

# Technical Manager's Report

May 2018

## **General Introduction**

Several key activities and deliverables were completed since the November meetings in Banff. Most important was the announcement of the first winners of the Best Management Practice Award to both Kinross and Rio Tinto. And the Global Cover Design Guidance Document was completed and is now available on the website and this after several more iterations. The Zoom platform was confirmed for the webinars series and INAP will start offering webinars starting in June. Tiered membership documentation was completed and INAP welcomed two new members in that category – Detour Gold and Lundin Mining. Project planning is in full discussion and INAP will have some new projects in 2018. SMI-ICE Chile was formerly welcomed in INAP as the new Global Alliance member for South America and a successful introductory workshop was held on May 9 in Santiago with more than 80 people in attendance. And congratulations to SMI Australia for a successful AMD Workshop that took place in Burnie in November.

## **INAP Op Com Meeting**

The November meeting was held in Banff, Alberta on November 8 and 9, 2017 following the Tailings and Mine Waste 2017 Conference. The first half-day, November 8, was a general discussion on INAP followed by a special presentation by Klohn Crippen Berger on the influence of geochemistry on dam materials. Key discussions from the November 9 Op Com meeting included finalizing the wording for the attributes that shows the value of INAP to its members, the official announcement of the winners for the Best Management Practice Award. The selection committee also presented their findings from the first round of evaluations and recommended that two awards be presented, one for a mining site and a second for the corporate level. This was later approved. Discussions were also had on the project priorities for 2018. The Board Meeting followed that same day.

## **INAP Australia**

INAP Australia continues to be quite active under the leadership of Dr. Bruce Kelley. The 9th Australian AMD Workshop was one of the main activities in Australia during the reporting period. INAP was well represented at the AMD workshop. An INAP Australia Members meeting and a network meeting were held in Perth the week after the workshop. Excellent discussion on possible future INAP project areas were held. The Technical Manager attended both the workshop and meetings and a trip report, by Gilles and Bruce, was produced and distributed to the members in February.

Bruce is also a member of the selection committee for INAP's Best Practice Award and has been working with the Technical Manager and SMI on finalizing the selection of the platform for INAP's Webinar series. He also met with SMI in January to discuss their ongoing role as INAP's Global Alliance partner for Australia and has been involved in discussions regarding the 2021 ICARD bidding process. Bruce has continued to maintain contact with David Mulligan regarding

the SMI-ICE-Chile in Santiago and has supported the efforts of the Technical Manager in his trip to Chile in May in establishing the South American Network on Acid Prevention (SANAP) as part of INAP's Global Alliance. The next INAP Op Com and Board meetings are planned for Perth in May and Bruce is very much part of the preparations for these meetings and technical workshop. He also continues to have regular interactions with the Technical Manager including phone calls on an as needed basis.

### **Global Alliance:**

**ADTI-MMS:** Monthly telephone meetings were held and an update on INAP activities was provided when I was available to be on the call. Key activities for the reporting period include the following.

- Geochemical Handbook now available. Volume 6 of the Series: ADTI-MMS/SME Management Technologies for Metal Mining Influenced Water: Geochemical Modeling for Mine Site Characterization and Remediation Modeling Workbook - Management Technologies for Metal Mining Influenced Water is now available via SME Bookstore. As for past ADTI workbooks, INAP has agreed to fund the purchase of hard or electronic copies for the reviewers as a thank you for their efforts. David Williams and Andrew Nicholson are coordinating this purchase and will inform INAP when this is done.
- 2018 Annual SME Conference – Minneapolis, February. ADTI-MMS hosted two environmental sessions. Devin Castendyk (Golder) hosted a session on Geochemical Modeling which included two presentations of the new ADTI-MMS Modeling volume, David Williams (BLM) and Linda Figueroa (Colorado School of Mines) hosted a session on Climate Change and Reclamation Modeling. The ADTI-MMS group also met for their annual face to face get together. Topics discussed included possible updates to the Mine Influenced Water volumes and what might work best, the upcoming 2018 ICARD, ADTI-MMS sessions ideas for the 2019 SME Conference in Denver and the 2021 ICARD in Central America.
- The Acid Drainage Technology Initiative - Metal Mining Sector (ADTI-MMS) are continuously updating their website <http://community.smenet.org/adti-mms/home?ssopc=1>.

**IMWA (PADRE):** All of IMWA's effort since the completion of IMWA 2017 in Finland in June 2017 has been the preparation of ICARD-IMWA 2018 which is covered in a separate heading. As a reminder, the proceedings for all IMWA conferences, are available from the IMWA web site at [www.IMWA.info/proceedings](http://www.IMWA.info/proceedings).

**MEND:** The report titled "*Study of Tailings Management Technologies*" (MEND 2.50.1) was released in November 2017 and is available from the MEND Website ([mend-nedem.org](http://mend-nedem.org)). The study examined and compared alternatives to conventional slurry for the management of tailings (e.g., thickened, paste and filtered tailings). Strengths, limitations and risk were considered across the entire life-cycle of tailings facilities, from design and construction through to long-term post-closure.

A draft of the “*Literature Review of Biological Effects of Sub-Aqueous Disposal of Reactive Mine Tailings*” was recently completed and the final report is expected to be released in Q2 2018. The project will provide guidance for future field studies into the biology and ecology of subaqueous tailings disposal.

The 24th Annual BC-MEND ML/ARD Workshop was held on November 29 and 30th in Vancouver, attracting over 200 participants to learn from case studies and technical presentations from leading practitioners. The topics for the 2017 event were tailings modification and mitigation, drainage treatment and prediction of drainage chemistry with a focus on new developments in Ontario and Quebec. Presentations also covered long-term performance in a changing climate and how genomics can innovate mining environmental management. The workshop consisted of twenty-four presentations and included issues at mine sites in Sweden, United States and across Canada. All presentations are posted on the BC MEND workshop website at <http://bc-mlard.ca>.

A new project underway is the “In Situ Application of In-pit Treatment for Water Management at Closed Mine Sites”. Its objective is to demonstrate that batch treatment of arsenic and other constituents in an open pit may represent a low-cost alternative to conventional treatment.

MEND continues to support two consortia projects, TERRE-NET and Thiosalts. Bill Price represents MEND on the TERRE-NET Scientific Advisory Committee and will be attending the 2nd Annual General Meeting planned for late June and hosted by the University of Ottawa.

**SMI (Australia):** The 9th Australian Workshop on Acid and Metalliferous Drainage was held November 19-23, 2017. The workshop was hosted by the University of Queensland’s Sustainable Minerals Institute (SMI), the Australian GA partner of INAP. The AMD Workshop is strategically positioned to take place between ICARDs. Originally, it was Australian focused but now it increasingly attracts international participants and a more global focus. Over 100 delegates attended this workshop which was preceded by two short courses. In summary, INAP enjoyed a high profile through short course participation, key note address, facilitation of closing session and targeted sponsorship.

Two short courses preceded the conference and INAP was involved in both. Bruce and Gilles presented in “Fundamentals of Acid and Metalliferous Drainage” short course and the second short course, given by O’Kane Consultants, was an “Introduction to INAP’s Global Cover System Design Technical Guidance Document”.

There was strong interest shown at the AMD Workshop for the Australians to prepare a bid to host the 2021 ICARD. Much discussions have taken place on this and SMI confirmed that they would be presenting their bid during the closing ceremony of the 2018 IACRD conference in South Africa in September.

SMI has also begun to establish a mailing list for the distribution of Global Alliance and INAP information. The attendees from the last three AMD Workshops will be used as a start and adjusted accordingly. A website is also in preparation.

Testing on the “Zoom” platform confirmed its use for the INAP webinar series and strategic planning for topics and scheduling can now begin. SMI in Australia currently host the webinars and discussions are under way with SMI-ICE Chile to also host webinars to allow for better starting times for North/South America members.

**SMI-ICE Chile:** The Sustainable Minerals Institute International Centre of Excellence Chile (SMI-ICE-Chile) was created in late 2014 as a partnership between The University of Queensland and the Chilean Government through Corfo, an agency under the Ministry of Economy. The new office in Santiago was officially opened in October 2017 and not long after, Jacques Wiertz was hired into the position of Research & Development Manager for the initiative. His job description included “Organize, implement and administrate the South American Network on Acid Prevention (SANAP) and fully integrate it as part of the Global Alliance. Organize SANAP activities such as workshops and professional training.” An excellent opportunity for SMI-ICE-Chile to be a stable Global Alliance node for INAP in South America.

INAP’s Technical Director travelled to Chile in early May to meet with David Mulligan, the Executive Director of SMI-ICE-Chile, and Jacques to discuss the role of SANAP as a Global Alliance member. Discussions included possible structures and organization, frameworks used by other GA members, possible collaborative projects, establishing a contact list for South America, assisting INAP initiatives such as webinars, possible translation and distribution of newsletters and the creation of a SANAP website.

Gilles also participated in a SANAP Workshop on May 9. The main objective was to gather people involved in ARD/AMD and interested to be part of SANAP. Over 80 people attended the 2.5-hour meeting which included an overview presentation by Jacques of the main challenges that ARD represents for the mining industry in Chile and in South America. Gilles then followed with an overview of INAP activities and future plans with a focus on the activities of the Global Alliance members. Jacques then opened the floor for a discussion on the objectives of SANAP, funding mechanisms, structure and membership.

Key outcomes included:

- Good support received for the establishment of SANAP. Several participants committed to take part in a meeting to discuss the preparation of a strategic plan to formalize the Network. This would be done by August.
- Network to concentrate on Chile as a starting point for SANAP and then expand to other South American jurisdictions.
- The first official meeting of SANAP is planned in conjunction with the Planning for Closure 2018 Conference in Santiago, November 7 to 9, 2018.

On May 10, Gilles gave a plenary presentation at Water Congress 2018 titled “Acid mine drainage: how do we build confidence in addressing the problem?” at Water Congress 2018 ([gecamin.com/watercongress](http://gecamin.com/watercongress)). He included in his talk key outcomes from the SANAP Workshop held the previous afternoon.

**WRC:** The Water Research Commission (WRC) has recently released a new South African Mine Water Atlas. This document, is set to be a vital decision-making tool in making available the necessary knowledge to reduce the impact of mining on water resources. In South Africa, the mining sector is a large user of water in certain areas, with the water pollution problems associated with mining being well publicised in recent years.

The Atlas is intended as a comprehensive reference of the true extent of mine-influenced water in the country, both on the surface and underground. Now published, it is the most comprehensive document of its kind worldwide. The Atlas consolidates data on mineralogy, water quality, water flow, present ecological state, and hydrogeological information, thereby assisting water resource managers from all sectors to understand where the vulnerabilities are, which should lead to more coordinated decision-making.

The South African Mine Water Atlas (WRC Report No. TT 670/16) paper report can be ordered from email [orders@wrc.org.za](mailto:orders@wrc.org.za) and by requesting a copy of TT670/16. The web-enabled atlas can be found at <http://www.wrc.org.za/Pages/MineWaterAtlas.aspx>.

As co-chair of ICARD 2018/IMWA 2018/MWD, Dr Jo Burgess is also very much involved in the planning of the conference.

### **Global Cover Guidance Document**

Several iterations of the final report were reviewed during the reporting period. “An Introduction to INAP’s Global Cover System Design Technical Guidance Document” was posted on the INAP website in early January.

Unfortunately, several errors were noted on the posted version and OKC made the corrections and a final version was received on April 26 that replaced the existing web version.

It should be noted that the report was officially launched in Burnie at the AMD Workshop in November at a short course given by O’Kane Consultants, “Introduction to INAP’s Global Cover System Design Technical Guidance Document”. The report was also included with the proceedings of the workshop that was distributed to participants.

### **ARD Best Practice Award**

The first recipients of INAP’s international ARD Best Practice Award are Kinross Brazil for their operation in Paracatu, Brazil and Rio Tinto’s Iron Ore Pilbara operations. The awards are presented in recognition of the implementation of best practice in the identification, planning and management of potentially reactive geologic materials at a mining site and at the corporate level. Both operations were found to exemplify global best practice and deserve international

recognition. These awards will be formally presented to Kinross Brazil and Rio Tinto Iron Ore at the 11th International Conference on Acid Rock Drainage (ICARD) in Pretoria, South Africa in September 2018.

The original criteria called for one award at the mine site level. After review of the two submissions by the selection committee, it was proposed, and accepted by the Board, that two awards be presented, one at the mine site and another at the corporate level. The criteria will be adjusted for the second go-around and companies would be asked to identify which of the award they are applying for. Discussions on how to attract more submissions will also need to take place.

### **GARD Guide Update**

At the last meeting it was agreed that the comments would be consolidated and recommendations presented to the next Op Com for decisions to be taken on chapters to be upgraded in 2018. This task has turned out to be more difficult than anticipated as comments have also included overarching type suggestions on how to make the guide more user-friendly. This would entail a much greater revision.

As an example, and this comment was made by several reviewers and I include a direct quote “The guide could be greatly improved by the addition of a new chapter that is essentially an Executive Summary aimed at non-specialists and specifically at decision-makers for proposed, operating and closing facilities. I would envision this chapter to be focused on bigger picture items related to mine waste management that could be then linked to more specific details that are presented in many of the existing chapters of the guide.”

Also, the treatment chapter received many recommendations for a review. It was last done in 2011 and for many proposed and operating sites is becoming a common strategy for water management. Efficiency of different treatment technology is a key parameter. Since the last update, one key reference would be the BATEA Study completed by MEND that looked at various field-tested treatment technologies. And INAP has received interest from a member company and ADTI, who are thinking of up-dating their treatment workbook.

Also received from many reviewers, were recommendations in track changes for the various chapters.

### **Pit Lake Database**

At the Banff meeting it was agreed to commit funds (\$50K) for the continuation of the pit lake database. This project was originally done when Devin Castendyk was at Oneida in New York State. He then joined Hatch and has since moved from Hatch to Golder. I spoke with Devin on April 19 about continuing to develop and populate the pit lake database. We discussed possible approaches including the pit lake analogues project funded by BHP and Rio Tinto that was presented in Burnie by ERM (copy sent to Devin). Devin suggested a project with data from the State of Nevada where most metal mining pit lakes are located. He will contact the State to verify the availability of data and their possible interest in helping with the project. Prior to

contacting Devin at Golder, I spoke with Rens Verburg about the possibility of Golder hiring a student to conduct the data research work under the supervision of Devin. INAP would reimburse Golder for the student. Rens was agreeable to this arrangement should the project go-ahead. Devin also mentioned that, in the future, INAP would need to think about upgrading the storage location (e.g. investing in a cloud system) for the data.

### **Toward Environmentally Responsible Resource Extraction Network (TERRE-NET)**

INAP is a partner in TERRE-NET, a multi-institutional and multi- and trans-disciplinary research Network comprised of 15 co-investigators from 7 universities across Canada, with the overarching goal of ensuring the “environmentally responsible, socially acceptable extraction of mineral and energy resources using cutting-edge approaches and technologies”. This five-year initiative, funded by the National Science and Engineering Research Council of Canada is led by Dr. David Blowes of the University of Waterloo and is supported by numerous partner organizations, as well as Canadian and international research collaborators.

The network is now completing Year 2 and the 2nd Annual General Meeting will be hosted by the University of Ottawa on June 26 and 27. Claudio Andrade and Gilles will represent INAP at the meeting and an update on TERRE-NET will be provided to INAP members following the meeting.

### **ICARD2018/IMWA2018/MWD**

The planning continues for the September 9-14, 2018 event in South Africa ([www.ICARD2018.org](http://www.ICARD2018.org) and [www.IMWA2018.info](http://www.IMWA2018.info)). Key activities include:

- Program schedule released
  - Pre-conference field trips and 6 short courses planned
  - INAP and GA Meeting, to be held on Monday September 10<sup>th</sup> from noon to 5 pm.
  - INAP’s Plenary Session scheduled for Tuesday September 11<sup>th</sup>. A 60-minute time slot for three presentations
    - General introduction on INAP plus award presentation
    - Best Practice Award Recipients – Kinross (Alessandro) followed by Rio Tinto (Rosalind).
  - Three and a half-days of parallel sessions (4) planned. Each morning starts with a plenary session comprised on two 30-minute presentations. Closing session, will include ICARD bids, is schedule for Friday afternoon following lunch.
- More than 220 abstracts accepted, which is slightly more than the 200 slots available. Cancellations are expected. Papers for review due May 15. Three INAP papers completed and sent in.
- INAP will sponsor Banquet “Taste of Africa” dinner on Thursday September 13. Note that tickets to attend the banquet are not included in the registration fee. All other meals are included. In general, sponsorship lower than expected.
- Issues remain regarding electronic payments. The organizers could not obtain a merchant number because of their affiliation with the technical university. Organizers

getting many complaints for only accepting wire transfer for registration. IMWA's PayPal account for payments is a possible solution that is being explored.

### **12<sup>th</sup> ICARD (2021)**

Call for Bids for the ICARD 2021 was sent via the Global Alliance in late February/early March. Two countries have confirmed, by the May 1<sup>st</sup> deadline, their intentions to bid for the 2021 ICARD, Australia (Brisbane) and Canada (Halifax).

There was some previous interest from Mexico (AIMMGM-the Mexican version of SME) and the Nicaraguan Chamber of Mining (CAMINIC). Patrick Williamson, Intera in Denver and ADTI-MMS member, was working with both organizations on a possible bid. Both have excellent facilities to host the conference but lack of a strong technical organizing committee was the reason that they decided not to bid. Thought was that ADTI members would offer their help with key technical roles but no one reached out to Patrick. IMWA also mentioned possible interest from China and Germany but nothing was received.

### **Technology Transfer Activities**

The following activities were completed by INAP members during the reporting period:

- Presentations at AMD Workshop and during Short Courses in Burnie, Tasmania (Kelley, Green, Marton, Tremblay, O'Kane).
- GARD Guide Short Course in Suriname (Parnow, Verburg)
- Presentation to University of Ottawa Environmental Sciences 3<sup>rd</sup> Year class (Tremblay)
- 2018 Q1 INAP Newsletter
- GARD Guide presentation for final trial of ZOOM platform for INAP Webinar series (Parnow)
- Presentations at SANAP Workshop and Water Congress 2018, Chile (Tremblay)
- Preparation of papers for ICARD 2018 plenary (Green, Nepomuceno (Kinross), Tremblay/Kelley)

### **INAP Website**

One of the Technical Director's ongoing deliverables is to update and populate the website. It was mentioned that this was important but not a priority. More time needs to be dedicated to this task in the next reporting period. Additions such as presentations for the GARD Guide webinar series, INAP presentations and information on key subject areas for the members section are priority.

### **Membership**

The current membership of INAP includes the following mining companies:

Anglo American  
BHP  
Newcrest Mining Ltd.  
Rio Tinto Ltd.  
Detour Gold

Barrick Gold Corp.  
Kinross Gold Corporation  
Newmont Mining Corp.  
Teck Resources Limited  
Lundin Mining

INAP has received interest from Agnico-Eagle Mines who are considering joining INAP as full member. Chris Kennedy, Geochemist, joined AEM last summer and has recommended to senior management that AEM join INAP.

Tiered membership was approved on a case by case basis in 2017 and both Detour Gold and Lundin Mining have since joined. Amendments required to the Constitution were also completed during the reporting period. Discussion on the number of companies that INAP would accept as tiered members will take place at the next Op Com.

### **Budget**

The Op Com continues to provide research and information transfer programs within the budget generated by INAP. The table below summarizes the state of the budget through 30 April 2018.

Projected Bank Balances for Period Ending April 30, 2018				
	Consolidated USD\$	AUS\$ 0.7570	USD\$	CDN\$ 0.7788
<b>Assets</b>				
Cash at Bank (actual)	379,361	164,569	178,988	35,804
<b>Non-Current</b>				
ANZ Term Deposit	284,428	448,997		
Total Cash Reserve	663,789			
Actual/Estimated Income for 2018	90,700			
Estimated Expenses for 2018	352,517	20,830	311,699	19,988
Expenses Carry Forward	88,360		88,360	
Estimated Cash Balance at Year End	313,612			

### **Projects and Project Ideas**

At the closing session for the AMD Workshop, Bruce led a discussion on emerging issues and opportunities from the workshop. INAP saw this as an opportunity for identifying ideas for a major research and development project. This list was refined in Perth at the INAP Open meeting. Ros and Richard, asked the participants to write down all their ideas and these were grouped and the top areas are as follows:

1. Pit lakes and voids
  - a. Including covers
2. AMD Treatment
  - a. Biological
  - b. Recovery of resources

3. Monitoring and modelling
  - a. Ecotoxicity
4. Business case for AMD management
5. Scaling: laboratory to dump
6. Dump design (co-disposal) and construction
7. Covers including alternatives
8. AMD in mining models
9. Tailings management – geochemistry
10. Closure criteria
11. Preventing AMD in underground
12. Interactive tools – dump, water quality
13. Standardizing approaches – prediction, modelling, validation
14. Neutral drainage (incl salinity) – prediction techniques and management

After several transition years, INAP is giving thoughts to the next big-ticket project. Several project presentations are planned for the next Op Com.

In terms of existing projects, INAP is still waiting on Rio Tinto regarding a decision on the funding for the continuation of the Diavik Country Rock Test Pile Program. No funding was committed for 2018 as the project is on hold. An update from Rio Tinto has been sought.

A summary of current INAP projects is provided below.

<b>Project</b>	<b>Researcher</b>	<b>INAP Budget</b>	<b>Status</b>
GARD Guide Chapter(s) Update(s)		US\$50,000	To be discussed at May Op Com Meeting
Update to Pit Lake Database	Golder	\$US50,000	In preparation
Workbook on Mathematical ARD Models is being finalized for publication in November 2017	ADTI	US\$2,000	Workbook available. Listing of reviewer names provided May 15 to receive copies.
Continuation of Country Rock Test Pile Program	Diavik, U of Waterloo, U of BC & U of Alberta	CDN\$0	No decision on status of project from Rio. Funding to be reviewed then.
Global Cover System Design Guidance Document	O’Kane Consulting	US\$88,360 2018	This project is now completed and final invoice requested.
TERRE-NET	Various universities	None	Year 2 completed. INAP represented by Claudio on Board. Important link for INAP.

## **Members of the INAP Board and Op Com Leadership and Secretariat**

### **INAP Board and Op Com Leadership and Secretariat members are:**

Board Chair: Open

Op Com Chair: Claudio Andrade, Barrick

Op Com Vice Chair: John Mudge, Kinross

Technical Manager: Gilles Tremblay

Technical Advisor: Bruce Kelley

Administrative Assistant: Open

### **INAP Board & Op Com members and participants in 2018 INAP activities:**

Anglo American: Hubert Fleming – Board, Caius Priscu

Barrick: Claudio Andrade – Board/Op Com, Johnny Zhan

BHP: Joanne Heyes – Board, Richard Marton – Op Com

Kinross Gold Corporation: John Mudge – Board/Op Com,

Newcrest Mining Limited: Blair Sands - Board, Ben Wither – Op Com

Newmont Mining Corp: Scott Miller - Board, Thiess Lindsay – Op Com

Rio Tinto: Rich Borden – Board, Rosalind Green – Op Com

Teck Resources Limited: Michael Davies – Board, Troy Jones – Op Com

Detour Lake Gold: Ruben Wallin and Veronika Shirokova – Op Com

Lundin Mining: Derek Riehm and Camilo Martinez – Op Com