**Introduction**

Background. I think that an introduction is needed that links strongly to the broader aspirations of the E2E EWS for Flood Forecasting (using a Community of Practice approach) of CHy, its various pieces and that this document addresses x, y, z. So there needs to be thought and agreement on the scope of the document. Is it restricted to the templates, where it reports on the design of a number of templates used to capture the types of models and platforms used to assist in the production of flood forecasts and the provision of warnings. Will it also address the modeling criteria used to screen potential models (as mentioned below by Hwirin)? Will the document also undertake an analysis of which models and platforms are being or are most used by National Hydrological Services for the provision of flood forecasts and warning services and how these rate versus the criteria? What about the training aspects etc under the work plan, etc…

This reference guide provides an explanation of what is required in each field or item in the Evaluation Criteria and the templates (Hydrologic Model, Hydraulic, Reservoir, Platform) by the task team on interoperable technologies to advance flood forecasting as a WMO Commission for Hydrology for establishing a Community of Practice on Flood Forecasting.

Interoperability: the ability of modelling systems or software to automatically exchange and make use of information from one to another. In the context of the flood forecasting domain, this can also mean interoperability between models made by different individuals or groups, such that they can easily interface with a platform

Platform: software able to provide interoperability of modelling systems that do not possess this capability. It may also allow input of data with different formats and may provide output in a multiple of ways (graphs, tables).

Interoperable Technology promoted by this CHy initiative must be operationally used, be freely available, have low hardware requirements, be available in one of the official UN languages, have available training material, be sustainable (longevity aspect) and be institutionally supported. Such technology also should be open source and be easy to use (simplicity).

Divided two components; criteria and template

**1. Criteria**

Developinitial list of review assessment criteria

Must: Strongly to be required

Should: Important components

Could: Less important but good to have

**Must**

Operationally used (model and platform): the model or platform is actually in use any country, watershed or agency

Freely available : the model and platform software can be used free of charge. It is not considering the consultant fee or other facilities, just software itself.

Hardware requirements (low end):

Availability of training material

Institutional support

Languages training and software

Sustainability (Longevity)

Peer review or Case studies (modeling only)

Data Format (platform)

Visualization (platform)

Data QA/QC (platform)

**Should**

Open source or source is available

Updating (modeling)

Simplicity – calibration, parsimony (modeling)

Open/closed (platform)**:** open systems can easily incorporate a variety of hydrological, hydraulic and reservoir models, while closed systems are built for specific models and cannot easily add other models without undertaking complex coding

**Could**

Pre-existing CoP

Data Format (modeling):

**Criteria for “data format” for models**: To promote interoperability, the hydrological, hydraulic or reservoir model’s data structure (input/output) ***should*** be documented with the programming Application Programming Interface (API) being made freely available

**Criteria for “data format” for platforms:** To promote interoperability, the platform ***must*** allow multiple input formats (documented), ***should*** support at least one WMO format, and ***should*** document its output format with the programming Application Programming Interface (API) being made freely available.

Internet-based system (platform)

Redundancy capability (platform)

**2. Template Terminology and Definitions**

**2.1 Hydrologic Model**

**Introduction**

This reference guide is designed to provide the terms and definitions for the hydrological model template. The template includes 56 criteria that have been grouped into 7 categories. The template includes the model response for each criteria. The template also includes a short guidance comment for each criteria which is useful while reading the template. This reference guide provides an expanded description with more detail for each of the guidance comments in the template. As much as possible, the terms and definitions used in this guide are consistent with general WMO terms and definitions in operational hydrology.

It is important to recall that the hydrological model template is intended to support stream flow forecasting and flood warning operations. The criteria have been specifically selected to provide information about the hydrological model in this context. As such, the template does not include criteria that would be helpful in other contexts such as water resources assessment or dam safety evaluation. The model described in a template may be useful for additional contexts. The *Usage* criteria in the *Summary* category is the only place where the hydrological model will be mentioned for other contexts beyond stream flow forecasting and flood warning.

This reference guide can be used for multiple purposes. First, it is helpful for model users or model developers preparing a template for a specific hydrological model; the model should be described in the template according to the terms and definitions provided in this guide. Second, it is helpful for learning about the general capabilities of hydrological models commonly used for stream flow forecasting and flood warning purposes; models in the inventory have a demonstrated history of use for these purposes. Third, it is helpful for selecting one or more hydrological models by translating a user's specific requirements into selection criteria in the template; selecting a model based on local needs.

This reference guide should not be used as an instruction manual for stream flow forecasting or flood warning. For this purpose, please see WMO publication number 1072, "Manual on Flood Forecasting and Warning." Specifically, Chapter 3 in the Manual provides even more detail than this guide on the characteristics of hydrological models used for stream flow forecasting and flood warning.

**Summary Category**

Short Name: The common short name of the hydrological model. This is often an acronym.

Long Name: The complete long name of the hydrological model. This is especially important when the model has a common short name.

Model Type: There are two important ways to classify hydrological models by type: time duration and spatial discretization. Time duration describes the length of model time that can be suitably simulated. Time duration is often simplified to event and continuous. A model for continuous time duration includes all of the physical processes necessary for simulations lasting from weeks to months. An event model makes simplifying assumptions that limit applicability to simulations lasting from one day to a week. Spatial discretization describes the typical size of modeling units. Spatial disaggregation is often simplified to distributed, semi-distributed, and lumped. Distributed models use hundreds to thousands of modeling units and it is often implied the units are square and small, for example, 100m by 100m. Lumped models use a single modeling unit to represent the entire watershed. Semi-distributed models may use any one of several techniques to provide more spatial detail than lumped models but less detail than distributed models. Some semi-distributed models use multiple lumped modeling units with an explicit representation of the river network within the watershed. Other semi-distributed models provide multiple hydrologic response units (HRU) within each lumped modeling unit to better account for differences in soil properties and land cover. Other semi-distributed models use conceptual runoff techniques to improve on unit hydrograph theory without the complexity of physically-based surface runoff. While some hydrological models are designed for one time duration type and one spatial discretization type, other models are designed to operate for several types and allow the user to make a selection. List the model type for the catchment as event or continuous, and the type as distributed, semi-distributed, or lumped.

Flood Mechanisms: The flood mechanism first describes the watershed context. The watershed context may be rural where the hydrologic regime is either unchanged from natural conditions or where human activities are primarily focused on agriculture. The context may also be urban where the hydrologic regime has been heavily modified by the city development; representation of the storm water management system is often a key requirement for hydrological models in the urban context. For both the rural and urban context, the timing may be of the flash flood variety (6 hours or less) or the more general, longer variety. The flood mechanism secondly describes the type of precipitation generating the flood. A flood may be caused by rainfall, or by melting snow, or by a combination of both rainfall and melting snow.

Usage: Hydrological models can be used for flood forecasting. However, there are also many more potential uses for models. Potential uses include water resources assessment, dam safety evaluation, and floodplain regulation, among others. It can be valuable when a hydrological model can support other uses in addition to flood forecasting. List the common and successful uses of the hydrological model.

Special: Some hydrological models have unique features designed for special uses. Describe any special features that are not covered elsewhere in the template.

Background: The historical background of the hydrological model can provide important details about why it was created and how it has evolved to the present. The background can be used to list the introduction of major new features and the expansion into new usage areas. It can be used to acknowledge early contributors if the model has undergone a change in developer. Provide the key historical details that help the reader understand the significance of the hydrological model.

Developer: List the government agency, university, or company which is primarily responsible for creating and distributing the hydrological model.

**Physical Processes Category**

Channel Routing: Channel routing is the process of determining progressively timing and shape of the flood wave at successive points along a river. Channel routing is a mathematical procedure to describe the translation and attenuation of water along various points in the river. It can also reflect the inclusion of engineering modifications to the natural river such as levees or canals. The mathematical representation of routing can range from simple conceptual methods such as Muskingum or lag-and-route, up to the full Saint-Venant dynamic wave equations. Intermediate methods that conserve volume and approximate conservation of momentum, such as Muskingum-Cunge, may also be used. Describe the options available for representing channel routing.

Reservoir Operation: Reservoirs are used to store water for many purposes, including flood management. When reservoirs are present in a watershed, it is usually critical to include them in the hydrologic modelling process in order to make accurate flow forecasts. Simple reservoir operations can be represented with a hydraulic table of reservoir storage versus discharge. Complex reservoir operations may require representing individual outlet pipes and spillway gates with scheduled gate operations. Describe the options available for representing reservoirs and their operations.

Shortwave Radiation: Shortwave radiation comes from the sun and is the major source of energy to the land surface, providing the energy for many natural processes. Shortwave radiation varies with latitude and time of year. It is reduced by clouds. It is especially important for some approaches to representing evapotranspiration and snowmelt in continuous simulation, but is often ignored in event simulation. Describe the options available for representing shortwave radiation.

Longwave Radiation: Longwave radiation is the radiative energy from all natural and manmade bodies. The radiative energy is based on the temperature of the body. In hydrologic modeling, longwave radiation commonly means the radiative energy that reaches the land surface. The source of the energy is the clear sky or the clouds in the sky. It is important for some approaches to representing snowmelt. Describe the options available for representing longwave radiation.

Precipitation: Precipitation is: (1) the liquid or solid products of the condensation or sublimation of water vapor falling from clouds or deposited from air onto the ground, (2) the amount of precipitation on a unit of horizontal surface per unit time. Precipitation is the most important atmospheric variable in hydrologic modeling. The amount and timing of precipitation is critical to producing accurate flow forecasts and flood warnings. Precipitation is often categorized based on the method of observing it. Gauges, radar, and sometimes satellites, are the most common methods for quantifying precipitation. Hydrologic models may provide methods for using point data from precipitation gauges, spatial data from radar or satellites, or a combination of these. Describe the options available for representing precipitation.

Evapotranspiration: Evapotranspiration is the combined processes by which water is transferred to the atmosphere from the soil by evaporation and from the vegetation by transpiration. Evapotranspiration includes the process of water evaporating from the vegetation canopy and land surface, and the more important process of the vegetation roots extracting water from the soil. It is common to ignore evapotranspiration during event simulation. Evapotranspiration becomes very important in continuous simulation, especially for accurately predicting soil water content at the beginning of each storm event. Estimation methods may use historical data, or be based on simple models using air temperature, or use more complex approaches. Advanced models such as Penman Monteith require more data types and may provide improved estimates. Describe the options available for representing evapotranspiration.

Snowmelt: Snowmelt is (1) the transformation of snow into liquid water, and (2) water from the melting of snow. Cold climates make the analysis of precipitation more complex. In these climates, precipitation may occur as rain, snow, or a combination of rain and snow, depending on air temperature. Snowmelt covers all aspects including the accumulation of a snow pack, evolution of the pack during the winter, and melting of the pack. Rapid melting of the snow pack may elevate the risk of flooding. Conversely, precipitation as snow does not participate in runoff but in the evolution of the snow pack. Simple models for snowmelt are based only on air temperature. Energy balance models require more data types and include all of the individual sources of energy driving snowmelt. Describe the options available for representing snowmelt.

Infiltration: Infiltration is the flow of water through the soil surface into a porous medium. Infiltration is one of the most important processes in flow forecasting. When rain falls on the land surface or the snow pack melts, some of that liquid water will infiltrate into the soil. The remainder of the water will move over the land surface to river channels. If only a small fraction of the precipitation infiltrates, then more water will enter the river channels and flood risk may be elevated. Accurate infiltration estimates are a key component of accurate flow forecasts and flood warnings. Simple models may use only a constant infiltration rate while more complex models such as Green Ampt are more closely linked to detailed soil physical properties. Additionally, some infiltration models are only suitable for event simulation, such as the SCS curve number. Other infiltration models include the effect of soil drying that becomes important for continuous simulation. Describe the options available for representing infiltration.

Surface Runoff: Surface runoff describes the movement of water over the land surface to the river channel. The runoff begins as shallow sheet flow but quickly concentrates in small channels that flow into larger channels. The accuracy of representing this process becomes more important in flow forecasting when large lumped catchments are used to represent the watershed. The most common simple model of this process is the unit hydrograph. Various complex representations of surface runoff have also been developed. Describe the options available for representing surface runoff.

Base Flow: Base flow comes from groundwater, but also from lakes and glaciers, during long periods when no precipitation or snowmelt occurs. Base flow is important in watersheds dominated by groundwater contributions. Base flow may also be important in watersheds where lake seepage and glacier melt contribute. It also becomes important in continuous simulation that spans multiple storm events. Most base flow models are fairly simple. In other cases, sophisticated groundwater flow models have been used. Describe the options available for representing base flow.

**Data and Analysis Category**

Input Data: All of the mandatory data types should be listed. For example, all hydrological models require precipitation data. Many models also require air temperature. Include qualifications for the data type where appropriate. For example, continuous air temperature may be required, or daily minimum and maximum air temperature may be required. Optional data types should also be listed if they are needed when selecting optional features or algorithms to better represent physical processes (e.g., selecting Penman Monteith versus Thornthwaite equations to estimate evapotranspiration). Describe the input data and provide clarification for required versus optional data types.

Input Format: List the file format used for the input data. If the file format includes metadata that is important for understanding the format, then the metadata should also be listed. Some models use a custom text file format. A technical reference should be provided for custom text files formats.

Input Time Interval: Some hydrological models require all input data to be at the same time interval as the computation time interval. Other models allow input data at various time intervals and provide automatic temporal interpolation for computations. Daily data (e.g., minimum and maximum air temperature) may be used with a diurnal interpolation scheme. Describe the requirements for input time interval and the operation of any included interpolation schemes.

Optimization: Optimization can be used to automatically adjust model parameters on the basis of comparing model output to observations. For example, model computed flow may be compared to observed flow at a stream gauge station. Optimization algorithms typically use the difference between computed flow and observed flow to infer parameter values that improve model performance. Describe the optimization approach and any features for its use included in the model.

Model Updating: Model updating can be used to automatically adjust model state variables or computed values using observations. For example, the state variable in the soil moisture model may be adjusted using observed soil moisture. In another example, forecast flow may be continuously adjusted by comparing previous forecasts to observed flow. Describe model updating features included in the model.

Ensemble: An ensemble is a collection of plausible alternative input data. Alternatives may be quantitative precipitation estimates (QPE) before the forecast time, or quantitative precipitation forecasts (QPF) after the forecast time. When forecast lead time is longer than the QPF, past observed climate data may be used with each year of record considered a plausible alternative. Passing each alternative input series through the hydrological model can help assess uncertainty attributed to observations and forecasted meteorological products (e.g. the QPF, air temperature) but generally does not help assess uncertainty due to model structure or parameters. Some models include features specifically designed to facilitate ensemble forecasts (bootstrapping and other techniques) and may produce summary statistics of the results. Describe the ensemble features included in the model.

Uncertainty: Hydrological simulation results are subject to uncertainty resulting from imperfect knowledge, variability in space and time, and many different sources of errors. Observed atmospheric variables such as precipitation and air temperature contain measurement error, and sampling error due to the fact that they are only observed at a small number of locations in or close to a watershed. Measurement and sampling errors create uncertainty in the input data. The most complex model configurations still represent simplifications of the actual watershed conditions. Process models include structural uncertainty due to simplifying assumptions about hydrological processes and parameter identification errors due to scale issues. Process models also include parametric uncertainty reflecting the inability to specify exact values of model parameters due to finite length and uncertainties in the calibration data. All of these factors contribute uncertainty in the modeling that leads to uncertainty in the output results. (See Ammar Rafiei Emmam et al, Frontiers of Earth Science, Dec 2018, Volume 12, issue 4, pp661 and Benjamin Renard et al, Water Resources Research, vol. 46, W05521 for more information on uncertainty in hydrological modelling.) Monte Carlo simulation is one approach to addressing uncertainty but there are also other techniques such as extended Kalman filter, Generalized Likelihood Uncertainty Estimation (GLUE), Bayesian model averaging, and bootstrapping. Describe the approaches and any features for their use included in the model for representing uncertainty in input data, simulation, and output results.

Computation Time Interval: Some hydrological models can only operate at one fixed time interval (or time step). Some models allow the user to choose a time interval from available choices ranging from minutes to hourly to daily. List the time intervals or range of time intervals for which the model can undertake computation of the processes available in the model.

Model Output Time-Series: Hydrological models often produce a large variety of output data types. Model computed streamflow discharge is critical for flood forecasts. Other data types can provide detailed information about land surface processes (e.g., soil moisture fraction, basin average soil moisture, snow cover depth and water equivalence, among others). List the output data types produced by the model.

Time-Series Format: List the file format used for the output data. Describe any metadata necessary to understand the output file. A technical reference can be helpful for explaining details of the format and how the output is organized. This information is important for users planning to integrate the output with external data analysis and visualization systems.

Model Output Statistics: Hydrological models may compute statistics of the simulated output time-series. For example, maximum stream flow discharge or total volume over a specified period may be computed by the model. Statistics can provide context when compared to long-term average values (e.g., normal conditions). Statistics may make it easy to assess simulated flow as approximately normal conditions, above normal, or below normal. The availability of observed data makes it possible to compute additional statistics on model performance, such as the Nash Sutcliffe coefficient or Root Mean Square Error. List the output statistics produced by the model.

Statistics Format: Some hydrological models compute statistics directly from time-series data. Other models may store statistics as metadata with the time-series output. Some models store statistics in a separate file from the time-series data. List the file format used for the output statistics, or describe the file where the statistics can be found.

**Ease of Use Category**

Installation: Describes the degree of difficulty for installing the hydrologic model software on a computer. Difficult installations may require the source code to be manually compiled. Medium installations may require the manual use of scripts for installation and configuration. Easy installations typically use an automatic installer that obtains key information from the user through a graphical user interface and then installs and configures the software automatically.

User Education: Describes the education level recommended for users of the hydrologic model. Many hydrologic model developers recommend a university education in hydrologic science or engineering. A typical degree for these models will be a bachelor's (BSc) degree. Some models may essentially require an advanced or graduate-level university education recognized with a master (MSc) or doctorate (PhD) degree.

Degree of Difficulty: Describes the overall degree of difficulty for using the hydrologic model using a quantitative measure. Difficulty of use partially depends on the skill and experience of the user. However, difficulty of use also depends on a number of factors in the hydrologic modelling software. Software with a graphical user interface is usually easier to use than software with no interface. Models using simple physical processes may be easier to use than models with complex physical processes, even if the complex physical processes used within the model better replicate theory. Models are easy to use when they include good error checking and descriptive error messages. Models are hard to use when they require input data in non-standard formats, but can be easier to use when they accept WMO formats such as netCDF or WaterML 2.0. The degree of difficulty criteria attempts to summarize all of these qualitative factors into a numeric score from 1 (difficult to use) up to 5 (easy to use).

GIS Support: Describes the GIS support available in the hydrologic model for delineation of watersheds. A common method for delineating watersheds is to begin with a digital elevation model (DEM). Outlet points are selected. GIS algorithms determine the area that drains to each outlet point. Delineation results must be converted to the format used by the hydrologic model. GIS can also provide support for parameter estimation. For example, soil properties mapping information can be used to estimate model parameters related to infiltration. Other types of mapping information can be used for other parameters. Hydrologic models with no GIS delineation support will require original work in an external GIS tool for delineation and manual transfer of the results to the model. Some model developers have created delineation tools in conjunction with a GIS tool to automate the steps of delineation and data transfer to the model. Some hydrologic models include GIS delineation tools directly within the model.

Data Preparation: Describes the tools available for preparing input data. Most hydrologic models require input such as precipitation and air temperature, among others. These data may be either time-series or gridded. Some models require users to format data using scripts or spreadsheets. Some model developers provide utility programs for reformatting data for use with the model. Some models included data import tools directly within the hydrologic model.

Land Surface Parameters: Describes the number of parameters for the land surface. Typically land surface parameters include these categories: plant canopy for transpiration, surface storage, soil properties for infiltration, and overland runoff. A common way to count parameters is to determine which parameters are subject to calibration. Some hydrologic models only provide one physical process option for each of these categories. In this case, add up the parameters across all categories. Other models provide multiple physical process options for each category. In this case, provide a range of the number of parameters across all categories.

Parameter Estimation: Describes the tools available to help with estimating parameters from physical data. Some hydrologic models provide parameter estimation guidance in documentation, or with a database of previously used parameter values. Parameter estimation may also be performed in an external GIS tool. Some hydrologic models include parameter estimation GIS tools or links to parameter databases directly integrated within the model.

Model Calibration: Describes the tools available to help with model calibration. Some hydrologic models include semi-automatic tools to assist with calibration. Examples include graphs of observed and simulated results, graphical interface controls to quickly change parameter values and perform the simulation, or statistics for goodness-of-fit. Other hydrologic models are designed to be used with external calibration tools, for example, Model-Independent Parameter Estimation & Uncertainty Analysis (PEST). Some hydrologic models include integrated tools for automatic calibration using optimization algorithms.

Model Verification: Describes the tools available to help with model verification. Model verification is the process of testing a calibrated model with data that was not used for calibration. Verification is an important part of determining if the calibrated model works relatively well on data not used for parameter estimation (calibration), and if so, is a good sign that it is suitable for operational use. Verification may also be known as evaluating the fitness-for-purpose. The tools or metrics that assist with verification are usually similar to the tools that assist with calibration. Examples include graphs of observed and simulation results, and statistics for goodness-of-fit.

**Computing Environment Category**

Hardware Requirements: Describes the minimum hardware requirements to use the hydrological model effectively. This should be the hardware necessary to compute the hydrological model for typical watershed applications in terms of model domain and complexity. The hardware should provide reasonable performance considering that flow forecasting requires timeliness. A basic and modern desktop computer can be described simply as "PC." If the hydrological model requires a server, cloud, or other specialized hardware, then additional details should be provided in the description.

Operating System: Describes the operating systems for which the hydrological model is provided ready to use. Microsoft Windows is the most common operating system. If the model is available for Linux, then the specific distribution of Linux should be listed. Other operating systems are less common but may also be listed.

Language of Core Code: Describes the programming language used to create the core code of the hydrological model. Common languages include FORTRAN, C/C++, .Net, and Java. If the hydrological model uses mixed languages, then describe all of the languages. Some hydrological models provide the option for customization or user control using a scripting language. If this is an option, describe the scripting language.

Open Source: Describe whether the hydrological model is available as open source. If this is an option, it is helpful to provide a link to the open source license agreement. Procedures for obtaining the source code may also be provided.

Latest Update & Version: Provide the date when the hydrological model was last released. Also provide the version number that was used to label the last release.

Next Update & Version: Provide the scheduled date when the hydrological model will next be released. Also provide the version number planned for the next release. If no future release is currently planned, then this should be specified.

Active Development Community: Describe the activity of the development community. Some hydrological models have been static for several years but remain valuable tools for flow forecasting. Other hydrological models are the target of ongoing research programs and new feature development.

**Download and Documentation Category**

Download URL: Provide the location on the internet where the software may be downloaded. If the software cannot be downloaded, provide details on how the software can be obtained.

Free to Download and Use: State whether the software can be downloaded and used for free, without any charge or cost. Describe the registration process if one exists.

Language of Interface: List the language of the software user interface. Multiple languages can be listed if they are available. Hydrological models with no graphical user interface may list the language of the input files if this is relevant, or may list the language as not applicable (n/a). Priority is for the official languages of the United Nations: Arabic, Chinese, English, French, Russian, and Spanish.

Online Support URL: Provide the location on the internet where users may obtain assistance with the software. Assistance may include any of the following: frequently asked questions, community forums, telephone support, or email support. Assistance may also include a procedure for reporting an error in the software.

Training Material URL: Provide the location on the internet where the training material may be downloaded. Training material may include a wide range of resources such as videos, presentations, and example data. It is not necessary to list the individual materials.

Language of Training: List the language of the training material.

Guidance Material URL: Provide the location on the internet where the guidance material may be downloaded. One type of guidance is the user's manual. The user's manual usually focuses on the procedures and mechanisms for using the software. A second type of guidance is the technical reference manual. The technical reference manual usually focuses on the mathematical equations and algorithms implemented in the hydrological model, and the correct techniques for estimating boundary conditions, initial conditions, and parameters. A third type of guidance is the applications manual. The applications manual usually describes how to correctly use the hydrological model for a scientific or engineering study. Other types of specialized guidance may also be provided for the hydrological model.

Language of Guidance: List the language of the guidance.

References: List an article published in a scientific journal or publication that describes the technical details of the hydrological model. A conference proceeding may be substituted if no articles have been published in a journal. It is not necessary to provide a comprehensive list if multiple references are available.

**Where do we add the definitions of flash flood, urban flooding and NWP?**

**Proposed definition for Flash Flood**

Flood of short duration with a relatively high peak discharge in which the time interval between the observable causative event and the flood is less than six hours.

**Proposed definition for Urban Flooding**

Flooding that occurs in urban areas due to severe rainfall that exceeds the hydraulic capacity of the stormwater drainage system or results from the rise in elevation of a nearby body of water such as a river, lake or sea.