Australian Government
Australian Research Council

EI 2018 ENGAGEMENT AND IMPACT

Engagement and Impact 2018

Western Sydney University

WSU05 (HLS) - Impact

Overview

Title

(Title of the impact study)

Addressing aquatic ecosystem pollution from underground coal mines

Unit of Assessment

05 - Environmental Sciences

Additional FoR codes

(Identify up to two additional two-digit FoRs that relate to the overall content of the impact study.)

04 - Earth Sciences

06 - Biological Sciences

Socio-Economic Objective (SEO) Codes

(Choose from the list of two-digit SEO codes that are relevant to the impact study.)

96 - Environment

Australian and New Zealand Standard Industrial Classification (ANZSIC) Codes

(Choose from the list of two-digit ANZSIC codes that are relevant to the impact study.)

06 - Coal Mining

Keywords

(List up to 10 keywords related to the impact described in Part A.)

Coal mine

Environmental regulation

Water quality

Aquatic life

Sustainability

Pollution control

Biodiversity

Sensitivities

Commercially sensitive

Yes

Culturally sensitive

Sensitivities description

(Please describe any sensitivities in relation to the impact study that need to be considered, including any particular instructions for ARC staff or assessors, or for the impact study to be made publicly available after EI 2018.)

Given the sensitive nature of this topic for coal miners, details of jobs created and costs of the new treatment plant (South 32 - West Cliff Colliery), are not available

Aboriginal and Torres Strait Islander research flag

(Is this impact study associated with Aboriginal and Torres Strait Islander content?
NOTE - institutions may identify impact studies where the impact, associated research and/or approach to impact relates to Aboriginal and Torres Strait Islander peoples, nations, communities, language, place, culture and knowledges and/or is undertaken with Aboriginal and Torres Strait Islander peoples, nations, and/or communities.)

No

Science and Research Priorities

(Does this impact study fall within one or more of the Science and Research Priorities?)

Yes

Science and	**Practical Research Challenge**

Research Priority	
Environmental change	Improved accuracy and precision in predicting and measuring the impact of environmental changes caused by climate and local factors.
Environmental change	Options for responding and adapting to the impacts of environmental change on biological systems, urban and rural communities and industry.

Impact

Summary of the impact

(Briefly describe the specific impact in simple, clear English. This will enable the general community to understand the impact of the research.)

Environmental research by Western Sydney University (WSU) found that waste water from coal mines in the Sydney Basin was polluting rivers and streams in drinking water catchment areas, national parks and wilderness regions, and that environmental regulations were ineffective in preventing it. The impetus to this research came from community tip offs to the lead researcher regarding river water pollution issues (given the researchers' profile in community). As a result NSW Environment Protection Authority (EPA) introduced more stringent licence conditions for mines; mine owners upgraded their wastewater treatment technologies; water quality and ecological health of several aquatic systems recovered; and once-strained relations between mining companies and local communities improved.

Beneficiaries

(List up to 10 beneficiaries related to the impact study)

Australian coal industry (such as South 32 Illawarra Metallurgical Coal; Centennial Coal; Boral)

Local employment by Westcliff Colliery (South 32) and Clarence Colliery (Centennial Coal).

National Parks Association; Colong Foundation for Wilderness; Blue Mountains Conservation Society; Sustainable Southern Highlands group)

Georges River Combined Councils Committee

NSW Environment Protection Authority (EPA) and NSW Department of Industry (Resources and Energy) and NSW Office of Environment and Heritage (OEH)

Australian tax payers from economic contribution of the coal mines (Illawarra steel making industry, electricity generation and exports of coal)

Consumers of Sydney's drinking water supply

Countries in which the impact occurred

(Search the list of countries and add as many as relate to the location of the impact)

Australia

Details of the impact

(Provide a narrative that clearly outlines the research impact. The narrative should explain the relationship between the associated research and the impact. It should also identify the contribution the research has made beyond academia, including:
- who or what has benefitted from the results of the research (this should identify relevant research end-users, or beneficiaries from industry, the community, government, wider public etc.)
- the nature or type of impact and how the research made a social, economic, cultural, and/or environmental impact
- the extent of the impact (with specific references to appropriate evidence, such as cost-benefit-analysis, quantity of those affected, reported benefits etc.)
- the dates and time period in which the impact occurred.

NOTE - the narrative must describe only impact that has occurred within the reference period, and must not make aspirational claims.)

WSU Environmental scientists investigated the geochemical and ecological impacts on rivers and streams of wastewater discharges from coal mines in the Sydney Basin (2003-2016). Most mines were located in environmentally sensitive locations (drinking water catchment areas, national parks and wilderness regions). The researchers' evidence of water pollution and ineffectiveness of environmental regulations led NSW EPA to introduce stringent licence conditions for mines, prompting mine owners to upgrade their wastewater treatment technologies and practices. Consequently the water quality and ecological health of several aquatic systems recovered. There were social ramifications: more stringent regulations led to higher levels of community acceptance of coal mining.

WEST CLIFF COLLIERY, DHARAWAL STATE CONSERVATION AREA
In 2010, WSU research investigated the effects of West Cliff Colliery's daily wastewater discharges into the Georges River. By 2012 they had demonstrated the discharge was directly responsible for increasing the river's salinity (by 592%) to a level three times higher than that stipulated in Australian water quality guidelines for protecting aquatic ecosystems; increasing the concentrations of aluminium (by 310%), zinc (by 247%) and copper (by 96%) to levels exceeding water quality guidelines for river flora and fauna species; and for damaging the river ecosystem and depleting populations of sensitive freshwater macroinvertebrates such as mayflies, caddisflies and stoneflies. The research demonstrated that EPA regulation of the mine's wastewater discharge was ineffective. EPA Licence issued to the mine specified discharge limits on only three pollutants/pollutant indicators: pH, suspended sediment, and oil/grease. But the researchers found that these pollutants were unlikely to be ecologically hazardous, whereas the pollutants of greatest concern (salinity, aluminium, zinc, and copper) had no discharge limits placed on them by the licence. West Cliff Colliery was under no obligation to treat its wastewater for these contaminants.

Two local community groups took the case of Westcliff Colliery to court and WSU expert witness evidence was the basis for the case documenting the water pollution in a landmark NSW Land and Environment Court Case in 2012. Following widespread media coverage, a NSW Environment Minister intervened and, EPA conducted its own investigation. The results concurred with those reported by WSU research. In 2013, EPA issued the mine with an amended licence that included discharge limits for additional pollutants. This was the most stringent EPA licence ever issued to a coal mine in NSW, and created a precedent for the industry. The Macarthur Bushwalking and Cycling Club expressed their appreciation of WSU's work: "We are very thankful for Ian Wright's research which prompted the EPA to take action to reduce water pollution of the Georges River from the Westcliff Colliery".

To comply with the amended licence, South 32 - Westcliff Colliery owner, invested in a state-of-the-art wastewater treatment plant servicing West Cliff Colliery and the company's other mines in the area. The treatment plant ensured South 32 met its regulatory obligations, created new jobs and improved community acceptance of coal-mining operations in the area.

The amended EPA licence requires South 32 to collect data on contaminants in West Cliff Colliery's wastewater and on water quality in the Georges River, and report the results publicly. The results show substantial reductions in mean concentrations of contaminants from 2012/2013 to 2016: salinity (by 68.3%), aluminium (by 9.7%), copper (by 56.6%), lead (by 43.9%), zinc (by 39.9%), arsenic (by 52%), and nitrogen (by 68.3%). Due to improvements in Georges River water quality, by end 2016 macroinvertebrates started returning to previously contaminated sections of the river. NSW EPA's Chief Environmental Regulator and two Regional Directors in a combined statement said: "Western Sydney University's input, particularly that of Dr Ian Wright was vitally important to achieving this outcome".

CLARENCE COLLIERY, GREATER BLUE MOUNTAINS WORLD HERITAGE AREA
In 2012, WSU research investigated the Clarence Colliery and found contaminated wastewater from the mine was significantly damaging the ecological health of at least 22 kms of the Wollangambe River, with elevated concentrations of metals and salinity and thermal pollution. EPA licence regulating the Colliery had major

inadequacies and failed to include environmentally effective discharge limits for key pollutants. The research triggered an EPA investigation that confirmed WSU findings, resulting in substantial amendment of the colliery's licence. The colliery implemented major upgrades to its water treatment system. As commented by a community member: "Great work collecting all this long-term data. Hopefully the Wollangambe acts as a precedent and we are able to prevent such tragedies before they occur in the future."

LEGACY OF CLOSED MINES CANYON & BERRIMA COLLIERIES
The Canyon Colliery ceased operating in 1997. In 2003, WSU's research showed contaminated groundwater continued to escape from the mine's flooded underground workings, causing substantial ecological damage to the Grose River in the Greater Blue Mountains World Heritage Area. The researchers alerted NSW EPA and NSW Department of Industry to the serious environmental problems that can unfold long after a coal mine closes, and both regulators resolved to avoid similar environmental legacies in the future. So, when the Berrima Colliery was due to shut down in 2013, the EPA invited WSU to investigate and advice on the closure process. The researchers reported that concentrations of metals in the groundwater were entering the Wingecarribee River which supplies Warragamba Dam, Sydney's main water supply catchment. Corrective action was consequently taken by the mine's owner and NSW regulators.

Associated research

(Briefly describe the research that led to the impact presented for the UoA. The research must meet the definition of research in Section 1.9 of the EI 2018 Submission Guidelines. The description should include details of:
- what was researched
- when the research occurred
- who conducted the research and what is the association with the institution)

The Environmental Science Water Pollution research team led by Dr Ian Wright investigated the impact of coal mine wastewater discharges on the geochemistry and ecology of rivers and streams in the Sydney Basin. This involved studies on 5 mines (4 discussed above, plus the Tahmmoor Colliery) between 2003 and 2016.

The research involved novel scientific studies on different facets of river pollution and ecological damage. The research team was developed through the involvement of: WSU Post-doctoral researcher, Dr Wallwood, who investigated sampling and analysis methodologies for measuring the river ecological response to water pollution from mining and industrial pollution. Dr Wallwood had also done a Master of Science research on the topic of organic and industrial water pollution on freshwater ecosystems through WSU.

Honours research by Sullivan investigated the impact of different levels of heavy-metal and geochemical pollution on freshwater ecosystems. The issue of chemical and ecological pollution from closed and active coal mines was examined by HDR student Price's honours research in 2015.

The research on the Berrima Colliery, detailed in Section 4 (first documented case in Australia of acceleration in water pollution from a closed coal mine) produced the most detailed time-series data ever collected from an Australian underground coal mine, showing the progressive deterioration of water quality after the coal mine had been closed.

FoR of associated research

(Up to three two-digit FoRs that best describe the associated research)

05 - Environmental Sciences

References (up to 10 references, 350 characters per reference)

(This section should include a list of up to 10 of the most relevant research outputs associated with the impact)

1.Price P, Wright I, 2016, Water quality impact from the discharge of coal mine wastes to receiving streams: comparison of impacts from an active mine with a closed mine, Water Air and Soil Pollution, vol 227, no 5, [ORS ID: 241768]

2.Wright I, Ryan M, 2016, Impact of mining and industrial pollution on stream macroinvertebrates: importance of taxonomic resolution, water geochemistry and EPT indices for impact detection, Hydrobiologia, vol 772, no 1, pp 103-115, [ORS ID: 240541]

3.Wright I, McCarthy B, Belmer N, Price P, 2015, Subsidence from an underground coal mine and mine wastewater discharge cause sing water pollution and degradation of aquatic ecosystems, Water, Air, and Soil Pollution, vol 226, no 10, [ORS ID: 239437]

4.Sullivan, R., Wright, I.A., et al. (2014) The assessment of impacts from mining wastes on water quality and aquatic ecosystems using freshwater macroinvertebrate communities and novel bio-assay tests, in Viets, G; Rutherfurd, I.D, and Hughes, R. (ed), Proceedings of the 7th Australian Stream Management Conference, Townsville, p. 369-376.

5.Belmer N, Tippler C, Davies P, Wright I, 2014, Impact of a coal mine waste discharge on water quality and aquatic ecosystems in the Blue Mountains World Heritage area, Australian Stream Management Conference, pp 385-391, [ORS ID: 235376]

6.Graham K, Wright I, 2012, The potential and reality of the environment protection licensing system in New South Wales : the case of water pollution, Environmental and Planning Law Journal, vol 29, no 5, pp 359-372, [ORS ID: 227409]

7.Wright I, 2012, Coal mine 'dewatering' of saline wastewater into NSW streams and rivers : a growing headache for water pollution regulators, Australian Stream Management Conference, pp 206-213, [ORS ID: 232005]

8.Wright I, Wright S, Graham K, Burgin S, 2011, Environmental protection and management: A water pollution case study within the Greater Blue Mountains World Heritage Area, Australia, Land Use Policy, vol 28, no 1, pp 353-360, [ORS ID: 217976]

9.Wright I, Burgin S, 2009, Comparison of sewage and coal-mine wastes on stream macroinvertebrates within an otherwise clean upland catchment, South-eastern Australia, Journal of Water, Air and Soil Pollution, vol 204, no 40634, pp 227-241, [ORS ID: 212025]

10.Wright I, Burgin S, 2009, Effects of organic and heavy metal pollution on chironomids within a pristine upland catchment, Hydrobiologia, vol 635, no 1, pp 15-25, [ORS ID: 210989]

Additional impact indicator information

Additional impact indicator information

(Provide information about any indicators not captured above that are relevant to the impact study, for example return on investment, jobs created, improvements in quality of life years (QALYs). Additional indicators should be quantitative in nature and include:
- name of indicator (100 characters)
- data for indicator (200 characters)
- brief description of indicator and how it is calculated (300 characters).)