WORLD BANK GROUP

THE WORLD BANK IBRD • IDA | IFC International Finance Corporation | MIGA Multilateral Investment Guarantee Agency

Environmental, Health, and Safety Guidelines

AIRPORTS

2025

1818 H Street NW, Washington DC 20433
Telephone: 202-473-1000; Internet: www.worldbank.org

DISCLAIMER

The World Bank Group is comprised of the International Bank for Reconstruction and Development, the International Development Association, the International Finance Corporation, the Multilateral Guarantee Agency, and the International Centre for Settlement of Investment Disputes. For purposes of this disclaimer, references to The World Bank Group means any or all of these member institutions, as the context may require.

The World Bank Group does not warrant or guarantee the accuracy, reliability, completeness, or fitness for purpose of the general environmental, health and safety guidelines (General EHS Guidelines) and the various industry-specific sector guidelines (Industry Sector EHS Guidelines), collectively referred to as the EHS Guidelines. Under no circumstances shall The World Bank Group be liable for any loss, damage, or liability of any kind (including special, indirect, incidental, consequential, or compensatory damages) or for any expense suffered in connection with the use of, failure to use, or reliance upon the EHS Guidelines or the information contained therein.

The World Bank Group makes no representations about the alignment or conformity of the EHS Guidelines with the international, national, or subnational legal requirements of any jurisdiction or any industry standards.

In publishing and making the EHS Guidelines available, no member institution of The World Bank Group is rendering professional or other services for, or on behalf of, any person or entity, nor is any member institution of The World Bank Group agreeing to perform any duty owed by any person or entity to another. Professional advice of qualified and experienced persons should be sought before entering (or refraining from entering) into any project activity.

The EHS Guidelines may contain citations or links to third-party web sites. This does not imply any endorsement or responsibility on the part of The World Bank Group with respect to the opinions, ideas, data or products presented by the authors of cited sources or the content of their works, or of third-party websites.

Nothing in the EHS Guidelines shall constitute or be construed as a waiver of, or be considered to be a limitation upon, the privileges and immunities of any of the member institutions of The World Bank Group, all of which are specifically reserved.

RIGHTS AND PERMISSIONS

Cover design: IFC 2024.

CONTENTS

1 INTRODUCTION

1. The Environmental, Health, and Safety Guidelines (EHS Guidelines) are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP).[1] They are comprised of the General Environmental, Health and Safety Guidelines (General EHS Guidelines) and Industry-specific Sector Guidelines (Industry Sector EHS Guidelines). The General EHS Guidelines present common environmental, health and safety (EHS) issues that potentially apply across industry sectors. The Industry Sector EHS Guidelines present EHS issues specific to each industry sector.

2. When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as described in their respective policies and standards. The Industry Sector EHS Guidelines are designed to be used together with the General EHS Guidelines. For complex projects, multiple Industry Sector EHS Guidelines may be relevant. A complete list of Industry Sector EHS Guidelines can be found at www.ifc.org/ehsguidelines.

3. The EHS Guidelines specify the performance levels and measures that are generally considered to be GIIP and achievable in new facilities by using existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve establishing site-specific targets, with an appropriate timetable for achieving them.

4. The applicability of EHS Guidelines should be tailored to the hazards and risks identified for each project based on results of an environmental assessment that considers site-specific variables, such as host country context, assimilative capacity of the environment, and other project-specific factors. The applicability of specific technical recommendations should follow GIIP and be based on the professional opinion of qualified and experienced professionals. When host country's regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent measures than those in the EHS Guidelines are appropriate due to specific project circumstances, a detailed justification for any proposed alternatives is needed as part of the site-specific assessment and should demonstrate that alternate performance levels are protective of human health and the environment.

2 APPLICABILITY

5. The EHS Guidelines for Airports cover the planning, construction, expansion, and operation of commercial airport facilities, including activities associated with approach, landing, taxiing, take-off, ground operations and the airport terminal and ancillary facilities. Annex A provides a general description of the airport components and activities.

6. These guidelines distinguish two airport areas:

- Airside: The portion of a terminal restricted to ticketed passengers, ground personnel and crew, including runways, taxiways, aprons, ramps and air traffic control (ATC) facilities.

1 GIIP is defined as the professional skill, diligence, prudence, and foresight that would be reasonably expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally. The circumstances that skilled and experienced professionals may find when evaluating the range of prevention and control techniques available to a project may include, but are not limited to, varying levels of EHS capabilities and capacities, and financial and technical feasibility.

- Landside: The portion of a terminal open to the public as well as airline ground staff and security, immigration and customs personnel; includes hotels, restaurants, stores, and parking facilities.

7. Given the interface between airport and airline operations, this guideline should be read alongside the EHS Guidelines for Airlines, which cover aircraft-related activities during flight, crew operations and maintenance.

3 DESIGN CONSIDERATIONS

8. This section summarizes key aspects related to project siting, design and engineering for greenfield airports, as well as expansions and refurbishments. Design considerations for buildings and ancillary facilities that are common to various industry sectors, such as energy and water conservation, renewable energy provision, use of sustainable building materials, climate resilience, road safety, or universal access for persons with disabilities are detailed in the General EHS Guidelines. Specific aspects relevant to airport security, life and fire safety, and pandemic preparedness and response, should adhere to the relevant industry standards.[2]

9. Considering EHS issues early in site planning and design can help avoid costly mitigation later. This applies to greenfield airports, airport expansions, and rehabilitation, where the presence of workers, passengers and the public needs to be considered.

10. Site selection for new airports or expansions, as well as ancillary facilities outside the airport boundaries (e.g., radars), should consider current and future:

- Land use and zoning[3]
- Population levels and density
- Nearby noise sensitive receptors[4]
- Nearby and associated infrastructure, roads and rails, energy generation, as well as topography and waterbodies that may pose occupational or community safety risks from airport operations or contribute to cumulative impacts (e.g., noise)
- Avoidance of sensitive areas, including waterbodies or landfills that attract wildlife, especially birds that may collide with aircraft turbines and cause accidents
- Acute climate hazards such as flooding, extreme temperatures, and storms as well as chronic climate hazards such as sea level rise, changes in wind patterns, and water stress, in the context of the facility's vulnerability and exposure to climate change

11. Airport facilities should be designed to minimize safety risks to passengers, workers, communities, and the environment and adhere to international, national, local safety standards and codes.[5]

2 IATA, *Airport Development Reference Manual.*
3 For example, in certain jurisdictions, sanitary protection zones are established around airports to restrict new residential development. Zoning is also often used to establish acceptable noise levels (e.g., industrial zones vs. residential zones).
4 Sensitive receptors are determined in the impact assessment and may include for example schools, hospitals, elderly homes, places of worship, among others.
5 ICAO, *Airport Planning Doc 9184*; ICAO, *Aerodrome Design Doc 9157*; FAA, *Airport Construction Standards*; IATA, *World Class Airports*. These are internationally recognized reference materails for the design and construction of airports. ICAO is a UN agency which provides technical guidance through the development of policies and standards and assists member countries to cooperate and share their skies.

12. Noise and vibration impacts should be considered at the design stage. Runway location, orientation (arrival/departure), and flight paths should aim to minimize noise impacts on nearby communities. Preliminary assessments should be conducted during early planning, followed by more detailed assessments as design progresses (see Section 4.1.4).

13. Airport design should consider the location of fuel supply and storage facilities, including fuel tanks and battery energy storage systems (BESS), to mitigate fire and explosion risks, as well as energy supply, including renewable energy sources.

14. While maximizing renewable energy use is considered good practice, operators should consider airport capacity, location, resources, and compatibility, as some technologies may interfere with airport operations (e.g., wind turbines interfering with navigation radars and glare from solar arrays).[6]

4 CONSTRUCTION AND OPERATIONAL CONSIDERATIONS

15. This section provides a summary of sector-specific EHS issues typically associated with the operational phase and provides guidance for mitigation and management measures. Where there are unique aspects to the construction, refurbishment, and decommissioning of this industry sector, guidance is also included. Recommendations for EHS issues and management common to the construction, refurbishment, and decommissioning phases of various sectors are provided in the General EHS Guidelines.

4.1 Environment

16. Key environmental issues for airports are listed below. The following sections provide guidance on managing these issues.

- Energy consumption
- Air and Greenhouse gas (GHG) emissions
- Climate resilience and adaptation
- Noise and vibration
- Waste management
- Hazardous materials management
- Water management
- Biodiversity management

4.1.1 Energy Consumption

17. Airports consume a significant amount of energy, including the following examples:

- Airside: Runway lighting, auxiliary power units (APU) and aircraft ground energy systems (AGES), ground vehicles (used by airport operators, ground-handling companies, and firefighting services) and maintenance hangars

6 ICAO, *Renewable Energy Airport Toolkit.*

- Landside: Terminal lighting, heating and cooling (air conditioning) and equipment (baggage handling systems, terminal bridges, escalators), as well as terminal facilities (restaurants, retail outlets, lounges, and waiting areas)

18. Energy audits can help airport operators be strategic about energy efficiency measures and technologies.[7] The General EHS Guidelines provide additional GIIP reference guides on energy consumption.[8]

4.1.2 Air and Greenhouse Gas (GHG) Emissions

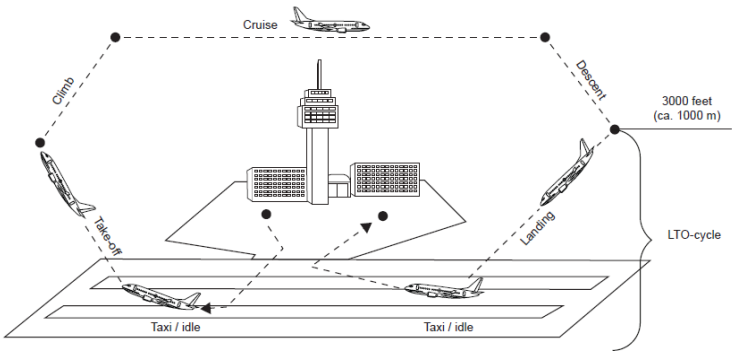
19. Airport air emissions mainly arise from fuel combustion and fugitive emissions, typically including pollutants such as Sulfur Dioxide (SO_2), Nitrogen Dioxide (NO_2), particulate matter (PM_{10} and $PM_{2.5}$) and Ozone, in addition to greenhouse gases (GHG), including Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_20) and industrial gases such as Hydrofluorocarbons (HFCs) Perfluorocarbons (PFCs), Sulfur hexafluoride (SF_6) Nitrogen trifluoride (NF_3). Emission standards are discussed in Section 5.1.2.

20. Emission sources are categorized as:[9]

- Aircraft emissions during landing and take-off (LTO)
- Aircraft ground handling emissions
- Infrastructure or stationary sources
- Vehicle traffic sources

21. The LTO cycle involves flight activities below 3000 feet (914.4 meters), including final approach, landing, taxiing, take-off, and initial climb, each with specific thrust settings (see figure 4-1). Aircraft LTO air emissions modelling often uses the above flight phases and aircraft engine models.[10]

Figure 4-1 Aircraft LTO Cycle



7 For benchmarking of airport energy use, refer to TRB Airport Terminal Building Energy Use Intensity (ATB-EUI) Benchmarking Tool.
8 USGBC, *LEED Operations and Maintenance*; ACI, *Sustainability Strategy for Airports*; TRB, *Energy Use Benchmarking Tool*. The LEED reference provides a guide for existing buildings that are undergoing improvement works with limited construction. The ACI reference includes energy management strategies.
9 ICAO, *Air Quality Doc 9889*.
10 ICAO, *Aircraft Engine Emissions Databank*.

22. Aircraft emissions during LTO cycles can be reduced by:

- Optimizing arrival and departure procedures through scheduling, single engine taxiing, reduced thrust operations, and Air Traffic Management (ATM) measures[11]
- Promoting the use of Sustainable Aviation Fuels (SAF) by airlines[12]
- Offering incentives to aircraft operators like discounted landing fees for low-emission aircraft

23. Aircraft ground handling emissions can be reduced by using a combination of:

- Participating in Airport Collaborative Decision-Making (A-CDM) schemes that optimize the predictability of aircraft movements[13]
- Meeting national vehicle emissions standards or using electric vehicles for passenger ground transport and aircraft handling
- Favoring ground power units (GPUs) over auxiliary power units (APUs) to power parked aircraft without consuming fuel
- Using alternative fuels (CNG, LNG, LPG, hydrogen, Li-Ion cells) or emission traps in Ground Support Equipment (GSE)

24. Air emissions from infrastructure or stationary sources can be reduced by:

- Incinerating waste only at permitted facilities operating under internationally recognized standards for pollution prevention and control, as addressed in General EHS Guidelines
- Managing fugitive air emissions from fuel storage and handling (see also EHS Guidelines for Crude Oil and Petroleum Product Terminals)

25. Vehicle emissions can be reduced by:

- Offering preferential parking and charging for electric vehicles
- Providing incentives for sustainable public and personal transport options (e.g., encouraging airlines to develop through-ticketing agreements with public transport operators)

26. Annual quantification of GHG emissions to benchmark reduction measures, such as energy efficiency and renewable energy use, using internationally recognized sector-specific methodologies.[14] Additional measures may be found in the General EHS Guidelines.

4.1.3 Climate Resilience and Adaptation

27. Airports are vulnerable to various climate hazards, which can in turn pose adverse effects on the environment and people. The risks and impacts of acute climate hazards (e.g., flooding, extreme temperatures and increased intensity of storms) and chronic climate

11 ICAO, *Doc 10177*. Examples of ATM measures include Area Navigation (RNAV), Required Navigational Performance (RNP), and Continuous Descent Operations (CDO).
12 SAF can be produced from a variety of materials, such as used cooking oil, waste materials, non-food crops, algae and recycled plastic. Barriers to the increased use of SAF include the requirement for aviation fuel to meet strict quality standards, infrastructure to deliver SAF to airports without contamination during transport and sufficient demand from airline operators to drive development of the SAF supply chain.
13 EUROCONTROL, *Specifications for Airport CDM*. Most schemes allow for the exchange of accurate departure information, which can minimize aircraft taxiing to the runway and reduce airfield congestion.
14 ACA, *Application Manual*. The Airport Carbon Accreditation Programme (ACA) is one of the most widely used framework for GHG emission in the airport sector. Airports can also use ACI's Airport Carbon and emission Reporting Tool (ACERT).

hazards (e.g., sea level rise, wind pattern changes, water stress and icing conditions) can damage airport infrastructure and alter its operations, which can in turn affect or exacerbate impacts such as more frequent or severe emergency scenarios (e.g., flooding affecting the risk of uncontrolled releases of hazardous materials) or operational changes (e.g., more frequent flight diversion and landing events at alternate airports due to weather hazards, resulting in increased impacts such as noise pollution and air emissions at the alternate airport).

28. Airports should assess climate change risks at the specific airport location and identify risks that can exacerbate impacts on the environment, workers and the public. Planning, design and operational mitigation measures should be considered in master plans and related procedures for site-specific measures and emergency preparedness and response.[15] Adaptation and resilience measures should align with maintenance cycles and upgrade plans. Other general measures are presented in the General EHS Guidelines.

4.1.4 Noise and Vibration

29. Noise and airborne vibration are inherently interconnected, and the strategies implemented to mitigate noise impacts will simultaneously address airborne vibration.

30. The primary source of airport noise and vibration are aircraft during LTO cycles and taxiing (see figure 4-1). Low frequency noise from aircraft during different LTO-phases can cause perceptible vibration levels with effects such as windows rattling. Other sources of noise and vibration related to the aircraft operation include ground operations such as operation of ground support vehicles (e.g., passenger buses, mobile lounges, fuel trucks, aircraft tugs, aircraft and baggage tractors, and dolly carts); aircraft APUs; and aircraft engine testing activities. Operational ground borne vibration is limited, and mitigation measures are described in the General EHS Guidelines.

31. Aircraft noise can cause various impacts on nearby communities, from nuisance to disruption of quality of life to health effects.[16] Impacts vary depending on the tolerance level and sensitivity of the receptors, described as the receptor's 'annoyance' level.[17]

Noise Assessment

32. The identification of potential aircraft noise impacts is done through numerical noise modelling, assessed against selected metrics and thresholds. Aircraft noise metrics and thresholds are typically defined by national regulations. In the absence of regulated aircraft noise thresholds, airports should select metrics and thresholds referred to in other jurisdictions (see table B1 for a description of various noise metrics and table B2 for examples of noise thresholds from various jurisdictions). This selection should be based on a site-specific assessment that considers factors like airport traffic volume, size and configuration of the airport, noise receptors, existing zoning and land use planning regulations. The selected threshold should be justified based on the specific airport conditions and objectives.[18]

15 ISO, *Adaptation to Climate Change*; ISO, *Guidelines on Vulnerability*; ICAO, *Climate Change Risk Assessment*; ICAO, *Climate Resilient Airports*; ACI, *Airports' Resilience and Adaptation*.
16 WHO, *Environmental Noise Guidelines European Region*.
17 ECAC, *Doc 29;* EU *598/2014.* Surveys conducted in Europe and the US have studied the level of annoyance that people experience from noise, which are presented in 'annoyance curves' (e.g., Schultz curve). The term 'highly-annoyed people' usually represents <15% of people most annoyed by aircraft noise, based on survey responses.
18 ICAO, *Balanced Approach to Aircraft Noise Management;* This resource provides an internationally agreed approach to identify a specific noise problem and tailored measures to manage the impacts. Airports determine threshold levels for defined metrics to establish noise objectives and intervening actions.

33. A noise assessment, based on numerical modelling, should be conducted to determine aircraft noise exposure at receptors around the airport and to identify the extent and significance of potential noise impacts. This should be done as early as possible when planning new airport developments or expansions and updated throughout the airport's life cycle. It should be done in coordination with the regulator and local authorities responsible for current and future zoning or land-use planning.

34. The noise modelling should assess both current and future traffic scenarios. Modelling parameters typically include:[19]

- Descriptions of the airport and its surrounding area, including elevation, topography, vegetation, structures and infrastructure, prevalent wind direction, runway length and orientation, landing and departure paths
- Representative periods of traffic data, including fleet mix, traffic volumes, and flight schedules occurring and/or expected
- Aircraft noise characteristics from standard performance databases[20]
- Information on the flight tracks during LTO cycles and runways used[21]

35. Modelling results help identify the location and number of receptors, including sensitive receptors, potentially affected by noise.[22] These results typically provide annual average noise exposure levels, which are depicted through contour maps around the airport for both day and night periods. These contour maps indicate the extent and magnitude of aircraft noise impact, with contours every 3 to 5 decibels (dB).[23] Values are compared to the selected noise threshold to determine the impacts and noise management measures.

Noise Management

36. A noise management strategy is developed based on the results of the noise assessment, considering identified noise impacts, thresholds, and necessary actions. The International Civil Aviation Organization (ICAO) Balanced Approach outlines the GIIP for managing aircraft noise through four main pillars:[19]

- Reduction of noise at source: Integrate noise reduction technology into aircraft design, retrofit existing aircraft, and aircraft certification. Airport operators may mandate aircraft certification to meet specific standards and can incentivize airlines to operate more efficient aircraft for lower charges.
- Land use planning and management: Collaborate with local authorities to plan and manage land use, implement noise control strategies beyond airport boundaries, and use financial instruments (e.g., promote industrial/commercial use around airports).[24] Provide relevant information (e.g., modelling results) and collaborate on zoning and building restrictions with authorities (e.g., buffer

19 ECAC, *Doc 29*; EUROCONTROL, *IMPACT;* FAA, *Aviation Environmental Design Tool (AEDT)*. Numerical modelling uses mathematical formulae (prediction methods) to generate aircraft noise predictions that are visualized through noise contour maps. Commercial software packages are available to implement a wide variety of noise prediction methods. There are many noise models used in the industry (e.g., IMPACT (EUROCONTROL) and AEDT (FAA)).
20 EASA, *Aircraft Noise and Performance Database (ANP)*. For example, ANP is a collection of data that provides detailed information about the noise levels and performance characteristics of various aircraft. Key features of the ANP include: aircraft types; noise levels (in decibels) from different types of aircraft during various stages of flight; and performance parameters such as fuel consumption, flights speeds, climb rates, etc. that affect aircraft efficiency and environmental impacts.
21 The airport authority typically collects detailed trajectories, runway usage, and type of aircraft for each flight arriving to or departing from the airport. Alternatively, commercial services usually collect flight tracking data. For large airports, modelling can extend to substantial distances (several kilometers), and thus flight track information is needed for those distances from the airport.
22 Sensitive receptors are identified in the impact assessment and may include, for exmple, schools, hospitals, elderly homes, places of worship, among others.
23 ICAO, *Noise Contours Guidance Doc 9911;* ECAC, *Computing Noise Contours*; SAE, *Calculation of Airplane Noise*.
24 ICAO, *Environmental Protection Appendix F;* ICAO, *Airport Planning Doc 9184*. These resources urge states to minimize noise through preventative land use planning.

areas to prevent encroachment that reduce the number of people affected by noise), or launch joint sound insulation programs for sensitive receptors, which can supplement when other measures are not sufficient.[25]

- Noise abatement operational procedures: Manage aircraft operations to reduce impacts on noise-sensitive receptors. The suitability of measures depends on the airport's physical layout and its surroundings, and safety must be prioritized.[26] For example, airport operators promote specific noise abatement departure procedures to reduce noise impacts at specific locations around the airport.
- Operating restrictions: Measures to limit or reduce aircraft activity, such as capacity caps, nighttime curfews, specific aircraft or runway restrictions, noise quotas, or limitations based on flight types.[27] For example, airport operators can work with regulators to prohibit specific aircraft types with poor noise performance during nighttime to reduce sleep disturbances.

37. Airport operators have varying degrees of control and influence over the ICAO Balanced Approach elements (e.g., aircraft performance is the responsibility of the airlines and regulators; land use planning is the primary responsibility of local authorities and regulators). Where possible, airport operators should collaborate with relevant stakeholders to influence measures relevant to the airport's context (e.g., consultative committee with air traffic control, local authorities, local communities, and airline operators). Measures should be tailored to each airport, considering cost-effectiveness, safety risks, financial feasibility of all associated implementation costs and other potential secondary effects on other environmental and social aspects. Examples of noise management measures are presented in table B-3.

4.1.5 Waste Management

Non-Hazardous Waste

38. Airport waste management systems should be developed and implemented according to the waste streams and disposal options, following the General EHS Guidelines and GIIP.[28] Airport operators should implement a collection and segregation system for landside and airside waste, processed by the airport operator or licensed waste management operators

39. Waste from airline operators and airplane cleaning contractors should be segregated and managed as part of their service.[29] Aircraft food waste should comply with local regulations to protect human and animal health, agriculture, and ecosystems. Some countries require specific disposal methods for international flight catering waste to prevent the spread of communicable diseases, pests, and invasive species that can pose biosecurity risks. Local requirements may include rendering, incinerating, or landfilling food catering and mixed waste.

25 FAA, *AC 150/5000-9B*; DOI, *Airport Sound Insulation Programs*. Sound insulation is typically considered in jurisdictions like Europe and the US, while its feasibility and effectiveness in emerging markets will depend on the context. These measures may include window/ door insulation or ceiling/roof sealing to reduce indoor noise levels.
26 Procedures and routes in the airport's Aeronautical Information Publication (AIP) are mandatory for airlines, designed to avoid noise-sensitive areas, and are developed in consultation with local authorities and airlines.
27 ICAO encourages States not to apply operating restriction as first resort but only after considerations of the benefit to be gained by the implementation of the three other principal elements of the Balanced Approach.
28 ICAO, *Waste Management at Airports*. ICAO advises states to use operating restrictions only after considering the benefits of the three other elements of the Balanced Approach
29 IATA, *Cabin Waste Handbook*.

Hazardous Waste

40. Airport hazardous waste streams include oils, solvents, and chemical waste from activities such as aircraft and ground vehicle cleaning, fuelling, maintenance, painting and metalwork, engine testing, de/anti-icing, and ground vehicle repairs. On-site hazardous waste management, including temporary storage should follow General EHS Guidelines recommendations.

41. Where airports provide health care during normal operations or during epidemics or pandemics, and produce biomedical hazardous waste, and discard Personal Protective Equipment (PPE) and testing kits, specific guidance on medical waste management should be followed according to local regulations and the General EHS Guidelines.[30]

4.1.6 Hazardous Materials Management

42. Airport operations may involve storing and handling hazardous materials, including jet fuel, aviation gasoline, SAF, and diesel, hydrogen, and chemical batteries. Fuel may be stored in aboveground or underground tanks and transported via piping systems. Equipment and tanks should be designed, installed, operated, maintained, and tested for containment integrity, including secondary storage for fuel tanks; and to prevent leaks, adhering to relevant industry standards and codes.[31] Operators should label, store, and manage hazardous materials, and develop spill prevention and emergency response plans, following the General EHS Guidelines; including at smaller airports using tanker trucks.

43. Ground support equipment (GSE) may use hydrogen and chemical batteries. Safe airport operations increasingly rely on proper storage and handling of hydrogen fuel cells and electric vehicles. Battery fires in GSE can be extinguished with a Class D fire extinguisher, a foam extinguisher, CO_2, Class ABC dry chemical, graphite powder, copper powder, or sodium carbonate.[32] Hydrogen fuel cell-powered GSE can pose flammability and combustibility risks when hydrogen meets air. Such equipment should be handled per GIIP.[33]

44. Contracts with third parties should include hazardous materials management and mitigations, including accidental releases of fuel, fire suppression materials, and de-icing solution.[34]

45. Airport operators should use non-hazardous substances or integrated pest or vector management (IPM/IVM) to control rodents. Hazardous herbicides and pesticides should be avoided, favouring low-toxicity alternatives. Pesticide and herbicide use should be monitored to prevent excessive application, as described in the General EHS Guidelines.

4.1.7 Water Management

30 ACI, *Aviation Operations during COVID-19*; ICAO, *Manual on COVID-19*; WBG, *EHS Guidelines for Health Care Facilities.*
31 ICAO, *Annex 6*; WBG, *EHS Guidelines for Crude Oil.*
32 TRB, *Preparing for Electric Aircraft.*
33 ACI, *Integration of Hydrogen Aircraft*; DOE, *H2 Hydrogen Tools.*
34 ACI, *Rescue and Firefighting Services.*

Water Consumption

46. Airport water consumption depends on airport capacity and terminal facilities such as restaurants, shops, lounges, restrooms, and maintenance areas. Operators should assess water supply options and sustainable alternatives, as described in the General EHS Guidelines.

47. A baseline for water consumption should be established, with goals to maximize efficiency and monitor progress. Guidelines for water conservation and quality should follow the General EHS Guidelines.

Wastewater/Stormwater Management

48. Airport wastewater, mainly greywater from terminals, washrooms, and cleaning services, should be collected, treated, and reused for washdown or irrigation.

49. Airports should have wastewater collection systems for stormwater that are designed with retention and isolation basins and proper treatment before discharge. The design should prevent runoff from fuel and chemical storage, transport and dispensing facilities, workshops and fire training areas, airplane maintenance hangars, de-icing agents, and ground service vehicle maintenance facilities. These areas should be monitored to prevent contamination. Where large stormwater ponds are needed, they should be designed to minimize risks to communities and wildlife (e.g., drowning or attracting avifauna).

50. Aircraft de-icing should be limited to small areas such as graded pads that collect de-icing fluid for recycling and/or disposal. Biodegradable de-icing fluid and mechanical de-icing methods such as sweepers and snow ploughs complement chemical de-icing and reduce chemical consumption and discharge. Paved surfaces should be pre-treated prior to the onset of ice to allow for easy removal.[35] Direct discharge of de-icing fluids in stormwater can impact aquatic environments increasing oxygen demand and eutrophication (e.g., nitrogen from urea and phosphorus from glycol).

51. Fire training should take place on impermeable surfaces with retaining bunding to prevent hazardous fire extinguishing agents or polluted fire water from entering stormwater systems. Water with extinguishing agents or flammable materials should be treated before discharge to surface water.[36] Airport operators should transition from per- and polyfluoroalkyl substances (PFAS) to synthetic fluorine-free foam (F3), which is a safer option for the environment and human health.[37]

52. Airports with on-site wastewater treatment systems should use oil separators, ponds, or filtration to remove sediment, pollutants, heavy metals, and hydrocarbons before discharge.[38] Wastewater discharged into sewage networks, should meet municipal wastewater treatment system specifications and limits.

53. Aircraft wastewater should be discharged to airport sanitary sewage systems, with international flight wastewater pre-treated entering treatment facilities.[39] Sanitary wastewater effluents should be managed per the General EHS Guidelines.

35 US EPA, *Airport De-icing Effluent Guidelines*; SAE, *Deicing/Anti-Icing Processes AS6285D*; ISO, *ISO 11076:2020 Aircraft – De-icing*; ICAO, *De-icing/Anti-icing Operations*.
36 ACI, *Rescue and Firefighting Services*.
37 FAA, *Fluorine-Free Foam Firefighting*.
38 FAA, *Hazardous Wildlife Attractants*.
39 ICAO, *Annex 14. Aerodromes I*.

54. Stormwater and wastewater management recommendations are also described in the General EHS Guidelines.

4.1.8 Biodiversity Management

55. Potential biodiversity risks related to airport operations include:

- Light pollution that disrupts circadian rhythms, especially for nocturnal species,
- Noise interference for animal communication and birdsong
- Water contamination from chemicals, hydrocarbons, and suspended solids
- Bird collisions with aircraft (see Section 4.3.5)
- Wildlife trafficking for the exotic pet trade
- Introduction of invasive species or pests from infested plants, fruits, animals or dirt with no phytosanitary certificate

56. Key mitigation includes preventing wildlife from accessing the airport site. Potential wildlife deterrence measures include boundary fencing, bird flappers on overhead power lines, spikes on building ledges, laser beam systems, acoustic systems, falconry, gas canons, pistols, and trained dogs to flush out roosting birds.

57. Airport operators should collaborate with authorities' routine baggage and airfreight searches to prevent animal trafficking, transport of exotic species, and illegal entry of pests and invasive species that can pose biosecurity risks and/ or damage local ecosystems.[40]

4.2 Occupational Health and Safety

58. This section presents sector-specific considerations for worker occupational health and safety (OHS) in airports, while OHS hazards and management common across sectors and related to construction activities are discussed in the General EHS Guidelines.

59. Airport-specific occupational health and safety hazards include:

- Operational safety: Focus on safety for workers, during operations, construction, expansion or rehabilitation of airports.
- Physical hazards: Address risks from baggage/ cargo handling, extreme weather, aircraft noise, ground vehicle operations, engine run-ups, aircraft pushback, and ground maneuvers.
- Chemical hazards: Manage flammable and hazardous substances, such as de-icing chemicals, hydraulic fluids, jet fuel, cleaning products, fire suppressants, and exhaust fumes.
- Biological hazards: Mitigate risks from infectious agents (bacteria, viruses, and fungi), vector-borne diseases, and biosecurity threats.

40 ACI, *Combatting Wildlife Trafficking Handbook*.

4.2.1 Operational Safety

60. Airport operators should maintain safe and efficient operations by developing and implementing a Safety Management System (SMS), aligned with GIIP and local safety regulations.[41] The SMS should be tailored to the airport's nature, size, and complexity, addressing airside and landside safety for airport operators and service providers, incorporating ongoing risk assessment and management and be amended as needed to integrate risk management measures, including contractor requirements and systems and joint health and safety committees to address interface aspects (e.g., signage, and communication tools) as well as Management of Change (MOC).

61. A Management of Change (MOC) procedure should assess safety hazards from changes to airport layout, operations, flight schedules, transportation routes, or new developments, including airport expansions and refurbishment.[42]

62. Regular health and safety audits should verify SMS effectiveness.[43] Such audits may be conducted by third-party providers, the airport operator's safety team, or qualified external safety auditors.

Construction Safety in Operational Airports

63. Construction safety of operational airport rehabilitation or expansion should address complex safety issues such as avoiding risks on airside and landside operations with clear communication protocols and coordinated schedules.[44] A Construction Safety Management Plan, including a MOC to assess and update plans, procedures, and the emergency response plan (ERP) for construction activities should be developed[45].

64. Some OHS considerations for operational airports under construction (expansion or rehabilitation) include:

- Phasing construction activities to minimize impacts on aircraft maneuvering, runways, taxiways, and gates
- Communication and awareness raising among passengers and airport users, training of workers on new emergency response
- Measures to control dust, foreign object debris (FOD), and litter in airside areas
- Safety barriers, fencing, signage, and lighting to demarcate construction and operation zones and to control access for contractors

4.2.2 Physical Hazards

Baggage and Cargo Handling

65. The design of baggage and cargo halls, and drop-off and pick-up areas should separate vehicles and pedestrians using surface markings for routes. Audible and visual warning systems on transportation vehicles alert personnel and passengers during baggage or cargo transfers.

66. General ergonomic, repetitive motion, and manual handling issues are outlined in the General EHS Guidelines. Airport-specific ergonomic and safe baggage and cargo handling measures include:

41 ICAO, *Safety Management Doc 9859*.
42 ICAO, *Doc 9981*
43 ICAO, *Annex 19 - Safety Management*; FAA, *AC 120-92D – Safety Management*; CASA, *Civil Aviation Safety Regulations*.
44 ACI, *Managing Operations During Construction*; FAA, *AC 150/5370-2G Safety During Construction*. These resources assist airport operators in complying with Title 14 Code of Federal Regulations (CFR) Part 139, Certification of Airports.
45 FAA, *Construction Safety Phasing Plan;* MWAA, *Construction Safety Manual*.

- Reducing tasks requiring manual handling with ground support equipment (GSE), such as belt loaders, baggage carts, dollies, trollies, and aircraft steps. Automated baggage and cargo handling systems should be considered if feasible.
- Tagging baggage exceeding 23 kilograms as "heavy" and using extending belt loader (EBL) technology or mobile belt conveyors to reduce the vertical distance that baggage and cargo are moved. Guidance and tools are available, including recommended lifting loads, lifting charts, and instruction manuals.[46]
- Selecting medically fit personnel, training on proper lifting techniques, and providing appropriate clothing and PPE. [47]
- Installing physical prevention and mitigation measures such as fixed guards to prevent access to moving parts, safety interlocks to control access to dangerous areas, and emergency shutdown systems.

Occupational Noise

67. Noise exposure from aircraft engines and ground maintenance activities poses a risk of noise-induced hearing loss (NIHL) to airside operations personnel, which should be addressed through implementation of a hearing conservation program (HCP). The HCP should include noise level monitoring, health surveillance covering audiometric testing, use of hearing protection devices (HPDs), training, and recordkeeping.[48] Noise exposure from sources other than aircraft, such as ground support equipment, should be mitigated through substitution with low-noise equipment, engineering controls such as acoustic barriers, isolating workers from sources, and use of hearing protection.

Ground Vehicle Traffic

68. Airport operators should develop and implement a traffic management plan for ground vehicle operations as airside vehicles pose a hazard to people, aircraft, and fixed structures.[49] To prevent and mitigate traffic-related incidents in airports, suitable surface markings, signs, and lighting should be utilized to allow pedestrians to circulate safely and permit aircraft and ground vehicles to manoeuvre and park in designated areas.
69. Ground support vehicles should be operated and maintained by trained personnel, using safe operating procedures, and should be fitted with safety features including communication devices, audible and visual reversing alarms, guards, and emergency stop or shut off switches. Vehicles should be subject to regular inspection by qualified persons.
70. Ground operations, including those outsourced to a third-party service provider or contractors, should be supervised by qualified personnel. Airside personnel should maintain situational awareness at all times.[50]

46 IATA, *Ground Operations Manual*; ACGIH, *TLVs® and BEIs®*; HSE, *Manual Handling Assessment Charts*; US CDC NIOSH, *Revised Lifting Equation*.
47 Alli, *Fundamental Principles in OHS;* HSE, *Ergonomics at Work*. This *Fundamentals* reference published by ILO sets out the roles and responsibilities of the authorities and employers regarding the right to a safe place of work. The HSE resource provides a brief guide to managing ergonomics in the workplace.
48 US DOL OSHA, *Hearing Conservation*; US CDC NIOSH, *Preventing Occupational Hearing Loss*; WHO, *World Report on Hearing*; SWA, *Preventing Hearing Loss*; HSE, *Noise at Work website*.
49 FAA, *Ground Vehicle Operations*.
50 IATA, *Ground Operations Manual.* This resource covers traffic issues specific to airports and provides GIIP on supervising roles and responsibilities.

Run-ups

71. Engine run-ups are essential for detecting malfunctions or technical issues before the aircraft becomes airborne. This activity, performed by pilots, can pose risks to airport personnel, including carbon monoxide exposure, foreign object debris (FOD), fire, noise, jet blast, and prop wash. Airport operators, in conjunction with aircraft carriers, should establish safe procedures and train ground crew accordingly. Key measures should include designated run-up areas, no-entry areas for ground personnel, and adherence to manufacturer's specifications and the airport's operating procedures.

72. FOD from weathering pavement, debris, and equipment poses serious safety risks to personnel and aircraft. Airport operators should implement a FOD management program for prompt and safe removal of debris.[51]

Pushback and Ground Manoeuvres

73. Ground handlers, pilots, and air traffic control should establish robust two-way communication channels and implement comprehensive safety measures and procedures to support safe airside movement.

74. Pushback operations pose risks between vehicles and aircraft. Addressing this risk should include a dedicated pushback driver, an individual responsible for communication with the pilot, personnel at intersections where the aircraft may need to traverse, and close coordination between dispatchers, pilots, and the control tower.

75. Ground personnel should be trained on risks, emergency procedures, and equipment use, including the correct use of PPE, such as high-visibility clothing and hearing protection.

76. Markings, signs, and lighting should be installed and maintained to reduce safety risks, including[52]:

- Runway markings for take-off and landing, taxiways, holding position and stand markings, and markings critical to instrument landings
- Ground service vehicle markings for movement, storage, and parking areas
- Pedestrian access route markings to aircraft stands or terminal buildings
- Aeronautical ground lighting for take-off and landing to guide pilots at night or in low visibility conditions and to highlight obstructions
- Airport beacons for nighttime operations in areas with challenging visibility or navigation.[53]

77. All lighting should have back-up power, a valid function test certificate, and undergo regular inspection and testing.

Adverse Weather

78. Adverse weather increases risks for vehicles, aircraft, and personnel. Airport operators should provide resources such as grit boxes for use during icy conditions and should employ preventive measures including weather monitoring. Airport operators should confirm

51 IATA, *Ground Operations Manual; FAA*, *AC 150/5210-24A FOD Management.* These resources provide guidance on the management of FOD issues.
52 ICAO, *Annex 14. Aerodromes I.* This resource provides a general description of the purpose and meaning of visual aids.
53 An airport beacon is the brightest flashing light, typically mounted on a tall structure such as the control tower to mark the location of the airport when visibility is reduced.

that airlines, ground handlers, and service providers have shared arrangements in place to address adverse weather, snow, and low-visibility plan.[54]

79. Weather hazards like heat and cold stress should be mitigated with protective clothing, sunscreen, hydration, thermal breaks, adjusted shifts, air conditioning in vehicles, and maintained HVAC systems.

80. As part of climate change risk assessment, activities should be evaluated to determine whether OHS risks may be exacerbated by climate change, and to consider adjustments to OHS procedures and measures, such as monitoring for heat exposure, alternative shift schedules, use of personal protective equipment, and emergency preparedness and response. Guidance on these issues is provided in the General EHS Guidelines.

4.2.3 Chemical Hazards

81. Airport personnel and contractors should be protected from hazardous substances that can impact their health such as aviation fuels, de-icing and anti-icing fluids, cleaning detergents, pesticides, asbestos, maintenance and firefighting chemicals, aircraft batteries and dangerous cargo, such as explosives or radioactive materials (see Section 4.1.6 for details on control measures for Hazardous Materials).

82. Airport construction often involves the use of intumescent or fire-retardant paints to meet fire standards. Prolonged exposure during application can lead to long-term health impacts. Adequate protection, use of PPE, and exposure times should be considered.

83. Airport personnel, particularly those involved in baggage inspections, security screening, personnel that may be or become pregnant or breastfeeding, should be identified and trained on exposure risks to chemicals and products. Adjustments may be necessary depending on the level of risk and exposure of personnel.

84. Airport security personnel should remain vigilant for hazardous materials, illegal substances, and safety violations, including explosives, flammable materials, and illicit drugs, and in rare cases, chemical warfare agents.[55]

85. Airport ERP should identify risks and address potential accidents involving hazardous substances, with tiered response protocols. For example, airports with co-location of fuel tanks or battery energy storage systems (off-gassing) that may ignite and/or explode, should be assessed and specific emergency response measures put in place with proper equipment.

4.2.4 Biological Hazards

86. Airport operations should address biological hazards from pathogens and communicable diseases, including food or water contamination, poor ventilation, medical waste disposal, pandemics, and animal transport.

87. Airport operators should implement a biosafety program to manage biological hazards from animals, people, or infectious plant materials. The program should include exposure assessment and mitigation measures for:

- Blood and other body fluids

54 WBG, *General EHS Guidelines*; US CDC NIOSH, *Preventing Cold-Related Illness;* US CDC NIOSH, *Preventing Heat-Related Illness*; ICAO, *Annex 3 Meteorological Service*; ICAO, *All-Weather Operations 9365.*
55 WBG, *General EHS Guidelines*; IATA, *Dangerous Goods Regulations Manual.* These resources recommended measures to minimize exposure to hazardous substances.

- Plants contaminated by fungi, mold, bacteria and viruses
- Insect and animal bites
- Animal and bird droppings
- Communicable diseases, including epidemics and pandemics[56]

88. Airport operators, ground handlers, airline personnel, and air traffic controllers should prioritize health and hygiene in common areas, including restrooms, to reduce the risk of disease transmission. PPE and other proactive measures based on current health guidelines should be implemented and communicated to personnel.

4.3 Community Health and Safety

89. Airports present health and safety risks to airport users and local communities. These risks include:

- Dust and air emissions (see Section 4.1.2)
- Noise and vibration from aircraft movements and ground service activities (see Section 4.1.4)
- Health epidemics and pandemics
- Fire and explosion hazards
- Airside safety
- Airport security
- Soil and water pollution (see Section Hazardous Waste/Materials)

4.3.1 Dust and Air Emissions

90. Exposure to dust from airport construction and operation and air emissions from airside and landside operations can have impacts beyond airport boundaries into nearby communities. Section 4.1.2 outlines dust and air emission control measures to minimize and manage these impacts.

4.3.2 Noise and Vibration

91. Airport operations generate noise and vibration impacts on surrounding communities. While hearing impairment from exposure to environmental noise is relatively low, routine exposure can negatively affect health and psychosocial well-being. Section 4.1.4 outlines noise management methodologies following the ICAO Balanced Approach, which includes stakeholder dialogues to develop effective noise mitigation measures.[57]

4.3.3 Epidemics and Pandemics

92. Due to the high volume of national and international travellers, airports can pose a risk for the spread of communicable diseases, such as influenza, Ebola, and COVID-19. A public health emergency contingency plan (PHECP) should be established at a designated

56 ICAO, *Managing Communicable Disease Guidelines.*
57 ICAO, *Balanced Approach to Aircraft Noise Management.*

Points of Entry (POE) in alignment with national regulations, local authorities, GIIP, national health policies, and international norms.[58] Airport operators should:[59]

- Designate a point person for pandemic preparedness
- Assign senior leadership responsibility for implementing pandemic preparedness plans, including communication procedures; risk assessments for entry/exit controls; coordination with local, regional, and national public health authorities; and flight restrictions and airport closures
- Inform airport personnel, ground staff, and airline personnel about the PEHCP plan[60]
- Provide appropriate signage, information points, and electronic displays to inform passengers in multiple languages

93. All health-related measures should be risk-based and aligned with the national infectious disease control requirements. Key considerations include:

- Emergency coordination among airport and airline personnel, medical staff, security, customs, immigration, quarantine officials, local and regional medical facilities, and transportation providers to address logistics, operations, data gathering, communication
- Entry and exit controls and trained personnel for passenger screening and area decontamination
- Designated spaces, isolated from public areas, for suspected cases
- Mitigation measures such as locator forms, mask mandates, physical distancing, quarantine and testing, and enhanced building management (ventilation, cleaning, hand sanitizer, and contactless procedures for baggage and handling as well as for restaurants, shopping areas, and restrooms)
- Communication channels with public health authorities for coordinated responses and information sharing

4.3.4 Fire and Explosion Hazards

94. Life and fire safety aspects of airports should be considered in the design and during any upgrades or refurbishment (see Section 3). Airport operators should appoint fire safety specialists to assess fire risks annually, considering traffic forecasts, expected passenger volumes, cargo capacity, on-site chemicals, and fuel. To maintain a dynamic and responsive safety infrastructure, fire safety assessments must be regularly revisited, especially when there are fluctuations in traffic volume or structural changes at the airport. More general aspects of life and fire safety for public access buildings is presented in the General EHS Guidelines.

95. Dangerous chemicals, flammable liquids, combustible materials, aircraft refuelling, battery storage systems and electrical equipment present fire and explosion hazards at airports, which can put passengers and the public at risk, and in some extreme cases, affect

58 WHO, *Public Health Emergency Planning.* This resource is an international legal framework that defines Member States rights and obligations in addressing public health-related events, including safeguards of the rights of passengers regarding personal data, informed consent, and non-discrimination in the application of health-measures under the Regulations.
59 ICAO, *Managing Communicable Disease Guidelines*.
60 ICAO, *Manual on COVID-19*; ACI*, Guidelines Outbreaks Communicable Disease*.

nearby communities. Airport operators should implement a fire hazard analysis and management plan. The plan should integrate relevant industry fire standards and codes and be maintained throughout the airport's lifecycle.

96. Tank farms for aviation fuel storage should comply with national regulations and applicable international industry standards and codes.[61] Standard fire prevention and safety procedures for fuel storage, delivery, and refuelling operations should be established and maintained.

97. Fuelling Safety Zones (FSZ) should be identified, with safe operating procedures developed for these zones. FSZ are defined as an area of at least 3 meters in any direction from the centre point of all fuel vent exits, refuelling plugs, aircraft refuelling ports, fuel hydrants, fuel hoses, and fuelling vehicles, or as required by local regulations.[62] Aircraft should be bonded to refuelling vehicles during refuelling or defueling to provide a conductive path to equalize the potential between the aircraft and fuelling equipment. During refuelling while passengers are embarking or disembarking, ground equipment should allow for sufficient exits for evacuation.

98. Firefighting personnel and equipment suitable for initial intervention should be present during the ground servicing or refuelling. Refuelling should be avoided during lightning or other electrical activity.

99. For airports with lithium batteries storage systems, emergency preparedness should include fire extinguishing agents specifically formulated for lithium battery fires. Airport operators should conduct risk assessments for battery energy storage systems, including the risk of off-gassing.

4.3.5 Airside Safety

Bird Strikes and Wildlife

100. Birds and wildlife near airports pose risks of strikes with aircraft turbines during LTO, potentially causing accidents that may affect communities. Where such risk is present, airport operators should develop and implement a wildlife hazard management plan to mitigate these risks.[63] The plan should include:

- Inventorying bird-attracting sites within the airport and surrounding areas
- Managing local habitats and minimizing areas that attract wildlife, such as water-filled pits, ditches, and shelters
- Wildlife-proof storage and bird deterrent technologies like spikes, netting, drones, lasers, distress calls, and trained birds of prey
- Collaborating with stakeholders to manage surrounding land use, encourage wildlife control measures, and conduct off-airport site monitoring

61 NFPA, *415 Standard on Airport Buildings;* NFPA, *30 Flammable and Combustible Liquids*; API, *Standard 650 Oil Storage*. These codes provide a system of classifying flammable liquids on their potential to cause harm and environmental contamination.
62 IATA, *Ground Operations Manual*.
63 ICAO, *Airport Emergency Planning 9137P7*; ACI, *Wildlife Hazard Management Handbook*.

Runway Overshoots

101. Runway overshoots, overruns, or incursions pose significant hazards to passengers and communities. Runway End Safety Areas (RESA) should be established within airport boundaries, designed to support aircraft that overrun or undershoot the runway. RESA distances should be based on runway codes.[64]

102. Airports in built-up areas may face restrictions on runway lengths, RESA, taxiways, and the number of stands, potentially limiting the types of aircraft they can accommodate. To mitigate risks associated with runway excursions:

- Construct and maintain runways in accordance with the national regulations and international standards
- Remove contaminants and FOD, and monitor runway friction regularly, notifying if friction falls below acceptable levels
- Maintain navigation aids, visual aids, and surface markings per ICAO standards
- Provide aerodrome information such as weather and runway conditions through automated systems
- Install engineered materials arresting systems (EMAS) at the end of runways where RESA requirements cannot be met

103. Public Safety Zones (PSZ) are areas outside airport boundaries at runway ends where development is restricted to limit the number of people at risk in the event of an aircraft accident.[65] Airport operators should collaborate with aviation regulators to determine if a PSZ is required and its size and characteristics, which may vary based on traffic volume.[66]

104. For existing airports and greenfield developments, airport operators should collaborate with relevant agencies to restrict development or activities that may present a hazard to aircraft operations such as:

- Roads and railways near runways
- Cranes exceeding 10 m in height near airports
- Intense lighting that could impair pilot visibility
- Large buildings with highly reflective surfaces.
- Sources of radiation or objects that may interfere with aeronautical communications, navigation, or surveillance systems

4.3.6 Airport Security

105. Airports face diverse security threats, including terrorism, active shooters, boundary intrusions, and human trafficking. Airport operators should conduct a threat and risk assessment and develop a security management plans in coordination and collaboration with local and law enforcement authorities. International guidelines and standards and relevant laws from national aviation authorities should be followed.[67]

64 ICAO, *Aerodrome Design Doc 9157*.
65 Public Safety Zones are located at either end of the runway and development is restricted within these zones to minimize the risk to people should an aircraft overshoot the runway on take-off or landing.
66 ICAO, *Airport Planning Manual II*; UKCAA, *CAA Website Aerdrome Safeguarding*.
67 ICAO, *Global Aviation Security Plan*.

106. Airport security measures should include:

- Fixed systems such as closed-circuit televisions (CCTV) and motion sensors and security personnel deployment
- Passenger, baggage, and cargo screening protocols
- Controlled access to secure areas and perimeter security patrols
- Artificial intelligence-based technologies as permitted by national regulations and international standards, such as digital and face recognition, with proper indication of such systems to the public
- Collaboration with regulatory authorities and law enforcement to combat human trafficking, including personnel training and public signage[68]
- Procedures to monitor and manage unauthorized unmanned aircraft systems (UAS) or drone activity near airports[69]
- Staying updated on the security protocols, ongoing training, and collaboration with regulatory authorities.

107. Certain jurisdictions may present the risk of unexploded ordinances (UXO) on or near airports. Where this risk is identified, it should be managed according to the guidance in the General EHS Guidelines.

4.3.7 Emergency Planning

108. Airport operators should develop, test, and revise emergency response plans (ERP) to minimize the impact of emergencies on the community. ERPs should address scenarios such as fires, explosions, terrorist attacks, pandemics, and extreme weather events. ERPs should be reviewed and updated following emergencies and should include: [70]

- Roles and responsibilities of involved agencies
- Emergency operations center and the command posts
- Airport rescue and emergency services
- Contact information for relevant authorities
- Maps of the airport and its immediate vicinity

109. ERPs should be coupled with a comprehensive emergency communication and training plan to support efficient and effective communication with nearby communities, as well as awareness raising and training of nearby communities. Coordination with and input from local and regional authorities, air traffic control, and relevant public emergency agencies, and first responders is essential.

68 IATA, *Combatting Human Trafficking*; ICAO, *Manual on Combating Trafficking*. These resources reflect the industry commitment to addressing human trafficking. In addition, the UN Protocol to Prevent, Suppress and Punish Trafficking in Persons, Especially Women and Children (Palermo Protocol), Article 3 states that '… "trafficking in persons" shall mean the recruitment, transportation, transfer, harbouring or receipt of persons, by means of the threat or use of force or other forms of coercion, of abduction, of fraud, of deception, of the abuse of power or of a position of vulnerability or of the giving or receiving of payments or benefits to achieve the consent of a person having control over another person, for the purpose of exploitation.'
69 EASA, *Drone Incident Management*; ICAO, *Annex 19 - Safety Management*; ICAO, *Safety Management Manual*; Interpol, *Framework for Drone Incident*.
70 ICAO, *Airport Emergency Planning 9137P7*. This resource includes guidance on the preparation of airport emergency plans, roles and responsibilities, emergency operations center, walking casualties, communication, and emergency exercises.

110. Other emergencies, such as runway overshoots, aircraft accidents during LTO and hazards such as extreme weather events, can pose significant challenges to airport safety and must be considered when emergency planning (see Section 4.3.5).[71]

111. As part of climate change risk assessment, activities should be evaluated to determine whether CHS risks may be exacerbated by climate change, and to consider adjustments to emergency preparedness and response procedures and measures for extreme weather, flooding, and extreme heat. Guidance on these issues is provided in the General EHS Guidelines.

5 PERFORMANCE INDICATORS AND MONITORING

112. This section describes relevant EHS performance indicators and industry benchmarks of GIIP for this industry sector. Indicators that are applicable across industries are available in the General EHS Guidelines.

5.1 Environmental Performance

113. Environmental monitoring programs should encompass activities with potentially significant impacts during normal operations and upset conditions. Monitoring should use direct or indirect indicators of emissions, effluents, noise, and resource use. Other parameters are described in the General EHS Guidelines. Monitoring methods including location, frequency and duration should provide representative data, follow GIIP, and include data verification processes.

114. Monitoring should be conducted by trained specialists using standard operating procedures for instrumentation deployment and retrieval, monitoring data collection and record-keeping, review, analysis and quality assurance and control (QA/QC). Monitoring equipment should be properly calibrated and maintained. Results should be analysed and reviewed regularly and compared to applicable standards to identify if corrective actions are necessary.

115. Exceedances of environmental limits should trigger a non-conformance review to identify causes and recommend changes to the operating procedures that prevent recurrence. The management plans, which are part of the management system, should be updated accordingly.

5.1.1 Resource Consumption

116. Monitoring energy consumption is necessary to identify equipment that is not commissioned for optimal operation or patterns of use that reflect inefficient operational activities or control systems. Separate metering and sub-metering are optimal for airport facilities, concessions and airlines to collect data on energy consumption. An energy audit can help an airport operator understand its energy usage and inform investments in energy efficiency technologies. The Energy Conservation section of the General EHS Guidelines describes measures to reduce overall energy consumption.

117. Monitoring of energy should also distinguish supply from the grid, renewable and alternative sources, such as hydrogen or biomass. Operational records, such as fuel consumption for ground vehicles, can also be used to monitor energy consumption and support reporting on GHG emissions and track the trend towards increasing use of renewable energy.

71 ICAO, *Rescue and Firefighting 9137P1*. This resource povides operators with requirements for fire and life safety systems.

118. Installation of water meters at strategic points throughout the airport provides disaggregated water use data to inform a water conservation strategy. Monitoring should be aligned with water performance targets and metering should also identify 'unaccounted' use to reduce water loss through leakage.

5.1.2 Air Emissions and Air Quality

119. Ambient air quality standards are typically specified within country regulations. Where ambient air quality regulations do not exist, a regional airshed approach can be used to establish acceptable emissions levels, considering if the airshed is already degraded. In airsheds where air quality parameters are above the ambient limits, specific Air Quality Management Frameworks are developed to prevent further degradation in air quality. The General EHS Guidelines provide some values for ambient air quality, and ICAO guidance is available regarding expected airport emissions, assessing airport air quality, and air quality management at airports.[72]

120. Airport operators should institute an air quality monitoring system that is proportionate to the operational capacity of the airport, the number of aircraft movements and the identified sensitive features of the surrounding environment.

121. Monitoring of ambient air quality within an airport can be done continuously using an automatic point monitoring station. This type of station provides high resolution data but requires regular servicing and trained technicians to ensure that instruments are always functional to maximize data collection and validity.

122. Air quality monitoring should include, at a minimum, pollutants expected from airport operations (see Section 4.1.2).[73]

123. When intermittent monitoring is required, a non-automatic (passive) method can be used where diffusion tubes are placed at a location for two to four weeks and subsequently sent for laboratory analysis. This requires a Standard Operating Procedure or Method Statement that describes the chain of custody to ensure the integrity of the data collection and analysis process.

5.1.3 Noise

124. Noise monitoring helps understand ambient noise levels and how these are affected by operating activities, especially changes to take-off and approach paths and aircraft types. Monitoring is usually conducted both within the airport boundary and at selected points in surrounding areas, such as local communities. This helps understand if changes in noise exposure and flight paths adversely affect nearby communities and allows for regular reviews of aircraft operations and noise abatement procedures, tracking changes in noise levels over time, and validating noise contour modelling.[74]

125. The requirements, methodology and scope of noise monitoring vary widely depending on the airport characteristics (e.g., location, current and projected air traffic, surrounding land use).[75] Airport noise monitoring can range from fixed stations as part of an integrated continuous noise and track keeping (NTK) system to portable measurements that are periodic and short-term (few weeks to months).[76]

72 ICAO, *Airport Planning Manual II*; ICAO, *Airport Air Quality Guidance*. These resources describe, respectively, emissions expected at an airport and basic elements of air quality management at airports.
73 WHO. 2021. *Global Air Quality Guidelines*; Greenhouse Gas Protocol, *GHG Corporate Accounting Standard*. These resources provide guidance on air quality standards and GHG emissions.
74 UKCAA, *Environmental Assessment Requirements 1616i*.
75 ISO, *20906:2009/Amd 1:2013 Acoustics*.
76 NTK systems collect noise and flight path information on a continual basis, usually using a network of noise monitoring terminals inside and outside the airport boundaries.

126. Permanent fixed monitoring stations may be located at each end of the runway center line and at selected points around the airport to continuously monitor noise events where a specific threshold may exceed a designated duration. Mobile noise monitoring stations may be used to undertake spot checks of noise levels at certain locations, either to confirm the data generated by the stationary monitoring stations, to check noise levels at a location where there has been an unexpected threshold exceedance or to confirm that the ambient noise levels are within specified limits.[77]

5.1.4 Effluents

127. Effluent parameters should be monitored prior to discharge to surface water bodies per the General EHS Guidelines to support compliance with ambient water quality limits per local requirements of publicly operated sewage or treatment systems or if discharged directly, per the receiving water use classification for the watershed.

128. Multiple sample sites may be required at a given airport and these sites should be made accessible under all conditions (e.g., vegetation or snow clearing may be required). This should include both underground and above ground channels that are fed by aprons, fueling compounds, runways and taxiways, hangars, oil separators, parking lots, etc. Regulations may specify the type and frequency of sampling activities and different limits for various parameters may exist based on the location of the airport or the regulatory requirements and may vary depending on the season. [78]

129. Critical drainage basins should be identified and ranked according to the likelihood of pollutant release. Consideration should be given to known volumes of released pollutants, quantities of runoff, how quickly a drainage basin will produce runoff (percent impervious surface). There are many potential receptors for stormwater runoff, the most sensitive being natural water bodies with little flow (streams, lakes, ponds, sloughs, and to a lesser extent, rivers).

5.2 Occupational Health and Safety Performance

130. Airport operators should adopt a proactive approach to occupational health and safety monitoring by using key performance indicators (KPIs) to evaluate conditions and maintain a safe, secure, and healthy work environment.[79]

5.2.1 Noise

131. Aircraft engines and ground support equipment can generate noise levels exceeding the ACGIH TLV of 85 dBA outlined in the General EHS Guidelines. As a result, airport operators should conduct baseline noise level mapping and routine monitoring in operational areas. Airport operators should implement health and safety indicators for occupational noise management, including the percentage of workers exposed to noise levels above the TLV, types of noise-related health impacts, and compliance with noise control measures.

77 The monitoring instrument should be a Type 1 Class A sound level meter that meets the international standard, or national equivalent, for instrument accuracy, performance, and calibration requirements.
78 ICAO, *Water Management at Airports*; ICAO, *Airport Planning Manual II*.
79 ICAO, *Safety Management Doc 9859;* ACGIH, *TLVs® and BEIs®*. ACGIH Threshold Limit Values (TLVs) define safe exposure limits for factors including noise, chemical agents, dust, vibration, heat and cold, serving as benchmarks to protect workplace health and safety.

5.2.2 Aviation Fuels

132. Long-term exposure to aviation fuels can harm the respiratory and nervous systems and cause serious skin irritation or dermatitis. Airport operators should identify the type of aviation fuel in use, such as Jet A-1, and make available safety data sheets specifying the Occupational Exposure Limits (OELs).[80] Airport operators should monitor worker exposure and implement health surveillance programs aligned with national guidelines.

5.2.3 Incident Reporting

133. Airport operators should implement a robust incident reporting and data management system to support prompt reporting, investigations, and corrective actions for health and safety incidents. This process should include reviewing the SMS and operating procedures to improve performance. Occupational health and safety performance should be assessed using metrics such as ground service incidents, fire incidents, runway incursions, near misses with high consequence potential (e.g., fatalities, explosions), and other work-related injuries, and compared to published statistics from regional or international organizations.[81]

80 These limits may be expressed as dermal long-term systemic effects in mg/kg/day and inhalation long-term systemic effects in mg/m^3.
81 US DOL BLS, *Fatal Occpational Injuries 2023;* EU OSHA, *Occupational Safety Health Europe;* HSE, *RIDDOR.* These resources provide statisticson work-related incidents and accidents. Also, ICAO developed a secure portal to collect information on emerging issues and operational safety risk. The provisions of Annex 13 Aircraft Accident and Incident Investigation require states to establish a mandatory occurrence reporting system to facilitate the collection of information on actual or potential safety deficiencies. Annex 13, Appendix C also provides a list of examples of serious incidents that are to be reported. e.g., bird strikes, aerodrome facility incident (fuel spillages), handling of baggage and cargo and aircraft ground handling incidents.

6 REFERENCES

ACA (Airport Carbon Accreditation). 2023. Application Manual (Issue 14). https://www.airportcarbonaccreditation.org/wp-content/uploads/2023/12/Airport-Carbon-Accreditation-Application-Manual-14-FINAL-01112023.pdf.

ACGIH (American Conference of Governmental Industrial Hygienists). n.d. *Threshold Limit Values (TLVs®) and Biological Exposure Indices (BEIs®)* https://www.acgih.org/science/tlv-bei-guidelines/.

ACI (Airports Council International). n.d. *Integration of Hydrogen Aircraft into the Air Transport System: An Airports Operations and Infrastructure Review*. https://store.aci.aero/product/integration-of-hydrogen-aircraft-into-the-air-transport-system-an-airports-operations-and-infrastructure-review/.

ACI. n.d. *Sustainability Strategy for Airports Worldwide.* https://store.aci.aero/product/sustainability-strategy-for-airports-worldwide/.

ACI. 2009. *Airport Preparedness Guidelines for Outbreaks of Communicable Disease.* https://aci.aero/wp-content/uploads/2021/08/Airport-Preparedness-Guidelines-For-Outbreaks-of-Communicable.pdf.

ACI. 2009. *Guidance Manual: Airport Greenhouse Gas Emissions Management.* https://store.aci.aero/product/guidance-manual-airport-greenhouse-gas-emissions-management/.

ACI. 2018. *Managing Operations During Construction Handbook.* First edition. https://store.aci.aero/product/managing-operations-construction-handbook-first-edition-2018/. [Available for purchase].

ACI. 2018. *Policy Brief: Airports' Resilience and Adaptation to a Changing Climate.* https://store.aci.aero/wp-content/uploads/2018/10/Policy_brief_airports_adaption_climate_change_V6_WEB.pdf.

ACI. 2019. *Managing Rescue and Firefighting Services at Airports – 1st Edition.* https://store.aci.aero/product/managing-rescue-and-firefighting-services-at-airports/. [Available for purchase].

ACI. 2020. *Aviation Operations during COVID-19 – Business Restart and Recovery (Version 2).* https://store.aci.aero/wp-content/uploads/2020/06/ACI-Airport-Operations-Business-Restart-and-Recovery-Jun-2020.pdf.

ACI. 2021. *Combatting Wildlife Trafficking Handbook.* First edition. https://store.aci.aero/product/combatting-wildlife-trafficking-handbook-first-edition-2021/?_gl=1*49w94h*_gcl_au*MTY0MjE1NTQ2My4xNzQ1MTM1NzEx.

ACI. 2022. *Policy Brief - Advanced Air Mobility: Integration into the Airport Environment. https://store.aci.aero/product/policy-brief-advanced-air-mobility-integration-into-the-airport-environment/.*

ACI. 2022. *Wildlife Hazard Management Handbook.* Third Edition. https://store.aci.aero/product/wildlife-hazard-management-handbook-third-edition-2022/. [Available for purchase].

ACI. 2023. *High-level Guidance for Developing and Costing an Airport Net Zero Roadmap.* https://store.aci.aero/product/high-level-guidance-for-developing-and-costing-an-airport-net-zero-roadmap/.

Alli, Benjamin O. 2018. *Fundamental Principles in Occupational Health and Safety.* Second edition. International Labour Organization. https://www.ilo.org/publications/fundamental-principles-occupational-health-and-safety-second-edition.

Brink M, Schäffer B, Pieren R, Wunderli JM. "Conversion between noise exposure indicators Leq24h, LDay, LEvening, LNight, Ldn and Lden: Principles and practical guidance." Int J Hyg Environ Health. 2018 Jan;221(1):54-63. doi: 10.1016/j.ijheh.2017.10.003.

Epub 2017 Oct 9.

CASA (Australian Government Civil Aviation Safety Authority). 2021. *Part 119 of Civil Aviation Safety Regulations (CASR) Australian Air Transport Operators – Certification and Management.* https://www.casa.gov.au/rules/regulatory-framework/casr/part-119-casr-australian-air-transport-operators-certification-and-management#Rulestatus.

DOI (Department of Interior). 2013. *Guidelines for Airport Sound Insulation Programs*. Washington, DC: The National Academies Press. https://doi.org/10.17226/22519.

DFS (Deutsche Flugsicherung). n.d. *How to Make Flying Quieter – Descent.* https://www.dfs.de/homepage/en/environment/aircraft-noise/continuous-descent-approach/.

EASA (European Union Aviation Safety Agency). n.d. *Aircraft Noise and Performance (ANP) Data.* https://www.easa.europa.eu/en/domains/environment/policy-support-and-research/aircraft-noise-and-performance-anp-data.

EASA. 2021. *Drone Incident Management at Aerodromes Part 1: The Challenge of Unauthorised Drones in the Surroundings of Aerodromes.* https://www.easa.europa.eu/sites/default/files/dfu/drone_incident_management_at_aerodromes_part1_website_suitable.pdf.

EASA. 2022. *Prototype Technical Specifications for the Design of VFR Vertiports for Operation with Manned VTOL-Capable Aircraft Certified in the Enhanced Category.* *https://www.easa.europa.eu/en/document-library/general-publications/prototype-technical-design-specifications-vertiports*.

ECAC (European Civil Aviation Conference). 2016. *Doc 29 4th Edition Report on Standard Method of Computing Noise Contours around Civil Airports.* https://www.ecac-ceac.org/images/documents/ECAC-Doc_29_4th_edition_Dec_2016_Volume_3_Part_1.pdf.

EEA (European Environment Agency). n.d. *Glossary*. https://www.eea.europa.eu/help/glossary/eea-glossary.

EU OSHA (European Agency for Safety and Health at Work). 2023. *Occupational Safety and Health in Europe: State and Trends 2023.* https://osha.europa.eu/sites/default/files/OSH_in_Europe_state_trends_report_2023_en.pdf.

EUROCONTROL. n.d. *IMPACT: Integrated Aircraft Noise and Emissions Modelling Platform.* https://www.eurocontrol.int/platform/integrated-aircraft-noise-and-emissions-modelling-platform.

EUROCONTROL. 2025. Specification for Airport Collaborative Decision Making (A-CDM). First Edition. EUROCONTROL-SPEC-198. https://www.eurocontrol.int/sites/default/files/2025-01/eurocontrol-specification-for-acdm.pdf.

European Union. 2014. Regulation (EU) No 598/2014 of the European Parliament and of the Council of 16 April 2014 on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Union airports within a Balanced Approach. https://eur-lex.europa.eu/eli/reg/2014/598/oj/eng.

Eurostat. n.d. *Accidents at work.* https://ec.europa.eu/eurostat/web/main/home.

FAA (Federal Aviation Administration). n.d. *Aviation Environmental Design Tool (AEDT)*. https://aedt.faa.gov/.

FAA. n.d. *Fluorine-Free Foam (F3) Transition for Aircraft Firefighting.* https://www.faa.gov/airports/airport_safety/aircraft_rescue_fire_fighting/f3_transition.

FAA. N.d. *Guide to Ground Vehicle Operations. A Comprehensive Guide to Safe Driving on the Airport Surface*. https://www.faa.gov/airports/runway_safety/publications/FAA-Guide-Ground-Vehicle-Operations.pdf.

FAA. 2009. *AC 150/5200-31C - Airport Emergency Plan (Consolidated AC includes Change 2).* *https://www.faa.gov/airports/resources/advisory_circulars/index.cfm/go/document.current/documentNumber/150_5200-31*.

FAA. 2012. *Municipal Airport Construction Safety Phasing Plan*. https://www.faa.gov/documentLibrary/media/Advisory_Circular/150_5370_2F_CSPPSample_RwySealingMarking.pdf.

FAA. 2017. *AC 150/5370-2G-Operational Safety on Airports During Construction.* https://www.faa.gov/airports/resources/advisory_circulars/index.cfm/go/document.current/documentnumber/150_5370-2.

FAA. 2018. *AC 150/5370-10H – Standard Specifications for Construction of Airports.* https://www.faa.gov/airports/resources/advisory_circulars/index.cfm/go/document.current/documentNumber/150_5370-10.

FAA. 2020. *AC 150/5200-33C – Hazardous Wildlife Attractants On Or Near Airports.* https://www.faa.gov/airports/resources/advisory_circulars/index.cfm/go/document.information/documentID/1037215.

FAA. 2022. AC 150/5000-9B - *Guidelines for Sound Insulation of Structures Exposed to Aircraft Noise.* https://www.faa.gov/documentLibrary/media/Advisory_Circular/150-5000-9B-Sound-Insulation-2022.pdf.

FAA. 2024. *AC 120-92D – Safety Management Systems for Aviation Service Providers.* https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_120-92D_FAA_Web.pdf.

FAA. 2024. *AC 150/5210-24A - Airport Foreign Object Debris (FOD) Management.* https://www.faa.gov/airports/resources/advisory_circulars/index.cfm/go/document.current/documentNumber/150_5210-24.

Greenhouse Gas Protocol (World Business Council for Sustainable Development, World Resources Institute). 2015. *The GHG Protocol Corporate Accounting and Reporting Standard.* https://ghgprotocol.org/corporate-standard.

HSE (UK Health and Safety Executive). n.d. *RIDDOR--Reporting of Injuries, Diseases and Dangerous Occurrences Regulations.* https://www.hse.gov.uk/riddor/index.htm.

HSE. n.d. *Manual Handling Assessment Charts (the MAC tool).* https://www.hse.gov.uk/msd/mac/.

HSE. n.d. *Noise at Work website.* https://www.hse.gov.uk/noise/index.htm.

HSE. 2013. *Ergonomics and Human Factors at Work.* https://www.hse.gov.uk/pubns/indg90.htm.

IATA (International Air Transport Association). n.d. *World Class Airports.* https://www.iata.org/contentassets/d1d4d535bf1c4ba695f43e9beff8294f/world-class-airports---best-practice.pdf.

IATA. 2019. *Cabin Waste Handbook.* https://www.iata.org/contentassets/821b593dd8cd4f4aa33b63ab9e35368b/iata-cabin-waste-handbook.pdf.

IATA.2020. *Safely Restarting Aviation ACI and IATA Joint Approach.* https://www.iata.org/contentassets/5c8786230ff34e2da406c72a52030e95/safely-restart-aviation-joint-aci-iata-approach.pdf.

IATA. 2022. *Airport Development Reference Manual (ADRM).* https://www.iata.org/en/publications/manuals/airport-development-reference-manual/. [Available for purchase].

IATA. 2023. *Combatting Human Trafficking: A Practical Guide for Airlines.* Second Edition. https://www.iata.org/contentassets/b24797c51f6a4b02a6b9036c49bc0b81/human-trafficking-guidelines.pdf.

IATA. 2025. *Ground Operations Manual (IGOM).* https://www.iata.org/en/publications/manuals/iata-ground-operations-manual/. [Available for purchase].

IATA. 2025. *The Dangerous Goods Regulations Manual.* https://www.iata.org/en/publications/dgr/. [Available for purchase].

ICAO (International Civil Aviation Organization). n.d. *A Focus on the Production of Renewable Energy at the Airport Site – Eco Airport Toolkit.* https://www.icao.int/environmental-protection/Documents/Energy%20at%20Airports.pdf.

ICAO. n.d. *Climate Resilient Airports.* https://www.icao.int/environmental-protection/Documents/Climate%20resilient%20airports.pdf.

ICAO. n.d. Consolidated Statement of Continuing ICAO Policies and Practices Related to Environmental Protection — General Provisions, Noise and Local Air Quality. Appendix F. https://www.icao.int/environmental-protection/Documents/Resolution_A41-20_General_provisions_noise_and_LAQ.pdf.

ICAO. n.d. *Guidelines for States Concerning the Management of Communicable Disease Posing a Serious Public Health Risk.* https://www.icao.int/safety/aviation-medicine/guidelines/AvInfluenza_guidelines.pdf.

ICAO. n.d. *Water Management at Airports.* https://www.icao.int/environmental-protection/Documents/Water%20management%20at%20airports.pdf.

ICAO. n.d. *Waste Management at Airports.* https://www.icao.int/environmental-protection/documents/waste_management_at_airports_booklet.pdf.

ICAO. n.d. Burbridge, Rachel; Deitz, Andrea. *Chapter 4: Climate Change Risk Assessment, Vulnerabilities, and Adaptation Measures.* https://www.icao.int/environmental-protection/Documents/EnvironmentalReports/2022/ENVReport2022_Art66.pdf.

ICAO. 1991. *Airport Services Manual – Part VII – Airport Emergency Planning Doc 9137P7.* Second Edition. https://store.icao.int/en/airport-services-manual-part-vii-airport-emergency-planning-doc-9137p7. [Available for purchase].

ICAO. 2008. *Guidance on the Balanced Approach to Aircraft Noise Management Doc 9829.* Second Edition. https://store.icao.int/en/guidance-on-the-balanced-approach-to-aircraft-noise-management-doc-9829. [Available for purchase].

ICAO. 2010. *Continuous Descent Operations (CDO) Manual Doc 9931. First Edition.* https://store.icao.int/en/continuous-descent-operations-cdo-manual-doc-9931. [Available for purchase].

ICAO. 2010. *Noise Abatement Procedures: Review of Research, Development and Implementation Projects Discussion of Survey Results Doc 9888. First Edition.* https://store.icao.int/en/noise-abatement-procedures-review-of-research-development-and-implementation-projects-discussion-of-survey-results-doc-9888. [Available for purchase].

ICAO. 2013. *Continuous Climb Operations (CCO) Manual Doc 9993. First Edition.* https://store.icao.int/en/continuous-climb-operations-cco-manual-doc-9993. [Available for purchase].

ICAO. 2013. *Safety Management Manual Doc 9859 AN/474.* Third edition. https://www.icao.int/SAM/Documents/2017-SSP-GUY/Doc%209859%20SMM%20Third%20edition%20en.pdf.

ICAO. 2014. *Guidance on Environmental Assessment of Proposed Air Traffic Management Operational Changes. Doc 10031*. First Edition. https://www.icao.int/publications/Documents/10031_en.pdf. [Available for purchase].

ICAO. 2015. *Airport Services Manual - Part I - Rescue and Firefighting Doc 9137P1.* Fourth Edition. https://store.icao.int/en/airport-services-manual-part-i-rescue-and-firefighting-doc-9137p1. [Available for purchase].

ICAO. 2015. *Helicopter Noise Reduction Technology Status Report.* https://www.icao.int/environmental-protection/Documents/Helicopter_Noise_Reduction_Technology_Status_Report_April_2015.pdf.

ICAO. 2016. *Annex 19 - Safety Management.* Second Edition. https://store.icao.int/en/annex-19-safety-management.

ICAO. 2016. *Working Paper Environmental Program on Helicopter Noise Mitigation by Operational Procedures*. A39-WP/156. https://www.icao.int/Meetings/a39/Documents/WP/wp_156_en.pdf.

ICAO. 2018. *Airport Planning Manual - Part II – Land Use and Environmental Doc 9184 – Part 2.* Fourth Edition. https://store.icao.int/en/airport-planning-manual-land-use-and-environmental-management-doc-9184-part-2. [Available for purchase].

ICAO. 2018. *Annex 3 to the Convention on International Civil Aviation: Meteorological Service for International Air Navigation.* 20th Edition. https://store.icao.int/en/annex-3-meteorological-service-for-international-air-navigation. [Available for purchase].

ICAO. 2018. Annex 6 to the Convention on International Civil Aviation. Operation of Aircraft. Part I — International Commercial Air Transport — Aeroplanes. Chapter 4. Eleventh Edition. https://www.icao.int/safety/CAPSCA/PublishingImages/Pages/ICAO-SARPs-(Annexes-and-PANS)/Annex%206.pdf.

ICAO. 2018. *Manual of Aircraft Ground De-icing/Anti-icing Operations Doc 9640.* Third Edition. https://store.icao.int/en/manual-of-aircraft-ground-de-icing-anti-icing-operations-doc-9640. [Available for purchase].

ICAO. 2018. *Recommended Method for Computing Noise Contours Around Airports Doc 9911.* https://store.icao.int/en/recommended-method-for-computing-noise-contours-around-airports-doc-9911. [Available for purchase].

ICAO. 2020. *Aerodrome Design Manual – Runways Doc 9157 – Part 1.* Fourth Edition. https://store.icao.int/en/aerodrome-design-manual-runways-doc-9157-part-1. [Available for purchase].

ICAO. 2020. *Airport Air Quality Guidance Manual Doc 9889.* https://www.icao.int/publications/documents/9889_cons_en.pdf.

ICAO. 2020. *Airport Economics Manual. Doc 9562.* Fourth Edition. https://data.icao.int/icads/Product/View/121.

ICAO. 2020. *Airport Services Manual - Part III - Wildlife Hazard Management Doc 9137P3.* Fifth Edition. https://store.icao.int/en/airport-services-manual-part-iii-wildlife-hazard-management-doc-9137p3.

ICAO. 2021. *Joint WCO-ICAO Guiding Principles for Pre-Loading Advance Cargo Information (PLACI).* https://www.icao.int/Security/aircargo/Documents/Joint%20WCOICAO%20Guiding%20Principles%20for%20PLACI%20EN.pdf.

ICAO. 2021. *Manual on COVID-19 Cross-Border Risk Management Guidelines Doc 10152.* Third Edition. https://www.icao.int/covid/cart/Documents/10152_manual_3rd_edition.en.pdf.

ICAO. 2022. *Annex 14. Aerodromes – Volume I – Aerodromes Design and Operations.* 9th Edition. https://store.icao.int/en/annex-14-aerodromes. [Available for purchase].

ICAO. 2023. *Airport Planning Manual – Part I – Master Planning Doc 9184 – Part 1.* https://store.icao.int/en/airport-planning-manual-master-planning-doc-9184-part-1. [Available for purchase].

ICAO. 2023. *Manual on a Comprehensive Strategy for Combating Human Trafficking in the Aviation Sector Doc 10171.* First Edition. https://www.icao.int/Security/FAL/ANNEX9/Documents/10171_cons_en.pdf.

ICAO. 2023. Manual on Operational Opportunities to Reduce Aircraft Noise Doc 10177. First Edition. https://www.icao.int/environmental-protection/pages/operational-measures.aspx.

ICAO. 2024. *Aircraft Engine Emissions Databank.* https://www.easa.europa.eu/en/domains/environment/icao-aircraft-engine-emissions-databank.

ICAO. 2024. *Annex 6 – Operation of Aircraft – Part IV – Remotely Piloted Aircraft Systems.* https://store.icao.int/en/annex-6-operation-of-aircraft-part-iv-remotely-piloted-aircraft-systems.

ICAO. 2024. Doc 10118. Global Aviation Security Plan (GASeP). Second Edition. https://www.icao.int/Security/Documents/GLOBAL%20AVIATION%20SECURITY%20PLAN%202nd%20Ed.EN.pdf.

ICAO. 2024. *Manual of All-Weather Operations Doc 9365.* Fifth Edition. https://store.icao.int/en/manual-of-all-weather-operations-doc-9365.

IFC (International Finance Corporation). 2012. *Performance Standard 6: Biodiversity Conservation and Sustainable Management tof Living Natural Resources.* https://www.ifc.org/en/insights-reports/2012/ifc-performance-standard-6.

IFC. 2017. *Good Practice Handbook. Use of Security Forces: Assessing and Managing Risks and Impacts.* s.l. : IFC. https://www.ifc.org/en/insights-reports/2017/publications-handbook-securityforces.

IFC. 2009. *Good Practice Note Addressing Grievances from Project-Affected Communities.* s.l. : IFC. https://www.ifc.org/en/insights-reports/2000/publications-gpn-grievances.

IFC. 2017. *Good Practice Note: Managing Contractors' Environmental and Social Performance*. s.l. : IFC. https://www.ifc.org/en/insights-reports/2017/publications-gpn-escontractormanagement.

IFC. EDGE Building Certification. https://edge.gbci.org/.

Interpol. 2020. *Framework for Responding to a Drone Incident For First Responders and Digital Forensics Practitioners.* https://www.interpol.int/content/download/15298/file/DFL_DroneIncident_Final_EN.pdf.

ISO (International Organization for Standardization). 2013. *ISO 20906:2009/Amd 1:2013 Acoustics – Unattended Monitoring of Aircraft Sound in the Vicinity of Airports Amendment 1.* https://www.iso.org/standard/55993.html. [Available for purchase].

ISO. 2020. *ISO 11076:2020 Aircraft – De-icing/Anti-Icing Methods on the Ground.* https://www.iso.org/standard/74304.html. [Available for purchase].

ISO. 2021. *ISO 14091:2021 Adaptation to climate change — Guidelines on vulnerability, impacts and risk.* https://www.iso.org/standard/68508.html.

Miller, N., et al. 2021. *Analysis of the neighborhood environmental survey.* Washington DC, US: HMMH Report 308520.004.001, prepared for the Federal Aviation Administration under contracts DTFACT-15-0-00008 and DTFACT-15-0-00007, 2021.

MWAA (Metropolitan Washington Airports Authority). 2019. *Construction Safety Manual.* Revision 18. https://www.mwaa.com/business/construction-safety-manual.

NFPA (National Fire Protection Association). 2022. *415 Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways.* https://www.nfpa.org/codes-and-standards/nfpa-415-standard-development/415.

NFPA. 2024. *NFPA 30 Flammable and Combustible Liquids Code.* https://www.nfpa.org/codes-and-standards/nfpa-30-standard-development/30.

SAE (Society of Automotive Engineers). 2012. *Procedure for the Calculation of Airplane Noise in the Vicinity of Airports AIR1845.* https://www.sae.org/standards/content/air1845a/.

SAE. 2021. *Aircraft Ground Deicing/Anti-Icing Processes AS6285D. https://www.sae.org/standards/content/as6285d/.* [Available for purchase].

SWA (Safe Work Australia). 2024. *Model Code of Practice: Managing Noise and Preventing Hearing Loss at Work.* https://www.safeworkaustralia.gov.au/doc/model-code-practice-managing-noise-and-preventing-hearing-loss-work.

TRB (National Academies of Sciences, Engineering, and Medicine, Transportation Research Board). 2016. *Airport Terminal Building Energy Use Intensity (ATB-EUI) Benchmarking Tool.* https://nap.nationalacademies.org/catalog/23495/methodology-to-develop-the-airport-terminal-building-energy-use-intensity-atb-eui-benchmarking-tool.

TRB. 2022. *Preparing Your Airport for Electric Aircraft and Hydrogen Technologies.* https://nap.nationalacademies.org/catalog/26512/preparing-your-airport-for-electric-aircraft-and-hydrogen-technologies.

UKCAA (UK Civil Aviation Authority). n.d. *Website on Aerodrome Safeguarding.* https://www.caa.co.uk/combined-aerodrome-safeguarding-team-cast/what-is-safeguarding/#:~:text=Public%20safety%20zones%20are%20areas,or%20fall%20short%20on%20landing.

UKCAA. 2024. *CAP 1616i Environmental Assessment Requirements and Guidance for Airspace Change Proposals.* https://www.caa.co.uk/our-work/publications/documents/content/cap1616i/.

UN (United Nations Human Rights Office of the High Commissioner). 2000. Protocol to Prevent, Suppress and Punish Trafficking in Persons Especially Women and Children, supplementing the United Nations Convention against Transnational Organized Crime (Palermo Protocol). https://www.ohchr.org/en/instruments-mechanisms/instruments/protocol-prevent-suppress-and-punish-trafficking-persons.

UNECE (UN Economic Commission for Europe). 2020. *International Fire Safety Standards: Common Principles "Safe Buildings Save Lives".* https://unece.org/fileadmin/DAM/hlm/documents/Standards/UNECE_International_Fire_Safety_Standards_October_2020.pdf.

US CDC NIOSH (US Centers for Disease Control and Prevention National Institute for Occupational Safety and Health). n.d. *Revised Lifting Equation. https://www.cdc.gov/niosh/ergonomics/about/RNLE.html.*

US CDC NIOSH. 1996. *Preventing Occupational Hearing Loss: A Practical Guide 96-110.* https://www.cdc.gov/niosh/docs/96-110/default.html.

US CDC NIOSH. 2019. *Preventing Cold-Related Illness, Injury & Death among Workers 2019-113.* https://www.cdc.gov/niosh/docs/wp-solutions/2019-113/default.html.

US CDC NIOSH. 2023. *Preventing Heat-Related Illness or Death of Outdoor Workers 2013-143.* https://www.cdc.gov/niosh/docs/wp-solutions/2013-143/default.html.

US DOE (US Department of Energy). n.d. H2 Hydrogen Tools. https://h2tools.org/about-us.

US DOL BLS (US Department of Labor Bureau of Labor Statistics). *News Release: National Census of Fatal Occpational Injuries in 2023.* s.l. : US Bureau of Labor Statistics, 2023. https://www.bls.gov/news.release/pdf/cfoi.pdf.

US DOL OSHA (Department of Labor Occupational Health and Safety Administration). 2002. *Hearing Conservation.* https://www.osha.gov/sites/default/files/publications/osha3074.pdf.

US EPA (United States Environmental Protection Agency). 2012. *Airport De-icing Effluent Guidelines.* https://www.epa.gov/eg/airport-deicing-effluent-guidelines.

USGBC (U.S. Green Building Council). n.d. *LEED V4. Reference Guide for Building Operations and Maintenance*. https://www.usgbc.org/guide/om.

WBG (World Bank Group). 2007. *EHS Guidelines for Crude Oil and Petroleum Product Terminals.* Washington, D.C.: World Bank Publications. https://www.ifc.org/content/dam/ifc/doc/2000/2007-crude-petroleum-products-terminals-ehs-guidelines-en.pdf.

WBG. 2007. *General EHS Guidelines.* Washington, D.C.: World Bank Publications. https://www.ifc.org/content/dam/ifc/doc/2000/2007-general-ehs-guidelines-en.pdf.

WBG. 2007. *General EHS Guidelines – Hazardous Materials Management, 35-45.* Washington, D.C.: World Bank Publications. https://www.ifc.org/content/dam/ifc/doc/2000/2007-general-ehs-guidelines-en.pdf.

WBG. 2007. *EHS Guidelines for Airlines.* https://www.ifc.org/content/dam/ifc/doc/2000/2007-airlines-ehs-guidelines-en.pdf.

WBG. 2007. *EHS Guidelines for Health Care Facilities*. https://www.ifc.org/content/dam/ifc/doc/2000/2007-health-care-facilities-ehs-guidelines-en.pdf.

WBG. 2007. *EHS Guidelines for Waste Management Facilities.* https://www.ifc.org/content/dam/ifc/doc/2000/2007-waste-management-facilities-ehs-guidelines-en.pdf.

WBG. 2017. *ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources.* https://thedocs.worldbank.org/en/doc/837721522762050108-0290022018/original/ESFFramework.pdf#page=81&zoom=80.

WEF (World Economic Forum). 2023. Financing the Airports of Tomorrow: A Green Transition Toolkit. https://www.weforum.org/publications/financing-the-airports-of-tomorrow-a-green-transition-toolkit/.

WHO (World Health Organization). 2005. *International Health Regulations: A Guide for Public Health Emergency Contingency Planning at Designated Points of Entry.* https://www.who.int/publications/i/item/international-health-regulations-(-2005)-a-guide-for-public-health-emergency-contingency-planning-at-designated-points-of-entry.

WHO. 2018. *Environmental Noise Guidelines for the European Region.* Copenhagen: WHO Regional Office for Europe; 2018 (https://iris.who.int/handle/10665/279952.

WHO. 2021. *Global Air Quality Guidelines.* https://www.who.int/publications/i/item/9789240034228.

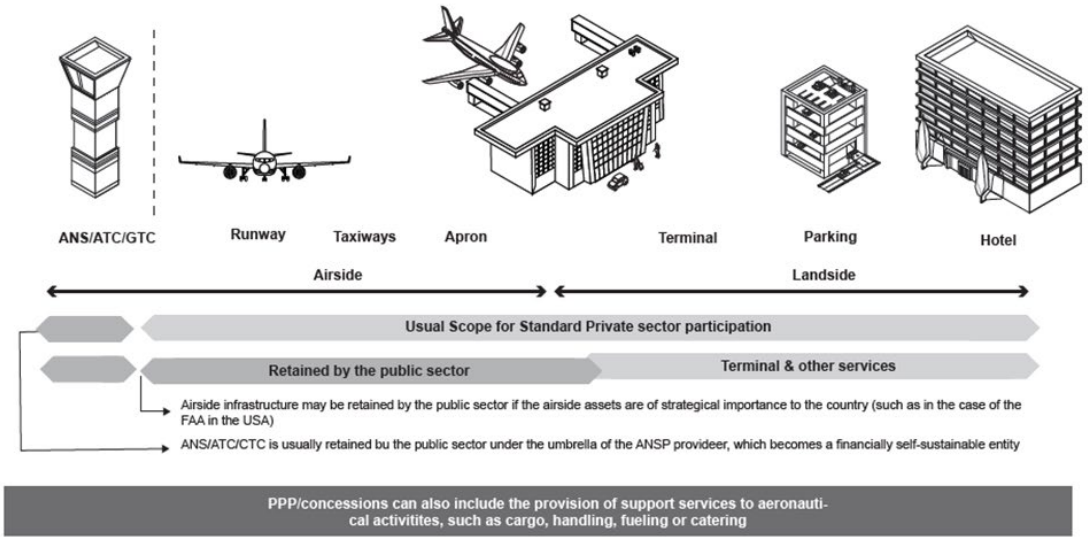
WHO. 2021. *World Report on Hearing*. https://www.who.int/publications/i/item/9789240020481.

WHO. 2022. *Compendium of WHO and other UN Guidance on Health and Environment.* https://www.who.int/tools/compendium-on-health-and-environment/environmental-noise.

7 ANNEX A: GENERAL DESCRIPTION OF INDUSTRY ACTIVITIES

134. Airports typically occupy large areas of land, with one or several runways. Airports may host commercial airlines along with other aircraft types, including air taxis, cargo, business, sport, helicopters, and military. The number and location of runways (each runway for heavy aircraft being approximately three kms long) typically determines the necessary land area requirements. For security, airports are divided into a landside and an airside area, with varying access levels. The relationship between airside and landside areas is illustrated in figure A1.

Figure A1. Airport airside and landside areas



Source: DFS, *Make Flying Quieter – Descent.*

135. Airports typically feature taxiways, aprons for passenger and cargo disembarkation and embarkation, ground handling areas, and terminal buildings. Facilities generally include air traffic control towers, airport security buildings, airline offices, aircraft maintenance companies, and cargo handling areas, depending on airport size.

136. Airport infrastructure typically includes fuel storage, facilities for heat and power supply, ground vehicle and aircraft maintenance hangers, repair and washing facilities, firefighting services, wastewater and stormwater management facilities, and waste storage. Airports are typically equipped with Instrument Landing Systems (ILS) and navigational aids like distance measuring equipment (DME) or radio beacons.[82]

137. Whether provided by the airport operator, the airline, or third-party service providers, aircraft receive a variety of services, including fuelling, waste removal, catering, luggage and cargo handling, and access to aprons. Ground services require trained personnel and specialized equipment. In cold climates, airport services may include snow and ice removal from runways, taxiways, and ramps as

82 Some airports may have additional areas outside of the airport boundaries to host ILS or radar systems.

well as aircraft de-icing and anti-icing. Electricity may be provided to aircraft through GPUs instead of APUs while passengers embark and disembark. Airports provide emergency rescue and firefighting services and air traffic control for LTO operations.

138. Aircraft may operate using Instrument Flight Rules (IFR) or Visual Flight Rules (VFR). IFR procedures, including Standard Arrival Routes (STAR) and Standard Instrument Departure (SID), vary by destination or origin of the aircraft, aircraft equipment, and certification. Table A1 outlines general features relevant to airport location, planning and design.

139. Other ancillary facilities such as hotels, medical services, subways or railways are not covered in this EHS Gudelines and should be referred to the corresponding EHS Guidelines.

Table A1. General features of airports

Typical characteristics	• An aerodrome with a demarcated runway for the landing and take-off of fixed-wing aircraft. • Associated infrastructure to facilitate the guidance and movement of aircraft between the runway and parking aprons. • Associated infrastructure to support the processing of passengers, baggage, or cargo.
Examples of common aerodrome design considerations	• Ability of the aerodrome to handle the most demanding operational performance and/or largest type of aircraft expected to use the aerodrome, including the consideration of runway length (if applicable) and wingspan clearances. Ability of associated infrastructure to process the volume of demand forecast for aircraft movements, passengers, baggage and cargo, commensurate with the minimum Level of Service (LoS) targeted by the aerodrome operator. A secure airfield boundary that prevents unauthorised persons, vehicles, animals and other objects from accessing safety critical areas. The provision of immigration and/or immigration facilities where international passengers are processed, depending on local requirements. • Ability of the airspace surrounding the aerodrome to be maintained free of either natural or human-made obstacles, which permit the safe aircraft operations to and from the aerodrome and prevent the aerodrome to become unusable by the growth of such obstacles.
Examples of specific design considerations	• Sufficient runway length to handle the expected aircraft types and their payloads to reach destinations expected to be served from the airport. • Airfield layout that supports the safe movement of aircraft between the runway(s) and parking aprons, with consideration of applicable design standards.[83] • Buildings with sufficient space and processors to handle the volume of passengers, baggage and cargo expected to use the airport. • Integration with surface access modes, including public mass transit modes for airports handling large volumes of passenger traffic. • Noise generated by aircraft using arrival and departure routes associated with the airport's runway(s), particularly in relation to sensitive areas such as residential zones or areas of natural significance. However, the airport operator may not have direct control over these routes. • Other environmental issues to be considered, such as air quality, water quality, environmental conservation areas; together with provision of sustainability measures such as net-zero policies, and the potential impact of climate change in buildings and pavements where aerodromes are impacted by the increase of the average annual temperature. • Topography of the airfield itself to ensure slopes are within recommended tolerances. • The Obstacle Limitation Surface (OLS) relative to the airport's runway(s) to ensure aircraft can operate safely without obstruction.

83 ICAO, Annex 14. Aerodromes I.

8 ANNEX B: NOISE LEVEL METRICS AND THRESHOLDS

Table B1. Noise metrics

Metric[84]	Definition	Comment
DNL (L_{dn})	A-weighted[85] day/night sound level averaged over a 24-hour period with 10 dB penalty weighting for noise events at night (i.e., between 10 pm and 7 am). Its unit is dB(A).	DNL is the standard noise metric for all US Federal Aviation Authority studies of aviation noise exposure in airport communities.
L_{den}	A-weighted noise level based on energy equivalent noise level (Leq) over a whole day with a penalty of 10 dB(A) for nighttime noise (11 pm -7:00 am) and an additional penalty of 5 dB(A) for evening noise (i.e., 7 pm -11 pm). Its unit is dB(A).	Lden is defined in EU Directive 2002/49/EC.
L_{night}, L_{day}, $L_{evening}$	A-weighted average sound level, determined over all day, evening, night periods of a year. Many jurisdictions consider 12-hour daytime periods, 4-hour evening periods, and 8-hour nighttime periods, although 16-hour day and 8-hour night periods are also common. The starting and ending hours of these periods vary depending on the jurisdiction. Its unit is dB(A).	L_{night}, L_{day}, $L_{evening}$ are used in the EU Directive 2002/49/EC and refer to the definition in ISO 1996-2: 1987
Equivalent Sound Pressure Level ($L_{eq,T}$) and $L_{Aeq,T}$	$L_{eq,T}$ is the time averaged, hypothetical steady sound, which contains the same sound energy as the actual variable sound, over a defined measurement period. Its unit is dB. $L_{Aeq,T}$ is the A-weighted version of time $L_{eq,T}$ and its unit is dB(A).	For example, $L_{eq,16h}$ is a sound pressure level equivalent in energy to a varying sound pressure level measured over a period of 16 hours.
L_{max}, Maximum Sound Level, and LA_{max}	The highest sound level measured during a single noise event (such as an aircraft takeoff) over a very short interval (e.g., 125 ms). L_{max} ignores the number and duration of these events and cannot be totaled into a one-hour or a 24-hour cumulative measure of impact. Its unit is dB. LA_{max} is the A-weighted version of Lmax and its unit is dB(A).	If used, measurements of L_{max} sound levels need to be interpreted with care since high-level short-duration sound levels can be caused by many events that are not related to air traffic noise. As it does not provide information about cumulative noise exposure (sound energy of the event), its results may not be comparable. In fact, two events with an identical maximum level may produce very different total exposures. For example, event 1 is produced by a heavy aircraft and may last for an extended period and be perceived as much more annoying than event 2 produced by a light aircraft and of a shorter duration.
NEF, Noise Exposure Forecast	A single-number quantification metric of air traffic noise used in some jurisdictions such as Australia and Canada, taking various parameters related to aircraft type and operation (loudness, frequency, duration, time of occurrence, tone, etc.) into account..	This metric can predict a community's response to aircraft noise, and it is not expressed in decibels.
L_{WECPNL}, Weighted Equivalent Continuous Perceived Noise Level	It adopts the weighted equivalent continued noise grade over one night. Its unit is dB.	L_{WECPNL} is the standard noise metric in China for noise exposure in airport communities.

84 Brink M, Schäffer B, Pieren R, Wunderli JM. "Conversion noise exposure indicators. This resource provides guidance on conversion among certain metrics.
85 EEA, *Glossary*. A-weighted decibels are decibels with the sound pressure scale adjusted to conform with the frequency response of the human ear. A sound level meter that measures A-weighted decibels has an electrical circuit that allows the meter to have the same sensitivity to sound at different frequencies as the average human ear. There are also B-weighted and C-weighted scales, but the A-weighted scale is the one most commonly used for measuring loud noise.

Table B1. Noise metrics		
Metric[84]	**Definition**	**Comment**

Table B2. Examples of noise thresholds from various jurisdictions[86]

Country	Source	Threshold for Noise Assessment	Comment
Australia	AS2021:2015	25 ANEF	Strictest limitations on residential, educational, and healthcare developments in area with 40 ANEF or higher. Limited residential development with mandatory noise insulation between 30 and 40 ANEF. Schools and hospitals may need mitigation.
Brazil	ANAC, RBAC 1	DNL 65 dB(A)	DNL 70 to 75 dB may have limited application for residential and commercial use, with required soundproofing measures. Sensitive areas (hospitals, schools) may be restricted. DNL >75 dB Strict restrictions on residential, commercial, and institutional buildings.
Canada	Canadian Aviation Regulations (SOR/96-433)	25 NEF	25<NEF<35 is the basis for zoning. New residential not recommended in NEF>30
China	GB 9660-88	70 dB(A) L_{WECPNL}	<70 dB(A) L_{WECPNL} for special residential area, residential area and area for culture and education purpose of use. Exemption for Grade I area: <75 dB(A) L_{WECPNL}
Colombia	Resolution 627 of 7th April of 2006	65 dB(A) L_{day} and 55 dB(A) L_{night}	65 dB(A) L_{day}, 7 am – 9 pm 55 dB(A) L_{night}, 9 pm – 7 am
India	MoEFCC REGD. NO. D. L.-33004/99	65 dB(A) L_{day} and 60 dB(A) L_{night}	Busy airports (more than 50,000 aircraft movements per year): 70 dB(A) L_{day}, 6 am -10 pm 65 dB(A) L_{night}, 10 pm – 6 am Non-busy airports (less than 50,000 aircraft movements per year): 65 dB(A) L_{day}, 6 am – 10 pm 60 dB(A) L_{night}, 10 pm – 6 am "The above specified limits shall have a tolerance limit of 10 dB(A) LAeq."
France	Art R 571-66 of the Environmental Code (Version in force since 1January 2016)	50 dB(A) L_{den}	Three noise zones for spatial planning purposes: Zone 1 > 70 dB(A) L_{den}, Zone 2 > 65 dB(A) L_{den} and Zone 3 > 55 dB(A) L_{den}.
Germany	German Act for Air traffic noise Protection from 2007	55 dB(A) L_{day} and 50 dB(A) L_{night}	Zone 1 (no new residential and sensitive receptors, existing buildings get compensation for insulation): L_{day} 65 dB(A) for an existing airport L_{day} 60 dB(A) for new/extended airports

86 When a jurisdiction does not have noise thresholds, airport-specific noise metrics and thresholds can be selected and justified using other jurisdictions as references. Selection of metrics and thresholds should consider specific airport conditions such as airport traffic volume, size of airport and configuration, noise receptors, zoning and land use planning.

Table B1. Noise metrics			
Metric[84]	**Definition**		**Comment**
			Zone 2 (restricted construction and use of buildings - sound insulation required, different level of compensation for insulation): L_{day} 60 dB(A) for an existing airport L_{day} 55 dB(A) for new/extended airports Zone 1 and Zone 2 (no new residential and sensitive receptors, existing buildings get compensation for insulation): L_{night} 55 dB(A) and LAmax 6 x 57 dB(A) for existing airports L_{night} 50 dB(A) and) and LAmax 6 x 53 dB(A) for new/extended airports
Malaysia	Guidelines for environmental noise limits and control (third edition 2019)	50 dB LA_{eq}	No new residential developments allowed in area with 40 NEF or higher. Malaysian guidelines present the noise threshold in dB LA_{eq} and building restriction and zoning in NEF.
Spain	Law 1367/2007 from 19th October	60 dB(A) L_{day} and 50 dB(A) L_{night}	Sectors of the territory with a predominance of soil for sanitary, teaching and cultural use that requires a special protection against noise pollution: 55 dB(A) L_{day}, 7 am – 11pm 45 dB(A) L_{night}, 11 pm – 7 am
Thailand	Environmental Quality Promotion and Conservation Act B.E. 2535 (1992)	30 NEF	Strictest limitations on residential, educational, and healthcare developments in area with 40 NEF or higher.
Turkey	Art. 20 from Law 26939	65 dB(A) L_{day}, 60 dB(A) $L_{evening}$ and 55 dB(A) L_{night}	Areas with both commercial and noise-sensitive buildings: 68 dB(A) L_{day}, 7 am – 7pm 63 dB(A) $L_{evening}$, 7 pm – 11pm 58 dB(A) L_{night}, 11 pm – 7am Areas with commercial buildings: 72 dB(A) L_{day}, 7 am – 7pm 67 dB(A) $L_{evening}$, 7 pm – 11pm 62 dB(A) L_{night}, 11 pm – 7am
United Kingdom	Cm 8584 Aviation Policy Framework	57 dB $LA_{eq,16h}$	Within 63 to 68 dB LA_{eq} new residential developments may require noise insulation. Schools and hospitals may receive government support for mitigation. Strict controls on new residential development apply above 69 dB LA_{eq} with compensation and mitigation for existing buildings.
United States	AC 150/5020-1	DNL 65 dB(A)	DNL 65 to 74 dB is incompatible with residential areas without proper soundproofing. DNL >75 dB considered unacceptable for residential, schools, hospitals, and other noise-sensitive land uses)

Table B3. Examples of noise management measures		
Balanced Approach Pillar[87]	**Examples of measures typically implemented at airports**	**Considerations**
Reduction of noise at source	Fleet renewal or retrofit with noise cancelling features	Responsibility of airlines
	Noise limits	Introduction of noise limits for specific aircraft types require support of competent authority
	Supporting airline operators flying quieter aircraft types / Discouraging airline operators flying noisier aircraft types	Main instrument for airport operators to achieve this is by differentiating the airport charges based on aircraft noise performance
Land-Use Planning and Management	Establish noise zones based on noise contours for spatial planning purposes	Implementation by local authorities/regulator
	Noise insulation schemes	Implementation by local authorities/regulator and/or airport operators
	Home relocation assistance	Implementation by local authorities/regulator, although implementation by airport operator is possible
Noise Abatement Operational Procedures	Preferred operating direction	Directed by Air Traffic Control authority or Air Navigation Service Provider (ANSP), airport operator can influence
	Preferential runways	In direct control of airport, with support of ANSP
	Runway alternation schemes	In direct control of airport, with support of ANSP
	Limiting use of reverse thrust	Limited use of reverse thrust during specific timeframes can be specified in Aeronautical Information Package (AIP)
	Single engine (N-1) taxi operations	Single engine (N-1) taxi operation preferences can be specified in AIP
	Displaced runway threshold	Displaced runway threshold can be specified in AIP
	Optimal Noise Abatement Departure Procedure (NADP)	Preferred NADP can be specified in AIP, under ANSP
	Increased use of Continuous descent arrivals/ Continuous climb operations	Implementation is mainly under control of airlines and ANSP
	Low power – low drag operations	
	(Slightly) steeper descent gradient during approach	
	Two-segment approach	
	Minimum height requirements	
	Performance Based Navigation to avoid (highly) populated areas	
	Noise preferential routes	
Operating restrictions	Restrictions on engine run-up/engine testing/APU runs	Specifically relevant for low frequency noise
	Limit use of auxiliary/ground power units and pre-conditioned air usage	
	Quota count system[88]	
	Movement cap (in general or for specific periods such as the night period)	Last resort measure

87 These noise management measures can be considered by airports to mitigate a noise problem. GIIP is to follow the pillars of the ICAO Balanced Approach when considering to implement measures: start with the measures to reduce the noise at source and if required implement additional measures from the other pillars.
88 Quota Count is a system used in to limit the amount of noise generated by aircraft movements at night time (23:30–06:00).