



Dr Rory Nathan

Principal Hydrologist

Qualifications

B.E.(Agr), University of Melbourne, 1980
M.Sc., D.I.C., University of London, 1984
Ph.D., University of Melbourne, 1990

Affiliations

Honorary Fellow, Dept. Civil and Environmental Engin., University of Melbourne
Honorary Fellow, Dept. Civil Engin., Monash University
Senior Member, Institution of Engineers, Australia
Floods Committee, International Committee on Large Dams (ICOLD Aust. Rep.)
Hydrology Sub-committee, NSW Dams Safety Council

Awards

National Civil Engineer of the Year, awarded by the Institution of Engineers, 2000
W.H. Warren Medal (1992, 1998, and 2005) for the best paper in Civil Engineering, IEAust.
ASCE Journal of Irrigation and Drainage Engineering Best Research Paper Award (1997)
G.N. Alexander Medal (1998) for the best paper in Hydrology and Water Resources, IEAust
Best presentation of a technical paper at the Hydrology & Water Resources Conf. (1993)
ACEA Award of Excellence for "Other Fields of Engineering" project category (1998).
Victorian Engineering Excellence Award for "Environmental Sustainability" project category (2003).

Fields of Special Competence

Dr Rory Nathan has around 25 years experience in environmental hydrology in both the academic and consulting fields. He has been actively involved in a number of research projects with the Cooperative Research Centre (CRC) for Catchment Hydrology, and is the Product Leader for delivery of a major component of the eWater CRC. While he has generally worked in areas of hydrological processes, regionalisation, and catchment hydrology, Dr Nathan has developed specific skills in the following areas:

- Characterisation of flow regimes for environmental flows
- Hydrologic estimation in ungauged catchments
- Regionalisation of hydrologic information
- Modelling and simulation of hydrologic processes
- Hydrologic model development and application
- Estimation of extreme hydrologic events (floods and low flows)

Relevant Experience

- Provision of advice to ACTEW/AGL on how to best account for climatic variability in the development of options for their future water supply options (ongoing)



- Assessment of the vulnerability to climate change and variability for the water resources of the Fitzroy River
- Provision of advice to Hunter Water on how to best characterise system performance to allow for climate variability in development of water supply agreement.
- Contracted by the U.S. Bureau of Reclamation to provide input to the development of guidelines on the characterisation of hydrologic inputs for risk analysis
- Contracted by the U.S. Army Corps of Engineers to help formulate research directions to be undertaken in the area of hydrologic risk using federal agency funding
- Development of procedure to characterise degree of ecological stress in rivers using hydrological indices (for both MDBC and DSE)
- Development of “sustainable limits of diversion” over the winterfill season for all of Victorian rivers
- Provision of a “hydrology atlas” for the Lake Eyre basin
- Assessment of the impact of farm dams on streamflow indices
- Characterisation of flow regimes in gauged and ungauged catchments for the specification of environmental water requirements in numerous catchments in south-east Australia
- Development of a procedure to South Australia Water Corporation - Development of daily, monthly, and long-term forecasts of reservoir inflows and demands to numerous sites within the South Australian headworks
- Kiewa System Forecasting - development of a computer model for the forecasting of snow-melt streamflows to a cascade of hydro-electric storages.
- Western Water - development of a streamflow forecast model for operational purposes
- Senior author of national flood guidelines on extreme flood estimation (Book VI, Australian Rainfall and Runoff)
- Expert Reviewer on a number of dam risk assessment projects (SE Queensland Water Board, Southern Rural Water, Hydro-Electric Corporation of Tasmania)
- Co-supervisor of PhD student at Monash University for research into estimating the exceedance probabilities of Probable Maximum Events
- Snowy Mountains HydroElectric Scheme - undertaking of risk calculations and assessment of hydrologic loads for input to dam risk assessment study (in association with RAC Engineers & Economists and SMEC).
- South Australia Water Corporation - undertaking of risk calculations, assessment of dam failure consequences, and assessment of hydrologic loads for input to dam risk assessment study (in association with RAC Engineers & Economists).
- Assessment of spillway adequacy and storage configuration under extreme flood events for numerous reservoirs ranging in size from small storages impounding 500 ML to large reservoirs of 4 GL capacity. Storages analysed include the Snowy Mountains HydroElectric Scheme, Lake Eildon, Lake Dartmouth, and Rocklands Reservoir.
- Sydney Water - analysis of environmental streamflow characteristics for the Hawkesbury-Nepean catchment.
- Development of a lumped conceptual model of regional water quantity and quality processes in surface and runoff and surface/subsurface interactions in the Tragowel Plains, an irrigation district located in Northern Victoria.
- Investigation of hydrologic influences causing degradation of the Yellingbo wetland area, Melbourne.
- Assessment of the impact of land use changes on water quality indices in the Goulburn River catchment.



- Derivation of a methodology for the determination of low flow environmental flows in the Thomson and Macalister catchments.
- The application of the complex physically-based SHE model to investigate water quantity and quality processes at the plot scale.
- Estimation of hydrologic inputs for numerous bulk-entitlement applications and water system simulations using catchment modelling, data transposition and extrapolation techniques, and multi-site stochastic data generation.
- Synthesis of hydrologic inputs and modelling of Lake Corangamite and associated wetlands to maximise management of both environmental and water conservation objectives.
- Computer modelling of the water quality along the Goulburn River between Lake Eildon and the Waranga basin, particularly in relation to developing dryland salinity problems.
- Compilation of a Low Flow Atlas and also an Evaporation Atlas for Victoria.
- Development of a generalised technique for the derivation of PMP temporal patterns for the Bureau of Meteorology.

Refereed Journal and Book Publications

- Nathan, R.J., T.A. McMahon, & B.L. Finlayson (1988): The impact of the greenhouse effect on catchment hydrology and storage-yield relationships in both winter and summer rainfall zones. In *Greenhouse, Planning for Climate Change*, G.I. Pearman (ed), CSIRO Publications and E.J. Brill Publishing Co., pp 273 - 295.
- Nathan, R.J. and T.A. McMahon (1990). Evaluation of automated techniques for baseflow and recession analyses. *Water Resources Research*, 26(7): 1565-1473.
- Nathan, R.J. and T.A. McMahon (1990). Practical aspects of low flow frequency analysis. *Water Resources Research*, 26(9): 2135-2141.
- Nathan, R.J. and T.A. McMahon (1990). Identification of homogeneous regions for the purposes of regionalisation. *Journal of Hydrology*, 121: 217 - 238.
- Nathan, R.J. and T.A. McMahon (1990): The SFB Model Part I - Validation of fixed model parameters. *Civil Engin. Trans., Instit. of Engin. Aust.*, CE32(3): 157-161.
- Nathan, R.J. and T.A. McMahon (1990): The SFB Model Part II - Operational Considerations *Civil Engin. Trans., Instit. of Engin. Aust.*, CE32(3): 162-166.
- Nathan, R.J. and T.A. McMahon (1991): Reply to Comment on "Evaluation of Automated Techniques for Base Flow and Recession Analyses", *Water Resources Research*, 27(7): 1783-1784.
- Nathan, R.J. and T.A. McMahon (1991): Reply to Discussion on "The SFB Model Part I - Validation of Fixed Model Parameters", *Civil Engin. Trans., Instit. of Engin. Aust.*, CE33(3): 209-212.
- Nathan, R.J. and T.A. McMahon (1991): Reply to Discussion on "The SFB Model Part II - Operational Considerations", *Civil Engin. Trans., Instit. of Engin. Aust.*, CE33(3): 217.
- Gordon, N.D., T.A. McMahon, and B.L. Finlayson (software author R.J. Nathan), (1992): *Stream Hydrology - An Introduction for Ecologists*. John Wiley & Sons, England, 526 pp.
- Nathan, R.J. (1992): The derivation of design temporal patterns for use with generalised estimates of probable maximum precipitation. *Civil engineering Transactions, I.E. Aust.* CE34(2): 139-150.
- Nathan, R.J. and T.A. McMahon (1992): Estimating low flow characteristics in ungauged catchments. *Water Resources Management*, Vol 6(3): 85-100.
- Nathan, R.J. and P.E. Weinmann (1992): Practical aspects of at-site and regional flood frequency analyses. *Civil engineering Transactions, I.E. Aust.* CE34(3): 81-88.
- Nathan, R.J. and Weinmann, P.E. (1993): *Low flow atlas for Victorian streams*, Division of Water Resources, Department of Conservation and Natural Resources, 170pp (ISBN 0 7306 3226 1).



- Dyer B., Nathan R.J., McMahon T.A., and O'Neill I.C. (1993): A cautionary note on modelling baseflow in RORB. *I.E. Aust. Civil Engin. Trans.* CE35(4): 337-340.
- Jayatilaka, C., Gillham, R., and Nathan, R.J. (1996) A deterministic-empirical model of the effect of the capillary fringe on near-stream are runoff: 2 testing and application. *J Hydrol* 184: 317-336.
- Dyer, B.G., Nathan, R.J., McMahon, T.A., O'Neill. I.C. (1996) Prediction equations for the RORB parameter Kc based on catchment similarity. *Aus J Water Resources*, 1(1): 29-38.
- Nathan, R.J. and Weinmann, P.E. (1995): The estimation of extreme floods - the need and scope for revision of our national guidelines. *Aus J Water Resources*, 1(1): 40-50.
- Nathan, R.J. and Weinmann, P.E. (1996): Reply to Discussion by Green et al.: "The estimation of extreme floods - the need and scope for revision of our national guidelines". *Aus J Water Resources*, 1(2): 106-107.
- Nathan, R.J., K. Austin, D. Crawford, and N. Jayasuriya (1996). The Estimation of Monthly Yield in Ungauged Catchments Using a Lumped Conceptual Model. *Aus J Water Resources*, 1(2): 65-75.
- Bailey, M.A., Connell, L.D. and Nathan, R.J. (1996): Accuracy of uncertainty estimation using inverse first-order reliability analysis. In *Calibration and Reliability in Groundwater Modelling*, IAHS Publication No. 237, ed K. Kovar and P. van der Heijde, pp 523-531.
- Grayson, R.B., Argent, R.M., Nathan, R.J., McMahon, T.A., and Mein, R.G. (1996): *Hydrological Recipes: Estimation Techniques in Australian Hydrology*. Cooperative Research Centre for Catchment Hydrology. (ISBN 1 876006 13 7), 125 pp.
- Mudgway, L.B., Nathan, R.J., McMahon, T.A., Malano, H.M. (1997): Estimation of salt export from high water table areas: I: identification of processes using a physically-based model. *J Irrig & Drainage Enging*, 123(2), 79-90.
- Nathan, R.J. and Mudgway, L.B. (1997): Estimation of salt export from high water table areas: II: identification of regional salt loads using a lumped conceptual model. *J Irrig & Drainage Enging*, 123(2), 91-99.
- Beverly, C.R., Nathan, R.J., Malafant, K.W., Fordham, D. (1998): Development of a simplified unsaturated module for providing recharge estimates to saturated groundwater models, *Hydrological Processes*, 13, 653-675.
- Nathan, R.J., Weinmann, P.E., and Minty, L. (1999): Estimation of the Annual Exceedance Probability of Probable Maximum Precipitation in South East Australia, *Aus J Water Resources* 3(1), 143-154.
- Nathan, R.J., Weinmann, P.E., (2000) *Book VI - Estimation of Large to Extreme Floods* in National Committee on Water Engineering (Eds) *Australian Rainfall and Runoff A Guide to Flood Estimation*. I.E. Aust. Canberra.
- Hill, P.I. Nathan, R.J., Weinmann, P.E., and Green, J.A.H. (2000): Improved estimates of hydrologic risks for dams - impacts of the new flood guidelines. *ANCOLD Bulletin* 114: 49-58.
- Connell, L.D., Jayatilaka, C.J., Nathan, R. (2001): Modelling flow and transport in irrigation catchments 2. Spatial application of subcatchment model. *Water Resources Research* 37(4), 965-977.
- Jolly, I.D., Williamson, D.R., Gilfedder, M., Walker, G., Morton, R., Robinson, G., Jones, H., Zhang, L., Dowling, T., Dyce, P., Nathan, R.J., Nandakumar, N., Clarke, R., and McNeill, V. (2001): Historical stream salinity trends and catchment salt balances in the Murray-Darling Basin, Australia. *Marine and Freshwater Research*, 52: 53-63.
- Hill, P.I., Cook, D., Nathan, R.J., Crowe, P., Green, J., Mayo, N., (2001): Development of a Comprehensive Approach to Consequence Assessment. *ANCOLD Bulletin* 117: 33 - 46.
- Letcher, R.A., Schreider, S. Yu., Jakeman, A.J., Neal, B.P. and Nathan, R.J. (2001): Methods for the analysis of trends in streamflow response due to changes in catchment condition. *Environmetrics*, 12: 613-630.



- Green, J.H., Weimann, P.E., Kuczera, G.A., Nathan R.J. and Laurenson E.M. (2002): Probabilities Of Extreme rainfall - Past, Present and Future *ANCOLD Bulletin* - Issue No. 122, 65-76
- Hill, P.I., Bowles, D.S., Nathan, R.J. and Herweymen, R. (2002): On The Art Of Event Tree Modeling For Portfolio Risk Analyses. *ANCOLD Bulletin* – Issue No. 121, 99-108.
- Nathan, R.J., Hill, P.I. and Griffith, H. (2002): Risk Implications Of The PMF and The PMP Design Flood *ANCOLD Bulletin* – Issue No. 121, 47-53.
- Nathan, R.J., Weimann, P.E. and Hill, P.I. (2002): Use Of A Monte Carlo Framework To Characterise Hydrological Risk, *ANCOLD Bulletin* - Issue No. 122, 55-64 .
- Nathan, R.J. Doeg, T., and Voorwinde, L. (2002): Towards defining sustainable limits to winter diversions in Victorian catchments. *Aust. Journal of Water Resources* 5(1): 49-60.
- Schredier, S. Yu., Jakeman, A.J., Letcher, R.A., Nathan, R.J., Neal, B.P., Beavis, S.G. (2002): Detecting changes in streamflow response to changes in non-climatic catchment conditions: farm dam development in the Murray Darling Basin, Australia. *J. Hydrol.* 262: 84-98.
- Neal, B., Nathan, R.J., Schreider, S., and Jakeman, T. (2002): Identifying the Separate Impact of Farm Dams and Land Use Changes on Catchment Yield. *Aust. Journal of Water Resources*, Vol 5(2): 165-175.
- Nathan, R.J., Rahman, A., Bagg, S., and Green, J.H. (2002): An Objective procedure for identifying regions of low flow homogeneity for the specification of environmental flows. *Aust. Journal of Water Resources* 6(1) 53-61.
- Weimann, P.E., Rahman, A., Hoang, T.M.T., Laurenson, E.M. and Nathan, R.J., (2002): Monte Carlo Simulation of Flood Frequency Curves from Rainfall – The Way Ahead. *Aust. Journal of Water Resources* 6(1) 71-79.
- Jordan, P. Nathan, R., Mittiga, L., Pearse, M., Taylor, B. (2004): Rainfall depths and temporal patterns for short duration extreme events, *ANCOLD Bulletin*, No. 126: 87-95.
- Hill, P., Bowles, D., Jordan, P. and Nathan, R. (2004): Estimating Overall Risk of Dam Failure: Practical Considerations in Combining Failure Probabilities. *ANCOLD Bulletin* - Issue No. 127, 63-72.
- Nathan, R.J. Crowe P.A., Neal B (2004): The estimation of farm dam yield in small agricultural catchments in south-eastern Australia. *Aus. J. Water Resour.* 8(1): 21-35.
- Treadwell, S.A., Shirley, M., Nathan, R.J. and Swingler, K. (2005): Modelling The Response Of Native Fish To Altered Habitat, Flow and Temperature Downstream Of Large Dams. *ANCOLD Bulletin* – Issue No. 129, 109 – 114.
- Nathan R, Jordan P, Morden R. (2005): “Assessing the Impact of Farm Dams on Streamflows, Part I: Development of Simulation Tools”. *Aust J Water Resour* 9(1), 1-12.
- Lowe L, Nathan R, Morden R (2005): “Assessing the Impact of Farm Dams on Streamflows, Part II: Regional Characterisation”. *Aus J Water Resour* 9(1), 13-26
- Jordan P, Nathan R., Mittiga L and Taylor B (2005): “Growth Curves and Temporal Patterns for Application to Short Duration Extreme Events”. *Aust J Water Resour* 9(1), 69-80.
- Lowe, L., Nathan , R. (2005): use of similarity criteria for transposing gauged streamflows to ungauged locations. *Aus J Water Resour.* 10(2): 161-170.

Conference Proceedings Publications

- Nathan, R.J. and T.A. McMahon (1988): Application of a rainfall-runoff model using synthetic rainfall data. *The Institution of Engineers, Australia, National Conference Publication* No. 88/12, pp 302-306.
- Jayasuriya, L.N.N., I.C. O’Niell, T.A. McMahon, and R.J. Nathan (1988): Parameter uncertainty in rainfall-runoff modelling. *The Institution of Engineers, Australia, National Conference Publication* No. 88/12, pp 292-296.

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- McMahon, T.A., R.J. Nathan, B.L. Finlayson, and A.T. Haines (1988): Reservoir system performance and climatic change. In: G.C. Dandy and A.R. Simpson (Eds.) *Proc. of the National Workshop on Planning and Management of Water Resource Systems: Risk and Reliability*, Aust. Water Resources Council Conf. Series No. 17 (AGPS, Canberra), pp 106-123.
- Nathan, R.J., K.C. Gan, N. Jayasuriya, T.A. McMahon, and I.C. O'Neill (1988): Preliminary analyses of low flow characteristics of ungauged catchments. *Proc. International Seminar on Hydrology of Extremes (Floods and Low Flows)*, Rorkee, India, pp 315 - 330.
- Nathan, R.J. and T.A. McMahon (1989): Evaluation of baseflow and recession analyses. *The Institution of Engineers, Australia, National Conference Publication No. 89/19*, pp 38 - 42.
- Nathan, R.J., G.A. Adams, and T.A. McMahon (1989): A case study of multi-site data generation applied to long term lake simulation. *The Institution of Engineers, Australia, National Conference Publication No. 89/19*, pp 48 - 52.
- Nathan, R.J. and T.A. McMahon (1990). Validation of the fixed parameters of the SFB model. *Instit. of Engin. Aust. Conf. on Agric. Eng.:* 279 - 283.
- Loh, M., I.C. O'Neill, T.A. McMahon, R.J. Nathan, and H.R. Graze (1990): Determining the long term operating policies of a reservoir system using the computer program HEC-5. *Instit. of Engin. Aust. Conf. on Agric. Eng.:* 261 - 265.
- Nathan, R.J. and T.A. McMahon (1991): Overview of a systems approach to the prediction of low flow characteristics in ungauged catchments. *International Hydrology and Water resources Symposium 1991, Perth, 2-4 October 1991 Volume 1. Institution of Engineers National Conference Publication No. 91/19:* 187-192.
- Nathan, R.J. and P.E. Weinmann (1991): Application of at-site regional flood frequency analyses. *International Hydrology and Water Resources Symposium 1991, Perth, 2-4 October 1991 Volume 3. Institution of Engineers National Conference Publication No. 91/19:* 769-774.
- Dyer, B., R.J. Nathan, T.A. McMahon, and I.C. O'Neill (1992): Regional relationships for the RORB model: a need for understanding. *Conference on Engineering in Agriculture*, Albury: 79-83.
- Mudgway, L., R.J. Nathan, T.A. McMahon, and H.M. Malano (1992): Data requirements and modelling strategy for application of the SHE model to an irrigation area. *Conference on Engineering in Agriculture*, Albury: 27-32.
- Grayson, R.B. and Nathan, R.J. (1993): On the role of physically based models in engineering hydrology. *Watercomp, I.E.Aust. National Conf. Publ. No. 93/2*, 45-50.
- Nathan, R.J. (1993): A lumped conceptual model for the prediction of regional salt loads from irrigated catchments. *Engineering for Hydrology and Water Resources Conference, Newcastle., I.E. Aust. National Conf. Publ. No. 93/14*, 451-456.
- Nathan, R.J. (1993): On the assessment of hydrologic similarity for the transposition of hydrologic indices. *Engineering for Hydrology and Water Resources Conference, Newcastle, I.E. Aust. National Conf. Publ. No. 93/14*, 93-98.
- Dyer B., Nathan R.J., McMahon T.A., and O'Neill I.C. (1993): Towards regionalisation of the RORB parameters. *Engineering for Hydrology and Water Resources Conference, Newcastle., I.E. Aust. National Conf. Publ. No. 93/14*, 133-139.
- Nathan, R.J., Weinmann, P.E., and Gato, S (1994): A quick method for estimation of the probable maximum flood in southe-east Australia. *International Hydrology and Water Resources Symposium: Water Down Under, November, Adelaide, I.E. Aust. Natl. Conf. Publ. No. /94*, 229-234.
- Jayasuriya, L.N.N., McMahon, T.A., O'Neill, I.C., Nathan, R.J. (1994): A methodology for estimating streamflow yield from small rural ungauged catchments. *International Hydrology and Water Resources Symposium: Water Down Under, November, Adelaide, I.E. Aust. Natl. Conf. Publ. No. /94*, 33-38.



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- Weinmann, P.E. and Nathan, R.J. (1994): Assessing spillway adequacy - a continuing challenge for hydrologists. *International Hydrology and Water Resources Symposium: Water Down Under, November, Adelaide, I.E. Aust. Natl. Conf. Publ. No. 194*, 271-277.
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- Nathan, R.J. and Erlanger, P.D. (1996): Development of a drought forecasting procedure to aid water supply management, *23rd Hydrology and Water Resources Symposium: Hobart Tasmania, May 1996*, 615-621.
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- Proceedings 2nd International Conference on Multiple Objective Decision Support Systems for Land, Water, and Environmental Management (MODSS99), 1-6 August 1999, Brisbane Australia.
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 - Crowe P, Nathan, R.J., Hill, P.I. (2000): Development of prediction equations for estimating catchment yield from farm dams. *Xth World Water Congress, Melbourne 2000, Paper# 285.*
 - Nathan R, Hill, P.I., Nandakumar, N., Croke, J., Hairsine, P., Vertessy, R., Cornish, P. (2000): Assessment of the impact of forest logging on water quantity and quality. *Xth World Water Congress, Melbourne 2000, Paper# 289.*
 - Nandakumar, N. Weinmann, P.E., Mein, R.G., and Nathan, R.J. (2000): Estimation of Spatial dependence for the CRC-FORGE method. Proc., Hydro 2000, 3rd International Hydrology and Water Resources Symposium, IE Aust, pp 553-563.
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 - Daamen, C., Hill, P.I., Munday, S., Nathan, R., and Cornish, P. (2001): Assessment of the impact of forest logging on water quantity in the Otway Ranges. In Ghassemi et al (eds.) *Proc Intern Congress on Modelling and Simulation (MODSIM 2001)*, Australian National University, December 2001, 443-448.
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 - Nathan, R.J., P.I. Hill, P.I., and Griffith, H. (2001): Risk implications of the PMF and the PMP Design Flood. Proceedings ANCOLD conference, Auckland, New Zealand.
 - Hill, P.I. D.S. Bowles, R.J. Nathan, R. Herweynen (2001): On the art of event tree modelling for portfolio risk analyses. Proceedings ANCOLD conference, Auckland, New Zealand.
 - Zou, S., Srikanthan, R., McMahon T.A., Wang, Q.J. and Nathan, R.J. (2002): Stochastic modelling of daily rainfall. Proc., 27th Hydrology and Water Resources Symposium, I.E.Aust, ISBN 0858257785.
 - Green, J., Weinmann, E., Laurenson, E., Nathan, R., Kuczera (2002): Estimation of storm arrival probabilities in the GSAM Inland Zone – storm data evaluation. Proc., 27th Hydrology and Water Resources Symposium, I.E.Aust, ISBN 0858257785.
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