Waste, Noise and Air Quality

This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Waste, Noise and Air Quality topic, relating to assessment, management, conformance/compliance and outcomes. The good practice criteria are expressed for the implementation stage.

In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in I-18. In the Hydropower Sustainability ESG Gap Analysis Tool (HESG), it is addressed in Section 1.

This guideline addresses the management of waste, noise and air quality issues associated with the project. The overall intent is that noise and air quality in the vicinity of the project are of a high quality and not adversely impacted by project activities, and that project wastes are responsibly managed. The following guidance provides more detail on (1) waste management and disposal, and on (2) noise, air quality and also vibration. Vibration is included because it can be closely associated with noise and is an impact area of heightened concern to local communities during the construction stage.

Waste management and disposal

Objectives for waste management and disposal assessment and management are to ensure that all wastes are managed responsibly and do not cause adverse effects on surrounding or future values and uses. Responsible waste management is consistent with the mitigation hierarchy and emphasises actions to avoid, reduce, reuse, and recycle wastes. The scope of waste management and disposal assessment and management should consider:

- Waste types – solid, liquid, chemical, hazardous, medical, e-waste (electronics), abandoned vehicles and infrastructure.
- Waste from excavation activities, which may be referred to as spoil (typically excavated materials unable to be reused) and/or muck (a commonly used term for material excavated from underground). For simplicity, all excavated waste will be called 'spoil' in this guideline.
- Waste from project construction areas (e.g. reservoir vegetation clearing, dams (coffer, main, saddle), adits, tunnels, power house).
- Waste from ancillary structures and activities – e.g. labour camps, offices, concrete batching plants, water supply intakes, material fabrication areas, supply storage areas, quarries, supply transport activities.
- Waste from mitigation measure areas – e.g. fish hatchery, reforestation activities, local benefits.

- Waste minimisation through design and through procurement policies, and through reuse and recycling.
- Temporary waste storage facilities.
- Waste transport – vehicles, capacities, operators, maintenance, licensing and waste tracking systems.
- Regional waste management facilities – locations, types, capacities, condition, operating measures, lining, cover, drainage, pest management measures and waste documentation.

Noise, air quality and vibration

Objectives for noise, air quality and vibration assessment and management are to ensure that there are no adverse effects for surrounding communities, biodiversity or other values created by implementation stage activities of the project. The scope of noise, air quality and vibration assessment and management must consider:

- All project-related activities both on and off the project sites, including road works.
- Air emissions from point sources, fugitive sources and mobile sources.
- The activities of primary suppliers.
- The proximity of sensitive receptors, including in the natural and the human environment.

Assessment

Assessment criterion - Implementation Stage: Waste, noise and air quality issues relevant to project implementation and operation have been identified through an assessment process utilising appropriate expertise; and monitoring is being undertaken during the project implementation stage appropriate to the identified issues.

The Environmental and Social Impact Assessment (ESIA) should include content on waste management, and on noise, air quality and vibration. All compliance requirements should be well-identified. Baseline data should be collected to understand the pre-project status and project-related impacts and to inform risk assessment and development of management plans. All implications for other social, environmental and/or economic objectives should be identified and evaluated. Monitoring activities included within the management plans should identify if issues are arising and if mitigation measures are effective.

Waste management and disposal

Requirements for baseline waste management and disposal information include the following:

- All of the aspects listed under the scope of this guideline are addressed using appropriate expertise.
- Relevant existing regional waste management facilities, activities and capacities are identified and evaluated in consultation with government authorities with respect to the different waste streams. The evaluation should consider if these can be used or enhanced, or if the project should develop its own facilities. Evaluations of existing facilities should include understanding of responsibilities, permits, tracking systems, and waste transport operators. If project-specific facilities are needed, the assessment process should evaluate the long-term options (e.g. closure or hand-over to local authorities).
- Primary data (i.e. sampling) and secondary data (i.e. reports) are collected for existing waste disposal sites intended to be used by the project to understand capacities and any existing issues, such as the quality of run-off. The methodology used for primary and secondary data capture is described.
- Areas are identified for potential disposal of all types of waste and evaluated based on the particular characteristics of each waste type and on social, environmental and financial criteria.
- Waste management and disposal risks at the construction stage should be identified and can arise due to:
- Underestimations of waste quantities and poor planning for waste disposal. This can lead to increased costs, time delays and potentially non-compliance issues while reactive management measures are implemented.
- Inappropriate separation, storage, transport and disposal of chemical, hazardous and medical wastes, leading to toxic chemicals in water and soils and occupational and public health risks.
- Inappropriate disposal and management of solid wastes. This can lead to wind-blown litter, poor water quality in the run-off, attraction of pest species, visual impacts, and public health risks.

- Inadequate liquid waste collection and treatment facilities, leading to poor water quality, soil contamination, and public health risks.
- High waste transport costs due to poor location choices for waste disposal sites.
- Non-compliances in waste transport and disposal management with permit requirements and management plans.
- Land degradation caused by location choices for spoil dumps, e.g. loss of agricultural land.
- Collapse, erosion, sediment run-off and poor water quality from inappropriate management of spoil dumps.

Waste management and disposal risks at the operation stage should be identified and may include:

- Degradation over time of construction-stage waste disposal areas due to poor site closure or poor follow-up management.
- Inability of the local government to sustain waste management systems developed during the construction stage and handed over to local authorities.
- Floating debris in the reservoir, often logs and vegetation associated with reservoir clearance or delivered during monsoons. This can cause local debris back-ups with associated visual, safety, pest and mechanical risks.
- Abandoned vehicles and infrastructure arising from poor project closure and rehabilitation measures.
- Waste management and disposal opportunities should be investigated and might include:
- Reduction, reuse and recycling through good site design and forward planning.
- Business opportunities from project waste streams (e.g. scrap metal).
- Improved regional waste transport and disposal facilities compared to pre-project conditions, if agreed with local authorities.
- Use of new monitoring or treatment technologies, such as high temperature incinerators for hazardous wastes or instrumentation to monitor the stability of spoil dumps.
- Creation of new land-use areas such as sports grounds through well-planned and implemented landfill with adherence to relevant soil quality standards.
- Partnerships with other waste generating industries in waste disposal and treatment facilities.

Monitoring should be embedded within the relevant management plans. Parameters commonly used for monitoring relating to waste management and disposal include:

- Routine visual inspections for waste disposal areas.
- Measurements of key physical characteristics of waste storage and disposal areas (e.g. area, volume, weight, compaction).
- Inspections of waste register documentation to understand what is in the waste disposal areas, when it was placed there, by whom, any accompanying treatment measures upon disposal, etc.
- Water quality measurements at drainage collection points receiving water from the disposal areas.
- Periodic inspections and tests of spoil dumps to ensure proper management and long-term stability of excavated wastes (e.g. compaction, moisture, run-off, slumping, movement of downslope barriers).

Noise, air quality and vibration

Requirements for baseline noise, air quality and vibration information include the following.

- All of the aspects listed under the scope of this guideline are addressed using appropriate expertise for the air quality and noise sampling design, data collection, data analysis and interpretation.
- Local knowledge and information is included, including from communities in the project affected areas.
- Primary air quality and noise data (i.e. sampling) is collected from locations which are meaningful in relation to the receptors of concern and where future complaints might be made, and are in areas where the construction stage monitoring can be compared.
- Air quality and noise sampling data is collected for the different seasons and is collected at different times of day and night according to standard methods. The methodologies used for primary and secondary data capture are described.

- Air quality and noise sampling results are described according to the national environmental standards or recognised international standards for any parameters of concern not in the national standards. Air quality and noise sampling results are linked to land uses, seasonal and climatic factors, topography and ground characteristics, wind speeds, etc. to enable explanation of pre-project trends and issues.
- Where there are highly sensitive receptors and air quality emissions of concern, atmospheric dispersion models are used.
- A pre-project survey is undertaken of the condition of infrastructure that could potentially be at risk from vibration damage, with particular attention to significant community or cultural heritage infrastructure. Data collected includes visual inspections, photos, and measurements of cracks.

Noise, air quality and vibration risks at the construction stage should be identified and can arise due to:

- Noise, air quality and vibration from excavation activities involving drilling, blasting and/or heavy machinery.
- Noise and air emissions from crushing plants, aggregate processing plants, concrete batching and fabrication activities.
- Transport-related emissions and noise.
- Wind-blown dust and toxins from uncovered waste disposal areas.
- Smoke from burning off cleared vegetation.
- Noise, air quality and vibration at the operation stage should be identified and may include:
- Noise and vibration from the power house.
- Vehicle emissions.
- Hydrogen sulphide releases through the turbines, due to decaying vegetation and anaerobic conditions in the reservoir, causing nuisance odours, corrosion of exposed metals, and discolouration of concrete.
- Smoke from burning of floating debris collected from the reservoir intake screens/trash racks.
- Formation of microclimates in the reservoir area, such as entrapped fog, colder temperatures or wind.

Noise, air quality and vibration opportunities might include the use of new monitoring or impact-reducing technologies, or improved air quality compared to pre-project conditions.

Clear monitoring objectives should be defined for noise, air quality and vibration for both the construction and operation stages as well as the monitoring activities embedded into management plans. Parameters commonly used for monitoring, depending on the focal area, include:

- **Air quality:** nitrogen oxides (NOx), sulphur dioxide (SO2), carbon monoxide (CO), particulate matter (PM), volatile organic compounds (VOCs), wind speed and direction. Emissions from highly variable processes should be sampled more frequently or through composite methods
- **Noise:** decibels (dBA)
- **Vibration:** ground-movement measurements, visual inspection and documentation of structural issues (e.g. cracks)

For monitoring of waste, noise, air quality and vibration, a logical design should be explained for the locations, timing, parameters and methodologies that are clearly linked to risks and objectives. The locations chosen should always include those that are near or at sensitive receptors. Monitoring should be conducted by trained specialists using established methods and quality control procedures. All findings are compared to the relevant environmental standards and interpreted in light of influential factors such as climate, topography, soils, wind direction and speed, season, and activities.

Management

Management criterion - Implementation Stage: Processes are in place to ensure management of identified waste, noise and air quality issues, and to meet commitments, relevant to the project implementation stage; and plans are in place for the operation stage for ongoing waste management.

The project Environmental and Social Management Plan (ESMP) should demonstrate that the needs and risks relating to waste, noise, air quality and vibration have been well-identified, and that the feasibility of avoidance and minimisation approaches has been fully explored. Risks will vary by site and different mitigation measures will be suitable depending on the project. Plans for minimising and mitigating actions should be outlined separately for project construction and operation. Processes to manage waste, noise and air quality should be informed by the assessment of issues and compliance requirements. Plans need to identify actions, time requirements, resource requirements, responsible parties, monitoring, reporting, and review, as described under the Environmental and Social Issues Management topic guideline.

Waste management and disposal

Measures to address waste management and disposal risks could include some of the following:

- Mitigate risks of underestimations of waste quantities and poor planning for waste disposal: engineering estimates are made of waste generation quantities, types and locations throughout the project construction cycle in the feasibility studies based on detailed analysis of all construction activities and the labour workforce, with a contingency factored in; project design and construction planning includes measures to minimise waste generation; spoil disposal is planned for within the dead storage in the reservoir or in quarry areas; agreements on storage areas and new waste disposal facilities are reached at the project outset with the local government; land acquisition for waste disposal is arranged at the project outset.
- Mitigate risks of inappropriate separation, storage, transport and disposal of chemical, hazardous and medical wastes: awareness-raising; education; relevant contractual requirements; waste handling procedures; training; appropriately designed storage areas (which may include being isolated with security features, labelling, bunding, etc.); permits; scheduled disposal arrangements; appropriate waste transport mechanisms; appropriate waste disposal mechanisms (e.g. high temperature incinerators); appropriate disposal of any residues; chain-of-custody documentation to the final destination.
- Mitigate risks of inappropriate disposal and management of solid wastes: solid waste disposal sites with appropriate management procedures including layering, covers, compaction, contouring, drainage, monitoring, inspections, security, controlled access, pest management and signage.
- Mitigate risks of inadequate liquid waste collection and treatment facilities: liquid wastes are treated in wastewater treatment plants or septic tanks as appropriate to the scale and location of wastes generated; procedures for maintenance are developed and implemented appropriate to the design of the treatment approach; drainage is designed to appropriate standards; biosolids are disposed of or reused as appropriate to the chemical characteristics and environmental permits
- Mitigate risks of high waste transport costs due to poor location choices for waste disposal sites: waste disposal sites are located in reasonable proximity to the waste generating activities provided that the environmental and social conditions are suitable; the cost and time factor for waste transport is considered as part of evaluation of potential waste disposal areas and factored into the project budget and logistics to ensure that illegal waste dumping does not occur to save time and costs; relevant contractual clauses; awareness-raising, education, training, inspections, and waste registers.
- Mitigate risks of land degradation caused by spoil dumps: areas of good environmental condition are avoided for spoil disposal sites; spoil disposal sites include backfilling in quarries where extraction has been finished or in the dead storage of the reservoir that will be inundated; spoil disposal requirements are minimised through reuse as much as possible, such as for concrete aggregate, embankment construction, and road base; spoil dump site selection aims to create future quality land-use areas for community benefit.
- Mitigate risks of collapse, erosion, sediment run-off and poor water quality from inappropriate management of spoil dumps: accurate quantification of spoil generation and disposal requirements taking into account a soil bulking factor of 30-40%; design of the spoil dump repose angle takes into account ground characteristics; spoil disposal locations are a safe distance from watercourses and avoid risks of inundation during flood or spill conditions; use of retaining walls; periodic compaction in layers as the spoil disposal area is being filled; diversion of drainage around the spoil disposal area; contouring; landscaping; afforestation with suitable plant species; soil binding using biofertiliser technology; monitoring.
- Mitigate risks of degradation over time of construction stage waste disposal areas: monitoring to ensure appropriate implementation of management procedures during design and filling of construction stage waste disposal areas; continued monitoring

during operation stage, potentially based on agreement with the local government if the facilities were handed over; closure and rehabilitation at the end of the useful life as per an agreed plan.

- Mitigate risks of inability of the local government to sustain waste management systems developed during the construction stage over the longer-term: agreements made with the local government about the long-term arrangements for any waste disposal developments created or expanded during the construction stage; these may include full handover, developer management or co-management for a fixed period, provision of support funds for a fixed period, provision of management training, or closure and rehabilitation.
- Mitigate risks of floating debris in the reservoir: log collection campaigns to reduce the quantity of debris reaching the intake; intake protection screens with scheduled clearing; management arrangements for disposal of floating debris such as provision of firewood or commercial uses (e.g. firing a kiln).
- Mitigate risks of abandoned vehicles and infrastructure: contractual clauses requiring appropriate disposal of abandoned vehicles, and dismantling and disposal of all infrastructure; identification of appropriate disposal areas.

Noise, Air Quality and Vibration

Measures to address noise, air quality and vibration risks could include some of the following:

- Mitigate risks of air emissions, noise and vibration from excavation activities involving drilling, blasting and/or heavy machinery: ensuring adequate distances from sensitive receptors; restrictions on times of day; restrictions on size of machinery; restrictions on allowable blasting charges; establishment of noise and emission dispersion barriers, such as through the creation of embankments or retention of natural vegetative screens; installation of vibration isolation for mechanical equipment.
- Mitigate risks of air emissions from crushing plants, aggregate processing plants, concrete batching and fabrication activities: enclosure of machines and plant areas; air emission control devices (e.g. bag filters); covered unloading points from crushers; raising chimney heights; water sprays around crushing sites (oil sprays should be avoided); proper and regular maintenance of machines and plants; detection and closure of leakage areas (e.g. for fumes); process modifications; use of alternative materials (e.g. cleaner fuels).
- Mitigate risks of dust from vehicle traffic on roads: seal or provide a gravel road surface near sensitive receptors; restrict construction vehicle routes to avoid sensitive receptors; provide alternative pedestrian pathways away from roads used by construction vehicles; restrict vehicle speeds and hours of travel near sensitive receptors; ensure vehicle loads are covered; implement dust-suppression measures such as water sprays on the road (oil sprays should be avoided); creation of wind barriers around sensitive receptors.
- Mitigate risks of noise from crushing plants, aggregate processing plants, concrete batching and fabrication activities, and from vehicles or other transport modes: locating noise sources within less sensitive areas to take advantage of distance and shielding; siting permanent facilities away from community areas; taking advantage of the natural topography as a noise buffer during facility design; selecting equipment with lower sound-power levels; installing silencers for fans; installing suitable mufflers on engine exhausts and compressor components; installing acoustic enclosures for equipment; using sound insulation; installing acoustic barriers; limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources; rerouting vehicle traffic to avoid community areas; planning flight routes, timing and altitude for aircraft flights (airplane and helicopter) to minimise impact to sensitive receptors.
- Mitigate risks of wind-blown dust and toxins from uncovered waste disposal areas: location of waste disposal areas away from sensitive receptors; layering, compaction and cover measures to avoid wind-blown emissions; use of topography and vegetation to create screens or barriers to dispersion of emissions.
- Mitigate risks of smoke from burning off cleared vegetation: rules specifying no burning or restricted conditions for burning; arrangements for reuse of timber debris; chipping of cleared vegetation for later use in land rehabilitation.
- Mitigate risks of noise and vibration from the power house: siting and design choices to avoid sensitive receptors; proper and regular maintenance; land contouring and planting of a greenbelt to limit effects on sensitive receptors.
- Mitigate risks of vehicle emissions: selection of

newer and/or relatively quiet vehicles; proper and regular maintenance to meet required standards; use of cleaner fuels (e.g. with lower sulphur content); fitting vehicles with emission control devices (e.g. catalytic converters).

- Mitigate risks of hydrogen sulphide releases through the turbines due to decaying vegetation and anaerobic conditions in the reservoir: siting and design choices to minimise reservoir biomass and anaerobic conditions; initial biomass removal from the reservoir; management of water and intake levels in the reservoir to avoid lower-level anaerobic water passing through the turbines; multi-level intakes.
- Mitigate risks of smoke from burning off floating debris collected in the intake screens: rules specifying no burning; arrangements for reuse of timber debris (e.g. in kilns); disposal of non-reusable solid waste into licensed waste disposal sites.
- Mitigate risks of formation of microclimates in the reservoir area, such as entrapped fog, colder temperatures or wind: siting and design choices to minimise risks of microclimate impacts; strategic planting of vegetation to minimise or avoid effects.

Conformance/Compliance

Conformance/Compliance criterion - Implementation Stage: Processes and objectives relating to waste, noise and air quality have been and are on track to be met with no significant non-compliances or non-conformances, and any related commitments have been or are on track to be met.

Assessment processes and management measures relating to waste, noise, air quality and vibration should be compliant with relevant legal or administrative requirements. These may be expressed in licence or permit conditions or captured in legislation. Implemented measures should be consistent with what is in the plans to demonstrate conformance with the plans. Relevant commitments may be expressed in policies of the developer or owner/operator, or in company statements made publicly or within management plans. Evidence of adherence to commitments could be provided through, for example, internal monitoring and reports, government inspections, or independent review.

Variations to commitments should be well-justified and approved by relevant authorities, with appropriate stakeholder liaison.

The significance of not meeting a compliance requirement or commitment is based on the magnitude and consequence of that omission and will be context-specific. For example, failure to identify, store or dispose of potentially toxic waste is likely to be a significant non-compliance. Failure to identify an opportunity for recycling packaging materials may be a non-significant non-conformance.

Outcomes

Outcomes criterion - Implementation Stage: Negative noise and air quality impacts arising from project activities are avoided, minimised and mitigated with no significant gaps, and project wastes managed responsibly.

An evidence-based approach should demonstrate that negative waste, noise and air quality impacts arising from project implementation activities are avoided, minimised and mitigated with no significant gaps. The developer should demonstrate that responsibilities and budgets have been allocated to implement relevant plans and commitments. Monitoring reports and data should clearly track performance against commitments and objectives and capture public health impacts. It should be possible to provide examples to show how identified risks from the assessment were avoided or minimised. It should also be possible to table evidence to show that mitigation plans have been implemented and are being monitored. Implementation of measures for waste, noise and air quality, such as new or enhanced waste management facilities, stockpiling of topsoil, noise buffers, and wetting of roads for dust suppression, should be evident and monitoring should show how they are achieving their stated objectives.

Evidence of monitoring may include waste disposal receipts or other such documentation which is common for restricted wastes. Evidence of legal requirements may be contained in project permit or licence conditions. Evidence of conformance with plans may be found in an on-site complaints register, in records of consultation with local stakeholders, or in the results of previous audits.