Natural vs. Man-made Water Bodies (Newsletter)*

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Project objectors claim that mining and energy projects cannot create "real" streams and lakes during reclamation. Regulators ask operators to respond, and too often responses are inconclusive. Delays, litigation, or expensive efforts that inadequately address those concerns can follow.

Non-ecologists might accept claims of adverse environmental impacts by man-made streams and lakes. However, when complete ecosystems are correctly characterized and classified the dynamics of natural and man-made water bodies are indistinguishable.

Streams are comparatively simple. Precipitation always flows downhill, creating new channels or directed into man-made channels. Sediments are sorted and transported by size in all channels, and benthic macroinvertebrates populate suitable upstrem habitats from perennial reaches further downstream. New man-made channels behave as natural first-order streams.

Reservoirs are interesting hybrids between flowing rivers and still lakes. The typical objection to irrigation, flood control, and hydroelectric dams (other than low-head ones) relate to migratory fish passage. Water quality of the ponded waters is infrequently a concern.

Man-made lakes begin as open-pit mines for phosphate, coal, aggregates, industrial minerals, and metals. Secondary beneficial uses, particularly in the mid-west and urban areas, include recreation and residential amenities. Gravel pits are often mined so as to leave a curved edge, shallow ledge below the rim, and a few columns in the middle that become wetlands and islands when filled with water. Residents frequently are unaware that their attractive environs once provided aggregate for roads and buildings.

Assessing a pit lake's suitability for any use should be based on the complex and highly nonlinear ecosystem that it is. This approach limits the value of numeric models because the relationships of all components, their relative importances, and other interactions are unknown and impractical to measure, thus requiring many assumptions to be made. Assessments using statistical models are based on probabilitie, not fixed values, and provide results that are technically sound and legally defensible. Because ecosystems are complex

with many unknowns one of the most powerful assessment tools is an artificial neural network (ANN).

ANNs are common and proven to solve difficult problems of pattern recognition, identification, classification, and prediction with both sparse and abundant data. In use since about 1986, ANNs are used in automated telephone answering systems that have you say your choices. Police in Westminster, CA, use an ANN to detect and map local crime patterns. ANNs guide investment decisions and combat financial fraud.

ANNs have been used to characterize and predict eutrophication in Turkish lakes and reservoirs and to quantify relationships of Portugese wolves and their habitats with little data on both. ANNs are robust tools for characterizing, classifying, and predicting lakes.

Inputs to a lake ANN can be as extensive as the available data including geomorphic, geologic, hydrologic, physical, chemical, and biological data. Output can be singular (TDS, DO, sulfate, chlorophyl-a, mercury) or multiple. Connecting inputs to outputs are hidden layers that work similar to how our brains work recognizing what we see; we don't know the exact path from eyeball to identification of the object, but experience has trained our neurons to recognize the pattern. ANNs work the same way: a portion of the availble data train the network to find the optimal weight of influence of each input on each output. A smaller portion of data validate the created model, and the final portion tests it to compare predicted and known results.

As new data are collected the model can easily be re-run to evaluate change. Since the output is based on statistical relationships of output to inputs without "best professional judgment" there is no subjectivity to be challenged. Operational and regulatory decisions can be made with confidence and minimal delays.

ANNs have been successfully applied to complex problems in the real world for almost 30 years. It is appropriate for complex environmental issues to be analysed using these proven methods for the benefit of operators, regulators, society, and the natural environment.

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