Identifying potential overlap between extractive industries (mining, oil and gas) and natural World Heritage sites

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The United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) is the specialist biodiversity assessment centre of the United Nations Environment Programme (UNEP), the world's foremost intergovernmental environmental organisation. The Centre has been in operation for over 30 years, combining scientific research with practical policy advice.

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Executive Summary

At the time of this study, the UNESCO World Heritage (WH) List included 217[a] properties recognized for their natural Outstanding Universal Values[b]. However, according to UNESCO, a significant number of these sites could be under development pressure from existing and future activities of extractive industries. This report analyses at the global level the association between extractive activities and WH sites, by providing statistical and geographical information on the location and extent of overlap between these sites and the extractives sector based on the best available global datasets.

Methodology

The spatial analyses carried out describe the number of WH sites which could overlap with mining projects and oil and gas wells, divided according to the development stage of these activities and certainty with which these activities can be spatially located. Data on mining was obtained from the MineSearch database of the SNL Metals Economics Group (MEG) and oil and gas data from the IRIS21 database from IHS Global Insight (IHS); data on WH sites were drawn from the World Database on Protected Areas (WDPA).

The spatial representation of extractive industry projects differed according to the type of activity considered:

- Mining projects were represented as point locations and described according to two criteria:
    - Project Development stage, divided in 4 stages (Active Exploration, Inactive Exploration, Production, and Closed), and
    - Spatial Uncertainty, which is the confidence held in the coordinate information used to assign a project to a given geographic location, classified as either Reliable or Less accurate.
- Oil and gas projects were considered both in terms of wells and concessions:
    - Well locations were used as a proxy for oil and gas projects; they were represented as point locations and also described according to two criteria:
        - Project Development stage, divided in 4 operational stages (Discovery, Appraising, Developing and Abandoned), and
        - Spatial Uncertainty (as defined above).
    - Oil and gas concessions were available in the form of polygons; they were classified according to their Stage of Application in 3 categories: Bid, Application and Contract; given the broad scale of reporting, spatial uncertainty was not considered.

[a] The analysis in this study was conducted using data from March 2013 when there were 217 World Heritage Sites recognised for their natural values. An additional five sites were added to the World Heritage List in June 2013.
[b] Outstanding Universal Value is the basis for inscription on the World Heritage List, recognising the important role these sites play in preserving the cultural and natural heritage of the world.

Three types of analyses were carried out looking at the overlap, proximity, and temporal comparisons of any overlaps between extractive activities and WH sites. The limitations of the datasets are also presented.

Given the limitation in spatial accuracy of the World Heritage site boundaries and mining and oil and gas databases, all results must be considered indicative. The intent of this study is not to identify specific mines or oil/gas fields which operate within specific World Heritage sites but to highlight trends and focal points for further research. On-ground, local scale investigations would be required to confirm the presence/absence of operations within World Heritage sites.

Mining projects

At a global scale, of the 12,592 mining projects analysed, 10 reliably located active mining projects were identified as being inside a WH site, 7 of which were in exploration stage and 3 in production stage. A total of 55 reliably located active projects were found within 10km of WH Sites, and the majority of these are categorised as active exploration activities.

Considering only those mining projects with reliable spatial locations, 4 WH sites contain or are in close proximity (<1km) to *producing* mines. Furthermore, 11 WH sites have producing mines within or to a distance of 10km from their site boundary, and this increases to 18 sites if the distance is extended to 25km.

A greater number of WH sites are in close proximity to active mining *exploration* activities. Based on reliably located mining projects, 7 WH sites contain or are in close proximity (<1km) of mine development.

Oil and gas projects

No active drilling was being conducted within WH sites at the time of the study. However, 16 reliably located completed wells at which on-ground activities are expected (development and production) were found to be spatially coincident with a WH site. These wells were all located within two WH sites. However, it should be noted that a degree of uncertainty is attached to the identification of producing wells. The analysis also showed that 31 sites have or had some interaction with wells (with reliable coordinates), but a significant number of these interactions are classified as inactive.

Furthermore, 5 WH sites were identified as having potentially producing wells within 10km of the site boundary, and 5 sites as having development wells (wells associated with exploration) within 10km of the site boundary. Only 3 wells associated with field development (Discovery, Appraising and Developing) were found to occur within or in close proximity (<1km) to WH sites.

Regarding oil and gas concessions, if all concession types are considered, 180 concessions overlap with WH sites. In most cases, the percentage area of any single concession falling within a WH site is less than 50%, but 16 concessions have 50% or more of their licensed area within 8 WH sites. 63 WH sites were identified as overlapping with oil and gas concessions; 22 sites have 50% or greater of their land area covered by concessions of any category from a total of 44 concessions; and 6 WH sites have 100% of their land area covered by concessions.

Conclusion

Combining active operations from both mining and oil and gas industries, based on reliably located data, 13 WH sites (6%) were found to occur within or in close proximity (<1km) to a mine or an oil/gas project (5 to producing operations, 6 to active exploration/development and 2 to both producing and active exploration/development). The results of the temporal analysis indicate that a very small number of WH sites may have been listed when resource extraction was already actively taking place within their boundaries.

Although the results of these analyses contribute to our understanding of the spatial overlap between WH sites and extractive industries, these results should be interpreted with caution, as there are a number of limitations to consider. Notably, the databases used represent the best available spatial information on extractive operations, but there are limitations in the coverage, accuracy and completeness of the data. For example, where information on the location of extractives projects is not reported (by the government or the company), these data are likely to be missing from the datasets. Furthermore, not all extractive operations contained in the databases were described by spatial coordinates and some were limited in their accuracy; and finally, the representation of mining projects as point features implied an underestimate of the operation size. In addition this study did not analyse artisanal mining or quarrying, or associated infrastructure.

As a next step to this study, the results presented here could be combined with other sources such as the forthcoming IUCN State of World Heritage monitoring system (to be available in 2014) and State of Conservation Reports to provide a more comprehensive picture of the overlap between natural World Heritage Sites and extractives activities.

1 Introduction

The UNESCO World Heritage List includes 217 properties recognized for their outstanding natural heritage values. Despite UNESCO estimating that up to a quarter of these World Heritage sites are under development pressure from existing and future activities of extractive industries[a]; to date, there is no reliable analysis of the extent of overlap on a global scale. To address this absence of evidence, UNEP-WCMC, together with IUCN (the Advisory Body to the UNESCO World Heritage Committee on natural heritage), the International Council on Mining and Metals (ICMM) (whose members have made a 'no-go' commitment for natural World Heritage sites), and WWF, conducted the first global analysis of extractive activities and World Heritage sites based on data from two industry datasets.

Using global spatial data provided by industry bodies on the location of extractive activity, this analysis provides information on the degree of overlap and the proximity of World Heritage sites and extractive operations. Owing to limitations in the availability, character and spatial accuracy of such data this analysis does not capture every extractive operation, nor instance of overlap. In addition, this study does not seek to analyse impacts from extractive activities as it does not include information on local environmental conditions. However, as the first and only global, spatial analysis of its sort the results of this work will provide much needed spatial information which can be used in conjunction with other field-based studies of the impacts of the extractive industry on World Heritage sites. For example, UNESCO/IUCN State of Conservation Reports[b] detail on-ground observations of extractive activities in World Heritage sites and, consequently, give a comprehensive indication of industry impacts with respect to local environmental and social conditions. IUCN is currently developing a State of World Heritage monitoring system for all natural and mixed World Heritage Sites, which will be published in 2014. However, such field studies are limited by the scale at which they can operate and the global analysis presented in this report may identify additional, and hitherto unknown, areas which overlap or occur in proximity to extractive sites. Moreover, used in combination, these types of studies can demonstrate data deficiencies and areas in need of further attention.

By providing an initial estimation of global statistics on the location and extent of overlap between the extractives sector and World Heritage sites, this analysis may help direct future management and conservation strategies and will enable the project partners, governments and the World Heritage Centre to communicate and engage on this issue on a global scale.

1.1 Aims and objectives

The project aim was to deliver a global geospatial analysis of the overlap and proximity of extractive industries with the natural World Heritage sites.

Outputs of these analyses describe the number (and percentage) of World Heritage sites which ***potentially*** overlap mining projects and/or wells broken down according to the development stage of these activities and certainty with which these activities can be spatially located.

[a] Turner, S.D. (2012) World Heritage sites and the extractive industries. Independent study commissioned by IUCN in conjunction with the UNESCO World Heritage Centre, ICMM and Shell. Available online: http://cmsdata.iucn.org/downloads/whs_and_extractive_industries_20_jun_12.pdf

[b] http://whc.unesco.org/en/soc/

2 Data

The analysis was based on mining data from the MineSearch database of the SNL Metals Economics Group (MEG) and oil and gas data from the IRIS21 database from IHS Global Insight (IHS), two leading industry datasets available to UNEP-WCMC[a]. Specifically, the analysis focused on mining projects and oil and gas wells as described by these databases, with additional information on oil and gas contract blocks (or concessions) being extracted from the IHS database. Both databases were accessed in April 2013. Data on World Heritage sites were drawn from the World Database on Protected Areas (IUCN and UNEP-WCMC, March 2013), the only global inventory of protected areas, maintained by UNEP-WCMC in collaboration with IUCN and under mandate from the UN.

As a consequence of limited data availability, accuracy and spatial resolution, there are a number of key limitations to consider when interpreting the results of this work (for full list of limitations see Section 13):

- Data used are based on a snapshot of industry databases taken in April 2013 and therefore only include projects recorded up until that date.

- Although among the best available global industry databases, neither MEG (mining) nor IHS (oil and gas) provide a complete record of operations. MEG data only relates to mining of specific commodities and excludes other forms of mining (e.g. artisanal) or quarrying (e.g. stone, gravel or sand). The database records point data on mining activity so that the full area or boundaries of mining concessions (areas leased for exploration and production activities related to the subsurface resources) could not be analysed. The IHS database includes both point data on oil/gas well locations and data on the boundaries of concessions. However, concessions are not included for the USA and Canada within the database used for this analysis.

- Not all extractive operations contained within the databases were described by spatial coordinates and even where coordinates were provided, a subset of these coordinates were limited in their spatial accuracy. As such, the analysis does not attempt to identify specific sites of overlap but rather highlight general trends and possible focal points for future study.

- All mining and oil and gas projects are categorised in the databases according to their developmental stage and this is used within the analysis to assess the types of operations that occur within or in proximity to World Heritage sites. However, recent changes in the development stage of projects will not always be reflected within the database. This temporal inconsistency may affect results. Furthermore, it should be noted that project categories are not comparable across the two databases.

- Results of the overlap between developmental stage projects and World Heritage sites may indicate areas that have the potential to come under pressure from future extractive operations. However, it is important to note that only a small proportion of developmental stage projects will continue to full production stage activities.

[a] Other industry datasets are available, however it was not deemed possible to combine datasets from different sources without introducing duplication.

- Issues of temporal incompatibility between industry activity and the World Heritage sites have not been considered; for instance, certain extractive operations may have been in place prior to the inscription of the World Heritage site. Such instances are identified in a subset of cases.

- This analysis assesses potential overlap of extractive operations and World Heritage sites but does not consider the impacts of the operations on their local environments. As such, this work should be used in combination with on-ground studies of local impacts in order to assess conservation priorities and management responses.

2.1 Mining projects

Data on mining projects relate to mines which meet the inclusion criteria for the MEG database, in brief mines must include one of MEG's core commodities and be of a minimum size (see Section 8.1 for information on the types of mines included in the analysis). These projects were represented as point locations and described according to the following criteria:

- Project development stage

- Spatial uncertainty

Contextual information on the type of mining operation (surface or underground), and commodity was available for a subset of the analysis.

Project development stage

For the purpose of this analysis, mining projects were aggregated into four broad development stages (Table 2.1); a final group of projects for which the development stage is "unknown" was also included.

Exploration: Exploration projects vary in their operational activities as a consequence of the stage of exploration and/or the commodity identified at a given location. Exploration projects were included as an indicator of potential future activities at World Heritage sites. This variable should be interpreted with care as the presence of an exploration project is not necessarily indicative of a future productive mine. The probability of project continuation beyond the exploration phase is variable. However, a significant proportion may not proceed to production stages. Exploration was divided into Active and Inactive (Table 2.1).

Production: Projects classified as 'producing' are characterised by a wide range of operational activities. The spatial extent of these activities could not be described using the data available. Equally, no information was integrated in regard to the temporal extent (operating time period) of the project. However, it was assumed that such projects represent a current and on-going extractive activity within or in proximity to a World Heritage site.

Closed: Little or no operational activities are currently undertaken at projects classified as closed. This may be due to the completion of project activities, activities becoming uneconomic or the ore being exhausted.

Table 2.1: Project development stage categories for mining projects according to the MineSearch database.

Project development stage	Description
Active Exploration	Active projects at all stages of development up to and including the preparation of a bankable feasibility study. Exploration activities include raw prospecting, exploration, target outline, reserves development and feasibility preparation. Early stage projects for base-metals and precious metals must have minimum reserves reported in order to be included. Specifically, project transactions must be greater than $10 million or financings greater than $2 million; gold grades (g/mt) multiplied by interval (m) must be 50 or greater; and/or base metals projects must total a minimum of $13-$15/mt for the first two to three metals.
Inactive Exploration	Includes all exploration projects (as outlined above) that have become inactive.
Production	Includes both (a) projects where a go-ahead decision has been made and the project is being readied for production; and (b) projects where commercial production has been achieved.
Closed	Includes those projects where (a) production is inactive, that is, all project activity has come to an end or (b) all activities have ceased, for example, due to the ore being exhausted.
Unknown	The status of the project, in terms of development, cannot be established from available information.

Spatial uncertainty

This variable describes the confidence held in the coordinate information used to assign an operation to a given geographic location and therefore describes the confidence that can be placed in the results of the overlap or proximity analysis. For example, greater confidence would be placed in results where projects described as reliable fall within a World Heritage site. The geographic location of each mining project was classified as reliable or less accurate where each is defined as:

- **Reliable:** Projects classified as exact within the MEG database. Projects with an exact location have a spatial coordinate which has been provided from an authoritative source.

- **Less accurate:** Projects classified as approximate or best guess within the MEG database. This includes projects which have been located by using a distance, direction or combination of these from a known point.

Mine project representation

The representation of mining projects as point features implied that the operational size of the project is infinitely small. Although it is acknowledged that this representation has the potential to significantly underestimate the size of an operation no data was available to better describe operations. The arbitrary assignment of a universal size to all operations was not considered appropriate.

2.2 Oil and gas projects

Oil and gas projects were considered both in terms of wells and concessions.

2.2.1 Oil and gas wells

Well locations contained within the IHS database were used as a proxy for oil and gas activities. Well locations were represented as point locations and described according to the following criteria:

- Project development stage
- Spatial uncertainty

Project development stage (wells)

Project (well) development stages are defined to reflect the structure and available information in the IHS database. The project development stage used in the analysis is a composite of the status of individual wells and the oil/gas field to which the wells belong (Table 2.2).

Table 2.2: The delineation of well development stage according to the IHS database.

Well status (According to IHS)	Well content (According to IHS)	Field Production Status (According to IHS)	Category (Assigned during analysis)
Active			**Active Drill**
Completed	All (excl. unreported, tight hole, unknown)	Abandon	**Abandon**
Completed	All (excl. unreported, tight hole, unknown)	Appraising	**Appraise**
Completed	All (excl. unreported, tight hole, unknown)	Discovery	**Discovery**
Completed	All (excl. unreported, tight hole, unknown)	Developing	**Developing**
Completed	All (excl. unreported, tight hole, unknown)	Producing	**Producing**
Completed	All (excl. unreported, tight hole, unknown)	Unknown	**Unknown**
Completed	Unreported, tight hole*, Unknown	-	**Unknown**
Plug & abandoned	-	-	**Inactive**
Junked	-	-	**Inactive**
Suspended	-	-	**Inactive**
Unknown	-	-	**Unknown**

** Tight hole describes those wells for which the content has not been reported or is being kept confidential.*

An initial distinction is made between wells that are being actively drilled and those where drilling has been completed. Active drilling implies that at the date of IHS database update, drilling was being conducted. This should be considered a coarse snapshot of activity with drilling prior to or subsequent to the date of database update not being reflected.

Completed wells, that is, wells at which drilling has ceased are described in the IHS database as (a) completed, (b) plugged and abandoned, (c) junked or (d) suspended. A significant distinction between these categories is (a) completed wells and (b-d) all other categories. A completed well is defined as a well at which equipment has been installed to produce hydrocarbons. Consequently, of the well types listed above only those described as completed (a) have the potential to become 'producing' wells. Conversely, wells described as plugged and abandoned, junked or suspended do not have subsequent producing activities associated with them.

It should be noted that plugged and abandoned wells may have been producing in the past. However, if recorded with this status, the well is no longer in use as it has ceased to produce or was originally a dry hole.

Within the IHS database, it is not possible to track the production status of completed wells. A well defined as completed may be currently producing or have been through a production cycle and subsequently abandoned. Wells do not have a standard length of operation; therefore, the date of drilling does not indicate the wells production status. For this reason, the current status of a well is implied from the status of the oil/gas field in which it occurs.

Fields were categorised into five operational stages (Table 2.3). All completed wells were assigned the operational status (or stage) of the field in which they occur. This assignment assumes that, for example, all completed wells which occur within producing fields are currently producing. It should be noted that this assumption may lead to the overestimation of producing wells since not all wells within a producing field will be producing at one time. This assumption is discussed further in section 8.3.

Table 2.3: Field status definitions according to the IHS database.

Field Production Stage	Definition
Discovery	A reservoir (pool) or group of reservoirs that have never been put into commercial production and/or no decision to develop has been taken. At least one well has tested substantial quantities of hydrocarbons.
Appraising	Additional exploration wells are being drilled to define the size of the discovery and to gather more information about the discovery for the purpose of generating a field development plan.
Developing	Operators have received approval from the government to develop at least one reservoir for commercial production and are implementing the field development plan to bring the field to production.
Producing	Commercial hydrocarbon production has commenced from at least one reservoir.
Abandoned	Production and drilling operations have temporarily or permanently ceased due to depletion of the reservoir, low production rates, or oil/gas prices have fallen to unprofitable level or all of the above.

All wells were included irrespective of their content (i.e. hydrocarbon, non-hydrocarbon, service, technical) as the presence of a well of any type implies disturbance of some sort at a site. As no measure of potential impact was included it was not considered necessary to segregate those wells containing hydrocarbons and non-hydrocarbons. However, the assumption that all wells (hydrocarbon and non-hydrocarbon) on a producing field are producing could lead to significant overestimation.

It should be noted that due to the difference between the two industry datasets, well development stages are not aligned to those of mining projects. Consequently, development stages should not be directly compared.

Spatial uncertainty (wells)

This parameter describes the confidence held in the coordinate information used to assign a well to a given geographic location and therefore describes the confidence that can be placed in the results of the overlap or proximity analysis. For example, greater confidence would be placed in results where wells described as reliable fall within a World Heritage site. The geographic location of each well is classified as reliable or less accurate where each is defined as:

- **Reliable:** Wells classified as having reliable coordinates or reliable coordinates with a specified datum within the IHS database.

- **Less accurate:** Wells which have a spatial coordinate but where this coordinate is described as approximate (to any level of degrees/minutes/seconds), estimated or representing the centre of a field in the IHS database.

Oil and gas project representation

Multiple wells can exist within a single operating area (field) or project. As a consequence, wells were represented at a different analytical scale to that used for mining projects where a single operating area was represented as a single point. Due to this difference in scale, well counts would be expected to be orders of magnitude greater than mine project counts.

2.2.2 Oil and gas concessions

In the mining database, concession activities were represented by points only, that is, on-ground exploration activities. Conversely, data on oil and gas concessions were available in the form of polygons from the IHS database. However, no data on oil and gas concessions were available for the onshore/continental USA, onshore/continental Canada or shallow water (< 200m) in the Gulf of Mexico.

Concessions were represented as polygons delineating the spatial boundary of the area leased to a company for the purpose of exploration related to specific sub-surface resources. The existence of concessions does not change the tenure of the area itself. Concessions are associated only with specific resources for which they are licensed. This area was described according to their application stage.

Application stage

Concessions were classified according to their stage of application (Table 2.4). Concessions typically follow a trajectory from bid to application to contract. However, it does not follow that concessions currently defined as bidding blocks or applications will automatically become contract blocks.

Table 2.4: Definitions of application stages of oil or gas concessions according to the IHS database.

Application stage	Definition
Bid	Concessions that are currently being offered by the respective governments for companies to bid on for exploration or production of oil & gas. These blocks will not be associated with any activity until (or if) they are granted full contract status.
Application	Concessions that have been applied for either through a formal bid round or by choosing an open area and requesting that the government allows exploration and or production rights over the area. Contracts in this category will not have any activity until (or if) they have been granted full contract status.
Contract	Concessions which have been formally given sanctions to explore or exploit (produce) oil and gas. Blocks can have a variety of terms regarding exploration/drilling. These licences can have terms from 1yr to 30yrs. Consequently, activities may not be constantly occurring.

Spatial uncertainty

Given the broad scale of reporting, spatial uncertainty in the delineation of contract blocks was not considered in the current analysis. Consequently, results should be reviewed at a broad scale and be considered indicative rather than absolute.

Concession representation

The analysis used oil and gas concessions as an indication of activity. However, it should be noted that while concessions represent a source of concern for conservation community, they are a weak proxy for development potential and/or on-ground exploration as not all of a concession may be exploited. Nonetheless, concessions indicate that the relevant government has included an area in the oil and gas licensing process.

The current analysis considered the application status of concessions as at the date of IHS database download. Historical or future changes in concessions (which expire and/or can be subject to future boundary changes) are not included.

2.3 World Heritage sites

Boundaries for all 217 natural and mixed World Heritage sites inscribed on the UNESCO World Heritage List as of March 2013 were extracted from the IUCN/UNEP-WCMC World Database on Protected Areas (WDPA). Boundaries represent the current extent of the World Heritage sites as recorded in the WDPA.

World Heritage site categories

No categorical distinctions were made between the 188 natural and 29 mixed World Heritage sites. Furthermore, World Heritage sites which have been delisted (one site) or those sites inscribed on national Tentative Lists (many sites) were not included in the analysis.

Spatial uncertainty

The boundaries of World Heritage sites are compiled from original nominations, retrospective inventory processes and best available information in the WDPA. They have been checked for consistency and accuracy and are updated after each Committee meeting, where new nominations are inscribed. However, errors related to projection associated with the original mapping or digitisation of boundaries may persist in the dataset. The proximity analysis takes account of the remaining uncertainty in the boundary of the World Heritage sites (Section 3).

3 Methodology

The methodological framework was split into three key components which compared the a) overlap, b) proximity and c) detailed temporal comparisons of any overlaps between extractive activities and World Heritage sites.

a) Overlap

This analysis set out to determine if extractive activities (as represented by mining projects and wells) occurred within current World Heritage site boundaries. As mining projects and wells were represented as point locations, this analysis represented an estimate of the number of activities occurring within World Heritage sites, but an estimate of any area of overlap was not possible. Outputs of these analysis describe the number (and percentage) of World Heritage sites which overlap mining projects and/or wells broken down according to development stage and spatial uncertainty.

b) Proximity

Proximity analysis was undertaken to account for spatial uncertainty in the World Heritage site boundaries, the location of extractive operations (mining projects and wells) and spatial representation of projects (operational footprints). Given the spatial uncertainty in the datasets, the aim of the proximity analysis was to identify potential overlaps and/or interactions between extractive operations and World Heritage sites. This was particularly true within the smaller distance categories.

The distance between all World Heritage sites and (a) mining projects, and (b) wells was calculated to a maximum distance of 500 km. Subsequently, mining projects and wells falling in discrete distance bands of 1, 5 and 10 km were calculated. Calculating the distance bands in this way helps to mitigate for spatial uncertainty in the mine/well location and World Heritage site boundary.

It should be noted that distance categories do not account for local conditions, such as terrain, watershed boundaries or prevailing wind conditions. Consequently, buffers do not measure, estimate or imply impact and are solely included to mitigate spatial uncertainty in the data sources.

A final element of the proximity analysis calculated the minimum distance between each World Heritage site boundary and (a) a mining project, and (b) a well. The intention of this analysis was to identify the range of distances between World Heritage sites and extractive operations.

c) Temporal comparison

Where spatial overlap between extractive operations and World Heritage sites was identified, analysis was undertaken on a case by case basis to determine (a) the certainty with which this overlap could be reported, and (b) temporal characteristics of the overlap. This case-by-case analysis was based on contextual information from all three datasets.

4 Results: Mining projects

4.1 The global context: Mining Projects

At a global scale between ten (reliably located) and 28 (including less reliably located), active mining projects were identified as being inside a World Heritage site. Of the ten reliably located projects, seven were in the development stage and three were in the production stage. These figures rise to 55 (reliably located) and 107 (including less reliably located) active mining projects within 10km of World Heritage Sites. (Table 4.1)

Table 4.1: The global count of active mining projects within each distance band categorised by project stage for reliably located projects only and all projects (numbers below relate to count of mining projects and not count of WHS)

Project Stage	Distance bands									
	Inside		Outside - 1 km		1 - 5 km		5 - 10 km		Total	
	Reliably located projects	All	Reliably located projects	All	Reliably located projects	All	Reliably located projects	All	Reliably located projects	All
Active Exploration	7	22	5	6	8	20	14	31	38	79
Production	3	6	1	2	6	9	11	11	21	28
Total	**10**	**28**	**6**	**8**	**14**	**29**	**25**	**42**	**55**	**107**

Table 4.2: The global count of inactive mining projects within each distance band categorised by project stage for reliably located projects only and all projects (numbers below relate to count of mining projects and not count of WHS)

Project Stage	Distance bands									
	Inside		Outside - 1 km		1 - 5 km		5 - 10 km		Total	
	Reliable	All	Reliable	All	Reliable	All	Reliable	All	Reliable	All
Closed	2	5	1	1	2	3	2	3	7	12
Inactive exploration	2	4	1	1	0	0	2	2	5	7
Unknown	0	0	0	0	0	0	1	1	1	1
Total	**4**	**9**	**2**	**2**	**2**	**3**	**5**	**6**	**13**	**20**

Table 4.1 and Table 4.2 include counts of the number of mining projects in each distance band. Values are given for reliably located projects and all projects, including those which are less reliably located. However, it should be noted that less accurate coordinates identified as falling within World Heritage sites are potentially inaccurate in all directions, consequently, they may or may not fall within the World Heritage boundary.

The most predominant projects found in, and in close proximity to, World Heritage sites are categorised as active exploration activities. This higher proportion might be expected given the high attrition rates of exploration stage projects. Although exploration projects may not always indicate future extractive activities, exploration operations in themselves may have significant impacts on the local environment and therefore still warrant investigation. It should also be noted that greater uncertainty may be associated with the location of exploration activities than with established production operations.

4.2 How many World Heritage sites are spatially coincident with mining projects?

Building on the analyses in the previous section, it is possible to determine the number of World Heritage Sites which overlap with, or are within 1km of, one or more mine, categorised by project stage.

The analysis shows that there are 10 World Heritage sites which interact with one or more reliably located mining projects which are reported at active exploration or production stage. This represents 5% of all 217 natural/mixed World Heritage sites. One site interacts with both active production and exploration projects, a further 3 with production projects and the remaining 6 with exploration projects.

Information on individual World Heritage Sites identified in the analysis can be found in section 7.3 which describes the results for all World Heritage Sites. The status of each World Heritage site is listed in Table 7.11 within that section.

How many World Heritage sites are spatially coincident with producing mining projects?

Four World Heritage sites have (reliably located) producing mine projects within or up to 1 km from their boundary. While it is assumed that spatial proximity between mining projects and World Heritage sites may be indicative of potential pressure from extractive operations, further local, contextual information is required to determine the temporal relationship of the operation to World Heritage site designation, to confirm the production status of the operation and the proximity of the mining project to the site boundary.

Interrogation of the four mining projects which interact with World Heritage sites demonstrates that the commodities being extracted are copper (two of four projects), gold (all projects) and silver (two of four projects). This is via a mix of both underground and surface operations. It should be noted that the producing status of two of the mining projects are listed as unknown in the MEG database. Consequently, further investigation would be required to determine if these projects are actively producing commodities.

How many World Heritage sites are spatially coincident with development activities?

Seven World Heritage sites have (reliably located) exploration mine projects within or up to 1 km from their boundary. Three of these seven sites are flagged as being spatially coincident with more than one active exploration project.

Are additional World Heritage sites identified if less accurately located mining projects are considered?

The addition of less accurately located producing mining projects within the above analysis, identifies an additional three World Heritage sites that are potentially spatially coincident (up to 1km) with producing mine projects. A greater number of World Heritage sites are added with the inclusion of less accurately located active exploration projects with ten further sites being identified.

Including both reliable and less reliable data on site location, and accounting for World Heritage sites which contain more than one mine type, a total of 20 World Heritage sites contain or are in close proximity to production (3), exploration (13) and both production and exploration (4) mines. This represents a potential 9% of World Heritage sites.

4.3 The minimum distance between World Heritage sites and mining projects

Previous analyses focused on the spatial overlap of mining projects and World Heritage sites. In addition to searching solely for those mining projects which overlap (or are in close proximity to) World Heritage sites, an analysis was also conducted to determine the minimum distance between each World Heritage site (boundary) and (a) producing, and (b) active exploration stage mining projects. Importantly, this analysis does not attempt to assess impacts of extractive operations and therefore the implications of varying distances between mining sites and World Heritage sites must be interpreted in combination with further local knowledge and assessment.

As indicated in Figure 4.1, based solely on reliably located mining projects, the distribution of distances between World Heritage sites and both producing and active exploration stage projects is skewed. In both cases, this skew is towards longer distances.

Eleven World Heritage sites, representing 5% of all sites, have producing mines within or to a distance of 10km from their site boundary. This increases to 18 sites (8%) if the distance band is extended to 25km. Conversely, for 180 sites, representing 82% of all sites, producing mines were identified as occurring further than 50km of the site boundary.

Following the trends of the previous analysis, a greater number of sites potentially interact with exploration projects. Fourteen World Heritage sites, representing 6% of all sites, have active exploration within 10km of the site boundary. This increases to 31 sites (14%) if the distance band is extended to 25km. However, for 168 sites, representing 77% of all sites, exploration activities were identified as occurring further than 50km of the site boundary.

(a) (b)

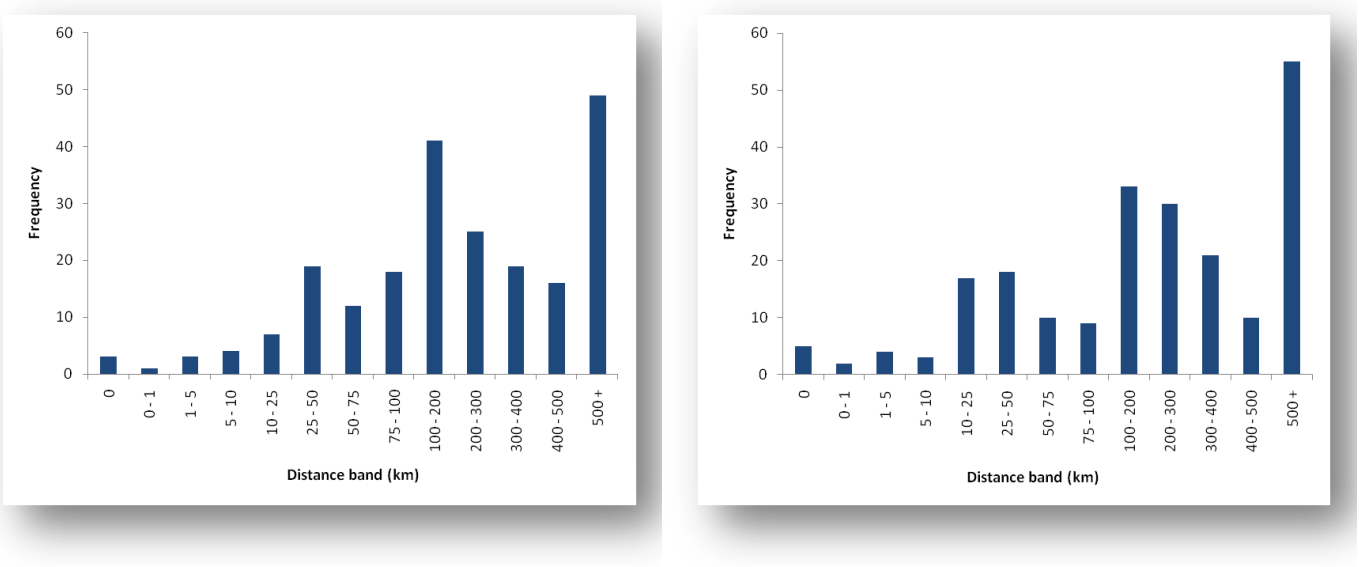

Figure 4.1: The frequency distribution of minimum distances between World Heritages sites and reliably located (a) producing and (b) active exploration mining projects.

4.4 Summary: World Heritage sites and mining projects

Based on the analysis in sections 4.1 and4.2, global statistics on the number of World Heritage sites which are spatially coincident with or proximal to (to allow for data uncertainty) mining projects were calculated. Further detailed/local scale analysis and data collation will be required to complement the findings of this study in order to generate a comprehensive baseline on the overlap between mining and World Heritage sites.

Producing mines: Considering only those mining projects with reliable spatial locations in the MEG dataset, four World Heritage sites contain or are in close proximity to producing extractive operations. This represents 2% of all 217 natural and mixed World Heritage sites. The inclusion of less accurately located projects increases this value to seven World Heritage sites (3% of all sites). At least one of these producing projects was initiated prior to the inscription of the World Heritage site.

Active exploration activities: A greater number of World Heritage sites contain or are in close proximity to exploration activities. Based solely on reliably located mining projects, seven World Heritage sites are flagged within 1km of mining sector development activities. This represents 3% of all 217 natural and mixed World Heritage sites. With the inclusion of less accurately located mining projects, the number of flagged World Heritage sites increases to 17 (8% of all sites).

5 Results: Oil and gas projects

Results in the following sections utilise wells as a proxy for oil and gas projects. As previously stated in section 2.2.1, well counts would be expected to be orders of magnitude greater than mining projects. This is a function of the data type and scale and not a true reflection of the magnitude of impact of each extractives sector. Furthermore, development stages are not directly aligned. Direct comparison is therefore not possible.

5.1 Are any World Heritage sites flagged as containing active drilling at the time of this study?

Interrogation of the IHS database indicates that, at the time of data collation/download, no active drilling was being conducted within World Heritage sites (Table 5.1). However, further detailed/local scale analysis would be required to validate this global scale finding.

Table 5.1: Global totals for wells being actively drilled inside and at increasing distances from World Heritage sites

	Distance Bands			
Spatial Uncertainty	**Inside**	**1 km**	**5 km**	**10km**
Reliable	0	0	8	8
Less Accurate	0	0	2	6

5.2 The global context: Wells

At a global scale, 16 reliably located wells at which on-ground activities are expected (development and production) were identified as being spatially coincident with a World Heritage site. These 16 wells are all completed wells on producing fields (Table 5.2). No reliably located wells associated with development/discovery fields were identified as occurring within World Heritage sites.

If wells within 1 km of a World Heritage site are considered, the number of potentially producing wells increases significantly with the identification of an additional 107 wells (Table 5.2). It should however be stated that all of these 107 wells are categorised as having reliable coordinates increasing the probability that they do not occur within the World Heritage sites.

A clear trend identified in Table 5.2 is the low number of wells associated with field development (discovery/appraise/development) within and in close proximity to World Heritage sites.

The totals row in Table 5.2 indicates the magnitude of oil and gas activities within and in close proximity to World Heritages sites. However, it is clear that a large proportion of these wells are inactive. Trends are therefore historic and may include drilling prior to World Heritage site designation.

Table 5.2: **Global counts of wells occurring within (and in close proximity to) World Heritage sites for reliably located projects only and for all projects (numbers below relate to count of oil and gas wells and not count of WHS)**

Distance bands										
Project Stage	Inside		Outside - 1 km		1 - 5 km		5 - 10 km		Total	
	Reliably located projects	All	Reliably located projects	All	Reliably located projects	All	Reliably located projects	All	Reliably located projects	All
Discovery	0	1	2	2	1	2	7	7	**10**	**12**
Appraise	0	0	0	0	1	2	5	8	**6**	**10**
Develop	0	0	0	0	0	0	1	4	**1**	**4**
Produce	16	16	107	107	169	169	326	333	**618**	**625**
Inactive	274	339	182	188	351	376	586	623	**1,393**	**1,526**
Abandon	2	2	6	6	46	46	127	129	**181**	**183**
Unknown	12	13	5	8	52	67	58	72	**127**	**160**
Total	**304**	**371**	**302**	**311**	**620**	**662**	**1110**	**1176**	**2,336**	**2,520**

5.3 How many World Heritage sites are spatially coincident with wells?

Information on individual World Heritage Sites identified in the analysis can be found in section 7.3 which describes the results for all World Heritage Sites. The status of each World Heritage site is listed in Table 7.11 within that section.

How many World Heritage sites overlap wells at any development stage?

It is possible to identify 31 sites which have/had some interaction with wells (with reliable coordinates). It is however, evident that a significant number of these interactions are classified as inactive, that is, wells were not completed or have subsequently been plugged and abandoned. The inclusion of wells with less accurate coordinate information did not identify any additional World Heritages sites which are in proximity to (within and up to 1 km) oil and gas activities. Three sites have wells at multiple stages, four have wells at an unknown stage, and the remaining 24 have inactive wells.

How many World Heritage sites interact with wells on producing fields?

As previously discussed, 16 completed wells located on producing fields were identified within World Heritage sites. These 16 reliably located wells are confined to two World Heritage sites.

It should be noted that a degree of uncertainty is attached to the identification of producing wells. This high uncertainty is a consequence of the assumption that all wells on producing fields are currently producing. This assumption would lead to an overestimation in the number of producing wells in the fields, which overlap the World Heritage site, relative to the reported producing wells for the field. It is therefore feasible that the wells which fall within the World Heritage sites have finished their life or been decommissioned.

The additional 107 wells flagged as occurring within 1 km of a World Heritage site are confined to a limited number of fields. Of these 107 wells, 105 occur within 1km of the two World Heritage Sites already identified as containing wells, the remaining 2 are within 1km of an additional World Heritage site.

5.4 Minimum distance

Initial analyses focused on the spatial overlap of wells and World Heritage sites. In addition to searching solely for those wells which overlap (or are in close proximity to) World Heritage sites, an analysis was also conducted to determine the minimum distance between each World Heritage site (boundary) and (a) producing, and (b) development stage, that is, wells categorised as appraise, develop and discovery.

As indicated in Figure 5.1, based solely on reliably located wells projects, the distribution of distances between World Heritage sites and both producing and development stage (appraise, develop, discovery) wells is skewed. In both cases, this skew is towards longer distances.

Of the 217 World Heritage sites, five were identified as having potentially producing wells within 10km of the site boundary, this represents 2% of all sites. This increases to 12 sites (6%) when the distance bracket is expanded to 25km. Conversely, 193 sites, representing 89% of all sites, were identified as sites for which potentially producing wells were further than 50km from the site boundary.

Development wells follow similar trends with five sites (2%) having wells associated with exploration within 10km of the site boundary. This increases to 9 sites (4%) when the distance bracket is expanded to 25km. Conversely, 201 sites (93% of all sites) were identified as sites for which exploration/development wells were further than 50km from the site boundary.

(a) (b)

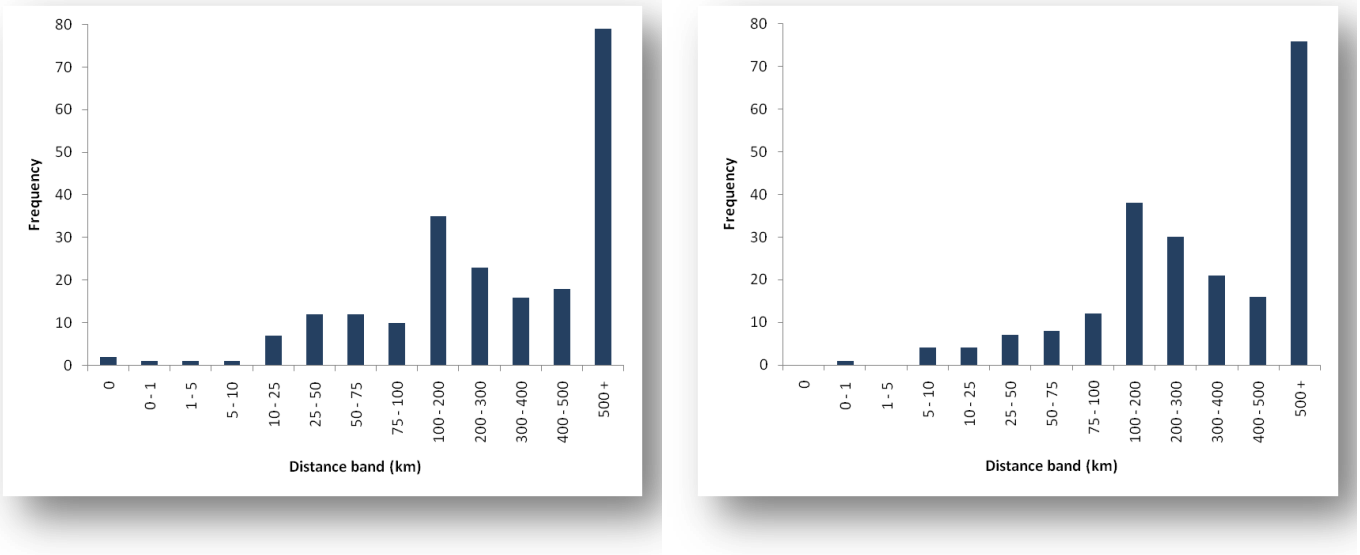

Figure 5.1: The frequency distribution of minimum distances between World Heritages sites and reliably located (a) producing and (b) active develop wells (appraise, discovery, develop) based solely on reliably located wells.

5.5 Summary: World Heritage sites and wells

Based on the analysis in the sections 5.2 and 5.3 global statistics on the number of World Heritage sites which are spatially coincident with or proximal to oil and gas activities (to allow for data uncertainty) can be calculated.

Producing wells: Considering only those wells with reliable spatial locations, two World Heritage sites contain producing oil and gas wells. This represents less than 1% of all 217 natural and mixed World Heritage sites. Inclusion of producing wells within 1 km of World Heritage sites identifies one further site. This does not increase when wells with less reliable coordinates are included.

Active development: Only three wells associated with field development (discovery/appraise/development) occur within or in close proximity (1 km) to World Heritage sites.

6 Results: Oil and gas concessions

As discussed in section 2.2.2, care of interpretation is required for the analysis of oil and gas concessions. Concessions are an indicator of tenure over sub-surface resources and do not necessarily imply any form of on-ground activity or ownership. Equally, where significant proportions of the concessions are located outside the World Heritage Site it may be that activities within the concession are not located within the site boundary. The existence of a concession indicates that the relevant government has made the area available in the licensing process. Licensing processes vary from country to country, and may contain specific caveats to restrict activities within protected areas (including World Heritage sites) where these overlap with the concession area.

6.1 What percentage of World Heritage sites are covered by oil and gas concessions?

Globally, 63 World heritage sites overlap oil and gas concessions (of all types). This represents 32% of all World Heritage sites assessed (with 20 sites in the USA and Canada excluded due to missing data). Of these 63 World Heritage sites, nine have an overlap of less than 1%. Such low overlap values are potentially a consequence of spatial uncertainty/errors in the site and/or contract boundaries. As illustrated in Figure 6.1, the overlap between World Heritage sites and concessions is typically low and skewed towards lower percentages.

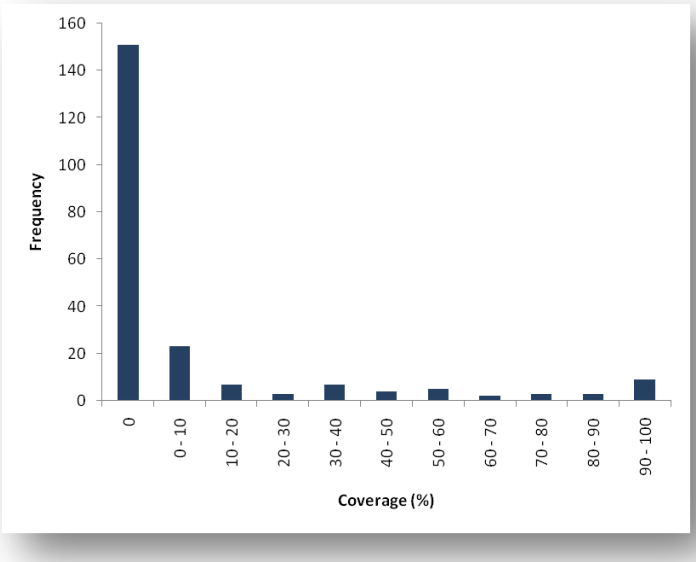

Figure 6.1: Histogram illustrating the percentage of each World Heritage site overlapped by oil and gas blocks (of any category).

Twenty-two of the 197 World Heritage sites assessed have 50% or greater of their land area covered by concessions of any category from a total of 44 concessions. Six World Heritage sites have 100% of their land area covered by concessions.

6.2 What percentage of a single concession falls within any World Heritage site?

The analysis has also considered the area of each concession contained within a World Heritage site. Concessions with very limited amounts of overlap might be less likely to have extractive activities within the site. In contrast, identifying instances with high degrees of overlap may be useful for identifying areas with active or potential extractive operations within a World Heritage site. However, it should be noted that this study does not consider the specific location of resource deposits within a concession nor the impact of operations which may be severe, regardless of the degree of overlap. Consequently, the results of this analysis ought to be interpreted with due care.

If all concessions (of all types) are considered (24,625 in total), 180 concessions or 0.7% overlap with World Heritage sites globally. In the majority of these cases, the percentage of any single block falling within a World Heritage site is less than 50% (Figure 6.2). However, sixteen concessions, were identified as having 50% or greater of their licensed area within eight World Heritage sites.

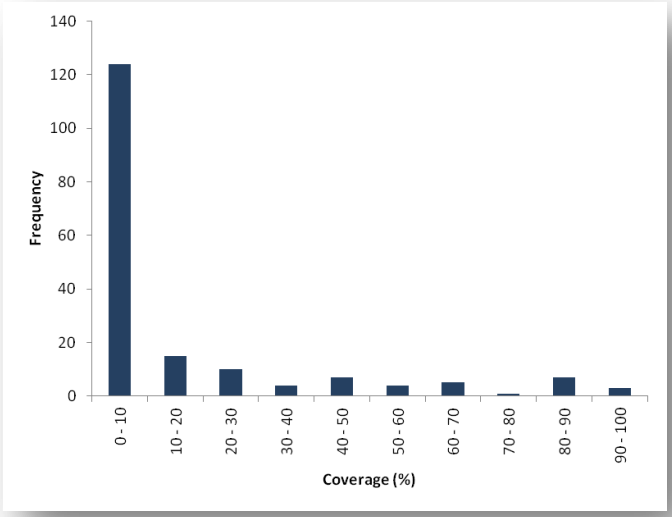

Figure 6.2: Histogram for the 180 concessions (of any type) overlapping with WHS of the percentage overlap with World Heritage sites.

7 Results: Overall trends

7.1 How many World Heritage sites are spatially coincident with extractive industry?

By combining results from both mining and oil and gas activities, and within the limitations posed by the available data, the interaction between extractive industries and World Heritage sites was estimated at a global scale. Considering operations (mining projects and wells) to a distance of 1km (Table 7.1), the following trends were identified:

- Seven World Heritage sites (3% of all sites) were identified as being spatially coincident or proximal to producing operations. This has the potential to increase to 10 sites (5% of all sites) if less accurately located operations are considered.

- Eight World Heritage sites (4% of all sites) were identified as being spatially coincident or proximal to active exploration/development operations. This has the potential to increase to 20 sites (9% of all sites) if less accurately located operations are considered. These statistics are generated from mining projects categorised as active exploration and discovery wells (no other well project stages were found in the specified distance band).

- If all active operations, that is, active exploration/development and producing are combined, 13 World Heritage sites (6% of all sites) were identified as being spatially coincident or proximal to active extractive operations. This has the potential to increase to 24 sites (11% of all sites) if less accurately located operations are considered.

Table 7.1: Global counts of World Heritage sites identified as having extractive operations occurring within or in close proximity (to 1km) of their boundary. Counts are categorised according to the project stage.

Project stage	Number of unique World Heritage sites overlapping or proximal to wells and mines	
	Reliable	All
Active Exploration/Development*	8	20
Producing	7	10
All Active Operations	13	24

*Note: * Includes mines classified as active exploration and wells classified as discovery (remaining well development categories were not identified in the specified distance band).*

- Of the 217 World Heritage sites analysed, between 13 (based on reliably located data) and 24 (including less reliably located data) overlap an extractive site of some sort. In all cases, World Heritage sites were identified by either a mine or an oil/gas project. No World Heritage sites were flagged as being spatially coincident with or proximal to (to 1km) both mines and wells.

7.2 Categorising World Heritage sites according to their distance to active extractive operations

The minimum distance between each World Heritage site boundary and all active operations (mining projects and wells) was calculated. In this context, active operations are defined to include (a) active exploration and producing mine projects, and (b) discovery, appraise, develop and producing wells. As previously stated, project stages were defined independently for mining projects and wells. Consequently, this analysis could not be sub-divided into more finely resolved classes, such as, exploration and production.

World Heritage sites were sub-divided into three categories as a consequence of their minimum distance to active extractive operations (Table 7.2, Figure 7.1). The three distance categories are designed to assist the preliminary categorisation of World Heritage sites according to their potential overlap/proximity to active extractive operations; 0-10km, 10-50km, and greater than 50km. While it may be reasonable to assume that in many cases, operations closer to World Heritage sites represent priorities for attention, given that this analysis does not consider local environmental conditions nor the impact of operations on them, the distance categories must be interpreted with care. Figure 7.2 to Figure 7.9 present these results by region.

Table 7.2: The count of World Heritage sites categorised into three distance bands as a consequence of their minimum distance to active extractive operations.

Distance from extractive operations	Number of World Heritage sites (% of all sites)
0 - 10 km	46 (21%)
10 - 50 km	61 (28%)
Greater than 50 km	110 (51%)

Figure 7.1: Maps depicting World Heritage sites categorised according to their minimum distance to active extractive operations

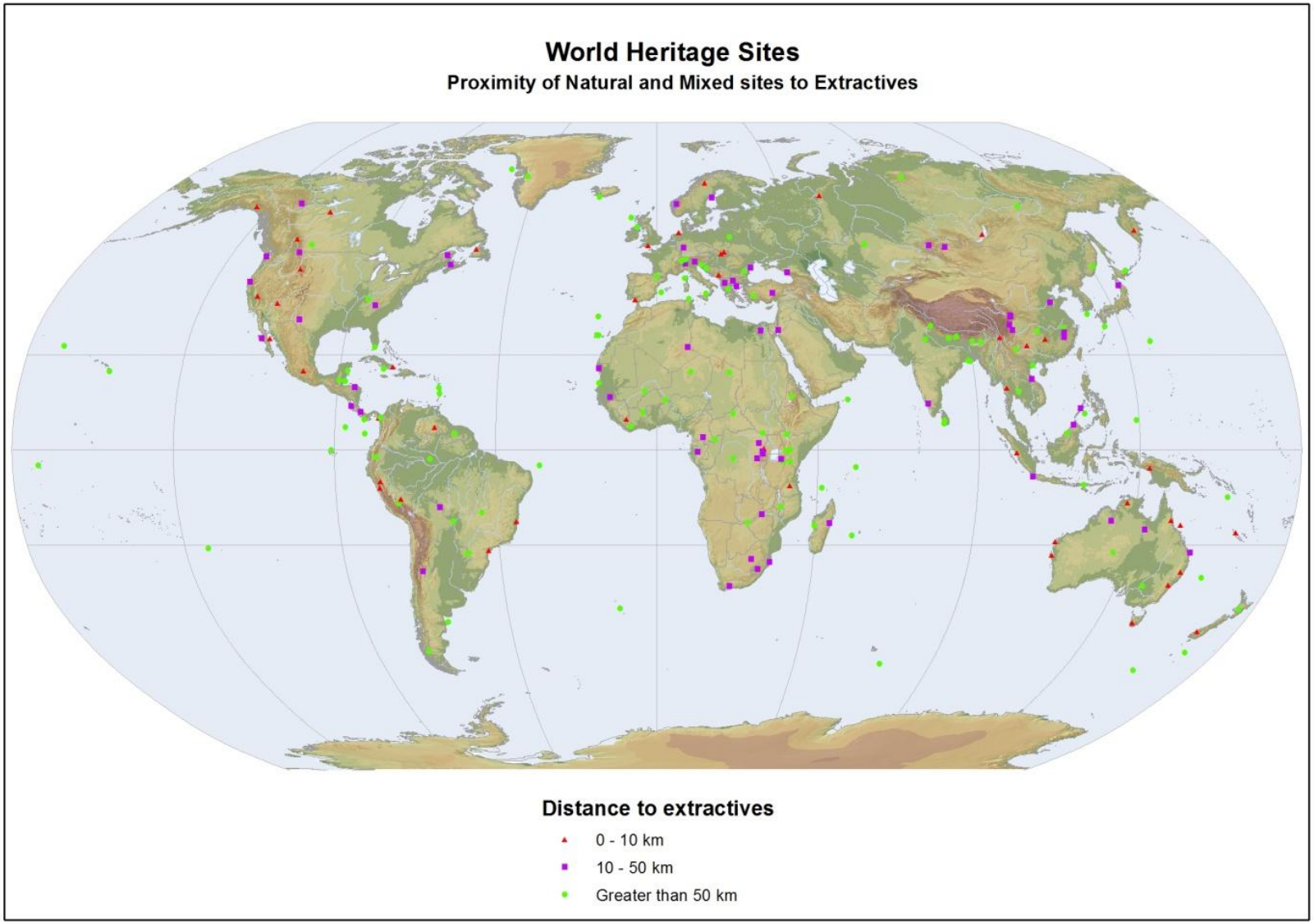

Figure 7.2: North America and the Caribbean depicting World Heritage sites categorised according to their minimum distance to active extractive operations (NB: Mining sites only for onshore USA and Canada)

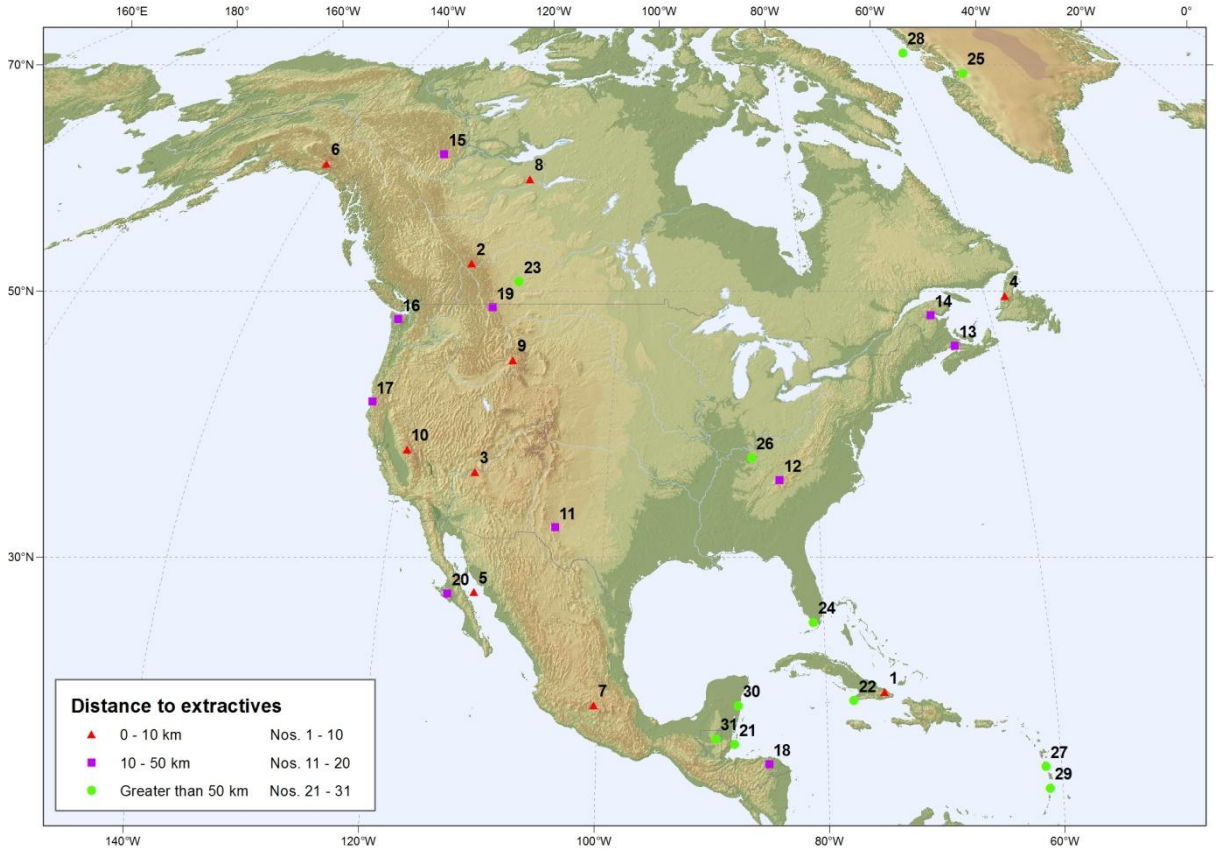

Figure 7.3: Pacific depicting World Heritage sites categorised according to their minimum distance to active extractive operations

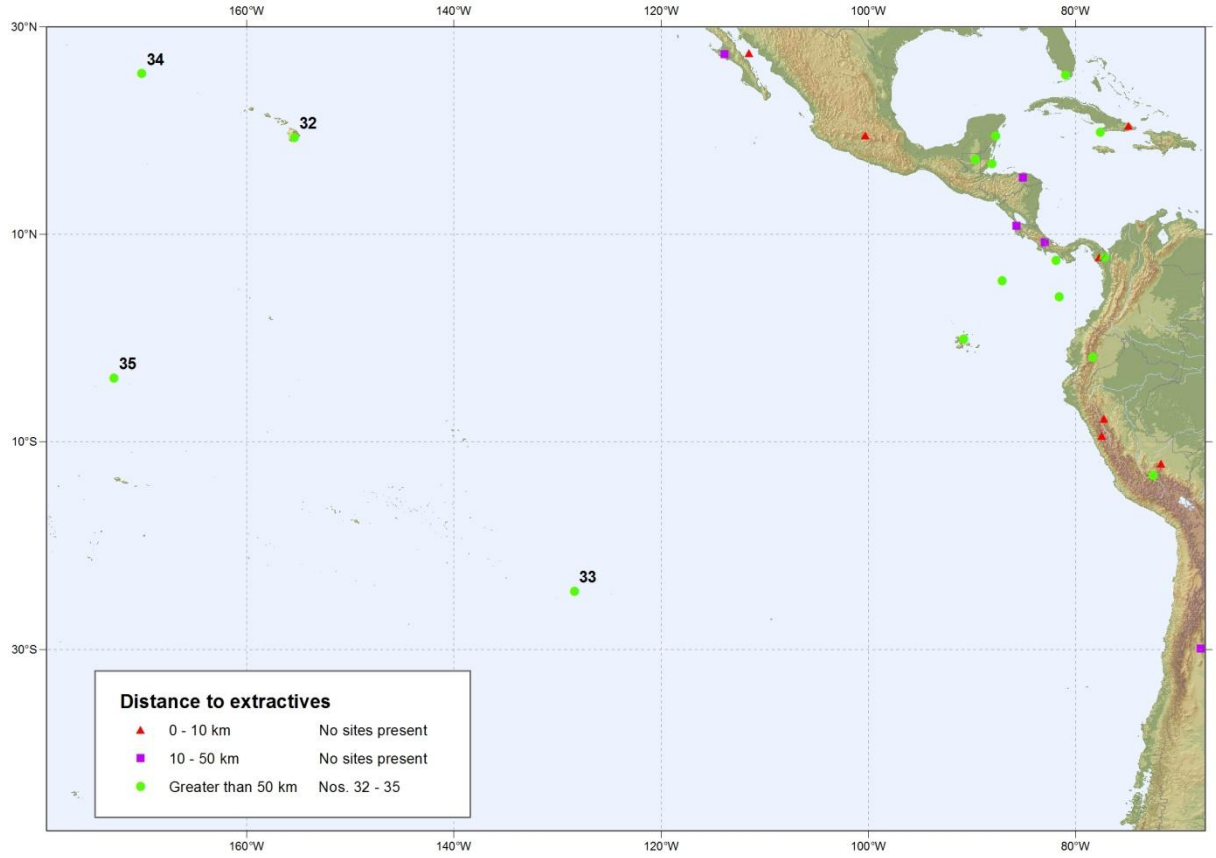

Table 7.3: North America and Caribbean map legend

World Heritage site	Distance from active extractives	Map reference number
Alejandro de Humboldt National Park	0 - 10 km	1
Canadian Rocky Mountain Parks	0 - 10 km	2
Grand Canyon National Park	0 - 10 km	3
Gros Morne National Park	0 - 10 km	4
Islands and Protected Areas of the Gulf of California	0 - 10 km	5
Kluane / Wrangell-St Elias / Glacier Bay / Tatshenshini-Alsek	0 - 10 km	6
Monarch Butterfly Biosphere Reserve	0 - 10 km	7
Wood Buffalo National Park	0 - 10 km	8
Yellowstone National Park	0 - 10 km	9
Yosemite National Park	0 - 10 km	10
Carlsbad Caverns National Park	10 - 50 km	11
Great Smoky Mountains National Park	10 - 50 km	12
Joggins Fossil Cliffs	10 - 50 km	13
Miguasha National Park	10 - 50 km	14
Nahanni National Park	10 - 50 km	15
Olympic National Park	10 - 50 km	16
Redwood National and State Parks	10 - 50 km	17
Río Plátano Biosphere Reserve	10 - 50 km	18
Waterton Glacier International Peace Park	10 - 50 km	19
Whale Sanctuary of El Vizcaino	10 - 50 km	20
Belize Barrier Reef Reserve System	Greater than 50 km	21
Desembarco del Granma National Park	Greater than 50 km	22
Dinosaur Provincial Park	Greater than 50 km	23
Everglades National Park	Greater than 50 km	24
Ilulissat Icefjord	Greater than 50 km	25
Mammoth Cave National Park	Greater than 50 km	26
Morne Trois Pitons National Park	Greater than 50 km	27
Natural System of Wrangel Island Reserve	Greater than 50 km	28
Pitons Management Area	Greater than 50 km	29
Sian Ka'an	Greater than 50 km	30
Tikal National Park	Greater than 50 km	31

Table 7.4: Pacific map legend

World Heritage site	Distance from active extractives	Map reference number
Hawaii Volcanoes National Park	Greater than 50 km	32
Henderson Island	Greater than 50 km	33
Papahanaumokuakea	Greater than 50 km	34
Phoenix Islands Protected Area	Greater than 50 km	35

Figure 7.4: South and Central America depicting World Heritage sites categorised according to their minimum distance to active extractive operations

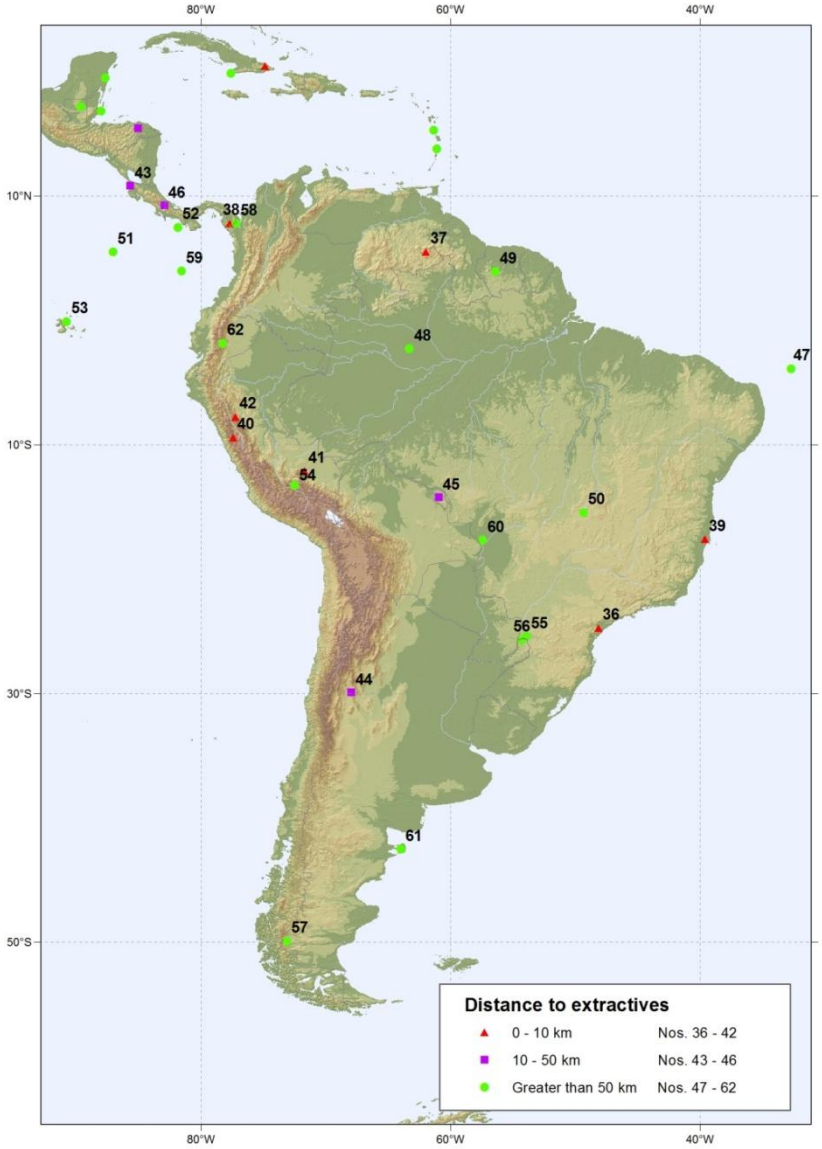

Figure 7.5: Africa depicting World Heritage sites categorised according to their minimum distance to active extractive operations

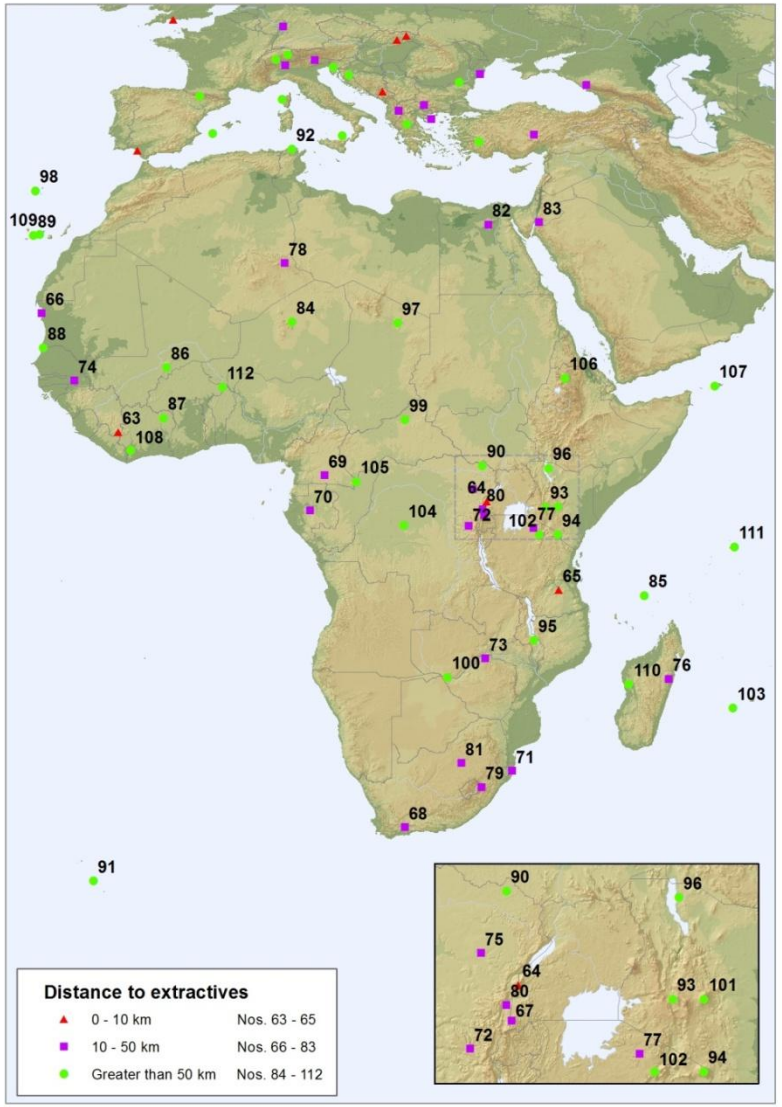

Table 7.5: South and Central America map legend

World Heritage site	Distance from active extractives	Map reference number
Atlantic Forest Southeast Reserves	0 - 10 km	36
Canaima National Park	0 - 10 km	37
Darien National Park	0 - 10 km	38
Discovery Coast Atlantic Forest Reserves	0 - 10 km	39
Huascarán National Park	0 - 10 km	40
Manú National Park	0 - 10 km	41
Río Abiseo National Park	0 - 10 km	42
Area de Conservación Guanacaste	10 - 50 km	43
Ischigualasto / Talampaya Natural Parks	10 - 50 km	44
Noel Kempff Mercado National Park	10 - 50 km	45
Talamanca Range-La Amistad Reserves / La Amistad National Park	10 - 50 km	46
Brazilian Atlantic Islands: Fernando de Noronha and Atol das Rocas Reserves	Greater than 50 km	47
Central Amazon Conservation Complex	Greater than 50 km	48
Central Suriname Nature Reserve	Greater than 50 km	49
Cerrado Protected Areas: Chapada dos Veadeiros and Emas National Parks	Greater than 50 km	50
Cocos Island National Park	Greater than 50 km	51
Coiba National Park and its Special Zone of Marine Protection	Greater than 50 km	52
Galápagos Islands	Greater than 50 km	53
Historic Sanctuary of Machu Picchu	Greater than 50 km	54
Iguaçu National Park	Greater than 50 km	55
Iguazu National Park	Greater than 50 km	56
Los Glaciares National Park	Greater than 50 km	57
Los Katíos National Park	Greater than 50 km	58
Malpelo Fauna and Flora Sanctuary	Greater than 50 km	59
Pantanal Conservation Complex	Greater than 50 km	60
Península Valdés	Greater than 50 km	61
Sangay National Park	Greater than 50 km	62

Table 7.6: Africa map legend

World Heritage site	Distance from active extractives	Map reference number
Mount Nimba Strict Nature Reserve	0 - 10 km	63
Rwenzori Mountains National Park	0 - 10 km	64
Selous Game Reserve	0 - 10 km	65
Banc d'Arguin National Park	10 - 50 km	66
Bwindi Impenetrable National Park	10 - 50 km	67
Cape Floral Region Protected Areas	10 - 50 km	68
Dja Faunal Reserve	10 - 50 km	69
Ecosystem and Relict Cultural Landscape of Lopé-Okanda	10 - 50 km	70
iSimangaliso Wetland Park	10 - 50 km	71
Kahuzi-Biega National Park	10 - 50 km	72
Mana Pools National Park, Sapi and Chewore Safari Areas	10 - 50 km	73

World Heritage site	Distance from active extractives	Map reference number
Niokolo-Koba National Park	10 - 50 km	74
Okapi Wildlife Reserve	10 - 50 km	75
Rainforests of the Atsinanana	10 - 50 km	76
Serengeti National Park	10 - 50 km	77
Tassili n'Ajjer	10 - 50 km	78
uKhahlamba / Drakensberg Park	10 - 50 km	79
Virunga National Park	10 - 50 km	80
Vredefort Dome	10 - 50 km	81
Wadi Al-Hitan (Whale Valley)	10 - 50 km	82
Wadi Rum Protected Area	10 - 50 km	83
Air and Ténéré Natural Reserves	Greater than 50 km	84
Aldabra Atoll	Greater than 50 km	85
Cliff of Bandiagara (Land of the Dogons)	Greater than 50 km	86
Comoé National Park	Greater than 50 km	87
Djoudj National Bird Sanctuary	Greater than 50 km	88
Garajonay National Park	Greater than 50 km	89
Garamba National Park	Greater than 50 km	90
Gough and Inaccessible Islands	Greater than 50 km	91
Ichkeul National Park	Greater than 50 km	92
Kenya Lake System in the Great Rift Valley	Greater than 50 km	93
Kilimanjaro National Park	Greater than 50 km	94
Lake Malawi National Park	Greater than 50 km	95
Lake Turkana National Parks	Greater than 50 km	96
Lakes of Ounianga	Greater than 50 km	97
Laurisilva of Madeira	Greater than 50 km	98
Manovo-Gounda St Floris National Park	Greater than 50 km	99
Mosi-oa-Tunya / Victoria Falls	Greater than 50 km	100
Mount Kenya National Park/Natural Forest	Greater than 50 km	101
Ngorongoro Conservation Area	Greater than 50 km	102
Pitons, cirques and remparts of Reunion Island	Greater than 50 km	103
Salonga National Park	Greater than 50 km	104
Sangha Trinational	Greater than 50 km	105
Simien National Park	Greater than 50 km	106
Socotra Archipelago	Greater than 50 km	107
Taï National Park	Greater than 50 km	108
Teide National Park	Greater than 50 km	109
Tsingy de Bemaraha Strict Nature Reserve	Greater than 50 km	110
Vallée de Mai Nature Reserve	Greater than 50 km	111
W National Park of Niger	Greater than 50 km	112

Figure 7.6: Europe depicting World Heritage sites categorised according to their minimum distance to active extractive operations

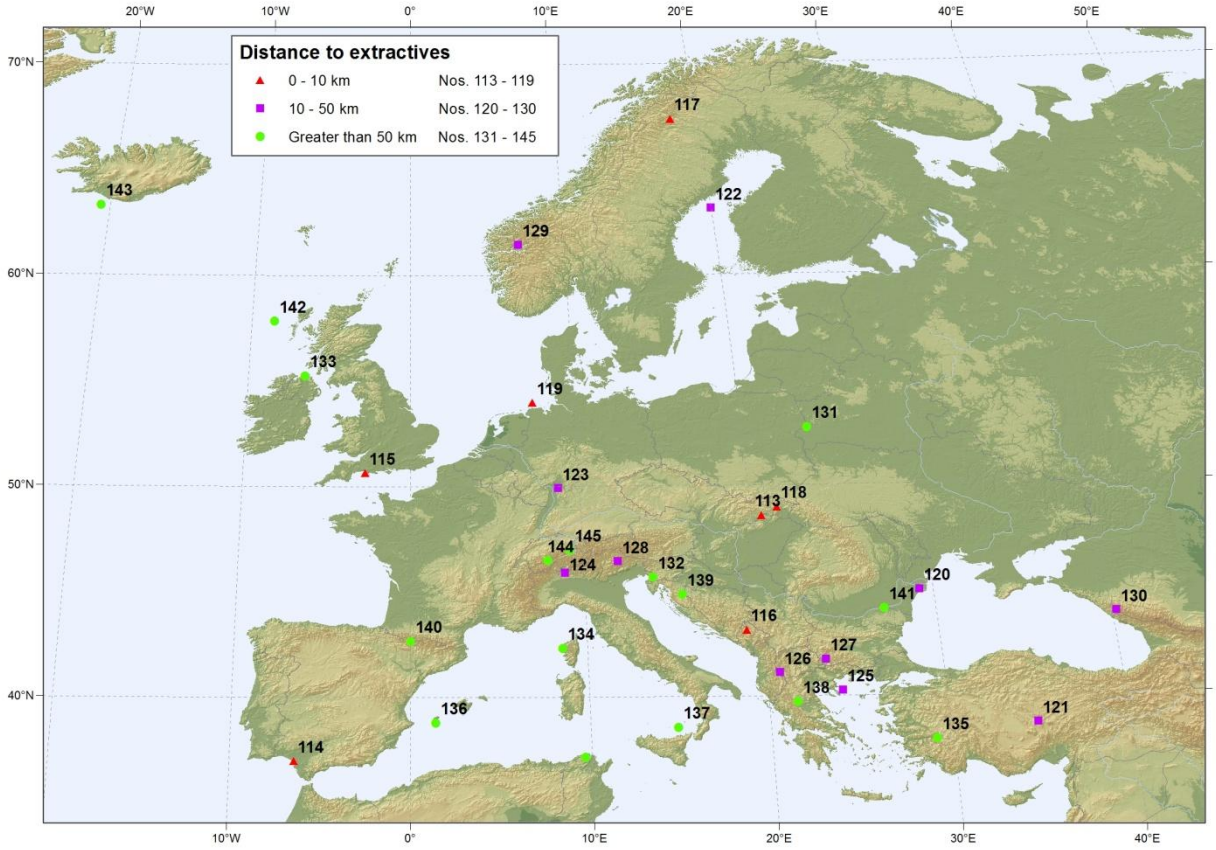

Figure 7.7: Russian Federation depicting World Heritage sites categorised according to their minimum distance to active extractive operations

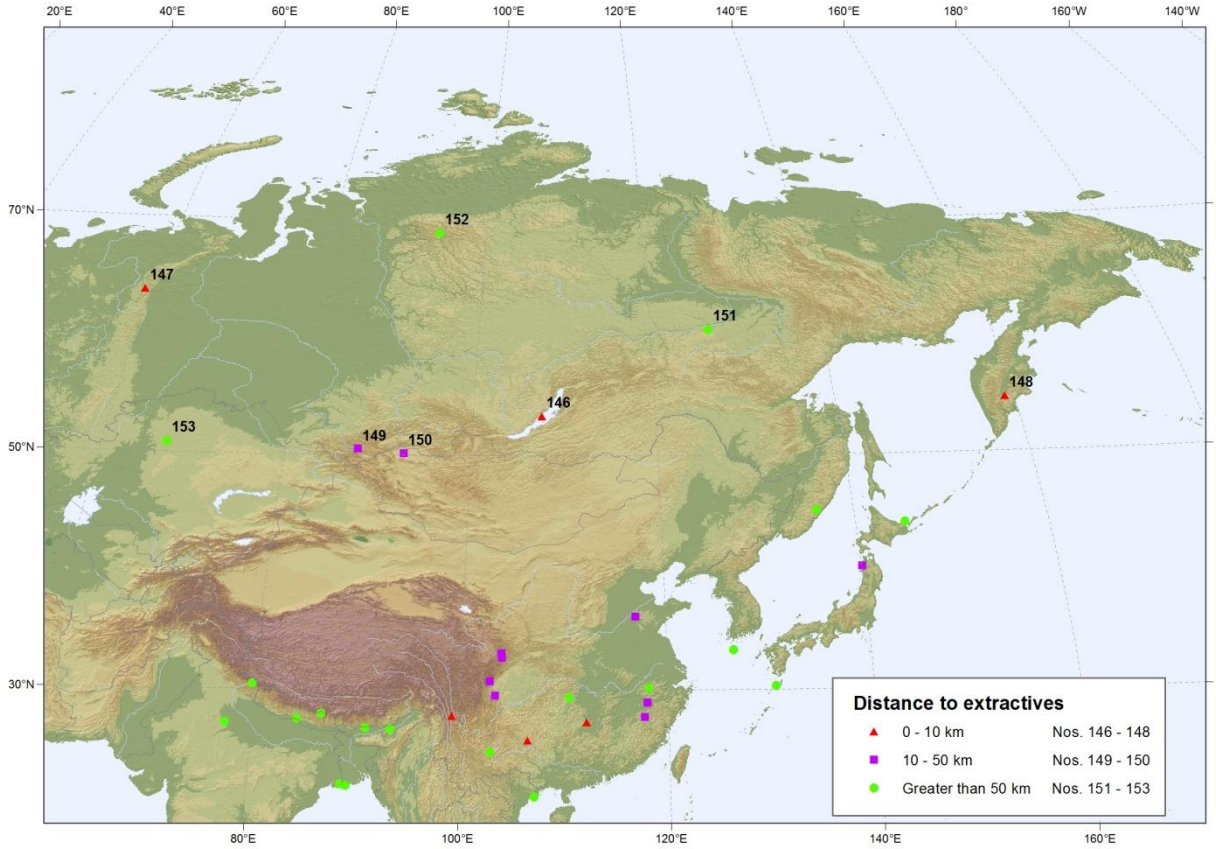

Table 7.7: Europe map legend

World Heritage site	Distance from active extractives	Map reference number
Caves of Aggtelek Karst and Slovak Karst	0 - 10 km	113
Doñana National Park	0 - 10 km	114
Dorset and East Devon Coast	0 - 10 km	115
Durmitor National Park	0 - 10 km	116
Laponian Area	0 - 10 km	117
Primeval Beech Forests of the Carpathians and the Ancient Beech Forests of Germany	0 - 10 km	118
The Wadden Sea	0 - 10 km	119
Danube Delta	10 - 50 km	120
Göreme National Park and the Rock Sites of Cappadocia	10 - 50 km	121
High Coast / Kvarken Archipelago	10 - 50 km	122
Messel Pit Fossil Site	10 - 50 km	123
Monte San Giorgio	10 - 50 km	124
Mount Athos	10 - 50 km	125
Natural and Cultural Heritage of the Ohrid region	10 - 50 km	126
Pirin National Park	10 - 50 km	127
The Dolomites	10 - 50 km	128
West Norwegian Fjords – Geirangerfjord and Nærøyfjord	10 - 50 km	129
Western Caucasus	10 - 50 km	130
Belovezhskaya Pushcha / Bialowieza Forest	Greater than 50 km	131
Škocjan Caves	Greater than 50 km	132
Giant's Causeway and Causeway Coast	Greater than 50 km	133
Gulf of Porto: Calanche of Piana, Gulf of Girolata, Scandola Reserve	Greater than 50 km	134
Hierapolis-Pamukkale	Greater than 50 km	135
Ibiza, Biodiversity and Culture	Greater than 50 km	136
Isole Eolie (Aeolian Islands)	Greater than 50 km	137
Meteora	Greater than 50 km	138
Plitvice Lakes National Park	Greater than 50 km	139
Pyrénées - Mont Perdu	Greater than 50 km	140
Srebarna Nature Reserve	Greater than 50 km	141
St Kilda	Greater than 50 km	142
Surtsey	Greater than 50 km	143
Swiss Alps Jungfrau-Aletsch	Greater than 50 km	144
Swiss Tectonic Arena Sardona	Greater than 50 km	145

Table 7.8: Russian Federation map legend

World Heritage site	Distance from active extractives	Map reference number
Lake Baikal	0 - 10 km	146
Virgin Komi Forests	0 - 10 km	147
Volcanoes of Kamchatka	0 - 10 km	148
Golden Mountains of Altai	10 - 50 km	149
Uvs Nuur Basin	10 - 50 km	150
Lena Pillars Nature Park	Greater than 50 km	151
Putorana Plateau	Greater than 50 km	152
Saryarka – Steppe and Lakes of Northern Kazakhstan	Greater than 50 km	153

Figure 7.8: Asia depicting World Heritage sites categorised according to their minimum distance to active extractive operations

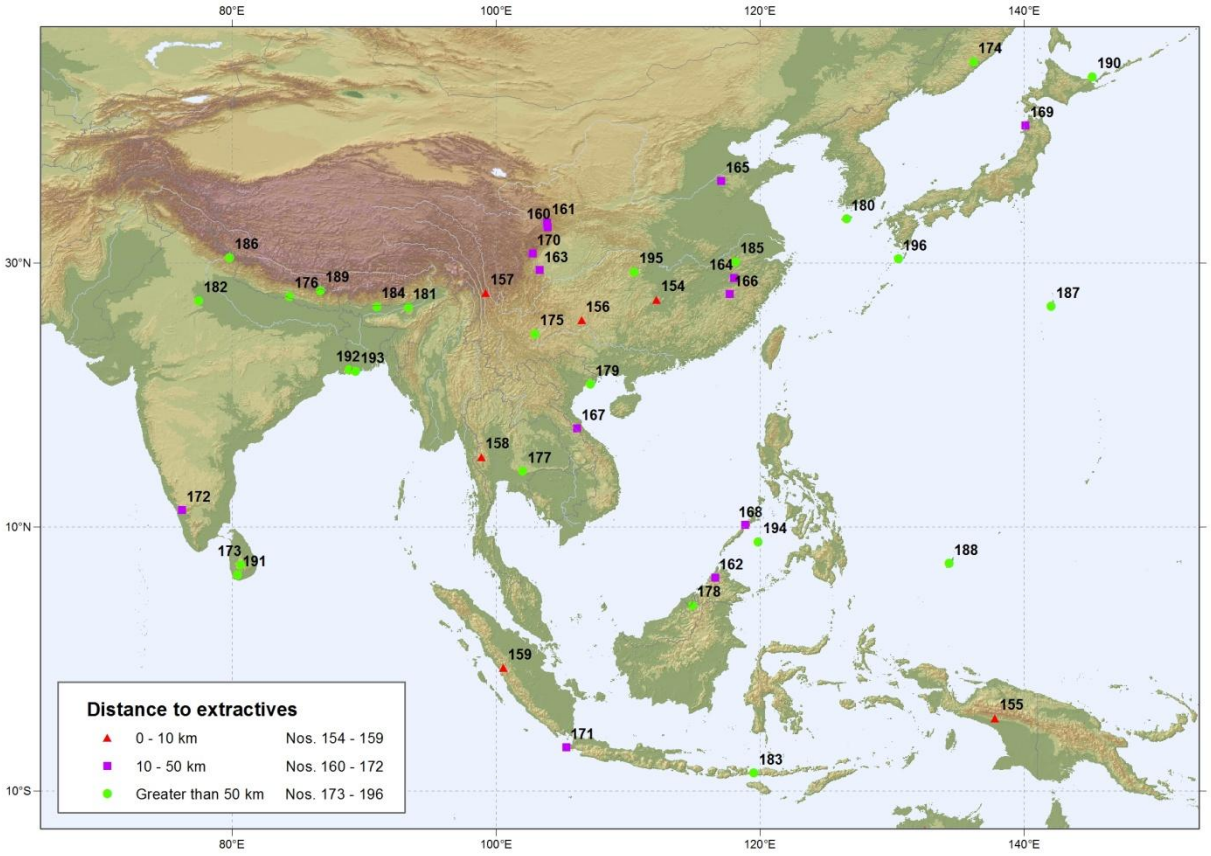

Figure 7.9: Oceania depicting World Heritage sites categorised according to their minimum distance to active extractive operations

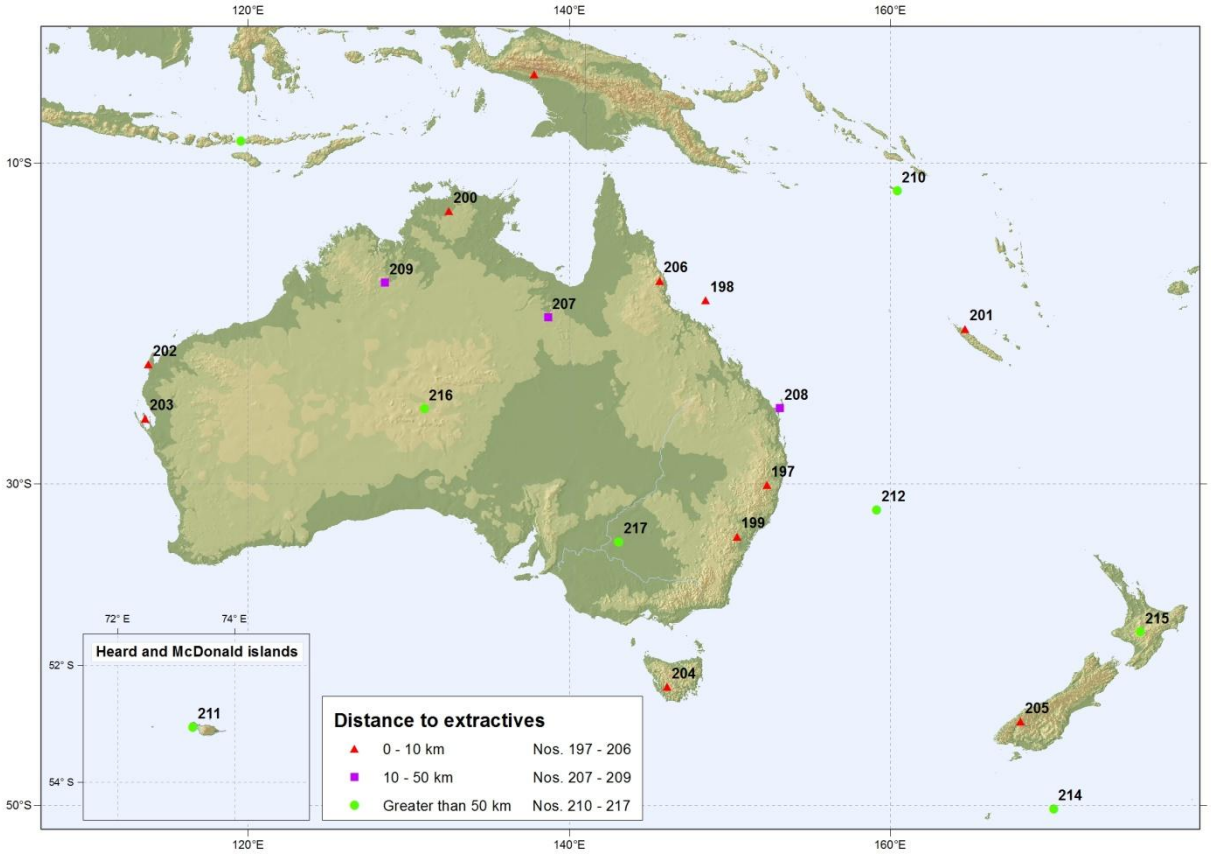

Table 7.9: Asia map legend

World Heritage site	Distance from active extractives	Map reference number
China Danxia	0 - 10 km	154
Lorentz National Park	0 - 10 km	155
South China Karst	0 - 10 km	156
Three Parallel Rivers of Yunnan Protected Areas	0 - 10 km	157
Thungyai - Huai Kha Khaeng Wildlife Sanctuaries	0 - 10 km	158
Tropical Rainforest Heritage of Sumatra	0 - 10 km	159
Huanglong Scenic and Historic Interest Area	10 - 50 km	160
Jiuzhaigou Valley Scenic and Historic Interest Area	10 - 50 km	161
Kinabalu Park	10 - 50 km	162
Mount Emei Scenic Area, including Leshan Giant Buddha Scenic Area	10 - 50 km	163
Mount Sanqingshan National Park	10 - 50 km	164
Mount Taishan	10 - 50 km	165
Mount Wuyi	10 - 50 km	166
Phong Nha-Ke Bang National Park	10 - 50 km	167
Puerto-Princesa Subterranean River National Park	10 - 50 km	168
Shirakami-Sanchi	10 - 50 km	169
Sichuan Giant Panda Sanctuaries - Wolong, Mt Siguniang and Jiajin Mountains	10 - 50 km	170
Ujung Kulon National Park	10 - 50 km	171
Western Ghats	10 - 50 km	172
Central Highlands of Sri Lanka	Greater than 50 km	173
Central Sikhote-Alin	Greater than 50 km	174
Chengjiang Fossil Site	Greater than 50 km	175
Chitwan National Park	Greater than 50 km	176
Dong Phayayen-Khao Yai Forest Complex	Greater than 50 km	177
Gunung Mulu National Park	Greater than 50 km	178
Ha Long Bay	Greater than 50 km	179
Jeju Volcanic Island and Lava Tubes	Greater than 50 km	180
Kaziranga National Park	Greater than 50 km	181
Keoladeo National Park	Greater than 50 km	182
Komodo National Park	Greater than 50 km	183
Manas Wildlife Sanctuary	Greater than 50 km	184
Mount Huangshan	Greater than 50 km	185
Nanda Devi and Valley of Flowers National Parks	Greater than 50 km	186
Ogasawara Islands	Greater than 50 km	187
Rock Islands Southern Lagoon	Greater than 50 km	188
Sagarmatha National Park	Greater than 50 km	189
Shiretoko	Greater than 50 km	190
Sinharaja Forest Reserve	Greater than 50 km	191
Sundarbans National Park	Greater than 50 km	192
The Sundarbans	Greater than 50 km	193
Tubbataha Reefs Marine Park	Greater than 50 km	194
Wulingyuan Scenic and Historic Interest Area	Greater than 50 km	195
Yakushima	Greater than 50 km	196

Table 7.10: Oceania map legend

World Heritage site	Distance from active extractives	Map reference number
Gondwana Rainforests of Australia	0 - 10 km	197
Great Barrier Reef	0 - 10 km	198
Greater Blue Mountains Area	0 - 10 km	199
Kakadu National Park	0 - 10 km	200
Lagoons of New Caledonia: Reef Diversity and Associated Ecosystems	0 - 10 km	201
Ningaloo Coast	0 - 10 km	202
Shark Bay, Western Australia	0 - 10 km	203
Tasmanian Wilderness	0 - 10 km	204
Te Wahipounamu – South West New Zealand	0 - 10 km	205
Wet Tropics of Queensland	0 - 10 km	206
Australian Fossil Mammal Sites (Riversleigh / Naracoorte)	10 - 50 km	207
Fraser Island	10 - 50 km	208
Purnululu National Park	10 - 50 km	209
East Rennell	Greater than 50 km	210
Heard and McDonald Islands	Greater than 50 km	211
Lord Howe Island Group	Greater than 50 km	212
Macquarie Island	Greater than 50 km	213
New Zealand Sub-Antarctic Islands	Greater than 50 km	214
Tongariro National Park	Greater than 50 km	215
Uluru-Kata Tjuta National Park	Greater than 50 km	216
Willandra Lakes Region	Greater than 50 km	217

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7.3 Results for all World Heritage Sites

The following table describes the results for key elements of the analysis for all World Heritage sites. The table includes each of the 217 sites assessed, plus the Arabian Oryx Sanctuary, which was not included in the GIS analysis because it was removed from the World Heritage List by the committee at the request of the State Party. Column 1: the name of the World Heritage site is followed by a reference number which relates to the maps shown in Figure 7.1- Figure 7.9.

Comparison between the GIS analysis and State of Conservation Reports (Column two)

Table 7.11 also provides a comparison between the sites identified in the GIS analysis, with those sites which have previously been the subject of a State of Conservation Report (SOC Report). SOC Reports are prepared by States Party to the Convention with scientific and technical input as appropriate. UNESCO maintains an Online Information System which stores records of the SOC Reports prepared between 1979-1998 and 2004-2013. To enable a comparison between the threats identified in SOC Reports and the proximity of sites to extractives identified in the GIS analysis, all SOC Reports which reference Oil and Gas and/or Mining as a "Threat" were identified from the database in May 2013. The second column in Table 7.11 describes how each sites features in the analysis, and is categorised in one of the following ways:

Both: The site is identified as being in proximity to extractives through the GIS analysis and has Oil and Gas and/or Mining categorised as a "Threat" in a SOC Report

Overlay only: The site is identified as being in proximity to extractives through the GIS analysis only, either a SOC Report has not been prepared for the site, or any SOC reports prepared do not categorise Oil and Gas and/or Mining as a "Threat" to the site.

SOC Report only: The site has been the subject of a SOC Report which categorises Oil and Gas and/or Mining as a "Threat" in the online database of SOC Reports, but is not flagged as being in proximity to extractives in the GIS analysis. Note that SOC Reports do not differentiate between the mining activities included in the GIS analysis (i.e. the minerals and metals incorporated in the MEG mining database) and quarrying or artisanal mining, which was not assessed in the GIS analysis.

Not ID'd: The site is not identified in the GIS analysis, and there are no available SOC Reports for the site which identify Oil and Gas and/or Mining as a "Threat" to the site.

Columns three to twelve of Table 7.11 describe the ways in which each site is flagged in the GIS analysis.

Active extractive projects inside or within 1km (Columns three to six)

Sites which were identified through the analysis as having active extractive activities within their boundary, or within 1km of the boundary are categorised on the basis of the reliability of the data and the activity being carried out. Those sites where the data shows active extractives projects have the activity listed as either ***exploration (Exp)***, ***discovery (Disc)*** or ***production (Prod).*** For example, Alejandro de Humboldt National Park has active exploration associated with a mining project either within, or up to 1km from its boundary. See sections 4.2 and 5.3.

Reliably located oil and gas wells (any stage) within 1km (Column seven)

Sites where Oil and Gas wells at any stage (i.e. Abandon, Appraise, Discovery, Developing, Producing, Unknown, Inactive) within 1km are identified in column seven. See section 5.3.

Greater than 50% of any single concession within the site boundary (Column eight)

Those sites which have >50% of any single Oil and Gas concession overlapping are identified in column eight. See section 6.2.

Greater than 50% of the WHS covered by oil and gas concessions (Column nine)

Sites which have greater than 50% of their total area covered by Oil and Gas concessions, are identified in column nine. The area of overlap may be made up of several Oil and Gas concessions, at any of the stages assessed. For each site with >50% overlap, the percentage overlap is given. See section 6.1.

Minimum distance from Active extractive projects (Columns ten to twelve)

The proximity analysis used to identify any active extractive projects within 10km, between 10km and 50km, and beyond 50km and displayed in the maps incorporated in Section 7.2 above is reported in the final three columns of the table. See section 7.2

Table 7.11: Full list of all World Heritage sites included in the GIS overlay analysis, including comparison with SOC Reports available online from UNESCO World Heritage Centre database. All sites where a SOC report is available are denoted with an * this includes sites where a SOC report exists, but does not identify mining or oil and gas extraction as a "Threat" to the WHS[a].

World Heritage Site (number brackets refers to maps shown in Figure 7.1- Figure 7.9)	Extractive activities identified by GIS overlay analysis, SOC report, both or neither	Active extractive projects inside or within 1km				Reliably located oil and gas wells (any stage) within 1km	Greater than 50% of any single concession within the site boundary	Greater than 50% of the WHS covered by oil and gas concessions	Minimum distance from active extractive projects according to GIS analysis		
		Reliable		Less reliable							
		Oil and Gas	Mining	Oil and Gas	Mining				<10km	10-50km	>50km
Alejandro de Humboldt National Park* (1)	Both				Exp.				✓		
Belize Barrier Reef Reserve System* (21)	Both					✓					✓
Canadian Rocky Mountain Parks* (2)	Both				Prod.				✓		
Doñana National Park* (114)	Both								✓		
Great Barrier Reef* (198)	Both		Exp			✓			✓		
Greater Blue Mountains Area* (199)	Both		Exp			✓	✓		✓		
iSimangaliso Wetland Park* (71)	Both					✓				✓	
Kakadu National Park* (200)	Both		Exp		Exp	✓			✓		
Lagoons of New Caledonia: Reef Diversity and Associated Ecosystems* (201)	Both					✓			✓		
Lake Baikal* (146)	Both				Exp				✓		
Lake Turkana National Parks* (96)	Both							100%			✓
Lorentz National Park* (155)	Both		Prod		Exp		✓		✓		
Manú National Park* (41)	Both								✓		
Miguasha National Park* (14)	Both					✓				✓	
Mount Nimba Strict Nature Reserve* (63)	Both								✓		

[a] NB: The UNESCO online database of State of Conservation Reports categorises the Threats for each site. The identification of Oil and Gas and Mining as a Threat within SoC reports and listed in the above table was based purely on this categorisation. No analysis was made of the detailed content of each report where mining might be included in the report body text, if this was not also categorised as one of the Threats to the WHS in the database.

World Heritage Site (number brackets refers to maps shown in Figure 7.1- Figure 7.9)	Extractive activities identified by GIS overlay analysis, SOC report, both or neither	Active extractive projects inside or within 1km				Reliably located oil and gas wells (any stage) within 1km	Greater than 50% of any single concession within the site boundary	Greater than 50% of the WHS covered by oil and gas concessions	Minimum distance from active extractive projects according to GIS analysis		
		Reliable		Less reliable					<10km	10-50km	>50km
		Oil and Gas	Mining	Oil and Gas	Mining						
Purnululu National Park* (209)	Both							100%		✓	
Rwenzori Mountains National Park* (64)	Both								✓		
Selous Game Reserve* (65)	Both				Exp	✓	✓	75%	✓		
Tasmanian Wilderness* (204)	Both				Exp				✓		
Three Parallel Rivers of Yunnan Protected Areas* (157)	Both		Prod		Exp/Prod				✓		
Tropical Rainforest Heritage of Sumatra* (159)	Both		Exp		Prod	✓			✓		
Tubbataha Reefs Marine Park (194)	Both					✓					✓
Virgin Komi Forests* (147)	Both					✓			✓		
Virunga National Park* (80)	Both							60%		✓	
Volcanoes of Kamchatka* (148)	Both		Prod/ Exp		Exp				✓		
Yellowstone National Park* (9)	Both								✓		
Air and Ténéré Natural Reserves* (84)	Overlay Only					✓	✓				✓
Atlantic Forest Southeast Reserves (36)	Overlay Only								✓		
Canaima National Park* (37)	Overlay Only				Prod				✓		
Caves of Aggtelek Karst and Slovak Karst* (113)	Overlay Only				Exp	✓			✓		
China Danxia (154)	Overlay Only					✓			✓		
Cliff of Bandiagara (Land of the Dogons)* (86)	Overlay Only							69%			✓
Danube Delta* (120)	Overlay Only					✓				✓	
Darien National Park (38)	Overlay Only		Prod						✓		
Discovery Coast Atlantic Forest Reserves (39)	Overlay Only	Prod				✓	✓		✓		

World Heritage Site (number brackets refers to maps shown in Figure 7.1- Figure 7.9)	Extractive activities identified by GIS overlay analysis, SOC report, both or neither	Active extractive projects inside or within 1km				Reliably located oil and gas wells (any stage) within 1km	Greater than 50% of any single concession within the site boundary	Greater than 50% of the WHS covered by oil and gas concessions	Minimum distance from active extractive projects according to GIS analysis		
		Reliable		Less reliable					<10km	10-50km	>50km
		Oil and Gas	Mining	Oil and Gas	Mining						
Djoudj National Bird Sanctuary* (88)	Overlay Only							100%			✓
Dorset and East Devon Coast* (115)	Overlay Only	Prod				✓			✓		
Durmitor National Park* (116)	Overlay Only								✓		
Fraser Island* (208)	Overlay Only					✓				✓	
Giant's Causeway and Causeway Coast* (133)	Overlay Only							99%			✓
Gondwana Rainforests of Australia* (197)	Overlay Only								✓		
Grand Canyon National Park (3)	Overlay Only								✓		
Gros Morne National Park* (4)	Overlay Only								✓		
Huanglong Scenic and Historic Interest Area* (160)	Overlay Only							59%		✓	
Huascarán National Park* (40)	Overlay Only		Exp					83%	✓		
Ichkeul National Park* (92)	Overlay Only							93%			✓
Islands and Protected Areas of the Gulf of California (5)	Overlay Only			Disc		✓			✓		
Jiuzhaigou Valley Scenic and Historic Interest Area* (161)	Overlay Only							53%		✓	
Kenya Lake System in the Great Rift Valley (93)	Overlay Only							100%			✓
Kluane / Wrangell-St Elias / Glacier Bay / Tatshenshini-Alsek (6)	Overlay Only		Exp		Exp	✓			✓		
Laponian Area (117)	Overlay Only								✓		
Monarch Butterfly Biosphere Reserve* (7)	Overlay Only								✓		
Monte San Giorgio* (124)	Overlay Only							78%		✓	
Ningaloo Coast (202)	Overlay Only					✓			✓		
Ogasawara Islands (187)	Overlay Only							88%			✓

World Heritage Site (number brackets refers to maps shown in Figure 7.1- Figure 7.9)	Extractive activities identified by GIS overlay analysis, SOC report, both or neither	Active extractive projects inside or within 1km				Reliably located oil and gas wells (any stage) within 1km	Greater than 50% of any single concession within the site boundary	Greater than 50% of the WHS covered by oil and gas concessions	Minimum distance from active extractive projects according to GIS analysis		
		Reliable		Less reliable							
		Oil and Gas	Mining	Oil and Gas	Mining				<10km	10-50km	>50km
Península Valdés (61)	Overlay Only					✓					✓
Primeval Beech Forests of the Carpathians and the Ancient Beech Forests of Germany* (118)	Overlay Only					✓			✓		
Río Abiseo National Park* (42)	Overlay Only				Exp			52%	✓		
Salonga National Park* (104)	Overlay Only						✓	79%			✓
Saryarka – Steppe and Lakes of Northern Kazakhstan (153)	Overlay Only					✓					✓
Shark Bay, Western Australia* (203)	Overlay Only					✓			✓		
South China Karst (156)	Overlay Only							63%	✓		
Swiss Tectonic Arena Sardona (145)	Overlay Only							85%			✓
Tassili n'Ajjer (78)	Overlay Only					✓				✓	
Te Wahipounamu – South West New Zealand* (205)	Overlay Only					✓			✓		
The Wadden Sea (119)	Overlay Only	Prod /Disc				✓	✓		✓		
Thungyai - Huai Kha Khaeng Wildlife Sanctuaries (158)	Overlay Only								✓		
Tsingy de Bemaraha Strict Nature Reserve* (110)	Overlay Only					✓		51%			✓
Wadi Rum Protected Area (83)	Overlay Only							100%		✓	
Wet Tropics of Queensland* (206)	Overlay Only				Exp				✓		
Willandra Lakes Region* (217)	Overlay Only					✓					✓
Wood Buffalo National Park* (8)	Overlay Only				Exp	✓			✓		
Wulingyuan Scenic and Historic Interest Area* (195)	Overlay Only							91%			✓
Yakushima (196)	Overlay Only							100%			✓
Yosemite National Park (10)	Overlay Only								✓		

World Heritage Site (number brackets refers to maps shown in Figure 7.1- Figure 7.9)	Extractive activities identified by GIS overlay analysis, SOC report, both or neither	Active extractive projects inside or within 1km				Reliably located oil and gas wells (any stage) within 1km	Greater than 50% of any single concession within the site boundary	Greater than 50% of the WHS covered by oil and gas concessions	Minimum distance from active extractive projects according to GIS analysis		
		Reliable		Less reliable							
		Oil and Gas	Mining	Oil and Gas	Mining				<10km	10-50km	>50km
Arabian Oryx Sanctuary (delisted, not shown)	SOC Reports Only	This site has been delisted and was therefore not included in the GIS analysis									
Banc d'Arguin National Park* (66)	SOC Reports Only									✓	
Dinosaur Provincial Park* (23)	SOC Reports Only										✓
Dja Faunal Reserve* (69)	SOC Reports Only									✓	
East Rennell* (210)	SOC Reports Only										✓
Golden Mountains of Altai* (149)	SOC Reports Only									✓	
Gulf of Porto: Calanche of Piana, Gulf of Girolata, Scandola Reserve* (134)	SOC Reports Only										✓
Ha Long Bay* (179)	SOC Reports Only										✓
Kahuzi-Biega National Park* (72)	SOC Reports Only									✓	
Lake Malawi National Park* (95)	SOC Reports Only										✓
Mana Pools National Park, Sapi and Chewore Safari Areas* (73)	SOC Reports Only									✓	
Manovo-Gounda St Floris National Park* (99)	SOC Reports Only										✓
Nahanni National Park* (15)	SOC Reports Only									✓	
Niokolo-Koba National Park* (74)	SOC Reports Only									✓	
Okapi Wildlife Reserve* (75)	SOC Reports Only									✓	
Rainforests of the Atsinanana* (76)	SOC Reports Only									✓	
Sagarmatha National Park* (189)	SOC Reports Only										✓
Taï National Park* (108)	SOC Reports Only										✓

World Heritage Site (number brackets refers to maps shown in Figure 7.1- Figure 7.9)	Extractive activities identified by GIS overlay analysis, SOC report, both or neither	Active extractive projects inside or within 1km				Reliably located oil and gas wells (any stage) within 1km	Greater than 50% of any single concession within the site boundary	Greater than 50% of the WHS covered by oil and gas concessions	Minimum distance from active extractive projects according to GIS analysis		
		Reliable		Less reliable							
		Oil and Gas	Mining	Oil and Gas	Mining				<10km	10-50km	>50km
Talamanca Range-La Amistad Reserves / La Amistad National Park* (46)	SOC Reports Only									✓	
W National Park of Niger* (112)	SOC Reports Only										✓
Waterton Glacier International Peace Park* (19)	SOC Reports Only									✓	
Aldabra Atoll* (85)	Not ID'd										✓
Area de Conservación Guanacaste (43)	Not ID'd									✓	
Australian Fossil Mammal Sites (Riversleigh / Naracoorte) (207)	Not ID'd									✓	
Belovezhskaya Pushcha / Bialowieza Forest (131)	Not ID'd										✓
Brazilian Atlantic Islands: Fernando de Noronha and Atol das Rocas Reserves (47)	Not ID'd										✓
Bwindi Impenetrable National Park* (67)	Not ID'd									✓	
Cape Floral Region Protected Areas* (68)	Not ID'd									✓	
Carlsbad Caverns National Park (11)	Not ID'd									✓	
Central Amazon Conservation Complex (48)	Not ID'd										✓
Central Highlands of Sri Lanka* (173)	Not ID'd										✓
Central Sikhote-Alin (174)	Not ID'd										✓
Central Suriname Nature Reserve (49)	Not ID'd										✓
Cerrado Protected Areas: Chapada dos Veadeiros and Emas National Parks* (50)	Not ID'd										✓
Chengjiang Fossil Site (175)	Not ID'd										✓
Chitwan National Park* (176)	Not ID'd										✓

World Heritage Site (number brackets refers to maps shown in Figure 7.1- Figure 7.9)	Extractive activities identified by GIS overlay analysis, SOC report, both or neither	Active extractive projects inside or within 1km				Reliably located oil and gas wells (any stage) within 1km	Greater than 50% of any single concession within the site boundary	Greater than 50% of the WHS covered by oil and gas concessions	Minimum distance from active extractive projects according to GIS analysis		
		Reliable		Less reliable							
		Oil and Gas	Mining	Oil and Gas	Mining				<10km	10-50km	>50km
Cocos Island National Park (51)	Not ID'd										✓
Coiba National Park and its Special Zone of Marine Protection* (52)	Not ID'd										✓
Comoé National Park* (87)	Not ID'd										✓
Desembarco del Granma National Park (22)	Not ID'd										✓
Dong Phayayen-Khao Yai Forest Complex* (177)	Not ID'd										✓
Ecosystem and Relict Cultural Landscape of Lopé-Okanda* (70)	Not ID'd									✓	
Everglades National Park* (24)	Not ID'd										✓
Galápagos Islands* (53)	Not ID'd										✓
Garajonay National Park* (89)	Not ID'd										✓
Garamba National Park* (90)	Not ID'd										✓
Göreme National Park and the Rock Sites of Cappadocia* (121)	Not ID'd									✓	
Gough and Inaccessible Islands* (91)	Not ID'd										✓
Great Smoky Mountains National Park* (12)	Not ID'd									✓	
Gunung Mulu National Park* (178)	Not ID'd										✓
Hawaii Volcanoes National Park* (32)	Not ID'd										✓
Heard and McDonald Islands* (211)	Not ID'd										✓
Henderson Island* (33)	Not ID'd										✓
Hierapolis-Pamukkale* (135)	Not ID'd										✓
High Coast / Kvarken Archipelago (122)	Not ID'd									✓	
Historic Sanctuary of Machu Picchu* (54)	Not ID'd										✓

World Heritage Site (number brackets refers to maps shown in Figure 7.1- Figure 7.9)	Extractive activities identified by GIS overlay analysis, SOC report, both or neither	Active extractive projects inside or within 1km				Reliably located oil and gas wells (any stage) within 1km	Greater than 50% of any single concession within the site boundary	Greater than 50% of the WHS covered by oil and gas concessions	Minimum distance from active extractive projects according to GIS analysis		
		Reliable		Less reliable							
		Oil and Gas	Mining	Oil and Gas	Mining				<10km	10-50km	>50km
Ibiza, Biodiversity and Culture* (136)	Not ID'd										✓
Iguaçu National Park* (55)	Not ID'd										✓
Iguazu National Park* (56)	Not ID'd										✓
Ilulissat Icefjord* (25)	Not ID'd										✓
Ischigualasto / Talampaya Natural Parks (44)	Not ID'd									✓	
Isole Eolie (Aeolian Islands)* (137)	Not ID'd										✓
Jeju Volcanic Island and Lava Tubes (180)	Not ID'd										✓
Joggins Fossil Cliffs (13)	Not ID'd									✓	
Kaziranga National Park* (181)	Not ID'd										✓
Keoladeo National Park* (182)	Not ID'd										✓
Kilimanjaro National Park (94)	Not ID'd										✓
Kinabalu Park (162)	Not ID'd									✓	
Komodo National Park* (183)	Not ID'd										✓
Lakes of Ounianga (97)	Not ID'd										✓
Laurisilva of Madeira* (98)	Not ID'd										✓
Lena Pillars Nature Park (151)	Not ID'd										✓
Lord Howe Island Group (212)	Not ID'd										✓
Los Glaciares National Park* (57)	Not ID'd										✓
Los Katíos National Park* (58)	Not ID'd										✓
Macquarie Island* (213)	Not ID'd										✓
Malpelo Fauna and Flora Sanctuary (59)	Not ID'd										✓

World Heritage Site (number brackets refers to maps shown in Figure 7.1- Figure 7.9)	Extractive activities identified by GIS overlay analysis, SOC report, both or neither	Active extractive projects inside or within 1km				Reliably located oil and gas wells (any stage) within 1km	Greater than 50% of any single concession within the site boundary	Greater than 50% of the WHS covered by oil and gas concessions	Minimum distance from active extractive projects according to GIS analysis		
		Reliable		Less reliable							
		Oil and Gas	Mining	Oil and Gas	Mining				<10km	10-50km	>50km
Mammoth Cave National Park (26)	Not ID'd										✓
Manas Wildlife Sanctuary* (184)	Not ID'd										✓
Messel Pit Fossil Site (123)	Not ID'd									✓	
Meteora (138)	Not ID'd										✓
Morne Trois Pitons National Park* (27)	Not ID'd										✓
Mosi-oa-Tunya / Victoria Falls* (100)	Not ID'd										✓
Mount Athos* (125)	Not ID'd									✓	
Mount Emei Scenic Area, including Leshan Giant Buddha Scenic Area* (163)	Not ID'd									✓	
Mount Huangshan* (185)	Not ID'd										✓
Mount Kenya National Park/Natural Forest* (101)	Not ID'd										✓
Mount Sanqingshan National Park (164)	Not ID'd									✓	
Mount Taishan* (165)	Not ID'd									✓	
Mount Wuyi (166)	Not ID'd									✓	
Nanda Devi and Valley of Flowers National Parks (186)	Not ID'd										✓
Natural and Cultural Heritage of the Ohrid region* (126)	Not ID'd									✓	
Natural System of Wrangel Island Reserve* (28)	Not ID'd										✓
New Zealand Sub-Antarctic Islands (214)	Not ID'd										✓
Ngorongoro Conservation Area* (102)	Not ID'd										✓
Noel Kempff Mercado National Park (45)	Not ID'd									✓	

World Heritage Site (number brackets refers to maps shown in Figure 7.1- Figure 7.9)	Extractive activities identified by GIS overlay analysis, SOC report, both or neither	Active extractive projects inside or within 1km				Reliably located oil and gas wells (any stage) within 1km	Greater than 50% of any single concession within the site boundary	Greater than 50% of the WHS covered by oil and gas concessions	Minimum distance from active extractive projects according to GIS analysis		
		Reliable		Less reliable							
		Oil and Gas	Mining	Oil and Gas	Mining				<10km	10-50km	>50km
Olympic National Park* (16)	Not ID'd									✓	
Pantanal Conservation Complex (60)	Not ID'd										✓
Papahanaumokuakea (34)	Not ID'd										✓
Phoenix Islands Protected Area* (35)	Not ID'd										✓
Phong Nha-Ke Bang National Park* (167)	Not ID'd									✓	
Pirin National Park* (127)	Not ID'd									✓	
Pitons Management Area* (29)	Not ID'd										✓
Pitons, cirques and remparts of Reunion Island* (103)	Not ID'd										✓
Plitvice Lakes National Park* (139)	Not ID'd										✓
Puerto-Princesa Subterranean River National Park (168)	Not ID'd									✓	
Putorana Plateau (152)	Not ID'd										✓
Pyrénées - Mont Perdu* (140)	Not ID'd										✓
Redwood National and State Parks* (17)	Not ID'd									✓	
Río Plátano Biosphere Reserve* (18)	Not ID'd									✓	
Rock Islands Southern Lagoon (188)	Not ID'd										✓
Sangay National Park* (62)	Not ID'd										✓
Sangha Trinational* (105)	Not ID'd										✓
Serengeti National Park* (77)	Not ID'd									✓	
Shirakami-Sanchi (169)	Not ID'd									✓	
Shiretoko* (190)	Not ID'd										✓
Sian Ka'an* (30)	Not ID'd										✓

World Heritage Site (number brackets refers to maps shown in Figure 7.1- Figure 7.9)	Extractive activities identified by GIS overlay analysis, SOC report, both or neither	Active extractive projects inside or within 1km				Reliably located oil and gas wells (any stage) within 1km	Greater than 50% of any single concession within the site boundary	Greater than 50% of the WHS covered by oil and gas concessions	Minimum distance from active extractive projects according to GIS analysis		
		Reliable		Less reliable							
		Oil and Gas	Mining	Oil and Gas	Mining				<10km	10-50km	>50km
Sichuan Giant Panda Sanctuaries - Wolong, Mt Siguniang and Jiajin Mountains (170)	Not ID'd									✓	
Simien National Park* (106)	Not ID'd										✓
Sinharaja Forest Reserve* (191)	Not ID'd										✓
Škocjan Caves* (132)	Not ID'd										✓
Socotra Archipelago* (107)	Not ID'd										✓
Srebarna Nature Reserve* (141)	Not ID'd										✓
St Kilda* (142)	Not ID'd										✓
Sundarbans National Park* (192)	Not ID'd										✓
Surtsey (143)	Not ID'd										✓
Swiss Alps Jungfrau-Aletsch (144)	Not ID'd										✓
Teide National Park (109)	Not ID'd										✓
The Dolomites (128)	Not ID'd									✓	
The Sundarbans* (193)	Not ID'd										✓
Tikal National Park* (31)	Not ID'd										✓
Tongariro National Park* (215)	Not ID'd										✓
Ujung Kulon National Park (171)	Not ID'd									✓	
uKhahlamba / Drakensberg Park (79)	Not ID'd									✓	
Uluru-Kata Tjuta National Park* (216)	Not ID'd										✓
Uvs Nuur Basin (150)	Not ID'd									✓	
Vallée de Mai Nature Reserve (111)	Not ID'd										✓
"Vredefort Dome (81)"	Not ID'd									✓	

World Heritage Site (number brackets refers to maps shown in Figure 7.1- Figure 7.9)	Extractive activities identified by GIS overlay analysis, SOC report, both or neither	Active extractive projects inside or within 1km				Reliably located oil and gas wells (any stage) within 1km	Greater than 50% of any single concession within the site boundary	Greater than 50% of the WHS covered by oil and gas concessions	Minimum distance from active extractive projects according to GIS analysis		
		Reliable		Less reliable							
		Oil and Gas	Mining	Oil and Gas	Mining				<10km	10-50km	>50km
Wadi Al-Hitan (Whale Valley)* (82)	Not ID'd									✓	
West Norwegian Fjords – Geirangerfjord and Nærøyfjord (129)	Not ID'd									✓	
Western Caucasus* (130)	Not ID'd									✓	
Western Ghats (172)	Not ID'd									✓	
Whale Sanctuary of El Vizcaino* (20)	Not ID'd									✓	

8 Limitations and constraints

8.1 Database inclusions and exclusions

This analysis is based on data extracted from the WDPA, MEG and IHS databases as at April 2013. All spatially located data available from these databases were included with no editing or filtering of project locations and/or criteria. Both the MEG and IHS databases are based on government, company and media reports. As such, they include only those projects which report to for example, stock-exchanges, shareholders or the industry more broadly. Consequently, neither database will be fully comprehensive. Where information on the location of extractives projects is not reported by either the government or the company, these data should be expected to be absent from the datasets. A further key exclusion of both datasets is artisanal operations. As globally consistent databases of artisanal operations are currently unavailable they are excluded from the current analysis.

MEG inclusion criteria: For a mining project to be included within the MEG database it must meet specific criteria concerning, for example, the primary commodity and project size (in the case of early-stage projects). Primary commodities covered by the database include precious metals (gold, silver), base metals (copper, lead, zinc, molybdenum, nickel, tin and cobalt), platinum group metals (platinum, palladium), rare earths (lithium, niobium), phosphates, tantalum, uranium, iron ore and coal. Early stage precious metal projects must have specific transactions greater than $10 million or financings greater than $2 million, gold grades (g/mt) multiplied by interval (m) of 50 or greater, or base metals where the first two or three metals total a minim of $13-15/mt.

Mining concessions: No globally consistent data was available to describe mining and mineral concessions in polygon format. Consequently, the spatial area of concessions is excluded from the analysis. The non-reporting of mineral concessions represented by boundaries does not imply that they do not occur in World Heritage sites only that the data were unavailable to perform the analysis.

Oil and gas concessions: The dataset utilised to map oil and gas blocks, did not include blocks for the onshore/continental USA, onshore/continental Canada or shallow water (< 200m) in the Gulf of Mexico. Consequently, the overlap of World Heritage sites in the USA and Canada, a total of 20 sites, with oil and gas blocks could not be assessed.

Extractive data deficiencies: This study does not include planned or future projects which sufficiently advanced to be included in the datasets. Furthermore it does not consider local knowledge or gather additional information outside the MEG and IHS databases, however, these could fill some of the data gaps, and be included in the analysis, once they become available.

8.2 Spatial accuracy

As outlined, both wells and mining projects are assigned a spatial accuracy within their respective databases. This spatial uncertainty has formed a key criterion in the preceding analysis. It must be recognised that even data points identified as "reliably" located must be assumed to incorporate a margin of error. This may result in both errors of omission and errors of commission in the analysis. Data for mining projects in particular is problematic as a single latitude/longitude point is unlikely to accurately describe the complete footprint of a mine project.

For a subset of records within the MEG and IHS databases no spatial coordinate information was available. Although attributed to a country, it was not possible to spatially locate a subset of mining project and wells. The spatial overlap between these operations and World Heritage sites could not be calculated.

The proportion of mining projects and wells which are not attributed to a spatial location is variable globally and unique to each database. The availability of spatial data (and indeed mining project reports) will be country specific. Potential future analysis would aim to quantify the global variability in spatial/non-spatial records for both databases.

Natural World Heritage sites (WHS) were taken from the World Database on Protected Areas (WDPA), the most comprehensive global dataset on marine and terrestrial protected areas. In comparison to the WDPA dataset as a whole where 11% of protected area records are represented by a single point coordinate as opposed to spatial boundaries, all WHS have polygon boundaries and are consistently updated according to the latest World Heritage committee decisions, regarding new inscriptions and boundary modification. However, in the absence of a mechanism for collating original boundary information directly from most States Parties, sites were compiled based on the best available sources. As a result, some sites may be less accurate than others due to the lack of high quality maps. Though all efforts have been made, it is possible that inaccurate boundaries still exist, especially in coastal areas, where inconsistent coastlines at different scales were used in the original maps.

Given the limitation in spatial accuracy of the World Heritage site boundaries and mining and oil and gas databases, all results must be considered indicative. The intent of this study is not to identify specific mines or oil/gas fields which operate within specific World Heritage sites but to highlight trends and focal points for further research. On-ground, local scale investigations would be required to confirm the presence/absence of operations within World Heritage sites.

8.3 Describing projects

Both mining projects and wells are categorised according to the properties listed in their respective databases. This categorisation does not consider the last date of database update. As such, project stages have the potential to be out dated in some circumstances. Given the broad development categories applied to the data (which represent generalisations from the databases) it is not expected that this will be a significant issue.

As previously discussed, a significant assumption was required to attach a development category to wells. This assumption, that all wells within a producing field are producing wells has the potential to

significantly overestimate the number of operational wells within World Heritage sites. Where possible the influence of this overestimation has been highlighted. However, counts of producing wells should be interpreted with caution. Future work would attempt to quantify the associated over/under estimation of producing wells via this assumption by comparing the number of producing wells reported for a field with the number identified by the stated assumption.

8.4 Temporal comparisons

Temporal comparisons for a limited number of sites have identified that extractive operations may have been in place prior to the inscription of the World Heritage site. This temporal comparison has not been included within the globally reported statistics nor in the contract blocks analysis. As such, a proportion of the reported overlaps may be a consequence of projects initiated prior to World Heritage site designation.

8.5 Identifying regions of future extractive operations

Identifying World Heritage sites which may be under pressure from future extractive activities is complex and care of interpretation is required. As stated throughout this document, concessions are a poor proxy for on-ground activities. Development stage mining projects and wells, as described by the MEG and IHS databases imply that activities have been undertaken at (or in proximity to) the reported location. Consequently, such results are potentially more informative in highlighting World Heritage sites under pressure from future extractive operations. However, it should not be assumed that all development projects will become producing operations.

8.6 Impact

This analysis is a purely spatial assessment of the location and overlap of extractive activities relative to World Heritage sites. Spatial data describing extractive operations for both oil and gas wells and mines represents locations/areas of known or possible activity and do not include any assessment of the area of impact of operations. The methodology does not include local environmental conditions, nor any other proxy which could infer the on-ground impacts of extractive operations. These factors should be considered in addition to the information presented in this analysis when interpreting the results.

9 Discussion and conclusions

Key findings from the preceding analysis can be summarised as follows, for information on specific World Heritage sites see Table 7.11:

- ***Producing mines***: Considering only those mining projects with reliable spatial locations, four World Heritage sites proximal to producing extractive operations. This represents 2% of all 217 natural and mixed World Heritage sites. The inclusion of less accurately located projects increases this value to seven World Heritage sites (3% of all sites).

- ***Active exploration activities within the mining industry***: A greater number of World Heritage sites are proximal to exploration activities. Based solely on reliably located mining projects, seven World Heritage sites are flagged as proximal to mining sector development activities. This represents 3% of all 217 natural and mixed World Heritage sites. With the inclusion of less accurately located mining projects, the number of flagged World Heritage sites increases to 17 (8% of all sites).

- ***Producing wells***: Considering only those wells with reliable spatial locations, two World Heritage sites are proximal to producing oil and gas wells. This represents less than 1% of all 217 natural and mixed World Heritage sites.

- ***Active development activities within the oil and gas industry***: A low number of wells associated with field development (discovery/appraise/development) occur within or in close proximity (1 km) to World Heritage sites. Only two World Heritage sites were identified as having development wells (specifically discovery) within 1km of the site boundary. This represents less than 1% of all 217 natural and mixed World Heritage sites.

- ***Active extractive operations***: If all active operations, that is, active exploration/development and producing are combined, 13 World Heritage sites (6% of all sites) were identified as being spatially proximal to active extractive operations. This has the potential to increase to 24 sites (11% of all sites) if less accurately located operations are considered.

This project has enabled project partners to identify a number of weaknesses in the understanding of the interaction between the extractive industry and World Heritage sites, and highlighted several areas for future study. Among the next steps for this work should be a gap analysis identifying spatial data deficiencies; and on-ground assessments of World Heritage sites which contain or are in close proximity to extractive projects.

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