Affected Ecosystems (e.g. crops).
Regional	Residents, landowners, and companies within the wider region (Krasnodar Krai) who directly or indirectly benefit from services provided by, or dependent upon, the Affected Ecosystems (e.g. fisheries).
National	Residents, landowners, and companies within the Russian Federation who directly or indirectly benefit from services provided by, or dependent upon, the Affected Ecosystems (e.g. tourism).
Global	Residents, landowners, and companies within other countries who directly or indirectly benefit from services provided by, or dependent upon, the Affected Ecosystems (e.g. carbon sequestration).

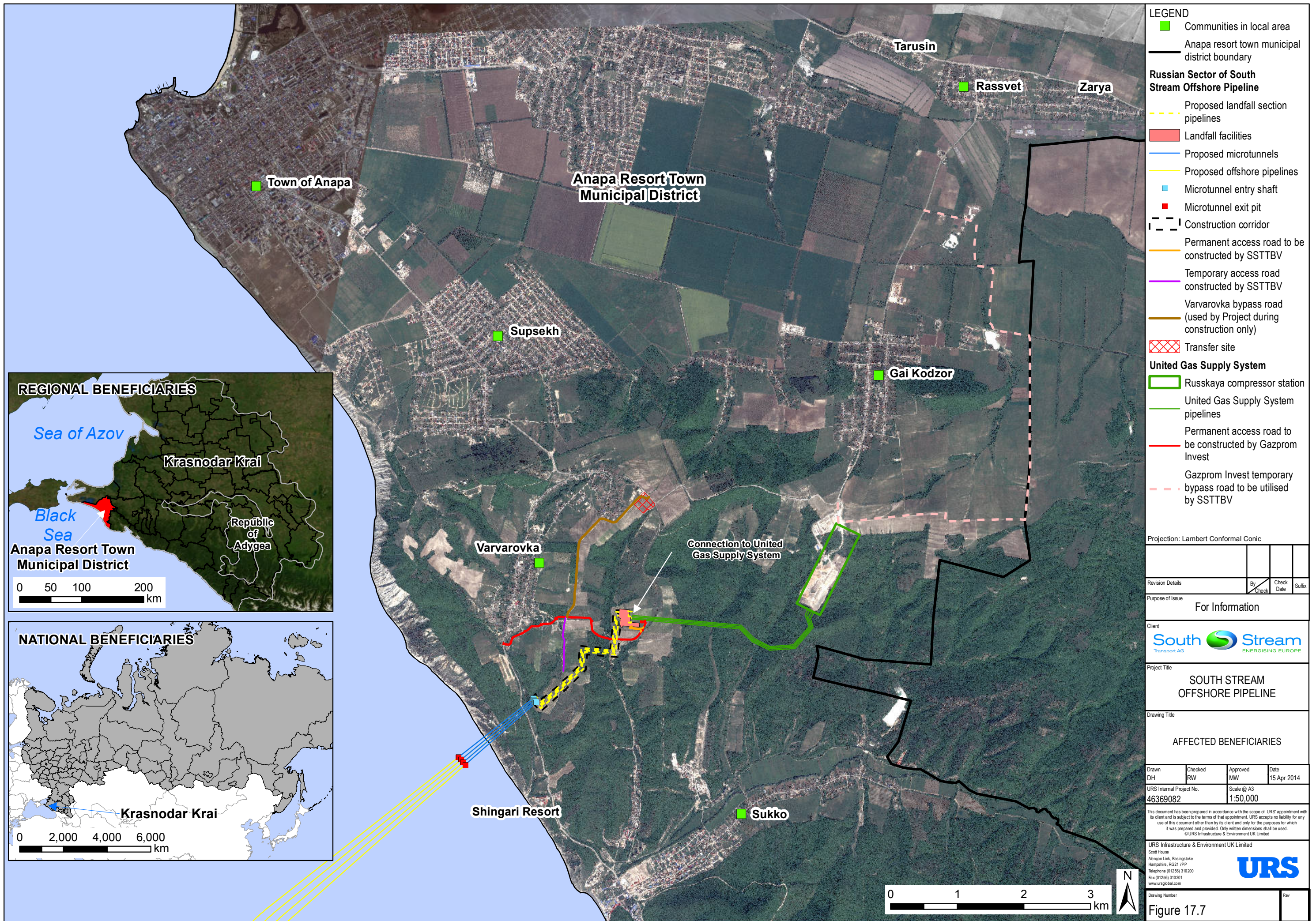
17.4.4 Temporal Boundaries

The temporal boundaries of this assessment are defined by the five key phases of the Project as set out in **Chapter 1 Introduction**. These include:

- Feasibility Phase (2007 to 2011);
- Development (or Design) Phase (2012 to 2013);
- Construction and Pre-Commissioning Phase (2013 to 2018);
- Operational Phase (2018 to 2065)⁶; and
- Decommissioning Phase (2065 onwards).

Unless otherwise indicated, the temporal boundaries of this assessment are assumed to be the life of the Project (i.e. 50 years).

⁶ First gas from Pipeline #1 is scheduled for late 2015, and all four pipelines are expected to be fully operational by the end of 2017.



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17.5 Baseline Data

17.5.1 Methodology and Data

Following the scoping exercise, the next step was to establish the present condition of the scoped-in services as well as broad trends in their provision and use. The baseline provides an analysis of the existing condition of an ecosystem and the services it provides in the absence of the Project, taking into account external factors (i.e. not related to the Project) that may affect future service provision including, for example, climate change, population growth, and changes in land management. Ultimately, the baseline provides a counterfactual or reference scenario from which the impacts of the Project can be measured and covers:

- Current provision of services and how the habitat / land cover supports their delivery;
- The importance of ecosystem services to beneficiaries; and
- How ecosystem services and the benefits they provide are likely to change in future in the absence of the Project.

The data used for the baseline assessment was obtained from a wide range of sources including secondary sources (i.e. existing data including government or academic reports etc.) and primary sources (i.e. new data collected through interviews, field surveys, and stakeholder engagement activities as described in **Chapter 6 Stakeholder Engagement**).

Information collected during the baseline data collection stage revealed locally important ecosystem services which were not included in the initial scoping exercise, as well as some services initially thought to be important which were found not to be of significant value. As data was collected, the outcomes of the original scoping exercise were updated to ensure that these more accurately reflected the importance of each of the ecosystem services to beneficiaries as suggested by the evidence from the baseline data analysis.

The remainder of this section sets out the data sources in more detail and the limitations of the assessment in terms of the availability of data collected.

17.5.2 Secondary Data

Secondary data and information was obtained through a literature review of relevant peer-reviewed journal articles, research reports, newspaper articles, and publically available databases.

17.5.3 Data Gaps

Due to the fact that the importance of services provided by different ecosystems depends upon how people interact with and value them, the analysis revealed a number of information gaps in relation to the provision and use of services which were not captured through secondary data sources.

17.5.4 Primary Data and Baseline Surveys

In light of the data gaps that emerged from the review of secondary data, a data collection exercise was undertaken which sought to supplement the secondary data gaps as well as to verify and ground-truth the secondary data available. Primary data on ecosystem services was collected during field visits in 2012 and 2013. These visits included: stakeholder meetings; observations of conditions; and meetings and interviews with local government authorities, local businesses including fisheries enterprises representatives, and local landowners.

Since ecosystem services represent the intersection of the natural and human environment, this chapter also draws upon the baseline information and analysis conducted in other relevant chapters of the ESIA. Any gaps in the baseline data relating to ecosystem services were discussed with the relevant technical chapter specialists in case the information was readily available and/or could be obtained through on-going data collection and stakeholder engagement. In order to ensure a comprehensive and collaborative approach to this process, a workshop was held with the technical specialists from each of the environmental and social disciplines covered in the ESIA to discuss the baseline, impacts, and mitigation sections of this chapter. Following the workshop, the collaborative approach was continued with an on-going dialogue with each of the specialists and reviews of the assessment in this chapter being undertaken by the relevant specialists as necessary.

17.5.5 Data Assumptions and Limitations

Accurate, quantifiable data on the use of ecosystem services is used where possible (e.g. loss of potential crop yield), however, for many ecosystem services the data were not available to establish a detailed and quantifiable metric in terms of baseline provision or use for each ecosystem service.

While this is a potential limitation, it does not significantly undermine the results of the assessment since the ecosystem services assessment refers to and builds upon the assessments undertaken in each chapter of the ESIA which use measurable metrics for assessing changes in the natural environment. The emphasis of this assessment is placed on drawing together the other chapters in the ESIA to assess the impacts on the well-being of beneficiaries resulting from changes in the natural environment. As such, the ecosystem services assessment aims to quantify changes in well-being as a result of changes in the provision of ecosystem services.

Due to the fact that there is a high degree of variance between the values different beneficiaries attach to different services, measuring well-being impacts using a single metric across all services and beneficiaries is a difficult task. One approach is to use economic valuation techniques to estimate the value of changes in well-being resulting from changes in ecosystem service provision in monetary terms.

However, due to the need for detailed, high quality primary data to establish reliable economic valuation estimates, and the time consuming nature of undertaking such primary data collection exercises, it is considered beyond the scope of an ESIA to carry out an economic valuation of ecosystem service use.

In light of this, the value of services provided by Affected Ecosystems has been assessed in a qualitative manner through stakeholder engagement exercises, expert discussion, and literature review. Where residual impacts are identified on priority ecosystem services which require compensation, economic valuation may be considered to evaluate the effectiveness of proposed mitigation and/or the value of economic displacement and the appropriate level of compensation.

17.6 Baseline Characteristics

17.6.1 Crops

Definition:

The provision of cultivated plants or agricultural products harvested by people for human consumption.

Krasnodar Krai is one of the leading agricultural regions in the country and is commonly referred to as “*the granary of Russia*” (Ref. 17.27). Agriculture and the food industry are important sectors of the region’s economy, with agriculture, hunting, and forestry contributing 12.6% of Gross Value Added⁷ in 2011. Within Anapa Resort Town, the sector is the fourth largest in terms of employment; making up 4.7% of the workforce (although this is down from 6% in 2006) (**Chapter 14 Socio-Economics**).

The largest agricultural organisation based in the Local Area is Agrifirm Kavkaz⁸. Kavkaz owns 1,975 hectares of land; around 400 ha of which are planted with vineyards and produce around 10-11 tonnes of grapes per ha. Depending on the season up to 100 people are employed by Kavkaz, including 40 – 70 workers cultivating and harvesting vineyards and 30 office staff and other workers. Around 30-40 of those employed are seasonal workers who come from Dagestan every year in April and return to Dagestan in November. The migrant workers live in portable cabins located near the new Varvarovka cemetery.

There is another winery based in the Local Area of similar size called Russkya Loza (1,580 hectares) based partly in Varvarovka and partly in Supsekh, which employs approximately 50 workers in Supsekh Rural District and a further 7 to 8 in Gai Kodzor Rural District (Ref. 17.28; Ref. 17.29). This vineyard is not directly impacted by land acquisition associated with the Project.

⁷ Gross Value Added is a measure of the contribution to GDP made by an individual producer, industry, or sector and is calculated by the value of output minus the value of intermediate consumption.

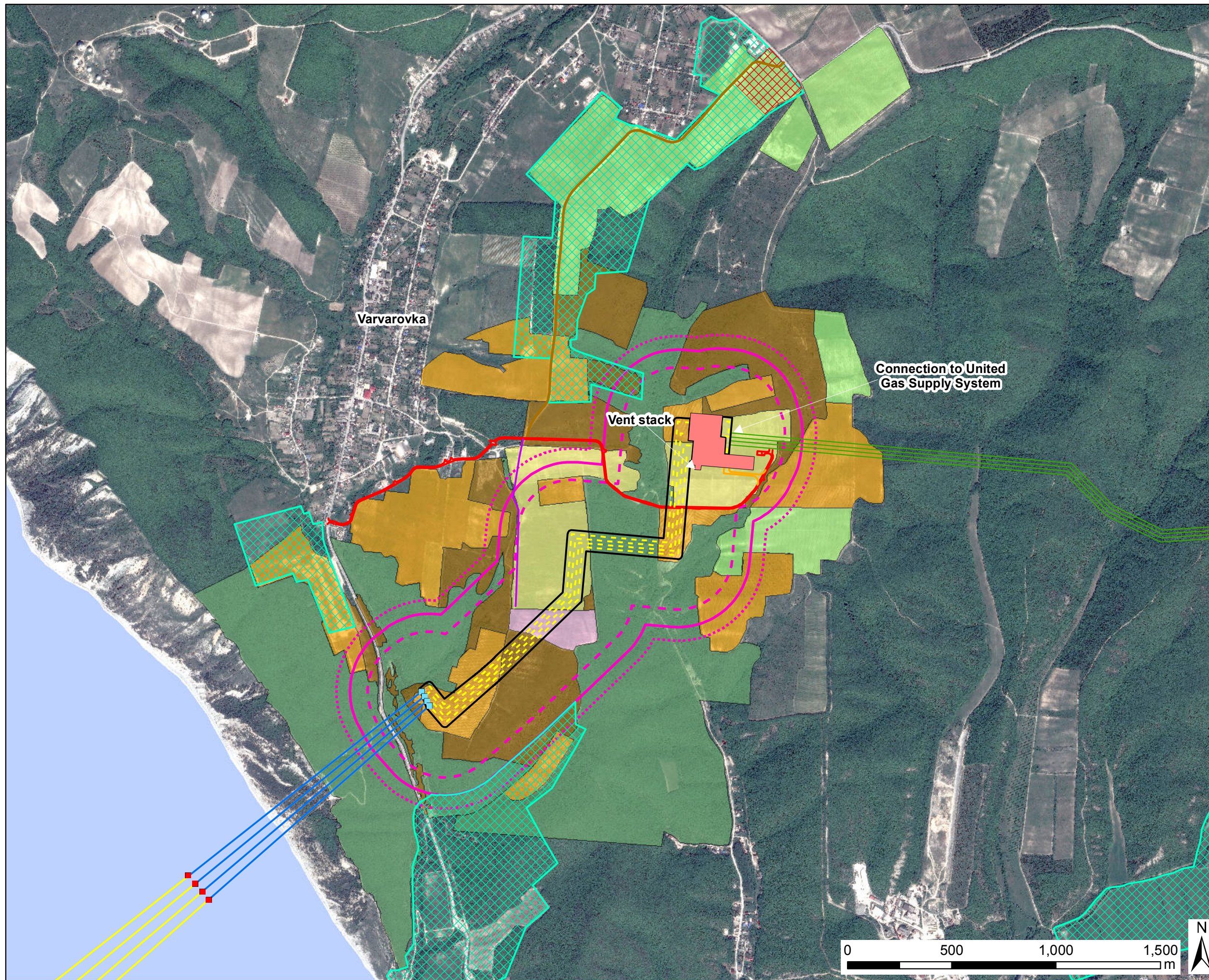
⁸ Agrifirm Kavkaz is owned by a parent company – Fond Yug – which is a property development company with two subsidiaries – Agrifirm Kavkaz and Kavkaz Winery. Ultimately Fond Yug owns the land; although the winery land is in effect owned and managed by Agrifirm Kavkaz. Kavkaz Winery is a separate company which makes and retails the wine.

Of those employed in the viticulture industry, the most vulnerable to any changes in provision of this ecosystem service are likely to be migrant workers who are typically employed on a seasonal basis living in portable cabins nearby the vineyards.

Within the Affected Ecosystems the predominant land uses are agriculture (owned by Agrifirm Kavkaz), and woodland (owned and administered by the Russian Federation State Forestry Fund) (Figure 17.8). The land within the Project Area consists almost entirely of agricultural land, with the only exception being a strip of forest that separates two large agricultural fields. There is also a much smaller area of forest that falls within the boundary of the microtunnel construction site.

Historically, agricultural land in the Affected Ecosystems was planted with vineyards although the land is now a mixture of fallow fields, scrub, and abandoned vineyard. The exception to this is the proposed optional transfer site and the land within the temporary construction area for the Varvarovka Bypass Road. This land is currently productively used as vineyard but is also within the confines of a proposed luxury residential development known as Chateau Club Village; the plans for which would retain as much of the vineyard as possible with the exception of sites for the construction of luxury residential homes. The areas where vines appear to have been eradicated due to the ageing of the plants are now either scrub or fallow fields. It was confirmed by an Agrifirm Kavkaz staff member during stakeholder engagement that the majority of the planted vineyards within the construction corridor, transfer sites and right of way had been abandoned in the last two to three years. This includes a range of mature and young (i.e. recently planted) vineyards (see **Chapter 14 Socio-Economics**).

The vineyards owned by Agrifirm Kavkaz are used to grow grapes for commercial wine production which is mostly sold locally, but also within the Russian Federation. The vineyards do not form a significant part of the local tourism industry (i.e. they are not a tourist attraction) unlike Abrau-Dyurso (located on the shore of Lake Abrau, 14 kilometres west of Novorossiysk) which lies at the centre of Russia's most important wine-growing region. The settlement was founded in 1870 as a royal winery to provide wine for the Tsar's household and developed a reputation for producing sparkling wine marketed under the name of *Sovetskoye Shampanskoye* which translates as "*Soviet Champagne*" or "*Champagne for the people*" (Ref. 17.30).



LEGEND

Land use (adjacent to Project)

- Confirmed productive vineyards
- Fallow field
- Forest
- Mature vineyard (abandoned)
- Recently planted vineyard (abandoned)
- Shrubs/uncultivated
- Proposed Real Estate Developments

Safety Exclusion Zones

- C- and E-class: no isolated buildings (1-2 levels), dachas, agricultural farms
- B-class: no cities, settlements, apartments of 3 levels or more, no developments/buildings with less than 100 people
- A-class: no airports, railways station, no developments/buildings with population of more than 100 persons

Russian Sector of South Stream Offshore Pipeline

- Proposed landfill section pipelines
- Landfall facilities
- Proposed microtunnels
- Proposed offshore pipelines
- Right-of-Way
- Microtunnel entry shaft
- Microtunnel exit pit
- Permanent access road to be constructed by SSTTBV
- Temporary access road constructed by SSTTBV
- Varvarovka bypass road (used by Project during construction only)
- Transfer site

United Gas Supply System

- United Gas Supply System pipelines
- Permanent access road to be constructed by Gazprom Invest

Projection: Lambert Conformal Conic

Revision Details		By	Check	Date	Suffix
Purpose of Issue		For Information			

Client

South Stream
Offshore Pipeline

Project Title

**SOUTH STREAM
OFFSHORE PIPELINE**

Drawing Title

**LAND USES WITHIN
THE AFFECTED ECOSYSTEMS**

Drawn	Checked	Approved	Date
AH	RW	MW	05 Mar 2014

URS Internal Project No.
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Drawing Number

Figure 17.8

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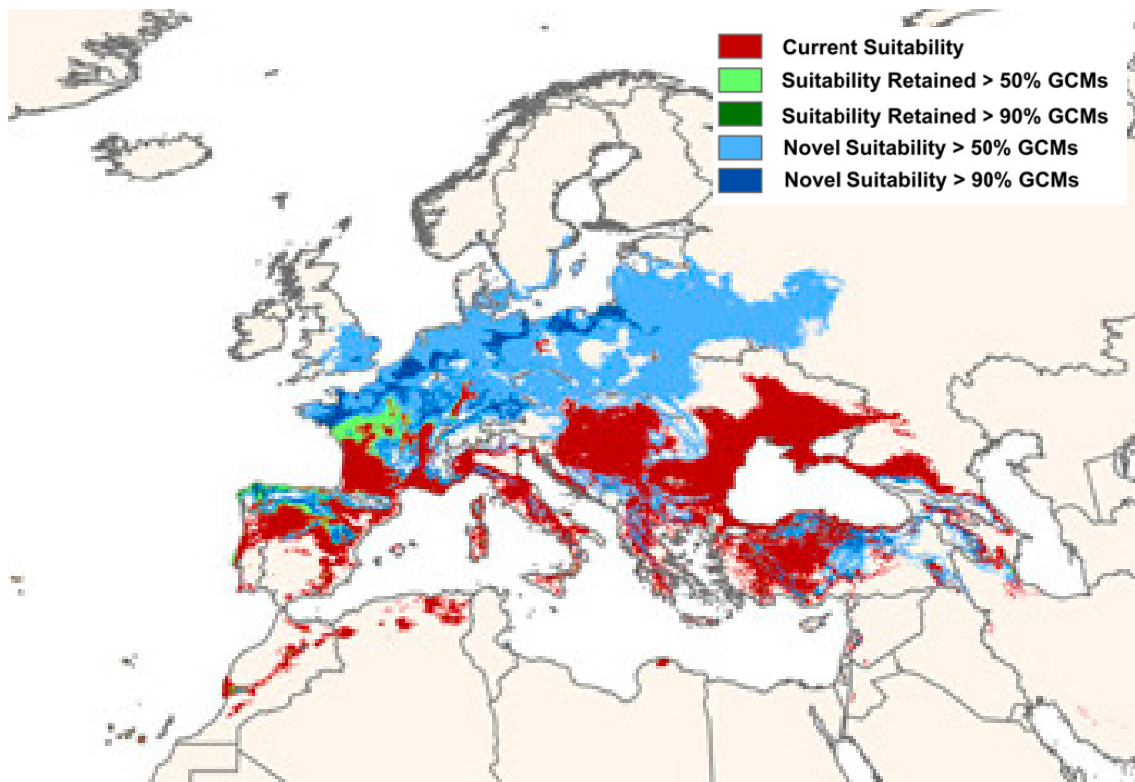
Climate projections suggest that the changing climate may impact the suitability of the region for agriculture and viticulture. In the last fifteen years, climate change has made it possible to expand winter grain production in Russia. More recently, however, the increasing incidence of drought and floods has begun to negatively affect agricultural production and offset the gains made through winter expansion (Ref. 17.27).

Due to a lack of detailed climate change projections in the Krasnodar region it is difficult to predict the likely impacts on agriculture in the Local Area with any certainty. However, a qualitative survey of the impacts on crop production and agricultural livelihoods under climate change was undertaken by Oxfam and the recorded observations of farmers across the Krasnodar Krai region may provide relevant insight (Ref. 17.27):

- Weather is increasingly becoming “*unpredictable*”;
- Harsher, damper climate with precipitation more unevenly distributed through the year;
- Longer, colder, and damper springs;
- Hotter, more arid summers with air temperatures reaching 40°C and soil 60°C;
- More radical temperature changes especially during spring to summer; and
- Stronger winds in winters, springs, and summers which farmers relate to deforestation.

In addition to observational evidence, a recent study of the impact of climate change on global wine production found that it is likely to lead to significant changes in the productivity of current wine-producing regions (Ref. 17.31). The study forecasts a radical shift in wine production with the total area suitable for viticulture decreasing between 25-73% in major wine producing regions by 2050, including parts of the Krasnodar Krai region and potentially the Local Area (Figure 17.9).

Figure 17.9 Global Change in Viticulture Suitability (areas with current suitability that is predicted to decrease by 2050 are indicated in red) (Ref. 17.31)



As such, in the absence of any adaptation measures, climate change may mean that the productivity of agriculture, and particularly viticulture, in the Local Area could decline in future (although more detailed modelling is needed to be certain). In order to adapt to the changing conditions it may therefore be necessary to shift towards more drought resistant crops (maize, millet, etc.), invest in irrigation infrastructure, and increase the adoption of new technologies.

The impact of such changes is likely to be greatest on small household farmers who may lack the resources necessary to invest in such adaption strategies, as well as on the viticulture industry since wine grapes are particularly sensitive to subtle shifts in temperature, rain, and sunshine. The subsequent increase in demand for irrigation may also lead to increasing pressures on water supplies within the Local Area (see Section 17.6.3).

For further details see **Chapter 14 Socio-Economics**.

17.6.2 Capture Fisheries

Definition:

The capture of wild fish for consumption and recreation purposes through trawling and other non-farming methods.

The Russian Black Sea fishery has undergone significant change in the last 40-50 years. While average annual catches ranged between 65,000 and 80,000 tonnes in the mid-1970s and 80s, by 2011 this had dropped by more than half to 30,900 tonnes. There are a number of factors that have led to this decline, including pollution, the introduction of invasive species (notably the predatory ctenophore *Mnemiopsis leidyi*), overfishing, and the decapitalisation of the Russian fishing fleet and associated onshore infrastructure and facilities following the break-up of the Soviet Union.

Most fishing takes place within Russian territorial waters (i.e. up to 12 nautical miles (22.2 km) from the mean low-water mark) (Ref. 17.32). The Azov Fisheries Research Institute recognises two administrative fishing zones within the area that extend from the Strait of Kerch (in the north) to Arkhipo-Osipovka, southeast of Novorossiysk. One of these, the Kerch-Taman zone, which stretches from the Kerch Strait to Cape Utrish, encompasses the entire nearshore section of the Project as well as some of the landfall and offshore sections. The second area, known as the Caucasus zone, stretches from Cape Utrish to the mouth of the Psou River at the border with Georgia. These zones are approximately equal in area, but different in terms of bioresources and productivity. Of the two zones, the most productive is the Kerch-Taman zone. This is reflected in the fact that approximately 96% of the total Russian Black Sea catch comes from waters bordering Krasnodar Krai.

The contribution of fisheries to the regional economy (of Krasnodar Krai) is small (around 0.1% in 2009) (Ref. 17.33). In recent years the size of the fishing fleet has contracted from around 30 vessels in the period 2003-2006 to around 16 in 2013 (Ref. 17.33) and the number of commercial entities engaged in fishing has decreased from 19 to 14 over the same period (Ref. 17.32). The fishery sector can nevertheless make an important contribution to sustaining the livelihoods of certain individuals and families, as well as having historical and cultural significance.

Fishing is also evident and has been observed in Anapa. Based on observations, it is most likely that this tends to be for recreation, rather than as a primary means to support livelihoods. However, according to local officials there may be some isolated but unrecorded instances of fishing to support or supplement livelihoods, although the officials were not able to provide any records or specific examples (**Chapter 14 Socio-Economics**).

There are around eight commercial fishing enterprises operating within the Russian Black Sea fishery between Temryuk and Novorossiysk, employing around 425 people. The two largest entities operating within the Kerch-Taman zone are RPK Briz (who employ around 30 staff, operating 1 trawler and 5 smaller boats) and OOO RAM (who employ around 14 staff, operating 1 trawler and 3 smaller boats). Most of their catch is sold in Anapa itself in various markets and other outlets, and some as far away as Krasnodar. While other enterprises are active in the Kerch-Taman zone these are generally relatively small (employing 2-3 people each) or they mostly fish in other areas (e.g. the Azov Sea) with only occasional trips into the Kerch-Taman zone.

Due to the anoxic nature of the Black Sea (see Section 17.6.6) species diversity declines with depth. Marine surveys undertaken for the ESIA recorded 64 species at a depth of less than 25 m and only 8 species in deeper water (50-85 m) (**Chapter 12 Marine Ecology**). The

concentration of Russian Black Sea fishing activity / effort reflects this species gradient, with most commercial fishing occurring in nearshore waters out to a depth of around 100 m.

Anchovy (*Engraulis encrasicolus*) and sprat (*Sprattus sprattus*) are the most important species in the fishery, comprising 28% and 25% of the Russian Black Sea catch respectively, with an additional 16% from red mullet and 12% from whiting. Most of the commercial fish stocks in the Russian sector of the Black Sea show some seasonal movement and migration which are key factors in the fishery and also are relevant to the Project.

In the main, the sprat stocks spawn in the upper layers (at depths of 100-150 m) of the open waters of the Black Sea off the coast of Russia. This takes place in the winter months, from October to March, at which point the shoals are highly dispersed and not fished commercially. After spawning, the adults move inshore to the feeding grounds from mid-March to early June where they form shoals over the continental shelf in waters of 20 to 80 m depth. Sprats feed mainly on plankton in the upper layers of the water. These shoals form the main commercial concentrations for a trawl fishery in this area from April to September. The major concentrations are found on the continental shelf of the Kerch-Taman region as far south as Anapa and Utrish and also between Novorossiysk and Arkhipo-Osipovka. The narrow continental shelf further south restricts the aggregation of sprats and the fishery is therefore sparser.

The Black Sea anchovy feeds predominantly in the northwest area of the Black Sea in the vicinity of the rich inflows from rivers such as the Dneiper and Danube. In autumn they migrate southeast to winter and spawn along the coast of Turkey and Georgia. Only occasionally do concentrations occur in Russian waters so this has not normally formed part of the fishery in Russia (Ref. 17.32).

The Azov anchovy pass through the Straits of Kerch in March to early April and into the Sea of Azov where they both feed and spawn during the summer although some remain in the Black Sea to spawn over the continental shelf. During autumn they migrate to their wintering grounds, passing southwards along the coast to winter mainly in the southern Black Sea near Sochi and Adler and into Georgian waters. Thus, most of the Russian anchovy fishery is seasonal, targeting the migrating shoals in spring and autumn. To exploit these stocks, co-operative fishing brigades set nets across the main migration route. There are also some purse seiners⁹ operating in the fishery as well as mid-water trawlers.

While not featuring significantly in the composition of catches in the Russian Black Sea fishery (the annual catch is only around 240 t), horse mackerel spawn and feed in shallow water during the summer then move south, overwintering in the area around Sochi and the Georgian shelf, returning north in the summer. One of their main summer feeding grounds is the continental shelf around Anapa (see Appendix 14.1 Fisheries Study). The horse mackerel stock is currently recovering after a sharp decline in the early 1990s. They are reported to be difficult to catch due to their mobility during migration and the main fishery is during winter using attractant lights at night with lift nets from small vessels.

⁹ A purse seine is a very long net, which falls as a curtain from a floating head rope, that is use to surround shoals of open water fish. After encirclement, the bottom rope is pulled tight to trap the fish in the 'purse'. It never comes into contact with the sea bed.

Benthic and demersal fish typically migrate less extensively than pelagic species. Nevertheless, there are some appreciable migrations. The Black Sea turbot, *Scophthalmus maeoticus*, is probably the most valuable species with an international price of around \$4,000 / t, although it is now very scarce with an average annual catch of 10.6 t over the last five years. The species tends to move from deeper water in the winter into the shallower zones to spawn and feed during April to September. Protection of this stock was one reason for the designation of the Anapa Bank, a protected area constituting 33% of the Kerch-Taman fishing zone, within which seasonal fishing restrictions apply to ensure stock recovery. The area in which fishing is prohibited has, however, been reduced.

A recent (2012) assessment of Black Sea fish stocks by the European Commission Scientific, Technical, and Economic Committee for Fisheries (STECF) found that sprat, anchovy, and whiting stocks are all subject to overfishing, although a lack of data prevented projections of stocks in the medium term (Ref. 17.34). The assessment also reported that the Black Sea turbot stock was at an historical low (10% of 1970 levels) and therefore classed it as severely depleted as a result of unsustainable exploitation. Given the dramatic decline in the stock of turbot in the Black Sea, and the extremely high annual estimates of fishing mortality, STECF recommended that there should be no fisheries for turbot and individuals caught unintentionally should be released. In order to avoid further declines in turbot stock, STECF also recommended that an international management plan should be initiated to restore spawning stock biomass to the level capable of producing maximum sustainable yield (Ref. 17.34).

The most common demersal species, the whiting (*Merlangus merlangus*) usually occurs from 30 to 100 m depth where the water is cooler. Whiting show very few systematic movements with the exception that the younger individuals move inshore. Dense concentrations of whiting are to be found on the Anapa Bank, Southern Ozereevka and Arkhipo-Osipovka. The annual catch has been very variable from 3 t in 1997 to 655 t in 2002 but in the recent decade catches have been relatively small, at some 50 to 100 t, largely due to a lack of demand (Ref. 17.32).

The other main bottom-dwelling target species is the red mullet or 'barabulka' (*Mullus barbatus*) which occurs in two populations, one sedentary, remaining around Sochi and Georgia, and one migratory which moves seasonally along the coast as far as the Straits of Kerch. The average annual catch is around 110 tonnes.

In addition to the offshore fisheries there is also a degree of nearshore fishing activity, these consist of fish traps and fixed nets. The closest traps are owned by the Zao Moresky Club, who operate out of Bolshoi Utrish. They operate at least four fixed traps and a mussel farm, all serviced by a fleet of small vessels located approximately 5 km to the south of the Project Area. The fish traps are designed to trap migrating fish, the most significant to the Zao Moresky club being the red mullet, with catches of around 50 t per year. Around 3 t of horse mackerel and small amounts of pontiac shad (about 0.5 t) are also caught.

The fisheries of the Russian Black Sea shelf as a whole are very seasonal, ultimately relating to the migratory movements of the target stocks described above. This is reinforced by the regulations of the Federal Fisheries Agency (Ref. 17.35) and the Azov Fisheries Research Institute (Ref. 17.36). The lifecycle of fish species in the Black Sea and the nature of Black Sea currents mean that certain species within the Kerch-Taman zone can be important to fishing industries operating across the entire Black Sea. For example, the life-cycle of the anchovy

requires it to migrate extensively across the Black Sea, passing most coastal sections as well as open water, with important life stages (e.g. spawning, larvae, wintering, feeding) occurring in many different locations. Both migratory and non-migratory species regularly cross national territorial waters and EEZ boundaries. Any potential impacts on species stocks in the marine environment may therefore have the potential to influence fisheries in other Black Sea countries (**Chapter 21 Transboundary Impact Assessment**).

For further details see **Chapter 14 Socio-Economics**, Appendix 14.1 Fisheries Study and **Chapter 12 Marine Ecology**.

17.6.3 Water Supply

Definition:

The provision of freshwater in lakes, rivers, and underground aquifers.

The main inland freshwater body is the Shingar River, the source of which is a spring within the town of Varvarovka to the north of the proposed Pipeline route. The river is approximately 5.5 km long and runs parallel to the coastline. The river's channel in the upper reaches is stony and the basin territory is distinguished by a high level of wooded coverage.

The proposed Pipeline route crosses surface waters in two places: microtunneling underneath the Shingar River and crossing an unnamed tributary which drains the Graphova Gap (a small gully). For both water courses, intermittent low-water periods are typical. Low water flows are observed in the brief intervals of inter-flood periods during the whole year and longer periods of low flows are experienced in the summer period, during which the watercourses sometimes dry out and water in the channels stands in individual pools.

The hydrogeology of the area is characterised by a shallow alluvial aquifer overlying a carbonate aquifer. The alluvial aquifer is present along the narrow river valleys of the Shingar River and an unnamed tributary of the Sukko River. The anticipated depth to the water table varies between ground level to a few metres deep along the valley floors (where groundwater is in hydraulic continuity between the alluvium and carbonate aquifers) and up to 100 m beneath the higher areas. Groundwater recharge is through rainfall and discharge from surface water courses along their upper reaches. In the lower reaches of the valleys groundwater is likely to discharge to the river system and ephemeral springs during periods of high rainfall and corresponding high groundwater levels.

In addition to the Project itself, there are a number of beneficiaries of the ground and surface water resources in the area including the Russkaya compressor station which plans to abstract groundwater for drinking and industrial purposes from an aquifer approximately 3 to 4 km north of the Project Area. This abstraction is likely to be hydraulically upgradient from the Project Area and the Project does not lie within the designated sanitary protection zone for this abstraction.

There is a well owned by the Ministry of Defence located near the settlement of Sukko drawing from an aquifer downgradient of the Project Area (Figure 17.10). The Project is dependent upon this resource for freshwater required in construction activities. While the water supply is owned by the Ministry of Defence it also utilised by third parties. Water may only be abstracted from

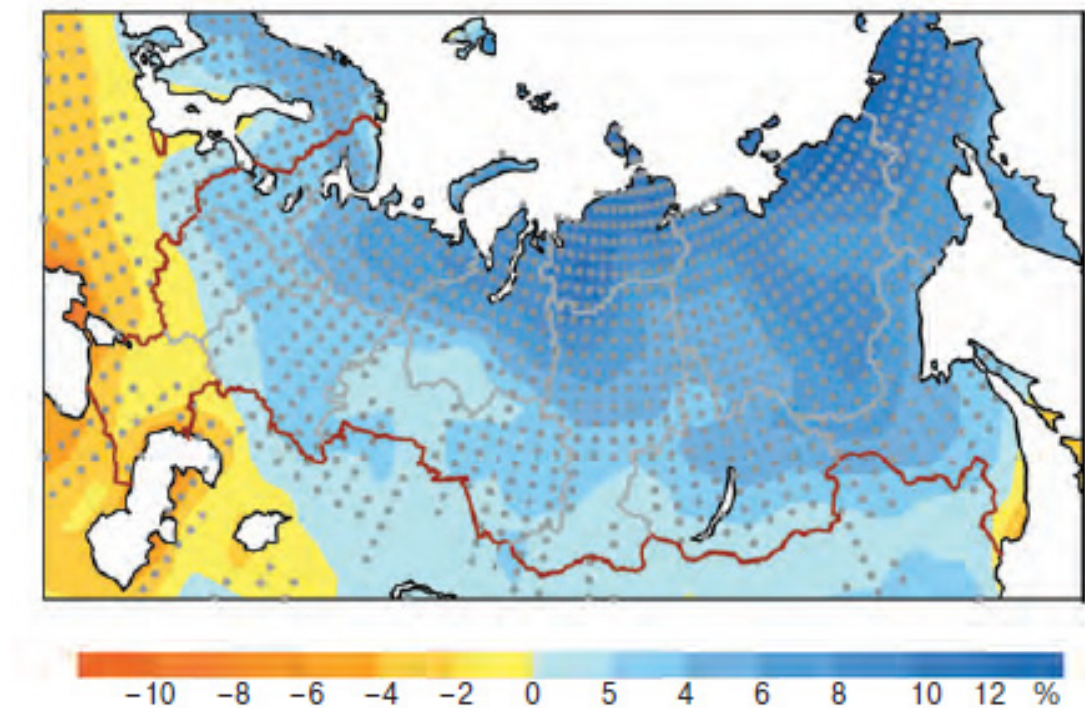
the Sukko source between October and April; it is understood that the restriction on summer abstraction is in place to prevent derogation of the aquifer (**Chapter 8 Soils, Groundwater and Surface Water**).

There are no licensed surface water abstractions for drinking water within or downstream of the Project Area. There is, however, a small impoundment on the watercourse in the Graphova Gap located upstream of the proposed RoW crossing. This impoundment structure retains surface water flows to enable abstraction by the Agrifirm Kavkaz for use in viticulture. There is also a natural spring known as St. Barbara's Source reputed to have healing powers located in Varvarovka (upstream of the Project Area) which is of cultural importance to people living in the Local Area and to visitors.

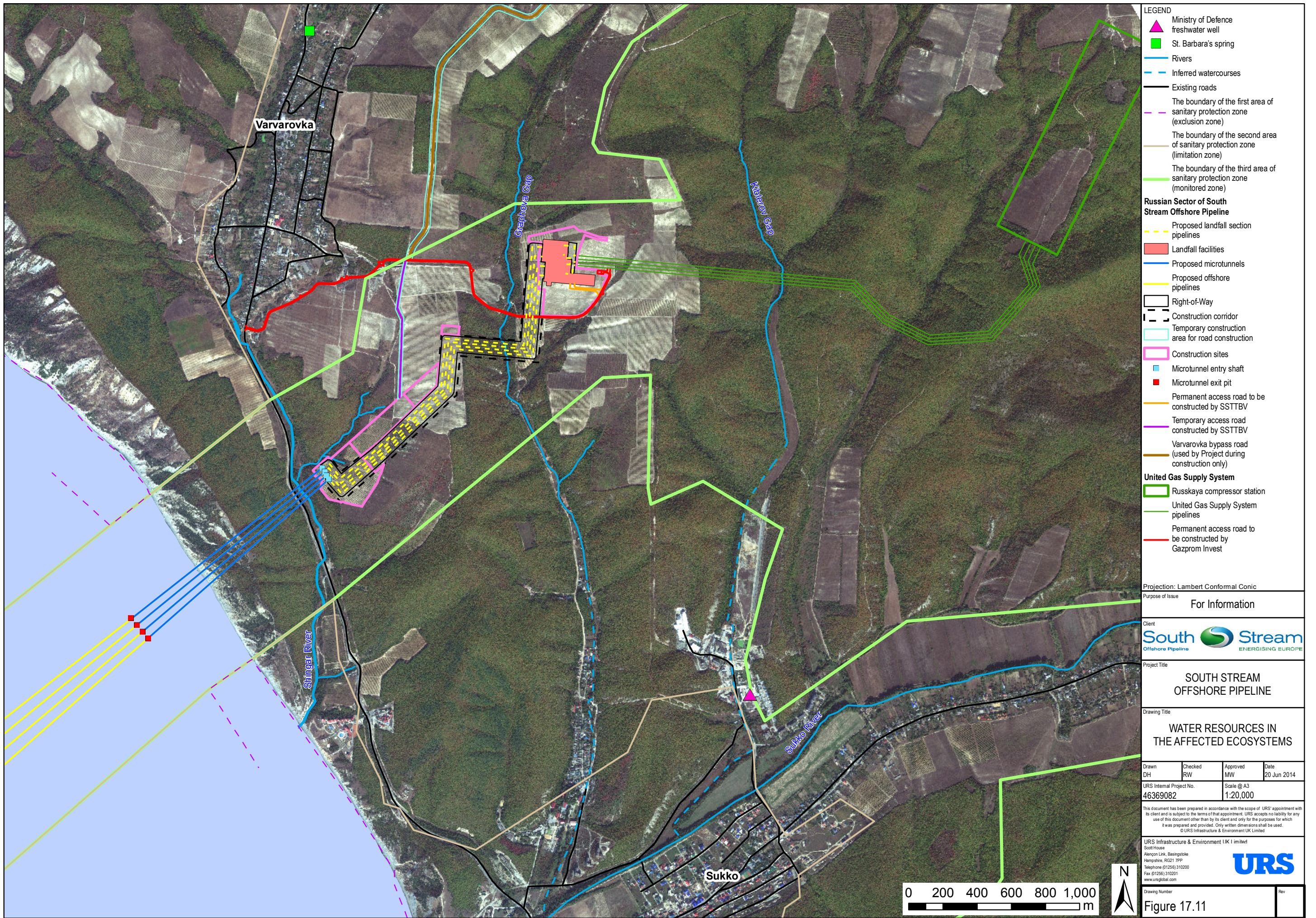
There is considerable variation amongst communities in the Local Area with respect to access to mains water supply. While all households in Supsekh and Gai Kodzor have mains water supply and 80% in Varvarovka, only 50% of households have access in Sukko with the remaining 50% obtaining water from wells on their property (**Chapter 14 Socio Economics**).

Across Russia as a whole, climate change is predicted to lead to an increase in surface water flows and precipitation levels. However, within the Krasnodar region, there is a projected decline in water availability (Figure 17.11); although there are no available projections specific to the Local Area (Ref. 17.37). Attempts to maintain or increase wine productivity in the face of a changing climate may lead to an increase in water use for irrigation as well as to cool grapes through misting or sprinkling. These factors could result in increasing pressure on water resources within the Local Area which could be exacerbated by population growth and growing demand for water for other uses.

Figure 17.10 Predicted Changes in Annual Runoff During the Period 2041–2060 (values are given in % change relative to the period 1980-1999 and dots denote areas where two thirds of the models show changes of the same sign) (Ref. 17.37)



For further details see **Chapter 8 Soils, Groundwater and Surface Water.**



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17.6.4 Hazard Regulation

Definition:

The capacity of the natural environment to regulate water, soil, and sediment transfer so as to: maintain the integrity of land surfaces in order to reduce the hazards associated with mass movements (e.g. landslides and slumping), coastal erosion, and flooding; maintain "intact" soil cover and low suspended sediment loads in fluvial systems; and retain and store water and delay release from the land surface and attenuation of peaks as flood water passes through river networks to reduce the risks associated with runoff and flooding (Ref. 17.19).

There are a number of hazards associated with the Local Area, including gravity-induced landslides, linear erosion, mudslides, and flooding. The key features within the Affected Ecosystems which contribute to the regulation of natural hazards include vegetation which binds together soil particles and attenuates surface water flows; Phaeozom soils which absorb water and play an important role in flow regulation; and coastal habitats including underwater sandbars, beaches, and cliffs which dissipate energy from waves and regulate levels of coastal erosion and flooding.

Watercourses flowing through the Affected Ecosystems are predominantly precipitation fed, with frequent and short floods. Surface waters are partly recharged from high groundwater tables (often associated with springs) and flows typically peak during winter months when rainfall is highest. In addition to the natural watercourses, there are artificial drainage ditches which are used to manage flood risk locally.

Phaeozem soils in the Affected Ecosystems have a high water absorption capacity and play a key role in water regulation. During summer months when precipitation is limited, most surface water permeates the underlying soils and further reduces flow through the rivers. This typically results in watercourses becoming dry or the formation of discrete ponds within the river bed.

Storms and the associated surface run-off can lead to soil erosion, subsequent aggradation and accumulation of sediments on lower slopes, and degradation of water quality due to an increase in suspended sediments. Forested areas where trees line the valley slopes form a canopy to protect soils, take up water and reduce the amount of surface run-off, and reduce soil erosion as the roots bind together soil particles.

The sudden formation of mudflow and mudrock flows is possible in the valleys of the Shingar River and the unnamed tributary of the Sukko River. Retrospective analysis indicates that mudflows occur once every several (5 to 7) years (**Chapter 7 Physical and Geophysical Environment**). Mudflows are typically triggered by intense rainfall events and/or prolonged periods of rain (Ref. 17.38).

Erosional processes are associated with the coastal cliff zone. The relatively narrow beach provides limited protection to the base of the cliffs against direct wave action. Waves also assist in the removal of material at the toe of the cliffs resulting in periodic landsliding and slumping events. The risk of landslide activity is enhanced by seismic activity in the vicinity of the

Affected Ecosystems which typically has potential to cause earthquakes of magnitude 5 to 6 on the Richter Scale.

The wave climate adjacent to the Russian coastline of the Black Sea is heavily influenced by the shallow continental shelf which results in smaller, primarily wind driven waves. The typical maximum wave height in the marine Affected Ecosystems is around 2.9 m, reaching 4.8 m in 1 in 100 years. Short-term sea level variations are also associated with varying meteorological conditions and can result in localised sea level surges of up to 1 m, although they are typically less than 40 cm (**Chapter 7 Physical and Geophysical Environment**).

The risk of natural hazards to local communities is relatively low and natural ecosystems play a role in regulating the extent of such hazards through erosion and water flow regulation arising from soils and trees, as well as providing some level of protection from storms through coastal cliffs and beaches. The beneficiaries of this service are therefore widespread and diffuse, including landowners, residents, and workers in the area who benefit from the regulation of flooding and erosion, and users of the beach and coastal area for recreational uses and livelihoods. The Project also benefits to some extent from the regulation of such processes.

Climate change in Russia is projected to lead to an increase in the frequency of hazard events including floods, droughts, wild fires, and mudflows (Ref. 17.37). Across Russia as a whole, there was an annual increase in the number of hazardous weather events from 1991–2005 of 6.3% and this increasing trend is expected to continue (although there is a lack of projections available for the Local Area). Sea levels in the Black Sea have been rising steadily since the 1920s, with the rise becoming much more rapid since the mid-1980s (around 2 cm per year) (Ref. 17.37). The changing climate, together with further development within the Local Area which requires clearance of vegetation and increases use of impermeable surfaces, are likely to increase the pressure on the functioning of this ecosystem service and lead to higher rates of flooding, erosion, and mud slides in future.

For further details see **Chapter 7 Physical and Geophysical Environment** and **Chapter 8 Soils, Groundwater and Surface Water**.

17.6.5 Air Quality Regulation

Definition:

The natural environment influences atmospheric concentrations of air pollutants and their deposition to land and water surfaces through the removal and detoxification of pollutants from the atmosphere. Gases and particles, for example, are deposited to ecosystem (primarily plant) surfaces and pollutant gases enter leaves through stomata. The extent of this removal depends on a number of factors, including the turbulence of the air above the ecosystem (taller vegetation has a greater efficiency), the duration of leaf cover (evergreen tree species are more effective than deciduous species), and the stomatal aperture of the vegetation (deposition may decrease under drought conditions). The ability of ecosystems to provide this service also depends upon the extent of other pollutant sources (both manmade and natural) and the resulting concentration of pollutants in the atmosphere. If, for example, the concentration exceeds the assimilative capacity of an ecosystem to absorb and detoxify pollutants, critical thresholds can be reached above which the ecosystem can no longer provide this service. As such, this service depends on both the regulatory capacity of ecosystems and the inputs of pollutants to this system from other sources (Ref. 17.19).

There are several residential areas within the Local Area which are likely to be dependent on the regulation of air quality. These include residential areas in Rassvet, a kindergarten and school within Varvarovka, high schools in Gai Kodzor and Supsekh, outpatient facilities within local towns including Varvarovka, a hospital in Anapa, and the Shingari and Don holiday resorts (see Section 17.6.8).

In addition to residential receptors, there are also several nationally and internationally protected habitat sites that may be considered sensitive to air emissions attributed to the Project including the Utrish state national reserve, which is located approximately 3.2 km southeast of the microtunneling location, and critical (but not designated) habitat through which the landfall section will be constructed.

Further, the Anapa Resort Town (ART) municipal district was designated a health resort town in 1957 and is designated at a Russian federal level as a Specially Protected Natural Area (SPNA), for the purpose of providing a *"health improving (spa) resort area"*. The SPNA designation entails a series of development control regimes that apply to different zones within the SPNA area, the general purpose of which is to control development and protect the area from any activities that may cause adverse impact on the natural therapeutic resources and sanitary conditions of the resort town area.

As such, ART markets itself as a health tourism destination in an area with unique air and water quality (Ref 17.24). As a result, one of the main branches of the economy is the health resort complex which includes over 150 institutions (including 44 recreation facilities for children), about 250 hotels, and more than 2,000 private landlords (Ref. 17.39). Beneficiaries of this service are therefore likely to include people visiting the area for the air quality benefits, and anyone with respiratory conditions who lives in or visits the Local Area is likely to be particularly vulnerable to any impacts on air quality regulation.

Data provided by the Krasnodar Regional Centre for Hydrometeorology and Environmental Monitoring found that concentrations of pollutants in the Local Area generally comply with

national and IFC limits, with the exception of NO₂ and particulate matter which are high. However, these values are derived from short term monitoring undertaken in central Anapa, Varvarovka, and Gostagaevskaya which are unlikely to be representative of the land in the vicinity of the Project Area which is more rural in character (**Chapter 9 Air Quality**).

Diffusion tube monitoring was undertaken for the ESIA and covered a greater spatial extent of the Local Area. The results easily complied with national and IFC guidelines for the parameters monitored; with NO₂ concentrations between 14-31% of the limit (considerably less than the concentration measured at the automated stations).

The main source of emissions in the Anapa and Krasnodar regions are road vehicles which contribute an estimated 92% of total atmospheric emissions in the Krasnodar region. Almost all of the remaining emissions are from industrial sources (7.9%), of which the main sources in the region are the Krasnodar Thermoelectric Power Plant, AO Novorostsement in Novorossiysk, and the Krasnodar combined cycle gas turbine Combined Heat and Power Plant.

The high levels of forest coverage within the Local Area are likely to play an important role in regulating air quality by directly absorbing pollutants such as volatile organic compounds and particulate matter (Refs 17.40 and 17.41). Studies have estimated that a single hectare of mixed forest can remove 15 tonnes of particulates per year from the air (Ref. 17.42), although this varies according to tree species, stomatal conductance, environmental conditions, and pollutant concentration in the atmosphere (Ref. 17.43). As set out in Table 17.6 in Section 17.6.10, there is approximately 490 ha of woodland cover within the Affected Ecosystems (including Shiblyak, Mesophilic forest, and Juniper woodlands), which suggests they could absorb up to 7,440 tonnes of pollutants each year.

The ability of ecosystems to regulate air quality is likely to come under increasing pressure in the Local Area due to economic development and population growth which can lead to increases in atmospheric pollutants and the clearance of vegetation which plays a role in regulating pollutants. Further, climate change and associated warmer temperatures can decrease the absorption rates of vegetation and thereby reduce the effectiveness of ecosystems at regulating air quality (Ref. 17.44).

For further details see **Chapter 9 Air Quality**.

17.6.6 Water Quality Regulation

Definition:

The natural environment can regulate marine and fresh water quality through processes such as: plant and microbial nutrient uptake, pollutant sequestration in soil and marine and freshwater sediments, biofiltration from marine and freshwater organisms, breakdown of organic pollutants, acidity buffering, and denitrification. These processes contribute to the detoxification and purification of water used for human uses such as drinking, agriculture, industrial uses, fisheries, tourism, and recreation (Ref. 17.19).

Similar to the air quality regulation service, the ability of ecosystems to regulate water quality depends on the extent to which ecosystems can purify water by filtering pollutants from, and reducing inputs into, water resources, and the level of pollutant inputs and pressures placed on the natural environment and its capacity to regulate.

Within the Local Area there are several freshwater resources for which quality is of particular importance to the local population, including the well at Sukko and St. Barbara's Source, Varvarovka. Water quality is also important for any direct abstractors of groundwater in the Local Area as any contamination can have lasting impacts on human health. There are also a number of mineral water deposits located in the ART and the high quality of these mineral water sources in ART has supported the development of a health tourism industry and designation of the region as an SPNA (see Section 17.6.5).

As part of the ESIA a number of water quality surveys were undertaken in the Local Area (**Chapter 8 Soils, Groundwater and Surface Water**). Groundwater samples were taken from three springs and hydrocarbons were detected in one of the samples at a concentration which exceeds the maximum permissible concentration for drinking and domestic water quality (Ref. 17.45). There was no evidence of contamination from other pollutants exceeding the national limit values. Four surface water quality samples were taken and for all samples, elevated copper levels exceeded the standards for fisheries. Water in the Shingar River exceeded the fisheries standard levels for several parameters including: phosphate, copper, nitrites, nitrates, sulphates, mercury, phenols, and oil products. Several parameters (including phosphate, copper, sulphate, ammonia and phenols) exceeded the fisheries standard levels in the Graphova Gap.

Marine water quality in the Affected Ecosystems plays an important role in supporting the recreational / tourism industry. Of particular importance in the Local Area are people engaged in water sports, bathing, scuba diving operations, and the Shingari and Don holiday complexes for which recreational water use is an important facility for visitors (see Section 15.6.8). Marine water quality is also important for human health, with contaminants in the marine environment potentially having significant impacts on those exposed to concentrations of contaminants, toxic algae blooms, or through bioaccumulation of contaminants and subsequent entry into human food sources.

Marine water quality surveys undertaken for the ESIA found that phosphate and nitrate content did not exceed maximum allowable concentrations for fisheries (Ref. 17.46). Generally, suspended solids concentrations varied between 0.2 and 7 milligrams per litre, the main sources

of which are from river waters, wave induced disturbance of seabed sediments, and deposition of airborne particles (**Chapter 7 Physical and Geophysical Environment**). Surveys also indicated a low degree of eutrophication due to the prevalence of brown algae over green algae, the high population of pollution-intolerant species, and the low number of epiphytes (algae that grow on other species).

Many contaminants in the marine environment are able to bind to sediments (thereby being locked up indefinitely) and surveys of the Affected Ecosystems identified the presence of contaminants in marine sediments including petroleum hydrocarbons, phenols, anionic surfactants, and heavy metals (**Chapter 7 Physical and Geophysical Environment**).

Contaminants can also be accumulated by organisms such as invertebrates and macroalgae. Benthic macroalgae and grasses (macrophytobenthos), in particular, enrich water with oxygen, take up dissolved organic matter, and assimilate heavy metal contaminants, thereby increasing the quality of coastal waters (Ref. 17.47 and Ref. 17.48). Macrophytobenthos are also critical components of the marine ecosystem as primary producers, providing food and shelter to a wide variety of organisms either as living plant matter or detritus.

The bivalve *Mytilaster lineatus* is one of the main components of seaweed thickets throughout the Black Sea due to its high settlement density and resistance to pollution. This is of wider significance because *M. lineatus* is therefore the main provider of natural bio-filtration along the Black Sea coast and can be present in high densities.

Surveys of the Affected Ecosystems found that, in shallow waters (up to 2-3 m depth), macroalgae communities are characterised by a relatively low diversity and biomass. In the mid photic zone (between 3-10 m) algal communities are dominated by large structural brown algae. While at depths over 10-15 m, communities of Phyllophora and *Codium vermilara* are observed. The greatest diversity of algae is found in the mid photic zone which supports a high species diversity and considerable biomass of the mussel *Mytilaster lineatus* in some areas.

In deeper waters, marine water quality in the Black Sea is anoxic. Waters with hypoxic or entirely anoxic conditions are typically incapable of sustaining permanent populations of species dependant on aerobic respiration. Oxygen depletion occurs in layers below 80 to 150 m and hydrogen sulphide (H₂S) builds up below these depths. Consequently, the potential for significant marine life occurring at depths of greater than 200 m within the Black Sea is likely to be limited to those organisms capable of anaerobic respiration (e.g. chemosynthetic life). Anaerobic respiration typically produces H₂S and methane (CH₄) as a by-product. Concentrations of H₂S are known to be elevated within the bottom waters of the Black Sea.

Marine water quality throughout the Black Sea has been affected by rapid economic development and a lack of adequate management of marine resources in the later decades of the 20th Century, resulting in major environmental and ecological changes in the Black Sea ecosystem. In particular, eutrophication, due to excessive levels of nitrogen from land based sources into the Black Sea, and the introduction of invasive species, have given rise to massive increases in primary production and a shift in the abundance and composition of phytoplankton species. Larger and more frequent algal blooms have increased sedimentation of decaying plants and detritus to the seabed inducing a sharp decline of dissolved oxygen and a silting of benthic communities in many areas. Increased incidence of harmful algal blooms have led to

the death of many fish and the increased turbidity of the water column has reduced light availability to macroalgae in deeper waters.

It is possible that pressures on the capacity of ecosystems to regulate water quality will increase in future due to a combination of climate change (which may lead to rising water temperatures, acidification of marine water, and concentration of surface water pollutants during periods of lower flows e.g. in summer) and increasing development (particularly any expansion in the agricultural industry and subsequent increase in surface water runoff from vineyard areas which could lead to eutrophication in both marine and freshwater environments).

However, since the early 2000s the governments of the Black Sea coastal states have adopted a basin-wide approach to pollution reduction and enhancement of cooperation of coastal and non-coastal states towards a strategic goal of achieving the ecological status of the Black Sea similar to the one observed in the 1960s (Ref. 17.49). Pollution pressure from land based sources, although still intense, shows a decreasing trend and some improvements in ecological status have been observed. This coordinated action, if continued, may offset and reduce the pressures on water quality within the Local Area.

For further information see **Chapter 7 Physical and Geophysical Environment, Chapter 8 Soils, Groundwater and Surface Water, Chapter 12 Marine Ecology, and Chapter 14 Socio-Economics.**

17.6.7 Soil Quality Regulation

Definition:

The capacity of natural processes to regulate soil quality through the storage and degradation of organic matter leading to replenishment of the topsoil layer; storing, degrading, and transforming materials such as nutrients and contaminants; mediating exchange of gases to the atmosphere; and maintaining a structural composition which supports growth of plants and water flow regulation.

There are a number of soil types within the Local Area including Cambisols, Phaeozem soils, Arenosols, Fluvisols, Abrazems / Regosols, and Anthropogenic soils. These soil types provide important services to a range of beneficiaries.

Agricultural areas (principally vineyards) in the Local Area are predominantly located on Arenosols and Abrazem / Regosol soils. These soils are predominantly used for agricultural production of grapes. Grapes are perennial crops and cultivation involves ploughing and tillage which can lead to soil compaction. These soils can also experience a homogenizing effect due to the fact that there is no organic matter influx which results in differences between the soils being evened out in terms of the vegetation contribution to humus- and soil-formation (Ref. 17.50).

Owners of land within the Affected Ecosystems (principally Agrifirm Kavkaz) benefit from the economic rents associated with good quality soil and productive use in agriculture. The regulation of soil quality by natural processes also provides a service to workers who come into contact with soils. Workers and owners of land adjacent to the Affected Ecosystems may also

benefit from soil quality regulation processes since, depending on the physical properties of the soil (including soil porosity, soil potential for pollutant absorption, and soil saturation); contamination of soil within the Affected Ecosystems could lead to contaminant migration and impacts on soils in adjacent areas of land.

Phaeozem soils comprise a soft organic rich topsoil layer covered in vegetation and have a high water absorption capacity. As a result, they play a role in regulating water flows in the Local Area. The soil quality regulation service is therefore linked to hazard regulation and all households living within the area benefit from an indirect reduction in flood risk due to the role of soil quality regulation. These soils are structurally prone to compaction and erosion, and are vulnerable to contamination through surface spills.

Fluvisol soils are present in the valley bottoms and also play a role in the hydrological cycle. These soils are associated with watercourses and valley bottoms and can act as pathways for the movement of chemical contaminants into groundwater and surface water. As such, the regulation of soil quality is also linked to water quality processes. Fluvisol soils also support populations of the critically endangered Nikolski's tortoise.

Surveys of soil quality within the Local Area found elevated concentrations (above maximum permissible thresholds) of arsenic, copper, lead, zinc, benzo(a)pyrene, polychlorinated biphenyl, and pesticides. The sources could be natural or manmade (**Chapter 8 Soils, Groundwater and Surface Water**). There are also areas of soils used for informal waste disposal which could potentially be contaminated with substances such as asbestos. The contaminants present in the soil are known to be harmful to human health under certain exposure scenarios and concentrations appear to be highest in agricultural areas, at watercourse crossings, and near existing roads (**Chapter 8 Soils, Groundwater and Surface Water**).

Expansion of the agriculture and viticulture industry within the Local Area is likely to increase pressure on soil quality regulation. Further, increases in traffic and vehicle emissions could lead to greater deposition of airborne particles which could also increase pressure on soils.

For further information see **Chapter 8 Soils, Groundwater and Surface Water**.

17.6.8 Tourism and Recreation Values

Definition:

Natural environments such as woodlands, rivers, beaches, and marine ecosystems provide a variety of tourism and recreation opportunities such as: hiking, walking, camping, horse riding, health based tourism, scuba diving, picnicking, and beach based recreation.

The ART municipal district is a designated 'resort town' which provides for a regime of measures intended to safeguard the district's important tourism attraction features. Tourism is the most important industry in the ART municipal district and visitor numbers and accommodation facilities have displayed continuing strong growth over recent years (**Chapter 14 Socio-Economics**).

The town of Anapa is the key focus for tourist activity and accommodation within the municipal district and has a large number of hotels, restaurants and associated infrastructure to support the tourism economy. Sukko is also an important area and has a beach which is used by local residents and tourists as well as offering camping, horse riding, and fishing. Sukko beach is the principal and only easily accessible public beach between the town of Anapa and Utrish Specially Protected Natural Area (SPNA). Paragliding is undertaken off the cliffs of Sukko with gliders flying out to sea and special recreational programmes for children are carried out involving sea trips, diving, and environmental tourism / education (Figure 17.12).

While most of the land based tourism activity takes place within and around Anapa or Sukko, rather than within the Affected Ecosystems themselves, the "*Mountains of the Caucasus*" trail (which involves hiking, waterfalls, and camping) starts in Anapa and finishes in Utrish, passing over a hill under which the microtunneling will take place. There is also a business based in Varvarovka, with approximately 30 horses, which offers horse-riding tours including a route that traverses the Agrifirm Kavkaz fields in the direction of a lake north of Sukko. The business has approximately 20 customers per day in the summer.

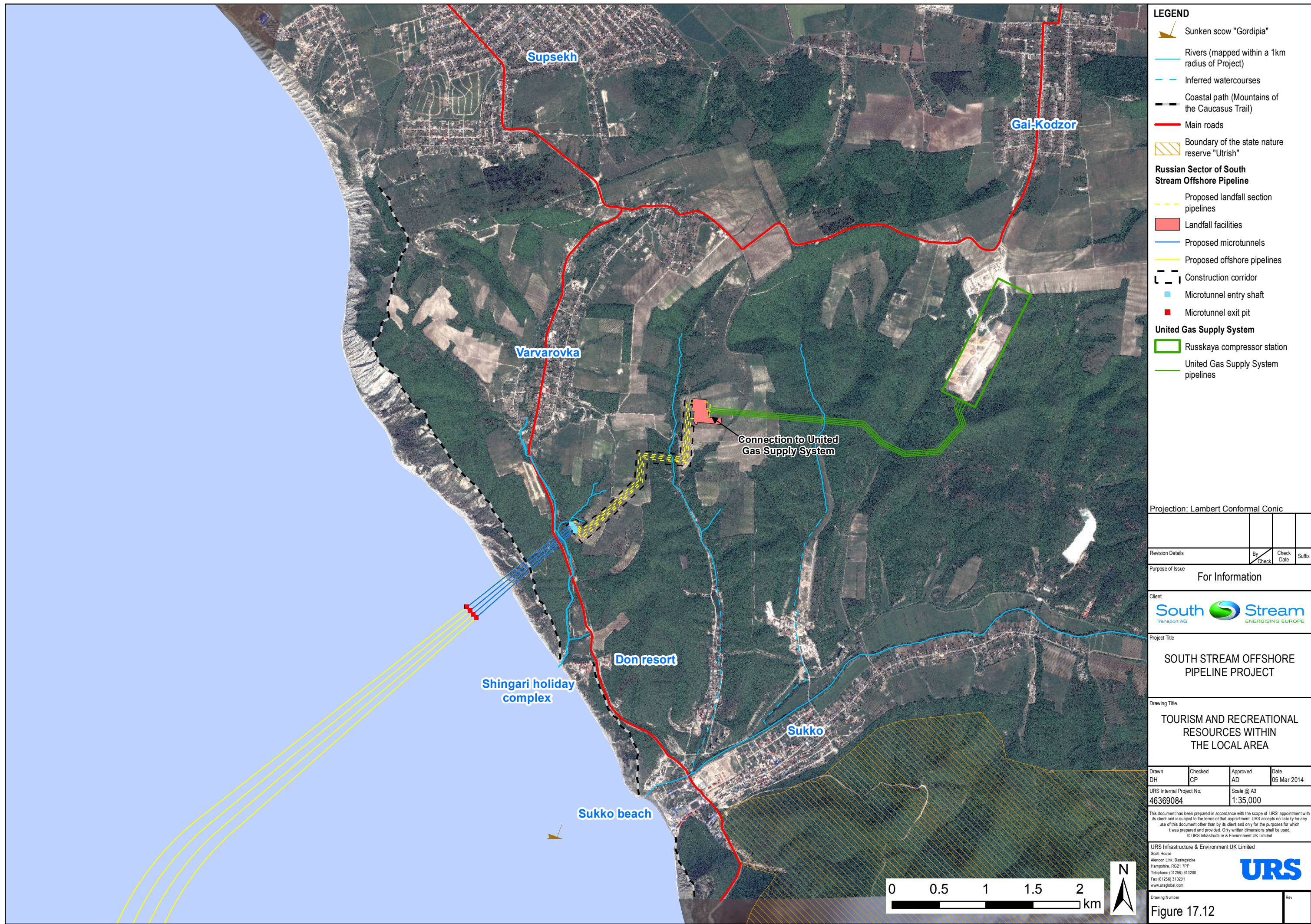
Within the marine environment, the area around Sukko beach and the nearby waters are used for sun bathing, swimming, fishing, and yachting. There is also a scuba dive operator in Anapa who utilises a number of sites along the coast. The closest site to the Affected Ecosystems is the ship "*Gordipiya*" which sank in February 1943. The ship is on an even keel at a depth of 18 metres and has become an artificial reef providing habitat for mussels.

Approximately 1.5 km south of the Project Area are two neighbouring holiday complexes (tourist resorts) known as Shingari and Don. Shingari is a privately owned complex of holiday residences built on the coastal cliff top adjacent to the Project Area. There is a private beach belonging to Shingari immediately below the complex, accessible by steps from the resort.

The Shingari resort receives around 6,000-7,000 people each year with the peak season lasting from June till the beginning of October (housing up to 380 people at a time). Most visits are arranged through company bookings and visitors are from different regions of Russia, with around 3% coming from other countries within the former Soviet Union. Around 150 people are employed by Shingari although this rises to 200 during peak season. Most employees are local and reside in Anapa.

Don is located on the north side of the roadway running between Varvarovka and Sukko. Don is a holiday complex owned by Russian Railways and is only open to its employees (or people invited by Russian Railways). Don is located opposite Shingari on the north side of the roadway running between Varvarovka and Sukko, and its residents also have access to the beach via a path that runs on the outside of the Shingari complex perimeter boundary.

Plot Date: 12/03/2014
File Name: I:\5004 - Information Systems\46369082_South_Stream\MXDs\Report Maps - Russia\Russian ESIA\Chapter 15 Ecosystem Services\Figure 15.12 Tourism and Recreation Resources in the Local Area.mxd



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Beaches along the coast are important for recreation and tourism in the wider region and ecosystem processes underpin the continued provision and evolution of such natural landforms. The Anapa Bay Bar, for example, which lies within the wider region, is a 50 km long accumulation of sand which forms a natural beach barrier separating the system of firths and salty lakes from the Black Sea. The continuous strip of sandy beach, several hundred metres in width in places, is a natural reserve of significant recreational importance for Russia and makes Anapa a popular holiday destination.

Several mollusc species play a role in the lithodynamic processes of the marine environment and the accumulation of sand and shell plays a significant role in the balance of the beach and bottom sediments. According to unpublished data obtained in 2010 by the Department of the Coastline of the Southern Branch of the Institute of Oceanology of the Russian Academy of Sciences, the concentration of carbonates of mollusc origin, coming into the sand of the Anapa Bay Bar as shells, may reach up to 53% (Ref. 17.51).

The venus clam (*Chamelea gallina*), found in soft sediment habitats at depths of 5 to 10 m, is the major source of the shelly sand component of the beaches of Anapa Bay. The annual input of carbonates of biogenic origin to the bay bar is estimated to be 3,500 tons, 91% from *Chamelea gallina*, the remainder from a range of other molluscs including the bivalve *Donax trunculus* and the gastropod snail *Rapana venosa*. These organisms contribute to the composition and aesthetic value of beaches in the wider region and thereby support the use and enjoyment of beach resources by beneficiaries.

The large scale ecological changes witnessed throughout the Black Sea have had a significant impact on benthic ecosystems including the diversity, abundance, and biomass of most mollusc species (Ref. 17.52). For example, only four of the 11 species of mollusc found in the shelly sand of the Anapa beach are now found as living individuals (Ref. 17.51) and the distribution, abundance and biomass of *Chamelea gallina* have declined significantly since the 1990s (Ref. 17.52). As such, in recent decades the supply of biogenic carbonate to the sands of the bar has been appreciably reduced, exacerbating an on-going process of erosion in the area. Over the past 40 years, the morphology of the Anapa spit barrier has changed probably due to a combination of natural processes and the impact of economic activities such as the sand recovery (Ref. 17.3) and the construction of a great number of recreation complexes at Anapa.

While there are no direct projections of the future growth of the tourism or recreation sectors in the region, the current steady growth is expected to continue and may experience an increase due to the impacts of the 2014 Winter Olympics in Sochi.

For further information see **Chapter 14 Socio-Economics**.

17.6.9 Cultural and Spiritual Values

Definition:

The diversity of ecosystems is one factor influencing the diversity of cultures and many religions attach spiritual and religious values to ecosystems or their components. Many societies also place a high value on the maintenance of historically important landscapes and value the “sense of place” that is associated with recognised features of their environment. Cultural services can include tangible services for which environmental processes or settings play an important role in their use or value (such as archaeological sites, shipwrecks, and natural springs), intangible services which are dependent on the natural environment (such as local festivals, cultural identity, and spiritual practices), and natural sites themselves with cultural importance (such as cultural landscapes and particular physical, biological, or geological formations).

The environmental setting of the Local Area is characterised by a deeply undulating, extensively wooded landscape. The woodland is interspersed with open, cultivated land comprising vineyards, orchards, and meadows. The coastline provides a combination of steep slopes, cliffs, rocky outcrops, beach, and maritime vegetation fronting the Black Sea which is valued for its combination of wildness and far-reaching, panoramic views of the coastline and open sea. As identified in **Chapter 13 Landscape and Visual Assessment**, the visual quality of the woodland and agricultural landscape is important for both residents and tourists who visit the region.

Baseline surveys identified a number of archaeological and cultural heritage sites in the Local Area. The earliest evidence for human activity in the area comprises Upper Palaeolithic stone tools found in the vicinity of Supsekh. There are also four Bronze Age *kurgans* (burial mounds) located on high points between the villages of Varvarovka and Supsekh, over 4.5 km north of the Project Area. A group of rural villas and farmsteads dating to the Antique period have been identified around 1.6 km northwest of Varvarovka. A burial dated to the 6th to 4th century BC is recorded between the villages of Varvarovka and Supsekh, located over 4 km north of the Project Area.

There is also a designated *kurgan* located approximately 50 m northwest of the pipeline microtunnel section which dates from the Antique to medieval period and is identified as critical cultural heritage. While there is extensive tourist interest in Krasnodar’s Bronze Age dolmens, some of which are subject to tourist pilgrimages and offerings, no such activities have been observed to be associated with this *kurgan* site and the value is likely to be primarily scientific (**Chapter 16 Cultural Heritage**).

There is a designated statue of DS Kalinin, Hero of the Soviet Union and commander of the 2nd Reconnaissance Detachment Staff of the Black Sea Fleet (1910-1943), who was killed in action when leading a seaborne assault south of the village of Supsekh in May 1943. This event is commemorated with a major memorial erected close to the Anapa-Sukko road, 750 m east of the Project Area. Designated war memorials in the village of Gai-Kodzor commemorate Soviet soldiers killed during the Great Patriotic War and villagers executed at Gai-Kodzor in August and December 1942. At Varvarovka, there are monuments to the Soviet marines and villagers killed by invaders in 1942-1943, and to countrymen who died in the Great Patriotic War. Varvarovka village cemetery includes the common grave of Soviet soldiers and civilians killed in 1942-1943.

There are a number of cemeteries associated with the villages to the north of the Project. The closest of these to the Project Area is the Varvarovka village cemetery, a mixed Armenian and Russian cemetery approximately 398 m north of the northern pipeline centre-line and close to the Gazprom Invest Road (permanent access road) and 100 m west of the South Stream Transport temporary access road to the microtunnel site. The Varvarovka Armenian and Russian cemetery lies on the eastern edge of Varvarovka village, close to Agrifirm Kavkaz vineyards. The cemetery is extensive and divided into family plots. It includes the common grave of Soviet soldiers and civilians killed in the fighting and executed by the fascist invaders in 1942 and 1943 (National Monument No. 380). Further away from the Project Area are the Varvarovka Armenian cemetery, approximately 2.1 km northwest of the connection with the Russian gas network, and the Gai Kodzor Armenian cemetery and church, approximately 5.6 km northeast of the connection with the Russian gas network.

A new Russian Orthodox church is under construction at Varvarovka. The Armenian Apostolic Church of St. Sarkis (St. Sergius) at Gai-Kodzor was built in 1997 and a new Armenian church is also under construction on the same site. Adjacent to the churches is a Gai-Kodzor Armenian *khachkar* cross stone, erected in 1992. It depicts two phoenix birds, symbolizing the friendship between the Armenian and Russian peoples. Khachkars or Armenian cross-stones are carved outdoor stone stelae which act as a focal point for worship, as memorial stones and as relics facilitating communication between the secular and divine. They constitute a distinctive symbol of the identity of Armenian communities at home and abroad. The symbolism and craftsmanship of *khachkars* was inscribed on the UNESCO Representative List of the Intangible Cultural Heritage of Humanity in 2010.

Specific natural resources with a cultural or spiritual role within the area include St. Barbara's Source, Varvarovka, a natural spring reputed to have healing powers and the focus of an annual procession and ceremonies during the Feast of the Theophany in January. Attendees include local parishioners and pilgrims from further afield. St. Barbara's Source is located around 1.9 km northwest of the Project Area.¹⁰ There is a sacred tree located west of the road between Sukko and Anapa. The species is Blackthorn (*Prunus spinosa*) and prayer ribbons and cloth rags are suspended from its branches. Sacred trees and groves occur in many cultures across the world. In the Kuban region, the custom may date back to Circassian / Adyghe traditions, which in turn overlie earlier practices.

Socially significant religious and secular events celebrated in the region include national and international festivals, processions, village days, and commemorations of military and historical people and events who have made a significant contribution to the development of Russia and Kuban. On Victory Day (9 May) and Anapa region Liberation Day (21 September) there are rallies, vigils, and wreath- and flower-laying ceremonies at monuments and war memorials. A festival is held at the *khachkar* in the last week of every May, involving representatives from all communities in the Anapa area.

¹⁰ Note, there is some overlap with the Water Supply and Water Quality services, in order to avoid double counting, impacts on St. Barbara's Source will be assessed in the Water Quality section.

There are several cultural groups based in the Local Area including the Center of Armenian Culture, Council of Veterans, and Cossack Society. There are also a number of amateur associations and clubs such as folk dancing, choirs, and orchestral groups. Traditional Kuban Cossack culture and local folk arts and crafts are being revived with state support, and include weaving, traditional embroidery, pottery, woodworking, basketry, leather manufacture, wool felting and blacksmithing; masters of these arts are honoured with the title "*Master of arts and crafts of Kuban*".

The Local Area is characterised by an agricultural and coastal landscape which plays a role in the cultural identity of the area and of the aesthetic qualities of the landscape. Gastronomic specialities include local wine (Gai-Kodzor Vineyards, first harvested in 2008), as well as Kuban produce including pickles, boiled pork, lard, blinis (pancakes), and pastries. Distinctive local cultural elements of note include traditional Cossack costume, which dates back to the late 19th century. Baseline data collection did not identify any groups who have a particular interest in the natural environment (such as bird watching groups). If such groups are present, it is likely that such activities would take place within the Utrish protected area.

Marine surveys revealed that there are three archaeological objects located within 150 m of the Project Area, including: a modern period aircraft wing, a medieval period ceramic amphora, and a medieval to post-medieval period wooden shipwreck.

None of these sites were identified as being visited by local dive operators and their value is likely to be predominantly scientific. Due to the anoxic conditions in the Black Sea, which inhibit corrosion and microbial degradation, the preservation potential for objects is greatly enhanced below a water depth of 120 m to 200 m. As such, the nearshore and offshore sections have high potential for featuring archaeological elements such as: prehistoric sites that became submerged as a result of the Black Sea flooding; historic coastal settlements; shipwrecks and maritime structures; and remains associated with 19th and 20th century conflict.

For further information see **Chapter 16 Cultural Heritage**.

17.6.10 Wild Species Diversity

Definition:

People derive value from interaction with wild species as well as from knowledge of their continued existence, these values may extend locally, regionally, nationally, or even globally. Species are considered to be locally important if they are valued by local communities for reasons in addition to the other ecosystem services they may provide. For example, the importance of mussel species in providing water quality regulation services is discussed in the water quality chapter, however, some species do not provide any identifiable services and are not identified as being of conservation importance at any level. Nevertheless, they may be of importance to local communities and any impacts on their populations (such as the loss of commonly seen birds or butterflies) could impact the well-being of local beneficiaries. Species are considered to be regionally important if they are listed on the Krasnodar Red data list, nationally important if listed on the Russian Federation Red data list, and globally important if listed on the IUCN Red data list as being vulnerable, endangered, or critically endangered.

Terrestrial Affected Ecosystems

The most common concern raised by stakeholders during consultation (raised 33 times) was the Project's potentially negative impact on the natural environment, including the marine environment, the coastline, onshore valuable habitat area (e.g. the mountain area of the Kilberov Canyon), juniper trees, and local wildlife around the proposed compressor station.

There are a total of eight natural¹¹ and two modified¹² habitat types within the terrestrial Affected Ecosystems. While none of these habitats are protected sites designated for nature conservation, all forest or woodland habitat are identified as "*protective forests*", as defined within the Forest Code of the Russian Federation (**Chapter 11 Terrestrial Ecology**). This includes all mesophilic forest, shiblyak, and juniper woodland. These forests are recognised as important features within the environment, as they perform important functions, such as protection of water resources and soils, and recreational spaces for local communities. This designation is not strictly related to the forest's intrinsic "*biodiversity value*", but rather is associated with the ecosystem services they provide.

Table 17.6 lists these habitats and the area of each habitat falling within the Affected Ecosystems. Full descriptions of each of these habitats are provided in **Chapter 11 Terrestrial Ecology**.

Table 17.6 Habitat Extent in the Terrestrial Affected Ecosystems

Habitat Type	Area of Habitat (ha)
Shiblyak	426
Mesophilic forest	63
Juniper woodlands	56
Tomillyar	7
Steppefied secondary meadow*	110
Mesophilic meadow	10
Rocky outcrops	8

Continued...

¹¹ As set out in IFC PS 6, natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition.

¹² As set out in IFC PS6, modified habitats are areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition.

Habitat Type	Area of Habitat (ha)
Coastal shingle	3
Urban and Agricultural habitats*	239
Running water	2
*Modified habitats <i>Complete.</i>	

The habitats within the terrestrial Affected Ecosystems have the potential to support a number of flora and fauna species which are of local value and some of which are of regional, national, and global conservation significance.

In terms of locally important species, juniper trees were identified to be of particular value to local communities. During consultation, stakeholders asked about the felling of juniper trees in both the Varvarovka / Sukko community meetings and the Anapa roundtable meeting. Stakeholders asked whether the juniper trees would be re-planted or the area restored (**Chapter 6 Stakeholder Engagement**).

In addition, surveys undertaken for the ESIA found 26 plant species listed within the Red Data Book of Krasnodor Krai, including two juniper species. These flora species make up part of the Juniper scrub / woodland, Shiblyak, and Tomillyar habitats which provide important habitat and play a role in air, water quality, and hazard regulation.

Regarding fauna, the Nikolski's tortoise is known to be present within areas of Shiblyak and Mesophilic forest. Nikolski's tortoise is a regionally, nationally, and internationally threatened species that is listed as critically endangered on the IUCN Red Data List. A population survey, undertaken during October and November 2013 recorded a total of 51 individual Nikolski's tortoises and the total population size is estimated to be around 150 individuals.

The major threats to this species include loss of habitat due to the expansion of agriculture and urbanisation. There is also evidence of local use of this species through the collection of tortoises for bush meat and the pet trade. Local ecologists identified the persecution of tortoises for their meat and carapaces as the most critical threat facing the species in the locality. In particular, inspectors of the Utrish reserve have reported isolated incidents of vagrants collecting tortoises for food and observations have been made of the illegal trade in Mediterranean tortoises in shops and markets of several towns on the outskirts of the Krasnodar region, including animal shops in Novorossisk (Ref. 17.53).

Other species of conservation importance identified include 38 species of invertebrate; six breeding bird species; and a range of mammal species including twelve species of bat (see **Chapter 11 Terrestrial Ecology** for a full list of species).

Due to the presence of two specific habitat types (Mesophilic forest and Tomillyar) and several endangered and endemic species, the Affected Ecosystems were identified as supporting Critical Habitat.

A Special Protected Natural Area is also located within the Local Area. The site is of federal significance and is located in Krasnodar Krai approximately 4 km south-east of the Project Area. The total reserve area is around 10,000 hectares and covers both the terrestrial and marine environments. It is adjoined to the south-east coast of the Abrau peninsula and the site is known to support a diverse range of flora and fauna including protected and notable plant species, herpetofauna (including Nikolski's tortoise), mammals, birds, and invertebrates. The reserve extends into the Black Sea and supports various notable ichthyofauna and marine habitats. The site was first established in 1987 to preserve the Mediterranean landscapes and their characteristic ecosystems which are typical of the North-Western Black Sea coast area of the Russian Federation.

As such, when viewed within the context of the Local Area, there are relatively large expanses of similar or higher quality habitat than are present within the Affected Ecosystems which are likely to be better suited to supporting any threatened plant and animal species.

Marine Affected Ecosystems

Potential impacts on the marine environment were raised by local communities and NGOs during consultation (**Chapter 6 Stakeholder Consultation**) suggesting that marine habitats and species within them are of importance to people living in the Local Area.

There are three broad habitat types in the Black Sea, including:

- Surface waters (typically 0 to 50 m water depth) which are well oxygenated, have a fairly low salinity, and have historically supported large populations of pelagic fish. There are a number of different benthic habitat types within these shallow waters including: rocky substrates which allow the development of macroalgal beds that in turn support a highly diverse array of fauna; sandy sediments which support a range of infaunal communities, typically bivalve dominated; and mud sediments which support infaunal communities;
- Mid-depth waters (approximately 50 to 100 m water depth) which show decreasing oxygen concentrations and increasing salinity. Benthic habitats at these depths are often muddy sediments; and
- Deep waters (below about 150 to 200 m) where conditions are anoxic. Muddy sediments predominate in deeper waters, and while little is known about the benthos of the deep Black Sea, chemosynthetic bacteria can occur here.

Within the marine Affected Ecosystems, surveys carried out for the ESIA found several species of macroalgae that are listed in the Red Data Book of Krasnodar Krai. Eight fish species of conservation importance have been observed from the Russian Black Sea coastline caught in fixed gear at commercial fishing stations and could potentially be found within the marine Affected Ecosystems. Of particular note are the Russian sturgeon (*Acipenser gueldenstaedtii*) and stellate sturgeon (*Acipenser stellatus*) which are listed by the IUCN as critically endangered (although they are not included in the Red Books of either the Russian Federation or Krasnodar Krai).

Long snouted seahorse, currently listed as data deficient by the IUCN (formerly considered vulnerable), were observed at depths of 1 to 30 m throughout the marine Affected Ecosystems. Seahorses have been significantly exploited by manufacturers of souvenir products and were

initially included in the Red Data Book of the Krasnodar Territory as a protective measure. However, the population in the Black Sea has increased significantly and it was removed. It remains on a list of species that are prohibited for catching by the Fishing Rules for the Sea of Azov-Black Sea commercial fishing region.

A further species which may be found within the marine Affected Ecosystems is the tub gurnard. This species may have local importance in the manufacture of souvenirs and to underwater hunters. Due to a combination of human exploitation, pollution of the marine environment, and illegal fishing, the species has become increasingly rare in the last decade. As a result, the tub gurnard has been entered into the Red Data Books of the Russian Federation and the Krasnodar Territory to ensure its strict protection.

Several bird species of conservation importance were also observed in the marine Affected Ecosystems including the Black-throated diver, Mediterranean gull, and Mediterranean shearwater. An additional protected species that is likely to occur but not directly observed in surveys is the gull-billed tern. This species is in both the Russian and Krasnodar Red Data Books.

Cetacean species of conservation importance off the Russian coast include the harbour porpoise (*Phocoena phocoena relicta*), bottlenose dolphin (*Tursiops truncatus ponticus*), and common dolphin (*Delphinus delphis ponticus*). All three are protected on a national level by environmental legislation and governmental decrees and were observed in surveys undertaken for the ESIA.

Charismatic and visible species such as dolphins are also likely to have local importance to people in the Local Area. Within Anapa, for example, there is a dolphinarium which offers dolphin therapy sessions to children with development difficulties which aim to: improve coordination, develop motor skills, stabilise mood, raise self-confidence, develop communication, and encourage thought development (Ref. 17.54).

During the 1980s to early 2000s, the number of facilities for dolphin shows and "swim with dolphins" programmes greatly increased in Black Sea countries. The export of bottlenose dolphins from Russia and Ukraine for permanent and seasonal shows also expanded to over 20 countries in Europe and the Middle East. According to CITES statistics, at least 92 individuals were removed from the Black Sea region during 1990-1999 and Russia reportedly has exported at least 66 for traveling shows since 1997.

Due to the presence of threatened species in the marine Affected Ecosystems the area has been identified as Tier 2 critical habitat as defined by the IFC. It should be noted that the Project Area does not, per se, represent particular habitat that is not replicated elsewhere in the Russian Black Sea; it is merely part of a wider zone that meets the requisite criteria (**Chapter 12 Marine Ecology**).

For further information see **Chapter 11 Terrestrial Ecology** and **Chapter 12 Marine Ecology**.

17.6.11 Baseline Summary

A summary of the baseline conditions of the ten key ecosystem services is provided in Table 17.7. Likely future trends are indicated as follows: ↗ increasing provision; ↘ decreasing provision; ↔ no overall change in provision; and ± some increases and some decreases in provision. The importance of the ecosystem service to beneficiaries is indicated by: ■ high importance; ■ moderate importance; ■ low importance; and ■ negligible importance.

Table 17.7 Baseline Summary

Service	Provision	Future Trend and Importance	Key Drivers of Change	Key Beneficiaries
Crops	Viticulture is a source of income to landowners in the Affected Ecosystems	■	Climate change, water availability	Agrifirm Kavkaz Wine consumers Local individuals and migrant workers employed in sector
Capture fisheries	Important service for particular groups although insignificant part of local economy	■	Overfishing, pollution, invasive species	Small and medium scale fishing companies (and their employees) Fishing companies (and their employees) operating throughout the Black Sea
Water supply	Several ground and surface water abstractors for a range of drinking, industrial, and agricultural uses	■	Climate change, population growth, increasing demand	Ground and surface water abstractors (including Agrifirm Kavkaz and MoD) Visitors to St. Barbara's Source Project itself Households dependent on supply from Sukko aquifer
Hazard regulation	Natural habitat and vegetation regulate water flows and reduce erosion rates	■	Climate change	Local households and private companies Recreational beach users Project itself

Continued...

Service	Provision	Future Trend and Importance	Key Drivers of Change	Key Beneficiaries
Air quality regulation	Important service in an area which has a reputation for therapeutic air		Traffic and industrial emissions	Local landowners, households, and workers Tourism industry in Anapa SPNA Tourists from wider region / country
Water quality regulation	Water quality regulated through a number of processes and supports range of uses		Eutrophication, climate change, legislation and control of pollutants, invasive species	Local abstractors Tourists, recreational users, and tourism industry in Anapa SPNA Fishing industry and fish consumers Visitors to St. Barbara's source
Soil quality regulation	Important service in reducing health risks, determining land productivity, and regulating surface flows		Airborne emissions, surface run-off	Landowners Workers who may contact contaminated soils Local residents benefiting from reduced flood risk
Tourism and recreation	Important sector of local economy and important resource for local recreational users		Expansion and development, Winter Olympics	Recreational beach and ocean users Visitors to resorts Tourism industry Users of hiking and horse riding trails
Cultural and spiritual	Cultural landscape with a number of unique sites		Development of landscape	Local and regional site users Local population National and global scientific community

Continued...

Service	Provision	Future Trend and Importance	Key Drivers of Change	Key Beneficiaries
Wild species diversity	A number of highly threatened terrestrial and marine species and species of local importance		Climate change, pollution, hunting, regulation, habitat loss, invasive species	Local communities and NGOs Regional, national, and global conservation community

Complete.

17.7 Impact Assessment

17.7.1 Impact Assessment Methodology

The assessment of impacts on ecosystem services broadly follows the approach set out in **Chapter 3 Impact Assessment Methodology**. It follows the same steps and uses the same assessment criteria but differs in one important respect: it assesses impacts from the point of view of the ecosystem service beneficiaries. The impact is therefore measured as the change in human well-being (relative to the baseline) as a result of a change in the level of provision of an ecosystem service.

The nature and significance of impacts are determined using a set of criteria that reflect the value of ecosystem services to beneficiaries, the resilience of ecosystems and their beneficiaries to change, and the extent, duration, reversibility, and frequency of the impacts. These criteria are explained more fully in the sections that follow.

17.7.1.1 Impact Assessment Criteria

Receptor Sensitivity

Receptor sensitivity is determined using information from the baseline and provides a detailed understanding of the importance of each ecosystem service to its respective beneficiaries, taking account of:

The **value** of ecosystem services to beneficiaries, i.e.:

- The extent to which beneficiaries are **dependent on the ecosystem service** (e.g. whether fishing is undertaken occasionally as a recreational activity or regularly as an important part of livelihoods); and
- The **scarcity value** of the ecosystem service (e.g. the availability of suitable alternatives or substitutes) and how readily replaceable it is considering accessibility and affordability.

And the **resilience** of ecosystems and beneficiaries to change, i.e.:

- The **sensitivity of the ecosystem** to change (e.g. as a result of climate change, population pressures, etc.). This will depend on *inter alia* the existing condition of the ecosystem, its functions, and its thresholds. For example, some fish species (such as sturgeon) are particularly sensitive to changes in water temperature (Ref. 17.55); and
- The **sensitivity of beneficiaries** to changes in ecosystem service provision. This will depend on *inter alia* beneficiaries' existing endowments of, or access to, factors such as financial, human, physical, natural, and institutional capital. For example, poorer rural households who collect water directly from the environment through household wells are likely to be more sensitive to changes in the supply and quality of their water than wealthier households in urban centres who are connected to a public water supply system.

The extent to which an ecosystem service fulfils each of these criteria is scored on a four point scale as shown in Table 17.8. Note that receptor sensitivity is independent of Project impacts and relates to the existing situation and the capacity of ecosystems and ecosystem service beneficiaries to adapt to any type of change (e.g. climate change, population growth, etc.).

Table 17.8 Criteria Used to Determine Receptor Sensitivity

Significance Criteria		Assigned Scores			
		Score 1	Score 2	Score 3	Score 4
Value	What is the degree of dependence by beneficiaries on the ecosystem service? Note: this can include type of use e.g. subsistence vs. recreational and intensity of use e.g. occasional vs. continual	Negligible	Low	Moderate	High
	To what extent is this ESS replaceable? Or are good substitutes available without entailing significant costs? Note: this should specifically refer to the availability of alternatives	Service is widely available	Some alternatives available	Few alternatives available	No alternatives available
Resilience	What is the sensitivity of the ecosystem to change? Note: this should refer to the biological sensitivity of the ecosystem to change	Negligible	Low	Moderate	High
	What is the vulnerability of the human receptors to any change in ecosystem service provision? Note: this should refer to the socio-economic capacity of people to adapt	Negligible	Low	Moderate	High

The scores assigned to each criterion are then added together for each ecosystem service to arrive at the overall receptor sensitivity score as shown in Table 17.9.

Table 17.9 Approach to Determining Overall Receptor Sensitivity

Receptor Sensitivity		Score
Negligible	The service is of low value to beneficiaries (due to low dependency or the existence of widely available alternatives) and the environmental and human receptors are highly resilient.	4
Low	The service is of low value to beneficiaries (due to low dependency or the existence of widely available alternatives) and the environmental and human receptors are moderately to highly resilient. Alternatively, the service is of moderate value to beneficiaries and the environmental and human receptors are highly resilient.	5-8
Moderate	The service is of moderate value to beneficiaries (due to moderate dependency or the existence of some alternatives) and the environmental and human receptors are moderately resilient. Alternatively, the service is of high value to beneficiaries and the environmental and human receptors are highly resilient.	9-12
High	The service is of high value to beneficiaries (due to high dependency or the lack of suitable alternatives) and the environmental and human receptors have low resilience. Alternatively, the service is of moderate value to beneficiaries and the environmental and human receptors have low resilience.	13-16

Impact Magnitude

The assessment of Project impacts on ecosystem services follows the methodology described in **Chapter 3 Impact Assessment**. The magnitude of each of the identified impacts on ecosystem services is evaluated on the basis of the following criteria:

- The **severity of the impact** on the well-being of ecosystem service beneficiaries;
- The **reversibility** of the impact (i.e. how quickly is the ecosystem able to recover from the impact); and, based on this,
- The **duration** of the impact *on beneficiaries*; and
- The **frequency** with which ecosystem service beneficiaries are affected by the impacts of Project activities.

Each impact is scored against each of the criteria on a four point scale as shown in Table 17.10 below.

Table 17.10 Criteria for Determining Impact Magnitude

Magnitude Criteria	Assigned Scores			
	Score 1	Score 2	Score 3	Score 4
Severity: What is the likely severity of the impact on the well-being of any beneficiaries of the service, considering both the number of beneficiaries affected and the degree to which they are affected?	Negligible	Low	Moderate	High
Reversibility: How quickly is the ecosystem (or ecosystem functionality) able to recover from the impact?	Short term <i>Will recover completely in a short period of time once the activity ceases, e.g. turbidity levels in a water column</i>	Medium term <i>Reversible after some time with no intervention. Ecosystem functionality will recover with some changes to ecosystem function at natural recovery rates (e.g. re-establishment of riverbed)</i>	Long term <i>Reversible after some time with intervention. Recovery will occur but is retarded by impact (e.g. regrowth of vegetation once original topsoil has been replaced)</i>	Permanent
Duration: How long is the impact on beneficiaries expected to last?	Short term <i>Impacts occur over a few weeks or for a single season</i>	Medium term <i>Impacts occur over an extended period covering multiple seasons</i>	Long term <i>Impacts affect the current human generation, e.g. 25 years</i>	Permanent <i>Impacts extend over multiple generations, e.g. >25 years</i>
Frequency: How often are ecosystem service beneficiaries affected by the impacts of the Project activity?	Once off	Periodic <i>Effects are intermittent and sporadic over assessment period</i>	Regular <i>Effects are intermittent but regularly repeated over assessment period</i>	Continuous

The scores assigned to each criterion are added together for each ecosystem service to arrive at a total impact magnitude score for each ecosystem service which is classified as shown in Table 17.11.

Table 17.11 Determining Overall Impact Magnitude

Impact Magnitude		Score
Negligible	The impact is within the normal range of variation of the ecosystem and is not significant for the ESS beneficiaries	4
Low	The impact results in a small reduction in the availability or functionality of the ecosystem but is unlikely to give rise to any significant, lasting change in service provision or well-being of any beneficiaries and will not impact on Project operations	5-8
Moderate	The impact results in a moderate reduction in the availability or functionality of the ecosystem which may give rise to a change in service provision and the well-being of any beneficiaries and/or may compromise Project operations	9-12
High	The impact results in the loss of all or a significant proportion of the availability or functionality of an ecosystem which is likely to give rise to a significant change in service provision and the well-being of any beneficiaries and/or will compromise Project operations	13-16

17.7.1.2 Impact Significance

Once the receptor sensitivity and impact magnitude for each of the ecosystem services is estimated they are then combined to estimate the impact significance using the impacts significance matrix set out in Table 17.12 which is consistent with the overall approach to determining impact significance as set out in **Chapter 3 Impact Assessment Methodology**.

Table 17.12 Impacts Significance Matrix for Ecosystem Services

		Receptor Sensitivity			
		Negligible	Low	Moderate	High
Impact Magnitude	Negligible	Not Significant	Not Significant	Not Significant	Not Significant / Low
	Low	Not Significant	Low	Low / Moderate	Moderate
	Moderate	Not Significant	Low / Moderate	Moderate	High
	High	Low	Moderate	High	High

Based upon the resulting impact significance score, *priority ecosystem services* i.e. those upon which the Project is likely to have a significant impact and which result in adverse impacts on beneficiaries, and/or those upon which the Project is directly dependent for its operations are determined as follows:

- **Not Significant** to **Low** impact significance – not a priority service and no mitigation required beyond that which is set out in other chapters; and
- **Moderate** to **High** impact significance – **priority service** and further mitigation measures required to maintain the value and functionality of the affected service.

Once the data necessary to inform the impact assessment was collated and entered into the ESIVI tool, the technical specialists from each of the environmental and social disciplines covered in the ESIA were invited to participate in a workshop in order to:

- Draw on the specialist knowledge of each of the participants to determine impact magnitude and impact significance and to identify which services should be considered priority ecosystem services;
- Identify where further information may be required to inform the ecosystem services assessment and/or where the ecosystem services assessment could inform the assessments presented in the other chapters of the ESIA particularly in relation to livelihoods, health, safety, and cultural heritage; and
- Begin to identify appropriate mitigation measures which aim to maintain the value and functionality of priority services using the mitigation hierarchy.

Following the workshop, the residual impact assessment was completed. This follows the same process as described above in terms of assessing impact magnitude but includes consideration of the effectiveness of the proposed mitigation measures. Where the proposed measures are not able to avoid or reduce impacts on priority services, or to restore ecosystem service functionality and value, then appropriate forms and levels of compensation have been discussed with the local communities.

17.7.2 Assessment of Potential Impacts: Construction and Pre-Commissioning

17.7.2.1 Introduction

The following sections provide a description of the nature and significance of Project impacts on ecosystem services and their beneficiaries during the Construction and Pre-Commissioning Phase. A detailed breakdown of the scoring assigned to each ecosystem service is provided in Appendix 17.3 Impact Assessment – Construction and Pre-Commissioning.

17.7.2.2 Assessment of Potential Impacts (pre-mitigation)

Crops

The service considered in this assessment is the provision of crops grown on agricultural land within the Affected Ecosystems. The key beneficiaries include:

- Agrifirm Kavkaz;
- Consumers of wine produced by Agrifirm Kavkaz; and
- Migrant workers temporarily living in the Local Area who depend on seasonal employment by Agrifirm Kavkaz.

Due to the relatively small extent of productive agricultural land which will be cleared by the Project, together with the fact that much of the land is scrub, fallow land, or abandoned vineyard (Table 17.13), it is unlikely that the Project will lead to any impact on the ability of consumers to purchase wine.

Further, since there is no provision under Russian Federal law for compulsory land purchase, South Stream Transport cannot expropriate land to make it available to the Project. South Stream Transport must therefore reach an agreement with land owners to acquire or temporarily use land (e.g. by leasing) through negotiated settlement according to a Project Land Acquisition Plan.

As land will be acquired by way of negotiated settlement, within the context of a legal system that does not sanction expropriation or other compulsory procedures, any impacts on the respective land owners will be identified and compensated accordingly as part of the negotiated settlement. It is therefore considered that there will not be any impacts on well-being associated with either the permanent or temporary change of use of the land needing to be acquired (**Chapter 14 Socio-Economics**).

As such, the impact assessment therefore focuses on workers employed by Agrifirm Kavkaz.

The Project activities which could impact provision of this service include:

- Clearance of vegetation within the Affected Ecosystems;
- Restrictions on re-vegetation and land use post-clearance;
- Smothering of crops due to dust released during construction activities; and
- Leaks or spills which could contaminate soils in the Affected Ecosystems and reduce productivity (impacts on soils are assessed in the Soil Quality Regulation section below).

Receptor Sensitivity

Due to the distance to which migrant workers travel to work on the vineyards within the Affected Ecosystems, it is likely that they are highly dependent on this service for employment and livelihoods. Agrifirm Kavkaz does have other land holdings in the Local Area (total land holdings are around 1,975 ha) which are currently fallow or uncultivated and could potentially be used as alternative locations for grape cultivation. While cultivation of such land could provide alternative sources of employment for workers and there are other potential alternative sources of employment (such as in the tourism sector), there is no certainty that jobs would be available on a like for like basis. As such, it is considered that there are some alternatives for this service.

Vineyard ecosystem services are considered to be moderately sensitive to change due to the sensitivity of grape production to shifts in temperature, rain, sunshine, and soil conditions. Further, the resilience of the ecosystem to change may come under increasing pressure as a result of climate change. While the effects of climate change may threaten the longer term sustainability of wine production, the winery itself is considered to be fairly resilient to relatively small changes in access to factors of production (particularly land) as it owns (and could acquire) other land holdings which could potentially be brought into production. However, migrant workers are likely to be highly vulnerable to any change in employment and may have limited capacity to adapt to such changes.

The overall receptor sensitivity is therefore considered to be high.

Impact Magnitude

Construction of the Project will require clearance of approximately 53.5 ha of agricultural land for construction of the landfill facilities, the access road, and for the Pipeline Right-of-Way. Of the land to be cleared, around 41.69 ha (78%) is scrub, fallow land, or recently abandoned vineyard and approximately 11.81 ha (12%) is productive vineyard.

Around 8.7 ha (16%) of agricultural land will be taken out of agricultural use permanently and 23.75 ha (44%) will require temporary clearance before being returned to the land owner following the construction period. The remaining 21.05 ha (39%) will be returned to the landowners but future use will be restricted. For this land within the Pipeline Right-of-Way, no deep rooting trees or permanent crops will be allowed to grow back following construction, although bushes and other shallow rooted vegetation, including grape vines, will be allowed to be replanted and the land will be returned to landowners.

However, it is considered unlikely that the land owner or manager would replant vines or other long term cultures within the Pipeline Right-of-Way because of the possibility that they may need to be dug up at any time in the operational phase to allow for maintenance of the pipelines, thereby causing substantial disruption. Therefore on balance, it is considered that the land that would remain within the right of way would not be likely to be replanted with vines (even if the precedent can allow for it) but will be able to be planted with seasonal crops.

Table 17.13 shows the breakdown by permanent, temporary, and restricted use land take for Kavkaz, according to the existing land use pattern of Agrifirm Kavkaz's arable land.

Table 17.13 Land take for Agrifirm Kavkaz

Arable Land take	Cultivated Vineyard (ha)	Scrub, Fallow, and Abandoned Land (ha)	Total (ha)
Permanent	1.7	7	8.7
Temporary	10.11	10.94	21.05
Restricted use	0	23.75	23.75
Total			53.5

Emissions of dust from construction activities could have a temporary impact on productivity of cultivated land in the Affected Ecosystems although this is likely to be minimal. As such, the main impacts of the Project are likely to arise from a decrease in current and future crop production, and a corresponding decrease in employment opportunities, resulting from the permanent loss of 1.7 ha, and the loss of income and costs of reestablishment following the temporary loss of 10.11 ha of cultivated vineyard. There could also be a reduction in future crop production due to the permanent loss of 7 ha, temporary loss of 10.94 ha, and restricted use of 23.75 ha of scrub, fallow, and abandoned land, although any losses are likely to be minimal.

The limited amount of cultivated land to be cleared means that it is highly unlikely that any loss of land will result in on-going economic displacement of workers, although there could be some temporary displacement during seasons which coincide with construction activities. The total area of vineyard currently under cultivation by Agrifirm Kavkaz is 416 ha and it is understood that there is sufficient land under production, with related tasks that can be undertaken, to ensure that the displaced workforce would be absorbed elsewhere in the vineyard. Part of the land is also set aside for the Chateau development which will require some clearance in the absence of the Project (e.g. for construction of the properties and driveways) and may lead to a change in demand for such labour if the new vineyard owners do not elect to hire migrant workers to cultivate their private plots. As such the magnitude of the impact on well-being is considered to be low.

Most of the land to be cleared for the Project will be able to be replanted with crops following construction allowing ecosystem functionality, crop productivity, and employment opportunities to be restored. For land which is to be replanted for viticulture, vineyard ecosystems are estimated to take around three years (or three growing seasons) to reach a productive state that is sufficient to enable harvesting for the purposes of wine making.

While there will be some loss of crop production due to the permanent clearance of 1.7 ha land for the landfall facilities and an on-going restriction on the ability to cultivate land for viticulture in future, this is likely to be very small. The main impacts are likely to be felt in terms of temporary loss of productive land during the construction period. For workers employed by Agrifirm Kavkaz there is unlikely to be a significant on-going impact on job opportunities although there could be some short term disruption during the construction period. Impacts would be felt periodically during harvests taking place within the construction phase.

The overall impact magnitude is therefore considered to be low (refer to Appendix 17.3 for the scores against each of the magnitude scoring criteria).

Impact Significance

In combination, the total impact significance on the crops ecosystem service is therefore judged to be **Moderate** and crops are identified as a priority service during the Construction and Pre-Commissioning Phase.

Capture Fisheries

The service considered in this assessment is the capture of wild fish for consumption and recreational purposes through trawling and other non-farming methods within an area that extends along the coast from the Kerch Strait in the north to Arkhipo-Osipovka in the south. The key beneficiaries are:

- The two main commercial fishing enterprises based in Anapa who operate in the Kerch-Taman fishing zone (RPK Briz and OOO RAM) and their employees;
- A number of smaller commercial fishing organisations operating out of Novorossiysk and Temryuk who fish in the Kerch-Taman zone; and
- Commercial fishing organisations based elsewhere (including other Black Sea countries) that harvest stocks of fish in the Black Sea that may migrate or spawn in waters within the Kerch-Taman zone.

The specific effects of Project pre-commissioning and construction activities which could potentially impact upon capture fisheries include and which were considered in the assessment include:

- Sediment disturbance during dredging, installation of pipelines, pipe-laying, and back-filling;
- Implementation of safety exclusion zones around anchored vehicles (during surveys) and during dredging, installation of pipelines, pipe-laying, back-filling and tie-ins; and
- Disturbance caused by noise, vibration and light from vessels used for surveying, dredging, installation of pipelines, pipe-laying, back-filling, and tie-ins.

Receptor Sensitivity

Given the relatively low importance of fisheries to the local economy, dependence on fisheries is generally low although, for particular individuals working for smaller fishing organisations who have less access to alternative sources of income, the dependence on this service for livelihoods is likely to be higher. Due to the extensive fishing grounds which are used by fishing organisations, the overall dependence on capture fisheries within the Project Area is likely to be low.

The available fishing grounds are extensive (from the Kerch Strait to the mouth of the Psou River on the border with Georgia) and therefore access to fishing grounds other than those within the Project Area are considered to be available. However, given the additional costs of travelling further afield and the declining level of fish stocks generally, the alternative fishing grounds are not considered to be widely available without incurring additional costs (i.e. the fuel used to access fishing grounds that are further afield and the opportunity cost of the additional time spent at sea).

Fish stocks within the Black Sea are sensitive to change and there are recorded declines in a number of species as a result of over-fishing, eutrophication, and the introduction of alien invasive species. The Anapa Bank has been specifically designated as a protected area in order to encourage the replenishment of fish stocks, particularly for the Black Sea turbot whose stocks are presently at historically low levels. As such, the ecosystem is considered highly sensitive to change.

Any change in fish stocks would impact upon all beneficiaries who would either incur greater expenditure in order to travel to alternative fishing grounds further afield or obtain smaller catches. While larger commercial fishing organisations are likely to be able to adapt to such changes by shifting to new fishing grounds, smaller organisations with smaller fleets and less access to technological / financial resources are likely to be more sensitive to any change in provision of this service. Further, due to the poor state of the fishery in terms of vessel age and infrastructure investment, the sector is likely to be highly sensitive to any changes.

Overall receptor sensitivity is assessed as being moderate.

Impact Magnitude

A fisheries study was undertaken in order to assess the potential Project impacts on fish stocks and the beneficiaries dependent upon them. The report identified three potential impacts: disturbance to fish through sedimentation from dredging; loss of access to fishing grounds due to the exclusion zone; and noise and light disturbance to fish species (Appendix 14.1).

The first potential impact is seabed sediment dispersion caused by the construction of the microtunnel and the seabed dredging process. Increased sediment may affect fish in two ways: through increased turbidity caused by high suspended sediment concentrations reducing the capacity of visual predators to locate prey; and through sediment settling on the seabed smothering eggs and possible prey items for some benthic feeders as well as restricting the settlement of larvae. Both of these have the potential to reduce the reproductive capacity of fish species causing a reduction in stocks over time or causing fish stocks to relocate elsewhere.

While there will be some disturbance of sediment during the dredging of the exit pits and transition trenches, sediment modelling undertaken for the ESIA shows that the duration of this operation will be approximately 1.5 to 2 days (depending on the scenario assumed). Modelling also shows that, in the most extreme case, the sediment plume disperses rapidly to the lowest detectable level as it is carried down the coast over a 4 to 5 day period. The extent of this sediment disturbance will therefore not be at an intensity or duration that would affect fish species or the ability of beneficiaries to undertake fishing activities.

The second potential impact is the imposition of a safety exclusion zone of approximately 3 km (1.6 NM) radius which will be enforced during construction to avoid incidents with marine traffic. The safety exclusion zone will mean that access to a certain area of the fishing grounds will be lost during construction which could potentially impact on the livelihoods of those in the fishing industry.

However, the loss of access to potential fishing grounds will be minimal relative to the fishing area. An estimate of the shelf area above 100 m depth between Arkhipo-Osipovka and the northerly limit of the Anapa Bank, which is largely coincident with the anchovy feeding grounds, is approximately 2,235 km², while the area of the 3 km exclusion zone around the near shore construction will be around 14 km², less than 0.01% of the shelf area which constitutes the fishing grounds. Interference with the sprat fishery, which is largely confluent with the anchovy grounds, is therefore also unlikely. Further, any loss of fishing area will be less important to the sprat, anchovy, and other pelagic fisheries since they use mid-water methods which are less dependent on specific areas.

More direct impacts might be felt by fishing operations for benthic and demersal species since there will be loss of access to a specific area of habitat. This, however, will be limited to 3 km either side of the works and will cover a relatively small area in relation to the total fishing grounds. The potential for impacts will be further limited due to the absence of any bottom fishing in the area. While smaller vessels can trawl for benthic and demersal species, it is likely that they do this using a midwater trawl setup and fish close to, rather than on, the bottom. In addition, demersal species make up only 9% of the total catch and are normally caught using fixed nets. While the 3 km exclusion zone around the pipe-laying vessel may cause some temporary inconvenience and increased costs due to the need for fishing vessels to avoid the safety exclusion zone around the construction spread, there are unlikely to be any significant impacts on catches or livelihoods.

The greatest potential impact during the Construction and Pre-Commissioning Phase, and the greatest concern outlined by the fishing companies interviewed, is the possible disturbance to fish migration due to noise and vibration.

The fish species migrating along the coast which are most likely to be impacted are anchovy, horse mackerel, and to a lesser extent some of the bottom dwelling species such as migrating red mullet. Anchovy migrate along the coast from the Kerch Strait to the southern wintering areas off Sochi and the coast of Georgia. The main north-south autumn migration is October to November while the return spring migration is April to June. The Pipeline cuts across this line of movement.

The pipe-laying vessel will be a moving source of continuous noise and light. The anticipated noise level from vessels used in the Pipeline construction is between 169 and 192 dB. Using weighted thresholds, it was found that behavioural effects may be apparent in some hearing specialist fish such as sprat in certain situations (though not shad or anchovy because they have a different hearing range). Anchor handling is the activity most likely to generate such responses, and in shallow water may extend up to 260 m from activity, with an affected area of approximately 0.2 km². In deep water, where anchor handling will not take place, the pipe-laying vessel itself may generate similar impacts at a lesser range of approximately 140 m (area of effect approximately 0.06 km²).

As virtually all fishing takes place within 12 NM (equivalent to 21.6 km) of the coast, there should always be an undisturbed corridor of 5 to 6 km through which fish can pass. Moreover, since the vessel lays pipes at between 2.5 and 2.75 km per day over a 21.6 km distance, it should only take around nine days to traverse the fishing zone on the main continental shelf area down to 100 m water depth where the fish migrate. Since the periods of migration of both the anchovy and mackerel are at least 2 months, any disturbance will therefore only be temporary. Fish species are also likely to become habituated to vessel noise sources.

It is further noted that the authorities have put a ban on any construction activity taking place in waters to 100 m depth during the month of May, which coincides with the peak of the main spring anchovy migration, thereby further reducing the likelihood of any impact.

Due to the fact that the vessel will be brightly illuminated at all times, light disturbance could also potentially be an impact, although the attraction effect of light is relatively localised and is

only a factor at night. As such, any disturbance can be bypassed by migrating fish during the day.

To provide an overall point of comparison with regard to disturbance from construction activities, in a similar situation for the North Stream pipeline, monitoring of fish densities showed no changes attributable to construction and there was no discernible impact on fish catches over the period (Appendix 14.1).

On the basis of the analysis presented above, it is concluded that there will be no distinguishable differences in fish catches outside of the normal annual fluctuations and it is unlikely that the fishing industry will experience a reduction in catch during the Construction and Pre-commissioning Phase. As such, there are unlikely to be any identifiable impacts on beneficiary well-being resulting from Project activities.

The impact magnitude is therefore considered to be negligible (refer to Appendix 17.3 for the scoring against each criterion).

Impact Significance

The overall significance of the impacts of Project activities on capture fisheries is assessed as being **Not Significant** and fisheries are not considered to be a priority service requiring mitigation.

Water (supply)

The service considered in this assessment is the use of ground and surface freshwater resources provided by, or dependent upon, the Affected Ecosystems. This includes water resources used throughout the Shingar catchment. The baseline identified a number of beneficiaries using freshwater resources within the Shingar catchment who are located upstream of the Affected Ecosystems, including:

- The Russkaya compressor station which abstracts groundwater from a source north of the Affected Ecosystems;
- Agrifirm Kavkaz which abstracts water from an impoundment in the Graphova Gap; and
- Visitors to St. Barbara's source located in Varvarovka.

Due to the hydrological gradient and distance from the Project Area of these abstractions, the Project is unlikely to lead to any impacts on the provision or use of these water resources and, as such, the assessment focuses on downstream beneficiaries including:

- The Project itself which is dependent upon the Ministry of Defence well in Sukko; and
- The Ministry of Defence and any households dependent on the water abstracted from their well.

The specific Project activities that could affect the water (supply) services provided by or dependent on the Affected Ecosystems include:

- Construction activities which require dewatering of groundwater resources;
- Abstraction from aquifers for use in construction leading to decreasing groundwater levels; and

- Alterations to surface water flows during construction due to crossing of surface waters and alterations to vegetation cover.

Receptor Sensitivity

Companies and households abstracting from groundwater resources (including the Project itself) are highly dependent on the water supply for their health, operation, and well-being. Alternative supplies of water are widely available through the use of other aquifers or surface water resources, the public water supply system, or tinkering / piping in supplies from other areas (although the last approach is likely to incur significant environmental and social costs).

The sensitivity of the Affected Ecosystems to change is likely to be moderate. While there are relatively large quantities of water resources available in the Local Area, the aquifer from which the MOD operates a well is under pressure from abstraction and is managed through a licencing system which sets limits on abstraction volumes to ensure sustainable use. Commercial organisations are likely to be of low sensitivity to change as the main direct abstractors (the Project itself and the Ministry of Defence) are likely to have the financial and technological resources to be able to adapt to changes in supply. Residents of Sukko currently drawing water from wells are likely to be of moderate sensitivity as they are reliant on the municipal authorities for any alternative sources of water should the well water sources be affected.

The overall receptor sensitivity is therefore considered to be moderate (refer to Appendix 17.3 for the scoring against each of the magnitude significance criteria).

Impact Magnitude

Construction activities are likely to require groundwater control at certain points. While this may involve dewatering abstractions¹³, the impacts will be temporary and recovery is expected to be rapid. The Pipeline route crosses surface waters, the potential disruption of which could impact on the hydro-morphology of the river channel depending on the timing of the construction works. However, the channel crossings have been designed so as to minimise the impact on the river channel and to ensure that flows are maintained. As such, there is unlikely to be a significant impact on downstream flows (**Chapter 8 Soils, Groundwater and Surface Water**).

Alterations to surface water flows may occur, however, as a result of land clearance, changes to topography, and development of temporary construction areas. It is unlikely that there will be any significant impacts on water flows due to changes in topography although surface water run-off may increase due to the removal of vegetation and compaction of bare soils. However, as streams are ephemeral, any changes in water flows are likely to be minimal and there are no identified surface water abstractors dependent upon surface water flows within the Affected Ecosystems. Further, the extent of clearance of natural habitat is small relative to the surrounding extent and so impacts on downstream water flows are likely to be insignificant.

¹³ A dewatering abstraction is the removal or draining of groundwater or surface water from an aquifer, riverbed, construction site, caisson, or mine shaft, by pumping or evaporation. Dewatering may be implemented before subsurface excavation to lower the water table.

Saltwater will be used for hydro-testing purposes although some freshwater will be required for construction activities such as the cleaning of plant and equipment, worker amenities, and in the use of construction materials such as concrete. All freshwater required during construction will be supplied from the Ministry of Defence well in Sukko. An estimated total volume of 37,000 m³ of freshwater is required for the microtunneling process. In addition there will be a maximum usage of 25 m³ per day for freshwater for general construction activities (domestic usages, wheel washing etc.) during peak periods. The water will be trucked to the construction areas from Sukko. There is a May – September (inclusive) exclusion period when water cannot be abstracted from the existing source at Sukko. Due to this restriction, a large quantity of water (up to 10,000 m³) may need to be stored adjacent to the microtunnel construction site. A much smaller quantity of water (no more than 800 m³) may need to be stored at the landfill facilities site.

Abstraction from the aquifer is managed through a licencing system which sets limits on abstraction volumes to ensure sustainable use. It is assumed that the licensed abstraction rate, including the seasonal exclusion period, has been set at a rate that will not cause the derogation, in terms of quality and quantity, of the aquifer resources, or of any other groundwater users within Sukko that utilise the same aquifer. Since all water required for Project activities will be managed through this licensing system and the rate of abstraction during construction will not exceed the licensed rate, Project impacts on the well-being of other water uses and the wider environment are likely to be negligible.

The overall impact magnitude is therefore considered negligible (refer to Appendix 17.3 for the scoring against each of the impact magnitude criteria).

Impact Significance

The overall significance of the Construction and Pre-Commissioning Phase of the Project on water (supply) is assessed as being **Not Significant** and water (supply) is not considered to be a priority service.

Hazard Regulation

The service considered in this assessment is the capacity of Affected Ecosystems to regulate natural hazards. The key beneficiaries include:

- Households and businesses located along the coastline and/or in areas that are vulnerable to flooding, erosion, and landslides;
- Recreational users who benefit from beaches along the coastline; and
- The Project itself which may be affected by flooding, erosion, and landslides.

The specific Project activities which could affect the hazard regulating services include:

- Site clearance and earthworks, particularly where these result in changes in topography and loss of vegetation;
- Impacts on the structural composition of Phaeozem soils which play an important role in water storage and flow regulation;

- Preparation of foundations may induce ground instability which could trigger mass movement of soils; and
- Dredging processes in the marine environment, particularly if this impacts upon coastal processes, and the effects of sea surges.

Receptor Sensitivity

The level of dependence on this service by the beneficiaries discussed above is assessed as low. The risk of surface water flooding and landslides to beneficiaries is low and vegetation within the Affected Ecosystems is considered to have a relatively limited role in regulating this risk relative to the surrounding habitat. Beneficiaries living in coastal areas, users of coastal beaches, and the Project itself are more dependent upon the regulation of coastal erosion and flooding, which could have significant impacts on health, operation, and well-being. However, the Affected Ecosystems again play a relatively small role in regulating this risk.

The role Affected Ecosystems currently play in regulating hazard risks could be replicated and improved through various engineered alternatives such as the construction of coastal flood defences, beach reclamation, creation of flood water attenuation ponds, or afforestation. Many of these approaches would, however, be expensive and/or take a long time to implement. It is therefore considered that there are few viable alternatives.

The Affected Ecosystems are considered to be moderately sensitive to change with respect to their ability to provide a hazard regulating service. Climate change is projected to lead to an increase in the frequency of extreme events including flooding and sea level rise over the next 50 years. Phaeozem soils are structurally prone to compaction and erosion which can reduce their ability to store and filter water and regulate flows. Subsequently, they are considered to have a low resilience to impacts, and would not readily return to their natural state within the Project's lifetime.

Beneficiaries of this service (including the Project itself) are considered to be moderately vulnerable to any change in the provision of this service. While the ecosystems currently play a relatively limited role in regulating this hazard, small changes in ecosystem functioning can lead to changes in hazard risk which can lead to significant changes in well-being. For example, a change in vegetation cover in an area or an increase in intense rainfall events can lead to an increase in frequency of mudflows which can lead to structural damage and loss of crops. Larger towns (such as Anapa) are likely to have access to the resources necessary to adapt to changes in hazard risk, although there are a number of individual households and smaller communities which may be less able to adapt to changes in flood or erosion rates.

Overall the receptor sensitivity is therefore assessed as being moderate.

Impact Magnitude

Around 12.4 ha of natural habitat in the Affected Ecosystems will require some form of clearance during the Construction and Pre-Commissioning Phase. The removal of this area of vegetation (which binds soil particles together and protects the soil surface from wind and rain exposure) will expose bare soils to erosion and/or compaction caused by weather and the movement of heavy machinery and vehicles. The loss of Phaeozem soils, in particular, or

damage to their structural composition, could also impact on the ability of ecosystems to regulate water flows.

As such, it is likely that surface water run-off will increase which could in turn increase flood risk. However, the clearance of natural habitat is small relative to the service provision in the surrounding area and a qualitative flood risk assessment was undertaken within the catchment which found that impacts on surface water flows and flood risk are likely to be localised and are not likely to have a measurable impact on the well-being of any beneficiaries.

Construction of the stream crossing at the Graphova Gap could temporarily alter water flows during the works and could potentially result in flood flows being diverted onto the surrounding floodplain. Given the nature of the topography at the crossing site with relatively steep valley sides, any impacts on the flow regime are likely to be local to the crossing. The impacts of the construction works will be temporary and the watercourse will recover through natural processes. Further, it is proposed that any construction activities in the Graphova Gap will be undertaken during dry weather as far as is practicable, when the groundwater levels and surface water flows are expected to be lower.

Vegetation and soil also plays a role in maintaining slope stability and preventing landslides, mud flows, and erosion. Earthmoving activities (including vegetation clearance, construction activities for the facilities, trenching activities for the Pipeline, and road access construction) may cause ground instability due to overloading of slopes and stockpiles of excess spoil waste. This could lead to slope collapse, gravitational slides (including landslides), mass soil movement, ground subsidence, and the formation of slope erosion features.

Depending on the size and nature of the soil loading and potential for subsequent ground movement, this could cause soil stability impacts that may be on-going over several years. Incidents of prolonged and heavy rainfall during the construction period could lead to mudflows which may be exacerbated by soil instability. This could potentially impact the Project itself and beneficiaries in the Local Area.

However, as described in **Chapter 4 Analysis of Alternatives** and **Chapter 5 Project Description**, the design and proposed construction methodology for the landfall facilities and Pipeline route have taken into consideration the potential geohazards, mitigating the risks as far as is practicable and the likelihood of the Project causing any landslide activity that could affect any beneficiaries is low.

Excavation and removal of marine sediment during nearshore dredging could potentially lead to alterations in coastal processes leading to changes in coastal flooding and erosion rates. However, it is considered extremely unlikely that dredging will result in a change in coastal erosion or flooding rates, as the dredging is taking place in water depths which should not change the height of incoming waves i.e. the wave height is not limited by the water depth. If the dredging site were closer to the shore, where the wave climate is significantly influenced by the bathymetry, then it is possible that increasing water depths (dredging) would increase wave heights and thus result in an increase in coastal erosion potential and/or flooding. However, even if this were the case, the change in depth would need to be significant before there was any attributable impact on the coast. As such, any impacts on coastal processes and beach formation / erosion rates or their users are likely to be negligible.

Taken together, it is unlikely that the Project will have any significant impact on the well-being of beneficiaries in terms of increased flood risk or through coastal erosion and flooding. The Project could, however, lead to a destabilisation of soils and land forms within the Affected Ecosystems. While this is unlikely to directly impact any identified beneficiaries, if there are periods of heavy and prolonged rains during construction, the measures taken to reduce impacts on soil stability could fail. This could potentially contribute to the formation of mudslides that may lead to disruption of Project activities, loss of agricultural land, and damage to buildings.

The likelihood of any impacts on beneficiaries' well-being is likely to be low and any potential increase in risk of mud flows or slope instability would be felt periodically following heavy rains. Ecosystem functionality should be fully reversible following the construction period and any impacts in terms of increased instability would extend over several years as soil stability recovers through natural processes.

The impact magnitude is therefore considered to be low (refer to Appendix 17.3 for the scoring against each of the impact magnitude criteria).

Impact Significance

The overall significance of the impact of the Construction and Pre-Commissioning Phase on the well-being of people benefitting from hazard regulating services provided by Affected Ecosystems is assessed as being **Low**. Hazard regulation is therefore not considered to be a priority service during this Phase.

Air Quality Regulation

The service considered in this assessment is the capacity of Affected Ecosystems to regulate air quality. Due to the spatially diffuse nature of air and pollutant concentrations, the air quality regulation service cannot be directly linked to any particular ecosystem or area within it but rather is a cumulative service based on the interactions of multiple ecosystems.

While airborne pollutants can travel for long distances, those generated by Project activities are expected to disperse relatively quickly and to have a limited geographical extent. As such, the geographic scope of the service assessed within this section is the regulation of air quality within a 2 km radius of the Project Area, which is expected to be the greatest distance that any Project impacts could be felt (**Chapter 9 Air Quality**). The key beneficiaries include:

- Residential dwellings, a nursery, and school in Varvarovka;
- Residents and workers (particularly individuals with respiratory illnesses) in areas of Supsekh, Anapa, Rassvet and Gai Kodzor who benefit from clean air;
- The tourism industry (including the Shingari and Don resorts) which benefit from the influx of tourists seeking clean air; and
- People from across the region visiting the Local Area in order to benefit from the perceived health benefits of clean air (Ref. 17.24).

The Project activities which may impact provision of this service include:

- Clearance of vegetation;
- Emissions from offshore and nearshore vessels during pipeline installation;
- Emissions of pollutants from construction activities associated with the landfall section of the Project;
- Dust generation from construction traffic, land clearance, installation of the Project facilities, and installation of the Pipeline; and
- Emissions from road traffic during construction.

Receptor Sensitivity

Beneficiaries are highly dependent on the ability of ecosystems to regulate air quality as poor quality air, where pollutant thresholds are exceeded, is correlated with respiratory illness and death (Ref 17.56). The tourism industry is also dependent on good quality air for its marketing as a health resort. There are some activities which could feasibly be adopted to replace the air quality regulation service currently provided by Affected Ecosystems such as planting additional trees and green roofs (particularly in urban areas) to absorb more pollutants, or reducing pollutant emissions into the air quality regulatory system.

Based on the diffusion tube monitoring results, the ecosystem is considered to be of low vulnerability to changes in air quality, as vegetation cover is high and air quality thresholds within rural areas in the Local Area are not close to being exceeded. The vulnerability of receptors is considered to be moderate as there are significant resources within urban areas available for adapting to any changes in air quality, although there are some rural households and elderly or sick individuals who may be less able to adapt to a change in this service.

The overall receptor sensitivity is therefore considered to be moderate.

Impact Magnitude

Due to the relatively small amounts of pollutants released by the Project and the limited area of vegetation clearance required, the Project is not likely to significantly impact the ability of ecosystems to regulate air quality or lead to any negative impacts on the well-being of any beneficiaries of this service. The results of air quality modelling exercises found that there are unlikely to be any significant impacts on any identified beneficiaries (or any ecosystem functioning) in the area (**Chapter 9 Air Quality**).

The area of forest to be cleared (i.e. Shiblyak, Mesophilic forest, and Juniper woodland habitats) totals 7.6 ha (around 1.4% of the natural forested habitat in the Affected Ecosystems and a much lower percentage of the Local Area), which could lead to a reduction in the capacity of ecosystems to remove up to 114 tonnes of pollutants each year.

Due to the limited extent of this level of habitat clearance and the fact that the pollutant concentrations are generally significantly below threshold levels in rural areas, the magnitude of the impact on beneficiaries' well-being is likely to be negligible (refer to Appendix 17.3 for the scoring against each of the impact magnitude criteria).

Impact Significance

In combination, the total impact significance on the well-being of people benefitting from the air quality regulation service provided by the Affected Ecosystems is considered to be **Not Significant** and air quality regulation is not identified as a priority service.

Water Quality Regulation

The service considered in this section is the capacity of Affected Ecosystems to regulate and maintain marine and fresh water quality. This includes water in Affected Ecosystems in the marine environment and freshwater resources used throughout the Shingar catchment. The key beneficiaries include:

- Local households and private companies within the Shingar catchment who abstract groundwater for drinking and industrial purposes (e.g. MOD and households with wells on properties);
- Users of St. Barbara's Source for its spiritual / healing properties;
- Visitors, residents, and industry in Anapa SPNA dependent upon high water quality; and
- People working in the fishing industry who are in contact with marine water and those consuming the captured fish who benefit from the regulation of health risks.

Further beneficiaries of this service include tourists, recreational users, and the tourism industry who rely on good quality marine water for water sports, bathing, and scuba diving. In order to avoid double counting, impacts on these beneficiaries are assessed in Tourism and Recreation Values.

The specific Project activities that could affect the water quality regulating service include:

- An increase in pollution levels in surface and ground waters during construction activities due to soil disturbance, aerial deposition of dust generated by construction, leaks and spills from vehicles / plant, and waste generation;
- Clearance of terrestrial vegetation which absorbs pollutants and sediment from water resources;
- Disposal of contaminated water into the marine environment after use for hydro-testing, cleaning, and gauging the Pipeline;
- Seabed disturbance and release of sediments into the marine water column as a result of vessel movements, dredging, and Pipeline construction; and
- Reduction in the capacity of marine organisms to filter contaminants from the water due to loss of mussel beds and/or macrophyte strands.

Receptor Sensitivity

The dependence of beneficiaries on water quality is assessed as being high. Contamination of groundwater could have direct impacts on human health for those abstracting water from the environment, while contamination within the marine environment could also impact human health if marine water users come into direct contact with particular pollutants or if contaminants enter the food chain. Further, the Anapa Resort Town is a designated Sanitary Protection Area and the operation of the health industry and mineral water production is dependent on the continued supply of good quality water.

For both fresh and marine waters there are a number of alternatives to the water quality regulation service provided by the natural environment. These include planting new trees or creating wetlands in appropriate locations, chemically treating polluted waters, supporting the growth of biofiltering organisms within the marine environment, or reducing pollutant inputs from other sources. Since these activities are likely to incur relatively high costs, it is considered that there are some alternatives available.

Contaminant concentrations in fresh and saline resources in the Local Area exceed thresholds for a number of pollutants and marine sediments were found to have high concentrations of heavy metal contaminants (**Chapter 8 Soils, Groundwater and Surface Water** and **Chapter 12 Marine Ecology**). The capacity of these resources to assimilate any additional contamination is therefore likely to be limited. However, as noted in Section 17.6.6, actions by Black Sea States to restoring the ecological status of the Black Sea to a condition similar to that of the 1960s, has resulted in a decline in land-based sources of pollution and some improvements in ecological status. There are, nevertheless, still a number of external pressures which could impact the ability of ecosystems to regulate marine and fresh water quality such as climate change, rising water temperatures, and increasing development leading to habitat clearance and pollutant runoff. As such, fresh and saline water resources in the Affected Ecosystems are assessed as being of moderate sensitivity to change.

The sensitivity of beneficiaries of water quality regulating services provided by ecosystems within the Local Area is assessed as being moderate. While companies which abstract water directly (such as the Ministry of Defence) and the health industry within the Anapa Resort Town are likely to be able to access financial, technological, and legislative resources in order to adapt to any changes, groups such as individuals dependent on household wells (e.g. in Sukko) are less likely to be able to adapt to any change in this service.

The receptor sensitivity is therefore assessed as being moderate.

Impact Magnitude

Within the terrestrial environment, the Project could lead to contamination of surface and ground waters from leaks and spills during the construction period. The majority of leaks and spills are likely to be relatively small in volume and the construction drainage systems as outlined in **Chapter 5 Project Description** will collect and manage surface water runoff to reduce contamination risks. While ground and surface water quality could be locally affected, it is expected to recover through natural regulatory processes. Thus, the likely volumes of any spills are unlikely to significantly alter local pollutant concentrations or have significant lasting impacts on the ability of ecosystems to assimilate and regulate water quality.

Wastewater from domestic and industrial sources will be tankered off-site to an appropriate waste treatment facility and the risks associated with accidental release of oil, fuel, concrete and other pollutants will be controlled through appropriate storage, handling, and accident prevention procedures. Health complexes in Anapa Resort Town and St. Barbara's Source are located upstream of the Project Area and are therefore unlikely to be impacted by any possible leaks or spills. As such the impact on beneficiaries is not likely to be significant.

Land clearance including the removal of vegetation, topsoil, hardstanding or existing structures may increase the potential for infiltration of precipitation through the soil, increasing leaching of soil contaminants to groundwater. Increased sediment entering the surface watercourses could result from land clearance, excavation works and erosional processes (particularly on soil stockpiles and on access roads close to gullies until road drainage is established). The eroded sediment may also have a high nutrient or contaminant content which can contribute to the enrichment and contamination of downstream waters. Impacts on surface water quality will typically be of short duration (i.e. during and immediately after a storm event) and for low concentrations of contaminants this will be off-set by natural regulatory processes in the Affected Ecosystems.

Disposal of hydrotest water and leaks or spills could release contaminants into the marine environment and lead to localised changes in water temperature and quality, although this is unlikely to significantly impact the ability of ecosystems to regulate water quality. The principal impact on the capacity of the environment to regulate water quality is likely to come from dredging activities and the resultant dispersal of sediments in the water column. High levels of Total Suspended Solids (TSS) can cause, *inter alia*, reduction in light penetration (leading to reduced photosynthesis), reduction in visual awareness, irritation of sensitive organs (gills), clogging of delicate filter feeding mechanisms, and the potential release of contaminants from disturbance of marine sediments.

Contaminants within the marine environment, such as heavy metals, bind onto sediment and can remain locked up indefinitely. As a result of the dredging process, any contaminants locked in the sediments could be dispersed into the water column which could pose a risk to human health for those using the marine environment for swimming and recreation. These contaminants could also be ingested by benthic organisms which filter seawater for food particles. As this group provides a valuable food source for many commercially important fish species (as well as some species such as sea snails being harvested directly), the contamination released through dredging could lead to uptake by marine life with potential negative impacts on human health in the area. Surveys of marine sediments in the Affected Ecosystems suggest that there are contaminants present which could be disturbed by dredging activities although the extent of disturbance of the seabed is likely to be limited due to the small spatial and temporal scale of the dredging activities required. The limited extent of disturbance and the fact that fish are likely to avoid areas of dredging suggests that the impact on the well-being of any beneficiaries is likely to be low (**Chapter 15 Community Health, Safety and Security**).

The loss of mussel beds and macrophytes due to the laying of the pipelines on the seabed and disturbance during the dredging process could potentially have a permanent, negative impact on the ability of the marine environment to regulate water pollution. However, there is unlikely to be any significant impact on mussel beds or sea grasses as there are none present within the route of the Pipeline. Seaweed beds in shallow water within the Affected Ecosystems will be temporarily impacted by sediment plumes and more distant mussel beds could theoretically be impacted by plumes, although the duration and extent of plumes is limited. According to sediment modelling results, the deposition of sediment on the sea bed will not cause any long range impacts or smothering of such species (**Chapter 12 Marine Ecology**).

The impacts on well-being arising from changes in water quality regulation are therefore likely to be low. Spillages and sediment plumes may occur periodically throughout the construction

period and any impacts on beneficiaries are likely to be limited to this period. Impacts are of short duration (e.g. during and immediately after storm events), and the environment would be able to recover relatively rapidly through natural processes.

The overall impact on water quality regulating services is therefore assessed as being of low magnitude (refer to Appendix 17.3 for the scoring against each of the impact magnitude criteria).

Impact Significance

The impacts of the Construction and Pre-Commissioning Phase on the well-being of beneficiaries of the water quality regulation services provided by the Affected Ecosystems are considered to be of **Low** significance and water quality is not considered a priority service.

Soil Quality Regulation

The service considered in this section is the capacity of Affected Ecosystems to regulate and maintain soil quality. The key beneficiaries include:

- Landowners and the agriculture / viticulture industry within and around Affected Ecosystems (including consumers); and
- Workers who interact with soils and benefit from the regulation of health risks.

Further beneficiaries of this service include local residents and businesses who benefit from the soil's capacity to store water and reduce flood risk, as well as people dependent on surface water quality which can be impacted by changes in soils. In order to avoid double counting, impacts on these beneficiaries are assessed under Hazard Regulation and Water Quality Regulation sections respectively.¹⁴

The Project activities which may impact provision of this service include:

- Increase in concentration of contaminants which could exceed the capacity of soils to regulate quality through leaks and spills and deposition of dust and atmospheric pollutants generated during construction activities;
- Exposure and disturbance of existing areas of contaminated soil which are currently unknown to the Project;
- Increased susceptibility of soil to erosion through clearance of vegetation and excavation works;
- Loss of soils as a natural resource due to hardstanding / development relating to Project;
- Loss of nutrients and soil carbon due to soil excavation and removal of vegetation which contributes to soil composition; and

¹⁴ There is a significant degree of overlap with the soils service and other services such as crops, water quality, and hazard regulation. This is because soil regulation is part supporting service and part final service. In order to untangle the impacts and avoid double counting, any impacts on soils and soil productivity are considered in this section (not in the crops section) and any impacts on the ability of soils to regulate water flows or quality are discussed in the hazard regulation and water quality sections).

- Degradation of soil, physical damage, and compaction through stockpiling of soils during construction.

Receptor Sensitivity

Agrifirm Kavkaz is dependent on the regulation of soil quality for the production of crops and value of uncultivated land as highly degraded soil, which is unable to regulate contaminants through natural processes, is likely to be of lower productivity and of lower value as a potential asset for sale. Workers are also dependent on the soil quality regulation service as disturbance of contaminated soil can lead to adverse health impacts. Taken together, the dependence on this service is considered to be high.

The regulation of soil quality played by ecosystems could potentially be replaced through the treatment of soils to get rid of contaminants, use of fertilisers (which could replace loss of nutrients or organic carbon), import of good quality soils from other regions, or through the purchase of good quality agricultural land elsewhere, although the costs of some of these measures may be high. As such, there are some alternatives considered available for this service.

The baseline data suggests that while soils are typically of good quality there are areas of elevated concentrations of particular substances which could be due to natural or manmade causes. Growing use of agrochemicals, motor vehicles, and air borne particles could increase pressure on soil quality regulation in future. While soils used for agricultural purpose are resilient to disturbance, Phaoezem soils are structurally prone to compaction or erosion, and to contamination through surface spills. As such, the sensitivity of the ecosystem to change is considered to be moderate.

Agrifirm Kavkaz is considered to be of moderate vulnerability to a change in provision of this ecosystem service as reductions in soil quality and the on-going ability of soil ecosystems to regulate contaminants could reduce the potential use and potential value of their landholdings. Workers are also likely to be vulnerable to changes in soil quality regulation although they are likely to be able to mitigate such changes through the adoption of adequate health and safety procedures and protective clothing which should be provided by their employers. Overall, the sensitivity of human receptors to changes in this service is considered to be moderate.

The overall receptor sensitivity is therefore considered moderate.

Impact Magnitude

The potential impact of the Project on the well-being of beneficiaries is considered to be high since the potential for contamination of soils which exceeds the assimilative capacity of ecosystems present could have lasting impacts on the quality of soil with subsequent impacts on human health and livelihoods.

Contamination of the soil may result through accidental leaks or spills during construction (e.g. during refuelling or waste handling). Potential pollutants include fuels, lubricants, cement, concrete, grout and slurry additives, and metals. Further risks of contamination arise through the potential for leakage during hydro-testing. Hydro-test water may contain high concentrations of suspended sediment including metal particulates. Other contaminants such as

hydrocarbons may also be present. Depending on the location of the leaks, this may permit test water to infiltrate through the soil, potentially influencing soil quality.

The Project could also disturb currently unidentified, localised pockets of soil contamination related to past land use or illegal dumping, although it is considered that the likelihood of encountering unidentified contamination is relatively low given the current land use.

Contaminated soil may affect workers through being inadvertently ingested or inhaled or through dermal contact and could have lasting impacts on the health of anyone exposed to soil contamination. Contamination of soil resources could also lead to reduced land values for Agrifirm Kavkaz if the long term productivity of soil is reduced. Further, if contamination from the Project impacts soil quality and the subsequent crops grown on that land are also contaminated, then there could potentially be human health risks due to the presence of contaminants in the food chain.

The removal of vegetation (which previously bound soil particles together and protected the soil surface from wind and rain exposure) will expose bare soils to erosion and/or compaction by the movement of heavy machinery and vehicles. The release of soil particles into surface watercourses and general migration down slopes could occur as a result of erosional processes. Earthworks and stockpiling of soils can lead to the mixing of different soil types, and also the changing of the soil structure. Such mixing can influence soil type and structure, which may influence ecosystems or agricultural usage. Similarly, mixing of excavated soil types can result in the contamination of previously clean soils by contaminated soils.

The impact of the Project on beneficiaries of the soil quality regulation service is long-term, with any contamination or impact on the structure of the soil occurring during the construction period likely to affect the current generation of users in terms of lower productivity, reduced ecosystem functioning, and increased health risk. Following the construction period, the ecosystem is expected to be able to recover from any impacts at natural recovery rates although for certain contaminants (such as heavy metals) or for significant structural damage, this could take significant periods of time. Impacts on soil quality are likely to be periodic, accidental events resulting from particular activities such as excavation works, vegetation clearance, and occasional spills or contamination events.

The overall impact magnitude is therefore considered moderate (refer to Appendix 17.3 for the scoring against each of the impact magnitude criteria).

Impact Significance

As such, the impact significance on the well-being of beneficiaries of the soil quality regulation service provided by Affected Ecosystems is therefore judged to be **Moderate** and soil quality regulation is identified as a priority service.

Tourism and Recreation Values

The service considered in this section is the enjoyment of natural features in the Affected Ecosystems and activities provided by the natural environment or any livelihoods derived from such services. The key beneficiaries include:

- Users of the Mountains of the Caucasus trail and horse riding trails;
- People using Sukko beach and the surrounding marine environment for activities such as sun bathing, swimming, yachting, scuba diving etc.;
- Visitors to the Shingari and Don holiday complexes; and
- Tourism operators and their employees operating in the Local Area who may depend on tourism for their livelihoods including dive operators, horse riding operations, and holiday complexes.

The specific Project activities that could affect these services during the Construction and Pre-Commissioning Phase include:

- Noise and visual disturbance during construction activities;
- Reduced access to sites used for recreation such as horse riding trails or areas of marine space used for yachting and swimming;
- Reductions in marine water quality which could impact on bathing activities, water sports, and scuba diving etc.;
- Impacts on marine ecology such as loss of mussels and other benthic species which contribute to beach formation or disturbance to species of importance for scuba diving; and
- Impacts on beach formation due to dredging activities and changes in coastal erosion and deposition rates (impacts on coastal processes are assessed under Hazard Regulation earlier in this section).

Receptor Sensitivity

Tourism makes an important contribution to the economy of the Local Area, with up to 4.5 million visitors travelling to ART each year. The designation of Anapa as a resort town recognises its national importance as a place for tourism. Further, a number of smaller scale tourist organisations are dependent on income from tourists visiting ecosystems in the area including the owners of the Shingari and Don complexes. As such, dependency on this service is considered to be high and, while there are alternative tourist destinations, few are considered to offer equivalent benefits as the ART area.

Many of the tourism and recreation opportunities provided within the Local Area are ecosystem based, including hiking along the Mountains of Caucasus trail, horse riding, bathing, beach-based recreation, water sports, and scuba diving. As such, it is considered that tourism is highly sensitive to changes in the quality of the natural environment in terms of both levels of enjoyment (by visitors and recreationalists) and income and employment generated by visitors to ART.

The receptor sensitivity for tourism and recreation services is therefore considered to be high.

Impact Magnitude

There are four potential Project impacts which could affect the ability of beneficiaries to enjoy recreation or derive livelihoods from this service: noise and visual disturbance; loss of access to recreational resources; declines in water quality; and impacts on marine ecology.

The presence of pipe laying vessels and other construction vessels may give rise to adverse visual and noise impacts on recreational users of beaches, hiking trails, and the sea. This could temporarily reduce the enjoyment of the Affected Ecosystems by visitors and could potentially reduce customer numbers for certain businesses leading to impacts on livelihoods.

The beneficiaries of most concern with respect to these impacts are visitors to, and owners of, the Shingari and Don holiday complexes, as well as visitors to the Sukko public beach. Consultation with owners of the Shingari resort revealed that they are particularly concerned about the impacts of construction activities on noise and sea water quality as swimming and other water based activities form a key component of the leisure opportunities offered at the resort.

As set out in **Chapter 10 Noise and Vibration**, noise modelling suggests there will be a residual impact of Low significance on the Shingari and Don resorts during Pre-Commissioning associated with cleaning, gauging, and drying of the pipelines. The impact is temporary and is expected to last for around 20 days. **Chapter 13 Landscape and Visual Assessment** identifies a moderate adverse residual visual impact on these beneficiaries during construction. The visual impact assessment states that the impact will be temporary and short term as the marine construction vessels, and in particular the pipe laying vessel, will only be highly visible to visitors at Shingari and Don holiday complexes for a few days (or a week at most) during the construction of each pipeline. The four pipelines are to be laid as quickly as possible over a period of approximately 15 months commencing in Q1 2015. Visual disturbance will be likely to occur on a single occasion during the main summer peak period when occupancy of the holiday complexes would be at its highest. Following construction the impact will cease. Disturbance from the Project will therefore be temporary and is unlikely to prevent anybody from undertaking recreational activities in the Affected Ecosystems. As such, it is considered that the magnitude of impact on the Shingari and Don holiday complexes will be low.

While the magnitude of any impact is considered likely to be low, visual impacts on beach users could potentially impact on the business revenues of the Shingari and Don Holiday complexes if guests are deterred from staying. This will depend on the timing of the construction work, particularly in the nearshore section closest to the holiday complexes, and the perceptions and reactions of guests. Impacts could therefore last beyond the Construction and Pre-Commissioning Phase of the Project if guests do not return or provide negative feedback to others.

For users of Sukko beach, marine construction vessels, and in particular the pipe laying vessel, will be highly visible for a few days (or a week at most) during the construction of each pipeline. The four pipelines are to be laid as quickly as possible over a period of approximately 15 months commencing in Q1 2015. As such, the impact will be likely to occur on a single occasion during the main summer peak period, when usage of the beach would be highest. Following construction, the impact will cease and beach users will not experience any impacts in

relation to the operation of the Pipeline. As such, amenity-related visual impacts are temporary and unlikely to compromise beach users' ability to enjoy recreational activities such as swimming, playing, sunbathing etc. Therefore, any impacts on the well-being of beneficiaries are likely to be of low magnitude.

There is a potentially significant adverse visual impact on users of the Mountain of the Caucasus Trail which runs along the top of the cliff and affords users clear views out to sea. However, these impacts are likely to be temporary and aside from a changed visual outlook, there will be no other impact on users' enjoyment of, or access to, the trail. The extent of the impacts, in terms of the number of people affected, would be low given the relatively low usage of the trail.

In addition to noise and visual disturbance, the Project may restrict access to certain recreational activities in the marine and terrestrial Affected Ecosystems. In the marine environment, safety exclusion zones will be created in order to avoid impacts on recreational water users. While there could potentially be an adverse impact on sailing activities, it is considered that recreational sailors will not be impacted by the Project given their ability to easily navigate around the vessel spread during construction of the nearshore and offshore sections. There is one dive site (the Gordiyya barge, a sunken wooden shipwreck which has become an artificial reef) located close to the nearshore section of the Project although the site lies outside of the safety exclusion zone and access will not be restricted (Figure 17.13).

In the terrestrial environment, impacts on horse riding operations could be more significant as, in addition to visual disturbance, the operator may lose access to horse riding trails (or at least parts of them) during the Construction Phase which could impact on their business. While the exact details of the riding route have not yet been identified, if it crosses the Pipeline route, the business will not be able to use that route during the period of construction of the Pipeline and the owner will need to find a suitable replacement riding route. However, until the current route is confirmed, it is not possible to assess what impact the Project may have on this business.

A further potential impact is a decline in marine water quality due to sediment dispersal during the dredging process which could potentially impact on the Shingari and Don resorts, recreational water users, and scuba diving operations. The results of sediment modelling studies undertaken for the ESIA found that sediment is dispersed from each proposed dredging and disposal operation, a process that lasts 1.3 days per pipeline operation (Appendix 12.2 Sediment Dispersion Study).

Dredging activity could potentially affect the quality of the water at the beach in front of the Shingari complex for short periods of time under certain conditions depending on the prevailing currents and the level of sediment suspension in the water. However, modelling indicates that even in a worst case scenario, any sediment plume impact on the beach will be minor and concentrated in one area for 3 to 5 days per pipeline. Taking these factors into account, the magnitude of impact on visitors to and owners of the resort are likely to be low.

There is a potential risk to scuba dive operators if sediment dispersal reduces seawater quality and clarity at diving spots used by diving tour operator businesses off the coast from Sukko. However, the extent of sediment blooms are likely to be small and of short duration (a matter of days). Alternative dive sites are also available and, as such, the significance of any impacts on divers and dive operators are likely to be low and easily avoidable.

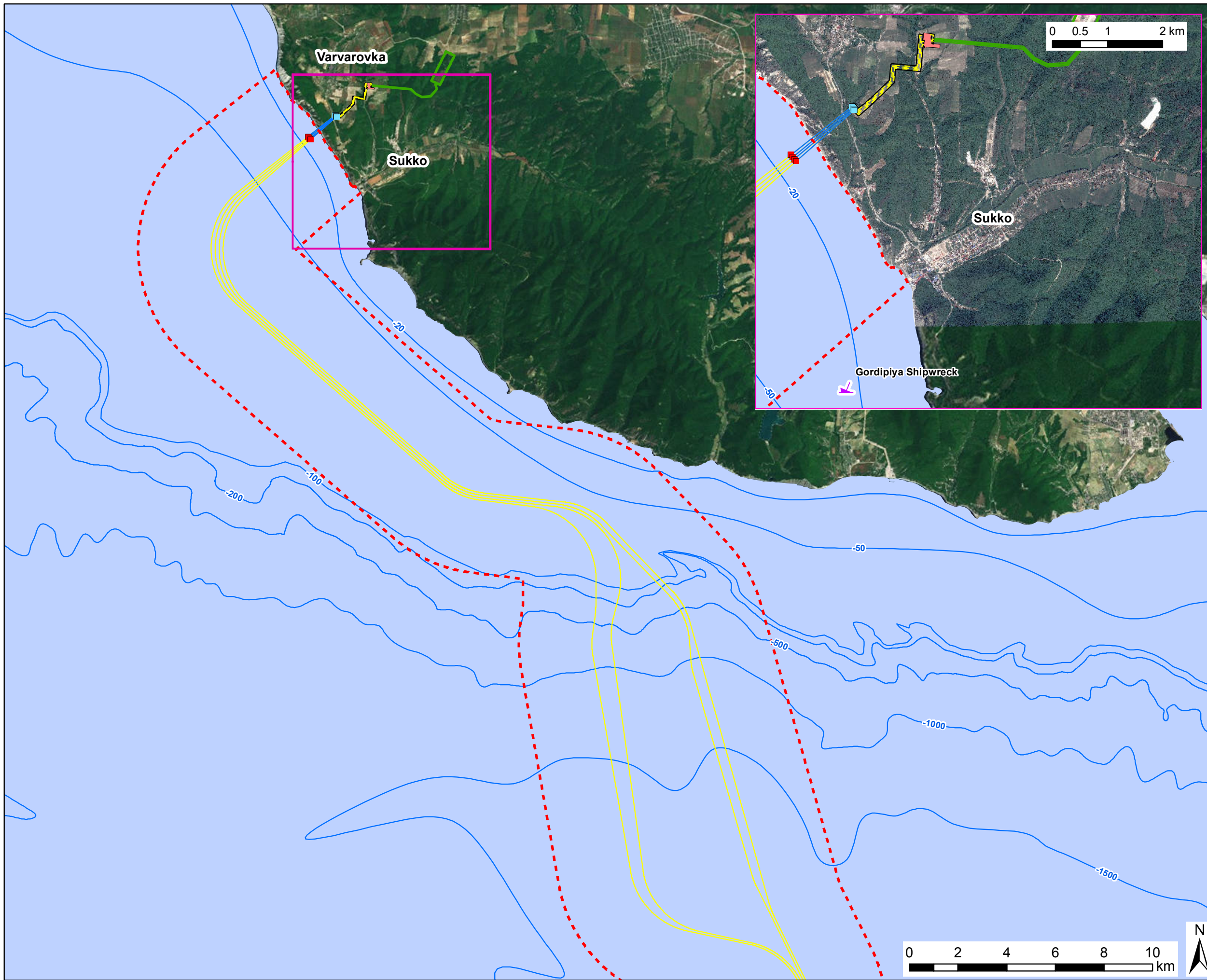
The quality of diving conditions is also dependent upon the range of marine species present although **Chapter 12 Marine Ecology** indicates the significance of Project impacts upon marine species is generally low and temporary. As such the impact on the well-being of divers is not likely to be significant. Impacts on mussel and other benthic species are likely to be limited and there is unlikely to be any resulting change in beach formation rates.

Taken together, the impacts of the Project on the well-being of beneficiaries of the tourism and recreation services are likely to be low, as it is unlikely that any activities or uses will be prevented. However, there is potential for some loss of well-being and livelihoods for visitors to and owners of the Shingari and Don holiday complexes, the horse riding operator in Varvarovka, visitors to Sukko beach, and users of the hiking trail. The impacts are expected to occur for short periods during the Construction and Pre-Commissioning Phase whereafter the Affected Ecosystems are expected to recover completely in a short period of time (as impacts are primarily visual disturbance and reduced access). The beneficiaries will be affected periodically by discrete activities during the Construction and Pre-Commissioning Phase.

The overall impact magnitude is therefore considered to be low (refer to Appendix 17.3 for the scoring against each of the impact magnitude criteria).

Impact Significance

The overall significance of the impact of the Construction and Pre-Commissioning Phase is considered to be **Moderate** and tourism and recreation services are identified as a priority service.



LEGEND

- Approximate 3km offshore construction safety exclusion zone
- Shipwreck diving site (plotted based on approximate location coordinates N 44°46' E 37°22')
- Russian Sector of South Stream Offshore Pipeline
 - Proposed landfall section pipelines
 - Landfall facilities
 - Proposed microtunnels
 - Right-of-Way
 - Proposed offshore pipelines
 - Microtunnel entry shaft
 - Microtunnel exit pit
- United Gas Supply System
 - Russkaya compressor station
 - United Gas Supply System pipelines
 - Isobaths

Projection: Lambert Conformal Conic

Revision Details	By	Check	Date	Suffix

Purpose of Issue: For Information

Client: **South Stream**
Offshore Pipeline ENERGISING EUROPE

Project Title: **SOUTH STREAM OFFSHORE PIPELINE**

Drawing Title: **LOCATION OF DIVE SITE CLOSEST TO THE SAFETY EXCLUSION ZONE OF THE PROJECT**

Drawn	Checked	Approved	Date
DH	RW	MW	05 Mar 2014

URS Internal Project No. 46369082
Scale @ A3 1:150,000

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Drawing Number	Rev
Figure 17.13	

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Cultural and Spiritual Values

The services considered in this section are the cultural and spiritual values provided by, or dependent upon, Affected Ecosystems. The key beneficiaries of this service are therefore:

- Local and regional visitors to the Varvarovka cemetery; and
- Local residents and visitors who benefit from the cultural and aesthetic qualities of the landscape, its history and identity as an area of agricultural production, and its situation adjacent to the Black Sea.

Additional beneficiaries of this service include visitors to memorials and religious sites such as St. Barbara's Source and the festival at the khachkar, although there are no identified Project activities which may impact on the ability of beneficiaries to access or use these services.

Wider beneficiaries could also include the national and global scientific community who may be interested in terrestrial and marine archaeological sites. **Chapter 16 Cultural Heritage** identified a number of archaeological resources which could be impacted by the Project, including: a burial mound, a submerged aircraft wing, a ceramic amphora, and a wooden shipwreck.

However, the sites do not presently have any strong or special significance for any particular community or cultural group for social, cultural, or spiritual reasons. The sites of cultural or archaeological heritage identified are not sacred sites and are not the focus of traditional beliefs and ceremonies, mainstream religious practices, secular pilgrimage, or cultural identity. As such, the value of the sites that may be disturbed is considered to be principally historic and scientific, rather than of aesthetic, community / social or spiritual value for present or future generations. A full discussion of the Project's impact on these sites is provided in **Chapter 16 Cultural Heritage**.

Therefore, the assessment focuses on potential impacts on visitors to the Varvarovka cemetery and residents of the Local Area who value the cultural and aesthetic nature of the landscape.

The Project activities which may impact provision of this service include:

- Damage to the environmental setting of the Local Area and particular sites through vegetation clearance, noise pollution, and visual disturbance; and
- Loss of tranquility and disturbance to cemetery visitors through increased construction related traffic and visual disturbance.

Receptor Sensitivity

While local and regional populations are not likely to be dependent on cultural services for their livelihoods or income, they may nevertheless value them and derive spiritual and cultural gratification. Within the area the agricultural and coastal landscape has an important aesthetic value and plays a role in the cultural identity of local communities. Further, relatives of those buried in the Varvarovka cemetery are likely to be highly dependent on this service in terms of their ability to remember and pay respects to the deceased.

The aesthetic and cultural identity of a landscape and the populations living within it cannot be replaced through construction or engineering. Likewise, there are no alternative sites for visitors to the Varvarovka cemetery where they can visit their deceased relatives and, while it may be

possible to relocate the cemetery, it would entail significant social and economic costs. As such, it is considered that there are no alternatives to this service.

The environmental setting of cultural sites is considered of low sensitivity to change since habitat is well replicated in the area and, although ecosystems may be vulnerable to direct impacts such as land and vegetation clearance, they are not likely to be particularly vulnerable to more indirect changes such as climate change, population growth, changing water availability or temperature etc.

Local populations are likely to be sensitive to significant changes in the nature of the landscape although will be less sensitive to small changes due to the extent of natural habitat and its ability to absorb visual impacts. Visitors to the cemetery, on the other hand are likely to be highly sensitive to change spiritual services are strongly linked to the nature of the environmental setting.

In sum, the receptor sensitivity for cultural and spiritual services is considered to be high.

Impact Magnitude

Any development which requires vegetation clearance within a landscape with cultural and aesthetic value to local populations will have an impact on the aesthetics and identity of the area. However, the relatively small extent of natural habitat loss and productive agricultural land which will be cleared by the Project (Table 17.13 and Table 17.14), together with the use of microtunneling which means that most of the cleared land can be replanted following construction, mean that it is unlikely the Project will significantly change the character of the landscape or the nature of the Local Area as a productive agricultural region (**Chapter 13 Landscape and Visual Assessment**). As such, the Project is unlikely to have a significant impact on the cultural value of the landscape and is unlikely to lead to a significant change in the well-being of any beneficiaries of this service.

In addition to general landscape impacts, there may be a localised increase in noise and visual intrusion to the environment surrounding the Russian Orthodox and Armenian cemetery at Varvarovka. Visitors to the cemetery are likely to value and also place importance on the surrounding environment, and any disturbance of tranquillity to users could have an impact on well-being during construction activities.

Chapter 10 Noise and Vibration finds the impacts in terms of noise and vibration on the cemetery to be negligible, however, **Chapter 13 Landscape and Visual Assessment** finds an impact of moderate magnitude due to views of the construction activities and use of the access road along the northern and eastern boundaries of the cemetery. While there is likely to be a degree of visual intrusion into the environment surrounding the cemetery it will be temporary and the extent of disturbance is not likely to prevent visitors from using the site or being able to pay their respects.

Impacts on the well-being of beneficiaries of cultural services are therefore likely to be low and any disturbance is likely to be felt periodically throughout the duration of the Construction period. The ecosystems themselves are likely to be able recover naturally within the short term from such disturbance.

In sum, the impact magnitude for cultural and spiritual services is considered to be low (refer to Appendix 17.3 for the scoring against each of the impact magnitude criteria).

Impact Significance

In combination, the total impact significance on the cultural and spiritual values ecosystem service is therefore judged to be **Moderate** and cultural and spiritual services are identified as a priority service.

Wild Species Diversity

The service considered in this section is the diversity of locally, regionally, nationally, or globally important species which live within, or are dependent upon, Affected Ecosystems. The beneficiaries include:

- Any communities within the Local Area, wider region, nation, or global area who value and appreciate the existence and diversity of species living within or dependent upon Affected Ecosystems.

The Project activities which may impact provision of this service include:

- Loss and fragmentation of terrestrial habitat resulting from vegetation clearance during soil stripping and land clearance;
- Killing, injury, and disturbance of individual terrestrial species during site preparation and construction as well as noise and vibration emissions from vehicles, plant, and construction activities;
- Introduction of non-native species to the terrestrial environment;
- Impacts on aquatic life through vessel and welding wastes, cooling water discharge, proximity of vessels, and use of lighting;
- Impacts on benthic communities from seabed disturbing activities including surveys and inspections, obstacle removal ("pre-sweeping"), dredging, pipe-laying, post-lay trenching, rock placement / seabed intervention, and anchoring;
- Disturbance to seabirds through vessel movements during mobilisation, surveying and pipe-laying activities, displacement or loss of prey in the nearshore area, and mortality due to bird strikes on highly illuminated offshore installations; and
- Disturbance to marine mammals through surveying and pipe-laying activities, cooling water discharges, displacement of food resources, noise and collisions from vessel movements and use of dynamic positioning.

Receptor Sensitivity

Beneficiaries of wild species diversity (i.e. those who value the existence of wild species) are considered to be of moderate dependence on the service. While there were no beneficiaries identified as being dependent on any species for livelihoods or income, the high level of concern about impacts on wild species raised during consultation, together with the presence of critically

endangered species of global conservation significance, suggest that this is an important service to beneficiaries and one on which welfare depends to a moderate extent.

The ecological role of a particular species could potentially be replaced by others although the existence value of that species cannot. Therefore, there are no replacements available to individual species. If a species is lost from an area it could be reintroduced from other areas although there are significant costs associated with such processes and a successful reintroduction can be difficult to achieve.

Due to the identification of Critical Habitat within the Affected Ecosystems and presence of the critically endangered Nikolski's tortoise in the terrestrial environment the ecosystem sensitivity is considered to be high, although the receptor sensitivity is considered low due to the widespread national and international financial and legislative resources available to adapt to any changes.

In sum, the receptor sensitivity for the wild species diversity service is considered to be high.

Impact Magnitude

There are a total of ten habitat types falling within the terrestrial Affected Ecosystems, five of which will require an area of habitat loss. Table 17.14 lists these habitats and the area of each habitat falling within the Affected Ecosystems which will be cleared or which have already been cleared to facilitate the geotechnical surveys undertaken in 2012 (**Chapter 11 Terrestrial Ecology**).

Table 17.14 Habitat Clearance in the Terrestrial Affected Ecosystems

Habitat Type	Area of Habitat Within the Affected Ecosystems (ha)	Area of Habitat Within the Affected Ecosystems already lost (ha)	Area of Habitat Within the Affected Ecosystems subject to loss (ha)
Shiblyak	426	0.39 (0.09%)	3.6 (0.8%)
Mesophilic forest	63	0	1.4 (2.2%)
Juniper woodlands	56	0.32 (0.6%)	2.6 (4.6%)
Tomillyar	7	0.03 (0.4%)	0
Steppefied secondary meadow*	110	0	4.1 (3.7%)
Mesophilic meadow	10	0	0
Rocky outcrops	8	0	0
Coastal shingle	3	0	0

Continued...

Habitat Type	Area of Habitat Within the Affected Ecosystems (ha)	Area of Habitat Within the Affected Ecosystems already lost (ha)	Area of Habitat Within the Affected Ecosystems subject to loss (ha)
Urban and Agricultural habitats*	239	0	59 (24.7%)
Running water	2	0	0

*Modified habitats

Complete.

As set out in Table 17.14, the Project requires clearance of Critical Habitat (Mesophilic forest and Tomillyar) and habitat which has important local values (Juniper woodlands). However, the extent of habitat clearance relative to the surrounding area is relatively small scale and is unlikely to have long term impacts on the nature or population viability of the habitats to be cleared. As such, the impact on beneficiaries is likely to be low.

In the absence of appropriate design controls, there is the potential for the introduction of invasive fauna and flora during construction. Although of a relatively low probability, introduction of invasive species has the potential to significantly alter the ecology of natural habitats and affect their overall integrity in the long term.

With regards to fauna species, the greatest impacts within the terrestrial Affected Ecosystems are likely to occur due to the removal of mesophilic and shiblyak woodland which provide habitats for nesting birds and reptiles. Of particular concern are potential impacts on Nikolski's tortoise which is known to occur within the Affected Ecosystems.

These habitats, together with juniper woodland and secondary steppefied meadow, are of particular importance to the tortoise during the active period for foraging, shelter, breeding and hibernation and have the potential to support significant numbers of Nikolski's tortoise. Local populations of this species are of important conservation significance to this species and construction activities may lead to disturbance and direct mortality of the species. Further impacts on this species could occur through loss and fragmentation of habitat (due to road construction), soil excavation which may impact hibernating and reproduction, or direct mortality through construction activities and are likely to be of significance to the global conservation community.

The marine Affected Ecosystems lie within Tier 2 critical habitat, which was identified according to IFC criteria for endangered, migratory, and congregatory species for certain pelagic fish, seabirds, and cetaceans. While the Project is unlikely to have any significant impact on this habitat, there may be some disturbance to particular species during construction activities. In particular, vessel movements during mobilisation, surveying and pipe-laying activities have the potential to temporarily disturb marine mammals which are of value to people in the region. However, these are highly mobile animals with acute sensory perception and are generally able to avoid areas of disturbance and only a few individuals are likely to be affected, if any. As such, there are unlikely to be any threats to the population of cetacean species or any significant impacts on the well-being of beneficiaries who value these species.

There may also be some temporary disturbance to fish and bird species although they are likely to be of low significance. The tub gurnard, which may be of importance in the Local Area, faces some risk due to potential loss of food and habitat in excavated areas, however, there are unlikely to be any significant impacts on populations or their beneficiaries.

Taken together, the small extent of habitat required for the Project and the nature of the construction activities are unlikely to have a significant impact on the long term viability of populations of any of the species in the area. As such the impact on well-being is expected to be low. However, the length of impact on beneficiaries of the service (such as through clearance of valued habitat) is likely to extend across the current human generation who value species diversity in the affected area.

Populations are likely to recover from any noise, disturbance, or collision damage following the construction period, however, loss of terrestrial habitat or introduction of any species which become successfully established could have longer lasting impacts on the ability of species to feed and reproduce, which could have long term impacts on population structures. The risks and disturbance to species (and therefore the impact on beneficiaries) are likely to occur regularly throughout the construction period.

In sum, the impact magnitude on the wild species service is considered to be moderate (see Appendix 17.3 for the scoring against each of the impact magnitude criteria).

Impact Significance

In combination, the total impact significance on the wild species diversity ecosystem service is therefore judged to be **High** and is identified as a priority service.

17.7.2.3 Mitigation and Monitoring

Based on the results of the impact assessment (see Appendix 17.3 for a detailed summary of the scoring assigned to each ecosystem service), five ecosystem services were identified as priority services which are likely to be significantly impacted during the Construction and Pre-Commissioning Phases of the Project and which will require further mitigation:

- Crops;
- Soil quality regulation;
- Tourism and recreation values;
- Cultural and spiritual values; and
- Wild species diversity.

In accordance with Good International Industry Practice, the Project will strive to avoid and then to minimise impacts as far as possible through design before undertaking mitigation measures. Design controls aimed at achieving this goal are summarised in the description of relevant Project design controls set out in **Chapter 5 Project Description**.

Where impacts cannot be avoided through design, appropriate mitigation measures for each of the adverse environmental and social impacts identified are discussed in detail in the relevant technical chapters. For the priority services identified, the measures implemented by the Project

have the additional goal of maintaining (or restoring where they have been damaged or degraded) the value and functionality of these services for beneficiaries over the short and long-term.

Due to the cross-cutting nature of ecosystem services, mitigation of impacts on these services will be captured under a range of Construction Management Plans (CMPs) in the Health, Safety, Security and Environmental Integrated Management System (**Chapter 22 Environmental and Social Management**).

General Mitigation Measures

A number of General Mitigation measures will be adopted by South Stream to address adverse impacts where appropriate. These include:

- A Grievance Procedure which will be implemented by South Stream Transport in partnership with its contractors and will ensure that grievances are brought to the attention of the appropriate Project staff and addressed in an appropriate and timely way, following a standard procedure of investigation, analysis, and resolution. It will also ensure that resolutions are documented and communicated to the appropriate stakeholders;
- A Compensation Management Framework to guide the evaluation and determination of compensation measures. The Compensation Management Framework will capture the process and requirements for assessing compensation claims and implementing compensation measures;
- A Livelihood Restoration Framework to provide for the possibility that livelihood impacts do occur. This Framework will define the process that will be undertaken to identify the need for specific livelihood restoration measures, and the development of these measures in consultation with affected stakeholders and relevant local agencies. The overall goal will be to ensure that affected livelihoods are restored, at minimum, to pre-impact levels;
- On-going Stakeholder Consultation throughout the Construction and Pre-Commissioning Phase. These engagement activities will be designed to facilitate dialogue with relevant stakeholders, including those potentially affected by the Project, or who are concerned about or interested in the Project. These activities will allow potential impacts, issues and concerns to be identified early on and addressed in an expedient manner. These activities will also inform stakeholders of upcoming construction activities, as well as Project Activities that have been completed, and provide advance warning of any anticipated changes; and
- A Community Investment Plan to guide community investment initiatives and opportunities for the Project.

Further details on these measures are set out in **Chapter 14 Socio-Economics**.

In addition to applying these General Mitigation measures where appropriate, a number of specific measures will be adopted to address impacts on ecosystem services and their beneficiaries where required. The full range of mitigation measures for each priority service is set out below.

Crops

The Project was identified as having an impact of moderate significance on provision and use of this service due to potential economic displacement of workers employed by Agrifirm Kavkaz.

Measures to avoid impacts on land use and vegetation clearance are set out in **Chapter 5 Project Description**. However, it is not possible to avoid all impacts on this service as an area of productive agricultural land will need to be cleared to allow construction of the Project.

While it is unlikely that the clearance of agricultural land will lead to any on-going displacement of workers, there could potentially be limited, temporary displacement during construction activities. As such, the General Measures at the start of this section, Section 17.7.2.3, will apply as appropriate.

In addition, after construction, all land that is not required for permanent above ground infrastructure in the Operational Phase will be reinstated to a state as near to the original condition as possible or to a form in keeping with the surrounding topography where this is not precluded by risk to integrity of the Pipeline or erosion considerations. All necessary actions will be applied to ensure that reinstated land can function, at minimum, as productively as that prior to land acquisition.

Residual Impact

While it is unlikely that there will be any displacement of workers, the Grievance Procedure, Livelihood Restoration Framework, Land Acquisition Policy, and Compensation Management Framework are in place to ensure that there are no lasting impacts on the wellbeing of any workers if displacement does occur. These policies will compensate for any impacts on livelihoods.

The small extent of agricultural land clearance together with the development and implementation of a LRF mean that there are unlikely to be any significant residual impacts on workers employed by Agrifirm Kavkaz, although it is not certain at this stage. As such, while the impact magnitude with mitigation in place is likely to be reduced to negligible, it is considered that the overall residual impact is of **Low** significance.

Soil Quality Regulation

The impact on soil quality was assessed as being of moderate significance. The primary impacts with respect to beneficiaries are likely to be in terms of potential contamination of soils or disturbance of existing areas of contamination which could lead to human health risks, and structural damage to soils which could lead to lower soil productivity and impairment of natural ecosystem functioning. Mitigation measures for these impacts are set out below.

Human Health Risk

The main risks of soil contamination can be avoided by adopting the mitigation measures set out in **Chapter 8 Soils, Groundwater and Surface Water**. While it is unlikely that contamination risks can be avoided completely, development of a Spill Prevention and Response Plan for early identification and disposal of contamination should minimise any remaining risk.

In addition, in order to reduce the risk of disturbing existing areas of contamination a contingency plan will be developed in the ESMP to deal with encountering soil contamination not identified during the pre-construction studies. In the event that previously unidentified contamination is observed during construction, the plan will set out that works in the affected area will cease and appropriate mitigation measures will be designed.

Following these mitigation measures there may be potential risks to workers on the Project who are in contact with soil if contamination is identified. Workers will therefore be given access to the necessary safety equipment as well as full health and safety training in accordance with the Health and Safety Plan.

Structural Damage to Soils

A number of measures are also set out in **Chapter 8 Soils, Groundwater and Surface Water** to minimise structural impacts on soils including careful management of the topsoil to be displaced during construction as well as replanting of native vegetation which will help to maintain the structural and ecological integrity of the soil.

Residual Impact

With the mitigation measures set out above, the risks to the health of workers and structural composition of the soil should be reduced to negligible. As such, the magnitude of impacts with mitigation is considered to be negligible and the overall residual impact is therefore **Not Significant**.

Tourism and Recreational Values

The impact significance of the Project on tourism and recreation values was assessed as moderate. The principal impacts on beneficiaries are likely to be in terms of disruption to users and owners of the Shingari and Don resorts due to visual impact; disruption to users of Sukko beach and the surrounding marine environment; and potential disruption of horse riding operations.

Design controls are set out in **Chapter 5 Project Description** to avoid impacts on this service although it is unlikely that adverse impacts on beneficiaries can be avoided altogether. Measures to minimise unavoidable impacts and compensate beneficiaries where necessary are set out below.

Disturbance to Shingari and Don Resorts

The General Measures at the start of this section, Section 17.7.2.3, will apply as appropriate. In addition:

- Plans indicating the Pipeline route and construction phase vessel spread along with timing of construction activities will be provided to the relevant authorities for distribution to local businesses as appropriate, including Shingari and Don holiday complexes;
- For visual impacts that have not been avoided through design controls, **Chapter 13 Landscape and Visual** has set out mitigation measures to mitigate visual impacts. Specifically, to mitigate impacts on recreational visitors to the seashore, including the public

beaches at Sukko and Anapa, and the private beach at the Shingari and Don holiday complexes, mitigation includes: phasing construction where practicable; avoidance of night-time construction activities as far as practicable; and directional shielding for lighting on vessels, other than navigational lights on vessels; and

- **Chapter 12 Marine Ecology** sets out measures to prevent sedimentation impacts on recreational water users along the coast line.

Disturbance to Users of Sukko Beach and the Surrounding Marine Environment

The General Measures at the start of this section, Section 17.7.2.3, will apply as appropriate. Specific to recreational beach users, the Project will provide regular updates to beach users regarding construction activities and schedule, both on land and at sea. Updates and information provided to beach users will also include information about how interested parties can contact South Stream Transport with questions, concerns or complaints.

As set out in respect to the potential for reduced business revenues on Shingari and Don holiday complexes and the Anapa Resort Town tourism sector, **Chapter 13 Landscape and Visual** has set out mitigation measures to mitigate visual impacts. Likewise, **Chapter 12 Marine Ecology** also sets out measures to prevent sedimentation impacts on recreational water users along the coast line.

Impacts on Horse Riding Operations

The General Measures at the start of this section, Section 17.7.2.3, will apply as appropriate. In addition:

- The Project will work with the Varvarovka Horse Riding Business to undertake further investigation to check the horse riding route prior to construction to understand whether or not there may be an impact on the horse riding business if the route is not usable during the construction period and, if so, whether mitigation is required; and
- If access to all or part of the horse riding route is restricted or severed by the Project, South Stream Transport will work with the business owner to identify a suitable alternative. Whether or not an alternative can be found, the Compensation Management Framework and Livelihood Restoration Framework will also apply in the event that impacts on business revenues are evident. South Stream Transport will also engage with the stakeholder prior to and throughout the Construction and Pre-Commissioning Phase to ensure that the stakeholder is informed of Project activities and restrictions, and to understand any concerns the stakeholder may have. The Grievance Procedure will also apply to any complaints related to horse riding and related business impacts.

Residual Impact

The mitigation measures set out above are expected to reduce the significance of any impacts on the Don and Shingari resorts to negligible as financial compensation will be provided if necessary to ensure there is no loss of livelihoods.

For users of Sukko beach and the surrounding marine environment the mitigation measures listed above are unlikely to entirely eliminate potential impacts on beneficiaries as there will be

some level of temporary visual disruption. While they cannot be eliminated, the impacts are unlikely to have a significant lasting effect on the ability of any beneficiaries to enjoy recreational services in the area or impact on livelihoods derived or dependent on this service.

The measures set out to address impacts on the horse riding operation (including the Livelihood Restoration Framework) should reduce the magnitude of the impact.

As such, with the proposed mitigation measures in place the magnitude of impacts is expected to be negligible and the residual impact significance is expected to be **Low**.

Cultural and Spiritual Values

The impact on this service was assessed as moderate significance, primarily due to loss of tranquillity and disturbance to users of the Varvarovka cemetery.

The General Measures at the start of this section, Section 17.7.2.3, will apply as appropriate. Further mitigation measures to address this are set out in **Chapter 13 Landscape and Visual** and **Chapter 16 Cultural Heritage** including re-routing the proposed access road in proximity to the cemetery in order to minimise the impact on visual amenity and landscape character, and planting of vegetation to act as screening.

The implementation of this mitigation should reduce the impact on well-being to negligible and the impact significance to **Low**.

Wild Species Diversity

The impact significance of the Project on wild species diversity was assessed as high. The principal impacts on beneficiaries of terrestrial wild species are likely to be in terms of habitat clearance, in particular loss of Critical Habitat and juniper woodlands of important local value; the risk of introduction of alien invasive species which could disrupt populations of existing species and disrupt the balance of ecosystem functioning; and disturbance to an important population of the critically endangered Nikolski's tortoise. With regards to beneficiaries of marine wild species, the principal impact is likely to be disturbance to charismatic cetacean species in the marine environment.

Chapter 5 Project Description sets out a range of design control measures to avoid impacts on this service. Since some level of impact is unavoidable, additional measures are set out in **Chapter 11 Terrestrial Ecology** and **Chapter 12 Marine Ecology**. These chapters set out a detailed mitigation approach which comprises general mitigation measures for addressing impacts on the terrestrial environment, a herpetile mitigation strategy for addressing impacts on herpetile species including Nikolski's tortoise, a Biodiversity Action Plan (BAP) for ensuring net gain in critical habitat, and measures for addressing impacts on the marine environment.

Impacts on Terrestrial Species and their Beneficiaries

The general mitigation measures will include provision for an Ecological Clerk of Works (ECoW), training of construction personnel, and implementation of a CMP which will minimise the risk of introduction of invasive species.

The Herpetile Mitigation Strategy will cover the construction period and will detail the measures to be employed to protect key ecological receptors such as the Nikolski's tortoise, particularly during initial site clearance works. One of the main risks to this species is harvesting for use in the pet trade, for medicinal purposes, and for food (Ref 17.53). All such, all workers on site will receive education and training with regards to identification of this species and the importance of protecting individuals and avoiding any unnecessary disturbance.

While these measures should reduce the residual impacts on the species to low, given the sensitivity of the receptor, the conservation community may still be concerned about the impacts of the Project. Given this, the Project will further mitigate any potential impacts on the species and its beneficiaries through engaging with local stakeholders (e.g. the Utrish reserve and universities researching this species) and support research and conservation efforts directed at the species.

The Project's mitigation strategy will be described in a BAP and will be designed to achieve net gains of those biodiversity values for which the critical habitat was designated. Management and monitoring requirements for an appropriate length of time will also be specified.

Since particular habitats such as juniper woodlands have important local value and the habitat mosaic provides important ecosystem services in addition to its role in supporting wild species diversity (such as enabling soil, water, and air quality regulation; cultural / aesthetic values; hazard regulation; provision of wild foods etc.), the BAP will take such considerations into account when designing any habitat restoration measures.

Impacts on Marine Species and their Beneficiaries

Within the marine environment, measures are set out in **Chapter 12 Marine Ecology** to reduce disturbance to cetacean species. A monitoring programme, particularly for fish, birds and mammals, will be appropriately designed to meet research objectives that enhance knowledge to the point that conservation measures can be tangibly improved. The scope of such programmes will be developed in consultation with relevant parties to ensure the maximum benefit is delivered.

Residual Impact

Through the adoption of these mitigation measures the extent of habitat loss, risk of introduction of invasive species, and direct Project impacts on populations of Nikolski's tortoise and marine species should be minimised. The development via a BAP of a mitigation strategy that will be designed to achieve net gains of those biodiversity values for which the critical habitat was designated is expected to address some of the key pressures on this species and increase awareness of the value of this species amongst the local population. As such the magnitude of the residual impact on the well-being of beneficiaries with mitigation is considered to be negligible and the overall significance of the impact is **Not Significant**.

17.7.2.4 Residual Impacts: Construction and Pre-Commissioning

The residual Project impacts during the Construction and Pre-Commissioning Phase are discussed in the above sections and a summary is presented in Table 17.15 below.

Table 17.15 Assessment of Potential Impacts: Construction and Pre-Commissioning

Ecosystem Service	Activity	Potential Impact	Receptor(s)	Receptor Sensitivity	Impact Magnitude / Likelihood	Pre-Mitigation Impact Significance	Mitigation Measures	Residual Impact Significance
Crops	Vegetation clearance for Pipeline corridor	Loss of current production and future use, potential loss of jobs	Migrant workers	High	Low	Moderate	Land reinstatement On-going stakeholder consultation Grievance Procedure Compensation Management Framework Livelihood Restoration Framework	Low
Capture fisheries	Sedimentation, safety exclusion zones, noise and visual disturbance	Changes in fishery productivity, loss of access to fishing grounds, barrier to migration	Fishing industry	Moderate	Negligible	Not significant	n/a	Not significant

Continued...

Ecosystem Service	Activity	Potential Impact	Receptor(s)	Receptor Sensitivity	Impact Magnitude / Likelihood	Pre-Mitigation Impact Significance	Mitigation Measures	Residual Impact Significance
Water (supply)	Dewatering, abstraction, changes in surface water flows	Reduced accessibility of water resources	Downstream abstractors including Project, MoD and local households	Moderate	Negligible	Not significant	n/a	Not significant
Hazard regulation	Vegetation clearance, earthworks, soil excavation, dredging	Increases in flood / landslide risk, changes in coastal erosion rates	Households and businesses, recreational beach users, Project itself	Moderate	Low	Low	n/a	Low
Air quality regulation	Emissions, vegetation clearance, dust generation	Lower air quality, human health risk, impact on tourism	Local households, workers, visitors, tourism industry	Moderate	Negligible	Not significant	n/a	Not significant

Continued...

Ecosystem Service	Activity	Potential Impact	Receptor(s)	Receptor Sensitivity	Impact Magnitude / Likelihood	Pre-Mitigation Impact Significance	Mitigation Measures	Residual Impact Significance
Water quality regulation	Waste disposal, contamination, vegetation clearance, sediment plumes, impacts on marine environment	Risk to human health	Households, visitors to St. Barbara's Source, tourism and fishing industries	Moderate	Low	Low	n/a	Low
Soil quality regulation	Contamination, leaks and spills, structural damage, loss of vegetation, disturbance of unidentified contamination	Lower soil productivity, health risks to workers, reduced ecosystem functioning	Landowners, viticulture industry including food consumers, workers on site and in the area	Moderate	Moderate	Moderate	Measures set out in Chapter 8 Soils, Groundwater and Surface Water Early identification and removal of contamination, Spill Prevention and Response Plan Restoration of native vegetation Health and safety plan for workers	Not significant

Continued...

Ecosystem Service	Activity	Potential Impact	Receptor(s)	Receptor Sensitivity	Impact Magnitude / Likelihood	Pre-Mitigation Impact Significance	Mitigation Measures	Residual Impact Significance
Tourism and recreation values	Noise and visual disturbance, exclusion zones, water quality decline, marine ecology impacts	Reduced recreational use of area and corresponding impact on livelihoods	Resort owners and visitors, users of beaches and marine areas, walkers and horse riders	High	Low	Moderate	On-going stakeholder engagement Provision of construction plans to relevant authorities Grievance Procedure Compensation Management Framework Livelihood Restoration Framework Sediment prevention mitigation as detailed in Chapter 12 Marine Ecology Visual impact mitigation as detailed in Chapter 13 Landscape and Visual	Low

Continued...

Ecosystem Service	Activity	Potential Impact	Receptor(s)	Receptor Sensitivity	Impact Magnitude / Likelihood	Pre-Mitigation Impact Significance	Mitigation Measures	Residual Impact Significance
Cultural and spiritual values	Vegetation clearance, noise and visual disturbance	Loss of cultural and aesthetic values of landscape, disturbance to cemetery	Visitors to cemetery, local residents	High	Low	Moderate	On-going stakeholder consultation Grievance Procedure Re-routing proposed access road as set out in Chapter 16 Cultural Heritage Vegetation screening as set out in Chapter 13 Landscape and Visual	Low
Wild species diversity	Loss of critical habitat and disruption to critically endangered tortoise species, risk of invasive species introduction, disturbance to marine mammals	Increase vulnerability of threatened species, loss of valued habitat	Local communities, global conservation community	High	Moderate	High	Measures set out in Chapter 11 Terrestrial Ecology Measures set out in Chapter 12 Marine Ecology Worker education Stakeholder engagement BAP with ecosystem service considerations where possible	Not significant

Complete.

17.7.3 Assessment of Potential Impacts: Operational Phase

17.7.3.1 Introduction

In the following sections the key beneficiaries of each ecosystem service and the relevant Project impacts during the Operational Phase are discussed. For each of the ecosystem services the beneficiaries are grouped together and the Project impact is assessed in terms of the total impacts on that service across all of its beneficiaries. A detailed breakdown of the scoring assigned to each ecosystem service is provided in Appendix 17.4 Impact Assessment – Operational.

17.7.3.2 Assessment of Potential Impacts (pre-mitigation)

Crops

The impacts on beneficiaries of crop services in terms of vegetation clearance during construction, loss of land, and corresponding impacts on employment opportunities are discussed in Section 17.7.2.2. While these impacts are on-going and are likely to be felt during the Operational Phase (as crops are re-established) they are assessed as part of the Construction and Pre-Commissioning Phase as that is when the activities leading to the impacts are undertaken.

In terms of activities undertaken during the Operational Phase, there are none identified which could significantly impact provision or use of crops within the Affected Ecosystems or the well-being of beneficiaries of this service.

The Operational Phase is therefore likely to have a negligible impact magnitude and the impact significance is assessed as **Not Significant**. Crop production is therefore not considered to be a priority ecosystem service during the Operational Phase

Capture Fisheries

The specific Project activities during the Operational Phase that could impact upon capture fisheries include restriction of access to fishing grounds due to an exclusion zone, and noise disturbance from Pipeline operation (Appendix 14.1).

With regards to the exclusion zone, beyond approximately 600 m from the shoreline the Pipeline will lie unburied on the seabed creating a potential hazard for fishing vessels which could make contact with their gear. To ensure that the Pipeline and fishing vessels are not damaged during the Operational Phase (e.g. dragged anchors, fishing gear, etc.), exclusion zones will be put in place along the Pipeline route to restrict activities that may cause damage (such as bottom trawling).

While the final design of the exclusion zones will be agreed in consultation with the appropriate authorities, it is anticipated that they will extend to 0.5 km (0.27 NM) either side of the outermost pipelines from the microtunnel exit pit until the Russian / Turkish EEZ boundary. The full width of the exclusion zone would therefore be a corridor of up to approximately 1.5 km, allowing for the spread of the four pipes.

While there may be some inconvenience due to access restrictions, the loss of fishing ground will only affect bottom trawling which is limited in the area. Further, the area of the shelf suitable for bottom fishing within the exclusion zone represents an insignificant amount (2.4%) of the total shelf area shallower than 100 m.

With regards to noise disturbance, the presence of a pipeline on the seabed should neither pose a physical barrier to fish movement nor act as a deterrent noise source; particularly since the main migratory species are pelagic species which live in the waters well above the pipeline. Evidence from monitoring of the fisheries within the vicinity of the North Stream pipeline in the Baltic (which includes several species related to those in the Black Sea and the same species of sprat) shows no discernible impacts on fish catches.

As such, the likelihood of the fishing industry experiencing any reductions in catches during the operational phase is considered to be minimal and there are unlikely to be any distinguishable differences from normal annual fluctuations.

The impact magnitude is therefore considered negligible and the overall significance of the Operational Phase of the Project on capture fisheries is assessed as being **Not Significant**.

Water (supply)

Due to the use of tunnelling, operation of the Pipeline could lead to on-going obstruction of groundwater flows within the Local Area although the extent of such changes are likely to be minimal and are not expected to lead to a measurable change in the well-being of any beneficiaries. As such the impact magnitude is assessed as negligible and the overall impact is considered **Not Significant**.

Hazard Regulation

There are no identified activities during the Operational Phase that are likely to have a significant impact on provision of this service or the well-being of any beneficiaries. As described in **Chapter 5 Project Description**, regular monitoring and inspection of the Pipeline will be undertaken throughout the Operational Phase. This will enable any changes to the local environment, particularly those relating to seismic and geomorphological processes, to be identified and managed.

As such the impact magnitude is assessed as negligible and the overall impact significance is assessed to be **Not Significant**.

Air Quality Regulation

There are no identified activities during the Operational Phase that are likely to have a significant impact on provision of this service or the well-being of any beneficiaries. As such the impact magnitude is negligible and the overall impact significance is assessed to be **Not Significant**.

Water Quality Regulation

There are no identified activities during the Operational Phase that are likely to have a significant impact on provision of this service or the well-being of any beneficiaries. As such the impact magnitude is negligible and the overall impact is assessed to be **Not Significant**.

Soil Quality Regulation

There are no identified activities during the Operational Phase that are likely to have a significant impact on provision of this service or the well-being of any beneficiaries. As such the impact magnitude is negligible and the overall impact is assessed to be **Not Significant**.

Tourism and Recreation Values

There are no identified activities during the Operational Phase that are likely to have a significant impact on provision of this service or the well-being of any beneficiaries. As such the impact magnitude is negligible and the overall impact is assessed to be **Not Significant**.

Cultural and Spiritual Values

Operation of the Pipeline could lead to further disturbance of sites of cultural value, in particular the Varvarovka Armenian and Russian cemetery, as well as a change in the cultural and aesthetic value of the Local Area as an agricultural landscape due to noise and visual disturbance from the operation of the landfall facilities. Potential impacts on archaeological sites are discussed in **Chapter 16 Cultural Heritage**.

In terms of landscape changes, the use of microtunneling effectively minimises the potential impacts on the landscape and visual amenity due to Pipeline operation. There will be further visual impact due to the presence the proposed landfall section facilities include a metering facility, pipeline inspection gauge (PIG) traps and electrical and instrumentation installations. However, extensive woodland surrounding this area of the Project is effective at 'absorbing' development by screening much of the Project and the extent of any change is small relative to the total landscape (see **Chapter 13 Landscape and Visual**). Likewise, with regards to users of the cemetery, while there will be some visual impact it is unlikely to be of an extent which prohibits anyone from accessing the site or being able to derive spiritual value from the area due to the sensitive design of the microtunneling site access road.

As such, while there will be some visual change there are not expected to be any significant impacts on beneficiaries of cultural services and the impact magnitude is negligible. The overall impact significance is considered to be **Low**.

Wild Species Diversity

In the terrestrial Affected Ecosystems operational impacts resulting from the Project are limited given that all of the significant impacts on habitats as a result of habitat loss or fragmentation will have occurred at the Construction Phase. During the Commissioning and Operational Phase many of the mitigation measures for the impacts of construction (such as vegetation replanting) will occur. The overall impact of the Commissioning and Operational Phase will therefore be considerably lower than those during construction.

The overall impact on habitats during operation will be **Not Significant** due to the lack of any significant ground-works or other major works. The only activities that will be undertaken during this Project phase will be related to land remediation and maintenance of the RoW.

There is some potential for impacts on flora (including potentially red list species) as a result of maintenance to keep the RoW free of large trees and deep-rooted shrubs for the lifespan of the Project. However, considering that the worst case scenario of habitat and species loss for flora of conservation importance has been assessed for construction, the effect of operational activities is not likely to be significant.

There may be some disturbance to invertebrates, reptiles, birds, and mammals as a result of small-scale works, movement of vehicles and other machinery and vegetation clearance although there are unlikely to be any significant impacts on population viability or on the well-being of beneficiaries (see **Chapter 11 Terrestrial Ecology**).

The presence of the operational Pipeline within the marine environment is not expected to result in any significant impacts on benthic habitats, seabirds, marine mammals or fish. The movement of vessels (including noise) used for pipeline inspection and maintenance could periodically disturb some seabirds and marine mammals although the impacts on population viability and beneficiary well-being is unlikely to be significant (see **Chapter 12 Marine Ecology**).

Overall, the magnitude of impacts on beneficiary wellbeing are considered to be negligible and the impact **Not Significant**.

17.7.3.3 Mitigation and Monitoring

Based on the results of the impact assessment (see Appendix 17.4 for a detailed summary of the scoring assigned to each ecosystem service), there are no priority services likely to be significantly impacted during the Operational Phase of the Project and which will require further mitigation.

17.7.3.4 Residual Impacts: Operational Phase

Table 17.16 presents a summary of the residual effects of impacts on ecosystem services on their beneficiaries following mitigation.

Table 17.16 Assessment of Potential Impacts: Operational Phase

Ecosystem Service	Activity	Potential Impact	Receptor(s)	Receptor Sensitivity	Impact Magnitude / Likelihood	Pre-Mitigation Impact Significance	Mitigation Measures	Residual Impact Significance
Crops	Operation of the Pipeline	n/a	Migrant workers	Low	Negligible	Not significant	n/a	Not significant
Capture Fisheries	Noise and vibration from Pipeline operation, imposition of exclusion zones	Potential (or perceived) disturbance to fish communities, loss of access to fishing grounds, snagging of equipment	Fishing industry	Moderate	Negligible	Not significant	n/a	Not significant
Water (supply)	Obstruction of groundwater flows	Reduced accessibility of water to downstream beneficiaries	Downstream abstractors including MoD and local households	Moderate	Negligible	Not significant	n/a	Not significant
Hazard regulation	Operation of the Pipeline	n/a	Households and businesses, recreational beach users, Project itself	Moderate	Negligible	Not significant	n/a	Not significant

Continued...

Ecosystem Service	Activity	Potential Impact	Receptor(s)	Receptor Sensitivity	Impact Magnitude / Likelihood	Pre-Mitigation Impact Significance	Mitigation Measures	Residual Impact Significance
Air quality regulation	Operation of the Pipeline	n/a	Local households, workers, visitors	Moderate	Negligible	Not significant	n/a	Not significant
Water quality regulation	Operation of the Pipeline	n/a	Fishers, consumers, water users	Moderate	Negligible	Not significant	n/a	Not significant
Soil quality regulation	Operation of the Pipeline	n/a	Farmers, food consumers, workers on site and in the area	Moderate	Negligible	Not significant	n/a	Not significant
Tourism and recreation values	Operation of the Pipeline and landfall facilities	n/a	Beach users, dive operators, Shingari and Don resort owners, walkers / horse riders	High	Negligible	Not significant	n/a	Not significant

Continued...

Ecosystem Service	Activity	Potential Impact	Receptor(s)	Receptor Sensitivity	Impact Magnitude / Likelihood	Pre-Mitigation Impact Significance	Mitigation Measures	Residual Impact Significance
Cultural and spiritual values	Visual disturbance	Change in cultural and aesthetic values of landscape, disturbance to cemetery	Visitors to cemetery, local residents	High	Negligible	Low	n/a	Low
Wild species diversity	Routine inspection and maintenance	Injury and death of wild species from vehicle and vessel collisions, disturbance from noise	Local communities, global conservation community	High	Negligible	Not significant	n/a	Not significant

Complete.

17.7.4 Assessment of Potential Impacts: Decommissioning Phase

17.7.4.1 Introduction

Decommissioning of the South Stream Pipeline will be carried out according to prevailing international and national legislation and regulations and GIIP regarding environmental and other potential impacts. An assessment will be undertaken to confirm that the planned decommissioning activities are the most appropriate to the prevailing circumstances and future land use. The assessment of decommissioning impacts set out below is therefore provisional, based on current practices and technologies. It is not intended to be definitive, but may serve as a high level comparison between two alternative strategies:

- **Option 1** – In situ decommissioning which involves cleaning the Pipeline and filling it with seawater. The receptors that might be impacted are thus the same as those for the Operational Phase; and
- **Option 2** – Removal of the Pipeline which is essentially a similar operation to pipe-laying, but in reverse. The receptors and degree of impact will thus be similar to those identified for the Construction and Pre-Commissioning Phase.

17.7.4.2 Assessment of Potential Impacts (pre-mitigation)

Crops

Under Option 1 there are not likely to be any impacts on the provision or use of the crops service. As such the impact significance is **Not Significant**.

Under Option 2, the removal of the Pipeline will require clearance of an area of land similar to that required in the Construction and Pre-Commissioning Phase. This land may be used for productive agricultural uses depending on whether or not the area has been replanted following the vegetation clearance undertaken in the Construction and Pre-Commissioning Phase.

The receptor sensitivity in this Phase is likely to be high if the area of land currently fallow is planted at some point during the Operational Phase. Further, the projected changes in climate may make wine production more vulnerable to Project impacts and could increase the vulnerability of production if, for example, viticulture in the Local Area becomes increasingly challenging under a future climate thereby reducing the profitability of the enterprise.

Any loss of productive agricultural land would have an impact on the livelihoods of those employed on the land. Therefore, assuming that viticulture in the Local Area is still viable in 2065 and that at least the area currently in agricultural production is replanted following the Construction and Pre-Commissioning Phase, the Project could have an impact of **Moderate** significance.

Capture Fisheries

Under Option 1, there are not likely to be any significant impacts on fisheries productivity or on access to fishing grounds beyond the restrictions that exist during the Operational Phase. As such the significance of impacts is deemed **Not Significant**.

The removal of the Pipeline (Option 2) may result in disturbance from additional vessel movements and potentially the re-instatement of a wider exclusion zone around the vessels involved in decommissioning. This is unlikely to have a significant impact on fisheries productivity as the affected area is small relative to the total fishing area and fish are able to avoid the area of disturbance. As such, the significance of impacts is assessed as being **Not Significant**.

Water (supply)

Under Option 1 there are not likely to be any impacts on the provision or use of water (supply). As such the impact significance is **Not Significant**.

Under Option 2, the removal of the Pipeline could impact water supply for downstream users through the potential abstraction from aquifers for use in decommissioning activities leading to decreasing groundwater levels, and alterations to surface water flows during construction due to crossing of surface waters and alterations to vegetation cover.

Due to the on-going abstraction of water from groundwater aquifers throughout the Project's life, groundwater levels are likely to be lower in 50 years' time than at present. Further, factors such as the changing climate, projected decreases in water availability, potential population increases, new downstream water users, as well as growing demands for water in irrigated agriculture, could increase the sensitivity of water resources and their users to any changes in supply.

As such, the receptor sensitivity for this service is likely to be higher in this Phase than in the Construction and Pre-Commissioning Phase. However, the Project is unlikely to significantly alter water flows or the ability of any beneficiaries to access water. As such, the impact on well-being is likely to be negligible and the impact significance is assessed as **Low** significance.

Hazard Regulation

Under Option 1 there are not likely to be any impacts on the provision or use of hazard regulation services. As such the impact significance is **Not Significant**.

Under Option 2, the removal of the Pipeline could impact hazard regulation through site clearance and earthworks, particularly where these result in loss of vegetation; preparation of foundations which may induce tremors that trigger mass movement of soils; impacts on the structural composition of Phaeozem soils which play an important role in water storage and flow regulation; and any dredging activities which could impact upon coastal processes and the effects of sea surges.

Climate change projections are likely to increase the frequency of hazards in the region although it is not possible to accurately predict changes in the Local Area at this stage. Any

growth in populations in the Local Area could increase the amount of people vulnerable to hazards.

While the likelihood of any impact on beneficiaries well-being is likely to be low the receptor sensitivity is likely to be higher due to the impacts of climate change and, as such, the impact significance is assessed as **Moderate** significance.

Air Quality Regulation

Under Option 1 there are not likely to be any impacts on the provision or use of air quality regulation services. As such the impact significance is **Not Significant**.

Under Option 2, vegetation clearance and emissions during decommissioning activities could reduce the ability of the Affected Ecosystems to regulate air quality. However, as in the Construction and Pre-Commissioning Phase, due to the limited extent of emissions and vegetation loss relative to the surrounding ecosystem cover the impact on air quality and the well-being of beneficiaries of this service is not likely to be significant.

Warming of the climate could reduce the uptake of pollutants by vegetation in the Local Area and further development which requires vegetation clearance could reduce the extent of natural habitat which can play this role. As such the ecosystem receptors are likely to be higher sensitivity to any Project impacts.

While the receptor sensitivity is likely to be higher, the likelihood of any impact on beneficiaries well-being is likely to be negligible. As such, the impact significance is assessed as **Not Significant**.

Water Quality Regulation

Under Option 1 there are not likely to be any impacts on the provision or use of water quality regulation services. As such the impact significance is **Not Significant**.

Under Option 2, the Project could lead to higher pollution levels in surface and ground waters due to decommissioning activities and removal of vegetation; accidental leaks and spills; impacts on mussels and other marine organisms capable of biofiltration if present in 50 years' time; and seabed disturbance and release of sediments into the marine water column as a result of dredging and pipeline removal.

Assuming that the regulatory frameworks for improving water quality in the Local Area are implemented successfully, inputs of pollution into the marine and freshwater ecosystems should be lower by 2065. As such, receptor sensitivity would be lower and the impact significance is assessed as **Low** significance.

Soil Quality Regulation

Under Option 1 there are not likely to be any impacts on the provision or use of soil quality regulation services. As such the impact significance is **Not Significant**.

Under Option 2, the Project could reduce the ability of ecosystems to regulate soil quality through an increase in concentration of contaminants through leaks, spills, and emissions;

increased susceptibility of soil to erosion through clearance of vegetation and excavation works; loss of nutrients and soil carbon due to soil excavation and removal of vegetation which contributes to soil composition; degradation of soil, physical damage, and compaction through stockpiling of soils during decommissioning; and displacement of soils through effects on the river channel.

While pressures on soil resources and the ability of ecosystems to regulate soil quality may increase over the life of the Project due to increased levels of development in the Local Area, vegetation clearance, growing air borne emissions, and greater pollutant from surface runoff, there is unlikely to be a significant change in the sensitivity of the receptors or the potential Project impacts. As such, the impact significance is assessed as **Moderate** significance.

Tourism and Recreation Values

Under Option 1 there are not likely to be any impacts on the provision or use of tourism and recreation services. As such the impact significance is **Not Significant**.

Under Option 2, the Project could reduce the ability of ecosystems to provide opportunities for tourism and recreation primarily through visual disturbance to beach users and visitors to nearby resort complexes. The receptor sensitivity and impact magnitude are likely to be similar to the Construction and Pre-Commissioning Phase and, as such, the impact significance is assessed as **Moderate** significance.

Cultural and Spiritual Values

Under Option 1 there are not likely to be any impacts on the provision or use of cultural and spiritual services. As such the impact significance is **Low** significance.

Under Option 2, the Project could damage the aesthetics and agricultural nature of the landscape as well as causing damage to sites of cultural importance and their environmental setting. The receptor sensitivity and impact magnitude are likely to be similar to the Construction and Pre-Commissioning Phase and, as such, the impact significance is assessed as **Moderate** significance.

Wild Species Diversity

Under Option 1 there are not likely to be any impacts on wild species diversity. As such the impact is assessed as being **Not Significant**.

Under Option 2, the Project could impact on wild species diversity through habitat loss, disturbance during decommissioning activities, pollution incidents, and introduction of invasive species. The receptor sensitivity and impact magnitude are likely to be similar to the Construction and Pre-Commissioning Phase and, as such, the impact significance is assessed as **High** significance.

17.7.4.3 Mitigation and Monitoring

Based on the results of the impact assessment there are no priority services identified for Option 1 and six priority ecosystem services identified for Option 2:

- Crops;
- Hazard regulation;
- Soil quality regulation;
- Tourism and recreation values;
- Cultural and spiritual values; and
- Wild species diversity.

Due to the similar nature of the impacts the mitigation requirements for the second options of the Decommissioning Phase are likely to mirror those required for the Construction and Pre-Commissioning Phase. As such, the mitigation requirements will be similar to those set out in Section 17.7.2.3, although a full EIA will need to be undertaken prior to decommissioning to ensure that the impact assessment and mitigation recommendations are still appropriate.

Hazard regulation is the only service which was not identified as a priority service in the Construction and Pre-Commissioning Phase. The increase in significance is due to the likely increase in hazard risk due to climate change within the Local Area. While the nature of such risks are difficult to predict at present, there could be increases in surface water flooding, coastal erosion, coastal flooding, and mudflows (as a result of more intense rainfall patterns).

In order to mitigate impacts on this service during the Decommissioning Phase, a detailed, quantitative study of hazard risk in the Local Area should be undertaken prior to decommissioning and used to inform appropriate mitigation measures.

17.7.4.4 Residual Impacts: Decommissioning Phase

Table 17.17 presents a summary of the residual effects of impacts on ecosystem services on their beneficiaries following mitigation.

Table 17.17 Assessment of Potential Impacts: Decommissioning (under Option 2)

Ecosystem Service	Activity	Potential Impact	Receptor(s)	Receptor Sensitivity	Impact Magnitude / Likelihood	Pre-Mitigation Impact Significance	Mitigation Measures	Residual Impact Significance
Crops	Vegetation clearance for Pipeline corridor	Loss of current production and future use, potential loss of jobs	Migrant workers	High	Low	High	Land reinstatement On-going stakeholder consultation Grievance Procedure Compensation Management Framework Livelihood Restoration Framework	Low
Capture fisheries	Sedimentation, safety exclusion zones, noise and visual disturbance	Changes in fishery productivity, loss of access to fishing grounds, barrier to migration	Fishing industry	Moderate	Negligible	Not significant	n/a	Not significant

Continued...

Ecosystem Service	Activity	Potential Impact	Receptor(s)	Receptor Sensitivity	Impact Magnitude / Likelihood	Pre-Mitigation Impact Significance	Mitigation Measures	Residual Impact Significance
Water (supply)	Dewatering, abstraction, changes in surface water flows	Reduced accessibility of water resources	Downstream abstractors including Project, MoD and local households	High	Negligible	Low	n/a	Low
Hazard regulation	Vegetation clearance, earthworks, soil excavation, dredging	Increases in flood/landslide risk, changes in coastal erosion rates	Households and businesses, recreational beach users, Project itself	Moderate	Low	Moderate	Detailed quantitative study of hazard risk and appropriate mitigation based on results	Low
Air quality regulation	Emissions, vegetation clearance, dust generation	Lower air quality, human health risk, impact on tourism	Local households, workers, visitors, tourism industry	High	Negligible	Not significant	n/a	Not significant

Continued...

Ecosystem Service	Activity	Potential Impact	Receptor(s)	Receptor Sensitivity	Impact Magnitude / Likelihood	Pre-Mitigation Impact Significance	Mitigation Measures	Residual Impact Significance
Water quality regulation	Waste disposal, contamination, vegetation clearance, sediment plumes, impacts on marine environment	Risk to human health	Households, visitors to St. Barbara's Source, tourism and fishing industries	Low	Low	Low	n/a	Low
Soil quality regulation	Contamination, leaks and spills, structural damage, loss of vegetation, disturbance of unidentified contamination	Lower soil productivity, health risks to workers, reduced ecosystem functioning	Landowners, viticulture industry including food consumers, workers on site and in the area	Moderate	Moderate	Moderate	Measures set out in Chapter 8 Soils, Groundwater and Surface Water Early identification and removal of contamination, Spill Prevention and Response Plan Restoration of native vegetation Health and safety plan for workers	Not significant

Continued...

Ecosystem Service	Activity	Potential Impact	Receptor(s)	Receptor Sensitivity	Impact Magnitude / Likelihood	Pre-Mitigation Impact Significance	Mitigation Measures	Residual Impact Significance
Tourism and recreation values	Noise and visual disturbance, exclusion zones, water quality decline, marine ecology impacts	Reduced recreational use of area and corresponding impact on livelihoods	Resort owners and visitors, users of beaches and marine areas, walkers and horse riders	High	Low	Moderate	On-going stakeholder engagement Provision of construction plans to relevant authorities Grievance Procedure Compensation Management Framework Livelihood Restoration Framework Sediment prevention mitigation as detailed in Chapter 12 Marine Ecology Visual impact mitigation as detailed in Chapter 13 Landscape and Visual	Low

Continued...

Ecosystem Service	Activity	Potential Impact	Receptor(s)	Receptor Sensitivity	Impact Magnitude / Likelihood	Pre-Mitigation Impact Significance	Mitigation Measures	Residual Impact Significance
Cultural and spiritual values	Vegetation clearance, noise and visual disturbance	Loss of cultural and aesthetic values of landscape, disturbance to cemetery	Visitors to cemetery, local residents	High	Low	Moderate	On-going stakeholder consultation Grievance Procedure Re-routing proposed access road as set out in Chapter 16 Cultural Heritage Vegetation screening as set out in Chapter 13 Landscape and Visual Assessment	Low

Continued...

Ecosystem Service	Activity	Potential Impact	Receptor(s)	Receptor Sensitivity	Impact Magnitude / Likelihood	Pre-Mitigation Impact Significance	Mitigation Measures	Residual Impact Significance
Wild species diversity	Loss of critical habitat and disruption to critically endangered tortoise species, risk of invasive species introduction, disturbance to marine mammals	Increase vulnerability of threatened species, loss of valued habitat	Local communities, global conservation community	High	Moderate	High	Measures set out in Chapter 11 Terrestrial Ecology and Biodiversity Measures set out in Chapter 12 Marine Ecology, Worker education Stakeholder engagement BAP with ecosystem service considerations where possible	Not significant

Complete...

17.8 Unplanned Events

Unplanned events are considered separately from planned activities as they only arise as a result of a technical failure, human error, or as a result of natural phenomena such as a seismic event. As such, unplanned events are assessed and relevant mitigation measures are presented in **Chapter 19 Unplanned Events**. Those relevant to the provision or use of ecosystem services include fuel and oil spillages; fire risk; introduction of invasive non-native species into the marine environment; and large scale release of natural gas.

Spillages of fuel and oil during construction activities could potentially have widespread impacts on a range of services provided by both terrestrial and marine ecosystems including crops, fisheries, and tourism and recreation. However, through adherence with the Spill Prevention and Response Plan, it is concluded that the actions taken will prevent any long term significant adverse impacts on the environment as a result of such events.

Fire risks during construction will be minimised through the definition and enforcement of strict control measures, which will include the adoption of a "*permit to work*" system for hot works and a smoking ban for all construction personnel whilst undertaking construction activities. Additional measures will include the development of an Emergency Response Plan, inclusive of fire prevention and suppression measures which will be developed and maintained by each construction contractor. The Emergency Response Plan will include specific measures to prevent the spread of any fires to the natural habitats within the Project Area.

Vessel operations during construction also have the potential to inadvertently introduce invasive alien species, either in ballast water, on the biofilm inside ballast tanks, or carried as fouling organisms on the hull. Despite its low probability of occurrence, the possibility of population or community-wide effects on the entire ecology of the sea makes this a potentially highly significant impact with potential impacts on a range of services including fisheries, water quality, and wild species diversity. In order to minimise the risk of accidental introductions, appropriate mitigation measures will be implemented as set out in **Chapter 19 Unplanned Events**.

During the Operational Phase, unplanned events are similar to those listed above for the Construction and Pre-Commissioning Phase however there is also a risk of large scale releases of un-ignited natural gas from the pipelines. The majority of failures would be small, e.g. pin-hole releases from valve stems and flanges, and the frequency of catastrophic events that may cause a long-term shutdown is extremely low. Further detail is contained in **Chapter 19 Unplanned Events**.

17.9 Cumulative Impacts Assessment

Cumulative impacts associated with the Project are assessed in **Chapter 20 Cumulative Impact Assessment**.

17.10 Conclusions

A total of ten ecosystem services were scoped into the assessment in this chapter. For these ten services, the significance of the Project's impacts during the Construction and Pre-Commissioning Phase before mitigation was assessed as follows:

- **Not Significant:** Capture fisheries, water supply, and air quality regulation;
- **Low:** Hazard regulation and water quality regulation;
- **Moderate:** Crops, soil quality regulation, tourism and recreation values, and cultural and spiritual values; and
- **High:** Wild species diversity.

During the Operational Phase, the impacts on cultural and spiritual values were found to be of **Low** significance and impacts on all other services were found to be **Not Significant**.

The assessment therefore identifies five priority services on which the Project would likely have a significant impact (pre-mitigation) during the Construction and Pre-Commissioning Phase. No priority services are expected to be impacted during the Operational Phase. A summary of the priority services, the likely impacts, the proposed mitigation measures, and residual impacts is provided in Table 17.18.

Table 17.18 Assessment Summary of Priority Services identified during Construction and Pre-Commissioning

Priority Service	Potential Impact	Impact Significance	Mitigation Measures	Residual Impact
Crops	Loss of current production and future use, loss of jobs	Moderate	Land reinstatement On-going stakeholder consultation Grievance Procedure Compensation Management Framework Livelihood Restoration Framework	Low

Continued...

Priority Service	Potential Impact	Impact Significance	Mitigation Measures	Residual Impact
Soil quality regulation	Contamination from Project could lower soil productivity, introduce contaminants into the food chain, and present health risks to workers, structural damage could impact on soil productivity and ecosystem functioning	Moderate	Measures set out in Chapter 8 Soils, Groundwater and Surface Water Early identification and removal of contamination Spill Prevention and Response Plan Restoration of native vegetation Health and safety plan for workers	Not significant
Tourism and recreation values	Reduced recreational use of area and corresponding impact on livelihoods	Moderate	On-going stakeholder engagement Provision of construction plans to relevant authorities Grievance Procedure Compensation Management Framework Livelihood Restoration Framework Sediment prevention mitigation as detailed in Chapter 12 Marine Ecology Visual impact mitigation as detailed in Chapter 13 Landscape and Visual	Low

Continued...

Priority Service	Potential Impact	Impact Significance	Mitigation Measures	Residual Impact
Cultural and spiritual values	Vegetation clearance and disturbance to visitors of the Varvarovka cemetery	Moderate	On-going stakeholder consultation Grievance Procedure Re-routing proposed access road as set out in Chapter 16 Cultural Heritage Vegetation screening as set out in Chapter 13 Landscape and Visual Assessment	Low
Wild species diversity	Loss of critical habitat and disruption to critically endangered tortoise species, risk of invasive species introduction, disturbance to marine mammals	High	Measures set out in Chapter 11 Terrestrial Ecology and Biodiversity Measures set out in Chapter 12 Marine Ecology, Worker education Stakeholder engagement BAP with ecosystem service considerations where possible	Not significant

Complete.

The mitigation measures identified are intended to anticipate and avoid, or where avoidance is not possible, minimize, and, where significant residual impacts remain, compensate / offset impacts on receptors. Assuming that the mitigation measures suggested in this assessment are successfully implemented, it will be possible for the Project to mitigate all adverse effects associated with the Project to the degree that most impacts after mitigation would be low or not significant.

Hazard regulation was identified as an additional priority service during the Decommissioning Phase if the option to remove the Pipeline is selected. However, as the approach has not yet been decided and due to the large degree of uncertainty of assessing impacts over this timeframe, appropriate mitigation should be determined based on a survey of the risks nearer the time of decommissioning.

The combined effects of the Project and other developments are not expected to result in any significant cumulative impacts on ecosystem service beneficiaries.

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