

## Mining in Papua New Guinea: A complex story of trends, impacts and governance

### Maining long Papua Niugini: Plenti stori, impacts na gavanens

This synopsis was prepared as part of a series research translations relating to mining in PNG, and the proposed Wafi-Golpu mine in the Morobe Province of Papua New Guinea. Because the article contains a lot of data which cannot be summarised, this summary is brief, giving an insight into the main article in accessible language. Article numbering below relates to the original sections in the article *Mining in Papua New Guinea: A complex story of trends, impacts and governance* co-authored by Gavin Mudd, Charles Roche, Stephen Northey, Simon Jowitt and Gama Gamato, which is an academic journal paper and fully referenced version. Copies and more information is available from Charles, via [charles.roche@murdoch.edu.au](mailto:charles.roche@murdoch.edu.au) or phone +6145901714 or Howard on +675 7141 0311.

Dispela sotpela ripot ol ibin redim hap blong ol research wok blong mining insait long PNG, na dispela Wafi Golpu main ibai kamap long Morobe Provins long Papua Niugini. Bikos dispela pepa igat plenti infomesen ino inap long mekim sotpela ripot, dispela em sotpela samari o ripot, we igivim lukluk igo insait long bikpela bodi blong stori mekim isi long rid. Igat namba long ripot tamblo makim stat na sections blong article *Maining insait long Papua Niugini: A complex story of trends, impacts and governance* co-authored by Gavin Mudd, Charles Roche, Stephen Northey, Simon Jowitt and Gama Gamato, dispela em bikpela save pepa na olgeta referens. Ol kopi na moa infomesen istap wantaim Charles, [charles.roche@murdoch.edu.au](mailto:charles.roche@murdoch.edu.au) or telefon +6145901714 o Howard long +67571410311

**1. Introduction:** PNG has an interesting mining story and provides a case study of balancing the negative impacts from mining with the pursuit of sustainable development. The article provides a unique national level assessment of the mining industry and the social and governance challenges that must be overcome if PNG is to reduce the negative impacts from mining and achieve sustainable development.

**Stat:** PNG igat interesting maining stori na givim case stadi long luksave long nobut blong main lukluk igo insait sustainable divilopmen. Pepa ripot igivim unique Nesenol level assessmen blong maining industry na sosel gavernens salens we ol mas stretim sapos PNG laik daunim impact nogut blong maining na kisim gutpla divilopmen.

**2. Geology:** Despite a century of mining, the geology of PNG is not well known due to the difficulties of mapping its mountainous terrain, climate and its logistical and infrastructure challenges.

**Stadi blong minerals:** Maski handet yia main istap, geologi o wok blong minerals long PNG ino kamap klia long wanem em hat long putim long piksa map bikos em maunten tumas, climate inogut na hat long go mekim wok na not gat rot na bris.

**3. Brief mining history:** Mining in PNG started with rich grades and small scale operations at Misima, Woodlark, Wau-Buloloo and Mt Kare. After closing during WW2, the mining industry restarted in the late 1940's, but it was not until the 1960's that global mining companies started targeting PNG for exploration. Panguna, was PNG's first big mine, starting in 1972 until the large scale of environmental and social impacts led to the Bougainville Crisis.

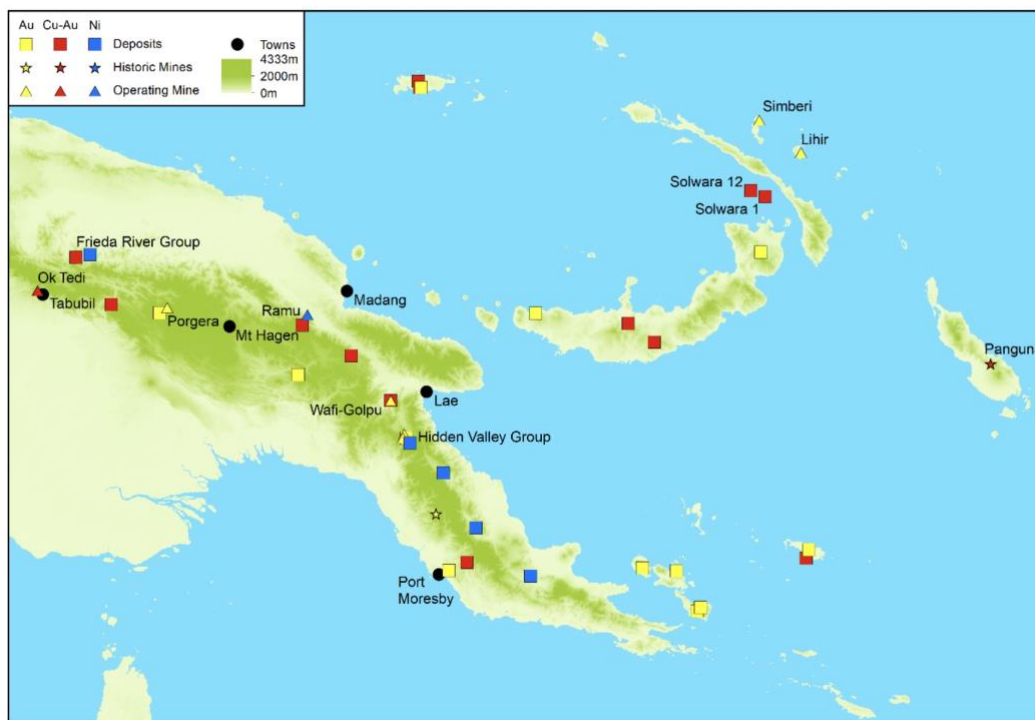
**Sotpla histori blong maining:** Maining insait long PNG stat wantaim strongpla grade na liklik skel operesen long Misima, Woodlark, Wau-Bulolo na Mt Kare. Bihain long pas long WW2, maining indastri stat gen long late 1940's tasol bihain liklik long 1960's ol maining kampani blong world stat lukluk long Papua Niugini long wok exploresen o painim aut. Panguna ibin wanbawan bikpla main blong PNG. Em stat long 1972 inap bikpla bagarap blong environment na manmeri bungim hevi na dispela kamapim Bougainville Crisis.

Then Ok Tedi was developed in 1984, Porgera in 1990 and Lihir in 1997, with the Hidden Valley and Ramu mines developed in the late 2000's. These and smaller mines are shown in map 1, below. Apart from Hidden Valley, which built a tailings dams, the other mines disposed of their mine waste into PNG's rivers and seas.

Na Ok Tedi ibin divilop long 1984, Porgera long 1990 na Lihir long 1997 wantaim Hidden valley na Ramu Main divilop long late 2000's. Dispela na ol liklik main kamap lo map 1 aninit. Narakain long Hidden Valley, husait mekim tailing dam, ol arapla maines tromoi pipia blong main blong ol igo insait long ol wara na sol wara blong PNG.

**4. Mineral resources:** The article presents data on mineral resources drawn from company reports and technical papers, showing that ore grades are declining.

**Minerel risos:** Dispela pepa tokaut long mineral risos infomesen ikam long kampany ripot na teknikel pepa isoim olsem ore grade wok long igo daun.



**5. Mining production trends:** The dominant metals in PNG have been gold and copper, with nickel mined more recently. The article presents and discusses the data in table and graphs

**Main kamapim mineral luksave:** Ol metal long PNG ibin gold na copper wantaim nickel ol digim sampela yias igo pinis. Pepa itokaut long data istap long tebol na graphs.

**6. Environmental and social issues:** this section explores significant environmental issues such as marine and river mine waste disposal and then links them to social and governance issues. The article does not fully explore social impacts, but does recognise western and scientific practices often misunderstand the importance of environmental and social impacts, these are explored more fully in the sister articles on Wafi-Golpu. Mine waste and tailings output is shown in Fig 4, below.

**Hevi blong bus graun wara na manmeri:** Dispela hap wokpainim aut blong bus, graun, wara bungim hevi blong tromoi pipia blong main em bung wantaim sosel na govenens. Dispela stori ino mekim ful wok painimaut blong hevi ol manmeri ibungim, tasol em luksave long autsait scientific praktis na dispela ino save kamap klia long gutpela blong bus graun wara na hevi manmeri bungim, dispela wok painim aut long narapla susa ripot blong Wafi Golpu. Pipia blong main na tailings istap long Fig 4 aninit.

**6.1** Despite being common in PNG, the disposal of mine waste into rivers or oceans is a controversial practice which only occurs in Indonesia and Turkey, in small mines in Norway and in single mines each in England, Greece, Finland, France and Chile. The main argument for disposing of mine waste into water bodies is the cost and difficulty of building engineered tailings dams. This is certainly true in PNG which has high rainfall, mountains, erodible soils and potential earthquakes. By dumping mine waste into rivers and seas the mining companies save money on mine development costs, but pushing the impacts of the mine onto the environment and communities.

Maski dispela em wankain insait long PNG, tromoi pipia blong main long wara na solwara em igat toktok plenty long praktis na displa kamap long Indonesia tasol na Turkey, insait long liklik main long Norway na tupelo liklik main long England, Greece, Finland, France na Chile. Bikpela toktok pait blong tromoi pipia blong main igo insait long wara em cost na hard long wokim dam blong holim tailings. Dispela em tru stret long PNG igat bikpela rain save pundaun, maunten tumas, rain wara save wasim graun igo daun na guria/earthquake save kamap. Long tromoi pipia blong main igo insait long wara na sea em ol mining kampani savim moni long divolopim main, na pusim hevi blong main igo long bus graun wara na kominiti.

The decisions to dump waste into water bodies are made by the companies and not usually subjected to independent review. But the Hidden Valley mine proves it is possible to build safe tailings dams in PNG. Dumping mine waste into rivers causes; (1) sedimentation which pollutes rivers and alters riverbeds; (2) pollution from heavy metals; (3) the heavy metals to end up in the rivers and fish; (4) reductions in biodiversity and oxygen in the water; (5) impacts on water quality.

Ol disisen blong dumpim pipia igo insait long bodi blong wara em ol kampani save mekim na ino ol independent view. Tasol Hiden Valley main iprovim em orait long kamapim seif tailings dam long PNG. Tromoi pipia blong main igo insait long ol wara kamapim; (1) sedimentation bagarapim wara na ass blong wara; (2) bagarap kam long hevi metals; (3) ol hevi metal end up long wara na fish; (4) daunim laip istap long wara na oxygen insait long wara; (5) hevi blong gutpela quality wara.

The article acknowledges the many social impacts of mine waste are complex, interrelated and multigenerational, and uses examples to describe some. At Panguna, mine waste damaged gardens and rivers and meant villages had to be moved. Despite problems being identified before the mine was fully built, the problems were not addressed and eventually led to the armed shut-down of the mine and the ensuing Bougainville Crisis.

Dispela pepa luksave long plenti hevi manmeri bungim long pipia blong main long kainkain level na ol konek igo long laip blong bihain, na displa usim ol example long describim sampla. Long Panguna, pipia blong main bagarapim ol gaden na wara na mekim ol ples muv igo long narapla hap. Luksave blong hevi bin kamap bipo long ol bildim main, ol ino bin addressim hevi na dispela lid igo insait long pait ishut down main na Bougainville Crisis.

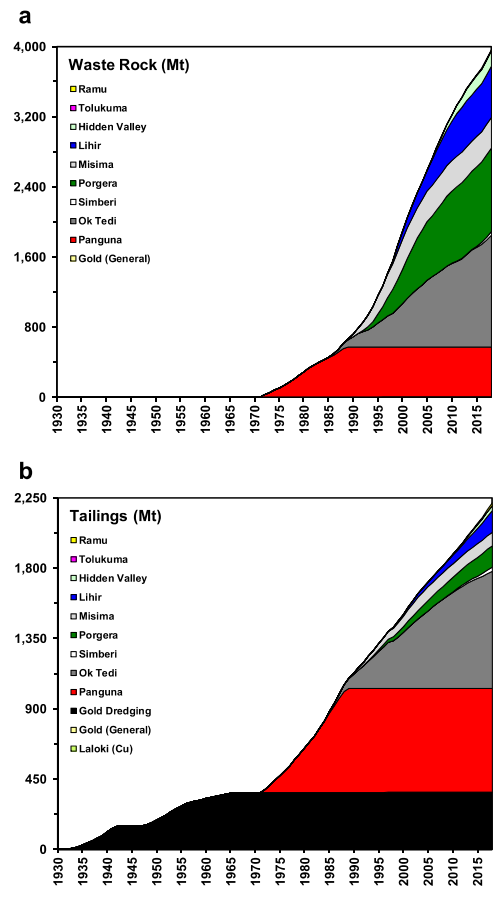


Fig. 4. Estimated cumulative waste rock (left) and tailings (right) for Papua New Guinea (data to 2018).

At Ok Tedi the planned tailings dam broke during construction and BHP ask the PNG government to allow them to put the tailings and waste rock into the Fly River. Despite earning a lot of money for landowners and compensation for downstream communities, the impacts of the waste are severe and will have environmental, health and cultural impacts for decades to come.

Long Ok Tedi displa dailing dam ol ibin plenim bruk long taim blong construction na BHP askim Gayman blong PNG long putim pipia blong tailing na pipia ston igo insait long Fly River. Maski bikpela moni ol papagraun na kominiti arere igo daun long wara kisim kompensen, hevi blong pipia blong main em nogut tru na bai igat enviornment, helt na kalsaral impacts ikam bihain.

At Porgera mine, tailings is dumped into the Porgera River and waste dumps are allowed to erode and discharge sediments into the river. Like Panguna and Ok Tedi, there is controversy and conflict over the impacts of mine waste on communities.

Long Porgera main, tailings ol dumpim igo insait long Porgera wara na pipia ol tromoi igo insait long wara. Olsem Panguna na Ok Tedi, igat bikpela hevi toktok nap ait kamap antap long bagarap blong pipia blong main kamapim long ol kominiti.

Riverine disposal of mine waste is not used in the prominent mining countries such as Australia, Chile, Canada, South Africa or the USA. Independent, comparative assessments of the risks of river or marine waste disposal are rare, but would be useful in determining the best way of managing of mine waste.

Tromoi pipia blong main long wara em ol ino save usim long biknem maining katri olsem Australia, Chile, Canada, South Africa na USA. Independent, skelim assesmen blong bagarap blong wara o tromoi pipia blong main em ino common, tasol em bai igat wok blong mekim kliapla tingting long gutpla rot blong lukautim pipia blong main.

Marine mine waste disposal is also common in PNG and was used at Misima Island, is currently used for Simberi, Lihir and Ramu, has been approved for Woodlark and proposed for Wafi-Golpu. While it is hard to see or determine the impacts from mine waste in the sea, communities and scientists are concerned about impacts. Again, the main reasons for dumping mine waste at sea is the reduced cost, but it has significant environmental impacts. At Lihir the seafloor has been smothered and species

abundance has been reduced with changes in the composition of larger fish species. There are also significant mine related social issues on. In a positive step, Hidden Valley has a tailings dam, though the benefits were reduced by the erosion of waste rock into the Watut River during mine construction.

Putim pipia blong main long solwara em common long PNG na ol bin mekim long Misima ailan, nau Simberi, Lihir na Ramu, na ol approvim long Woodlark na proposed Wafi Golpu. Na em ino isi long lukim o skelim bagarap blong pipia blong main long solwara, kominitis na scientists tingting plenty long bagarap. Bikpela as tingting blong dampim pipia blong main long solwara em cost liklik tasol bikpela bagarap long environmen. Long Lihir seafloor Igat bikpela hevi blong main ol manmeri bungim. Long gutpla step, Hidden Valley igat tailings dam, ol benefits ol daunim igo daun long wara, graun bruk igo daun long Watut wara long taim blong main construction.

Mine waste is a wicked sustainability problem, with complex interactions with the environments and affected by PNG's colonial past and the unequal relations between communities, proponents and governments. Mine closure is rarely addressed in PNG, with troublesome sites at Tolukuma, Sinivit and Mount Victor still needing rehabilitation. The larger mines will be very difficult to close in a manner that protects local environments and communities. While Prime Minister Marape has recently refused to extend the Porgera mine license and banned new river-based mine waste disposal, ocean dumping is being considered for Wafi-Golpu and river disposal is expected to continue for many years at Ok Tedi and Porgera.

Pipia blong main em ino stretpla rot, em igat plenty toktok blong environment bikos long colonial experiens blong PNG na wok bung ino wankain namel long ol kominitis, sapota blong main na gavman. Main Closure long PNG ino save stretim gut. Wantaim hevi eria long Tolukuma, Sinivit and Mount Victor nid long stretim wok go mas go yet. Ol bikpela main bai hard tru long pasim long pasin blong proktetim lokol environment na manmeri. Taim Prime Minista Marape nau ino wanbel long surukim taim blong Progera main license na tambuim nupela proposal blong tromoi pipia blong main long wara, tromoi pipia blong main long solwara em ol laikim long Wafi Golpu na tromoi pipia blong main long wara em yumi expectim long go het yet long plenty yia ken long Ok Tedi na Porgera.

**6.2** The article also details metrics, use and production of energy, greenhouse gas emissions, water, reagents and consumables.

Dispela artikel tu itoktok moa long metrics, wok na kamap blong energy, greenhouse gas emissions, wara, reagents na consumables.

There are many complex and interrelated issues when it comes to mining governance, with the large scale of mining creating significant community concerns. In PNG flaws in the impact assessment (IA) system and in the environmental impact statements (EIS) written by proponents make it hard to properly identify, assess and manage the impacts from mining. One example is that despite mines growing in size overtime, IA processes are rarely re-initiated meaning that despite growing impacts communities do not have access to information about impacts or how they are managed.

Igat plenti wankain hevi taim em kam long maining govenans wantaim bikpla wok maining wok long kamapim bikpela kominiti toktok plenti. Long Papua Niugini igat hevi insait long impact assesement (IA) system na environment impact statements (EIS) ol sapota blong maining mekim hard long manmeri ritim na luksave, skelim na managim hevi blong maining. Wanpela example em olsem taim main grow long size ovataim, IA process em ol ino save mekim toktok gen antap long em meaning

maski hevi insait long kominiti inogat access long informesen toktok long nogut o how ol save managim.

Ok Tedi provides a relevant example, with a number IA failings and mine problems: (1) construction on the mine started before the EIA was even released to the public; (2) despite proposing a tailings dam in the EIS, tailings and mine waste was later approved to be disposed of into the river; (3) impacts were assumed to be local only, but later polluted the Fly River system, with pollution loads at increasing from 3-4 to approximately 45 million tonnes per year; (4) widespread community concern about extensive damage to River and floodplains with 2000 km<sup>2</sup> affected; (5) the scale of mine now far exceeds initial planning; (6) assumed trickle down benefits failed to significantly help Western Province which is still the least developed in PNG.

Ok Tedi givim example wantaim namba IA fail na hevi blong main: (1) construction long main stat pas long EIA na bihain public kisim EIA; (2) maski ol tok long tailings dam insait long EIS, tailings na pipia blong main ibin wanbel bihain long tromoi pipia blong main igo insait long wara; (3) hevi/impacts ol ibin tok em bai liklik, tasol bihain Fly River system bagarap wantaim pollution load igo antap long 3-4 na clostu 45 million tonnes long wanpla yia; (4) bikpela kominiti wari long bikpela bagarap blong wara na floodplains wantaim 2000 km<sup>2</sup>; (5) mak blong main nau abrusim tru nambawan plening; (6) plen nating blong bikpela benefit igo daun long helpim Western Provins ino bin kamap na em ino divilop long PNG

There are also significant controversies and problems at other mine sites, with impacts far exceeding those identified during IA. Meaning the impacts on communities are far bigger and arguably worse than they first expected. Both the Wafi-Golpu and Freida River projects are currently being assessed under the same system with significant concern about impacts voiced by the ELCPNG, communities and NGO's.

Igat bikpela toktok na hevi long arapla hap blong main eria, wantaim hevi abrusim dispela we ol luksave long IA. Dispela min bagarap em bikpela kominiti bungim hevi abrusim mak go worse moa long ol tingting long en. Wafi Golpu na Freida River projek nau ol wok long skelim aninit long same system wantaim wari long bagarap we ELCPNG, kominitis na NGOs wok long tokaut istap.

Water quality can also be significantly affected by mine development and operations. These can be made worse by poor or no standards and inadequate monitoring. While water quality regulation has improved in recent decades, sometimes regulatory criteria is not available, key weaknesses are shown in table 3, below.

Qualiti bilong wara tu bai bungim bagarap long divilopmen blong main na opersen. Dispela ken kamap nogut tru sapos nogat standard o gutpela monitoring em istap. Igat wara quality loa ibin improve long sampela tenpla yia igo pinis, sampela taim nogat pasin blong skelim em istap, ki weakness em soim long table 3 aninit.

Good governance is critical in managing mining, key issues in PNG include: (1) a lack of resourcing for regulatory bodies, resulting in company self-regulating which erodes public trust in companies and Government agencies; (2) a lack of enforcement to protect environment or people; (3) failure to comply with court conditions i.e. Ramu; (4) often poor public environment reporting with limited access to data – despite companies such as Newcrest doing both for some of their Australian mines; (5) lack of transparency, with EITI unable to track or monitor payments to communities.

Gutpela gavenens em ino isi long managim maining, ki hevi long PNG em: (1) nogat helpim blong regulatori bodis; displa mekim kampani mekim sefl-regulatim dispel brukim public trust long kampani na gavman agensi; (2) nogat enforsment long sapotim invironmen o pipol; (3) fail long bihainim kondisen blong kot i.e. Ramu; (4) ino gutpla public environment reporting bikos nogat data o infomesen-narakain long ol kampani olsem Newcrest mekim long sampla blong kamapni blong ol long Austrlia; (5) nogat transparency, wantaim EITI ino inap long trackim o skelim wok blong paymen long ol kominitis.

While PNG has looked to the mining industry to develop PNG, it has failed to deliver the expected benefits at a national level, with significant reforms required if the PNG mining sector is to make a more positive contribution to well-being. Again, more information and data is required to assess and then improve the contribution of the mining to the people of PNG and to meeting the sustainable development goals.

Taim Papua Niugini lukim maining indastri long divilopim PNG em ifail long givim benefit ol expectim long nesenol level, wantaim bikpla nid blong senis sapos PNG main sector iken mekim gutpela kondribusen blong gutpla sindaun blong manmeri. Na tu moa infomesen na data igat nid long skelim na improvim kontribusen blong main igo long pipol blong PNG na long bungim sustainable development goals.

**Table 3**  
Water quality regulation for PNG mines - key criteria, strengths and weaknesses.

	Water resources	Compliance location (s)	Water quality basis	Transparency <sup>#</sup>	Strengths	Weaknesses
Ok Tedi <sup>b</sup>	Fresh	Along entire river system	ANZECC 95% Values	High	<ul style="list-style-type: none"> <li>• Extensive monitoring</li> <li>• Annual public reporting</li> <li>• Ecotoxicological basis</li> <li>• Clarity on compliance</li> </ul>	<ul style="list-style-type: none"> <li>• Fails to address bioaccumulation of metals and long-term acid drainage risks</li> <li>• Still allows significant impacts along river system</li> </ul>
Porgera	Fresh	~180 km downstream (SG3)	ANZECC 95% Values (mostly)	High	<ul style="list-style-type: none"> <li>• Extensive monitoring</li> <li>• Annual public reporting</li> <li>• Ecotoxicological basis</li> <li>• Clarity on compliance</li> </ul>	<ul style="list-style-type: none"> <li>• Fails to address bioaccumulation of metals and long-term acid drainage risks</li> <li>• Still allows significant impacts along river system</li> </ul>
Hidden Valley	Fresh	~20 km downstream (Nauti)	Unclear	Medium	<ul style="list-style-type: none"> <li>• Extensive monitoring</li> <li>• Some historic public reporting</li> <li>• Unclear scientific basis</li> <li>• Some clarity on compliance</li> </ul>	<ul style="list-style-type: none"> <li>• Fails to address bioaccumulation of metals and long-term acid drainage risks</li> </ul>
Lihir	Marine	Tailings discharge point	Unclear	Low	<ul style="list-style-type: none"> <li>• None identified</li> </ul>	<ul style="list-style-type: none"> <li>• No public transparency</li> <li>• Uncertain compliance</li> <li>• Unclear scientific basis</li> </ul>
Simberi	Marine	Unclear	Unclear	Low	<ul style="list-style-type: none"> <li>• None identified</li> </ul>	<ul style="list-style-type: none"> <li>• No public transparency</li> <li>• Uncertain compliance</li> <li>• Unclear scientific basis</li> </ul>
Ramu	Marine	Unclear	Unclear	Low	<ul style="list-style-type: none"> <li>• None identified</li> </ul>	<ul style="list-style-type: none"> <li>• No public transparency</li> <li>• Uncertain compliance</li> <li>• Unclear scientific basis</li> </ul>

Notes: <sup>#</sup>Based on public reporting and scientific justification of compliance regime (Low = no public reporting or explanation; Medium = infrequent public reporting and explanation; High = frequent public reporting (e.g. annual), clear scientific explanation and regular review and improvement in regime criteria).

**7. Summary** Despite a wealth of mineral resources in PNG, mining has played a controversial role in the development of the country. With world-class deposits and the potential for further discoveries mining can positively contribute to PNG, but mining processes have also damaged social cohesion and caused considerable environmental damage, with complex social and environmental legacies that will remain for decades or centuries. PNG needs better standards, regulatory and approval processes – particularly in relation to the disposal of mine waste and the lack of recognition of the negative impacts

of intentional and unplanned developments on the people of PNG. But PNG can shift the balance of regulation, adopt international best practices for mine waste management and achieve more sustainable outcomes for communities and stakeholders.

Maski igat pleti mineral risos long PNG, maining kamapin pinis plenti hevi na tok pait insait long divilopmen blong kantri. Wantaim wol klass deposit na igat moa wok painim aut maining iken mekim gutpela contribution long PNG, tasol rot blong maining bagarap tru sindaun blong manmeri na bagarap blong bus, graun na wara, wantaim plenty hevi manmeri bungim na bagarap blong environment istap longpela taim o plenti yia ikam bihain. PNG nidim gutpela standard, skelim na lukave proses-long sait blong tromoi pipia blong main na inogat luksave kamap long bagarap ol min long mekim na displa kamap tasol ino istap long plen blong divilopmen blong pipol blong PNG. Tasol PNG ken mekim senis long balancim regulation o loa, adoptim gutpela international praktis blong tromoi pipia blong main managmen long kamapim moa gutplea result blong kominitis na stakeholders.