Port Kembla Harbour Environment Group

Meeting No. 151
Wednesday 3 August 2022
9.00 a.m. – 11.00 a.m.

Inside Industry, BlueScope

Minutes

Attendees	
Community members Ron Hales Mark Peterlin Jess Whittaker Phillip Laird **Business Representatives** Paul Bollen – Morgan Cement Nigel Harpley – Ixom Kate Flint – Pacific National **University of Wollongong** Andy Davis **NSW Ports representatives** Peter Munro Bryan Beudeker **Port Authority of NSW** Peter Ernst **NSW EPA** Greg Newman Craig Patterson Anya Palaversich	**Wollongong City Council** Karl Batshon **Dept of Agriculture** None present **Guest Presenters** Craig Patterson – EPA Greg Newman – EPA Chantel Carr – UoW Amelia Hine - UoW **Apologies** Renee Winsor – Wollongong City Council Wayne Vorley – PKCT Dave Allan – Quattro Ports Kevin Edward – GrainCorp Michael Curley – Port Kembla Coal Terminal Peter Maywald – Community Member Trevor Brown – NSW Ports Sharad Bhasin – Port Authority of NSW Rosa Thomson – Australian Industrial Energy (AIE) Evan Wissell - Australian Amalgamated Terminals (AAT) Sara Starr – (AAT) Lorrie Zammit – BlueScope Brian Kiely – Port Kembla Gateway **Chairperson & Minutes** Chris Haley – Chairperson Natalie Murphy – Minute Taker

1. Introduction & Apologies:

1.1 Acknowledgment of the Dharawal people – Chris Haley
1.2 Welcome attendees and guest presenters– Chris Haley
1.3 Acknowledgment of John Morrison's contribution to the PKHEG Committee and his comment regarding the Committee:

"I had noted the comments about the PKHEG in emails. I think the most important point is to keep the Group operating. Priorities and membership may change from time to time, but regular meetings of users will in my opinion continue to be useful - particularly if members provide accurate information at meetings. There are significant changes coming to PK and having an advisory group that can discuss issues 'informally' has great potential to sort out issues before they become unresolvable." John

John attached two articles which may be of interest to the Committee –

- **Appendix A - Blue Business**
- **Appendix B – High Seas**

2. Minutes of Meeting and Actions

2.1 Acceptance of Minutes of Meeting held 5 July 2022
2.2 Business arising from Minutes 5 July 2022

3. Guest Presenters – Amelia Hine and Chantel Carr – UoW

- Amelia and Chantel are social scientists working on a project with the University of Wollongong within Port Kembla, with six researchers on the team.
- It is a federal government sponsored project looking at the work that goes under the radar and further understanding of the operations of the import function at Port Kembla.
- The team are interested in the some of the challenges of managing commodities in a complex port, while considering the environment.
- A couple of researchers are working with Harbour Pilots at the moment. This Committee and others around the port will be contacted at some stage to have input into the research.
- At the completion of the research there will be a number of papers and a series of podcasts.
- Chantel mentioned the UoW has ethical requirements so you can feel comfortable in providing sensitive information if needed. The researchers will de-identify individual names and companies and will provide a transcript of the interview for you to check if requested.

Queries relating to:	**Responses/Updates**
Community Member queried if the research is confined to Port Kembla or is there a comparison to other ports?	The research at this stage is limited to Port Kembla. The research team, however, are in consultation with the Port of Newcastle. Learning the lessons and challenges at Port Kembla will be available for other ports.
Question: What will the outcome be?	There will be an interactive community facing website and podcast with academic output. There will be a number of reports written that will be submitted to Australian Research Council.
Question: How far back are you researching?	We have gone back as far as 1980. However, this is a general guide and we are open to looking further back if it becomes relevant in our research.

A community member suggested going back to 1979 as there were 6 lives lost on Mount Ousley that year. Increased Coal trucks on our roads impact accidents on our roads. It was a significant event with Premier Wran visiting the Illawarra and addressing the issue.	Amelia and Chantel noted this.

4. Darcy Creek Drain Presentation – Craig Paterson and Greg Newman – Appendix C

- A special mention of thanks to the Community Members Jess Whittaker, Mark Peterlin and Pat Bradley who accompanied Craig during sampling.

Queries relating to:	**Responses/Updates**
Does Port Kembla Copper still operate?	They still hold a licence. Since the demolition of the plant, PKC have been required to continue the operation of the wastewater treatment plant to treat surface water runoff from the premises.
Was there subsurface contaminated water on site?	PKC completed a Voluntary Remediation Proposal to assess both shallow and deep groundwater, which included a pump and treat component. This was followed by a Maintenance of Remediation Notice requiring PKC to undertake groundwater monitoring over a six-year period. The site was capped and a public positive covenant was then placed on the land with an associated long-term environmental management plan, which includes management strategies for minimising the disturbance of contamination onsite.
Any changes in PH?	Fairly neutral over the time. Some fluctuations, which can be put down to rainfall etc.
Did you look at dissolved oxygen?	No. Flow in the drain was very low at times. This would have made DO measurement very difficult.
Did PKC initiate the environment plan due to the drain results?	No. PKC were already undertaking their own investigations onsite in relation to surface water contamination. These investigations are ongoing. PKC has also undertaken offsite soil contamination investigations that may be related to historical smelter operations. The EPA has also undertaken a contaminated soil investigation program within the Port Kembla area.
	Nigel from IXOM noted that the Mobil refinery shut down in 2021 and was IXOM's only remaining customer providing spent acid feed. In March 2022, the IXOM spent acid plant was closed for good. Wastewater discharge information is available on the IXOM website.
The community is comforted that the EPA is in consultation with Department of Fisheries. The ongoing water quality and diversity of the harbour can be passed onto the public.	Historically, ecological water studies are surprisingly good and have shown ongoing improvements. There is a ban on some fishing in both the inner and outer harbour areas. The bans are not pollution related. The EPA will liaise with Fisheries about signage for pollution in fish in the outer harbour. In the past, signage has been either removed or damaged.
Have you done samples of pollution in shellfish?	EPA has done some in the past. Could consider for future work but it was not done in this study.
A community member suggested a future	It was noted that even though there is a fishing

presentation from Fisheries would be useful to the Committee.	ban in the outer harbour the public take very little notice as it is not enforced and the community ignore it. It is a real problem with line fisherman at night and is a hazard for pilots.

5. Round Table Reports

5.1 NSW Ports

- The Community Grants recipients will be announced in the next couple of weeks. Peter will send out comms to this group.
- Trade is strong. However, significant recent weather events have impacted the Port.
- LNG Terminal dredging works start next month and are scheduled to finish by March 2023. The terminal is scheduled to be operational by December 2023.

ACTION: Peter to contact AIE and ask for an update/ general presentation at the next meeting.

5.2 Community

- Jess Whittaker would like to thank Craig Patterson and the EPA team for their contribution and reporting on the Darcy Creek Drain sampling.
- Jess is also now a member of Lake Illawarra Committee.

6. General Business

6.1 Proposed Lifejacket Legislation for Rock Fishing – Noted

6.2 Land Use Study – Peter Munro, NSW Ports

- NSW Ports advised that a Land Use Safety Study for Port Kembla is being undertaken by the Department of Planning and Environment. NSW Ports understands that the department has engaged consultants to prepare the study for Port Kembla. NSW Ports understands that the study will be completed by early 2023. Queries about the study should be directed to the department.
- Separately, the planning rules for bulk liquid storage and handling developments at Port Kembla have been amended to “switch off” the standard complying development pathway. This change does not apply to other types of port development, as set out in Schedule 11 of the Transport and Infrastructure SEPP 2021.

6.3 Manildra DA approval process – Mark Peterlin

- The community is concerned that is noted that Manildra had discussions with the community regarding the DA.

Queries relating to:	**Responses/Updates**
Community member notes that the Department of Planning communications refer to community consultation by Manildra. Mark believes this consultation has not happened or has been inadequate.	Mark Peterlin wrote to Deanna Burn. No reply as yet. **ACTION:** Peter Munro said he would clarify what community consultation was had in relation to the DA proposal. He subsequently sent the following information to members via email: “Following on from discussion at yesterday’s meeting about Manildra Group’s community consultation, I would like to refer members to two documents that are available on the Department of Planning website, along with Manildra’s other EIS documents: https://www.planningportal.nsw.gov.au/major-

	projects/projects/manildra-port-kembla-bulk-liquid-terminal. Specifically: - Manildra-Port Kembla_Environmental Impact Statement_D. I refer you to section 6 (pages 62-72), "Consultation and stakeholder engagement". The document contains a summary of the consultation that has taken place to date, including community feedback, plus details of future consultation. - APPK_Community Consultation Materials. This document contains copies of the materials that have been provided to the community and advertised locally. You will find both documents on the website under the EIS tab. The documents are too large to send as attachments via email. The proposal remains on public exhibition for submissions and feedback until 15 August. I encourage anyone interested in the proposal to review the documents and make a submission.
The Community is also concerned with the additional trucks on the road and the use of Downey's bridge.	Karl from Wollongong City Council works on SEARS and notes that Downey's Bridge will no longer be used as a transport route. Karl also noted that he has requested the traffic report.

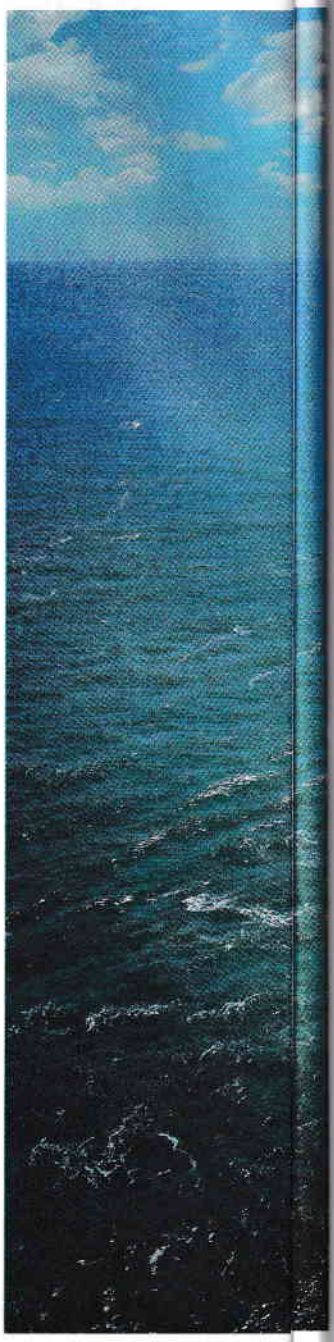
- Philip noted that the Moss Vale–Unanderra rail line has been closed for months. Peter Munro advised that the authorities are carrying out repair works and the line, which has been closed since March, is expected to reopen in September. Everyone is looking forward to the line becoming operational again.
- Mark Peterlin made special mention that the first women involved in life saving activities were from Pork Kembla Life Saving Club. There will be a dedication/monument recognising these four women.

7. Next Meeting:

DATE: 11 October 2022
VENUE: Inside Industry, BlueScope
TIME: 9am to 11am

THE BLUE ACCELERATION

Humanity's expansionist drive is increasingly taking us into the deep ocean. How can we balance that with vital environmental protections, asks **Graham Lawton**



NARVIK/GETTY IMAGES

IN THE 1970s, the tiny Pacific island state of Nauru was briefly one of the richest countries in the world. Its per-capita income was on a par with Saudi Arabia, only this wealth was built not on oil, but on faeces. For millennia, passing seabirds deposited their droppings on the island, creating a thick crust of phosphate-rich guano, ripe to be made into fertiliser.

It didn't last: the guano was all scraped away around 20 years ago. Now Nauru, no longer filthy rich, is the prime mover in another, controversial push to exploit resources. As of last year, the country is fronting an effort to kick-start deep-sea mining in the Pacific, perhaps as early as 2023.

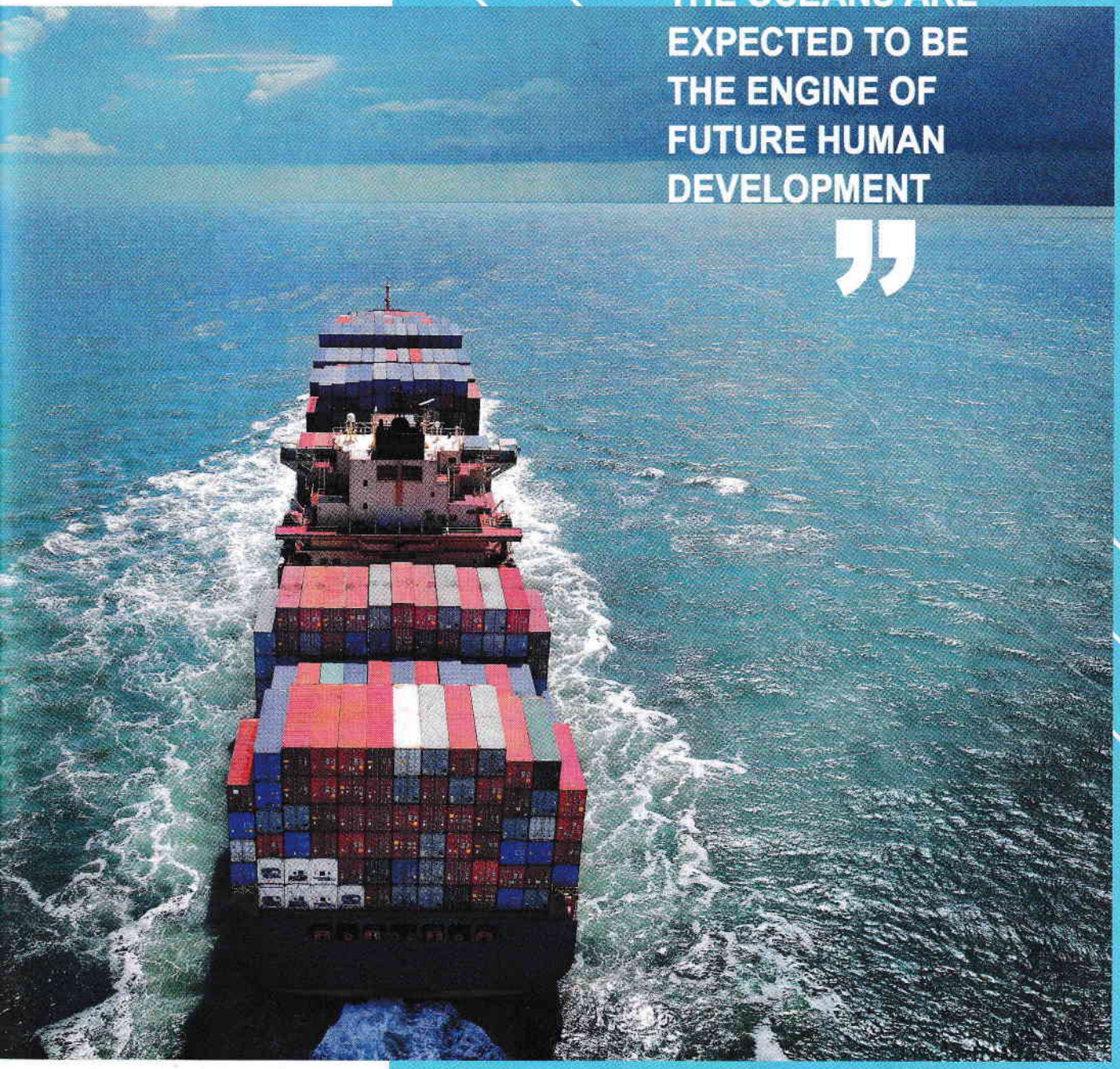
It is a microcosm of a much wider story. As pressures on Earth's land grow and terrestrial resources look increasingly exhausted, governments and corporations are seeing the next big wins on, in and under the high seas. Whether it is mineral exploration, shipping, energy, tourism, desalination, cable laying, bioprospecting or more, ocean-based industries are picking up speed fast.

This "blue acceleration" has many people worried. Our record on sustainable development on land is hardly good. With the power to profit from remote ocean resources growing rapidly, and the laws that govern their exploitation less than clear, we risk a free-for-all in the deep. "Our society has been based on the degradation of nature, destruction of nature," says marine ecologist Enric Sala, a National Geographic Explorer in Residence. "It is very important to understand that we cannot repeat the mistakes of the land in the ocean." The multibillion-dollar question is: how?

Exploiting – indeed, overexploiting – the oceans isn't a new story. Think of the collapse of whale populations through hunting in the 19th and 20th centuries, the loss of once-plentiful fisheries and the destruction of the seabed by bottom trawling. But in the past decade or so, our interest in the oceans has taken on entirely new dimensions. In 2016, the OECD, a club of rich-world countries, forecast that the marine economy would become a key driver of global economic growth, doubling in size to around $3 trillion between 2010 and 2030.

"We are in a new phase of humanity's relationship with the ocean," says Jean-Baptiste Jouffray at the Stockholm Resilience Centre at Stockholm University in Sweden. "You have all these hopes and expectations for the ocean to be the next economic frontier and the engine of future human development." Jouffray and his colleagues coined the term blue acceleration in a paper they published in 2020. It riffs off the Great Acceleration, the name given to the period starting in about 1950 when every measure of humanity's impact ›

> THE OCEANS ARE EXPECTED TO BE THE ENGINE OF FUTURE HUMAN DEVELOPMENT



Container shipping now carries 80 per cent of global trade by volume

WHAT MAKES THE OCEANS DIFFERENT?

Switching to more sustainable development on land is hard enough, but the OECD report *The Ocean Economy in 2030* sets out nine things that make this even more difficult in the marine environment.

1. The sea is much larger than the land surface, subject to different legal regimes and with natural processes, species and ecosystems that cross between them.

2. Water is less transparent than air, making remote sensing of the oceans and the seabed more difficult.

3. The sea is more three-dimensional, adding to the complexity of mapping, planning and managing processes and activities within it.

4. It is fluid and interconnected, allowing for easier transport of pollutants and alien species.

5. Marine species travel further, making the management and tracking of resources more difficult.

6. Marine species can shift location rapidly, so measures to protect them in one place may be less effective as time goes by.

7. Nutrients and pollutants can cycle in the ocean for decades, making it harder to assess the long-term impact of human activities.

8. There is a lack of ownership and responsibility in much of the ocean, making regulation and exclusion of non-authorised activities harder.

9. Humans don't live in the ocean, requiring the development of new technologies for its exploitation and making law enforcement more difficult and costly.

MIGUEL NAVARRO/GETTY IMAGES

Wind power could require 45,000 km² of European waters by 2050

› on the planet's land surfaces, from population growth to resource extraction, grew rapidly.

The new plunge into the ocean has come about in part because technologies – from ocean drilling and offshore wind turbines to desalination plants and factory trawlers – have made it possible. "A lot of offshore industries were unthinkable even just a few decades ago," says Jouffray.

And sustainable isn't exactly a word you would use for the bulk of today's marine industries. By far the largest sector of today's $1.7 trillion ocean economy is offshore production of climate-polluting oil and gas, which rakes in $830 billion a year, followed by the construction of marine equipment, fisheries and container shipping – the last a major, largely unregulated emitter of greenhouse gases. In this list, sustainable industries of the future barely register. Offshore wind trails in a distant 8th, with revenues of just $37 billion (see "Blue business: Power and comms", right).

That state of affairs is taking a toll. "The ocean is already in a deep crisis," says Sebastian Unger at the Institute for Advanced Sustainability Studies in Potsdam, Germany. More than 50 per cent of it is already impacted by biodiversity loss, noise from human activity, chemical influx and plastic pollution, he says, and few parts are completely untouched. Meanwhile, a target for 10 per cent of coastal and marine areas to be protected by 2020, especially those of particular importance for biodiversity, was missed, with 7.7 per cent protected in some way, only 2.7 per cent completely protected – and just 1 per cent of the high seas.

Visions of a more sustainable future have been swirling around since the 2010s, sometimes under the guise of the "blue economy" – although not everyone is a fan of that term, which can also be used to mean continued unsustainable exploitation. "That's not what we want to see," says Julian Barbière at UNESCO's Intergovernmental Oceanographic Commission. "We need to find the right balance between conservation and economic development."

Many factors currently militate against that. For a start, the current ocean economy is heavily concentrated in the hands of a small number of established companies. Nine of the 10 biggest are oil firms. Research led by John Virdin at Duke University in North Carolina found that in the eight largest sectors of the ocean economy – the five already mentioned, plus shipbuilding, cruise tourism and ports – just 100 companies hog 60 per cent of the revenues. They are largely headquartered in just six countries: the US, Saudi Arabia, China, Norway, France and the UK. "It's the usual suspects," says Jouffray.

And the status quo pays handsomely. Around 40 per cent of offshore oil and gas revenues, for example, end up in government coffers, and governments respond in kind ›

BLUE BUSINESS: POWER AND COMMS

The world's first offshore wind farm opened off the coast of Lolland, Denmark, in 1991. Since then, the global installed capacity has grown to nearly 35 gigawatts – enough to power the entire UK – almost all of it in European (25 GW) and Chinese (9 GW) waters. Other sources of ocean renewable energy are also being eyed up, including waves, tides, currents, salinity gradients, thermal gradients and marine biomass. The EU has a target of installing 1 GW of these alternative sources by 2030, says Benjamin Lehner at the Dutch Marine Energy Centre in The Hague.

All these figures are a drop in the ocean compared with the world's 1840 GW of gas-fired power capacity. Yet with wind power generation getting cheaper all the time – costs declined 70 per cent between 2012 and 2021 – rapid growth looks like a foregone conclusion. The trade association Wind Europe estimates that, by 2050, Europe will have 450 GW of offshore wind.

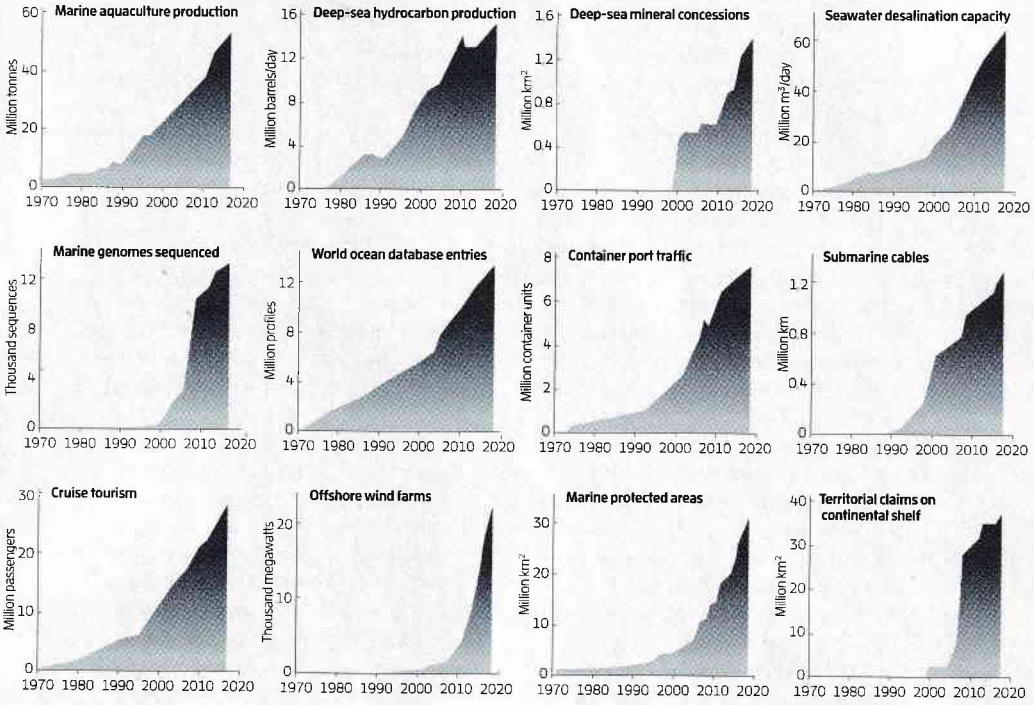
That brings its own challenges. It will require about 45,000 square kilometres of ocean, most of it between 11 and 22 kilometres from shore, the goldilocks zone for offshore wind. Europe has 550,000 square kilometres of this real estate in total, but more than 60 per cent is earmarked for marine protected areas, says António Sarmento at consultancy firm WavEC Offshore Renewables in Lisbon, Portugal. Building, operating and maintaining offshore wind farms can damage the seabed, while the power cables that carry electricity to shore emit electromagnetic fields to which some species are sensitive.

A possible answer, says Sarmento, is the "multi-use of maritime space" – combining wind farms with marine protected areas and adding in seaweed and shellfish farming. "We can create economic value, we can create local jobs and we can do something in benefit of the environment," he says.

Meanwhile, around 99 per cent of international telecommunications is carried by undersea fibre-optic cables.

RACE TO THE BOTTOM

Most measures of human activity in the ocean have increased significantly in the past half-century



SOURCE: JOUFFRAY ET AL. DOI.ORG/GG4RDF

> "WE CAN CREATE ECONOMIC VALUE AND JOBS AND PROTECT THE OCEAN ENVIRONMENT"

The current network, known as the "cloud beneath the sea", stretches for 1.4 million kilometres and is lengthening constantly as demand for bandwidth grows.

Cables are either buried in the sediment or simply laid on the sea floor. Both have a minimal ecological footprint, says Lionel Carter at Victoria University of Wellington, New Zealand, who was marine environmental adviser for the International Cable Protection Committee from 2003 to 2019. In fact, cables can have a positive effect on the environment, as critical infrastructure for sustainable development in lower-income parts of the world and a barrier to destructive trawling of the seabed for fish. The very first marine cable, a telegraph line laid between Dover and Calais in 1850, was caught and cut by French fishermen who mistook it for seaweed.

BLUE BUSINESS: DEEP-SEA MINING

Minerals companies have been coveting the deep seabed since the 1960s. According to one industry analysis, deep-sea mining could grow from essentially zero today into a $15-billion industry by 2030.

The International Seabed Authority, established in 1994 to regulate the industry's development, has handed out 31 exploration licences to 21 contractors so far. But it can't yet authorise commercial deep-sea mining operations as its member states are still thrashing out the rules.

That could be about to change. In June 2021, the Pacific island state of Nauru triggered a clause of the UN Convention on the Law of the Sea demanding that the rules be finalised within two years. It is acting as a state sponsor for a private firm, The Metals Company, based in Vancouver, Canada, that wants to develop a mine not near Nauru, but at the eastern end of the Clarion-Clipperton Zone (CCZ), on the other side of the Pacific Ocean roughly between Hawaii and Mexico.

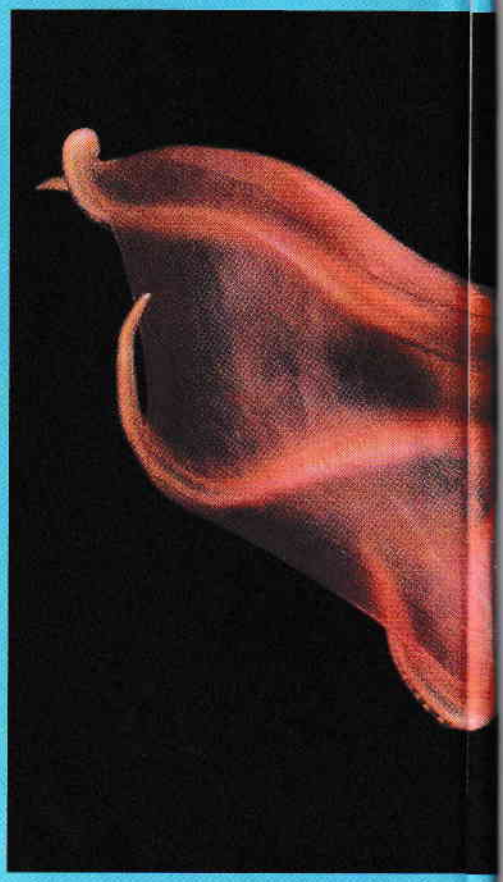
The CCZ is thick with potato-sized metallic nodules rich in nickel, cobalt, copper and manganese, all critical metals for the green energy transition. The nodules lie on the seabed and The Metals Company describes its planned operation as "collection" rather than mining. It and other proponents of deep-sea mining claim this approach is environmentally more benign than mining on land. The CCZ is mostly abyssal plain, the most common type of environment on Earth, covering about a third of the ocean floor. "It is pitch black, cold, high pressure and food-poor, resulting in 1500 times less biomass than in a rainforest," says Rory Usher at The Metals Company. "It is essentially a desert."

Others disagree. "There is remarkable diversity in these areas," says Megan Cook at the Ocean Exploration Trust. "We find many species here that rely on the nodules, using that hard platform of a nodule to grow off, like sponges and anemones, and we're still encountering dozens of new species each time an expedition goes there." The denser the nodules in an area, the richer the biodiversity, she says.

Two other sources of deep-sea metal ores have mining companies salivating: sulphides found around hydrothermal vents, and cobalt crusts covering flat-topped seamounts called guyots. Exploiting both is much more destructive than plucking loose nodules off the abyssal plain.

Nautilus Minerals, a Canadian company in which the government of Papua New Guinea held a stake, attempted to mine hydrothermal vents in the territorial waters of Papua New Guinea, starting in 2011. The venture collapsed in 2019. For now, the CCZ is the only part of the deep seabed outside national territorial waters in play for mining as it is the only area for which the International Seabed Authority has completed a mandatory piece of paperwork called a regional environmental management plan.

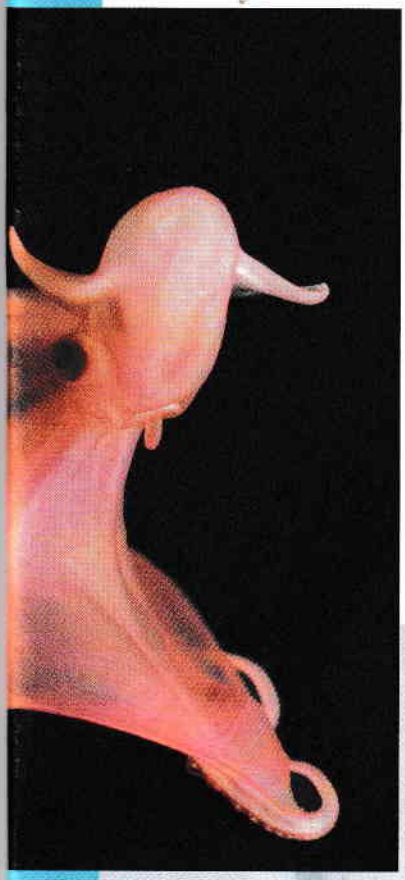
But Nauru may also have accessible minerals inside its own waters, which could be exploited once a deep-sea mining industry is established in the CCZ. Other island nations have signalled their intent to go down that road: the Cook Islands, for example, has nodules galore and plans to exploit them as soon as it can, even though its waters are designated as a marine protected zone. Such plans within territorial waters are beyond the reach of the International Seabed Authority. Around 900,000 square kilometres of seabed under national jurisdiction are under exploration for mining.



Many species that inhabit the deep sea, such as this glowing sucker octopus, remain under-researched

CAROLYN COLE/LOS ANGELES TIMES VIA GETTY IMAGES

Researchers disembark a ship in San Diego, California, from the Clarion-Clipperton Zone



DAVID SHALE/NATUREPL.COM

> "ONE HINDRANCE TO OCEAN CONSERVATION IS NOT KNOWING WHAT WE ARE CONSERVING"

THE UNKNOWN DEEP

The oft-quoted factoid that more people have walked on the moon than have visited the deepest part of the ocean, the Challenger Deep in the Pacific Ocean, is no longer true – the score stands at moon 12, ocean 22. But we still know little about the deep ocean, especially its remoter parts. "We only have about 20 per cent of the ocean sea floor mapped in high resolution. We only have systematic observation on the top 2000 metres, we have very little observation in the deeper parts," says Julian Barbière at UNESCO, the UN body that takes the lead on ocean science.

A complete map would be a big boost to ocean science, and is also essential for a more sustainable ocean economy. "You wouldn't build a city on an area that you haven't mapped; you wouldn't build a house in a field that you haven't mapped," says hydrographer Jamie McMichael-Phillips. "But we are operating in our oceans and using ocean resources when we haven't mapped our oceans."

"You need a map to figure out what you're going to do with these things," says Catherine Novelli, former under-secretary for economic growth, energy and the environment at the US Department of State. "Not only how are you going to conserve them, but how are you going to economically make use of the resources that are there. If we want to preserve the ocean so that it can be a sustainable resource, we have to have a map."

McMichael-Phillips is director of the Nippon Foundation-GEBCO Seabed 2030 Project. GEBCO stands for General Bathymetric Chart of the Oceans, a mapping project set up in 1903 by Prince Albert I of Monaco. It started life as a hand-drawn contour map created by dropping lead-weighted lines onto the seabed, but has since evolved into a high-resolution digital chart of sonar readings.

But sonar is slow and only 20 per cent of the chart is drawn. Seabed 2030 intends to capture the remaining 80 per cent in just over eight years, which McMichael-Phillips accepts is a "monumental task" – but a doable one. "We've calculated that it's 200 ship years: one ship operating for 200 years to map the ocean floor," he says. "You can drive that down to 50 ships in the remaining eight years. And that makes our mission entirely achievable."

› with lucrative subsidies. Over the past 10 years, less than 1 per cent of the total value of the ocean economy has been invested in sustainable projects via philanthropic grants and government assistance, says Jouffray. Redirecting subsidies that currently prop up overfishing and offshore fossil fuel development has been on the to-do list of the World Trade Organization (WTO) for 20 years.

There are some vaguely positive signs. Finance for the ocean economy largely comes from the world's big asset managers – BlackRock, Vanguard, State Street and the like. They are gradually seeing the light on green investment onshore, says Jouffray, and there is some hope the same thinking might percolate into offshore investments.

But it isn't just finance. Another hindrance to sustainable development and ocean conservation is simply a lack of knowledge of what we are trying to develop and conserve (see "The unknown deep", left). Then there is the disjointed way different ocean activities are – or are not – overseen by various UN agencies: shipping by the International Maritime Organization, fisheries by the Food and Agriculture Organization (FAO), biodiversity by the UN Environment Programme, science by UNESCO, and so on. "These sectors don't speak to each other," says Unger.

Cutting across this is UNCLOS, the UN Convention on the Law of the Sea, which came into force in 1994. This established "exclusive economic zones", or EEZs – areas of the sea out to 200 nautical miles (370 kilometres) from a country's shore over which it has full sovereignty and exploitation rights, provided there is no overlap with another country's EEZ. It also enshrined the relative lawlessness of what lies outside these zones. Technically called the Area Beyond National Jurisdiction, this is subdivided into "the Area", denoting the seabed and what lies beneath it, and "the High Seas", for the water column above it. The UN says resources in these places are the "common heritage of all mankind", while obliging every country to protect and preserve the marine environment.

"UNCLOS was an amazing, extraordinary achievement of international cooperation, but it leaves two-thirds of the ocean beyond jurisdiction," says Virdin. "At least, two-thirds of everything above the seabed." The Area is governed by the International Seabed Authority, established as part of UNCLOS to regulate future mining there – an issue that now, thanks to Nauru's move, has become very live (see "Blue business: Deep-sea mining", far left).

This gappy regulatory system has been left floundering in the wake of the ›

› blue acceleration. As recognition of the potential riches in EEZs has increased, nations' attempts to claim more of the sea as their own have too (see "Ocean grabbing", opposite page). Meanwhile, technology is making it easier to exploit parts of the high seas. The system as it stands makes sustainable development of the ocean all-but impossible, says Unger. "We need to transform how we are governing the ocean," he says.

In some places, this is happening, on paper at least. One example is the fishing industry. While UNCLOS guarantees access to the high seas, they are now far from the fishing wild west they once were, says Manuel Barange at the FAO. It helps that there aren't plenty of fish in the high seas. Nutrient availability means fish tend to be associated with a specific habitat, such as a sea bottom, a coral reef or a coastline. "In the middle of the ocean, you have tuna and marlin, but you don't have much more," says Barange. Large areas where fish actually live are now governed by a patchwork of some 50 agreements between countries known as Regional Fisheries Management Organisations (RFMOs) – something that should be extended to all international waters, says Barange.

Regulated the right way, there is no reason why our demand for seafood can't be supplied sustainably (see "Blue business: Aquaculture", right). The same goes for other aspects of the oceans. One effort to do this is the proposed UN-sponsored BBNJ treaty, for Biodiversity Beyond National Jurisdiction. Its principal goals are to lay down rules for the creation and protection of marine reserves, the requirement for environmental impact assessments of planned economic expansion into the high ›

> **"TWO-THIRDS OF THE OCEANS ARE CURRENTLY HARDLY REGULATED"**

BLUE BUSINESS: AQUACULTURE

MAHMUT SERDAR ALKUSINMEDOLU AGENCY VIA GETTY IMAGES

Humans eat seafood in copious quantity and variety. Annual global consumption is around 155 million tonnes, about a third of all of the animal flesh eaten in total, with demand forecast to double by 2050. More than 2000 species are consumed worldwide.

Even now, that has a devastating effect. Around 70 per cent of wild fish stocks are overfished, says Julian Barbière at UNESCO, while fishing methods such as bottom trawling are horribly destructive. Modern fishing vessels burn a lot of oil to chug around the ocean, haul their nets and refrigerate their catch, making the average carbon footprint of a kilogram of wild-caught fish greater than that of a kilogram of pork and approaching that of beef.

Overfishing meant hauls from wild-caught fisheries plateaued in the 1990s. Most growth in consumption since then has been supplied by farming, or aquaculture, which now provides half of the seafood eaten worldwide. It is no panacea, however. The Aichi targets on biodiversity, which were set in 2010 and expired in 2020, called for aquaculture to be "managed sustainably, ensuring conservation of biodiversity". Along with all the other targets, it was missed by a nautical mile. Among the charges against aquaculture are destruction of coastal wetlands, especially mangroves, huge energy cost and the inefficiencies of a system that relies on feeding small fry such as anchovies to larger fish.

The notion that aquaculture as currently practised can feed the world is nonsense, says Daniel Pauly at the University of British Columbia in Canada. "Actually, it can feed the rich. It takes fish that were available to poor people and turns them into fish that are preferred by rich people. It's as crude as that," he says.

In 2021, Jessica Gephart at the American University in Washington DC and her colleagues took a deep dive into what they call "blue food", a catch-all category for anything edible from fresh water or the sea. That includes fish, shellfish and cephalopods, but also an aquarium of lesser-eaten creatures such as sea cucumbers, jellyfish, seaweed and microalgae. If managed carefully, they concluded, blue foods have a lot of room for sustainable growth. "There is such a thing as sustainably managed fisheries," says John Virdin at Duke University in North Carolina. "It takes smart rules and enforcing those rules, but it can be done. And it's not impossible to do aquaculture sustainably."

Part of that is eating more seaweed and bivalves such as oysters and mussels, which have a minimal environmental impact and can be powerful carbon sinks. It may mean more salmon, which can thrive on a vegan diet and have a footprint comparable to rearing chickens, the most efficient form of land-based meat. Sea urchins also look promising. Farmed bluefin tuna isn't the answer, but wild-caught tuna may be, provided the fishing industry switches to less energy-intensive trawlers and fishing gear.

OCEAN GRABBING

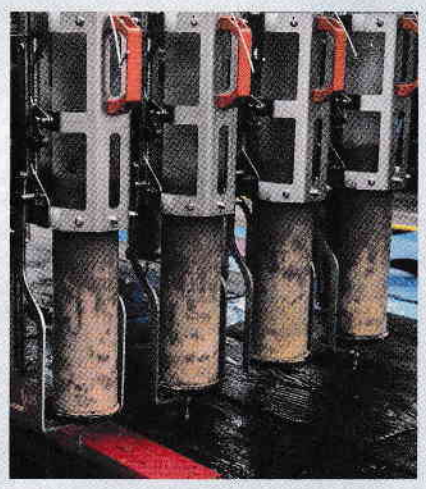
Nauru is the smallest island nation on Earth, with a land area of 21 square kilometres, little bigger than the London Borough of Hackney. If you count its exclusive economic zone (EEZ), stretching up to 200 nautical miles out to sea in each direction, however, that increases to 308,480 square kilometres, around 15,000 times bigger than the island itself and roughly the size of Poland. Other island nations command even vaster areas by virtue of being scattered archipelagos. Nauru's neighbour Kiribati, which is composed of 33 atolls and islands strung across 3.5 million square kilometres of the equatorial Pacific, is the 172nd largest nation on Earth by land area, but the 12th by EEZ.

These island nations are increasingly rebranding themselves. "We may be small island developing states, but we are also large ocean developing states. We are a lot bigger than we think we are," Camillo Gonsalves, minister of finance of St Vincent and the Grenadines, told a meeting of the Organisation of Eastern Caribbean States in 2020. "We must cast our eyes outward and recognise that the beach or the coastline is not the edge of our world, but the beginning of the immense untapped resource that can sustainably fuel our growth and development."

The realisation that surrounding seas may harbour vast untapped wealth has added another dimension to the "blue acceleration" (see main story), called ocean grabbing. This is where a country attempts to extend its marine territory by claiming dots of land or discovering hitherto-unknown bits of continental shelf: under the UN Convention on the Law of the Sea, countries can claim areas of continental shelf as their own even if they lie beyond 200 nautical miles from the shore.

Russia set the ball rolling in 2001 when it claimed 1.2 million square kilometres of the Arctic Ocean along an the undersea Lomonosov Ridge, which it says is an extension of Siberia. Denmark begs to differ, claiming that the feature it calls Lomonosovryggen is an extension of Greenland.

Since then, 83 other countries have submitted claims to the UN, totalling over 37 million square kilometres of sea floor. Some have succeeded. In 2012, Australia claimed and was later granted more than 2.5 million square kilometres of seabed around a remote cluster of uninhabited islets in the Southern Ocean. "It has literally been a scramble for the seabed," says Jean-Baptiste Jouffray at Stockholm University in Sweden.



THE METALS COMPANY

Top left: A tuna farm near Izmir, Turkey. Above right: The Nauru government is sponsoring Canada-based The Metals Company to harvest metal-containing nodules from the ocean floor

› seas, and the fair and sustainable use of genetic resources, seen as important for the emerging ocean biotechnology industry (see "Blue business: Ocean bioprospecting", page 46). The completion of the BBNJ would be "an important step to create this new vision" of ocean governance for the two-thirds of it that is currently hardly regulated, says Unger. The negotiations have been dragging on for years, however, and the latest round of talks broke up in March without the hoped-for agreement.

Meanwhile, at the delayed Convention for Biological Diversity summit in Kunming, China, later this year, nations are due to agree a new set of biodiversity targets for 2030. Despite the comprehensive failure to meet the previous targets set in Aichi, Japan, in 2010 – including one for marine conservation areas – the 2030 draft agreement is significantly more ambitious, calling for at least 30 per cent of land, freshwater areas and oceans to be protected by the end of the decade (16 April, p 48). This "30 by 30" target would be a "game changer" for ocean conservation, according to Peter Thomson, the UN secretary-general's special envoy for the ocean.

There are reasons to be optimistic about the ocean part of the biodiversity goals this time round, says Sala. "We see countries understanding that there is no future to their ocean economies without protected areas." Fishing areas, for example, are much more productive and sustainable if they are next to zones where catching fish is banned.

More than 70 countries have pledged to hit 30 by 30 by joining the UK-led Global Ocean Alliance; more than 90 nations have joined the High Ambition Coalition for Nature and People, which is committed to 30 by 30 on land and sea. Last year, the UK created the 700,000-square-kilometre Tristan da Cunha Marine Protection Zone around this Atlantic ›

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BLUE BUSINESS: OCEAN BIOPROSPECTING

In 1951, bioprospectors from the drug company Pfizer isolated a compound from a species of sponge they had discovered off Florida and the Bahamas. Named spongouridine, it was later developed into an antiviral called vidarabine, the world's first-ever marine-derived drug.

Marine species are highly interesting to the biotech industry as they have evolved to live in extremes of pressure, temperature, chemistry and darkness not found on land, giving them potential biological superpowers likely to be useful in biomedicine and industrial applications. More than 34,000 natural products from the ocean have been identified as possibly useful to date, including one sponge-derived compound that was adapted to create the groundbreaking drug AZT, the first treatment for HIV infection. Since 1988, some 13,000 marine genetic sequences from 865 marine species have been patented. Around three-quarters are from microorganisms, but genes have also been extracted from fish, crustaceans, corals, molluscs, sponges and even whales.

As yet, this bounty has only yielded a handful of actual products, but advances in remotely operated vehicles and sampling technologies is expected to spur it on. By 2025, the global market for marine biotechnology is projected to reach $6.4 billion, according to Jean-Baptiste Jouffray at Stockholm University, Sweden.

> archipelago and Costa Rica expanded the size of its Cocos Island National Park in the Pacific Ocean by 27 times. "We've seen this incredible increase, exponential increase, in the surface of the ocean that has been protected," says Sala.

There are other hopeful signs, too. The Glasgow Climate Pact, signed at the COP26 summit in November 2021, put ocean warming and acidification firmly on the to-do list, while the next round of climate talks, in Egypt this November, will continue the work of curbing what Thomson says is the "central nemesis of the ocean's problems" – greenhouse gas emissions. Even the shipping industry, a notorious laggard on this, is starting to think seriously about decarbonisation, with member states of the International Maritime Organization now committed to reducing shipping emissions by at least 40 per cent between 2008 and 2030 and reportedly tacking towards a commitment to hit net zero by 2050.

Meanwhile last month, the world agreed to negotiate a treaty to deal with plastic pollution. In June, the WTO will again attempt to abolish harmful fisheries subsidies, which currently fund industrialised plunder of fish stocks to the tune of $20 to $30 billion a year. Next up is the UN Ocean Conference in Lisbon, Portugal, in June and July, which will aim to set out the route to a science-based sustainable ocean economy with major participation from private companies and financiers.

But all of this is happening as the clock ticks. Virdin sees two possible trajectories between now and 2030, which is just a way station to 2050, a date the UN wants humanity to be living in harmony with nature again. One is business as usual, where we mindlessly trundle sideways like a crab. Another is much more positive, says Virdin. "Protection ramps up, maybe we hit 30 by 30. Shipping decarbonises, our emissions trajectory goes down. The WTO bans or reduces fishing subsidies. We develop standard reporting systems for the ecological and social footprint of the growing ocean economy. We get a treaty that sets meaningful targets to reduce the plastic waste. And then we start getting into ecological restoration, people see the merits in investing in that and it becomes a natural climate solution. That's a good scenario for 2030," he says.

Decisions we take this year will determine whether it is possible, and how far we move from the current situation to an ocean economy that is profitable, sustainable and equitable. "There are success stories, there are causes for optimism," says Virdin. "I am not a fatalist that it cannot be done, or that we shouldn't do everything we can to bend the curve."

It will still be a hell of a big ship to turn around. "We have major biodiversity loss, pollution and overfishing," says Barbière. "But if by 2030 we have sustainable ocean planning processes across all countries around the world, we will be in a much better shape than we are now. I think that is possible." ∎

SVEN ZEA/SPONGEGUIDE.ORG

The antiviral drug vidarabine was extracted from the sponge *Tectitethya crypta*

> "DECISIONS WE TAKE THIS YEAR WILL DECIDE HOW SUSTAINABLE THE OCEAN'S FUTURE IS"

Graham Lawton is a feature writer for *New Scientist*

THE HIGH SEAS

The rise in sea levels driven by global warming is a disaster in slow motion. How do we respond most effectively, asks **Simon Usborne**

AMINATH SHAUNA grew up on the Addu Atoll, a small group of islands in the Maldives whose villages and beach resorts are spread around a central lagoon. When viewed from above, it all looks about as permanent as the ring left by a coffee cup.

Low-lying islands like those of the Maldives, where half a million people live barely a metre above the Indian Ocean, are ground zero when it comes to the threat of rising sea levels driven by global warming. "One of my earliest memories is of a tidal swell and a big breadfruit tree falling down right in front of our house," says Aminath, now in her 30s. "This is something I have grown up with."

But the effects of rising seas will be felt far and wide. In the worst-case scenario, average sea level could rise by nearly 2.5 metres this century. Even a fraction of this would be

SHUTTERSTOCK/ [illegible]

catastrophic. Globally, over a quarter of a billion people live less than 2 metres above sea level, including in cities such as Jakarta, Rio de Janeiro and Miami.

Aminath knows this all too well. As the environment and climate change minister for the Maldives, she is part of a community of politicians and scientists trying to work out how quickly sea levels will rise, if this can be slowed and what it means for us all. In some places, new ways of holding back the tide may buy us a few decades. Elsewhere, this won't be possible. We are facing a disaster unfolding in slow motion. Responding effectively means a sea change in the way we think.

Earth's water lives almost entirely in the oceans or in polar ice caps. Sea levels are largely determined by the balance between evaporating seawater and melting ice returning as liquid to the oceans. If evaporation and melting are equal, all is well. "But as the climate warms, evaporation and snowfall increases a little bit, but the amount of water returned goes way, way up," says glaciologist Sridhar Anandakrishnan at Pennsylvania State University.

Sea levels are going up, then, but that isn't as simple as filling a bath. There is no single equation setting out how much a given amount of warming raises sea levels, because multiple factors are at play. Warming water expands, causing levels to rise even without ice melting. The seabed can subside as more water enters the oceans, lessening the effective rise in the surface level. The weakened gravitational pull of melted ice caps can have an impact too, as can the regional effects of prevailing winds and swirling ocean currents.

It isn't even easy to figure out how sea levels have changed in the deep past – they can vary from place to place and, until recently, there wasn't a good enough spread of geological samples that record past sea levels from a variety of locations around the globe. In 2016, a team led by Robert Kopp at Rutgers University in New Jersey compiled a database of indicators that tell us the sea level over the past 3000 years in 24 locations and used statistics to calculate the average past sea level. This work showed that the ocean surface went up and down by no more than 8 centimetres for most of those three millennia. Between 1900 and 2016, however, the level rose by 14 centimetres. Estimates suggest it has risen another 8 centimetres since then.

What happens next depends on how much we cut greenhouse emissions in response to the climate crisis, but seas will continue to rise in the medium term no matter what we do. "The best we can hope for in the next 100 years is that the rate of rise remains constant," says oceanographer Stefan Rahmstorf at the University of Potsdam in Germany.

Our most robust estimates of this rise come from the Intergovernmental Panel on Climate Change (IPCC), which collates published scientific evidence. Rahmstorf says the IPCC has traditionally been accused by climatologists of underestimating future sea level rises. But he says he gasped when he read its latest report, released last August. It sets out the sea level changes we can expect under several scenarios that differ significantly according to what action humanity takes to reduce emissions (see "How much will the seas rise?", page 47). Even under the most optimistic scenario, in which global carbon emissions are cut to net zero by 2050, a further 50 centimetres of sea level rise is predicted by 2100. On the other hand, if little action is taken on emissions and the climate proves highly sensitive to this, we might see a rise of nearly 2.5 metres by 2100 and 5 metres by 2150.

One of the big uncertainties in these predictions is how the Antarctic ice sheets will respond to warming temperatures. If scientists' worst fears are realised and the vast Thwaites glacier collapses, unleashing a huge tide of ice into the ocean, that could push us towards the more terrifying scenarios (see ›

"The doomsday glacier", opposite). However the future pans out, there will be bad news. "We have more than 150 cities with more than a million inhabitants on coasts around the world," says Rahmstorf. "Even a 1-metre rise is quite catastrophic. Five metres on that timescale would basically be an unimaginable disaster."

Precisely how many people will be affected has been tricky to gauge until recently because, strange as it may sound, there was a great deal of uncertainty about the height of the world's coastal dry land. Without a good handle on this, it is hard to establish which bits of coastline will be affected by each centimetre of ocean encroachment. "There hasn't been a proper elevation map for the world, which is odd because we have one for Mars and the moon," says Aljosja Hooijer, a water resources expert at Deltares, a research institute in the Netherlands.

Orbiting radar systems are typically used to determine topography, but these use signals that tend to bounce back off the first thing they hit. That isn't a problem on the moon, but on Earth, the presence of buildings and tree canopies can lead to overestimated elevations. For accurate data, we need lidar, a laser-based measurement system that can penetrate the densest canopy. This was only sparsely available until 2018, when NASA's ICESat-2 released a global database of elevation data measured with lidar.

Last year, Hooijer and his colleague Ronald Vernimmen, also at Deltares, combined this information with population data and established that 267 million people are at risk because they live on land that is less than 2 metres above sea level. If sea levels rise, the 2-metre zone of most at-risk land rises with it, putting more people in danger. Taking a reasonable projection of a 1-metre rise over the next 80 years – and assuming no change in the number and distribution of people in lowland areas – the researchers calculated that the population of this 2-metre zone will increase to at least 410 million by 2100, a number greater than the current US population. Of these people, 72 per cent will be in the tropics.

The most pressing problem for coastal communities and cities isn't the slow incursion of water, however, but what will come first: worsening tidal surges, storms and floods that will eventually make coastal areas unbearable to live in.

Engineering has long been the go-to solution, and projects are getting bigger across the world. In the Maldives, sea walls protect the capital Male, where more than 200,000 people live on an island roughly the size of London's

RIJKSWATERSTAAT

"A 5-metre sea level rise by 2150 would basically be an unimaginable disaster"

TRISWANTO/AP/SHUTTERSTOCK

A giant sea wall in Jakarta, Indonesia, will protect the city

Hyde Park. In 2020, the UK finished the £100 million Boston Barrier in Lincolnshire, which can be raised to cut off tidal surges along the river Witham, protecting the town of Boston upstream from flooding. It was activated for the first time in November after warnings of a dangerously high tide. In Jakarta, Indonesia, where land is sinking due to groundwater extraction, the Giant Sea Wall is being built. The $40 billion dyke designed to protect the city is due to be completed in 2025.

But physical defences like these are expensive, impermanent and, in some cases, unintentionally harmful. Take groynes, structures built perpendicularly out from beaches into the sea. A series of these is good at stopping protective sediment such as sand from being washed away along the coast through a process called longshore drift, but it can actually increase erosion after the last groyne because this area receives less sand than it would otherwise.

A softer solution has begun to catch on in the past decade. In the Netherlands, where a quarter of land lies below sea level, authorities are racing to protect eroding beaches. They typically dredge sand from the bottom of the North Sea once every three years or so and use it to nourish their beaches, staving off erosion. But in 2011, a new strategy was piloted. The Dutch government had a huge amount of sand – some 21.5 million cubic metres – dredged up and deposited in a heap just offshore. This was then left to be gradually

The Netherlands is trialling artificial offshore sandbars as a coastal defence

blown and washed away to form an offshore sandbar. The hope was that this would protect the coast for longer and reduce how often the bed of the North Sea had to be disturbed. While scientific studies on this "sand motor" are still to come, the Dutch government has published a 10-year report declaring it a success. The distributed sand has contributed to the growth of dunes, which provide further protection, while the numbers of feeding birds, including cormorants and terns, has risen. (The kitesurfers who found a playground in the lagoon behind the sandbar were happy too.) It is now expected that the project will last much longer than its intended 20-year lifespan. A similar sand motor was introduced in the UK in 2019, between Bacton and Walcott in Norfolk.

Meanwhile, so-called nature-based solutions are getting more attention too, not least because they help preserve biodiversity as well as protect coasts. Multiple studies have revealed the extent to which coral reefs are not only vital marine breeding and feeding grounds, but natural diffusers of wave energy. Aminath says the Maldives has so far given legal protection to 13 per cent of its reef area against future degradation caused by fishing or pollution. Elsewhere, artificial reefs – breakwaters made of rubble that attract marine species – are being considered specifically with erosion prevention in mind. A feasibility study of a beach in Kangwŏn province, South Korea, suggested that such a reef would reduce wave height by up to 70 per cent and cause large waves to break before they reach the shore. Mangrove forests are also known to attenuate wave power and there are projects around the world to both protect existing mangroves and plant new ones.

Where coastal protection is needed, decisions about what kind of scheme to implement and whether it is worth it come down to local conditions – and money. "If you can gain 100 years, that's worth the investment in many places," says Rahmstorf. "But if we're talking about 5 metres of sea level rise, that will really hit the limits of what we can do." Sooner or later, he says, we are going to be in a situation where coastal communities become unsustainable, creating extreme geopolitical problems, including a massive refugee crisis.

This means that, in many places, we are going to have to shift our mindset from what climate scientists call mitigation to adaptation. Instead of relying on technology and engineering to protect us from rising seas, we must change how and where we live.

High-income nations won't be immune. In the UK, the Environment Agency is still spending on coastal flood defences in some places in England. But in others, such as parts of Norfolk and Yorkshire, where cliffs are crumbling away at more than 1.5 metres a year, that is no longer always a viable option. There is a growing recognition that, in the coming decades, a managed retreat from the coast may be necessary in some places. "We're updating our understanding of erosion all the time, but some of the options are really difficult for people to comprehend," says Julie Foley, director of flood risk strategy and national adaptation at the Environment Agency.

The organisation doesn't have any firm plans for managed retreat yet. But there are already hints that it may be on the cards. In Withernsea in Yorkshire, some 24 homes are at risk of falling into the sea and need to be demolished, at a cost of up to £40,000 each. In the past, this bill would have been partly met by the local council, but it can't afford to pay for all the work. So there are calls for the UK government to stump up the cash. "We need to be thinking about how communities over a reasonable period of time start to think about how they can transition away from the coastline," says Foley. "That's a really difficult conversation."

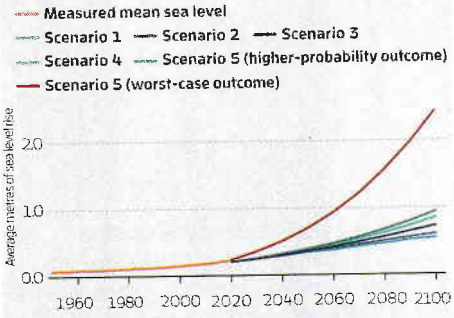
In some cases, we have gone as far as moving whole buildings inland, but only where they are historically important. In 2019, engineers laid temporary tracks to slide the 720-tonne Rubjerg Knude lighthouse in Denmark 70 metres away from crumbling cliffs. But even this may prove a short-term solution. The Belle Tout lighthouse at Beachy Head in East Sussex, UK, is now just 20 metres from the cliff edge, 23 years after it was shifted inland.

Back in the Maldives, Aminath is making plans for what she calls "population consolidation": the further relocation of people to higher ground. By 2019, 50,000 islanders had moved from across the country to Hulhumalé, a bigger, 2-metre-high island to the north of Male built with dredged sand. Since at least 2008, the Maldives has considered purchasing new territory away from its own islands, in India, Sri Lanka or Australia. Aminath clings to the hope that mitigating measures, allied with global action on emissions, may give her fellow islanders a lifeline. The stakes for her personally are now higher than ever: she recently had her first child. "It's very scary for me," she says, "to think that, one day, my 1-year-old daughter might not have a home." ▮

Simon Usborne is a journalist based in London

How much will the seas rise?

Although seas will rise at least 0.5 metres on average by 2100, anything beyond that will depend on how fast greenhouse gas emissions are cut. Forecasts for sea level rise are based on five emissions scenarios, ranging from the best (a global shift to clean energy, or scenario 1) to the worst (scenario 5). This chart shows the most probable outcomes for each scenario together with the worst possible outcome under scenario 5, which would see sea levels rise by almost 2.5 metres.



Source: IPCC, Sixth Assessment Report

The doomsday glacier

The Thwaites glacier is a Florida-sized chunk of West Antarctica that is so precariously poised above the warming Antarctic Ocean that it is known as the doomsday glacier. Unlike the other big Antarctic glaciers, which flow onto ice shelves, Thwaites flows straight into the ocean. The glacier's 160-kilometre face is totally exposed to the mingling currents of warming seawater, which swirl beneath its front section, creating vast cavities and causing rapid crumbling.

As its face retreats, the glacier's ice cliffs become higher and less stable, making further crumbling more likely. Worse still, Thwaites acts as a giant cork holding back a much larger expanse of ice poised on rock that slopes downwards behind it. As the melting gathers pace, the cork weakens, increasing the potential for a rapid collapse of vast quantities of ice. Thwaites alone contains enough ice to increase global sea levels by 65 centimetres.

Environment Protection Authority

Darcy Road Drain Port Kembla

Water Quality Monitoring Program
November 2020 to September 2021

Environment Protection Authority
August 2022

Acknowledgement of Country

The EPA acknowledges the traditional custodians of the land on which we live and work, and pay our respects to Elders past, present and future.

Background

Community sampling Oct 2020

- Identified elevated levels of some metals.
- As, Cu, Pb, & Zn above water quality guidelines

EPA Preliminary sampling Nov 2020

- EPA conducted preliminary sampling
- Results for most metals lower than October 2020 results

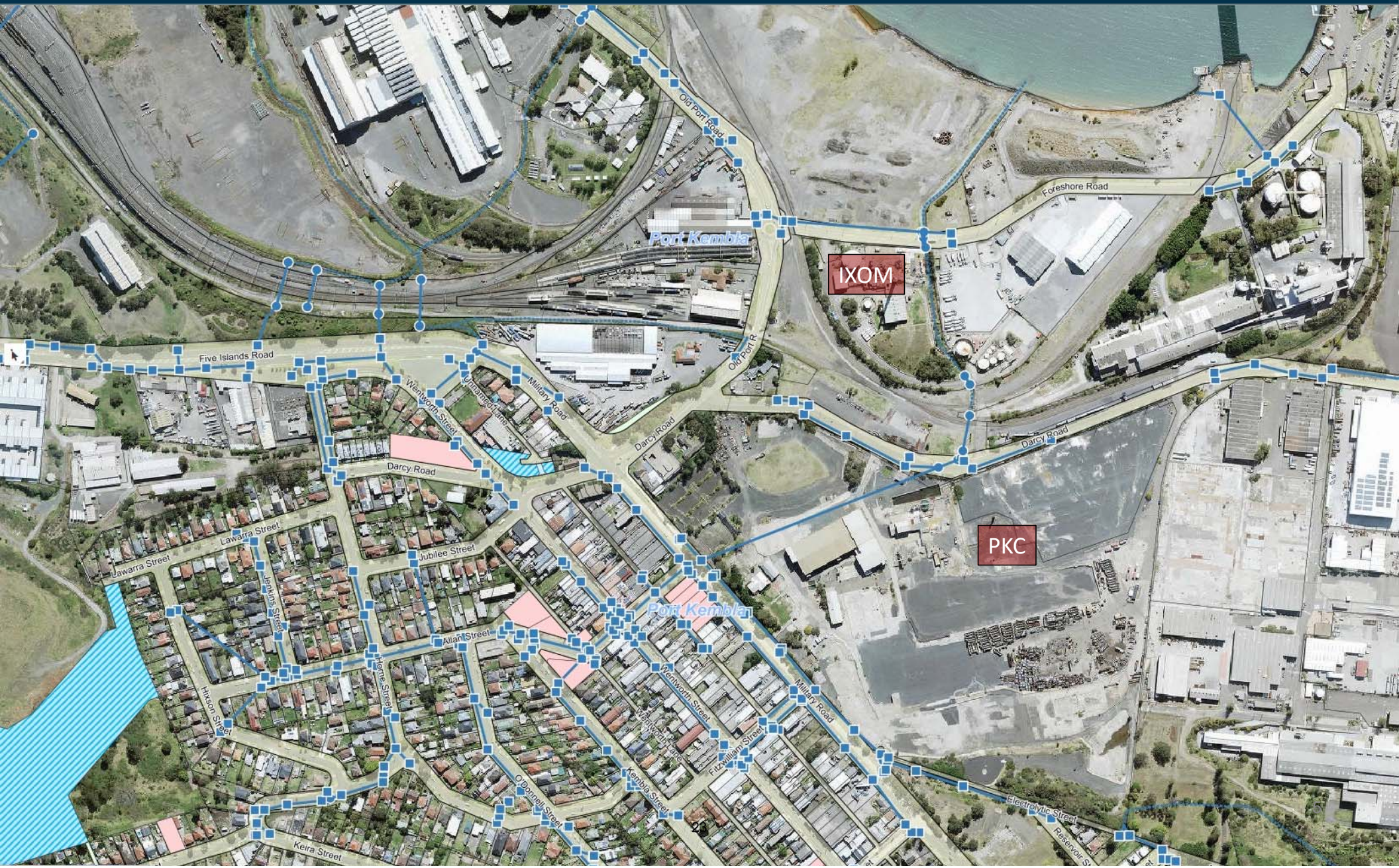
EPA 6-month sampling Jan 2021

- EPA commenced 6-month sampling program (9-months)
- Why? - Better understand the water quality in the drain
- Community involvement

About Darcy Road Drain

- Concrete lined stormwater drain
- Drains to Port Kembla outer harbour
- Tidal influence
- Stormwater from urban and industrial areas
- Diffuse (Port Kembla township) and point (Licensed premises) sources of heavy metals

About Darcy Road Drain



Sampling Program

- Nov 2020 to Sep 2021
- Two locations – FS1 & DAR1
- 31 samples (inc. QA/QC dup)
- Sampling conditions
  - low tide
  - different days & times
  - rainfall
  - discharges - PKC & IXOM
- Unannounced sampling
- Samples analysed for
  - Total & filtered metals
  - EC & pH
- Australian and New Zealand Guidelines for Fresh & Marine Water Quality (ANZG, 2018)

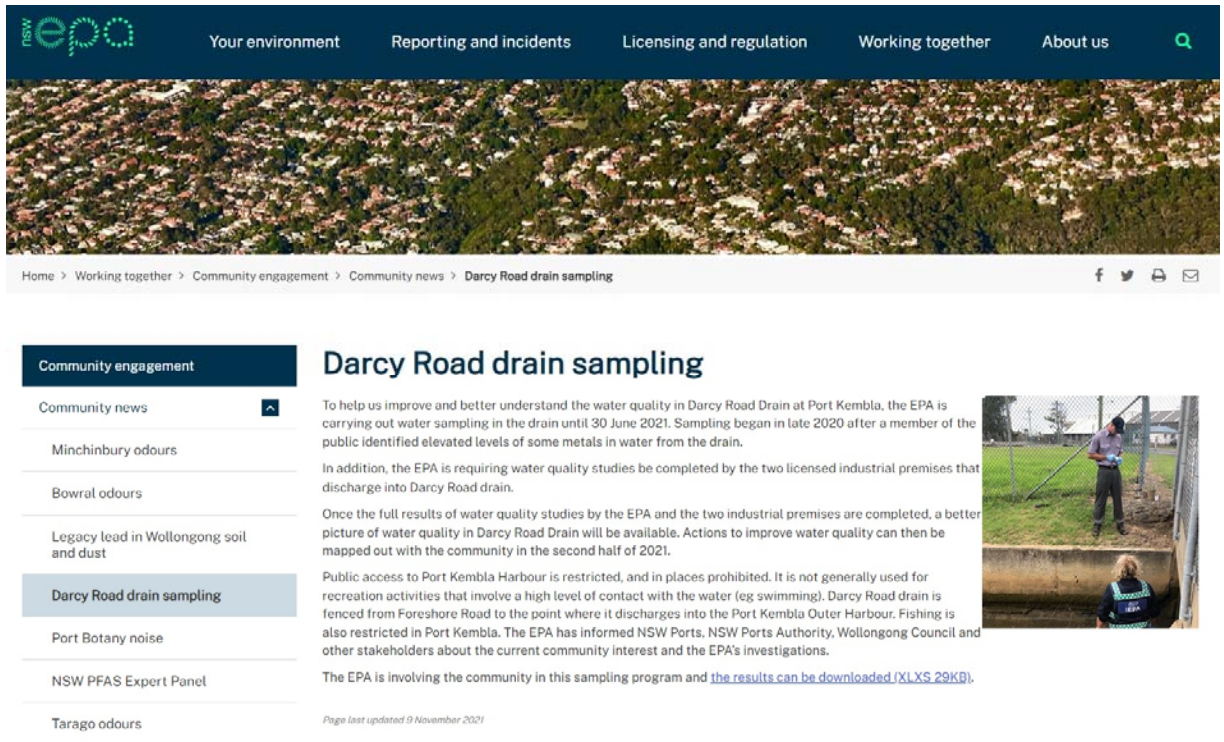
Australian and New Zealand Guidelines for Fresh and Marine Water Quality

- Helps identify appropriate guideline values for selected pollutants
- Guideline value as a quantity (threshold) below which we consider to be a low risk of unacceptable effects occurring.
- They are not limits
- Any result above a threshold is intended to prompt further investigation and evaluation of the issue
- https://www.waterquality.gov.au/anz-guidelines

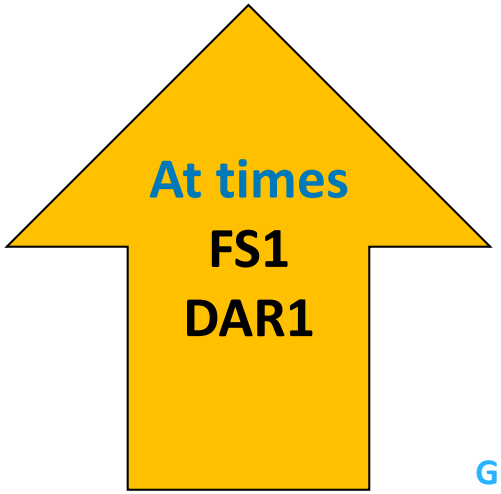
Sample results

- Results indicate poor water quality in the Darcy Road Drain
- Not unexpected given the long industrial history of the area
- Water quality influenced by rainfall, tidal and discharge conditions
- A range of point and diffuse pollutant sources related to both current and historical activities are likely to be contributing to the water quality in the drain

Full table of results
EPA website
(*click image*)



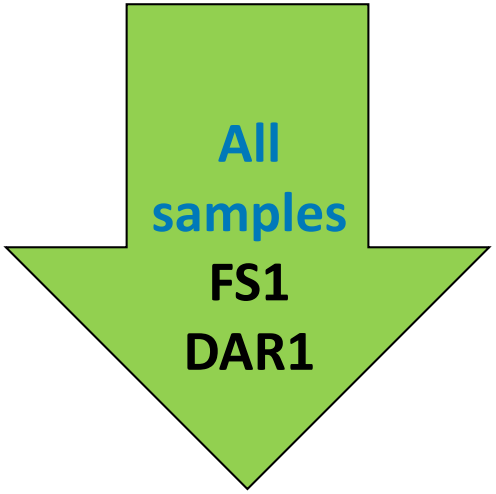
Sample results



Filtered concentrations

Cadmium, cobalt, copper, nickel and zinc

Guideline value (95%) - Slightly to moderately disturbed marine ecosystems

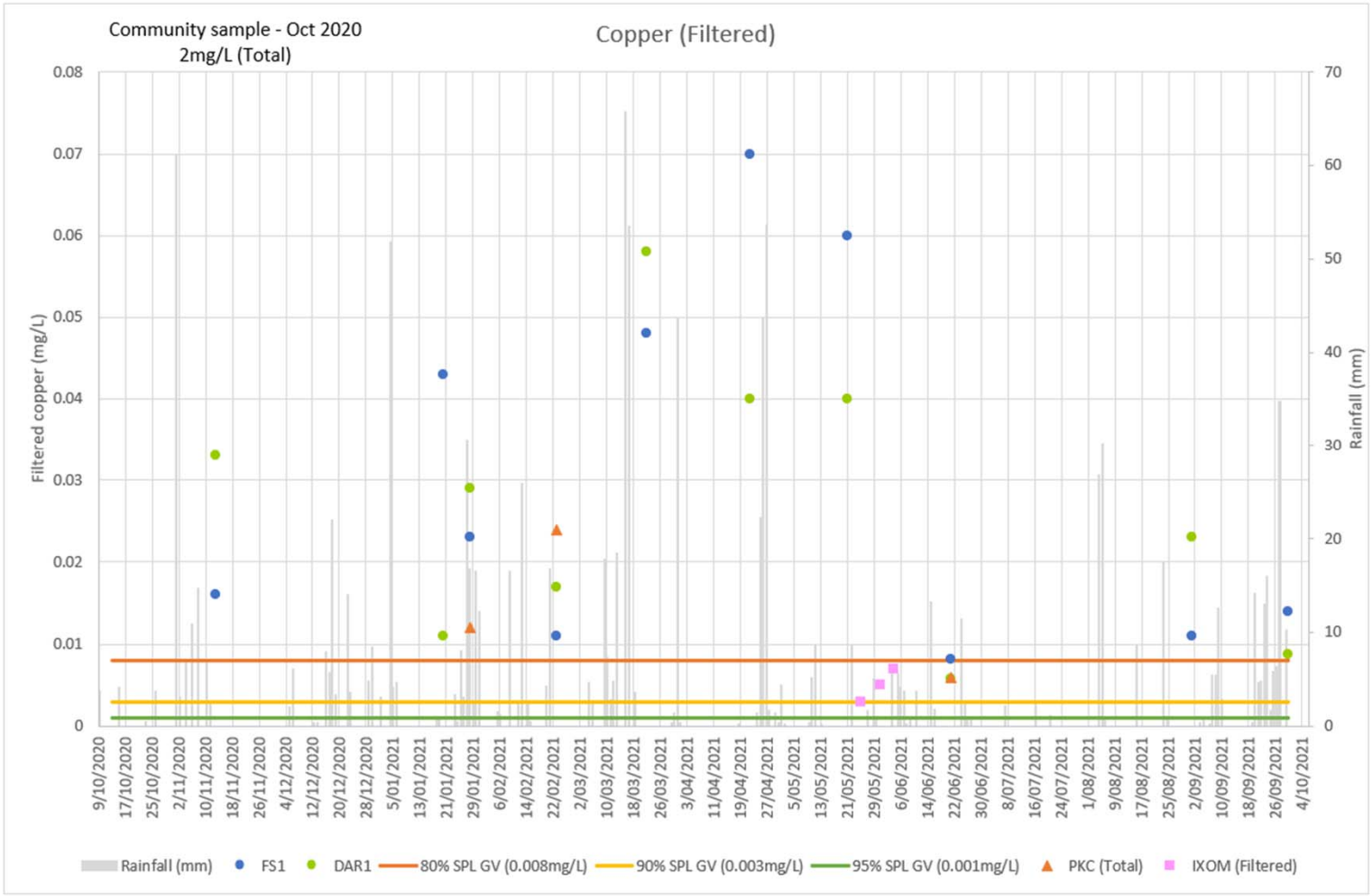


Filtered concentrations

Antimony, boron, chromium, lead, silver, thallium and vanadium

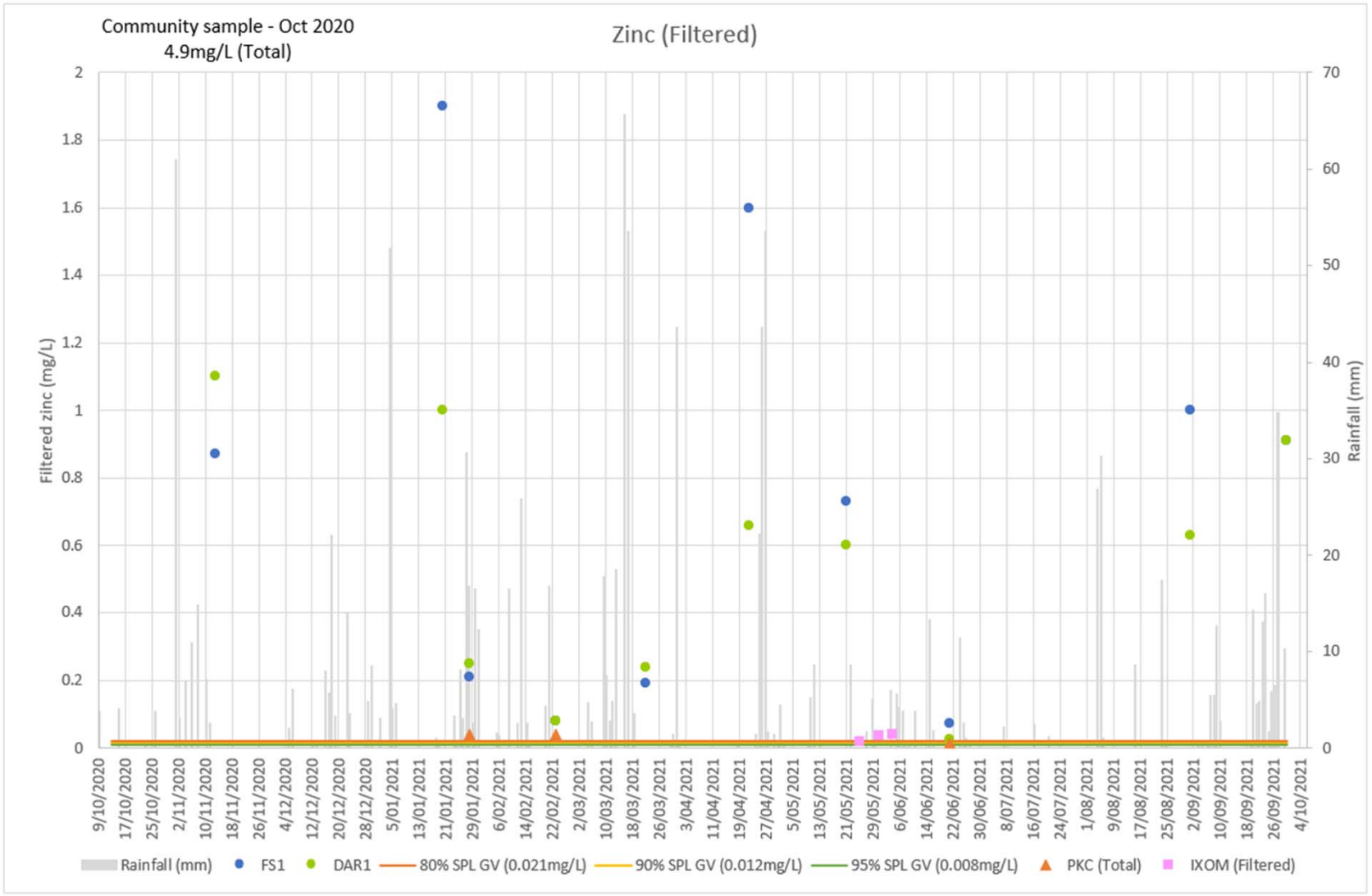
Sample results

- Copper & zinc were particularly elevated relative to the guideline values



Note: PKC discharges are monitored for concentrations of total metals (not filtered metals). Filtered metal concentrations would be lower than the total metal concentrations.

Sample results



Note: PKC discharges are monitored for concentrations of total metals (not filtered metals). Filtered metal concentrations would be lower than the total metal concentrations.

Regulation of Licensed Premises

PKC (EPL 1753)

- PKC required to continue to operate wastewater treatment plant
- Management strategies developed & implemented since 2016
- EPA accredited Site Auditor engaged to provide independent advice
- Investigations identified surface water contains elevated metals (ANZG)
- PKC identified seepage from former blending shed area as primary source
- New treatment plant installed in 2021 to treat BS seepage & discharge to sewer
- PKC continue to investigate & develop water management strategies in consultation with the auditor

IXOM (EPL 549)

- EPA required PRP for wastewater characterisation assessment in 2021
- Identified wastewater contained elevated metal concentrations at or above guideline values (ANZG)
- EPA required options report for a non-discharge option
- IXOM recently advised SARP now shutdown
- > 90% reduction in wastewater discharged
- IXOM has committed to no discharge of wastewater to Darcy Rd drain

Next steps

Next Steps

- Publish the report and continue to engage with the community
- Continue to work with PKC and IXOM in relation to discharges to the drain
- Engage with relevant state government departments (eg DPI Fisheries)
- Engage with Wollongong City Council in relation to non-licensed premises

Questions/Feedback