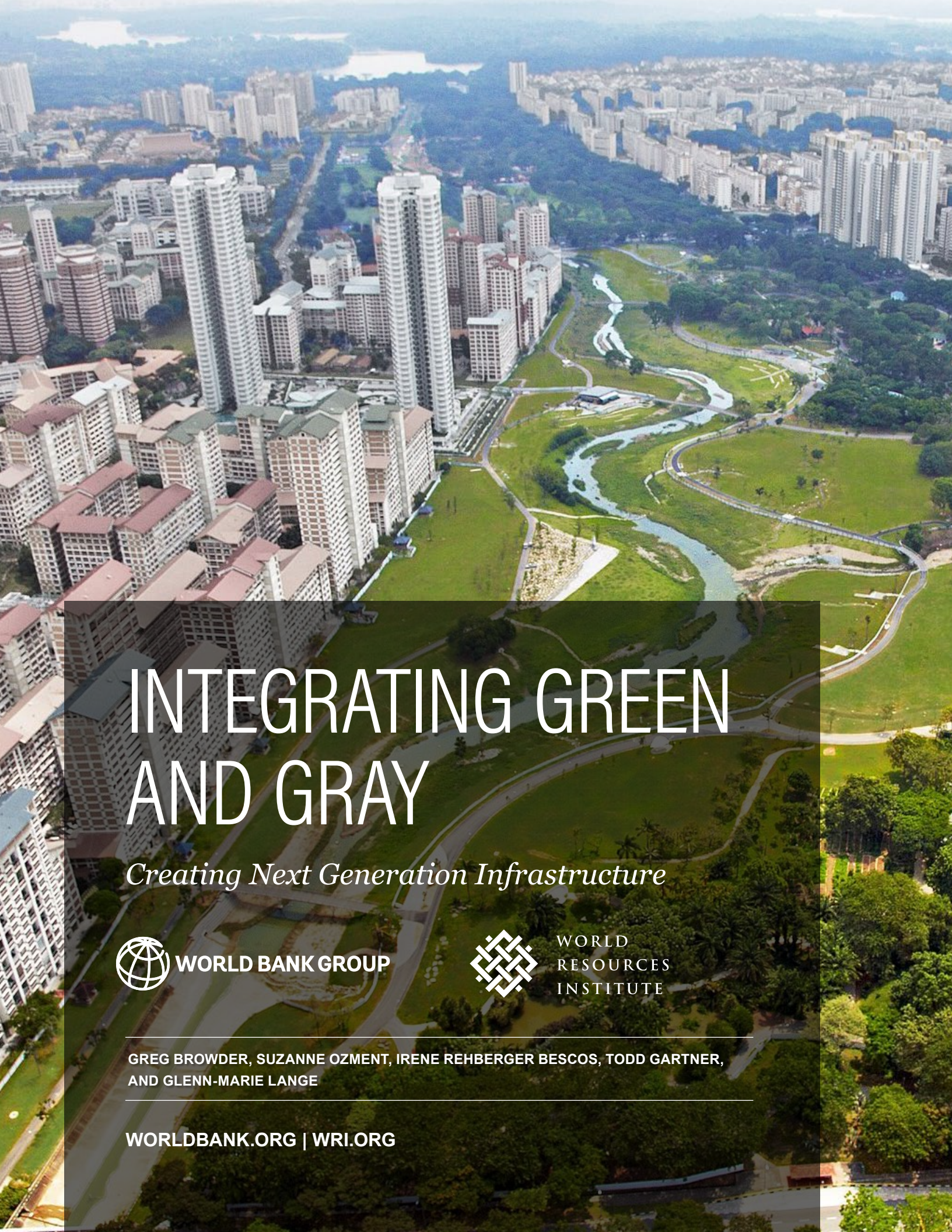

INTEGRATING GREEN AND GRAY

Creating Next Generation Infrastructure

WORLD BANK GROUP

WORLD RESOURCES INSTITUTE

GREG BROWDER, SUZANNE OZMENT, IRENE REHBERGER BESCOS, TODD GARTNER, AND GLENN-MARIE LANGE

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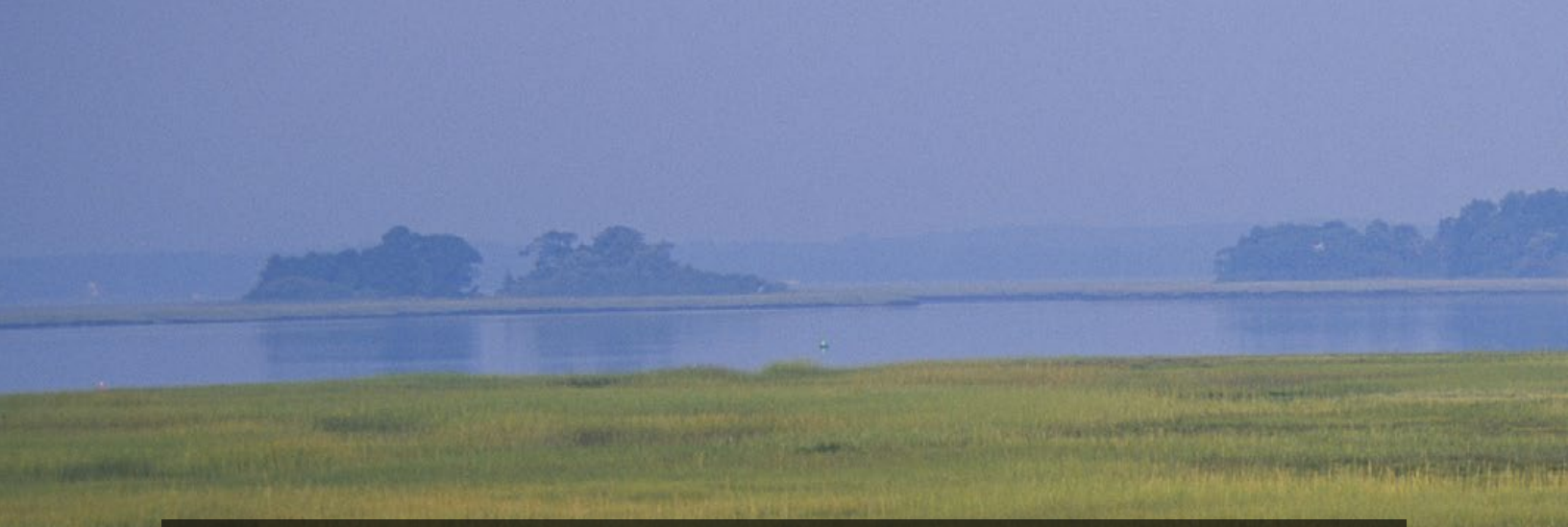

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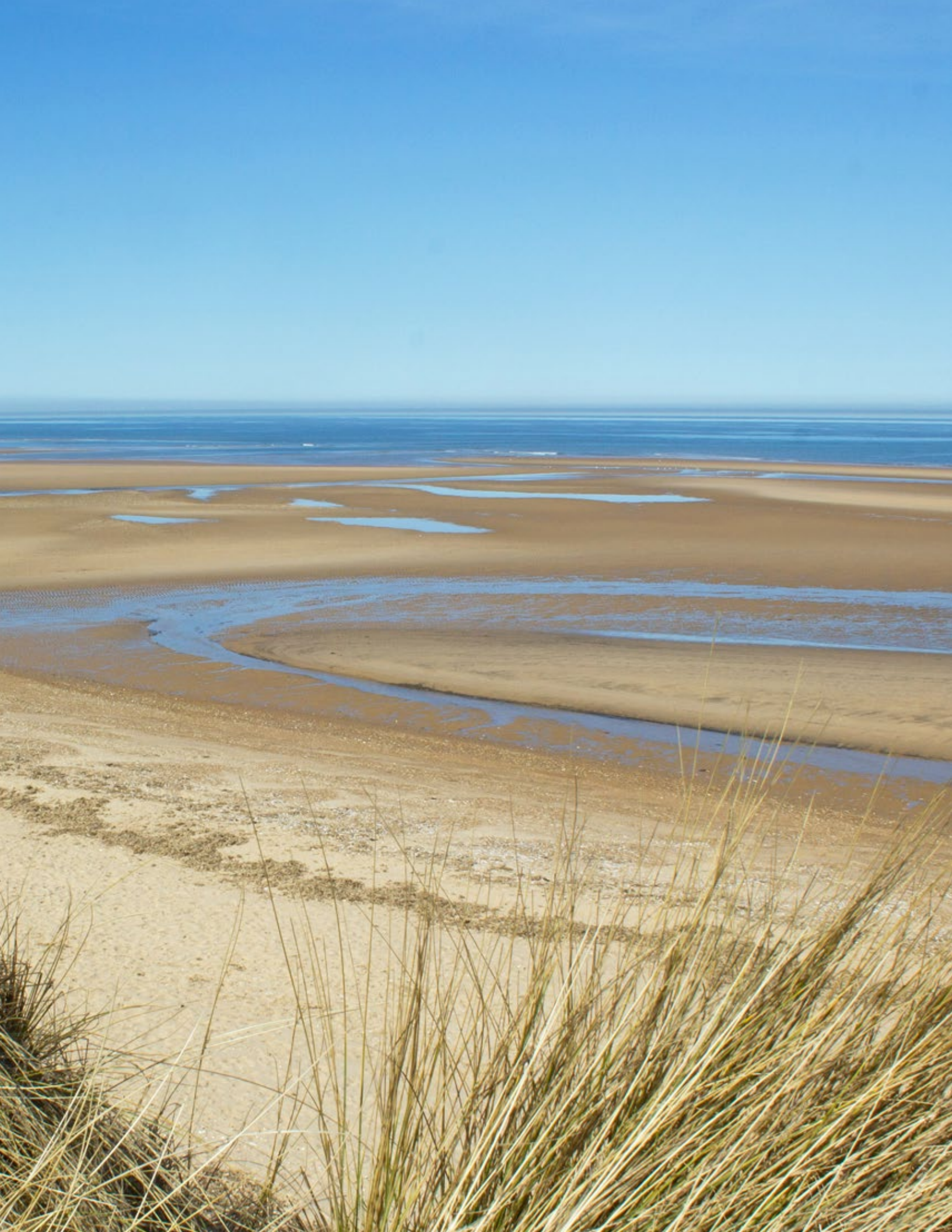

FOREWORD

The world has huge infrastructure needs for economic growth, jobs, and poverty reduction. In developing countries, achieving the infrastructure-related Sustainable Development Goals (SDGs) and staying on track to limit global temperature increase to two degrees could cost 4.5 percent to 8 percent of GDP, depending on how efficiently it is done. A traditional focus on exclusively human-built "gray" infrastructure would put costs at the higher end of that spectrum and make it more challenging to meet these needs.

But this challenge also provides an incentive to take advantage of an opportunity we have always had: using "green" systems such as forests, wetlands, and mangroves to complement gray infrastructure. By harnessing the power of nature, infrastructure services can be provided at a lower cost while delivering greater impact.

In this report, the World Bank and World Resources Institute show how the next generation of infrastructure projects can tap natural systems and, where appropriate, integrate green and gray infrastructure. This call for the next generation of infrastructure—both green and gray—echoes the World Bank's *Changing Wealth of Nations 2018* report, which showed that natural capital can be leveraged rather than liquidated through the development process.

Natural systems have long been recognized for their ability to deliver or contribute to core infrastructure services—water purification and storage, flood management, irrigation, and electricity generation. But, until now, there has been a lack of clear guidance on how to integrate green infrastructure into human-built projects so that they deliver better services at lower cost.

This report is, therefore, essential reading for those responsible for delivering infrastructure services. Water and power utilities, storm and flood management agencies, and irrigation departments can use the guidelines to integrate natural approaches into their plans. Public officials can learn to how to enable green-gray infrastructure development through improved policies, laws, and regulations. Ministries of Finance and Budget can gain insights on how to approach financing, often a major barrier for infrastructure, by opening new financing channels from mission-driven investors and governments.

The World Bank Group aims to elevate the role of natural infrastructure across its operations. It has committed to leveraging its finance to catalyze potentially billions of additional dollars from public and private sources for climate adaptation. To meet its ambitious goals in this area, ensuring that infrastructure performs well under a changing climate will be essential to success. World Resources Institute is also expanding its analytical, convening, and coalition-building roles in advancing natural infrastructure, while pioneering new financing models to increase investment in green-gray approaches.

The next generation of infrastructure can help drive economies and strengthen communities and the environment. But this needs governments, service providers, and development agencies to work together to amplify the benefits of natural solutions. We hope this report provides them with the inspiration and guidance to do just that.

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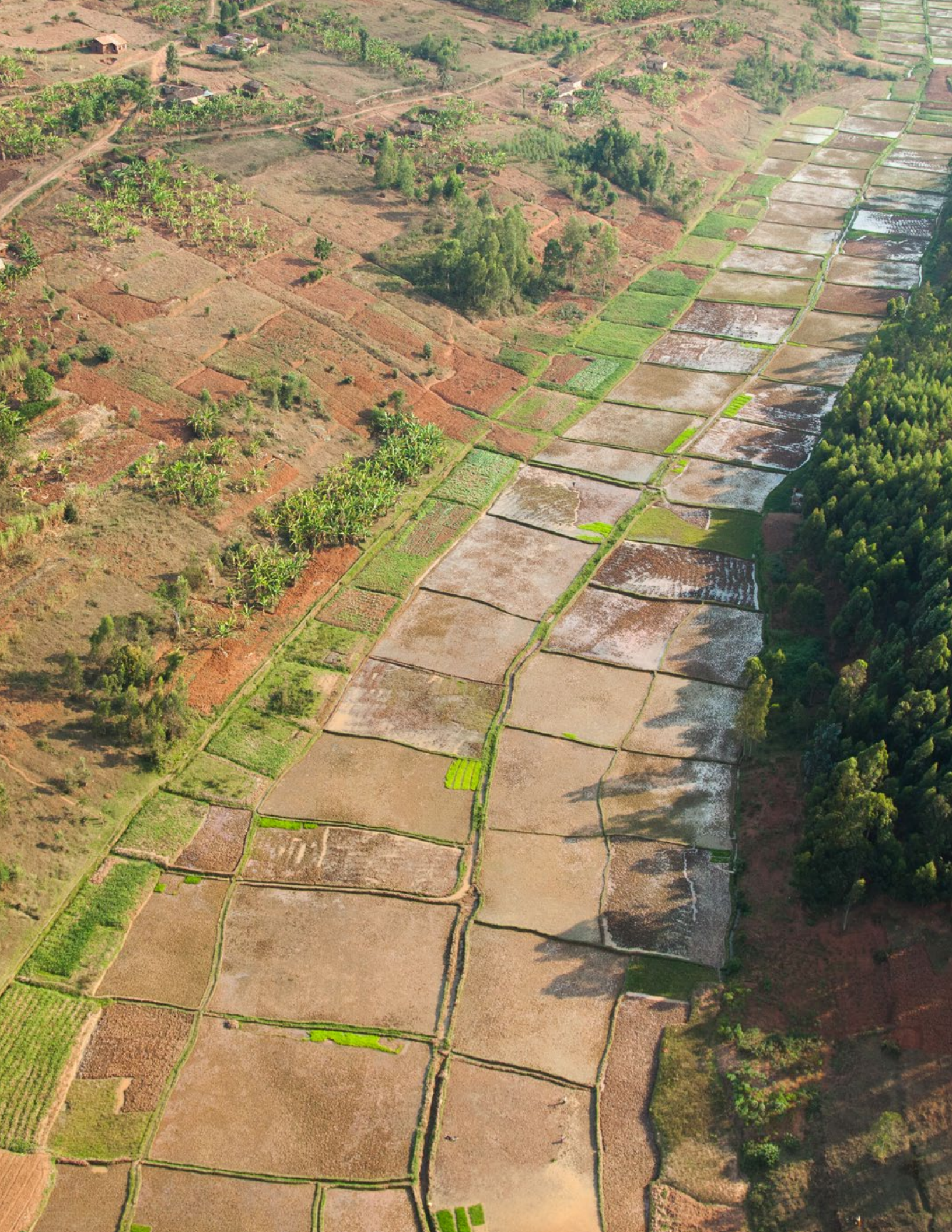

EXECUTIVE SUMMARY

Integrating nature into mainstream infrastructure systems can produce lower cost and more resilient services. This report guides developing country service providers and their partners on how to seize this opportunity. It reviews approaches and examples of how to integrate green infrastructure into mainstream project appraisal processes and investments.

HIGHLIGHTS

- Traditional infrastructure systems worldwide rely on built solutions to support the smooth and safe functioning of societies. In the face of multiplying environmental threats, this approach alone can no longer provide the climate resiliency and level of services required in the 21st century.
- Natural systems such as forests, floodplains, and soils can contribute to clean, reliable water supply and protect against floods and drought. In many circumstances, combining this "green infrastructure" with traditional "gray infrastructure," such as dams, levees, reservoirs, treatment systems, and pipes, can provide next generation solutions that enhance system performance and better protect communities.
- Service providers such as water utilities, flood management agencies, irrigation agencies, and hydropower companies can deliver more cost-effective and resilient services by integrating green infrastructure into their plans. However, to guide its appropriate use in mainstream infrastructure programs, green infrastructure must be as rigorously evaluated and carefully designed as gray projects.
- This report offers service providers a framework to evaluate green infrastructure from a technical, environmental, social, and economic perspective, and to assess key enabling conditions, with illustrative examples.
- It also provides guidance for policymakers and development partners, who must set the incentives and enabling conditions to mainstream solutions that unite green and gray infrastructure.

The Challenge

A new generation of infrastructure projects is necessary to achieve development goals, including water security, disaster risk reduction, poverty alleviation, and resilience to climate change. Nearly half the world's population already lives in areas with water scarcity, and natural disasters affected 96 million people in 2017 (Burek et al. 2016; CRED 2017). Climate change and growth patterns will exacerbate these threats: by 2050, nearly 20 percent of the world's population will be at risk of floods, and up to 5.7 billion people will live in water-scarce areas (WWAP 2018). At the same time, communities, rural and urban, developed and developing, are struggling to build reliable, safe, and economically viable infrastructure to provide residents with clean water and power, flood protection, and resilience against drought.

Protecting populations from these multiplying threats with traditional built infrastructure such as massive dams and seawalls alone will be insufficient. Projections of global financing needs for water supply infrastructure alone are estimated at US$6.7 trillion by 2030 and $22.6 trillion by 2050, significantly outpacing financial flows to this sector (OECD 2018). Against this backdrop, the gains the world has made toward meeting UN Sustainable Development Goals (SDGs), including ending poverty and hunger, and providing clean water and sanitation for all, are under threat. Solutions that are cost-effective, enhance infrastructure service provision, show resilience in a changing climate, and contribute to social and environmental goals must be developed and deployed worldwide.

Recognizing that next generation infrastructure has a critical role to play in meeting the climate adaptation challenge, a growing movement is promoting nature-based solutions and creating opportunities to scale up use of green infrastructure. The *United Nations World Water Development Report 2018* highlighted how nature-based solutions (including green infrastructure) can help meet the 2030 SDGs (WWAP 2018). Similarly, the High Level Panel on Water convened by the United Nations and World Bank concluded that green infrastructure can "help address some of the most pressing water challenges, particularly if planned in harmony with gray infrastructure" (HLP 2018).

Toward Next Generation Infrastructure

Integrating green and gray infrastructure can help fill the need for climate-resilient 21st century solutions. While it is still early days, there is mounting evidence that natural systems can be combined with traditional gray infrastructure to provide lower-cost and more resilient services. Over time, and done properly, combining green and gray infrastructure offers the potential to help provide water, food, and energy to growing populations, lift communities out of poverty, and mitigate climate change.

Table ES-1 | How Green and Gray Infrastructure Can Work Together

SERVICE	GRAY INFRASTRUCTURE COMPONENTS	EXAMPLES OF GREEN INFRASTRUCTURE COMPONENTS AND THEIR FUNCTION
Water supply and sanitation	Reservoirs, treatment plants, pipe network	**Watersheds:** Improve source water quality and thereby reduce treatment requirements **Wetlands:** Filter wastewater effluent and thereby reduce wastewater treatment requirements
Hydropower	Reservoirs and power plants	**Watersheds:** Reduce sediment inflows and extend life of reservoirs and power plants
Coastal flood protection	Embankments, groynes, sluice gates	**Mangrove forests:** Decrease wave energy and storm surges and thereby reduce embankment requirements
Urban flood management	Storm drains, pumps, outfalls	**Urban flood retention areas:** Store stormwater and thereby reduce drain and pump requirements
River flood management	Embankments, sluice gates, pump stations	**River floodplains:** Store flood waters and thereby reduce embankment requirements
Agriculture irrigation and drainage	Barrages/dams, irrigation and drainage canals	**Agricultural soils:** Increase soil water storage capacity and reduce irrigation requirements

Source: Authors.

While this report focuses on the services shown in Table ES-1, the general approach can be applied to almost all gray infrastructure, including transportation and power. Real world examples from around the world feature throughout the report, and Appendix A provides 12 detailed case studies, 6 of these from the World Bank's portfolio. These describe successful, innovative approaches to infrastructure service delivery being pioneered in Brazil, China, Costa Rica, Ecuador, India, Poland, Somalia, Sri Lanka, the Netherlands, United States, and Vietnam.

Ongoing projects that utilize green infrastructure have generated many lessons learned that can inform the next generation of infrastructure. Although green infrastructure may not be appropriate for every project or location, opportunities to use natural systems in project designs are frequently overlooked and have not yet entered the mainstream. This is partly the result of piecemeal research, focused mainly on isolated case studies with limited relevance to other contexts or insight into long-term trends. However, successful examples of and experience with green infrastructure have now gained critical mass, generating robust design processes that enable service providers and development partners to confidently consider green and gray infrastructure approaches, and investment opportunities, on an equal footing.

Green infrastructure has gained momentum among governments, civil society, and development partners such as multilateral development banks and bilateral agencies. As green infrastructure gains momentum, development partners historically focused on gray infrastructure are embracing the concept and value of "putting nature to work." For example, the World Bank's Wealth Accounting and the Valuation of Ecosystem Services framework seeks to account for the value of nature in mainstream planning processes, and its programs aim to drive uptake of nature-based solutions in disaster risk management and other relevant sectors (WAVES 2016). From 2012 to 2017, the World Bank approved at least 81 projects with green infrastructure components in the environment, urban, water, and agricultural sectors—however, this remains a small percentage of all approved projects in these sectors.

About This Report

This joint report by the World Bank and the World Resources Institute seeks to guide developing country service providers and their partners on how to integrate natural systems into their infrastructure programs in ways that better protect their populations and achieve service delivery goals. It provides insights, solutions, and examples that will guide the World Bank's thinking on how "putting nature to work" can help meet its core mandates related to reducing extreme poverty, promoting shared prosperity, and meeting the challenges of climate adaptation and resiliency.

The report is intended for a broad audience of stakeholders that are key to advancing the integration of green and gray infrastructure solutions on the ground. These include the following:

- Service providers, such as water utilities, municipal stormwater departments, flood management agencies, irrigation agencies, and hydropower companies in the vanguard of efforts to design and maintain green infrastructure.
- The coalition of partners, including local governments, central government agencies, and community leaders that are typically required to get green infrastructure off the ground.
- Policymakers looking to understand the challenges and opportunities of integrating green infrastructure into development plans and seeking guidance on the enabling conditions for green infrastructure investment.

Figure ES-1 | Integrating Green and Gray Infrastructure: Key Questions and Opportunities for Stakeholders

	TECHNICAL AND ENVIRONMENTAL	SOCIAL	ECONOMIC
OPPORTUNITIES	CHAPTER 2 Green infrastructure can boost infrastructure system resilience due to its natural adaptive and regenerative capacity. It can be multifunctional, generating numerous positive environmental impacts.	CHAPTER 3 Green infrastructure can empower communities through participation in project operations. This enhances project sustainability as long-term viability is highly dependent on community support.	CHAPTER 4 Green infrastructure can be low-cost, and cost-effective, helping enhance the economic efficiency of infrastructure investments. Its multiple benefits can generate both monetary values and nonmarket benefits.
			
QUESTIONS	**Can green infrastructure reduce the cost, increase the quality, and/or improve the resilience of the service?**	**Is it possible to get multiple stakeholders to support green infrastructure, and can land issues be addressed?**	**Can green infrastructure be justified in terms of cost, as well as in broader economic terms?**

ENABLING CONDITIONS: FINANCE AND POLICY

CHAPTERS 5 & 6

Green infrastructure's ability to provide multiple public and private benefits can unite interests of diverse investors and decision-makers to open pathways for financing, utilization, and large-scale promotion. Supportive policies can greatly aid in adoption of green infrastructure. Understanding policy and financing conditions is a key step of the project development process.

Source: Authors.

The report describes how combining green and gray infrastructure can deliver a triple win for the economy, communities, and the environment, and provides guidance on how to incorporate green infrastructure in project design, appraisal, and implementation. As shown in Figure ES-1, the report covers the technical, environmental, social, and economic dimensions of a typical project assessment and the key enabling conditions required to facilitate successful implementation of green-gray projects.

In Summary: Evaluating the Benefits and Limitations of Green Infrastructure

Strategically combining green and gray infrastructure to lower costs and improve resiliency can help tackle the looming financial and environmental crisis facing global infrastructure systems. With the right conditions, green infrastructure components can cost-effectively enhance service delivery, while also empowering communities and increasing infrastructure systems' resilience and flexibility in a changing climate. Below, we summarize the report's findings on the technical, social, and economic potential offered by green infrastructure, and the enabling conditions it requires. Readers should note that the mixed success of green infrastructure projects to date suggests that these advantages may not be realized unless service providers conduct an early, thorough, and robust assessment to inform the utilization, design, and implementation of combined green-gray solutions.

Figure ES-2 | Reservoir Lifespan Increases with Well-Designed Green Infrastructure for Erosion Control

Image: World Bank.

Improving Technical Performance

Considering green infrastructure creates new technical options for service delivery. By combining built infrastructure with solutions that harness natural systems, providers can improve performance and decrease risk. For example, Appendix A highlights a project in Poland where establishing multipurpose flood retention areas in the Odra and Vistula River Basins will reduce peak river flows. Together with traditional flood embankments, this will protect against the recurrence of a very severe (1,000-year) flood.

Defining the role natural systems such as forests, floodplains, and mangroves can play within infrastructure systems is becoming easier with emerging technology, scientific knowledge, and insights from a growing number of projects. These demonstrate that green infrastructure can be designed in response to local circumstances to complement, substitute, or safeguard gray infrastructure. New biophysical and economic modeling techniques can also enable green infrastructure assessments as part of typical project evaluation.

Stakeholders assessing the technical performance of green infrastructure must take into account complexity and uncertainty. The performance of green infrastructure depends greatly on ever-shifting local environmental, social, and political conditions, which can sometimes cast uncertainty onto projects. At the same time, green infrastructure's innate ability to adapt to changing climate conditions and its relative ease of reversibility are advantages in a rapidly changing world. Appendix A features an example of how to deal with uncertainty, centered on an urban wetland conservation project in Sri Lanka to improve stormwater drainage services. Project partners used a comprehensive "decision-making under uncertainty" economic model, which showed a wide range of potential outcomes but indicated that going ahead was worth the risk.

Figure ES-3 | Cobenefits for Communities Makes Next Generation Infrastructure More Successful

Image: Payton Chung/Flickr.

The Social Foundation of Green Infrastructure

Green infrastructure has an important social dimension. While gray infrastructure is usually operated and owned by a company or government entity, the main operators of green infrastructure are often local communities, responsible for implementing land stewardship practices, and for maintaining the project over the long term. Green infrastructure typically operates at a landscape level, crossing property boundaries or jurisdictions and often involving multiple stakeholder groups. Understanding the costs and benefits for different groups, including women, is therefore important for success; green infrastructure does, however, often have high social transaction costs.

Green infrastructure is most successful when it meets the needs and interests of local stakeholders and communities, and when these groups have a stake in maintaining the solution over the long term. Green infrastructure offers significant opportunities to resolve social inequality or to support vulnerable communities—but these opportunities can be missed, and social challenges exacerbated, if projects are poorly planned and executed. Although this typically requires more effort than employing social safeguards for gray infrastructure, it also opens opportunities to develop win-win solutions that both benefit communities and enhance services. For example, Appendix A presents a project in rural Somalia where simple "sand dams" were built in place of expensive and difficult-to-maintain groundwater wells, with the communities operating and maintaining the infrastructure. These small dams capture and store sand, which accumulates water and recharges readily accessible shallow aquifers.

The Economics of Green Infrastructure

Green infrastructure can be cost-effective and deliver wide-ranging cobenefits valuable to society. The financial case for considering green infrastructure has been well-documented in areas such as reducing the cost of water-related service provision, but varies depending on local conditions. Service providers and their partners should therefore conduct site-based assessments on a case-by-case basis to evaluate financial impacts. Savings generated by natural systems can be large—for example, Chapter 4 showcases how New York City saved 22 percent, or $1.5 billion, by combining green and gray infrastructure instead of pursuing a gray-only strategy to secure water supply for the city (Bloomberg and Holloway 2018).

While the financial case is critical to green-lighting projects, it is also advantageous for service providers to consider environmental and social cobenefits. These cobenefits can be expressed in either monetary or nonmonetary terms on the basis of a "multi-criteria analysis" of a green-gray infrastructure approach, including potential winners, losers, and trade-offs.

Creating Enabling Conditions: Finance and Policy

Green infrastructure opens up new financing frontiers for an industry facing major investment shortfalls. In general, tight government budgets are constraining infrastructure improvements even as need soars. However, because they generate significant environmental and social cobenefits, projects that harness natural systems are attractive options for grants, subsidies, and mission-driven investors. Leveraging government funds as cost-share, pooling investment across project beneficiaries, issuing green bonds for green infrastructure, and engaging insurance companies are all relevant approaches that mainstream financial institutions are pursuing. Appendix A includes a case in Quito, Ecuador, where water utilities, private companies, and nongovernmental organizations (NGOs) set up a "water fund," which acts both as an organization and a financing mechanism for watershed protection.

Policy support for green infrastructure can make good politics. A common barrier for widespread adoption of green infrastructure is that government agencies must develop enabling policies, laws, and regulations for its use. However, as evidence mounts that combined infrastructure approaches can provide multiple community and public benefits, several countries have adopted comprehensive enabling policies, blazing a trail for others to follow. Chapter 6 highlights the example of Peru, which passed a law requiring water utilities to earmark revenue for water conservation and combatting climate change, and to consider these strategies in their budgeting and planning processes.

Integrating green infrastructure into traditional projects helps overcome a common challenge with gray infrastructure: the "Not in My Back Yard!" (NIMBY) Syndrome. If project proponents engage with government agencies, civil society organizations, and communities to develop win-win green infrastructure, political leaders can have a dual incentive to support green infrastructure: public support and enhanced services. Governments or civil society can serve as intermediaries and guarantors between service providers and communities. Appendix A features the example of a flood bypass in California on land that farmers were allowed to cultivate between flood events and where a wetland conservation area was also created.

Recommendations for Scaling Green Infrastructure

Service providers, policymakers, financial institutions, researchers, civil society, regulators, and communities must cooperate to put green infrastructure to work. Partnerships among these actors in developing countries, in collaboration with and support from development partners, can spark the urgently needed transition to next generation infrastructure by integrating the consideration and assessment of natural systems throughout the project cycle. The following efforts are key:

- **All stakeholders must work with and encourage policymakers to promote green-gray approaches through policies, laws, and regulations.** Once there is policy commitment at multiple levels, then governments

can create the enabling conditions by adjusting laws and regulations to allow service providers to proactively develop green infrastructure.

- **National and local government agencies should routinely consider opportunities to integrate green infrastructure approaches in regional and master planning, as well as land-use planning processes, such as river basin or urban development plans.** This will encourage water service and other providers to assess if and how green infrastructure components might be incorporated into their infrastructure projects.
- **Service providers must utilize advanced methods and tools to analyze the performance of green infrastructure.** Specifically, they need to expand beyond traditional engineering approaches to incorporate new approaches related to ecology and environmental management. The same analytical rigor applied for gray infrastructure must be applied for "ecological engineering"—while recognizing that the complexity of natural systems may generate less precision.
- **Stakeholders should prioritize social support for green infrastructure and build long-term coalitions.** Service providers, in particular, need to invest resources in developing new areas of expertise related to stakeholder engagement and community interactions.
- **Service providers should take advantage of green infrastructure's characteristics to sell innovative financing approaches.** In addition to standard financing instruments for built engineering systems, service providers should increasingly tap emerging funding sources from governments, development agencies, and the private sector.
- **Service providers should develop supportive partnerships with approving bodies, civil society organizations, potential co-investors, and technical experts.** For example, multilateral development banks can bring financial resources, and bilateral development agencies can offer more upstream, specialized expertise to help plan green-gray solutions. Civil society groups often bring cutting-edge expertise and/or are well attuned to local circumstances.
- **In addition to supporting their client's efforts to develop green-gray infrastructure, development partners can advance the knowledge frontier for next generation infrastructure in three ways.** First, they can build capacity with their own organizations to understand the potential of green infrastructure and engage developing country clients. Next, they can utilize green-gray assessment tools and approaches in their internal processes. And finally, they can help overcome knowledge gaps that act as barriers to scaling green infrastructure, by investing in performance monitoring and in widely communicating results and real world experience.

REFERENCES

Bloomberg, M., and C. Holloway. 2018. "NYC Green Infrastructure Plan. Executive Summary." New York: City of New York. http://www.nyc.gov/html/dep/pdf/green_infrastructure/NYCGreenInfrastructurePlan_ExecutiveSummary.pdf.

Burek, P., Y. Satoh, G. Fischer, T. Kahil, L. Nava Jimenez, A. Scherzer, S. Tramberend, et al. 2016. "Water Futures and Solution Fast Track Initiative." Laxenburg, Austria: International Institute for Applied Systems Analysis.

CRED (Centre for Research on the Epidemiology of Disasters). 2017. "Natural Disasters 2017." Brussels: CRED.

HLP (High Level Panel on Water). 2018. "Making Every Drop Count: An Agenda for Water Action." Outcome Document. https://sustainabledevelopment.un.org/content/documents/17825HLPW_Outcome.pdf.

OECD. 2018. "Financing Water: Investing in Sustainable Growth." Paris: OECD Environment Policy Paper No. 11.

WAVES (Wealth Accounting and the Valuation of Ecosystem Services Partnership). 2016. "Managing Coasts with Natural Solutions: Guidelines for Measuring and Valuing the Coastal Protection Services of Mangroves and Coral Reefs." Washington, DC: World Bank.

WWAP (United Nations World Water Assessment Program)/UN Water. 2018. The United Nations World Water Development Report 2018: Nature-Based Solutions for Water. Paris: UNESCO. http://unesdoc.unesco.org/images/0026/002614/261424e.pdf.

The full report "Integrating Green and Gray: Creating Next Generation Infrastructure" is available at www.worldbank.org/water.

ABOUT WRI

World Resources Institute is a global research organization that turns big ideas into action at the nexus of environment, economic opportunity, and human well-being.

Our Challenge

Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

Our Vision

We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

Our Approach

COUNT IT

We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

CHANGE IT

We use our research to influence government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

SCALE IT

We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.

PHOTO CREDITS

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