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Report No: PAD1203

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED LOAN

IN THE AMOUNT OF EURO 460 MILLION
(US$504 MILLION EQUIVALENT)

TO THE
REPUBLIC OF POLAND

FOR A

ODRA-VISTULA FLOOD MANAGEMENT PROJECT

July 1, 2015

Water Global Practice
Central Europe and the Baltic Countries Country Unit
Europe and Central Asia Region

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CURRENCY EQUIVALENTS
(Exchange Rate Effective May 31, 2015)

Currency Unit	=	Polish Zloty (PLN)
€1	=	PLN 4.11263
€1	=	US$1.096

GOVERNMENT'S FISCAL YEAR

January 1 – December 31

ABBREVIATIONS AND ACRONYMS

AAD	Annual Average Damages
CEB	Council of Europe Development Bank
CPS	Country Partnership Strategy
DA	Designated Account
DG	Directorate General (a unit in the EC)
EC	European Commission
EMF	Environmental Management Framework
EMP	Environmental Management Plan
ERR	Economic Rate of Return
EU	European Union
FD	Flood Directive
FIDIC	*Fédération internationale des ingénieurs consultants* (International Federation of Consulting Engineers)
FM	Financial Management
ICB	International Competitive Bidding
ICR	Implementation Completion Report
IFR	Interim Financial Report (un-audited)
IMGW	*Instytut Meteorologii i Gospodarki Wodnej* (Institute of Meteorology and Water Management)
IMGW-PIB	*Państwowy Instytut Badawczy* (IMGW National Research Institute)
IT	Information Technology
IWRM	Integrated Water Resources Management
KZGW	*Krajowy Zarząd Gospodarki Wodnej* (National Water Management Authority)
LA	Loan Agreement
MAD	Ministry of Administration and Digitization
M&E	Monitoring and Evaluation
MIS	Management Information System
MoE	Ministry of Environment
MoF	Ministry of Finance
NCB	National Competitive Bidding
NFEP&WM	Polish National Fund for Environmental Protection and Water Management (NFOSiGW)
NFOSiGW	*Narodowy Fundusz Ochrony Środowiska i Gospodarki Wodnej*

NGO	Nongovernmental Organization
NIK	*Najwyższa Izba Kontroli* (Supreme Audit Chamber)
O&M	Operation and Maintenance
ONDR	Office of Natural Disaster Recovery
OP	Operational Policy
PCU	Project Coordination Unit
PDO	Project Development Objective
PIU	Project Implementation Unit
PLN	Polish Zloty (Currency of Poland)
POM	Project Operational Manual
RAP	Resettlement Action Plan
RBMP	River Basin Management Plan
RZGW	*Regionalny Zarząd Gospodarki Wodnej* (Regional Water Management Authority)
RPF	Resettlement Policy Framework
SBD	Standard Bidding Documents
SMOK	Hydrometeorological Monitoring, Forecasting and Warning System
SOE	Statement of Expenditures
TA	Technical Assistance
Voievode	Provincial Governor
WFD	Water Framework Directive (of the European Union)
ZMiUW	*Zarząd Melioracji i Urządzeń Wodnych Województwa* (Board of Land Reclamation and Waters)

Regional Vice President:	Cyril Muller
Country Director:	Mamta Murthi
Senior Global Practice Director:	Junaid Kamal Ahmad
Practice Manager:	Dina Umali-Deininger
Task Team Leader:	Winston Yu

REPUBLIC OF POLAND

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Poland

Odra-Vistula Flood Management Project (P147460)

PROJECT APPRAISAL DOCUMENT

EUROPE AND CENTRAL ASIA

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Report No.: PAD1203

Basic Information			
Project ID P147460	EA Category B - Partial Assessment		Team Leader(s) Winston Yu
Lending Instrument Investment Project Financing	Fragile and/or Capacity Constraints [ ] Financial Intermediaries [ ] Series of Projects [ ]		
Project Implementation Start Date July 24, 2015	Project Implementation End Date June 15, 2023		
Expected Effectiveness Date October 15, 2015	Expected Closing Date December 15, 2023		
Joint IFC No			
Practice Manager/Manager Dina Umali-Deininger	Senior Global Practice Director Junaid Kamal Ahmad	Country Director Mamta Murthi	Regional Vice President Cyril Muller
Borrower: Republic of Poland			
Responsible Agency: Ministry of Administration and Digitization			
Contact: Mr. Stanislaw Huskowski Telephone No.: 48222455846		Title: Secretary of State Email: mac@mac.gov.pl	

Responsible Agency: Ministry of Environment			
Contact:	Mr. Stanislaw Gawlowski	Title:	Secretary of State
Telephone No.:	48223692377	Email:	info@mos.gov.pl

Project Financing Data (in USD Million)

[X]	Loan	[ ]	IDA Grant	[ ]	Guarantee
[ ]	Credit	[ ]	Grant	[ ]	Other

Total Project Cost:	1,317	Total Bank Financing:	504
Financing Gap:	0.00		

Financing Source	**Amount**
Borrower	210
International Bank for Reconstruction and Development	504
Borrower European Union (EU) Funds	219
Council of Europe Development Bank (CEB)	329
Polish National Fund for Environmental Protection and Water Management (NFEP&WM)	55
Total	1,317

Expected Disbursements

Fiscal Year	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	9	42	63	84	105	84	76	36	5
Cumulative	9	51	114	198	303	387	463	499	504

Institutional Data

Practice Area (Lead)

Water

Contributing Practice Areas

Cross Cutting Areas

[X] Climate Change

[ ] Fragile, Conflict & Violence

[ ] Gender

[ ] Jobs

[ ] Public Private Partnership

Sectors / Climate Change

Sector (Maximum 5 and total % must equal 100)

Major Sector	Sector	%	Adaptation Co-benefits %	Mitigation Co-benefits %
Water, sanitation, and flood protection	General water, sanitation, and flood protection sector	100	100	
Total		100		

☐ I certify that there is no Adaptation and Mitigation Climate Change Co-benefits information applicable to this project.

Themes

Theme (Maximum 5 and total % must equal 100)

Major theme	Theme	%
Environment and natural resources management	Water resource management	100
Total		100

Proposed Development Objective(s)

The project development objectives are to increase access to flood protection for people living in selected areas of the Odra River and the Upper Vistula River basins and to strengthen the institutional capacity of the Borrower to mitigate the impact of floods more effectively.

Components (not including front-end fee)

Component Name	**Cost (USD Millions)**
Component 1: Flood protection of Middle and Lower Odra	542
Component 2: Flood protection of Nysa Kłodzka Valley	290
Component 3: Flood protection of Upper Vistula	242
Component 4: Institutional strengthening and enhanced forecasting	141
Component 5: Project management and studies	95

Systematic Operations Risk-Rating Tool (SORT)

Risk Category	**Rating**

1. Political and Governance	Moderate
2. Macroeconomic	Moderate
3. Sector Strategies and Policies	Moderate
4. Technical Design of Project or Program	Substantial
5. Institutional Capacity for Implementation and Sustainability	Moderate
6. Fiduciary	Moderate
7. Environment and Social	Moderate
8. Stakeholders	Substantial
9. Other	
OVERALL	Moderate

Compliance	
Policy	
Does the project depart from the CAS in content or in other significant respects?	Yes [ ] No [X]
Does the project require any waivers of Bank policies?	Yes [ ] No [X]
Have these been approved by Bank management?	Yes [ ] No [ ]
Is approval for any policy waiver sought from the Board?	Yes [ ] No [X]
Does the project meet the Regional criteria for readiness for implementation?	Yes [X] No [ ]

Safeguard Policies Triggered by the Project	**Yes**	**No**
Environmental Assessment OP/BP 4.01	**X**	
Natural Habitats OP/BP 4.04	**X**	
Forests OP/BP 4.36		**X**
Pest Management OP 4.09		**X**
Physical Cultural Resources OP/BP 4.11	**X**	
Indigenous Peoples OP/BP 4.10		**X**
Involuntary Resettlement OP/BP 4.12	**X**	
Safety of Dams OP/BP 4.37	**X**	
Projects on International Waterways OP/BP 7.50	**X**	
Projects in Disputed Areas OP/BP 7.60		**X**

Legal Covenants			
Name	**Recurrent**	**Due Date**	**Frequency**
Institutional Arrangements	**X**		Yearly
Description of Covenant			
The Borrower shall maintain the following institutional arrangements throughout the Project life: PSC for reviewing the overall implementation and the overall Project management and supervision; MoE through the KZGW, and MAD for the coordination and monitoring of Project activities at the technical level; PCU for day-to-day coordination and overall administration of the Project			
Name	**Recurrent**	**Due Date**	**Frequency**
Carrying out the Project	**X**		Yearly
Description of Covenant			
The Borrower shall (a) carry out the Project in accordance with the POM, the respective Annual Work Programs, the Environmental Management Plan(s) and the Resettlement Action Plan, and (b) shall not amend, suspend, abrogate, repeal or waive any provision of the POM, AWP, the EMP(s) or the RAP, without the prior approval of the Bank.			
Name	**Recurrent**	**Due Date**	**Frequency**
Preparation of Annual Work Program for the following calendar year	**X**		Yearly
Description of Covenant			
The Borrower, through the PCU, shall not later than November 15 of each year during the implementation of the Project, starting November 15, 2015, prepare in accordance with the format included in the POM and submit to the Bank for review and approval an AWP for the following calendar year			
Name	**Recurrent**	**Due Date**	**Frequency**
Report on Performance of the Annual Work Program	**X**		Yearly
Description of Covenant			
The Borrower, through the PCU, shall each year during the project implementation, starting March 31, 2016, as part of the progress report referred to in Section II.A.1 of Schedule2, submit to the Bank, a report, acceptable to the Bank, on the performance of the AWP for the preceding calendar year based on the indicators and monitoring arrangements for said calendar year, set forth in the POM			
Name	**Recurrent**	**Due Date**	**Frequency**
Budgeting funds of the pertinent Annual Work Program	**X**		Yearly
Description of Covenant			
Without limitations to the provisions of Section 5.03 of the General Conditions, the Borrower shall each year during the implementation of the Project include in its overall budget the funds to finance the carrying out of the pertinent Annual Work Program for the respective calendar year.			
Name	**Recurrent**	**Due Date**	**Frequency**

Mid-Term Review		15-Dec-2019	

Description of Covenant

The Borrower shall no later than December 15, 2019 or such other date as may be agreed with the Bank carry out jointly with the Bank, a mid-term review of the progress made in carrying out the Project and overall Project performance against Project performance indicators; at least four weeks prior to the Mid-Term Review, prepare and furnish to the Bank, a report

Conditions

Source Of Fund	Name	Type
IBRD	Project Operations Manual	Effectiveness

Description of Condition

The Borrower, through PSC, has approved the Project Operations Manual in a manner acceptable to the Bank.

Source Of Fund	Name	Type
IBRD	Front-end Fee	Disbursement

Description of Condition

No withdrawal shall be made: from the Loan Account until the Bank has received payment in full of the Front-end Fee; and for payments made prior to the date of this Agreement

Source Of Fund	Name	Type
IBRD	The Bank's financing percentage of Eligible Expenditures	Disbursement

Description of Condition

The sum of the Bank's financing percentage of Eligible Expenditures under the Loan combined with the financing percentage provide by the Co-financier CEB and the Borrower equals 100% of each Eligible Expenditure

Team Composition

Bank Staff

Name	Role	Title	Unit
Winston Yu	Team Leader (ADM Responsible)	Sr. Water Resources Spec.	GWADR
Iwona Warzecha	Financial Management Specialist	Sr. Financial Management Specialist	GGODR
Ama Esson	Team Member	Program Assistant	GFADR
Barbara Ziolkowska	Team Member	Procurement Analyst	GGODR
Damir Leljak	Team Member	Finance Analyst	WFALA

Daria Goldstein	Counsel	Senior Counsel	LEGLE
Hiromi Yamaguchi	Team Member	Consultant	GFADR
Jasna Mestnik	Team Member	Finance Officer	WFALA
Jorge E. Villegas	Safeguards Specialist	Senior Social Development Specialist	GSURR
Kunduz Masylkanova	Team Member	Senior Agriculture Economist	GFADR
Małgorzata Michnowska	Team Member	Program Assistant	ECCPL
Nikola Ille	Safeguards Specialist	Senior Environmental Specialist	GENDR

Extended Team

Name	**Title**	**Office Phone**	**Location**
Adrianus Verwey	Hydr. modelling expert	+31 6 5197 0120	Delft, The Netherlands
Jerzy Posnik	Civil and contract engineer		Wrocław
Juan Morelli	Economist		Montevideo

Locations

Country	**First Administrative Division**	**Location**	**Planned**	**Actual**	**Comments**
Poland	Masovian Voivodship	Warsaw		**X**	Operations in Wrocław, Szczecin, Kraków

I. STRATEGIC CONTEXT

A. Country Context

1. Poland has made remarkable progress on the economic and social front, with GDP per capita rising from slightly above US$2,000 in the early 1990's to more than US$12,500 in 2012. Its GDP has grown from 1.7 percent in 2012 to 3.3 percent in 2014, and is expected to grow by 3.2 percent in 2015 and 3.3 percent in 2016. The rapid economic growth has been constrained by a number of factors. Sustainability is tainted by lingering problems with environmental management and issues of government credibility. The European Union (EU) membership, since 2004, has been instrumental in modernizing many of the country's policies and administrative structures. Poland also has been one of the largest recipients of the EU's structural funds for roads and highways, urban development, environment, and, to a much lesser extent, water resources management.

2. Devastating flood episodes have reminded the country of its intrinsic vulnerability to flooding caused by the mountainous and hilly landscape and by decades of neglect. The pace of urbanization and industrialization over the past half century—and especially since 1995—has far exceeded investment in water resources and flood management. Most dikes systems and much of the river infrastructure date back to the beginning of the 20th century. In the meantime, land uses have been altered, exacerbating the generation of flood waves, and damage from floods has become more costly. This vulnerability is forecasted to further increase as climate change projections indicate that, if not at a regional level then at the local level, the country will become subject to gradually increasing temperatures, and likely drier summers and more concentrated and more intensive precipitation.

B. Sector and Institutional Context

3. The Odra and the Vistula are Poland's main rivers. They rise in the southern Carpathian mountains and flow to the north across, first, hilly areas and, thereafter, flat lowlands before discharging into the Baltic Sea. They count among Europe's longest rivers with the length of their main stems of 854 and 1,047 km, respectively. The catchment areas of the Odra and the Upper Vistula (comprising about one-third of the total Vistula basin) together cover 168,580 km^2 or 54 percent of the Polish territory, underscoring the strategic significance of the proposed project.

4. Flood damages in terms of recovery costs and the economic losses from income foregone are significant and recurring; the recent floods have also claimed scores of casualties. The flood episode of 1997 affected primarily the Upper Odra River basin, especially the city of Wrocław, which is one of the country's growth poles. In both 1997 and 1998, the Nysa, a main tributary of the Upper Odra, was severely affected, with widespread devastation in the Nysa Kłodzka Valley. In 2006 and again in 2010, the western and southern parts of Poland—which comprise 60 percent of the population and 80 percent of the economic productivity—were subjected to severe and prolonged inundations. In those years it was especially the Upper Vistula and the Lower Odra basins that were hit, as well as in the Nysa Kłodzka Valley. In the Upper Vistula, in 2010, Kraków, Poland's second most important city, was partly inundated for two weeks and wide swathes of southern Poland came to a standstill for months, including the Sandomierz-Tarnobrzeg industrial center in the heartland of the country. Successive governments have responded to these threats by launching dedicated investment programs to support recovery, improve the preparedness, and

generally invest in more effective river and flood protection management. In 1997, the Odra 2006 Program and Law were developed to ensure the protection of the Upper and Lower Odra against 1-in-100-year floods, or better. To date, this program has helped restructure the administrative tools for flood protection and has funded major investments in a variety of measures and infrastructure to achieve the specified protection levels. In 2011, a similar Vistula Flood Protection Program and Law were set up and the Voievode of Małopolskie appointed as plenipotentiary.

5. The World Bank, the Council of Europe Development Bank (CEB) and the European Commission (EC) have (co-)financed several of these initiatives. The most significant and ambitious of these is the Odra River Basin Flood Protection Project (P086768)(2007–2017), that aims to increase flood protection levels along the Upper Odra and notably for the city of Wrocław, and that is under implementation. This project experienced a slow start in 2007 for a number of external reasons, including introduction of the new Polish policies and administrative structures after EU accession and the newly imposed regulations. The project is currently performing satisfactorily with to date full commitment of funds for the total cost of about US$1 billion. The project is also credited with having developed the institutional administrative structure and capacity in south-west Poland to implement very complex hydraulic works for which the cooperation of four ministries[1] and about 24 local governments and agencies[2], and four financiers is required.

6. In March 2014, the government requested the Bank to provide support for the preparation of a second initiative of national importance with the strategic aim to further complete the protection of all the most vulnerable areas in the Odra basin, and implement a first set of measures to start providing the same level of protection for the Upper Vistula basin. The selection of the activities and investments would follow exhaustive analysis of the priority nature of all possible investments, based on integrated basin planning, flood risk analysis, and readiness and no-regret nature of the investment. This new project would also create the platform to start mainstreaming, at national scale, the lessons learnt in policy and institutional development during the Odra River Basin Flood Protection Project. While the Odra region has been benefiting from numerous studies on the river basin system that took place over more than a century, the Vistula region, which features a larger and more complex hydraulic system, has not been studied as thoroughly.

7. With its accession to the EU, Poland has had to reform the policies and institutions in its water resources sector to comply with the EU *acquis*, in particular the Water Framework Directive (WFD) and the Flood Directive (FD). This has led to significant reorganizations since 2004 that have enhanced the sector's performance. Tasks on water and flood management are assigned by territory and divided between the Regional Water Management Agencies (RZGWs) and the Boards of Amelioration and Hydraulic Structures of a Voivodship (ZMiUWs). The RZGWs are typically responsible for the main water bodies and rivers within an hydraulically coherent region, such as a large part of a river basin; they operate under the National Water Management Agency (KZGW), which is a semi-independent body under the Ministry of Environment (MoE), and

[1] Namely, the Ministry of Environment (MoE) for implementation, the Ministry of Administration and Digitization (formerly Home Affairs) for the flood protection budget, the Ministry of Finance (MoF), and the Ministry of Infrastructure and Regional Development for coordination of Borrower EU funds.

[2] This includes notably the Voivodes and Marshals of the involved Voivodeships, the District and Municipality Heads, and the Regional Environment Inspectorates.

funded from the national budget. The ZMiUWs, on the other hand, are responsible for rural infrastructure and small water courses, and thus, for many of the dike systems. They are under the administration of the Voivodships (comparable to provinces) under the authority of the Marshal of the Voivodships, and, therefore, funded largely from the regional government budget. The Institute of Meteorology and Water Management (IMGW) is responsible for meteorological forecasting and generic modeling of precipitation and run-off. It has four regional offices, often with specialized functions, among other cities, in Wrocław and Kraków.

8. The new Polish legislation requires the development of integrated river basin management plans (RBMPs) for each river basin. These plans are still under development and have followed the format of the Updated Master Plans, complemented with Flood Hazard Maps and Flood Risk Maps. The preliminary draft of these plans are in compliance with WFD. The first-generation RBMPs were prepared in 2012–2013, and Poland will prepare the next set of RBMPs in 2015–2016, to be repeated every six years. The Updated Master Plans were endorsed by the EC as intermediate plans in October 2014 to provide the prioritization of all measures based on a broad feasibility analysis. Many measures have been already identified and confirmed as 'no regret' measures for the areas that are most vulnerable to floods. Based on the master plans, the EC has specified a list of 2,100 measures that it considers as potentially eligible for EU Structural and Investment Funds in the Perspective 2014–2020, provided that the investments are further prepared taking into account all safeguards and based on sound economic analysis. The list identifies another 240 proposed measures that are expected to have longer-range or more complex impacts and will require embedding in a properly prepared RBMP before they are eligible. The implementation of the complete Vistula flood protection program may well take two to three decades, and will require numerous planning and consultation rounds to select and design the investments and measures. Many of those are confirmed already as high priority and feasible but others will require more in-depth analysis to allow a decision on the most cost-effective solution at a sub-basin scale. The proposed project targets measures that combine a high cost-effectiveness and a small, or at least, manageable ecological and hydraulic footprint. The project prioritizes areas, cities, and sub-basins that have a documented long history of substantial flood damage.

9. The project will support ongoing institutional strengthening activities. The EC and the prospective project co-financiers have confirmed their preference for the Bank leadership of the new large investment program, with the partial aim to use the program to bring the institutional innovations into practice.

C. Higher Level Objectives to which the Project Contributes

10. The Poland FY14–17 Country Partnership Strategy (CPS) (July 15, 2013) supports the Bank Group's overall strategic goals. In a country like Poland, where extreme poverty is marginal, the Bank Group program is aimed at promoting shared prosperity – economic competitiveness- equity and inclusion, and climate action to enhance the sustainability of Poland's economic and social development. The CPS calls for a close partnership with the EU and stresses making knowledge available and exploring knowledge transfers out of Poland. The project would contribute to the World Bank's twin goals of reducing poverty and sharing prosperity. The proposed project would address poverty. Foremost, in industrializing economies such as Poland, household incomes are closely tied to jobs. With floods reducing job opportunities, poverty is due to rise. Second, disaggregation of the data shows that of the sub-regions that are impacted by floods and that would

benefit from the project, most score at higher-than-average poverty vulnerability (with at-risk population higher than 20 percent) in particular the subregions of Nysa Kłodzka in the Upper Odra, several counties along the Lower Odra, and most of the central and eastern parts of the Upper Vistula basin.[3] Third, asset and real estate values, and household wealth, are strongly correlated to the likelihood of flooding and water damage. As a rule, the low-lying town quarters that are prone to flooding or regular inundation, have cheaper housing, receive fewer services and attract poorer occupants, who are the most vulnerable. This can be observed in quarters neighboring the river in Wrocław, Kraków, and other locations. Thus, even within richer sub-regions such as Kraków, flood protection will extend naturally to all income categories and it will be the poorer groups that will, in proportion, benefit the most.

11. The proposed project would support sharing prosperity. The flood episodes in 1997, 2006 and 2010 have highlighted that the large manufacturing, commercial, and touristic centers of Poland that provide jobs and contribute most to the national economy are particularly vulnerable to floods. Many of these centers have been located along transport corridors and, effectively, in former floodplains and in Poland's most productive agricultural area, with high added-value from orchards and horticulture. The nature of the floods has been such that these industrial centers and much of the transportation corridors had to shut down for several weeks and even months to first allow the water to drain away and then repair production equipment and other assets. These events impact industrial and agricultural output, and deteriorate the investment climate, and thus, reduce the sustainability of Poland's economic and social development.

II. PROJECT DEVELOPMENT OBJECTIVE

A. PDO

12. The project development objectives (PDOs) are to increase access to flood protection for people living in selected areas of the Odra River and the Upper Vistula River basins and to strengthen the institutional capacity of the Borrower to mitigate the impact of floods more effectively.

B. Project Beneficiaries

13. The project will provide three distinct areas with flood management infrastructure and related measures: (i) the Middle and Lower Odra; (ii) the Nysa Kłodzka Valley; and (iii) selected parts of the Upper Vistula including notably the areas of Kraków, Sandomierz, and communities in the Raba and the San tributary catchments. The population of the regions in the direct proximity of the proposed works and measures is estimated to be about 15.1 million; this is the population of the *powiats* (counties) that are reported to be either historically subject to significant flood damages and losses or at high risk (based on the Flood Risk Maps). This number includes the population of the towns and cities downstream of the Nysa Kłodzka Valley such as Nysa town and Wrocław that will enjoy further reduction in hazards thanks to the extra buffering capacity of four new proposed dry polders. This population will receive different types and extents of direct and indirect benefits,

[3] "Mapping Poverty at the Level of Subregions in Poland Using Indirect Estimation". Polish Statistical Office, Poznan, November 2013

of a physical, economic, and social nature.[4] Out of this population, about 5.2 million people are directly exposed to the floods, living in or in the immediate vicinity of areas and structures that are at risk of flooding; this number is approximated through the population of the *gminas* (communes) that represent the smallest-scale administrative communities. A total of 122,042 people are currently living in the actual flood zones of the 1-in-100 year floods and will receive full or improved physical protection benefit compared to the current situation.

14. The beneficiary population is generally mixed in terms of income-level and wealth. Most of the protected areas comprise both populated areas with town houses, apartment blocks, farms, etc. and economically productive areas and assets such as factories, commercial centers, touristic locations, strategic transport and communication networks, farms, etc. Thus, the project indirectly supports shared prosperity and job creation benefiting all of the identified beneficiary population. In effect, the externalities of economic losses are likely to be felt well beyond the narrow zones directly affected by the floods, and, thus, the number of beneficiaries on this account is likely to exceed the above-mentioned numbers. Moreover, a sizeable portion of the beneficiaries are in the lower-income brackets and the project therefore will have a poverty alleviation benefit. Avoiding floods will, in effect, generate the largest comparative benefit to this subset of beneficiaries.

15. The proposed project will further strengthen the national institutional capacity for flood management and forecasting, as well as improve the capabilities to operate existing and new infrastructure. This is done through more advanced weather forecasting equipment and flood simulation models that will inform decision-makers faster and more reliably regarding the need to evacuate and other precautionary measures to reduce loss of life and economic losses during emergency situations. The project will also help to strengthen the capacity to prepare RBMPs and investment prioritization plans, improve the flood policy framework, and enhance the capability for more reliable forecasting, early warning, and infrastructure operation of existing and new infrastructure. The latter will extend over the whole of south and west Poland and enhance protection levels to an overall population of over 38 million.

C. PDO Level Results Indicators

16. The PDO level indicators are the following:

- Total area in the 1-percent flood plain benefiting from enhanced protection and operational forecasts
- Total population benefiting from enhanced protection and operational forecasts (gender disaggregated)
- Flood Operation Centers established and functional

17. These indicators gauge the institutional and administrative capacity through the effectiveness of the system to avoid major impact of flood events and mount operational responses during a

[4] Physical protection benefits include avoidance of, among others: evacuation; inundation of house, factory or other asset to a depth of higher than 0.5m, and avoided loss of life and disease. Economic benefits include, for example, the avoidance of temporary or permanent job loss due to closing of factories, and disruption of transportation and communication lines. Social benefits include, for example, avoidance of disruption of normal life conduct, education, health services, as well as the costs of caretaking of family members and neighbors who are affected physically.

flood crisis. This effectiveness results from a sequence of proper actions that can happen only if capacities are in place within the RZGWs, ZMiUWs, KZGW, and IMGW: (i) early and reliable forecasting (well-equipped forecasting and run-off and hydraulic routing models); (ii) flood event development that confirms adequate design and construction criteria and decisions; (iii) operations centers that are equipped and staffed, and that are activated timely; and (iv) appropriate decision-making to mitigate the flood impact. It is unlikely that a flood crisis will emerge immediately after the completion of the project. Therefore, a separate assessment at the end of the project will be undertaken to determine any improvement in the quality of the procedures and in the ability of staff to manage flood risks.

III. PROJECT DESCRIPTION

A. Project Components

18. The proposed project will build on the lessons learned in the ongoing Odra Basin River Flood Protection Project. The proposed project will help demonstrate new approaches and support alignment with the EU WFD and FD—an area where the government is still struggling. To allow a timely start, the proposed project will focus on the 'hot spots' in the basins (that is, the parts that are documented to be most vulnerable) and the 'no regret' measures where technical merits are sufficiently clear (at the basin-scale perspective) and which are listed in Poland's Updated Master Plans or Flood Risk Management Plans for the river basins, as well as in the list of investments eligible for Borrower EU funding. The components, with their specific sub-objectives, are as follows:

Component 1: Flood Protection of the Middle and Lower Odra (Base Cost €446 million)

19. This component aims to enhance protection against summer floods and winter floods to the cities of Szczecin and Słubice, to the town of Gryfino, as well as other smaller towns along the Odra River. The activities will include the reconstruction of dikes and other bank protective works (revetments, parapets, and so on), dredging in the Odra River as well as in canals and the harbor of Szczecin, and river training works, that is, the recalibration and (re)construction of groynes and lateral submerged dams in the river, restoration of bends, and protection of banks. In addition, five bridges need to be raised to facilitate safe passage of icebreakers, and navigation and mooring facilities need to be expanded. A key activity concerns the revitalization of the Miedzyodrze wetland, upstream of Szczecin harbor, to help accommodate water surges and, at the same time, restore some of the ecological and touristic functions of the habitat. Four project implementation units (PIUs) will engage in the implementation of the works, of which one (RZGW Wrocław) has already been involved intensively in the ongoing Odra River Flood Protection Project.

Component 2: Flood Protection of the Nysa Kłodzka Valley (Base Cost €239 million)

20. This component will protect Kłodzka town and other small valley towns, as well as the city of Bardo at the outlet of the valley. The component will comprise the construction of four mid-sized dry polders ('active protection'), dike rehabilitation and construction, and reconstruction of the river alignments and embankments, as well as of bridges and other structures ('passive protection'), to allow the temporary retention and safe passage of flood waves accompanied by large amounts of debris. In addition, the works will have significant downstream benefits because

the four new dry polders will increase the buffer capacity in the valley by reducing the peak flows in the two downstream reservoirs, and lower the crest along the Nysa river downstream towns as well as the Wrocław conurbation.

Component 3: Flood Protection of the Upper Vistula (Base Cost €202 million)

21. This component intends to protect the Kraków agglomeration and Nowa Huta industrial area, the Sandomierz-Tarnobrzeg industrial and agricultural area, and selected towns on tributaries in the sub-basins of the San and Raba rivers. The works comprise of (i) the reconstruction and extension of dikes and embankments along the Vistula to replace old unreliable dikes; (ii) bank stabilization and strengthening with rip-rap, revetments, etc.; (iii) construction of identified dry polders and overflow areas (along the Serafa tributary, and the Raba tributary) to increase upstream water retention; (iv) interventions for river training; and (v) the adjustment of existing weirs and barrages to pass larger flood waves. Through Component 4 additional support will be provided for the preparation of the main parts of the RBMP and the investment prioritization plan for the Upper Vistula.

Component 4: Institutional Strengthening and Enhanced Forecasting (Base Cost €124 million)

22. This component will selectively support the strengthening of institutional capacity in priority areas by: (i) improving the emergency preparedness along the main rivers and their tributaries in south and west Poland by enhancing the forecasting and operational water management capacity; (ii) strengthening the procedures and capacity to prepare RBMPs and investment prioritization plans that are compliant with the EU WFD and FD; (iii) strengthening impact monitoring; and (iv) enhancing the communication capabilities. Assistance for applying integrated water resources management (IWRM) and investment scenario analysis to river basin management planning and management and investment prioritization will be focused on the Bóbr-Kwisa River (in the Lower Odra), the Upper Vistula part that is upstream of Kraków (including the Kraków passage), and the San, Raba, Wisłoka and Dunajec catchments—key areas in the basin with complex hydrology and various investment options that are to be studied before investments can be identified for later financing. Impact monitoring will take the form of developing procedures and guidelines, as well as conducting surveys for disaggregated analysis (by gender, age, income, etc.) of flood impacts and flood protection impacts, and on citizen engagement. This capability will enhance the government's ability to better target future investments and to decide on cost-effectiveness. In addition, the project will support deeper analysis of the consequences of long-term changes in the basins' environment, i.e., through climate change and variability, and changes in the land use and landscaping (more urbanization and "hard surface"). In general, the project will closely monitor the country's progress in meeting the requirements under the EU WFD and FD and support institutional reform steps with studies and dialogue. As part of this, funding will also be provided to facilitate peer-to-peer dialogue on IRWM with appropriate EU member states. A national communication strategy on flood risks and their management will also be developed.

23. The forecasting capability and the establishment of operation centers will be carried out at the RZGWs of Wrocław and Kraków, and the IMGW National Research Center (IMGW-PIB) (Kraków Office). The activities comprise installing new-generation telemetric weather stations and modernizing the POLRAD (Polish national weather radar) network, expanding and upgrading

the hydrological stations, incorporating better-performing simulation software, and improving flash flood forecasting. The operations centers are control rooms that will mine forecasting data, simulate likely run-off scenarios, support early warning and decision support processes for emergency response, and operate infrastructure such as weirs, reservoirs, and dry polders to manage the containment and release of flood waves.

Component 5: Project Management and Studies (Base Cost €73 million)

24. This component will fund the Project Coordination Unit (PCU) operation (supporting overall project management, reporting (periodical and annual), financial planning and monitoring, monitoring of flow of funds, and supervision of implementation of EMPs and RAPs – including compensation measures), and TA teams that support the PCU and PIU's operation, office equipment, and incremental operating costs. The studies will, among other things, cover the preparation of follow-up investments and the development of a project-based communication strategy.

B. Project Financing

25. The total project costs are US$1,317 million (€1,202 million). Of this amount US$265 million (€242 million) will be the counterpart funding covering, among other things, land acquisition expenditure, while US$219 million (€200 million) will be provided from the Polish allocation of the EU Cohesion Funds that were negotiated in December 2014. US$833 million (€760 million) will be furnished by other international financing institutions, of which the IBRD financing will amount to US$504 million (€460 million).

Table 1. Project Cost and Financing

Project Components	Project Cost (million)		IBRD Financing (million)*		% Financing
	(US$)	(€)	(US$)	(€)	
1. Flood protection of the Middle and Lower Odra	489	446	168	153	34
2.Flood protection of Nysa Kłodzka Valley	262	239	91	83	35
3. Flood protection of the Upper Vistula	221	202	71	65	32
4.Institutional strengthening and enhanced forecasting	136	124	66	60	48
5. Project management and studies	80	73	57	52	71
Total Baseline Cost	1,188	1,084	453	413	
Total Project Cost	1,317	1,202	504	460	
Total Financing Required	1,317	1,202	504	460	38

* Does not include contingencies (price and physical)

C. Lessons Learned and Reflected in the Project Design

26. The ongoing Odra Basin River Flood Protection Project (2007–2017)—that followed the first Odra Emergency Flood Recovery Project (1998–2004)—has evolved into a key platform to deepen

and operationalize the partnership with the Borrower and develop expertise in the strengthening of the public administration system, in the professional preparation of complex investments in compliance with the EU directives, and in the mobilization of international finance. The implementation of the project included the detail designing and the updating of safeguards arrangements, and took place at an opportune time, as the country was acceding to the EU and had to start implementing the WFD and other directives. The experience of preparing the first RBMPs with the project was helpful in showing how more streamlined and effective preparation and planning procedures can generate better RBMPs. Because of its size and cross-sector complexity, the project has acted as the 'feasibility benchmark'.

27. The operational challenges experienced in 2009–2010 with land acquisition for the Raciborz component of the project were a major factor in the August 2010 law that streamlined land acquisition procedures for flood protection investments, by aligning the principle with highway construction. The new project will engage with the national leadership in the MoE, the MoF, and the KZGW with respect to developing more effective procedures and programming and design principles that are also broadly acceptable by nongovernmental organizations (NGOs) and local governments.[5]

28. The project has strengthened the international financing partnerships. The Odra River Basin Flood Protection Project is co-financed by the CEB and the EC (Cohesion Funds) which provide parallel funding within the framework of the program and investment design parameters set by the Bank. While some concerns initially existed with respect to the eligibility of such expenses for EU purposes, these concerns have been addressed properly and timely. The cooperation has proved productive, with the co-financiers joining supervision missions and participating in key decisions. With the Cohesion Funds constrained in utilization, the CEB and Bank funds have been instrumental to maintain liquidity and furnish bridging funds, thus leveraging maximum absorption of the EU grants. Without this co-financing arrangement and flexible financial management (FM) by the Bank, the CEB, and the PCU, no Cohesion Funds could have been absorbed. The same co-financiers have expressed interest in joining a new operation. The new project will, therefore, continue and further refine this partnership.

29. People affected by a project should be involved from the early stages of project preparation and throughout the implementation period, in order to gain and maintain their support. Experience clearly demonstrates that sustainable engagement and changes in public behavior can only succeed if community participation as well as communication and awareness raising activities are fully integrated into the project design and implementation. Local stakeholders often have relevant experience and knowledge of the hazards and are able to identify critical areas and possible measures. These lessons are mainstreamed in the design of the components as well as through the

[5] In November 2013 and May 2014, the Administrator of the Supreme Audit Chamber (NIK) and the Deputy Minister of Finance stated the project had ensured the application of best-practices and effective delivery because of the Bank's approach to (i) operate simultaneously at policy, administrative, and work-floor level and (ii) require up-front preparation of the project details and safeguards while retaining flexibility to adjust during implementation. This compares favorably with other large hydraulic investments such as the construction of the Swinna-Poremba reservoir that after 25 years is not completed yet. Also, it is pointed out that the national highway construction program, while progressing fast, has caused numerous litigations by contractors that have stalled works.

extensive consultations that accompany the preparation of the RBMPs and Flood Management Plans, which has started in 2008 but will continue over the coming years.

30. Finally, it is universally accepted that there is a need to move from an exclusive infrastructure approach to a comprehensive and holistic approach to flood management combining infrastructural investments with management and policy measures. This is determined to be critical for long-term, sustainable, social, economic, and environment development of the affected areas. Integrated flood risk management should be integrated into comprehensive water resource management plans taking into account the socioeconomic realities, water uses, and vulnerabilities and risks at the river basin level. Thus, successful flood management should combine both structural and non-structural measures. Controlling floods is often proved to be unrealistic and strategies should focus on flood risk management that aims at enabling communities to 'live with floods' instead of controlling them, minimizing risks and losses, and improving preparedness and response to eventual flood disasters. Also, this lesson is embedded in the project design that prioritizes the creation of upstream storage capacity, the restoration of wetlands, and the improvement of forecasting and management capacity, over the construction of local dikes.

IV. IMPLEMENTATION

A. Institutional and Implementation Arrangements

31. The project requires the close coordination of four ministries: The MoE for implementation, the Ministry of Administration and Digitization (MAD, formerly Home Affairs) for the flood protection budget, the Ministry of Finance (MoF), and the Ministry of Infrastructure and Regional Development for coordination of Borrower EU funds. Other key national-level agencies are the National Water Management Authority (KZGW), the Institute of Meteorology and Water Management (IMGW), the National Fund for Environmental Protection and Water Management and the State Rural Property Agency. Several local government entities are also involved notably the Voievodes and Marshals of the involved Voivodships, the District and Municipality Heads, and the Regional Environment Inspectorates. These government officers and agencies decide on environmental, water use, and construction permits, manage the land acquisition processes, and issue important permits for, for example, the use of roads for truck transports. They also are crucial in facilitation of relations with local communities.

32. The overall strategic coordination, guidance, and quality control will continue to be delivered by the Inter-Ministerial Project Steering Committee (PSC), chaired by the MAD and the MoE, and in which also the MoF and the Ministry of Infrastructure and Regional Development participate. At the operational and day-to-day level, the coordination and quality control will remain the responsibility of the Project Coordination Unit (PCU) that is currently carrying out the same task for the Odra River Basin Flood Protection Project. The PCU will be expanded for this purpose (including local representatives in Kraków). The PCU will continue to report directly to the Minister of Environment, while administratively a part of the KZGW, an implementing unit of the MoE. This arrangement has proved effective in the ongoing Odra River Basin Flood Protection Project.

33. The PCU will work with the prospective implementing agencies that will need to appoint their PIUs. For all the activities in Components 2 and 4, and for some of those in Component 1, the

PIUs will be the same as under the ongoing Odra River Basin Flood Protection Project, providing continuity, and ensuring that lessons from the current project will be used in the new project.

34. The project components are to be prepared and implemented by the RZGWs and the ZMiUWs, and equivalent organizations, depending on location and nature. The RZGW of Wrocław and the Lower-Silesia ZMiUW have evolved over the Odra River Basin Flood Protection Project period as competent and reliable institutions with demonstrated capability to carry out the investment analysis and works preparation that define flood projects, including procurement, and works and safeguards supervision. The new project will build on the experiences and staff of these two institutions. Seven new prospective implementing agencies will be added and their capacities will need to be strengthened; this is planned to be done through the existing national systems of coordination and supervision. The new agencies are the RZGWs in Szczecin and the ZMiUWs of the Voievodes of Zachodniopomerskie (West Pomerania), Lubuskie, Małopolskie, Podkarpackie, and Swiętokrzyskie. RZGW Kraków will be a key beneficiary for the activities in the Upper Vistula and the operations center but will not be responsible for any procurement. Given that during implementation, studies will be prepared to identify future investments in the Upper Vistula, RZGW Kraków may be a future PIU and as such is included in the program. Each PIU will be responsible for the implementation of the assigned project subcomponents/activities. All PIUs will carry out procurement and supervision/monitoring of contracts, maintain effective internal control procedures, account for expenditures in their existing budgetary accounting systems, receive funds, make payments, and provide the PCU with documentations and information related to use of the loan proceeds, statement of expenditures (SOE) documentation of the eligible expenditures, project reporting, and monitoring. The PCU (with support from local representatives in Kraków) will be responsible for gathering and consolidation of entire project financial information through an online reporting system, preparation of disbursement documentation (withdrawal application and SOE documentation), reporting (periodical and annual), financial planning and monitoring, and monitoring of flow of funds.

35. Although the preliminary assessment suggests that these agencies are technically and managerially capable, the technical capacities, as well as their capacities with respect to World Bank procurement, FM, and environmental and social safeguards will need to be further strengthened. This will be monitored closely in the first years of project implementation and additional training and supervision extended, if necessary.

B. Results Monitoring and Evaluation

36. The PCU will submit quarterly reports in an agreed format to the MoE, the Project Steering Committee and the Office of Natural Disaster Recovery (ONDR), and the Bank no later than 45 days after the end of each quarter. The quarterly reports would cover, among others, the progress and expected completion date for civil works and goods contracts (both physical and financial progress with photographic evidence), progress and expected completion date for key consultancies, compliance towards environment and social safeguards (including implementation of key features of the environmental management plan (EMP) and resettlement action plans (RAPs)), progress on institutional components, progress toward indicators given in the results framework, training and studies, and activities of the PCU consultants. The reports would also cover detailed financial and procurement information, including (i) a comparison of actual physical and financial outputs with forecasts, and updated six-month project forecasts; (ii) project financial

statements, including sources and application of funds, expenditures by category statement, and special accounts reconciliation statement; and (iii) a procurement management report, showing status and contract commitments. A midterm review of the project will be undertaken by July 31, 2019. An Implementation Completion Report (ICR) will be submitted to the Bank no later than six months after the closing date.

37. A dedicated survey platform will be developed to allow impact evaluation of floods and flood mitigation efforts, to better analyze the disaggregated impact of the project as well as other investment programs (disaggregation by income, location, social variables, gender, and so on) and enable better targeting of future investments and measures. As was done under the ongoing Odra River Basin Flood Protection Project, the PCU will also prepare civil works monitoring tables to provide a more detailed account of progress under these contracts. These tables would provide basic contractual information, progress indicators (both with respect to interim payment certificates and paid invoices), and color-coded task progress. The M&E activities will provide continuous feedback to the MoE, MAD, ONDR, and the PSC on project performance and its impact on the various components so that corrective actions can be undertaken in a timely manner.

C. Sustainability

38. The project is considered sustainable as the proposed works and other measures have been prepared based on the Bank's guidelines and best practices, and have been supported by studies in accordance with the EU WFD and FD, notably the preparation of Flood Hazard Maps and Flood Risk Maps, and the development of first-generation RBMPs and Updated Master Plans. This extensive analysis and prioritization have allowed selection of the high-priority works and measures out of a long-list of possible identified needs in flood management. This selection and the specific design of the individual works and measures were based on extensive consultations with local governments and the public. Part of these consultations was undertaken in the context of the preparation of the first-generation RBMPs that the government is bound to prepare under the EU WFD and FD.

39. Secondly, the experience with the ongoing Odra River Basin Flood Protection Project has shown that the government is committed to provide the budgets for investment as well as for operation and maintenance (O&M). The field inspections in the territories of the prospective PIUs of the project demonstrate that in general adequate resources are provided for the maintenance and functioning of the infrastructure, recognizing that current O&M budget levels cannot compensate for the funding shortages in the second half of the 20th century. However, with the expansion of the infrastructure, the need to increase the O&M budget is growing apace. As part of the annual work program planning process, the Borrower will include O&M allocations to ensure adequate budgets for the works under the proposed project. Thus, the project is very likely to remain financially sustainable.

V. KEY RISKS AND MITIGATION MEASURES

Risk Category	**Rating**
1. Political and governance	**Moderate**
2. Macroeconomic	**Moderate**
3. Sector strategies and policies	**Moderate**

4. Technical design of project or program	**Substantial**
5. Institutional capacity for implementation and sustainability	**Moderate**
6. Fiduciary	**Moderate**
7. Environment and social	**Moderate**
8. Stakeholders	**Substantial**
9. Other	**n.a.**
Overall	**Moderate**

40. The stakeholders risk is considered Substantial. The risk pertains to the distributed nature of flood projects, requiring active commitment and involvement of several national ministries and numerous local governments at voievode, county, and municipality levels. In addition, civil society representatives and NGOs tend to play important roles as the investments and other measures may affect daily lives, livelihoods, and traditional habits. Furthermore, the national scope, the size of the project, and the desire to spread the risks, require the composition of a financing consortium; of these, the EC-related institutions (Directorate General Regional Development) have stated that they will accept Bank guidelines to be applied.

41. This risk is mitigated by maintaining the conducive and productive relationships that have been developed during the implementation of the ongoing Odra River Basin Flood Protection Project. At the level of local governments and civil society, several mayors, starostas, and voievodes involved in the ongoing project have expressed readiness to join the PIUs in approaching their peers and the communities to clarify the purposes and modalities of the project and reduce concerns.

42. The second key substantial risk is the technical quality of the programs for investments and managerial measures for flood risk mitigation that need to be technically adequate and cover the large hydraulically coherent parts of the river basins. In particular, a risk exists that investments are proposed that extend protection to local populations at the expense of downstream populations, and/or that are not of high-priority or no-regret nature.

43. This risk is mitigated, partly, by the following steps: (i) the extensive screening of investment proposals that has taken place over the past years by the prospective Implementing Agencies; (ii) the requirement that, for local situations where flood defense could be achieved through different alternatives (for example, through a flood by-pass, higher dikes, local overflow areas, or combinations) the alternatives have been exhaustively compared; and (iii) by the availability, since early 2014 of the draft Flood Risk Maps, that form the basis for the Updated Master Plans that have been completed in 2014 and re-confirm the prioritization of the project selection.

44. All other risks (environment and social, fiduciary discussed below) are Moderate in nature largely due to the experience and capacity developed under the on-going project. These risks can be mitigated as measures from the on-going project will continue to be used. The institutional capacity risk is also Moderate given that the project will utilize the same PCU and PIUs from the on-going project. Substantial capacity has been built with these entities in the proper application of Bank guidelines in procurement, financial management, and safeguards. Moreover, the ongoing

project has revealed the need for a nimble but effective PCU that performs more than just 'coordination'. As such, the PCU has acted as (i) overseer of the PIU works programming and financing, (ii) the single intermediary between the PIUs, the Bank, the steering committee, and the co-financiers, and (iii) the body to provide clearance to designs, tender documents, environmental and other safeguard documents, and so on. This same function will continue into the new operation. New PIUs will also benefit from this earlier/on-going experience. For these reasons, the overall risk rating is Moderate.

VI. APPRAISAL SUMMARY

A. Economic Analysis

45. The recent flood events that struck Nysa Kłodzka Valley, the Lower Odra, and the Upper Vistula have been analyzed with respect to the loss of life and the extent of damage. Based on the findings of the assessment, an economic analysis has been prepared following standard Bank procedures, as well as those commonly applied for investments that would be eligible for the EU Cohesion Funds. The 1997 and 1998 floods in the Nysa Kłodzka Valley are 100-year events and claimed 13 lives and resulted in about €290 million in direct damages. The 2010 spring floods on the Lower Odra inflicted damage estimated to cost €0.8 billion. The Upper Vistula experienced severe 1-in-20 to 1-in-50 year flooding in 1997 and 2001, but the 1-in-100 year flooding in 2010 cost several lives and about €2.8 billion in damages and indirect costs (income foregone). The majority of this damage accrued in the areas that are the subject of the proposed project.

46. Flood management is preeminently a public good with spatially distributed effects at the local level and at locations elsewhere in the river basin (externalities). In the EU, as well as in all mature market economies, it is one of the larger tasks in infrastructure and water service provision of national and local governments. The relationship between the service provision and the beneficiary cannot be individualized, rendering targeted fee collection tenuous. Generally, costs can only be recovered indirectly through increases in land and residential taxes, and the higher general public revenue generated by the improved investment climate and business activity. The private sector generally contributes to flood protection only through the insurance services to compensate households and businesses that could be affected.[6] In Poland, the private sector participates intensively in flood projects through the assignments for design, consulting, contracting, and maintenance of the infrastructure.

47. The economic rate of return (ERR) of the project is 13.5 percent. The Net Present Value (NPV) of the overall project is estimated at PLN 4,815 million (with 5 percent as discount rate) and at PLN 926 million (with 10 percent as discount rate)[7]. The non-material benefits include reduced stress, alcoholism, suicide rates, fear of floods, loss of control over recurrent situations, loss of memorabilia, and health problems (details of the analysis per component and description of the

[6] However, insurance policies restrict coverage of assets in flood-prone zones or require very high premiums (see, for example, the recent episode in the United States where, first in 2012, the Biggert-Waters Flood Insurance Reform Act intended to replace federal financial assistance to flood victims by private insurance, to be repealed, in 2014, as owners of large homes and businesses complained about forbiddingly high premium increases for zones deemed by the insurers to be insufficiently protected by infrastructure or otherwise).

[7] EUR1=PLN4.16 is used.

estimated benefits are presented in Annex 5). The estimated ERR is robust and not very sensitive to costs and benefits: even a 30% increase in investment costs, or up to 40% percent reduction of benefits from avoided material flood damage would maintain an ERR above 10 percent.

48. The main benefits quantified for this assessment are related to (i) the reduced *material* and *non-material* damages from flood hazards; (ii) induced economic activities including mining of aggregate; (iii) enhanced navigability of the Odra River; (iv) increased tourism due to improved safety conditions in the area; and (v) jobs created during the implementation of investments. For estimating the material benefits from flood protection, the area inundated for a sequence of flood events with progressively infrequent return periods were prepared. Hydraulic simulation models were used to provide water levels for floods and duration with different return periods. These levels were then overlaid on the topographic conditions (using digital terrain models) to estimate expected damages in the areas inundated "with the Project" and "without the Project". The actual damages of the 1997, 1998 and 2010 floods, together with the modeled areas of various land use categories that were inundated, were used to derive unit rates on a per square meter or a per hectare basis for each land use category. The methodology allowed estimating potential flood losses for each area at risk to be protected from flooding and in each of the predicted probabilities of an event.

B. Technical

49. Due to the complex hydraulic and hydrological processes causing the high water levels, flood management generally necessitates an array of physical and programmatic measures and activities that function in complementarity and are integrated into one management strategy. While a local dike can indeed help mitigate the risk of a local flood, principles of equity and cost-effectiveness impose an integrated approach and strategy at the scale of the complete river basin, in order to avoid protection in one (upstream) location displacing the risk to a different location along the same river (usually, downstream). The activities and measures that will be funded under the project notably comprise the following:

- 'Passive' infrastructure, such as dikes, embankments, and river bank stabilization works (revetments, foundations, parapets, and so on), through rehabilitation, modernization, or expansion of existing structures
- 'Active' infrastructure, such as dry polders and overflow areas (wetlands, agricultural lands) that absorb and temporarily retain the peak of flood waves
- River training, such as the rehabilitation or reconstruction of groynes and breakwaters in the river to create and maintain specified water depths to allow floodwater to discharge rapidly, and icebreakers to navigate; dredging (to allow floodwater to discharge rapidly); river bend restructuring to minimize scouring velocities, stabilize the river bed, and reduce vortices that create hydraulic resistance; and related measures such as increasing the vertical clearance under bridges (to allow modern-class icebreakers to pass underneath).
- Improvement of the warning time and accuracy in the forecasting capability for high waters, and enhanced remotely controlled operation of infrastructure (weirs, locks, reservoirs, dry polders, and so on) in such ways as to mitigate high water levels.

50. The identification of overflow areas and dry polders that are capable of absorbing a significant part of the flood wave in a cost-effective manner is complex and requires ample study. The Upper

Odra basin has benefited from such studies over the past century and a reasonably complete assessment is available of suitable sites, of which some are in use (such as the Buków dry polder upstream of Racibórz, the Oława polder upstream of Wrocław, and the Wilkanów and Lądek Zdrój dry polders built before World War II in the Nysa Kłodzka Valley), while others are under construction (the large Raciborz dry polder) or planned (four medium-sized dry polders in the Nysa Kłodzka Valley that will be financed under the project). In the Middle and Lower Odra, several natural areas alongside the river still give the river space to expand; immediately upstream of Szczecin the vast Miedzyodrze wetland, situated between the two parallel Odra channels, fulfills the same function. On the other hand, the studies on the Vistula, being a larger and more complex hydrological system, will need to be continued to identify all required and cost-effective options. The project would fund investments in medium-scale overflow polders that are located in strategic locations, but will not yet provide the final required space for flood wave absorption. Thus, the project will also support further in-depth studies to identify and prepare additional overflow areas. Over the past decade, under the guidance of the EU WFD and FD, numerous studies have been conducted based on the latest terrain survey technologies and flood risk maps. The proposed works have emerged as no-regret and feasible measures from extensive analytical work that takes into account the basin-wide interactions between different types of structures under different scenarios of precipitation. These studies take also into account the expected influence of climate change and land-use change, however, future investments, especially of more strategic structures, would require a deepening of such analysis and simulation.

51. The appropriateness of the selection of investments, of the conceptual designs and, where available, the detail designs, and the planning and implementation aspects, were reviewed by three independent senior experts including members of the International Dam Safety Panel for the on-going project, reflecting expertise in hydraulic engineering, water resource engineering, geo-technology, and construction engineering. They endorsed the project and its components, and raised technical issues that will need to be taken into account as the detail designs and bidding documents are prepared.

C. Financial Management

52. The FM arrangements that have been developed under the ongoing Odra River Basin Flood Protection Project will constitute the core for the new project. They were reviewed in May 2014 with a follow-up training for the new PIUs in October 2014. The FM arrangements were overall found acceptable for the new project implementation, subject to completion of the next steps before project effectiveness/disbursement, including the update of the information technology (IT) system, the update of the FM section of the Project Operational Manual and distribution to all of the PIUs, and the selection of the auditor, Supreme Audit Chamber (NIK) or a commercial auditor. The overall FM risk is Moderate with the application of the mitigation measures.

53. The PCU will consolidate the project financial information from all PIUs using an online reporting system and produce full sets of quarterly un-audited interim financial reports (IFRs) that will be submitted to the Bank within 45 days of the end of each calendar semester, from the first disbursement and throughout the project life. The audits of the project financial statements will be conducted annually by independent auditors (with defined terms of reference) and according to the auditing standards acceptable to the Bank. For the ongoing project the financial audit has been performed by the Supreme Audit Chamber (NIK). The annual audits of the project financial

statements will be provided to the Bank within six months of the end of each fiscal year, and also at the project closing. The Government will inform the Bank of its choice of auditing entity, acceptable to the Bank, for the new project by December 31, 2015.

54. To facilitate the internal administration of financial flows in the new project, the share of the IBRD funding in the overall proposed project cost would be determined on an annual basis, through an Annual Work Plan (AWP) prepared by the Borrower, and agreed between the Borrower, the Bank and other co-financier partners involved in the proposed project implementation. Therefore, the percentage of financing from the IBRD loan may be different in each year, depending on the availability of funds from other funding sources in each implementation year.

55. The MoF will open a separate Designated Account (DA) in the National Bank of Poland. The World Bank loan proceeds will flow to the DA and from there will be transferred to the PIUs in accordance with the existing budgetary procedures applicable for foreign sources of funding.

D. Procurement

56. Procurement activities under the proposed project will be carried out by the PCU and nine PIUs (RZGWs in Wrocław and Szczecin, and ZMiUWs of the Voievodes of West Pomerania, Dolnośląskie, Małopolskie, Podkarpackie, Swiętokrzyskie, and Lubuskie, as well as IMGW Kraków) in accordance with the World Bank's Guidelines: Procurement of Goods, Works and Non-Consulting Services under IBRD Loans and IDA Credits and Grants by World Bank Borrowers, dated January 2011 and revised on July 1, 2014 and Guidelines: Selection and Employment of Consultants under IBRD Loans and IDA Credits and Grants by World Bank Borrowers, dated January 2011 and revised on July 1, 2014, and the provisions stipulated in the Loan Agreement. A procurement assessment initiated in September 2014 concluded that there is adequate experience and capacity to carry out the procurement activities under the proposed project. Taking into account the PCU, RZGW Wrocław, ZMiUW Dolnośląskie, and IMGW's long experience with Bank-financed projects and successful implementation of the ongoing Odra River Basin Flood Protection Project, the assessment found the overall procurement risk for the project to be Moderate. The capacity of the new implementing agencies that have not been involved in implementation of the ongoing Odra River Basin Flood Protection Project will be strengthened based on close supervision, coordination, and training provided from the PCU and existing PIUs, as well as additional joint fiduciary training provided by the Bank.

57. With respect to fiduciary risks identified, there is a potential risk of delays in the implementation of the procurement procedures, especially for large civil works contracts that will require a prequalification procedure before inviting bids from the prequalified applicants. In addition, in civil works contracts there is a risk of cost overruns due to variation between orders and submission of claims. To mitigate the procurement risks the PCU and the PIUs will implement measures agreed with the Bank which will include: (i) initiation of prequalification procedures as early as possible and preparation of bidding documents for the first year of the project's implementation in advance; (ii) conducting business outreach organized by the PCU/PIUs for the private sector on future business opportunities under the project before launching first bidding procedures; (iii) hiring of consultants, experienced in International Federation of Consulting

Engineers (FIDIC) type of contracts, who will assist the PIUs in design and/or supervision of large civil works contracts.

58. The Bank will closely supervise the project and will review the procurement arrangements as performed by the PIUs—including contract packaging, applicable procedures, methods, and the scheduling of procurement processes—for conformity with the Loan Agreement, the proposed implementation program, and the disbursement schedule. The Bank's prior review thresholds will be provided in the agreed Procurement Plan. The remaining procurement procedures will be subject, on a random basis, to the Bank's ex post review. One in ten contracts under the project will be subject to ex post review. More detailed findings of the assessment, the proposed procurement arrangements, and measures to address the identified risks are presented in annex 3. The general Procurement Plan, and the detailed Plan for the first 18 months, have been agreed by the Bank.

E. Social (including Safeguards)

59. **Involuntary Resettlement.** The project is expected to have significant positive social impacts in terms of protection of life and property and creation of short-term jobs during construction; as well as improvement of public spaces and amenities. The selection criteria and technical design of all project activities considers the minimization of adverse impacts, including the need for involuntary resettlement. In many cases the works involve the rehabilitation of existing infrastructure in mostly government-owned lands located in sparsely populated peri-urban and rural areas (e.g. rehabilitation of existing dikes and groynes), for which land impacts are none or limited. However, other interventions, such as construction of new structures and dry polders, particularly in the Nysa Kłodzka Valley and some locations in the Upper Vistula, would likely require land acquisition involving displacement of some agricultural activities and resettlement of a limited number of households, which based on preliminary information for the first seven pre-identified project activities for the first 18 months of implementation could be less than 10 (less than 30 people). Based on the early conceptual designs for subprojects to be built in 2019 (Component 2), there is also the possibility that some additional 30 households (approximately 100 people) may also require resettlement. It must be noted that no project activities requiring significant resettlement will be supported by the project.

60. In order to manage this impact, in addition to the project-level Resettlement Policy Framework (RPF), which was approved by the Bank and disclosed in InfoShop on February 17, 2015, separate site-specific Resettlement Action Plans (RAPs) will be prepared for those project activities involving involuntary resettlement. The preparation of preliminary information for the RAPs of the seven pre-identified investment is underway and final RAPs will be in place well before construction starts. The land acquisition and resettlement processes required under this project will be based on Polish regulations, the Bank's Operational Policy (OP) on Involuntary Resettlement (OP 4.12) and lessons learned from the Odra River Basin Flood Protection Project, and will include a robust grievance redress mechanism.

61. **Gender:** Given that the Project will provide flood protection to the general population in the Odra and Vistula river basins no gender-differentiated benefits and/or impacts are expected. However, surveys to be conducted as part of the project's M&E will include gender disaggregated information and analysis. Finally, the RAPs will be gender-informed and include gender-

disaggregated information and specific measures aimed at ensuring effective participation of women during consultations and equal treatment. It must be noted that during the implementation of the Odra River Basin Flood Protection Project no gender-differentiated resettlement impacts were found and women had a very active participation in the process.

62. **Citizen Engagement:** Citizen engagement activities through the project will be implemented throughout the life of the project and at multiple levels. At the broader level, the preparation of the River Basin Management Plans (RBMPs) and prioritization of investments will be based on multi-stakeholder consultations (e.g. national government, regional and local governments and NGOs). A national communication strategy on flood risks and their management will also be developed. At the sub-project level, the location and design of the investments will also be subject to public information and consultation through the corresponding municipalities. Additionally, the preparation of the Project's ESMF and RPF have been subjected to public disclosure and consultations and the resulting ESMPs and RAPs will be also subjected to more in-depth consultation processes and the RAPs will include robust grievance redress mechanisms. Finally, project impact monitoring will include surveys for disaggregated analysis (by gender, age, income, etc.) of flood impacts and flood protection impacts, and on citizen engagement.

F. Environment (including Safeguards)

63. The project is categorized as environmental category B in accordance with OP 4.01. To assess the possible environmental impacts of the proposed project, and to set up principles, rules, guidelines, and procedures for preparation of site-specific plans to mitigate possible negative environmental impacts of proposed investments, the Environmental Safeguard Management Framework (ESMF) was prepared by the consultant, approved by the Bank in January 2015 and disclosed in Poland on February 9, 2015 and on the Bank's Infoshop on February 6, 2015. For the project, a selection of priority investments and measures was agreed upon on the basis of the EC's DG Environment's "List 1"–based on the interim Updated Master Plans–which contains all investments items that are acceptable and no-regret because they are well defined and do not require basin-wide analysis. The selection was guided, foremost by the locations that had experienced historical records of devastating nature ("hot spots" that are recognized to be particularly vulnerable to floods, yet where mitigation measures would probably be cost-effective without being environmentally or socially complex), by the desire to work in coherent areas, where it would be possible to build on the lessons learned and the institutions developed under the on-going Odra River Basin Flood Protection Project, and where a generally good level of institutional readiness was confirmed. The basic criteria for selection of investments were: (i) prioritization within the context of the RBMPs and comparison of all possible combinations of investments to identify the least-cost and lowest-impact variants; (ii) economic analyses to select cost-effective options including a risk-based approach to investments; (iii) creating "room for the river" and flood wave retention capacity upstream, rather than constraining river flow by dikes; (iv) integration with environmental values and protection of habitats; (v) management plans based on broad consultation with stakeholders; (vi) and sustained financing through fee collection and/or transfers from the national or regional budgets. The project scope includes only a fraction of the long list in "List 1". Certain proposed investments in "List 1" were excluded from the Project notably where they could possibly affect vulnerable areas, habitats and/or riverine forests, including Natura 2000 sites. For such investments, more extensive variant analysis will be required. Besides regular safeguards analyses, the individual selected works and measures were also reviewed through

mathematical simulation of water flow and flood routing to ascertain whether they create incremental negative or positive impacts on downstream or upstream communities. It is important to note that the majority of the investments concern rehabilitation and modernization of already existing structures.

64. By complying with the European Water Framework Directive, the requirements on environmental protection may often exceed the Bank's own safeguard policies. Thus, from a project implementation perspective, a high level of environmental protection is being applied (e.g. exclusion of activities within EC defined Natura 2000 sites, environmental compensation measures). This would apply to all components, including component 4.

65. The project is likely to have significant positive environmental impacts in terms of protecting floodplains and aquatic ecosystems. The main threats are related to potential changes in water regime and consequent impact on flora and fauna in the periodically flooded areas, which, if not properly managed, could create significant changes to local habitats. However, the application of selection criteria related to each particular investment, and exclusion of those investments that are likely to have larger impact will ensure that this risk will be avoided. The majority of identified activities will be undertaken outside nature protected areas, in particular in components 1 and 3. However, in some cases the activities will be implemented partly or completely within the areas of specific nature protection regime. Besides strictly applying the selection criteria for those investments, the site-specific Environmental Management Plans (EMPs) will emphasize the reduction and mitigation of potential negative impacts, chiefly during the construction phase. The activities within protected nature areas will be limited to the restoration of the existing linear flood defense infrastructure and, in a small number of cases, to local dredging aiming to restore the natural flow of water.

66. The project will also finance the construction of several overflow areas (dry polders). Since the specific locations of these have yet to be finalized, the project will ensure the application of the investment selection criteria during the feasibility study and conceptual design stages and require the polders to be carefully evaluated with respect to location, size and impacts, to ensure that possible adverse effects are minimized and adequately mitigated. Overflow areas and/or polders with major negative impacts will be analyzed further before suggesting appropriate environmental mitigation measures and/or change of locations. Any of the structures that may have a major negative impact on environment, or structures that can be categorized as environmental category A, will not be eligible for financing under the Project.

67. Beside the project-scale ESMF, separate site-specific Environmental Management Plans (EMPs) will be prepared for all investments once identified. The preparation of preliminary information for some EMPs is underway for the priority pre-identified project activities that could be ready for tendering in 2016 following their confirmation. These EMPs will become essential components to the bidding documents and subsequent construction contracts.

G. Other Safeguards Policies Triggered

68. OP 4.04 on Natural Habitats: Based on available information, the project will have significant positive environmental impacts in terms of protecting floodplains and aquatic ecosystems. The majority of proposed activities will be undertaken outside the nature-protected areas, particularly

for Components 1 and 3. However, in some cases the activities will be implemented partly or completely within areas of specific natural protection. For those activities, special emphasis will be placed in the EMPs on reducing and mitigating potential negative impacts, primarily during construction.

69. OP 4.11 on Physical Cultural Resources: Although the physical cultural resources are not expected to be encountered on river training works in floodplains, near and within the cities of Kraków, Sandomierz, and Słubice, the works will be carried out near the protected cultural heritage buildings. Additionally, rehabilitation of embankments in these and other cities will likely result in chance finds. Appropriate provisions for archeology investigation and rescue works near these buildings, and for chance finds have been included in the ESMF.

70. OP 4.37 on Safety of Dams: Although the final selection of polders to be rehabilitated or constructed has not been made, it is known that some of the polders will include construction of dams and weirs. It is likely that at least two of the polders-reservoirs in the Nysa Kłodzka Valley in Component 2 will include dams/embankments higher than 15 meters and with capacity over 5 million m^3. Therefore, the project retained the independent Panel of Dam Experts that already exists for the on-going Odra River Basin Protection Project and is adjusting its terms of reference. The Panel of Experts has already started review of feasibility studies (where existing), conceptual designs and other available documentation. The Panel will continue working on the project for its full duration. The design of all dry polders under the project will be prepared in compliance with the Safety of Dams policy.

71. OP 7.50 Projects on International Waterways: About 160 km of the Odra's 854 km total length is the so-called Border Odra (a sparsely populated part of the Lower Odra) which is shared by Poland and Germany. The Odra River basin measures 122,000 km^2, of which 90 percent lies in Polish territory, and 5 percent each in German and Czech territories. 95% of the Vistula River lies inside Polish territory while only minor portions of the upper watersheds are in the riparian countries of Slovakia, Ukraine and Belarus; thus there are no downstream externalities. Based on OP7.50, all riparian countries to the Odra and Vistula Rivers were notified. A Polish-German Government Commission for Cross-Border Cooperation is active at the ministerial level, with involvement of, on the Polish side the Voievodes, and on the German side, the *Länder* representatives. In parallel, the trilateral Odra River Commission addresses the technical aspects of the river issues of common interest. The Odra Commission has agreed on the technical specifications of flood protection along the Border Odra. Per the Bank requirement, the Polish government initiated in September 2014 the procedure of notification of the riparians to inform them of the project. By January 31, 2015, the stated deadline for responses, Germany, Czech Republic, Belarus and Ukraine have not submitted objections, while Slovakia sent a letter supporting the project and requested information be shared in case there would be works on the upper part of the Dunajec near the border. The project does not envision any works in that part of the sub-basin. On May 7, 2015, the Regional Vice-President for ECA endorsed the memorandum prepared by the Bank on the Results on Riparian Notification under OP7.50 for the Project."

ANNEX 1: RESULTS FRAMEWORK AND MONITORING AND EVALUATION

REPUBLIC OF POLAND: ODRA-VISTULA FLOOD MANAGEMENT PROJECT

Project Development Objectives

PDO Statement

The project development objectives are to increase access to flood protection for people living in selected areas of the Odra River and Upper Vistula River basins and to strengthen the institutional capacity of the Borrower to mitigate the impact of floods more effectively.

These results are at	Project Level

Project Development Objective Indicators

Indicator Name	Core	Unit of Measure	Baseline	Cumulative Target Values							Frequency	Data Source/ Method	Responsibility for Data Collection
				YR1	YR2	YR3	YR4	YR5	YR6	YR7			
Total area in the 1% flood plain benefiting from enhanced protection and operational forecasts		ha	0[8]	0	3,341	15,486	31,278	51,332	69,447	81,626[9]	Annual, after major floods	Satellite imagery, surveys	PCU, IMGW, KZGW, PIUs, and M&E consultants

[8] Based on current 1% flood maps (IMGW, 2014)

[9] Estimated for horizon to YR7 (2023), entire Project (2016-2027): 91,168 ha

Total population benefiting from enhanced protection and operational forecasts (gender disaggregated)		Number [million]	0[10]	0	0.7	2.4	5.1	8.3	10.5	12.4[11]	Annual, after major floods	Satellite imagery, surveys	PCU, IMGW, KZGW, PIUs, and M&E consultants
Flood Operation Centers established and functional		Number	0	0	0	1	1	1	2	2	Annual, after major floods	Contractor reports	PCU, IMGW, KZGW, RZGW Wrocław, and Kraków

Intermediate Results Indicators

Indicator Name	Core	Unit of Measure	Baseline	Cumulative Target Values							Frequency	Data Source/ Method	Responsibility for Data Collection
				YR1	YR2	YR3	YR4	YR5	YR6	YR7			
Component 1A: Length of enhanced protection in the		km	0	0	0	7.9	9.8	9.8	9.8	9.8	Annual, after major floods	Satellite imagery, surveys, contractor reports	PCU, IMGW, KZGW, ZMiUW Zachodniopomorskie, and M&E consultants

[10] Based on current flood maps and population data
[11] Estimated for horizon to YR7 (2023), entire Project (2016-2027): 14.1 millions

Zachodniopomorskie Province													
Component 1B: Modernizing and reconstructing the middle and lower Odra river systems to upgrade to a Class III waterway		- – [12]Yes /No	No	No	No	No	No	No	No	Yes	Annual, after major floods	Satellite imagery, surveys, contractor reports	PCU, IMGW, KZGW, RZGW Wrocław, RZGW Szczecin, and M&E consultants
Component 1C: Extension and construction of flood embankments to protect Słubice City		km	0	0	0	0	12.8	12.8	12.8	12.8	Annual, after major floods	Satellite imagery, surveys, contractor reports	PCU, IMGW, KZGW, ZMiUW Lubuskie, and M&E consultants
Component 2A: Construction of dry polders in the Nysa Kłodzka Valley		Number	0	0	0	0	4	4	4	4	Annual, after major floods	Satellite imagery, surveys, contractor reports	PCU, IMGW, KZGW, RZGW Wrocław, and M&E consultants
Component 2B: Length of enhanced protection in the Nysa Kłodzka Valley		km	0	0	0	0	0	0	0	177	Annual, after major floods	Satellite imagery, surveys, contractor reports	PCU, IMGW, KZGW, RZGW Wrocław, and M&E consultants

[12] This component represents a package of investments to achieve reduction in ice jams.

Component 3A: Construction of dry polders to protect Upper Vistula towns and Kraków		Number	0	0	3	3	3	3	3	3	Annual, after major floods	Satellite imagery, surveys, contractor reports	PCU, IMGW, KZGW, ZMiUW Małopolskie, and M&E consultants
Component 3B: Length of enhanced protection for Sandomierz and Tarnobrzeg		km	0	3.0	12.0	24.0	36.0	46.34	46.34	46.34	Annual, after major floods	Satellite imagery, surveys, contractor reports	PCU, IMGW, KZGW, ZMiUW Swiętokrzyskie, ZMiUW Podkarpackie, and M&E consultants
Component 3C: Length of enhanced protection for the Raba sub-basin		km	0	0	0	1.5	4.0	10.0	16.0	19.77	Annual, after major floods	Satellite imagery, surveys, contractor reports	PCU, IMGW, KZGW, ZMiUW Małopolskie, RZGW Kraków, and M&E cons.
Component 3D: Length of enhanced protection for the San sub-basin		km	0	0	0	0	0	1.6	1.6	1.6	Annual, after major floods	Satellite imagery, surveys, contractor reports	PCU, IMGW, KZGW, ZMiUW Podkarpackie, RZGW Kraków, and M&E consultants
Component 4B: Flash flood systems for sub-basins operational		Number	0	0	0	0	2	2	2	2	Annual, after major floods	Contractor reports	PCU and IMGW

RBMPs or Investment Prioritization Plans drafted for Vistula sub-basins		Number	0	0	0	0	2	2	2	2	Annual	Contractor reports	PCU, IMGW, and RZGW Kraków
% of project-supported RBMPs and investments informed by citizen feedback through consultations (disaggregated by gender)			0	0	0	10	30	50	75	100	Annual	Surveys	PCU

ANNEX 2: DETAILED PROJECT DESCRIPTION

REPUBLIC OF POLAND: ODRA-VISTULA FLOOD MANAGEMENT PROJECT

The Odra and Vistula Floods

1. The Polish territory is drained by two large river basins, of almost equal size, namely the Odra basin in the western part of the country and the Vistula in the middle and the eastern part of the country (Annex 6). The rivers rise in the mountains and hills along the southern fringe, run roughly in the northern direction into the plains, and discharge into the Baltic Sea. The combination of the mountainous and hilly landscape and copious rainfall cause these rivers to flood regularly. Table 2.1 provides basic facts about the size and characteristics of the two rivers. Both rivers count among the longest in the European continent. Depending on the landscape they cross, different segments are to be considered. The most upstream part of the Odra, in the mountains and hills, is the Upper Odra, which flows through the city of Raciborz up to Wrocław. The middle section where the river meanders through relatively flat and forested area is called the Middle Odra or Free-flowing Odra (from Wrocław to the Polish-German border at the confluence with the Nysa-Łuzycka/Neisse River—not to be confused with the Nysa tributary that flows into the Odra, upstream of Wrocław). The third section of the Odra that forms the border between Poland and Germany is about 160 km long and is called the Border Odra. The last section of about 54 km flows completely on Polish territory, before emptying into the Szczecin lagoon and, hence, into the coastal Świnoujście Bay. Similarly, the Vistula has a distinct upstream segment called the Upper Vistula, which runs from its source, past the economic and touristic centers of Kraków, Nowa Huta, and much downstream, Tarnobrzeg and Sandomierz. The Upper Vistula formally ends at Zawichost after which the Middle and, thereafter, the Lower Vistula become a wide and meandering flow, less constrained by hills and with more limited urbanization. After 181 km, the river flows past Warsaw and eventually reaches Gdansk where it enters the Baltic Sea.

2. Successive governments that were administering the Polish territory before World War II have addressed flood risks in different ways. In Western Poland, the Odra benefited from ample government attention starting in the 19th century and this had led to major investments in river navigability and flood protection in the early 20th century. The hydrology was studied extensively. The Upper Vistula, on the other hand, which also had a history of recurrent major floods, was subject to less attention although many of the existing large embankment systems date back to the early 20th century as well. After 1945, investments in flood protection took a back seat as the country was rebuilding its cities and its industrial base. Currently, flood protection is a high priority in government policy and has broad political support across all parties. This prioritization was triggered partly by the traumatic May and June 1997 floods along the Odra and, to a lesser extent, the Vistula, and was further accentuated by the July 2010 flood episode that hit, notably, the Upper Vistula as well as parts of the Odra basin. In response, the government established, in 1997, the ONDR in the Office of the Prime Minister; to date the ONDR manages the sizeable budgets directed at flood management and also the budgets that have co-financed the ongoing Odra River Basin Flood Protection Project. In 2005, the ONDR was placed in the (then) Ministry of Home Affairs (now, the Ministry of Administration and Digitization). After the 1997 flood episode, the Parliament enacted the law on the Odra 2006 Flood Program, and a plenipotentiary (the Voievode of Lower Silesia, in Wrocław) was appointed to coordinate and facilitate the program and use of funds. Similarly, following the 2010 floods, the Parliament enacted the 2011 law on the Vistula

Flood Program and the Voievode of Małopolskie in Kraków was appointed plenipotentiary. In addition, the Parliament also adopted a law in the summer of 2010 to streamline the land appropriation procedures for investments in flood protection, in line with the procedures for highway construction. The government policies call for a long-term program with institutional strengthening and extensive investments to address the flood risks. It is declared policy to start with coherent programs that address priority areas of national strategic relevance, that is, the Odra and the Upper Vistula River basins. These areas were identified in recognition of the high frequency of large-scale flooding with large damages. The Bank-supported Odra River Basin Flood Protection Project was the first coherent program and aimed to increase the protection level of the Wrocław conurbation and a series of cities and towns along the Upper Odra starting with Raciborz. The second program is the subject of the proposed Odra-Vistula Flood Management Project which targets (i) the remaining most vulnerable cities and towns along the main stem of the Odra as well as along one tributary (Nysa Kłodzka) that also represents a direct threat to Wrocław; (ii) the most vulnerable cities and industrial areas along the Upper Vistula; and (iii) selected high-priority areas on the main tributaries of the Upper Vistula.

3. Both rivers are located nearly entirely within the Polish borders. The Vistula has only remote minor headwaters in neighboring riparian countries whereas the Odra is shared with, notably, Germany; the Lower Odra (the so-called 'Border Odra') forms the border between the two countries. A Polish-German Government Commission for Cross-Border Cooperation is active at the ministerial level, with involvement of, on the Polish side, the Voievodes, and on the German side, the *Länder* representatives. In parallel, the Odra River Commission, comprising senior representatives of the Polish, German, and Czech authorities, addresses all technical aspects of the river issues of common interest. It sets the standards and aims for flood protection, river management, and commercial shipping.

4. Floods in Poland can be classified as three types. First, most floods in the Upper Odra and Upper Vistula are typical high-water floods commonly occurring in spring and early summer. These summer floods are driven by stochastic precipitation events. The main flood protection measure consists of passive dike systems for which the crest height can be calculated so that it can withstand all high-water waves smaller than the one that is calculated to recur once in, for example, 100 years (1 percent chance of occurrence per year), which is a common minimally desired protection level for most urbanized areas and compliant with EU directives. Protection levels in metropolises are typically against 1-in-500 or 1-in-1000 year floods, and it is the declared aim to achieve such level in the longer run for main cities such as Kraków, Wrocław, and Szczecin. While overtopping is a cause of much flooding, dike bodies are found to be breached even more often by lower flood waves if they are poorly designed, built, or maintained. Dikes need regular rehabilitation and upgrading to preserve their functionality. Most dikes along the Lower Odra and many along the Upper Vistula are more than half a century old, were designed and constructed applying lower technical standards, and are now in poor to modest shape.

5. Second, the Lower Odra is threatened by annual winter floods caused by ice flows that jam the waterway. On the Lower Odra, 8 to 9 percent of all days the river surface is frozen over; in about one-fifth of the years there is no ice formation but in other years there is up to 100 days of deep frost (for example, in 1996). On average, a serious winter flood condition occurs every six years. Nonetheless, ice-breaking needs to be carried out in almost every winter as it is a precautionary necessity. Ice flows damage and weaken the dike bodies and other structures in and alongside the

river but, importantly, where the river banks provide protrusions or obstacles they can build up easily into large ice dams that hinder the flow of water and jam the river. Such ice jams create a triple hazard: (i) They cause the water to back up behind them, thus flooding areas as far as 30 km upstream from the jam; (ii) they create large water pools that, when the ice jam breaks, are released suddenly and create catastrophic waves rushing downstream; and (iii) they damage river infrastructure and dikes. The most cost-effective technology to demolish ice dams in a controlled way is by icebreaking ships that cut the ice preventively before it forms thick aggregates.

6. Third, many tributaries (torrents) of the main rivers, such as the rivers in the Nysa Kłodzka Valley that are tributaries of the Upper Odra, rise in hilly or mountainous areas, and can create flash floods. These tributaries are very quick-moving and create short flood waves that require different technologies and management approaches. The response to flash floods remains poorly understood and is hard to address because of the very local nature of the flood.

7. A recent forensic analysis of about 600 flood events in Poland in the past 27 years showed, among other things, that the frequency and severity of flood events are increasing since the 1980s, caused by a combination of land use change and climate change at a very local level; and that about 10 percent of the events is caused by ice jams. The Polish government has the objective to develop its national expertise and institutions to better cope with the three flood types.

Characteristics of the Odra and Vistula Basins and their Flood Events

8. Table 2.1 provides key physical characteristics of the Odra, Vistula, and Upper Vistula Rivers and basins. The 1997 'benchmark' flood hit especially the Upper Odra, and was caused by prolonged and intensive heavy rainfall in the upper reaches of the river in the Czech Republic. Over a surface of 1000 km^2 the maximized point value of precipitation was 500–550 mm with an average rainfall of 420 mm over 3 days in the Czech headwaters. This would correspond to 80–90 percent of the probable maximum precipitation. This lead to a probable maximum flood at Raciborz, where the river enters Poland, of 3,700–4,000 m^3/s, which is representative of a 1-in-1,000 year event. Such an event, though rare, is likely to happen again. Nonetheless, Polish studies have not found evidence for a shift in precipitation patterns. Also, an in-depth analysis of the frequency of floods on the Elbe and Odra Rivers concluded that there is no upward trend in the occurrence of extreme floods in Central Europe.[13] However, such a regional-scale conclusion does not preclude significant shifts at the scale of sub-basins. After intensive studies carried out by German research institutes, the Odra Commission had agreed in the early 2000s on the technical specifications of flood protection along the Border Odra. Investments and measures under the project in and along the Border Odra will assist Poland to meet these agreements.

[13] M. Mudelsee et al. No upward trends in the occurrence of extreme floods in Central Europe, *Nature*, *125*, 11 (September 2003).

Table 2.1: Key Data on the Odra, Vistula, and Upper Vistula Rivers and Basins

	Odra	Vistula	Upper Vistula (Source to Zawichost)
Length (km)	854 (till Szczecin Lagoon)	1,047	295
Catchment total (km^2)	122,000	194,400	50,700 (31% of total)
Catchment in Poland	89% (108,580 km^2)	87% (169,128 km^2) (covering 54% of Poland)	95% (48,035 $km^{2)}$
Catchment in other countries	Czech Republic: 6% Germany: 5%	Byelorussia, Ukraine, Slovakia: 13%	Ukraine, Slovakia: 5%
Population of basin within Poland	Approx.14 million	Approx. 23 million (60% of Polish population)	Approx. 9 million

9. Table 2.2 provides an overview of the salient features of high water discharge rates along the Odra and Upper Vistula, as measured at strategic locations on the main river stem, as well at the mouth of the main right-bank tributaries of the Upper Vistula. The data are drawn from various studies and databases, mostly from the hydrological data collected and analyzed by the IMGW. The recurrence frequencies have been calculated applying standard hydrological and statistical tools; however, for complex river systems the recurrence frequencies are subject to inaccuracies and significant assumptions so the values should be used as guidance, not as hard facts. For instance, the 1-in-1,000 year flood discharge is a calculation construct as it has never been physically observed.

Table 2.2: Water Discharge Rates in the Odra and Upper Vistula Rivers (in m^3/s) for 1-in-2 Year (Q50%), 1-in-100 Year (Q1%) and 1-in-1000 Year Cresting (Q0.1%) at Key Locations along the Main River Stems and Main Tributaries

River/Location	Q50%	Q1%	Q0.1%	Recent Benchmark Maximum Flow
Odra:				
At Wrocław	608	2464	3,917*	May–June1997: 3,640
At Szczecin	1,170	2,700	3,520	n.a.

Upper Vistula				July 1997:	May 2010:
At Kraków (Bielany)	598	2,396	3,422	-	2,324
At Sandomierz	1,881	7,182	10,160	3,810	5,264
At Zawichost	2,596	7,436	9,975	3,966	5,590
Raba at mouth	378	1,561	2,205	730 (July 1997) 1,436 (May 2010)	
Dunajec at mouth	901	3,940	5,640	2,762 (July 1997) 3010 (May 2010)	
Wisłoka at mouth	438	1,564	2,200	390 (July 1997) 898 (April 1998)	
San at mouth	756	2,246	3,292	845 (July 1997) 1,552 (May 2010)	
Middle, Lower Vistula				July 1997:	May 2010:
At Warsaw	2,568	7,125	9,491	4,168	5,940 4,772 (July 2001)
At Tchew (mouth)	3,550	7,744	11,790	3,190	6,567

Sources: Hydrographical Yearbooks 1953–2012, IMGW, Warsaw; Hydrographic Analysis of the 1997 Flood on the Upper Vistula, IMGW, Warsaw, 1999; Hydrographic Analysis of the 2010 Flood on the Upper Vistula, IMGW, Warsaw, 2011 (in Polish); and Feasibility Study of the Wrocław Flood Way, Halcrow & Partners, 2004.
Note: * This is the situation as per 1997. The current Design for a "control flood" taking into account the attenuation effect of the large upstream Raciborz Dry Polder, under construction, is 3,100 m^3/s.

10. The Odra (main stem) has been subjected to historical severe flooding events in 1813, 1829, 1854, and 1880; and in the 20th century, 12 deep floods have been recorded of which those of 1903 and, in particular, 1997 are the largest by far. In the wake of the 1903 floods the extensive Wrocław Flood Waterway system was constructed; however, that proved seriously inadequate in 1997. Beside the flooding events along the main stem, severe flood episodes have occurred on tributaries, notably along the Nysa Kłodzka Valley torrents, the Nysa tributary, and the Warta tributary.

11. The Upper Vistula also has a long record with historical documented flood events starting in 1513 when nearly the whole town of Kraków was inundated. Over the last century, major devastating flood episodes occurred along the main stem, notably in 1934, 1960, 1997 and 2010 (more local ones in 1970 and 1972), with the 1960 and 2010 floods being the heaviest ones on record. Despite the heavy damage incurred in 2010, the data indicate that this event referred to a recurrence frequency of between 1-in-50 (in the lower reaches of the Upper Vistula) and 1-in-100 year (in Kraków). On the other hand, whereas the 2010 flood proved, in general, more damaging and heavier than the 1997 event in Kraków and across the whole Upper Vistula basin, the situation was different more downstream, for example, at Sandomierz and Zawichost, where the observed flow rates in 1997 exceeded those of 2010. This, again, demonstrates the hydrological complexity

of the basin and the difficulty of deriving unequivocal figures to describe recurrence frequencies. Because of the fractured nature of the Upper Vistula, a comprehensive and spatially integrated approach to flood protection as part of flood risk management was only proposed during a study designed to prepare the framework and tasks of The Upper Vistula River Basin Flood Protection Program which became a government document (Resolution No. 151/2011 of the Council of Ministers of the Republic of Poland, dated August 9, 2011). It is oriented toward structural and nonstructural flood protection measures which are designed to gradually increase the level of flood safety of people as well as economic and cultural assets in the Upper Vistula basin with a time horizon of 2030.

12. Importantly, the data suggest that the Middle and Lower Vistula have their own hydraulic dynamics that are influenced to only a modest extent by the Upper Vistula. Indeed, after the Upper Vistula transfigures into the Middle Vistula after Zawichost, the river meanders relatively unconstrained for the comparatively long distance of about 160 km through flat plains; the river has a very wide bed and floodplains that dampen and attenuate any flood wave coming down from Zawichost, creating longer but less high flood waves. The data in Table 2.2 show that the peak flows observed in 1997 and 2010 in Warsaw are significantly lower than those in Sandomierz and Zawichost, and this attenuation continues exerting its effect as the river flows more downstream. Also, analysis of the flood waves (Hydrographic Analysis of the 1997 Flood on the Upper Vistula, IMGW, Warsaw, 1999) confirms the hydraulic disconnect between the Upper, and the Middle and Lower Vistula segments. Thus, the construction of dike systems for the protection of Tarnobrzeg and Sandomierz—that would tend to increase the size of the flood wave traveling downstream—is not likely to have a negative effect on the water cresting in Warsaw.

Regulatory and Administrative Responses

13. With Poland's accession to the EU in 2004, the country has enacted reforms to apply the Water Framework Directive (WFD) and Flood Directive (FD). It also received access to large EU funding allocations (Structural and Cohesion Funds) that can finance up to 85 percent of eligible infrastructure and other measures. In the Budget Perspective of 2007–2013, over half a billion euro was planned to be disbursed for flood-related investments (by the end of 2015), of which about half to the Odra Flood Protection Project. To transpose the regulatory *acquis* of the EU, an umbrella-type Water Law was enacted, and the preparation of River Basin Management Plans (RBMPs) started. Also, the water administration was restructured with the establishment of seven RZGWs, with 3–4 RZGWs managing a hydrologically coherent part of the basin (Figure 2.1). However, RZGWs hold authority only over the main water bodies including large lakes and reservoirs as well as a narrow strip of the river bank along these. The Voivodship ZMiUWs are responsible for all minor water courses and all dike systems that stand apart from the rivers; this pertains to the majority of dikes and embankments. The RZGWs are decentralized, relatively autonomous executive entities that report to, and receive their budget from the KZGW, which in turn is a semi-independent budgetary unit of the MoE.

14. While these administrative steps are being implemented, further adjustments are planned in 2015 and beyond. The main concerns pertain to the following: (i) the RZGWs solely depend on the national budget and are predominantly organized for the purpose of infrastructure development, less so for water resources management; (ii) the local accountability of the RZGWs, for example, in the form of water fee collection or through a River Council, is still very weak; (iii)

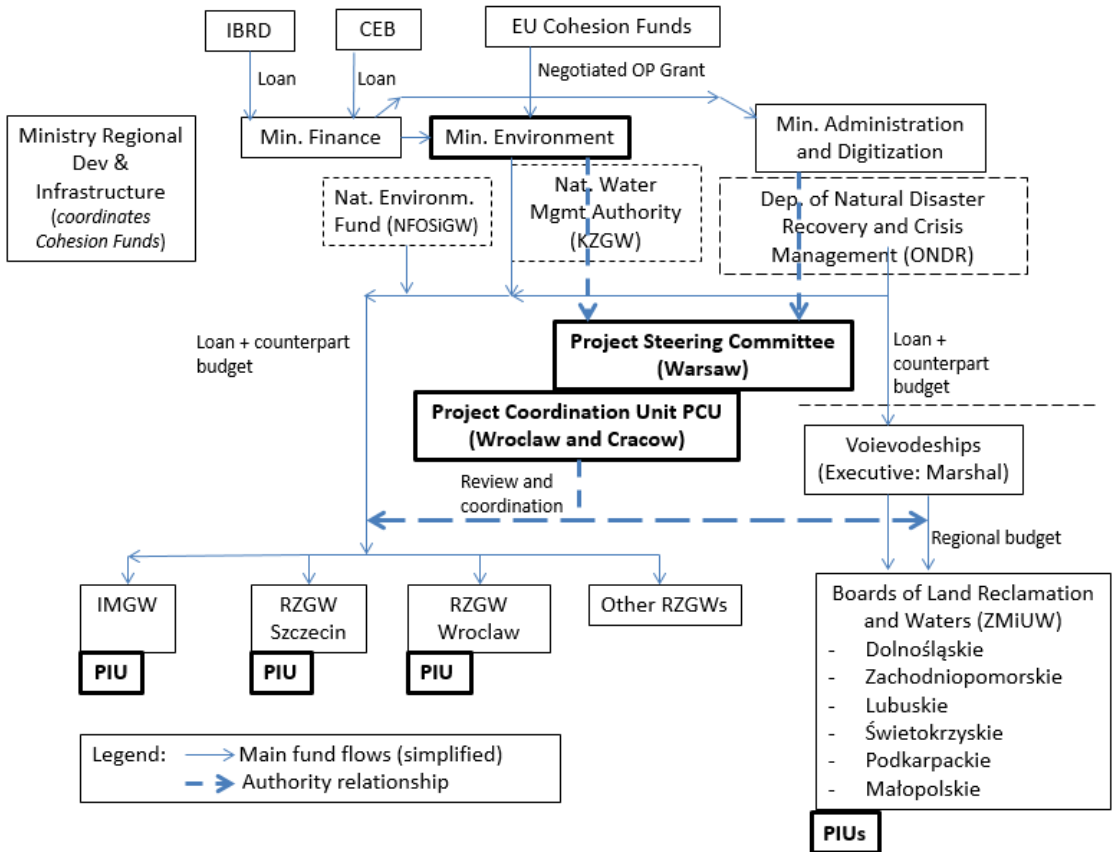
concern exists over the effectiveness of the integration of interests and the coordination between the 3–4 RZGWs that share responsibility over a basin, as well as between the RZGWs and the ZMiUWs; (iv) draft RBMPs that do not provide adequate rationale for the optimized selection of investments and measures based on coherent economic, environmental, and social strategies and prioritization.

15. The government has agreed with the EC on the following program to strengthen compliance with the directives. Firstly, a new Water Law is currently proposed for adoption in Parliament to streamline the water management administrative structure and update a number of regulatory features, for example, on the preparation of the RBMPs. Secondly, the administrative structure will be adjusted in line with the proposed law. Thirdly, by the end of 2015 revised RBMPs will be submitted, reflecting more in-depth strategic analyses of basin development and management (especially regarding flood management with 'hard' and 'soft' measures), more rigorous economic and cost-benefit analysis, and broader consultation. As it was recognized that possible approval of the RBMPs by late 2015 or 2016 could jeopardize the newly proposed Odra-Vistula Flood Management Project, the EC reviewed and endorsed the interim Updated Master Plans for the river basins in October 2014. The EC agreed to the principle that many proposed investments and measures are of no-regret nature, and can be implemented with due safeguards and proper cautious preparation, while other investments and measures have long-range and complex impacts that affect the design, operation, and integrity of other defense structures as well as other land use and environmental features in the basin, and, therefore, these need to be assessed within the context of a full-fledged basin-wide analysis and plan. In October 2014, the EC endorsed an Annex with List 1 identifying 2,100 proposed investments and measures that are of no-regret nature and, if prepared properly, would be eligible for EU Structural and Investment Funds in the Perspective 2014–2020. The Annex List 2 comprises 450 items that are considered complex and/or subject of decisions that require a basin-wide analysis; these investments and measures can potentially be eligible for EU funding after approval of the RBMPs that will need to be resubmitted after 2015.

Flood Management Investments and Measures Prioritization

16. The government is embarking on a nation-wide analysis of flood risks and response strategies to develop a comprehensive and long-term program for investments and measures—spanning several decades—to achieve protection levels against floods that are in line with the EU FD and good international practices. These levels are, in principle, against 1-in-100 year return period floods, but with 1-in-50 year for less valuable land, and 1-in-1000 year for highly valuable locations and main city centers. For the project, a selection of priority investments and measures was agreed upon. The selection was guided, foremost by the locations that had experienced historical records of devastating nature (existence of 'hot spots' that are recognized to be particularly vulnerable to floods, yet, where mitigation measures would probably be cost-effective), by the desire to work in coherent areas (thus, in certain sub-basins where individual investments and studies could generate mutual benefits), where it would be possible to build on the lessons learned and the institutions developed under the ongoing Odra River Basin Flood Protection Project, and where a generally good level of readiness was observed.

Figure 2.1: Diagram of Institutional Arrangement for Water Resource Management (Status 2014) Indicating Project Steering Committee, Project Coordination Unit (PCU), Project Implementation Units (PIUs), and Main Fund Flows (simplified).



17. Important guidance was derived from the Flood Hazard Maps (Figures 2.2, 2.3, 2.4, and 2.5) that indicate the river sections in the Odra basin, in the Nysa Kłodzka Valley, and along the Nysa River, and in the Vistula basin, that are prone to Q1% flood events. The Lower Odra map reflects the aggregate risk from summer and winter floods. The maps are based on new-generation digital elevation maps created from remote sensing and LiDAR surveys; they are prepared for return periods of 10, 100, and 500 years. However, they do not reflect the damages and losses[14] caused by floods, or the cost-effectiveness of mitigation scenarios. Thus, this flood hazard information needs to be complemented with both ground-truthing to ensure that the simulation outputs reflect actual observed flood extents and with an analysis of damages and losses. The project will also be

[14] Flood damage relates to the physical and non-physical costs for reconstruction and repairs of infrastructure and other assets to restore livelihoods to the situation before the flood. Flood losses comprise the costs to the economy resulting from disrupted economic activities, notably loss of income of businesses and households.

targeting investments and measures with a high level of technical readiness that can be completed by 2023 (which is also the closing date for EU-approved expenditures in the new Perspective). The project would notably seek 'no regret' investments and measures.[15] Finally, across the board the project would give priority to investments that (re-)create space for the river and/or increase the retention capacity upstream for excess water, over alternatives that construct dikes and embankments that may potentially increase the flood wave crest downstream. Investments in upstream retention, generally, can also lead to lower investments downstream. However, this needs to be checked on a case-by-case basis.

18. This analysis yielded the identification of the following components:

a. The Lower and Middle Odra, because of all Polish basins this sub-basin is the most vulnerable to repeated summer and winter floods, the latter being caused by ice jams. This component will also allow to maximally benefit from the existing institutional structure for project implementation created by the Odra River Basin Flood Protection Project. The city of Szczecin (near the mouth of the river) is considered as very vulnerable because of winter floods. The city of Słubice on the right bank of the Border Odra is known to be very prone to both summer and winter floods because the flood protection works on the opposing left (German) bank already have been upgraded to the agreed Odra protection standard of 1-in-100 year floods. It is expected that the results of this component will assist Poland to meet the international agreements on the Odra management.
b. The Nysa Kłodzka Valley torrents and tributaries of the Upper Odra, because this tributary has a long history of very frequent (every 5–8 years) and heavy flooding causing local devastation, while at the same time also contributing significantly to the flood waters entering the Wrocław Flood Way system. The construction of dry polders and modernization of the dikes and embankments will lead to local protection but also reduce the flood wave significantly along the Nysa River downstream as well as in distant Wrocław. It is important to note that the Flood Hazard Map (Figure 2.3) do not reflect well the extent of floods in the Nysa Kłodzka Valley itself—as the flood plain is very narrow on the steep mountains, the water flow is very concentrated and, therefore, has high energetic impact. The damages in the towns and cities are not so much caused by overflowing water but by floating debris and rolling gravel and rocks that are swept along by the kinetic energy of the water.
c. The Upper Vistula, because, beyond the Odra basin, this segment of the Vistula has the historical worst record of flood damages. The cities of Kraków, Nowa Huta (a large industrial complex and urban area adjacent to Kraków), Tarnobrzeg and Sandomierz (large industrial complexes and urban areas at the lower end of the Upper Vistula), are generally recognized as the 'hot spots' (Figure 2.5). In addition, in the sub-basins of the tributaries

[15] No regret measures are those that are characterized by the following: (i) having only local impact, hydraulically and environmentally, or, if there is downstream or upstream impact, this is well understood and managed; nor are they themselves impacted significantly by the design of future upstream or downstream investments; (ii) in demonstratively vulnerable areas associated with high benefits from protection measures that are unlikely to be excessively expensive; (iii) without complex interactions across a large part of the basin that would necessitate a robustly optimized basin plan to yield the most cost-effective variant, and (iv) have a comparatively modest ecological footprint and are otherwise non-controversial.

many parts are flood-prone. For several proposed works and measures, the economic rationale is confirmed and advanced documentation for works exists, yet for other sets of investments additional studies to optimize the investments will be required before further decisions can be made on their merit. The project will finance selected investments as well as studies that have the purpose to analyze different investment scenarios.

d. Flood forecasting and improved operational management, because it would assist the IMGW and the IMGW-PIB (the IMGW offices in Kraków) with further expanding their forecasting capabilities with respect to rainfall and flood wave propagation, based on the investments made under the Odra River Basin Flood Protection Project. The component would also finance two operations rooms in the RZGWs (Wrocław, Kraków) to allow real-time overview of flood wave development, analysis of flood hazards such as dike breaches, and the data-driven operation of reservoirs, dry polders, and barrages with the aim to minimize damages.

19. It is to be noted that the Flood Hazard Maps identify vulnerable areas that, however, have not been prioritized for the project. Firstly, the Border Odra receives the waters of an important right-bank tributary, namely the Warta. Map 2-1 shows that the lower reaches of this river are flood-prone. The Warta was not prioritized because it has a low readiness to proceed, which is the consequence of the presence of the large Natura 2000 protected forest tracts that, for the moment, preclude investments in flood management. Developing integrated plans and consensus on the management of the water resources and environmental values in that area will require more years of consultations and studies. Similarly, the flood map (Figure 2.5) suggests large flood extents in the middle reaches of the Upper Vistula. However, because the flood plain is relatively wide in that section and the vulnerable asset values in the surrounding areas are limited because of relatively good natural protection of towns, the area was not considered a priority.

20. The flood risks along the Odra main stem and its tributaries are well documented and the remedial investments and measures extensively studied. The draft Updated Master Plan and the draft RBMP for the Odra largely confirm the existing long-list of required investments and measures that had been identified before; however, the plan also introduced corrections. On the other hand, the preparation of such a long-list of meritorious investments and measures had to be initiated for the Upper Vistula. While some of these studies will be completed in 2015 or 2016, they now provide a robust basis to discern investments that can be considered no-regret, and (strings of) investments where more extensive analysis is required to decide on the variant.

21. The government has proceeded in 2013–2014 with a set of coherent studies and activities that are part of the preparation of the RBMPs. Similarly, the FD requires the preparation of Flood Risk Maps and Flood Hazard Maps. The ensuing flood management measures need to be informed by, and integrated in, the RBMPs. In particular, the Upper Vistula basin has a complex hydrology and, at the same time, is very vulnerable to flood risk, without benefiting from a large body of earlier work, as is the case with the Odra. Thus, under the plenipotentiaries, funding studies are being conducted in 2013–2015 to define flood management strategies and identify and describe the optimized strategies for investments and other measures. The Upper Vistula has several large right-bank tributaries that rise in the southern Carpathian mountains and piedmonts, of which four are of most concern, namely, going downstream from Kraków, the Raba, the Dunajec, the Wisłoka, and the San rivers. The San has, in turn a large tributary called the Wisłok. The study program comprises studies per sub-basin to identify all flood risks under 1-in-50 and 1-in-100 year flood

events, identify the possible investments and measures, analyze the possible hydraulic and other interactions between these individual investments and measures (applying routing and 1-D and 2-D simulation models), optimize the technical design of assemblages of all measures (the variants), quantify the costs of each variant as well as the benefits (assuming that dwellings can accept an occasional inundation of up to 0.5 m), and then optimize the variants based on economic, social, environmental, and operational criteria. Furthermore, in a separate study (using flood routing simulation models of the MIKE 11 suite) the hydraulic impacts are studied from the tributaries under different variants on the main-stem Vistula. In particular, these analyses investigate the net effect of new infrastructure on the string of downstream and upstream locations. For instance, while construction of dikes would have the effect of increasing the concentration of the flood wave and raising its crest downstream, the construction of overflow areas, reservoirs, or dry polders would help to retain water upstream and discharge it more slowly which would attenuate the flood wave height downstream. In some sub-basins and sub-sub-basins the variant with the string of investments along the river is heavily dependent on the feasibility of the option to construct sizeable (dry or wet) reservoirs upstream, such as is the case in the Wisłoka sub-basin where more extensive study is required on the upstream Kąty-Myscowa multipurpose (wet) reservoir. In these instances, the project will support financing for in-depth studies but not the investments in works.

Component 1: Flood Protection of the Middle and Lower Odra (Base Cost €446 million)

22. The Middle and Lower Odra is a coherent section of the Odra with similar flood typologies and landscape. The river flows relatively unconstrained over a long distance and its banks are dotted with comparatively small cities and towns interspaced by forests and agricultural land. The main city is Szczecin near the river's mouth, which is an important conurbation, sea port, and industrial and commercial center. Crossing a mostly rural and forested part of western Poland, the Free-flowing Odra does not need major dike systems, but primarily extensive river training.

23. The implementing agencies involved in this component are the RZGWs of Szczecin that is responsible for the rivers and their banks along the Lower and Border Odra, and the RZGW Wrocław, that is responsible for the rivers and their banks along the Middle or Free-flowing Odra. Dike systems and the protective structures of towns that stand apart from the river banks are under the responsibility of the ZMiUWs of Zachodniopomorskie and Lubuskie, based in, respectively, Szczecin and Zielona Góra. For the purposes of the project, the ZMiUW of Zachodniopomorskie is responsible for all dike systems to be upgraded and expanded along the Lower and Border Odra, including the wetland rehabilitation, while the ZMiUW of Lubuskie is responsible for the protective works for the town of Słubice.

24. As outlined before, the Middle and Lower Odra are subject to frequent summer and winter floods. Simulation studies have been conducted on the genesis and behavior of ice dams at the locations of Nowa Sól, Zator and Słubice, to corroborate and complement the historical observations. Major problems occurred along large tracts of the river in 1978, and in 2010 two ice jams developed that caused backflow flooding with levels that exceeded in some locations the 1997 summer flood levels. The winter floods need to be tackled by the operation of icebreakers that have to operate preventively to avoid the build-up of ice dams. The component comprises three main sets of investments. Firstly, many of the old dike and embankment systems near or around towns and infrastructure need to be modernized and/or expanded. They have been designed too low or have sagged, and are prone to seepage and other damage due to lower construction

standards at the time of construction. Secondly, as part of the strategy to protect the Szczecin region that is exposed to a combination of sea tide-driven and river-based flood waves, the large existing Międzyodrze wetland, upstream of the city and its port, will be rehabilitated to facilitate the Odra drainage (which will assist to mitigate winter floods) and accommodate high-water volumes (which will assist in summer and winter flood conditions when the northerly winds create very high tides that can last for 24 hours). A one meter high water layer on the wetland would store about 1 billion m^3 of floodwater. This rehabilitation will have the additional benefit of restoring the previous ecological conditions with significant improvements of water quality, and of the fish, macrophyte, and bird diversity. This, in turn, will help to reach the WFD goals, and it will also significantly enhance the tourist potential of the region, generating jobs.

25. Thirdly, a number of diverse investments along the river are necessary to allow the operation of the new generation of energy-efficient icebreakers. Typically, under international agreement the Polish authorities operate about six icebreakers on the Odra. Icebreaker operation is conditional upon the maintenance of the guaranteed river draught (depth) of 1.8 m (for 90 percent of a year's days in the section from the Warta river confluence to Wichoda, and for 80 percent of a year's days in the more upstream section from the Nysa-Łużycka confluence to the Warta confluence), the raising of bridges and other superstructures to allow safe passage of the ships under high-water conditions, the availability of appropriate mooring and navigation facilities, and, in general, river training measures to ensure a more balanced and sustained transport of river bed load. Bathymetric surveys indicate that the bed load is unevenly distributed with depths of 3–4 m in some places, adjacent to others where the depth is only 0.7 m. At present, older and less powerful low-draught icebreakers are carrying out these tasks but they are prevented from operating along large tracts of the river that are too shallow. These ships can pass certain low bridges only by taking on ballast that thereafter needs to be released again to enable the boat to pass shallows. These conditions are increasingly affecting the effectiveness of the operations, and are also endangering the ship crews.

26. After half a century of neglect, the Middle and Lower Odra River beds need to be thoroughly trained and dredged. To ensure adequate depth along the centerline of the river over long distances of the river, existing and new groynes (short low breakwaters protruding perpendicularly from both river banks) and lateral breakwaters need to be (re-)constructed. The groynes will be redesigned to maintain erosive conditions in the river centerline to reallocate bed loads though some stretches that need to be dredged. The hydraulics of the groyne designs have been studied earlier with both physical and numerical simulation models at various research institutes. The design dimensions to achieve protection levels against 100-year return floods (summer floods) and allow icebreaker operation in the winter, while at the same time avoid creating additional friction under high-water flow discharge condition, have been formally set in standards of the tri-lateral Odra River Commission. The groynes on the German bank have been reconstructed over the past 10 years to the agreed standard. The project, thus, will assist Poland to meet the international agreements on river management and flood protection. As an additional benefit, the river training and bridge elevation will facilitate commercial shipping of larger bulk loads (construction materials and grains) and containers.

27. The prioritization of the works and measures is based on several long-term analyses of the historical flood events and of the flood risks. The RZGWs of Szczecin and of Wrocław have developed a coherent program of river training works meeting the international Odra Commission agreements comprising groyne and lateral breakwater (re-)construction; river dredging;

rehabilitation and construction of bank revetments and protective works to strengthen the structural integrity of weak spots and reduce the risk of ice floe formation; dredging of selected shipping routes across lakes in the Szczecin harbor (Dąbie Lake); and the raising of four bridges. The protection investments of communities and other assets along the river is based on a prioritization analysis carried out for the Flood Risk Management Plans that have been carried out in 2014, as well as for the Updated Master Plan for the Odra that was approved in October 2014. All investments under Component 1 are listed in the Updated Master Plan as well as in the Annex List 1 in the EC's concurrence letter., This is with the exception of two additional sets of investments that are included given their importance to overall flood management namely (i) the raising of four low bridges to allow unrestricted icebreaker operation, and (ii) the modernization of old pumping stations that are essential to maintain proper drainage of lower-lying land located behind dikes. The economic analysis shows that the individual investments (where required, grouped per objective, such as river training) as well as per component, meet the prioritization requirements.

28. The Middle and Lower Odra region has suffered substantial damages from repeated flooding. The last summer flood episode, in 2010, was estimated to have caused damages of about Polish Zloty (PLN, Polish Currency) 302 million (€ 72.6 million)[16] in the two Voivodships of Zachodniopomorskie and Lubuskie.[17] Because the icebreaking is by their nature a preventive measure, minimizing the winter flood hazard, the aggregate actual benefits from the icebreakers are more difficult to assess as they would require a flood event without icebreaking). However, estimates have been made for the economic analysis based on summer flood damages and by extrapolating the more localized winter flood damages caused by local backwater flooding.

29. **Subcomponent 1.A: Flood protection of areas in Zachodniopomorskie Voivodship (Base Cost €31 million).** This subcomponent includes the following proposed works:

1.A.1 Chlewice-Porzecze. Backwater embankment of the Odra River at Myśla River. The works will comprise construction of 2.3 km of flood embankments with overpasses, anti-filtration membrane, provision of mobile flood screen for one location, gabion protection, and ancillary works to protect two towns from Odra water backflow. This task also includes modernization of the Marwicki polder. The works will include the reconstruction of the 3.49 km long dike with protective screens and a top road, as well as the modernization of the Krajnik pumping station.

1.A.2 Flood protection of Ognica village on Odra River. The works will comprise a 300 m long flood embankment with anti-filtration screens and access roads, as well as refurbishment of the Rynica-Ognica pumping station to drain water from the land side of the embankment. This task also includes works at Osinów-Łubnica comprising of the modernization of 26.2 km of open zone between embankments (by removing obstacles and creating smooth surfaces to reduce hydraulic friction during high-water and to minimize ice jamming) and flood protection works for the Radziszewo and Daleszewo villages on the Odra. These proposed works will

[16] EUR1=PNL4.16 is used.

[17] Winter J. et al.: Assessment of extreme events occurring in Poland in the context of costs and risks. IOŚ, Warsaw, March 2012.

comprise reconstruction of a 1.56 km long flood embankment with filtration screens and a top road.

1.A.3 Restoring natural values of the Lower Odra Valley by improving retention and flood protection capacities of the Międzyodrze Wetland. This wetland of 5,200 ha forms the former overflow plain situated between the two parallel arms of the Lower Odra between Gryfino and Szczecin. The works will include the dredging and stabilization of 21 channels; reconstruction of 32 automatic gates, locks, and passes; levelling of 60 km of dike tops; and provision of 32 footbridges. The works will include the development of a hydraulic-ecological simulation model to optimize flow patterns conducive to flood management and ecological productivity.

30. **Subcomponent 1.B: Flood Protection on the Middle and Lower Odra (Base Cost €365 million)**. This subcomponent includes the following proposed works:

1.B.1 Reconstruction of river control infrastructures on the Free-flowing Odra (under RZGW Wrocław). The task includes the reconstruction of regulating structures and groynes, lateral breakwaters, revetments along banks, bank stabilization, minor dredging, and so on. The works extend to about 115 km between Nowa Sól and the Nysa-Łużycka mouth and include both all activities to complete the program on the river to allow adaptation of the river to the conditions of a Class III waterway including a minimum draught of 1.8 m (Stages II and III).

1.B.2 Modernization works on the Border Odra and Lower Odra (under RZGW Szczecin) to provide good conditions for icebreaking in winter. The task includes the reconstruction of regulating structures and groynes, lateral breakwaters, revetments along banks, bank stabilization, minor dredging, and so on, on the river to allow adaptation of the river to the conditions of a Class III waterway including a minimum draught of 1.8 m. The works extend to about 162 km between the Nysa-Łużycka mouth and the bifurcation between the western and eastern Odra branches near Gryfino.

1.B.3 Construction of docking/mooring infrastructure on the Lower Odra and Border Odra including the new marking of the shipping lane.

1.B.4 Improvement of flood water-flow from Dąbie Lake in winter. This task includes the deepening of the shipping route on the lake and involves dredging of about 1 million m^3 of sediment, adjustments to banks and revetments, and so on. The dredge spoil, which is not polluted, will be deposited on nearby flats alongside the river in layers of 0.5 m only to facilitate rapid oxidation of organic matter. This task also includes dredging of the Klucz-Ustowo ditch. This is a minor shipping canal in the Szczecin waterway that needs to be dredged to allow ship passage.

1.B.5 Raising of five bridges to ensure a minimum clearance. One railway bridge (Regalica) is located in the Szczecin harbor. The other four bridges (of which one is a railroad bridge) are located upstream along the Border Odra. All three road bridges are under Polish authority. The adaptation of the bridges is agreed under the International Odra Commission; however, for the railroad bridge technical coordination will need to be ensured with German authorities. This has been initiated through the Chair of the Polish-German Border Commission, who is concurrently the plenipotentiary for the Lower Odra flood protection program.

1.B.6 Reconstruction of embankments, dikes and river bends to protect Nowa Sól and the river stretch downstream from Krosno Odrzańskie.

31. **Subcomponent 1.C: Flood protection of Słubice city (Base cost €50 million).** This subcomponent includes the following proposed works:

1.C.1 Extension and construction of flood embankments. The objective is to protect the city of Słubice against flood by reinforcing and widening the existing embankment along the Odra (from chainage kilometer 582+500 to kilometer 588+000) and building a new encircling embankment from the north (the embankment starts at kilometer 587+400 of the Odra course). The top of the embankment will be finished to allow emergency installation of mobile flood screens. This task also includes reconstruction of Czarny Kanał and Racza Struga. The reconstruction of the beds of these waterways has the objective to facilitate proper drainage of the adjacent areas and discharge of surface water to the Racza Struga and Czarny Kanał beds by restoring the proper technical condition of the existing hydrotechnical devices.

32. Readiness: The works 1.A.1 Chlewice-Porzecze, 1.B.1 Reconstruction of river control infrastructure (Stages II and III), 1.B.6 Flood protection of Nowa Sól and below Kosno Odrzańskie, and 1.C Flood protection of Słubice city have sufficient information to be pre-identified and selected for further detailed analysis to confirm their inclusion. These may be included in the first 18 month program (following confirmation) and procurement initiated for these investments (four contracts) with the aim to mobilize the contractor during 2016.

Component 2: Flood Protection of the Nysa Kłodzka Valley (Base Cost €239 million)

33. The Nysa Kłodzka Valley is a peculiar fan-shaped mountainous valley, west of Wrocław, from where the short headwaters emerge of the Nysa[18], a medium-sized tributary of the Odra, that ends in the Odra about 26 km upstream of Wrocław. The valley's steep topography causes the drainage to be very fast. The torrents and rivers in the valley are notorious for the flooding frequency and damage. The local damage is caused by the short but very high and high-energy peak waves that mobilize large debris such as tree trunks, boulders, and other bed load and that generate high impact on dwellings, bridges, and anything in their pathway.

34. There is a triple flood risk. First, the immediate damage is local, in the towns and cities (such as Kłodzka and Bardo) that are located in the narrow valleys of the torrents and through which the flood waves race. Summer flash floods that take place after short intense rainfall events, or after snowmelt, cause catastrophic destruction in the small catchments and occur in this region almost every year or even several times a year. These floods cause not only huge infrastructure losses, but they pose a real threat to human life due to a very rapid increase in the water level and the dynamic development of the flood situation. An example of such a flash flood is the catastrophic flood on the Bystrzyca Dusznicka River in July 1998 in which 13 people died. Severe and wide-spread

[18] The Nysa is not to be confused with the Nysa- Łużycka river [German: Neisse] that flows into the Border Odra from Germany, about 200 km downstream.

flooding was recorded in 1967, 1977, 1979, 1997 (the same event that also struck the Upper Odra and, in particular, Wrocław), 1998, 2006, and 2009. The damages of each of these events have been assessed at PLN 50–120 million, but the 1997 event caused damages of about PLN 450 million (€12-28.8 million and €108 million, respectively)[19](at 2012 price level). More than 470,000 people live in the valley's three districts and a large percentage of them are threatened directly by the floods.

35. Second, at mid-range, the aggregate floodwave, after having passed the narrows in Bardo, enters the plain of Wrocław and regularly expands to flood towns along the Nysa such as Lewin Brzeski and the city of Nysa itself.

36. Thirdly, the Nysa flood wave is a main contributor to the floods in the Wrocław conurbation, and, in 1997, according to the latest calculations by IMGW, contributed about 340 m^3/s of the peak flood discharge rate in Wrocław (that is, above the design flood pass capacity of 3,100 m^3/s of the new Wrocław Floodway System), as compared to the contribution of about 200 m^3/s generated by the Upper Odra in Raciborz.. Thus, this component will contribute significantly to the protection of the Wrocław conurbation and is a necessary complement to the investments on the Upper Odra (Raciborz) and in the Wrocław Floodway System that are funded through the ongoing Odra River Flood Protection Project.

37. The flood risk mitigation comprises a combination of upstream dry floodwater retention reservoirs (dry polders), dike systems, and measures to increase the flood wave passing capacity such as widening the channel girth by removing added obstacles and reducing friction, raising of minor bridges, and so on. The interaction of the different components has been modelled with mathematical simulation models for a variety of precipitation and investment scenarios, at the scale of the valley (tables 2-3 and 2-4) as well as of the Upper Odra. The aggregate effect of the four dry polders is to reduce the peak discharge rate by about 110 m^3/s in the town centers of Kłodzka and Bardo, and the aim is to cap the outflow from the valley at the Q1% discharge rate of 1,400 m^3/s; the effect would be to lower the flood wave peak level by 5–90 cm for the duration of the flood episode, depending on the location.

38. Downstream of Bardo, the Nysa flows into two existing wet reservoirs (as the future and final investment for flood protection of the Nysa Valley downstream of the city of Bardo, a third dry or wet reservoir Kamieniec Ząbkowicki is planned for which the technical and economic feasibility still needs to be studied comprehensively). The overall combined effect of the dry polders and the existing reservoirs on the towns along the Nysa is such that a Q1% flow of 600 m^3/s can be passed safely. With respect to the protection of Wrocław, the mathematical hydraulic routing studies have confirmed that the operation of the four new dry polders would add a delay factor that would help to avoid the synchronous cresting of both the Upper Odra and the Nysa near Wrocław, thus adding an additional level of security, and generating additional benefits.

39. The investments and measures will be implemented by the RZGW Wrocław and the ZMiUW of Dolnoslaskie in Wrocław. Both the PIUs have cooperated in the ongoing Odra River Basin Flood Protection Project and have, thus, a high level of institutional preparedness. The two PIUs

[19] EUR1=PNL4.16 is used.

will agree to aggregate contracts, and RZGW will assume some of the supervisory tasks from ZMiUW.

40. **Subcomponent 2.A: Active protection (Base Cost €108 million).** This subcomponent includes the following proposed works of dry polders (for technical specifications and effect, see table 2-3):

2.A.1 **Construction of the Boboszów dry flood control reservoir on the Nysa Kłodzka River and the Roztoki Bystrzyckie dry flood control reservoir on the Goworówka stream.** For the Boboszów, the dry detention basin will be located in the river valley near the towns of Boboszów and Pisary, above the locality of Międzylesie. The salient parameters of the reservoir are: maximum capacity of 1.4 million m^3; dam length along the crown axis of 230 m; maximum dam height of 17 m; reduction of the design flood wave (200 year return period) is 61 percent, and the reduction of the 'catastrophe' flood wave (500 year return period) to establish the structural integrity of the dam body, of 39 percent. For the Roztoki, the dry detention basin will be built in the Goworówka stream valley above the Roztoki locality. The salient parameters of the reservoir are: maximum capacity of 2.7 million m^3; dam length along the crown axis of 750 m; maximum dam height of 15.5 m; reduction of the design flood wave (200-year return period) is 58 percent, and the reduction of the control ('catastrophe') flow (500-year return period) to establish the structural integrity of the dam body, of 46 percent.

2.A.2 **Construction of the Szalejów Górny dry flood control reservoir on Bystrzyca Dusznicka River and the Krosnowice dry flood control reservoir on the Duna torrent.** For the Szalejów Górny, the basin will be constructed in the valley of the Bystrzyca Dusznicka River near the locality of Szalejów Górny and above the town of Szalejów Górny. The salient parameters of the reservoir are: maximum capacity of 9.9 million m^3; dam length along the crown axis of 735 m; maximum dam height of 19.3 m; reduction of the design flood wave (200-year return period) is 51 percent, and the reduction of the control flow (500-year return period) to establish the structural integrity of the dam body, of 20 percent. For the Krosnowice, the basin will be located in the Duna River valley, in its mouth section, approx. 500 m above the town of Krosnowice. The salient parameters of the reservoir are: maximum capacity of 1.9 million m^3; dam length along the crown axis of 450 m; maximum dam height of 15.7 m; reduction of the design flood wave (200-year return period) is 76 percent, and the reduction of the control flow (500-year return period) to establish the structural integrity of the dam body, of 54 percent.

Table 2.3: Aggregate Hydraulic Flood wave Attenuation Effect of Four Dry Polders at Different Downstream Transects

Key Transects of the Rivers in the Nysa Kłodzka Valley		Chainage m	Discharge Without Polders $Q_{1\%}$ m^3/s	Effects of 4 dry polders	
				Discharge Reduction $Q_{1\%}$ m^3/s	Descent of Peak Water Level m
1	Polder Boboszów	179,820	53	41	-0,94
2	Gauge station Międzylesie	172,855	69	19	-0,67
3	Nagodzice town	168,798	120	17	-0,13
4	Mouth of Goworowka River	167,108	141	24	-0,32
5	Gauge station Bystrzyca Kł.	151,438	337	42	-0,17
6	Downstream of Pławna River mouth	147,907	419	31	-0,52
7	Downstream of Duna River mouth	137,990	680	53	-0,09
8	At mouth of Biala Ladecka River	135,448	710	39	-0,05
9	At mouth of Bystrzyca River	132,814	786	58	-0,08
10	Gauge station Kłodzka	130,118	862	113	-0,14
11	Upstream of Ścinawka River	126,986	929	113	-0,19
12	Gauge station Bardo	113,400	1322	99	-0,63

Source: Feasibility Study on the Nysa Kłodzka Valley Flood Protection, RZGW, Wrocław

Table 2.4: Characteristics of the Four Dry Polders and Their Downstream Hydraulic Effect

Dry Polder	River Name Catchment Area (km^2) Flood Storage Capacity (m^3 million)	Dam height Avg (m) Max (m)	Crest Length (m)		Peak Flow at Outlet Location		
					Baseline m^3/s	With polder m^3/s	Peak flow reduction %
Boboszów	Nysa Kłodzka 17.9 1.40	12.0 17.4	230	Q1% (1-100y) Q0.5% (1-200y) Q0.2% (1-500y)	53.2 66.9 88	11.8 25.8 53.7	78 61 39
Krosnowice	Duna 32.6 1.9	8.0 15.7	450	Q1% (1-100y) Q0.5% (1-200y) Q0.2% (1-500y)	41.9 49 60	11.4 11.8 27.7	73 76 54
Szalejów Górny	Bystrzyca Dusznicka 129.5 9.9	14.0 19.3	735	Q1% (1-100y) Q0.5% (1-200y) Q0.2% (1-500y)	150 189 249	36 93 200	76 51 20
Roztoki Bystrzyckie	Goworówka 35.5 2.7	10.0 15.5	750	Q1% (1-100y) Q0.5% (1-200y) Q0.2% (1-500y)	76.2 95 122	20.3 39.6 66.2	73 58 46

41. **Subcomponent 2.B: Passive protection (Base Cost €131 million).** This subcomponent includes the following proposed works.

2.B.1 **Flood protection of the Nysa Kłodzka and Ścinawka River Valleys.** In the Nysa Kłodzka, the scope of work covers the section starting from kilometer 179+500, that is, the Boboszów reservoir, to kilometer 113+000, that is, above the locality of Bardo. Work will be performed on a 66.5 km long river section. As part of the entire work, in particular, the following will be performed: section-based modification and renovation of the existing bank protection measures; construction of new embankments and floodwalls on the section whose total length is 14.5 km; modification of the existing embankments and floodwalls on the section for a total length is 6.5 km; enhancement of throughput of 38 bridge and footpath structures; and enhancement of throughput of 13 small weirs and barrages. These works may involve the resettlement of about 12 households i.e. approximately 42 individuals. Nonetheless, these are estimates and will not be known with any certainty until the designs are finalized. Each activity requiring resettlement will be examined on a case-by-case basis by the Bank for its prior approval. In the Ścinawka valley, the scope of work covers the section starting from kilometer 26+850, that is, from the Polish-Czech border, to kilometer 0+000, that is, to the Nysa Kłodzka River mouth. In total, work will be performed on a 26.8 km long river section. As part of the

entire work, in particular the following will be performed: section-based modification and renovation of the existing bank protective measures and enhancing the throughput of river and stream beds; construction of new embankments and floodwalls on the section for a total length of 8.5 km; modification of the existing embankments and floodwalls on the section for a total length of 1 km; enhancement of throughput of 20 bridge and footpath structures; and enhancement of throughput of 5 minor weirs and barrages. These works may involve the resettlement of about 9 households, i.e approximately 31 individuals. Nonetheless, these are estimates and will not be known with any certainty until the designs are finalized. Each activity requiring resettlement will be examined on a case-by-case basis by the Bank for its prior approval.

2.B.2 **Flood protection of the Biała Lądecka River valley and Morawka River and the Bystrzyca Dusznicka River Valley and Kamienny Potok River.** In total, work will be performed on a 36.40 km long section of the Biała Lądecka River and a 6.90 km long section of the Morawka River. As part of the entire work, in particular, the following will be performed: section-based modification and renovation of the existing bank protective measures and enhancing the throughput of the two river beds; construction of new embankments and floodwalls on the section with a total length of 25 km; modification of the existing embankments and floodwalls on the section whose total length is 4 km; enhancement of throughput of 23 bridge and footpath structures; and enhancement of throughput of 9 minor weirs and barrages. These tasks may involve the resettlement of about 5 households, i.e 18 individuals. Nonetheless, these are estimates and will not be known with any certainty until the designs are finalized. Each activity requiring resettlement will be examined on a case-by-case basis by the Bank for its prior approval. For the Bystrzyca Dusznicka valley, in total, work will be performed on a 30 km long section of the Bystrzyca Dusznicka section and a 9.90 km long section of the Kamienny Potok. As part of the entire work, in particular, the following will be performed: section-based modification and renovation of the existing bank protective measures and enhancing the throughput of the beds of the two rivers; construction of new embankments and floodwalls on the section with a total length of 8 km; modification of the existing embankments and floodwalls on the section with a total length of 6.5 km; enhancement of throughput of 66 bridge and footpath structures; and enhancement of throughput of 12 minor weirs and barrages. These tasks may involve the resettlement of about 5 households, i.e approximately 18 individuals. Nonetheless, these are estimates and will not be known with any certainty until the designs are finalized. Each activity requiring resettlement will be examined on a case-by-case basis by the Bank for its prior approval.

42. Readiness: In this component, the four dry polders (Boboszów, Roztoki Bystrzyckie, Szalejów Górny and Krosnowice dry polders - Subcomponents 2.A.1, 2.A.2, 2.A.3 and 2.A.4) have sufficient information to be pre-identified and selected for further detailed analysis to confirm their inclusion. These may be included in the first 18 month program (following confirmation) and procurement initiated for these investments with the aim to mobilize the contractor during 2016.

Component 3: Flood Protection of the Upper Vistula (Base Cost €202 million)

43. The Upper Vistula (sub-)basin covers the section of the Vistula from its source to the mouth of the San River; the last town and transect before it enters the Middle and Lower Vistula plains is Zawichost, downstream of the Sandomierz and Tarnobrzeg industrial centers. The total area of the Upper Vistula catchment (including the area lying outside the territory of Poland) is 50,700 km^2 and out of that 48,035 km^2 is in Poland. Within the territory of Poland, the Upper Vistula basin is hydrologically and practically divided into two parts: the left-bank part (approximately 12,600 km^2), which drains the Lesser Poland Upland (*Wyżyna Małopolska*), and the right-bank Carpathian part (approximately 35,400 km^2). This basin is strongly asymmetrical. It is almost exclusively the right-bank tributaries that are draining the mountains that create the flood surges. It has a dense river network which is composed of 149 rivers, streams, and torrents with a catchment larger than 100 km^2, 33 rivers with a catchment larger than 500 km^2, and 15 rivers with a catchment larger than 1000 km^2, including 9 that are direct tributaries of the Vistula. As mentioned before, the Upper Vistula should be treated where possible as one hydrographic unit as it exhibits hydrological coherence, but also is hydraulically relatively disconnected from the Middle and Lower Vistula beyond Zawichost (see Annex 6), towards Warsaw, Torun and the mouth near Gdansk.

44. The proportion of annual run-off from the Upper Vistula basin to the national total run-off is more than 50 percent higher than the proportion of this basin's area to Poland's area. This relation demonstrates the much higher natural propensity of this region to generate flood hazards than the average risk for the whole country. In addition, the population density rate in the Upper Vistula basin also exceeds the national average by more than 40 percent. Therefore, the potential flood risk (the population number as well as their property and economic asset value, times the hazard) is also higher than the average risk for the whole country. Thus, the prioritization of the Upper Vistula for the project has a sound technical, social, and economic rationale.

45. The concerted action to prepare a comprehensive and long-term strategy was initiated in 2011 but was catalyzed by, on one hand, the requirement to develop EU-compliant Flood Hazard Maps and Flood Risk Maps, and, on the other, the opportunity to draw lessons from the Bank-financed Odra River Basin Flood Protection Project and extend its implementation structure to the Upper Vistula through the new project. Based on the preliminary analyses, the areas that are considered most vulnerable to flooding and that, on the other hand, demonstrate also the highest level of readiness, are the following:

1. The section of the Upper Vistula downstream of Kraków
2. The section of the Upper Vistula upstream and downstream of Tarnobrzeg and Sandomierz
3. The Raba tributary, and, inside that sub-basin, selected coherent investments that were prioritized based on a technical, social, and economic ranking of strings of investments
4. The San tributary, and, inside that sub-basin, selected coherent investments that were prioritized based on a technical, social, and economic ranking of strings of investments

46. Though the Raba and San rank high in priority among all right-bank sub-basins and command priority attention, they may not necessarily yield the highest economic returns when all benefits are calculated across the whole basin and for all possible precipitation and investment scenarios. However, these other sub-basins have a more complex hydrology, and the flood management

strategies for these sub-basins will need to be developed further over the next years. For example, of the right bank tributaries the Dunajec and the Wisłoka sub-basins, located between the Raba and the San sub-basins, carry the highest flood volumes into the Upper Vistula, but their flood management strategy and investment program would be greatly influenced by the question whether large multipurpose reservoirs in those sub-basins (for example, the Kąty- Myscowa on the Wisłoka) would be economically and socially feasible. Similarly, the scenarios for flood management in the part of the basin upstream of Kraków are complex, and they are heavily defined by the operational modes of the two existing large multipurpose reservoirs, that is, the Świnna-Poręba, located about 62 km upstream of Kraków on the Skawa tributary, and the reservoir cascade of the Tresna, Poręba, and Czaniec, on the Soła tributary, about 100 km upstream of Kraków. The project will fund the requisite integrated studies to assist the government with the development of integrated flood management strategies, and for the preparation of the tender documentation of selected prioritized investments, for the main right-bank sub-basins (San, Wisłoka, Dunajec and Raba) and for the Upper Vistula system, upstream of Kraków.

47. In the Upper Vistula basin, over the period 1953–2006, the total flood damages accounted for a disproportional 50 percent of total flood losses in Poland. The last large flood that occurred in the Upper Vistula basin, in May and June 2010, caused major flood damage to public assets estimated at nearly PLN 4.7 billion (€1.13 billion). It exceeded the total flood damage figures for 1997 and 2001 that were also punctuated by large floods. The spatial distribution of the flood damage to public assets in 2010 is shown in table 2.5, however, the figures exclude damage to movable assets of private entities and individuals, a part of the damage to municipal infrastructure, and the (indirect) losses, that is, those caused by disruption of economic activity, which were exceptionally high due to the two-month persistence period of the flood. Therefore, the aggregate flood damage and loss in 2010 should be estimated to be at least PLN 7.5 billion (€1.8 billion)[20].

Table 2.5: Damage to Public Assets in the Upper Vistula basin, 2010 Flood

Institutions Involved	Area	Damage (PLN million)[21]
RZGW Kraków	Upper Vistula basin	795.7
RZGW Gliwice	Upper Vistula basin (south-western part)	131.0
Regional and local government units, including losses in the infrastructure administered by the ZMiUWs	Małopolskie Voivodship	2,401.2
	Podkarpackie Voivodship	1,054,4
	Świętokrzyskie Voivodship	363.9
	Śląskie Voivodship	912.3
	Lubelskie Voivodship	52.0
	TOTAL	**4,676.7**

[20] EUR1=PNL4.16 is used.
[21] EUR1=PNL4.16 is used.

48. The implementing agencies include the ZMiUWs of the Voivodships of Małopolskie, Swiętokrzyskie, and Podkarpackie. Generally, these are competent agencies familiar with large hydraulic works. They have good cooperation experience, but a strong coordination function will be required. The PCU will set up a local coordination office in Kraków in the Office of the Plenipotentiary. RZGW Kraków that holds responsibility for all waters in Upper Vistula will be a beneficiary of these works. Moreover, given that during implementation, studies will be prepared to identify future investments in the Upper Vistula, RZGW Kraków may be a future PIU and as such is included in the program.

49. **Subcomponent 3.A: Flood protection of Upper Vistula towns and Kraków (Base Cost €52.5 million).** The city of Kraków is the most important agglomeration within the region of the Upper Vistula basin. The population of this agglomeration is close to one million. Kraków is under a constant pressure of development in its old historic center and externally, as the region is expanding its industries, commerce, and touristic assets. Having been a royal capital for many centuries, it contains very valuable physical and intangible cultural assets. The flood problem of the city of Kraków is determined by the following features of the Vistula, which has been progressively developed and regulated since the middle of the 19th century, and of which the qualitative and quantitative implications have been studied in detail through flood routing and hydraulic simulation studies, and bathymetrical and geotechnical surveys, as well as architectural analyses.

a. The river flows through Kraków (the 'Kraków passage') in a river channel which in the city center has a width three times narrower than in the sections of the river immediately upstream and downstream of the city, causing it to be 'straitjacketed'. Secondly, the river section has in the city center a sharp 90° bend with a very small radius creating vortices and hydraulic resistance. Furthermore, over the past century two bridge structures, one 50 m upstream (Dębnicki bridge) and the other 100 m downstream of the bend (Grunwaldzki bridge), have added to hydraulic friction in the form of the bridge buttresses in the river channel and (in high-flow condition) their low-hanging understructures and beams. The carrying capacity of the river within the city boundaries is variable along its course, especially during very high flood events. This creates the direct risk of flood waters overflowing into the city, and in addition eroding the low and high retaining walls as well as the bridge structures as a result of an increased force impacting these structures. Furthermore, the bathymetric surveys have indicated that very high erosive currents are active on the bed that may need to be controlled to minimize bed and bank instability.
b. The flood embankments that have been protecting the city center and the city outskirts, down to the industrial center of Nowa Huta, have been constructed in the early 20th century; the construction techniques employed at that time were not adequate. During the 2010 flood event, large parts of Kraków got flooded, however, none of the dikes was overtopped but in three locations the dikes succumbed to the prolonged water pressure that weakened the structures from inside. Thus, it has been concluded that the original embankment height should be essentially maintained, but that the dike bodies need to be rebuilt according to modern standards, and notably should have impermeable screens to prevent seepage and upwelling phenomena.

c. Rainwater and run-off management in the city region is mainly based on a combined sewer system and on storm water drainage. Therefore, measures need to be taken to readily convey rainwater from the city area to the river system.
d. Finally, three barrages regulate the Vistula River flow, that is, the Kościuszko Barrage (about 7 km upstream of the city), the Dąbie Barrage (about 5 km downstream of the city), and the Przewóz Barrage (near Nowa Huta, about 12 km downstream of the city). This infrastructure stabilizes the river water table within the city under normal conditions but it poses an additional risk under flood conditions, as two of the three barrages have proven unable to cope with the hydraulic discharge under high-water condition, which results in the reduced flood carrying capacity as well as in the loss of stability of the riverbed downstream of the barrages and adverse morphological changes in the riverbed upstream of the barrages.

50. This subcomponent comprises the following proposed works.

3.A.1 **Construction of Vistula embankments in Kraków**. This task comprises the completion of the passive protection along the Vistula over a distance of 20.95 km, in three sections. Section 1 comprises left bank works from the Wandy bridge (downstream of Kraków) to the Przewóz Barrage, including backflow embankments of the Dłubnia River and the Harbor Canal near Nowa Huta (7.13 km). Section 2 continues on the left bank from Przewóz Barrage to Suchy Jar, along Nowa Huta (3.17 km). Section 3 runs on the right bank, downstream from Kraków, from the Dąbie Barrage to the Przewóz Barrage (10.66 km) but excludes the Płaszów port (where dikes collapsed in 2010). The modernization and reconstruction of the dikes are based on the design flow of $Q_{0.1\%} = 2{,}800$ m^3/s and a control flow (to design for structural integrity) of 3,600 m^3/s which implies that the heights are determined by the existing structures with an extra crest elevation of 0.3–0.5 m to compensate for sagging of the dike body and provide adequate freeboard. These designs are based on the Concept Study of 2000, and the legal requirements for embankment design. The sections of the embankments upstream and inside the city have been, or are in the process of being completed (under the ZMiUW of Małopolskie and the City's Infrastructure and Drainage Department), and this also pertains to the embankments at Pleszów harbor.

3.A.2 **Flood protection in Serafa Valley.** The Serafa is a minor tributary that runs south of Kraków more or less parallel along the Vistula, and discharges into the Vistula, downstream of Kraków, opposite of Nowa Huta. While comparatively small, the damage of the frequent floods is high because the Serafa crosses suburbs of Kraków, industrial terrains, and strategic infrastructure such as the access roads to the A4 highway and the railroad emplacement and tracks to Rzeszow. Even minor floods cause significant disruption and economic losses. The task will comprise construction of four small dry polders to complement a fifth that has just been completed by the ZMiUW. The proposed dry polders are the Serafa 2 Dry Polder (dam height 2.2 m, storage volume 50,000 m^3), and three Malinówka Dry Polders (with dam heights of 4.9, 4.9, and 7.9 m, and storage volume of 115, 55, and 80 thousand m^3, respectively). The pre-feasibility studies were completed in 2010, based on hydraulic modelling of the flood routes.

51. **Subcomponent 3.B: Protection of Sandomierz and Tarnobrzeg (Base Cost €97.5 million).** The cities of Tarnobrzeg and Sandomierz are located in the most downstream section of the Upper Vistula, close to Zawichod where the Vistula enters the forested plains. The cities are home to extensive manufacturing centers and other businesses as well as to among the economically most productive horticulture (fruits and vegetables) of the country. Both the 1997 and the 2010 floods caused major damages and economic losses. The 2010 flood crest reached the top of the embankments but the dike breaches were caused by seepage and collapse of the embankments caused by saturation after an unusually protracted high water condition and the occurrence of a double wave crest (associated with flood waves of 5,264 and 4,722 m^3/s, respectively) of which the second proved most destructive. Simulation studies confirm that the goal to provide protection against 100-year return period floods at Sandomierz will require combining passive protection (embankments along the Vistula as well as along tributaries to protect against backwater) and active protection upstream in the form of overflow areas, dry polders, and multipurpose reservoirs both along the Upper Vistula itself and on the main tributaries whose mouths are located relatively close to Sandomierz, notably the Wisłoka, Dunajec, and Raba tributaries. The function and feasibility of large multipurpose reservoirs will need to be the subject of more expansive analysis, and this will, in turn, define the role of new overflow areas and dry polders upstream of Sandomierz. However, analysis to date suggests that large wet reservoirs on the tributaries are potentially more effective in mitigating the flood wave height at Sandomierz than overflow areas and dry polders. Therefore, the embankments at Sandomierz will be designed at levels that are comparable to the 1997 and 2010 floods, that is, for a design flood of 5,800m^3/s as these are about the tallest that can be feasibly constructed. The incremental protection to reach the $Q_{1\%}$ flood protection of 6,600 m^3/s will need to be obtained from upstream flood wave retention. Tentatively, the required storage capacity has been calculated as about 160 million m^3, which is also the volume that was spilled in the 2010 flood episode. The works are separated in tasks according to left-bank and right-bank works. This subcomponent includes the following proposed works.

3.B.1 **Flood protection Sandomierz.** The proposed works include the following:

1. Flood protection for Atramentówka river estuary including the new Kocmierzów pump station. The pump station will have a capacity of 1.5 m^3/s.
2. Struga A river flood protection including the Nadbrzezie pump station modernization. The Struga A flood protection will extend over a distance of 1.6 km; the pump station capacity will be upgraded to 2 m^3/s.
3. Expansion of embankments protecting the glassworks and residential areas in Sandomierz. The length of the embankments will be approximately 2.78 km, with a crest height of 1.67 m.
4. Protection of Koprzywianka River with embankments. The total embankment length will be 27.3 km, and the dikes will be raised by approx. 0.7–1 m from the current level.
5. Szewce pump station reconstruction. This will encompass the construction of a new retention tank extension and new outlet.
6. Extension of the Zajezierze pump station.

3.B.2 **Flood protection Tarnobrzeg.** The works will comprise the Vistula right bank dike extension (13.959 km), the San right bank dike extension (2.193 km), and the Łęg river left bank dike extension (0.112 km).

52. **Sub-component 3.C: Passive and active protection in Raba Sub-basin (Base Cost €32 million).** This subcomponent will include a number of works in the Raba sub-basin that are selected using an optimized investment variant (investment scenario) which prioritizes those investments that increase retention of water upstream and/or combine social and technical feasibility with the highest economic returns, that is, those that generate demonstrated benefits at local scale, in the downstream stretch, as well as further downstream along the Upper Vistula. The Implementing Agencies are the Małopolskie ZMiUW and the RZGW Kraków. A key structural element for generating flood protection is the Dobczyce Reservoir which was constructed in 1985 for the dual purpose of providing drinking water for the Kraków agglomeration[22] and for storing floodwaters. However, the new calculations show that the reservoir could play a larger role, at low cost, by storing an amount of 20 M m^3 of floodwater. This would have, possibly, implications for the safeguarding of the water quality. This will be subject of study. Similarly, other important active flood retention structures have been identified but the hydraulic impacts of these, and the technical feasibility need to be confirmed. The passive structures downstream of these reservoirs, therefore, also cannot yet be confirmed. The subcomponent will have two phases. The Phase 1 investments are those that have been confirmed on technical and economic merit, and whose functioning does not depend on the selection of the other structural elements and other measures (notably, the change in the operational schedule of the Dobczyce Reservoir) in the basin. The Phase 2 investments are those that have been identified as key elements in the most cost-effective and sustainable variant, but still need to be confirmed, as well as their geological surveys and detail designs completed; this would pertain to 4 dry polders, and 1.6 km of new dike. The Phase 1 investments concern the upgrade of the Wiśniowa lagoon (Krzyworzeka) near the Raba river outlet, and the modernization and expansion of selected dikes (15 km) and boulevards (3.3 km) along the Raba River itself and key tributaries. The subcomponent will finance the Phase 1 investments, and the full preparation of the Phase 2 investments, to bidding level.

53. **Subcomponent 3.D: Passive and active protection in San basin (Base Cost €20 million).** This subcomponent will include a number of works in the San sub-basin that are selected using an optimized investment variant (investment scenario) which prioritizes those investments that increase retention of water upstream and/or combine social and technical feasibility with the highest economic returns, that is, those that generate demonstrated benefits at local scale, in the downstream stretch, as well as further downstream along the Upper Vistula. The Implementing Agencies are the Podkarpackie ZMiUW. Like in the Raba basin, key structural elements for are flood reservoirs and dry polders that have been identified, but the hydraulic impacts of these, and the technical feasibility need to be confirmed. The passive structures downstream of these reservoirs, therefore, also cannot yet be confirmed. The subcomponent will have two parts. The Phase 1 investments have been confirmed on technical and economic merit, and their functioning does not depend on the selection of the other structural elements and other measures (notably, the construction of flood retention reservoirs and dry polders) in the basin. The Phase 2 investments are those that have been identified as key elements in the most cost-effective and sustainable

[22] The preparation involves the *Miejskie Przedsiębiorstwo Wodociągów i Kanalizacji Spółka Akcyjna w Krakówie* (Kraków Water Supply and Sewerage Corporation) as the conversion of the reservoir will likely affect water quality, and some adjustments need to be made to intake and other structures.

variant, but still need to be confirmed, as well as their geological surveys and detail designs completed. The Phase 1 investments concern the Sanozcek dike (1.61 km), and the construction of the Golcowa dry polder (Ropa River). The subcomponent will finance the Phase 1 investments, and the full preparation of the Phase 2 investments in the three sub-basins, to bidding level.

54. Readiness: In Component 3, the 3.B.1 Flood protection of Sandomierz (part 1 activities under the ŚZMiUW PIU) activity has sufficient information to be pre-identified and selected for further detailed analysis to confirm their inclusion. These may be included in the first 18 month program (following confirmation) and procurement initiated with the aim to mobilize the contractor during 2016.

Component 4: Institutional Strengthening and Enhanced Forecasting (Base Cost: €124 million)

55. The Bank has maintained a dialogue with the government and the EC on the institutional reforms and the next steps on the road toward integrated water resources management (IWRM) in Poland. A consensus has emerged that the EC is better placed to carry out a dialogue on the institutional and regulatory aspects of flood management, because of its *acquis communautaire (*the accumulated legislation, legal acts, and court decisions which constitute the body of European Union law) and the requirement that member states transpose the WFD. These arrangements are based on the following principles: identification of investments and measures based on a prioritization within the context of a river basin-wide management plan; economic analyses to select cost-effective options including a risk-based approach to investments; creating 'room for the river' and flood wave retention capacity upstream, rather than constraining river flow by dikes; integration with environmental values; management plans based on broad consultation with stakeholders; and sustained financing through fee collection and/or transfers from the national or regional budgets. The *acquis* is considered best-practice and compatible with the Bank's policies.

56. Poland is on the road to incorporate these principles in its legal and regulatory frameworks. The EC intensively monitors and assesses this development, is able to fund capacity building, and disposes of financial incentives to the reform. For example, the EC is the main financier of the national Flood Hazard and Flood Risk Maps, and of numerous studies and TA relating to the legal drafting and RBMP preparation. The project will incrementally support these ongoing institutional strengthening activities. Poland, EC and co-financiers have confirmed their preference of technical and operational leadership by the Bank for new large investment programs with the partial aim to use the programs to bring the institutional innovations into practice and pilot initiatives that are less well covered under EC support, such as the conversion of RBMPs into realistic investment programs. The project will therefore focus on (i) the support for the preparation of the RBMP and investment prioritization plans for key sub-basins of the Upper Vistula basin which has a complex hydrology; (ii) enhanced capacity for forecasting and early warning, and for real-time operational management; (iii) strengthened monitoring of impacts; (iv) and strategic communication of flood risks.

57. The component will selectively support the strengthening of institutional capacity in priority areas: (i) enhancing the emergency preparedness along the main rivers and their tributaries in South and West Poland by enhancing the forecasting and operational water management capacity; (ii) strengthening the procedures and capacity to prepare river basin management plans and investment

prioritization plans that are compliant with the EU WFD and FD; (iii) strengthening the impact monitoring; and (iv) enhance the communication capabilities. The forecasting capability and the establishment of operation centers, will be carried out at the RZGWs of Wrocław and Kraków, and the IMGW-PIB (Kraków Office).

58. The component builds logically on the support to the flood forecasting capacities of Poland extended under the two earlier Bank Odra Projects as well as under other financing from the EC. The ongoing Odra River Basin Flood Protection Project has notably assisted the IMGW to consolidate, on a generic basis at national level, its technical capacity for more reliable and more longer-time forecasts by improving its data base, its data management protocols, and its forecasting routines and Hydrometeorological Monitoring, Forecasting, and Warning System (SMOK). The new project will further strengthen the flood monitoring and warning system for the Upper Odra and for the Upper Vistula at a more operational level. These activities will be implemented primarily by the IMGW-PIB that is located in Kraków, with additional activities carried out by the RZGWs of Wrocław and Kraków with respect to the further development of their operations centers. The component will notably be arranged to ensure that the activities on the forecasting side (IMGW-PIB) and the operational side (RZGWs) will become better integrated and made complementary, avoiding overlaps and gaps. Strengthening of the flood forecasting system and the operations centers will contribute substantially to the flood reducing benefits obtained with the construction of dry polders for flood management in Poland under the current and all previous investment schemes. These activities have partially a piloting and development nature. If the operational centers are developing as expected, the KZGW will consider replicating the system to other RZGWs as well. The activities will also specifically investigate the type of appropriate software and hardware to improve the reliability and lead time for flash flood warnings in sub-basins that are prone to such events, and to analyze appropriate flood mitigation investments.

59. Component 4 consists of two subcomponents. These subcomponents complement each other and will lead to a fully integrated system which provides IMGW/ IMGW-PIB, in their forecasts, with the benefits of knowledge on the immediate hydraulic structure operations carried out by RZGW, while RZGW will have at any time the most up-to-date information on forecasted river discharges.

60. **Subcomponent 4.A: Improvement of the Flood Monitoring and Warning System (Base Cost: € 87 million).** SMOK, currently operational at IMGW, dates from 2004. While this has proven to be an effective and well-used system, specific improvements are deemed essential because of the following:

i. The data quality and reliability needs to be improved, in particular at remote locations. To achieve this, many of the monitoring instruments require replacement.
ii. The current World Meteorological Organization standards require a higher density of monitoring equipment and upgrading.
iii. For more effective flash flood forecasting, at this moment a weak class of forecasts, ‘nowcasting’ or ultra-short-term forecasting needs to be incorporated, primarily aimed at avoiding loss of life.
iv. Snow melt has to be included in monitoring and modelling.

v. Underlying numerical simulation models have become outdated and require extension and upgrades.
vi. Overall, the lead time of forecasts has to be increased, and the forecast accuracy improved.

61. The improvement of the flood forecasting system under the project foresees the following activities under the subcomponent[23]:

i. Modernization and expansion of the network of telemetry weather monitoring stations for the needs of hydrological forecasting and modelling. Principal investments include: (a) improvements/replacements at automatic weather stations; (b) replacing tipping bucket rain gauges by more reliable laser gauges; (c) installing snow depth sensors; (d) upgrading radio communication systems; (e) equipping some stations with water quality monitoring facilities; and (f) various installation and construction works.
ii. Modernization and expansion of the system of measurements and forecasts of hydro-meteorological and oceanographic parameters in the waters of the Baltic Sea to enhance the flood protection of the coastal areas. Principal investments include: (a) measurement equipment with sensors and data transmission equipment; (b) maintenance equipment; and (c) hydrodynamic modelling of the Baltic coastal zones.
iii. Modernization of the network of the POLRAD weather radars to increase the effectiveness of the hydrological models). Principal investments include the installation of various fixed and mobile radars, radar tower adaptations, or the new construction of these.
iv. Update and modernization of the Hydrology System (a Management Information System [MIS]), including the development of training, application, and infrastructure. Principal investments include: (a) hydrological and hydraulic model development; (b) further development of the MONITOR IMGW–PIB system or acquisition of an alternative platform; (c) workstations and other hardware; and (d) training and development of the simulation platform.
v. Modernization and development of an integrated hydrological and hydraulic modelling system as part of the hydrological monitoring, forecasting and warning system. Principal investments include: (a) rainfall-runoff model development; (b) hydrodynamic model development; and (c) training.
vi. A 'nowcasting' system and flash flood early warning system. Principal investments include: (a) IT platform extension; (b) development of the national flash flood forecasting system; and (c) catchment indexing and rainfall-runoff model development.

62. **Subcomponent 4.B: Further development of the operations centers at RZGWs Wrocław and Kraków (€38 million).** The objective of this investment is the further preparation of two RZGW operations centers (Wrocław and Kraków) to provide: (a) disaster risk reducing information during flood emergencies to the Voievodes in the respective RZGW regions; (b) improved operation of the dry polders, flood and multipurpose reservoirs, barrages and locks, and pumping stations, to create optimal flood wave routing scenarios that minimize flood damages; and (c) support the daily operations of hydraulic structures under RZGW's responsibilities. Partly,

[23] *Modernization and development of the flood monitoring and warning system*, IMGW-PIB, October 11, 2014

these services are a follow-up to the flood forecasting system and related flood forecasts developed further under IMGW responsibility. Principal achievements of this investment will be the high potential to reduce flood damages in case of emergencies and the prevention of flood damages due to better guidance for icebreaking operations.[24] Principal activities of this subcomponent are:

i. Detailed analysis and definition of the functionalities of the informatics platform that should retrieve extensive, readily available information to support the Voivodship's Crisis Centers in emergency situations and the RZGWs in their own day-to-day operations.
ii. Field and office installations. This work package comprises the following subtasks: (a) installation of monitoring and telemetry equipment at reservoirs, dry polders, and critical dam/dike sections; (b) modernization and implementation of local control systems for selected hydraulic structures; (c) improvement of equipment for guiding the inland navigation on the Upper, Free-flowing and Lower Odra; (d) modernization of field/mobile units; (e) installation of equipment at the operations and crisis centers to secure optimal provision of services; and (f) measures to assure reliable functioning and resilience of all essential installations).
iii. Design and development of the informatics platform at the operations centers, including the user interface and the database for the storage, quality control, and retrieval of information supporting the tasks).
iv. Integration of the dry polder and reservoir operation system of RZGWs into the operational forecasting system of IMGW;
v. Training of staff of the operations centers and the IT Department.

Component 5: Project Management and Studies (Base Cost: €73 million)

63. The PCU will be restructured to combine the coordination of the ongoing Odra River Basin Flood Protection Project and the new project. This will entail the definition of a new staffing plan and expansion of positions (with a reduction again of the PCU size once the ongoing project comes to an end). The PCU Main Office in Wroclaw will comprise following staff: Project Director, Office Director, Deputy Director, Procurement Specialist, Hydrotechnical Specialist (2), Environmental Specialist, Social Specialist, Accountant (2), Financial Controller, junior Financial Specialist, Coordination Specialist, MIS Specialist, Office manager, and administrative support staff (2).

64. The PCU will have local representatives in Kraków, hosted by the Voievode of Małopolskie in Kraków. The overall management and direction of the PCU will remain located in Wrocław, for reasons of logistics and continuity. The PCU Office in Kraków will comprise following staff: Office Director, Procurement Specialist, Hydrotechnical Specialist, Safeguards Specialist, and administrative support staff (2).

[24] A secondary benefit is that such system will allow simultaneously to streamline the operational supervision of shipping movements and the rapid response in case of threatening situations such as oilspills.

65. The support to the implementing agencies will consist of dedicated TA teams that will have the task to, among other things, but not limited to, review and update designs and permit applications; carry out detail designs; prepare procurement documents and supervise contractor procurement; carry out land acquisition and environmental studies; prepare FM documentation; and prepare all reporting. The following TA packages will be selected, based on the desire to limit the number of packages while at the same time reflecting the variability in the work and the spatial distribution of the tasks:

i. Consultant Team 1 - To support the PIUs of ZMiUW Dolnośląskie, ZMiUW Lubuskie, and ZMiUW Zachodniopomorskie
ii. Consultant Team 2 - To support RZGW Wrocław and RZGW Szczecin
iii. Consultant Team 3 - To support ZMiUW Małopolskie (Kraków), ZMiUW Podkarpackie, and ZMiUW Swiętokrzyskie
iv. Consultant Team 4 - To support IMGW Kraków

66. **Institutional strengthening for IWRM.** The assistance to applying IWRM and investment scenario analysis for river basin management planning and management and investment prioritization will be focused on the Bobr-Kwisa River (in the Lower Odra), and the Upper Vistula part upstream of Kraków[25] (and including the Kraków passage), the San catchment, the Raba catchment, and the Dunajec catchment—key areas of the basin with complex hydrology and various investment options to be studied.

67. The impact monitoring will take the form of the development of procedures and guidelines for, and the conduct of, surveys for disaggregated analysis of flood impacts and impacts from flood protection; this capability will enhance the government's capability to target future investments better and decide on cost-effectiveness. In general, the project will closely monitor the country's progress in meeting the requirements under the EU WFD and FD and it will support institutional reform steps with studies and dialogue. As part of this, funding will be provided to facilitate peer-to-peer dialogue on IWRM with another appropriate EU member state that is considered to have successfully transposed the EU *acquis*. A national communication strategy on floods will be developed.

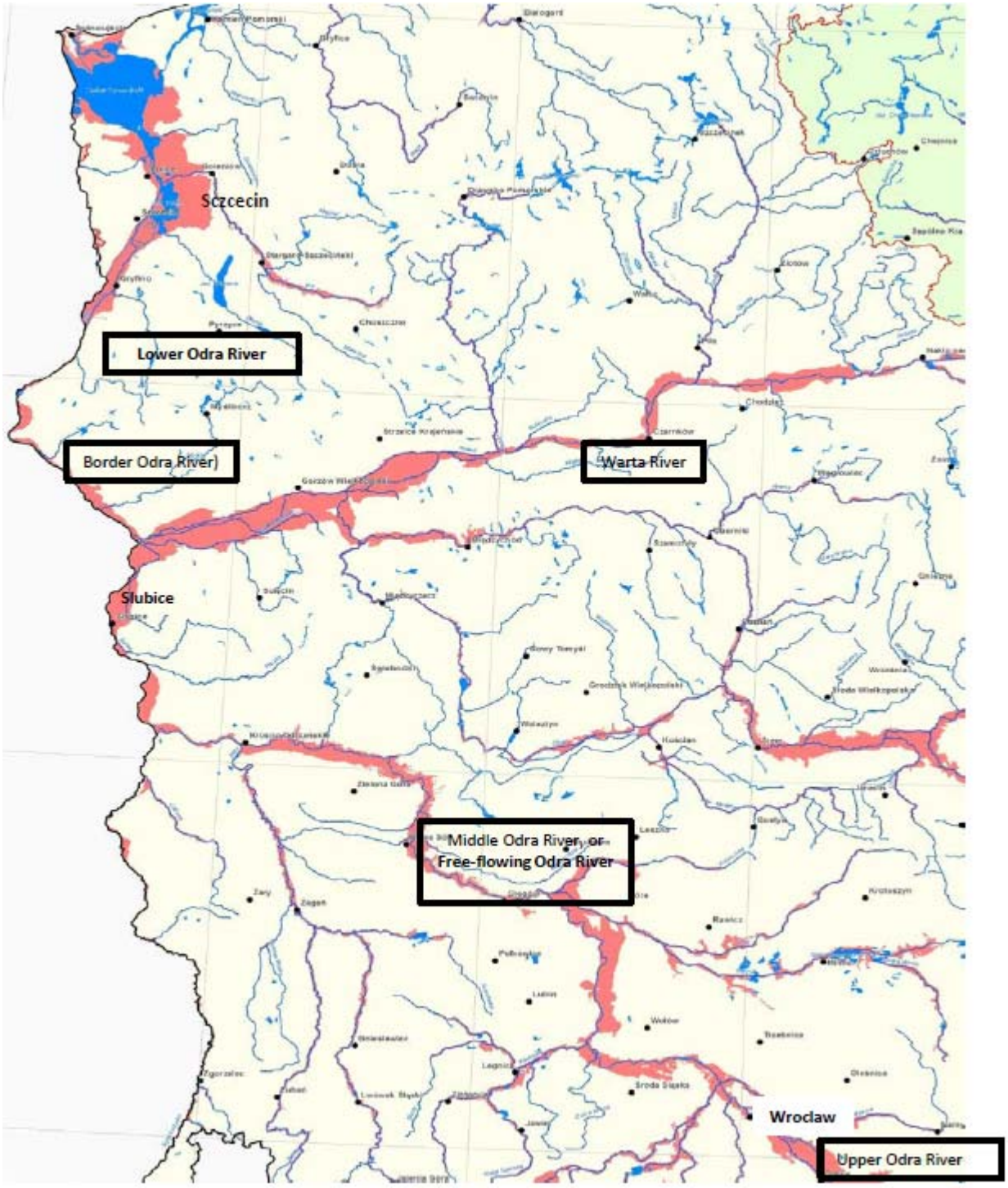
68. The PCU will be able to recruit experts and consultants, for legal assistance, for additional studies (including to prepare a follow-up project), for the International Dam Safety Panel, and for audits. The PCU will dispose of a modest budget for the equipping of offices and for incremental operating costs. Finally, the PCU will dispose of funds to organize training sessions and workshops, and facilitate international working visits and government-to-government cooperation

[25] As part of the measures to control the extent and crest height of flood waves entering the Vistula's Kraków section, the feasibility of dry polders will need to be studied to be located about 20 km upstream of Kraków. These dry polders are overflow areas alongside the river and would receive excess flood water beyond a certain crest level. The areas that could qualify are shallow and comprise meadows and bush, without fixed constructions; neither are they protected environmental areas. The polders are the Gromiec, Jankowice, Smolice, Spytkowice, Kamien, Rusocice, and Klokocyn and represent a total storage capacity of up to 110 million m^3. The surrounding dike bodies would be 32.75 km long and 2.5–3.5 m tall. The positive effect of the investment concerns the lowering of the flood wave crest height by 75, 63, and 40 cm at Denbicki bridge, Grunwaldzki bridge, and Nowa Huta, respectively.

(notably, to follow up on the November 2014 official visit to the Netherlands, and for peer-to-peer learning).

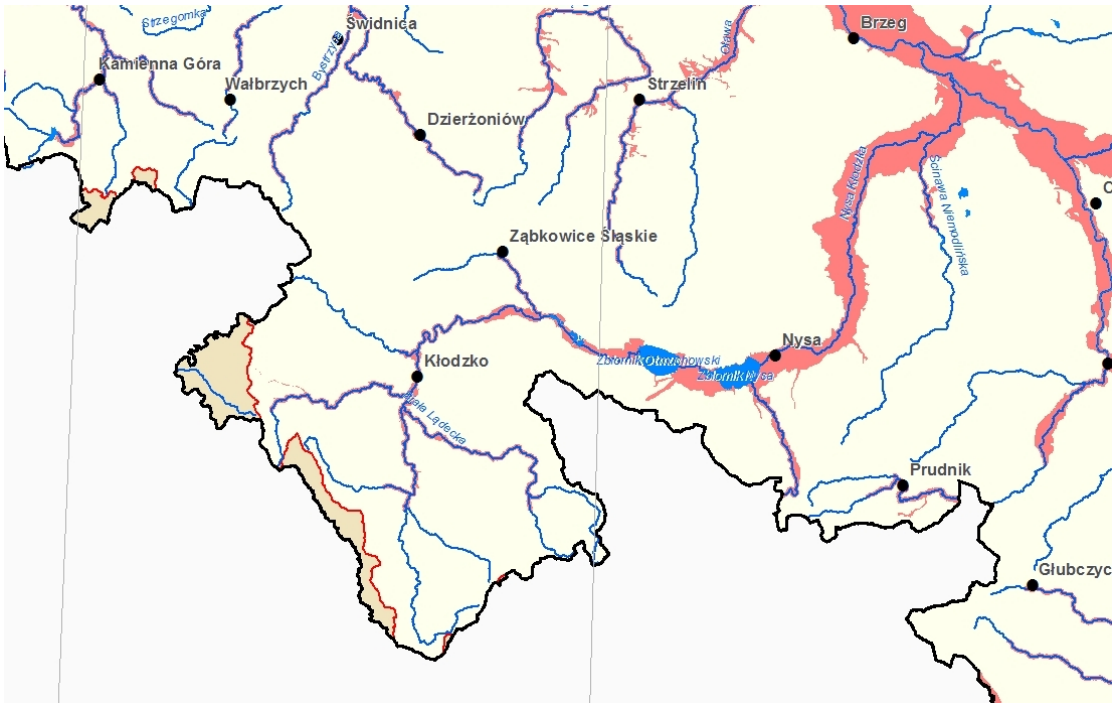
69. The project will support the development and application of a dedicated survey tool to assess citizen/ stakeholder engagement and perspectives on flood risks, risk improvement and communication with the government, disaggregated by gender, household income, location vis-à-vis risk, etc. The survey will be piloted during a first roll-out in the first year of project implementation to at the same time establish the baseline. The second and third surveys will be conducted at about mid-term and project completion. Secondly, the project will support the government with a general strategic study to assess the mid-term and long-term impacts of climate variability and land-use changes on the precipitation and temperature patterns and on the general characteristics of the run-off, hydrology and floodwave propagation. The study would formulate recommendations that would assist the government and other stakeholders to achieve better planning by incorporating such information in the river basin management plans and flood management plans.

Figure 2.2: Flood Hazard Map for $Q_{1\%}$ Floods for the Odra River Basin, Reflecting the Impacts of Both Summer and Winter Floods (Component 1)



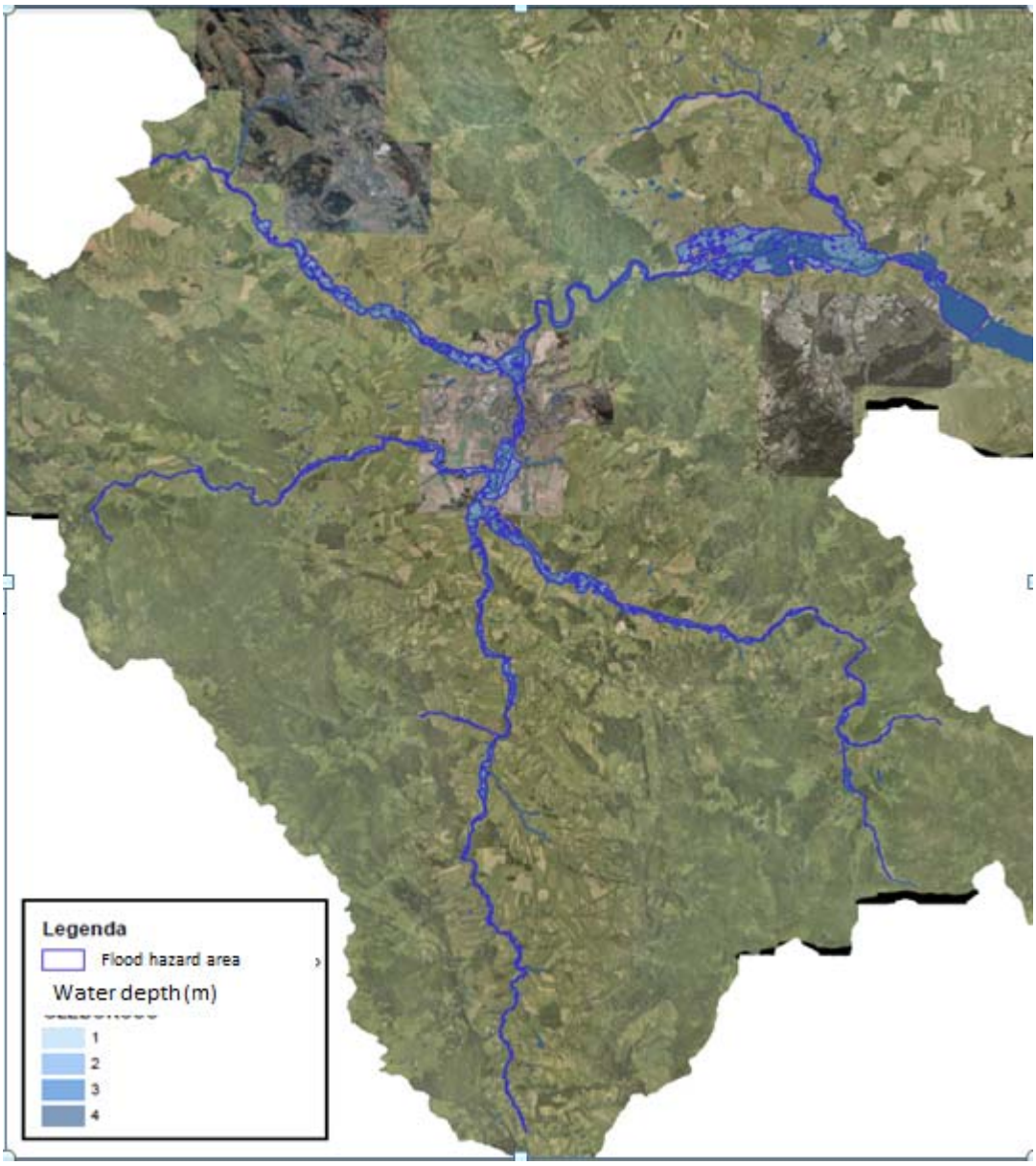
Source: "Preliminary assessment of flood risk", National Water Management Authority (KZGW), Warsaw, 2014 - http://www.kzgw.gov.pl/files/file/Materialy_i_Informacje/WORP/Polska/1.jpg.)

Figure 2.3: Flood Hazard Map for 100-year Return Period ($Q_{1\%}$) Floods for the Nysa Kłodzka Sub-basin (Component 2)



Source: "Preliminary assessment of flood risk", National Water Management Authority [KZGW], Warsaw, 2014. http://www.kzgw.gov.pl/files/file/Materialy_i_Informacje/WORP/Polska/1.jpg)

Figure 2.4: Flood Hazard Map with Depth of Water for 100-year Return Period ($Q_{1\%}$) Floods for the Nysa Kłodzka Sub-basin (Component 2)

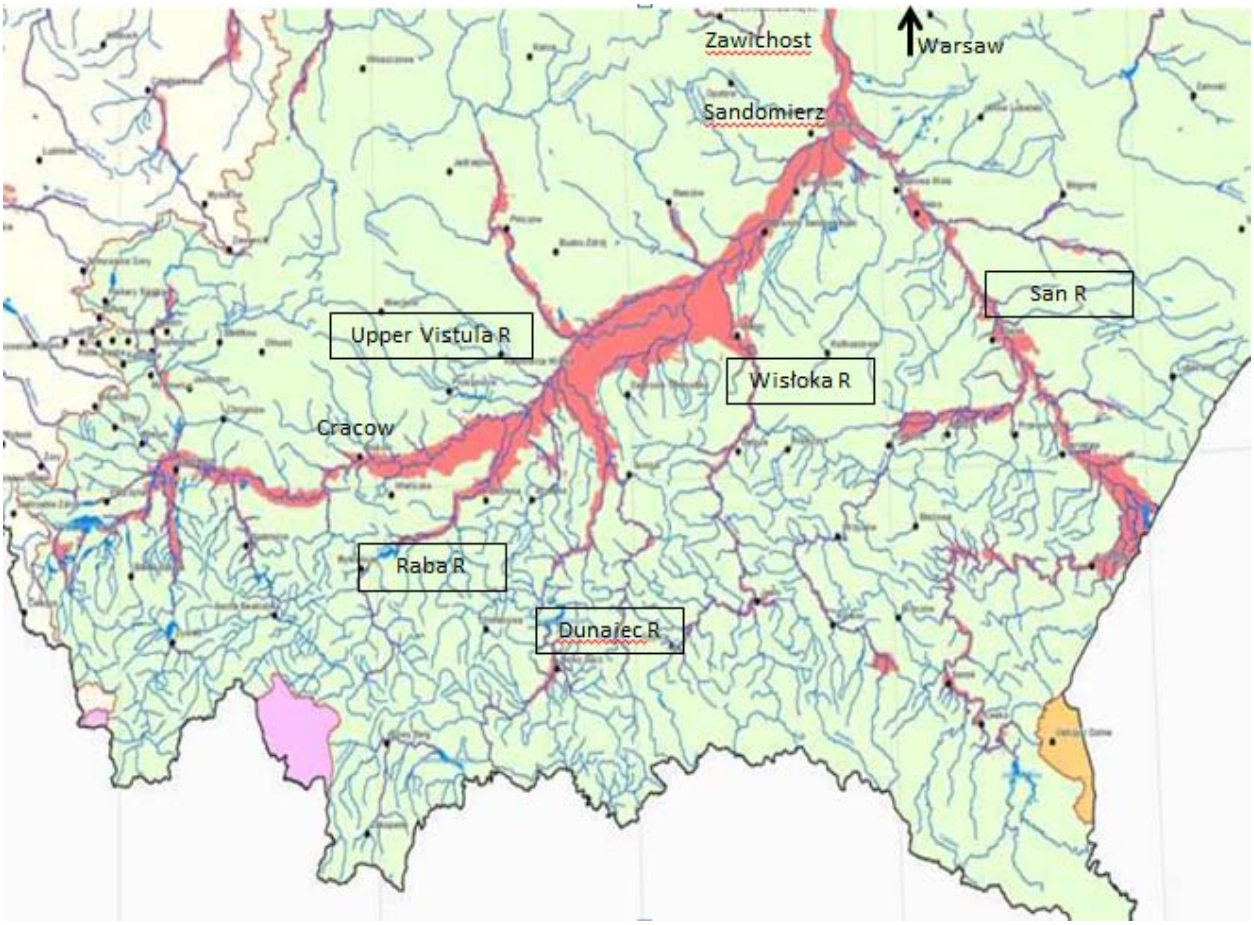


Source: National Institute of Meteorology and Water Management, IMGW - Pogodynka, Wrocław, 2014

Figure 2.5: Flood Hazard Map for $Q_{1\%}$ Floods for the Vistula and Odra River Basins

Source: Preliminary assessment of flood risk, National Water Management Authority, (KZGW), Warsaw, 2014.

Figure 2.6: Flood Hazard Map for $Q_{1\%}$ Floods for the Upper Vistula River Basin



Source: Preliminary assessment of flood risk, National Water Management Authority, (KZGW), Warsaw, 2014.

ANNEX 3: IMPLEMENTATION ARRANGEMENTS

REPUBLIC OF POLAND: ODRA-VISTULA FLOOD MANAGEMENT PROJECT

Project Institutional and Implementation Arrangements

Project administration mechanisms

1. The proposed project requires the close coordination of four ministries: The Ministry of Environment (MoE) for implementation, the Ministry of Administration and Digitization (formerly Home Affairs) for the flood protection budget, the Ministry of Finance (MoF), and the Ministry of Infrastructure and Regional Development for coordination of Borrower EU funds. Other key national-level agencies are the National Water Management Authority (KZGW), the Institute of Meteorology and Water Management (IMGW), the National Fund for Environmental Protection and Water Management and the State Rural Property Agency. Several local government entities are also involved notably the Voievodes and Marshals of the involved Voivodships, the District and Municipality Heads, and the Regional Environment Inspectorates. These government officers and agencies decide on environmental, water use, and construction permits, manage the land acquisition processes, and issue important permits for, for example, the use of roads for truck transports. They also are crucial in facilitation of relations with local communities.

2. The overall strategic coordination, guidance, and quality control will be delivered by the Inter-Ministerial Project Steering Committee (PSC)[26], chaired by the Ministry of Administration and Digitization (formerly, Home Affairs) and the MoE, and in which also the MoF and the Ministry of Infrastructure and Regional Development participate. At the operational and day-to-day level, the coordination and quality control will remain the responsibility of the Project Coordination Unit (PCU) that is currently carrying out the same task for the ongoing Odra River Basin Flood Protection Project. The PCU will be expanded for this purpose (including local representatives in Kraków). The PCU will continue to report directly to the Minister of Environment, and will be administratively a part of the KZGW, an implementing unit of the MoE. This arrangement has proved effective in the ongoing Odra River Basin Flood Protection Project.

3. The PCU will work with the prospective implementing agencies that will need to appoint their PIUs. For all the activities in Components 2 and 4, and for some of those in Component 1, the PIUs will be the same as under the ongoing Odra River Basin Flood Protection Project, providing continuity, and ensuring that lessons from the current Odra River Basin Flood Protection Project will be used in the new Odra-Vistula Flood Management Project. During preparation, the Bank team worked with the experienced PIU staff and their TA teams, who are on the ground, to share the operational experience with the prospective new PIUs. This arrangement will ensure effective sharing of implementation guidelines, training of staff, and optimizing the coordination and the coherence of actions. PCU would consist, inter alia, of a project director, a deputy director, technical specialists in the implementation of EMPs and RAPs, environment and social specialists, a procurement specialist, a financial management specialist, communications specialists, accountant, and support staff.

[26] PSC will be the same as the one for ongoing Odra River Basin Flood Protection Project.

4. The activities in the proposed project components are to be prepared and implemented by, depending on their location and nature, the RZGWs and the ZMiUWs and IMGW. The RZGW of Wrocław and the Dolnośląskie ZMiUW (DZMiUW) have grown over the on-going Odra River Basin Flood Protection Project period into competent and reliable institutions with demonstrated capability to carry out investment analysis and works preparation that define flood projects, including procurement and works and safeguards supervision. These two institutions have successfully prepared works and procured international bidding contracts of high technical sophistication and size (several of €100–250 million). In addition, the IMGW has implemented a large component aimed at strengthening the national early-warning and data management systems, to satisfaction. The new Odra-Vistula Flood Management Project will build on the experiences and staff of these two institutions. Seven new prospective implementing agencies would be new to WB-financed operations and their capacities will need to be strengthened; this is planned to be done through the existing national systems of coordination and supervision. The new agencies are the RZGWs in Szczecin and the ZMiUWs of the Voievodes of Zachodniopomorskie (West Pomerania), Lubuskie, Małopolskie, Podkarpackie, and Swiętokrzyskie. RZGW Kraków will be a key beneficiary for the activities in the Upper Vistula and the operations center but will not be responsible for any procurement. Given that during implementation, studies will be prepared to identify future investments in the Upper Vistula, RZGW Kraków may be a future PIU and as such is included in the program. Each PIU will be responsible for the implementation of the assigned project subcomponents/activities. All PIUs will carry out procurement and supervision/monitoring of contracts, maintain effective internal control procedures, account for expenditures in their existing budgetary accounting systems, receive funds, make payments, and provide the PCU with documentation and information related to the use of the loan proceeds, SOE documentation of the eligible expenditures, and project reporting and monitoring. The PCU (with support from the local representatives in Kraków) will be responsible for gathering and consolidating project financial information through the online reporting system, preparation of disbursement documentation (withdrawal application, SOE documentation), reporting (periodical and annual), financial planning and monitoring, monitoring of flow of funds, and supervision of implementation of EMPs and RAPs. Given the geographical extent of the potential investments and work sites, local representatives in Kraków is established for greater oversight and support to the local PIUs.

Table 3.1: Implementation structure of the project – New and existing Project Implementation Units (PIUs) and Project Coordination Unit (PCU)

Component	Existing Implementation Units	New Implementation Units (being established)
1 Flood protection of Middle and Lower Odra	RZGW Wrocław	RZGW Szczecin ZMiUW Zachodniopomorskie ZMiUW Lubuskie
2 Flood protection of Nysa Kłodzka Valley	RZGW Wrocław ZMiUW Dolnoslaskie	
3 Flood protection of Upper Vistula		ZMiUW Świętokrzyskie ZMiUW Podkarpackie ZMiUW Małopolskie

4 Institutional strengthening and Enhanced Forecasting	IMGW PCU (Wrocław)	
5 Project management and studies	PCU (Wrocław)	PCU Office (local representatives in Kraków)

5. The preliminary assessment suggests that these agencies are technically and managerially capable; have a tradition of managing medium to large investments; and have expressed readiness to participate in the proposed Odra-Vistula Flood Management Project. They have provided a series of preliminary conceptual designs for short-listed works that seem adequate and are based on extensive analysis and review and rejection of alternative options. The technical capacities, as well as their capacities with respect to World Bank procurement, FM, and environmental and social safeguards will need to be further strengthened; this will be monitored closely in particular in the first years of project implementation and additional training and supervision extended, if necessary.

Financial Management, Disbursements and Procurement

Financial Management

6. The FM arrangement of the ongoing Odra River Basin Flood Protection Project will constitute the core structure for the new Odra-Vistula Flood Management Project. It was reviewed in May 2014 and, in combination with the follow-up training for the new prospective PIUs in October 2014 and update in 2015, it was found to be acceptable overall for proposed project implementation. The FM assessment was completed including specification of the next steps related to the upcoming new Odra-Vistula Flood Management Project, including (i) updating of the FM section of the Project Operational Manual and its distribution to all PIUs and (ii) selection of the auditor type: NIK or private auditor. The overall initial FM risk for the proposed project before and after mitigation measures is assessed as Moderate.

7. The budget for the proposed project, including loan funds and counterpart funding, is included in the state budget and prepared and approved by the Parliament on an annual basis. The proposed project budget is prepared in accordance with the Public Finance Law and classified as a reserve for disaster recovery, including earmarked funding from the loans (the Bank and other IFIs) with co-financing by the national budget.

8. The loan funds will flow to the DA maintained by the MoF in the National Bank of Poland and from there will be transferred to the implementing agencies employing the existing budgetary procedures applicable for foreign funding sources. The loan funds are transferred from the MoF to the state budget account. The RZGWs and the IMGW—all national government agencies—receive the funds through the MOE/KZGW, while the ZMiUWs—all local government agencies—receive them through the account of the Voivodship Marshals. This process of application for funds, and, thereafter, the transfer of funds, is complex as each intermediary step requires a paper decision and separate approval from the KZGW, the MoE, the Ministry of Administration and Digitization (MAD), and the MoF. The time for issuing the payment decision and the actual transfer of funds via the TREZOR system takes approximately 40–60 days. In the ongoing Odra River Basin Flood

Protection Project, the PIUs have been requesting the funds in advance to mitigate the risk of delays.

9. The proposed project relies on existing FM/accounting staff employed in the PIUs. The staff in the new PIUs will be coached and trained by the PCU to train them on the proposed project specific procedures and reporting.

10. Overall, the internal control systems at the PCU and the PIUs have been enhanced and have proven adequate in the ongoing Odra River Basin Flood Protection Project, and it relies on the existing application of the Public Finance Law requirements including the requirement for efficient and economic use of the funds. The contracts to be financed from the proposed project sources will be included in the Procurement Plan to be approved by the Bank. Most of contracts are large construction contracts which require prior review and no-objection from the Bank. The funds for this proposed project are included in the state budget in the so-called special reserve which is used for all external loans. Implementing agencies will apply for the proposed project funds including loan and counterpart funding from the ministry in line with the budgetary procedures but with an additional acceptance by the PCU.

11. All proposed project expenditures will be originally recorded in the accounting books of the implementing agency. The PCU will continue to monitor and coordinate the flow of funds including the monitoring of the complex flow of funds from the MoF to the implementing agencies, managing the cash flow liquidity of the proposed project by consolidation of the cash forecast, consolidation of the information about the use of the funds, and preparation of the reports and records for documentation of the expenditures to the Bank. However, as described above, the PCU has yet to update project-specific FM procedures in the Project Operational Manual, and to update the IT system to the specific requirements of the proposed project including the installation and testing of the system in all the PIUs.

12. Contract management is the responsibility of, and is maintained by each implementing agency. Usually, contract monitoring is done in Excel and includes contract deliverables, unit/component price (if applicable), total amount of the contract, invoiced and paid amounts, and commitments. The contract monitoring is performed by the technical manager and/or by the financial staff in the implementing agency. In addition, the PCU online system includes basic contract monitoring tools regarding the total value of contracts and the paid amounts, which serves as ex post control.

13. Formats of the IFRs have been agreed with PCU and include (i) project sources and uses of funds, (ii) uses of funds by proposed project activity; (iii) DA statement, (iv) the disbursement summary, and (v) cash forecast, but might be updated with additional reports if required by other IFIs.

14. The PCU will consolidate the project financial information from all the PIUs using the online reporting system and produce full sets of quarterly IFRs to be submitted to the Bank within 45 days of the end of each calendar quarter, from the first disbursement and throughout the proposed project life.

15. The internal audit departments in the implementing agencies were created in 2002 as required by the Public Finance Law, and their work is providing additional fiduciary assurance to the

proposed project. The audit plans are established individually in each implementing agency and therefore the Bank is not able to solely rely on such audits for its fiduciary purposes. The audits of the proposed project financial statements will be conducted annually by independent auditors (with defined terms of reference) and according to auditing standards acceptable to the Bank. The MoF will inform the Bank, by December 31, 2015, of its choice of Auditor, acceptable to the Bank. For the ongoing Odra River Basin Flood Protection Project the financial audit has been performed by NIK and current auditing arrangements are satisfactory to the Bank. The annual audits of the proposed project financial statements will be provided to the Bank within six months after the end of each fiscal year, and also at the project closing. If the period from the date of effectiveness of the proposed project to the end of the borrower's fiscal year is no more than six months, the first audit report of the proposed project may cover financial statements for the period from effectiveness to the end of the second fiscal year. The borrower will disclose the audit reports for the proposed project within one month of their receipt from the auditors and acceptance by the Bank, by posting the reports on its websites. Following the Bank's formal receipt of these reports from the borrower, the Bank will also make them publicly available according to the World Bank Policy on Access to Information.

Withdrawal of Loan Proceeds

16. The MoF will open a separate Dedicated Account (DA) in the National Bank of Poland. Bank loan proceeds will flow to the DA and from there will be transferred to the PIUs in accordance with the existing budgetary procedures applicable for foreign sources of funding. The DA will be replenished on the basis of aggregated disbursement reports included in the quarterly IFRs. The withdrawal of loan proceeds is clarified in Table 3.2.

17. Withdrawal applications together with IFRs documenting the funds utilized from the DA and cash forecast requirement will be sent to the Bank every three months. The following disbursement methods may be used under the proposed project: Reimbursement and Advance. There will be no ceiling of DA under report-based disbursement which will be reflected in the Disbursement Letter. Detailed instructions on withdrawal of loan proceeds will be provided in the Disbursement Letter. It is strongly recommended to use the e-disbursement online mode for submission of withdrawal applications.

18. To facilitate the internal administration of financial flows, the share of the IBRD funding in the overall proposed project cost would be determined on an annual basis, through an Annual Work Plan (AWP) prepared by the Borrower, and agreed between the Borrower, the Bank and other partners involved in the proposed project implementation. AWP would provide a list of all annual activities supported by the proposed project and the co-financing arrangements for the relevant year. Therefore, the percentage of financing from the IBRD loan may be different in each year, depending on the availability of funds from other funding sources in each implementation year. However, the Borrower will ensure that the overall withdrawal rate, at the proposed project level, is maintained at the agreed level.

Table 3.2: Withdrawal of Loan Proceeds

Category	Amount of the Loan Allocated (Expressed in Euro)	Percentage of Expenditures to be Financed (inclusive of Taxes)
(1) Goods, works, non-consulting services, consultants' services (including Project audits), Resettlement Compensation, Training, and Incremental Operating Costs for the Project	460,000,000.00	Such percentage of Eligible Expenditures as the Bank may determine for each calendar year, starting in calendar year 2015, covered by the respective AWP in accordance with the provisions set forth in Section IV.B.2 of Schedule2 of the Loan Agreement.
TOTAL AMOUNT	460,000,000.00	

* The sum of the Bank's financing percentage of Eligible Expenditures under the Loan combined with the financing percentage provide by the Co-financier CEB and the Borrower equals 100% of each Eligible Expenditure

Procurement

19. ***Procurement of works.*** The proposed project would provide three distinct areas with flood management infrastructure and related measures (rehabilitation of dikes, reconstruction of embankments and polders, improvements of flood water flows, dredging works, construction of dry polder, and so on): (i) the Middle and Lower Odra; (ii) the Nysa Kłodzka Valley, a large sub-basin of the Upper Odra; and (iii) the Upper Vistula. The rehabilitation, reconstruction, and other large civil works will be procured through the International Competitive Bidding (ICB) procedure, following prequalification. The Bank's recent Standard Bidding Documents (SBD) for procurement of works will be used. There may be smaller value contracts, below US$20 million per contract (gross costs), which may be procured following the National Competitive Bidding (NCB) procedure—following the Polish Procurement Law, and open tender procedure. However, based on experience gained by the existing PIUs under the ongoing Odra River Basin Flood Protection Project, in conducting tenders based on the Bank's SBD for procurement of works and the FIDIC type of contract used, some PIUs may choose to follow the ICB procedure for contracts below US$20 million. However, for contracts below US$20 million per contract, if the PIUs follow the NCB procedure allowing use of an open tender under the Polish Procurement Law, the Bank will review and agree on appropriate SBD. For very small value civil works contracts estimated to cost not more than US$200,000 per contract the shopping procedure may be used.

20. ***Procurement of goods and non-consulting services.*** The proposed project would further strengthen the national flood forecasting and operational capability of south Poland, through more advanced equipment and mathematical simulation models. The most recent version of the Bank's SBD for goods shall be used for all ICB above US$2 million per contract. For contracts below

US$2 million, the Bank's sample bidding documents for goods under the NCB may be used and the shopping procedure for goods estimated to cost up to the equivalent of US$100,000 per contract. For the ICT related procurement under Component 4, the following different procurement strategies may be applied: (i) **Goods approach** - for general purpose hardware and off-the-shelves software (without customization) based on SBD for goods; (ii) **Consulting services approach** - if the hardware and packaged software content is minimal, for example, less than 20 percent of the estimated contract value, a consultancy selection procedure may be applicable with the Bank's standard request for proposal; (iii) **Single stage IT or Two Stage IT SBD** - if the procurement package combines critical goods and services elements, sophisticated hardware requiring an informed performance comparison and special training requirements, a dominating value of the software packages, extra installation and support requirements for these, software design, large-scale adaptation and/or development, requirements for the supplier to continue to operate the equipment after installation, and for contracts requiring pricing for both investment and recurrent costs (life-cycle).

21. Logistical services for training and workshops related to TA shall be procured as non-consulting services.

22. ***Selection of consultants.*** The consultant services under the proposed project will include, among other things: TA, preparation of feasibility studies, preliminary and detailed designs, and bidding documents for civil works contracts, as well as supervision of large civil works contracts. For assignments estimated to cost US$300,000 per contract, the short list may comprise entirely national consultants.

23. The Bank will review the procurement arrangements performed by the PIUs. The procurements not receiving prior review by the Bank will be subject, on a random basis, to the Bank's or Auditor's ex-post review in accordance with the procedures set forth in appendix 1 of the Procurement and Consultant Guidelines. One in ten contracts under the proposed project will be subject to the Bank's ex-post review. The ex-post review of procurement documents will normally be undertaken during the Bank's implementation support missions or the Bank may request for any contract at any time.

Project Procurement Plan

24. The general project procurement plan and the detailed procurement plan for the first 18 months have been drafted. The works have been consolidated into 20 contracts and the number of large works, goods and services contracts is 36 (with component 5).

25. Readiness of the proposed project contracting: An initial seven investments are pre-identified for further detailed analysis. Based on preliminary information, these could be part of the initial 18 month procurement plan with contracting in late 2016 for a total estimated contract value of €421.26 million (Table 3.3). The majority of these works will be implemented by the PIU in RZGW Wrocław which is an experienced unit. This figure excludes other contracts that will be committed in 2016 notably those for the TA contracts to support the PIUs and in Component 4.

Table 3.3: Works contracts expected to be committed in 2016

	Contract No.	Contract name	Contract value (€ mln)	Implementing Agency PIU
1	1.A1	Chlewice-Porzecze. Backwater embankment of Odra River at Myśla River and Modernization of Marwicki polder stage I and II	7.26	ZMiUW Zachodniopomorskie
2	1.B1	Reconstruction of river control infrastructure on Odra River (Stage II and III). Adaptation to the conditions of Class III roadway	130.39	RZGW Wrocław
3	1.B6	Flood protection of Nowa Sól and below Krosno Odrzańskie	54.33	ZMiUW Lubuskie
4	1.C1	Extension and construction of flood embankments of Słubice City and reconstruction of Czarny Kanał and Racza Struga	50.95	ZMiUW Lubuskie
5	2.A1	Construction of Boboszów and Roztoki Bystrzyckie dry flood control reservoirs	42.86	RZGW Wrocław
6	2.A2	Construction of Szalejów Górny and Krosnowice dry flood control reservoirs	64.69	RZGW Wrocław
7	3.B1	Flood protection of Sandomierz	70.98	ZMiUW Świętokrzyskie
		TOTAL	421.46	

Components Project Cost Summary

	(PLN Million)			(Euro Million)			%	% Total
	Local	Foreign	Total	Local	Foreign	Total	Foreign Exchange	Base Costs
A. Flood Protection of Middle and Lower Odra								
1. Flood Protection of Areas in Zachodniopomorskie Province								
Chlewice-Porzecze Embarkment of Odra River at Myśla River	7.1	2.3	9.4	1.7	0.5	2.3	24	-
Flood Protection of Ognica Village	2.0	0.6	2.6	0.5	0.2	0.6	24	-
Osinow-Lubnica Modernization of Inter-embarkment	11.9	3.8	15.8	2.9	0.9	3.8	24	-
Flood Protection of Radziszewo and Daleszewo Villages	4.1	1.3	5.4	1.0	0.3	1.3	24	-
Modernization of Marwicki Polder	16.3	5.3	21.6	3.9	1.3	5.2	24	-
Restoring Natural Values by Improving Międzyodrze	57.1	18.4	75.5	13.7	4.4	18.2	24	2
Subtotal	98.5	31.8	130.2	23.7	7.6	31.3	24	3
2. Flood Protection of Middle and Lower Odra River								
Reconstruction of River Control Infrastructure	350.6	113.1	463.7	84.3	27.2	111.5	24	10
Modernization Works on Boundary Sections for Ice-breaking	288.2	93.0	381.2	69.3	22.3	91.6	24	8
Construction of Docking-mooring infrastructure on Lower Odra	31.5	10.2	41.7	7.6	2.4	10.0	24	1
Improvement of Flood Water-flow from Dąbie Lake	74.0	23.9	97.8	17.8	5.7	23.5	24	2
Dredging of Klucz-Ustowo Ditch	1.7	0.6	2.3	0.4	0.1	0.5	24	-
Reconstruction of Bridges for Minimun clearance	229.0	73.9	302.9	55.1	17.8	72.8	24	7
Flood Protection of Nowa Sól and below Krosno Odzańskie	172.5	55.6	228.1	41.5	13.4	54.8	24	5
Subtotal	1,147.6	370.2	1,517.8	275.9	89.0	364.9	24	34
3. Flood Protection of Sublice City								
Extension and Construction of Flood Embankments	153.3	49.5	202.8	36.9	11.9	48.7	24	4
Reconstruction of Czarny Kana ł and Racza Struga	3.9	1.3	5.2	0.9	0.3	1.2	24	-
Subtotal	157.3	50.7	208.0	37.8	12.2	50.0	24	5
Subtotal	1,403.3	452.7	1,856.0	337.3	108.8	446.2	24	41
B. Flood Protection of the Nysa Kłodzka Valley								
1. Active Protection								
Construction of Boboszów Dry Flood Control Reservoir	57.4	18.5	76.0	13.8	4.5	18.3	24	2
Construction of Roztoki Bystrzyckie Dry Flood Control Reservoir	80.1	25.8	105.9	19.2	6.2	25.5	24	2
Construction of Szalejów Górny Dry Flood Control Reservoir	122.9	39.7	162.6	29.5	9.5	39.1	24	4
Construction of Krosnowice Dry Flood Control Reservoir	79.2	25.5	104.7	19.0	6.1	25.2	24	2
Subtotal	339.6	109.5	449.1	81.6	26.3	108.0	24	10
2. Pasive-Protection								
Flood Protection of Nysa Kłodzka River Valley	141.7	45.7	187.4	34.1	11.0	45.0	24	4

Flood Protection of Ścinawka River Valley	74.1	23.9	98.1	17.8	5.7	23.6	24	2
Flood Protection of Biała Lądecka River Valley & Morawa River	107.4	34.6	142.1	25.8	8.3	34.1	24	3
Flood Protection Bystrzyca Dusznicka RV & Kamienny Potok River	90.1	29.1	119.1	21.7	7.0	28.6	24	3
Subtotal	413.3	133.3	546.7	99.4	32.1	131.4	24	12
Subtotal	752.9	242.9	995.8	181.0	58.4	239.4	24	22
C. Flood Protection of the Upper Vistula								
1. Flood Protection of Kraków and Wieliczka								
Upgrading of Vistula including embankments in KrakówKraków	113.4	36.6	150.0	27.3	8.8	36.0	24	3
Flood Protection in Serafa Valley	51.7	16.7	68.3	12.4	4.0	16.4	24	2
Subtotal	165.1	53.2	218.3	39.7	12.8	52.5	24	5
2. Protection of Sandomierz and Tarnobrzeg								
Protectionof Sandomierz	228.7	73.8	302.4	55.0	17.7	72.7	24	7
Protection of Tarnobrzeg	78.0	25.2	103.2	18.8	6.1	24.8	24	2
Subtotal	306.7	98.9	405.7	73.7	23.8	97.5	24	9
3. Raba Sub-basin Pasive and Active Protection	100.0	32.3	132.3	24.0	7.8	31.8	24	3
4. San Sub-basin Pasive and Active Protection	63.5	20.5	84.0	15.3	4.9	20.2	24	2
Subtotal	635.3	204.9	840.2	152.7	49.3	202.0	24	19
D. Institutional Strengthening and Enhanced Forecasting								
1. Improvement of the Flood Monitoring and Warning System								
Telemetric Weather Monitoring Stations	155.0	50.0	205.0	37.3	12.0	49.3	24	5
Hydrometeorological Flood Forecasting	11.2	3.6	14.8	2.7	0.9	3.5	24	-
Modernization of POLRAD Network	27.9	9.0	36.9	6.7	2.2	8.9	24	1
Modernization of Hydrology Systems	22.6	7.3	29.9	5.4	1.8	7.2	24	1
Integration of Hydrological and Hydraulic Modelling	28.1	9.1	37.1	6.7	2.2	8.9	24	1
Nowcasting System and Flash Flood Early Warning	27.9	9.0	36.9	6.7	2.2	8.9	24	1
Subtotal	272.6	87.9	360.5	65.5	21.1	86.7	24	8
2. Development of the Operational Centers at RZGWs Wroclaw and Kraków								
Wroclaw Operational Center	72.7	23.5	96.2	17.5	5.6	23.1	24	2
Kraków Operational Center	46.1	14.9	61.0	11.1	3.6	14.7	24	1
Subtotal	118.9	38.3	157.2	28.6	9.2	37.8	24	3
Subtotal	391.5	126.3	517.7	94.1	30.3	124.5	24	11
E. Project Management and Studies	130.4	42.0	172.4	31.3	10.1	41.4	24	4
Institutional Strengthening for Integrated Water Resources Management	98.9	31.9	130.8	23.8	7.7	31.4	24	3
Subtotal	229.3	73.9	303.2	55.1	17.8	72.8	24	7
	3,412.3	1,100.7	4,513.0	820.3	264.6	1,084.9	24	100
Physical Contingencies	170.6	55.0	225.6	41.0	13.2	54.2	24	5
Price Contingencies	138.0	105.7	243.6	33.2	25.4	58.6	43	5
	3,720.8	1,261.4	4,982.3	894.4	303.2	1,197.7	25	110
Front-end fees	-	19.1	19.1	-	4.6	4.6	100	-
	3,720.8	1,280.6	5,001.4	894.4	307.8	1,202.3	26	111

Cost estimates and Financing Plan (incl. contingencies, in € million)

Project Component	Total Cost	Nat. budget	NFEP NFOSiGW	CEB	Borrower EU Coh. Funds	World Bank	WB as %
1. Flood Protection of Lower and Middle Odra River							
1.A Areas in Zachodniopomorskie	35	2	4	5	3	21	61
Province	406	74	19	114	66	134	33
1.B Middle and Lower Odra	54	6	2	19	12	15	27
1.C Słubice City							
Sub-total	495	82	25	139	81	170	34
2. Flood Protection of Nysa Klodzka Valley							
2.A Active protection	117	17	4	37	21	39	33
2.B Passive protection	148	28	5	40	22	53	36
Sub-total	265	45	9	76	43	92	35
3. Flood Protection of Upper Vistula							
3.A Upper Vistula Towns and Kraków	57	11	2	15	8	22	39
3.B Protection of Sandomierz and Tamobrzeg	106	14	4	36	22	30	28
3.C Raba sub-basin	36	6	1	11	7	11	31
3.D San sub-basin	23	6	1	5	3	9	37
Sub-total	221	36	8	67	39	71	32
4. Institutional Strengthening & Enhanced Forecasting							
4.A Enhanced Forecasting	95	10	5	0	21	59	62
4.B Operational Centers	41	9	2	9	9	12	30
Sub-total	129	18	7	7	29	69	53
5. Project Management and Studies	46	3	0	2	0	41	89
Institutional Strengthening	34	8	2	7	8	10	30
Sub-total	87	12	2	11	9	53	61
Front-end Fee	5	0	0	0	0	5	100
TOTAL	1,202	192	50	300	200	460	38

Expenditure Accounts by Financiers (Euro million)

	IBRD		Borrower EU Funds		CEB		NFEP		The Government		Total		For.	Local (Excl.	Duties &
	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Exch.	Taxes)	Taxes
I. Investment Costs															
A. Civil Works	274.2	32.4	150.3	17.8	258.8	30.6	38.4	4.5	123.7	14.6	845.4	70.3	214.5	472.8	158.1
B. Land Acquisition and Resettlement Costs	34.8	52.1	-	-	1.3	2.0	0.1	0.1	30.6	45.8	66.8	5.6	16.8	37.5	12.5
C. Design Costs	11.9	34.5	6.2	18.1	11.0	32.0	1.4	4.2	3.9	11.2	34.4	2.9	8.7	19.3	6.4
D. Supervision of Construction	12.6	36.1	6.0	17.1	10.7	30.5	1.5	4.3	4.2	12.1	35.0	2.9	8.9	19.6	6.5
E. Studies	37.6	57.9	7.5	11.6	8.7	13.4	1.5	2.4	9.6	14.7	65.0	5.4	16.4	36.5	12.2
F. Goods	71.6	52.4	30.0	21.9	8.7	6.4	7.1	5.2	19.3	14.1	136.7	11.4	34.4	76.8	25.6
G. Operating Costs	12.7	89.0	-	-	0.7	5.0	-	-	0.9	6.0	14.3	1.2	3.6	8.0	2.7
Total PROJECT COSTS	455.4	38.0	200.0	16.7	300.0	25.1	50.0	4.2	192.2	16.0	1,197.7	99.6	303.2	670.5	224.0
Front-end fees	4.6	100.0	-	-	-	-	-	-	-	-	4.6	0.4	-	-	-
Total Disbursement	460.0	38.3	200.0	16.6	300.0	25.0	50.0	4.2	192.2	16.0	1,202.3	100.0	303.2	670.5	224.0

Monitoring and Evaluation

26. The PCU will submit quarterly reports in an agreed format to the MoE, the PSC and the Office of Natural Disaster Recovery (ONDR), and the Bank no later than 45 days after the end of each quarter. The quarterly reports would cover, among others, the progress and expected completion date for civil works and goods contracts (both physical and financial progress with photographic evidence), progress and expected completion date for key consultancies, compliance towards environment and social safeguards, including implementation of key features of the environmental management plan (EMP) and resettlement action plans (RAPs), progress on institutional components, progress toward indicators given in the results framework, training and studies, and activities of the PCU consultants. The reports would also cover detailed financial and procurement information, including (i) a comparison of actual physical and financial outputs with forecasts, and updated six-month project forecasts; (ii) project financial statements, including sources and application of funds, expenditures by category statement, and special accounts reconciliation statement; and (iii) a procurement management report, showing status and contract commitments. A midterm review of the project will be undertaken by July 31, 2019. An Implementation Completion Report (ICR) will be submitted to the Bank no later than six months after the closing date.

27. Monitoring and evaluation (M&E) staff will be recruited by the PCU to monitor the success in project implementation in terms of meeting the project's objectives (as defined in the results framework), and to assess its physical, hydrological, environmental, social, and economic impacts. A dedicated survey platform will be developed to allow impact evaluation of floods and flood mitigation efforts, to better analyze the disaggregated impact of the project as well as other investment programs (disaggregation by income, location, social variables, gender, and so on) and enable better targeting of future investments and measures. As was done under the ongoing Odra River Basin Flood Protection Project, the PCU will also prepare civil works monitoring tables to provide a more detailed account of progress under these contracts. These tables would provide basic contractual information, progress indicators (both with respect to interim payment certificates and paid invoices), and color-coded task progress. The M&E activities will provide continuous feedback to the MoE, MAD, ONDR, and the PSC on project performance and its impact on the various components so that corrective actions can be undertaken in a timely manner. The frequency of these monitoring tables will be determined as needed.

ANNEX 4: IMPLEMENTATION SUPPORT PLAN

REPUBLIC OF POLAND: ODRA-VISTULA FLOOD MANAGEMENT PROJECT

Implementation Support Plan

1. The Bank team will hold a project launch workshop shortly after project effectiveness. Later, the Bank will field semiannual supervision missions. A mid-term review mission will be fielded in 2018/19, with the duration depending on the progress in implementation and the possible emergence of structural implementation challenges, the resolution of which would require an in-depth analysis and restructuring.

2. The project supervision missions would occasionally be integrated with missions of the other ongoing Odra River Basin Flood Protection Project under the same Steering Committee. The project procurement, FM, and safeguards missions could be undertaken as part of the periodic fiduciary support done concurrently across operations of all Bank sectors in Poland (the Procurement Specialist and FM specialist are based in the country unit, and the environmental specialist and social safeguards specialist in other offices in Europe). An exception to the latter would be the project launch workshop and the mid-term review and ICR missions, where it is likely that the entire task team will participate. Procurement prior reviews will be ongoing whereas post reviews will be annual.

3. Importantly, the missions will be determined and carried out in close consultation with the other co-financiers, that is, the CEB and EU through the EC's DG Regional Development. The CEB will contribute toward the mobilization of appropriate technical and review expertise for the supervision.

4. ***FM Supervision.*** As part of its project implementation support and supervision missions, the Bank will conduct risk-based FM implementation support and supervisions within a year after the project effectiveness and then at appropriate intervals. During project implementation, the Bank will supervise the project's FM arrangements in the following ways: (a) review the project's quarterly IFRs and annual audited financial statements and the auditor's management letters and remedial actions recommended in those letters and (b) during the Bank's on-site missions, review the following key areas: (i) project accounting and internal control systems; (ii) budgeting and financial planning arrangements; (iii) disbursement arrangements and financial flows, including counterpart funds, as applicable; and (iv) any incidences of corrupt practices involving project resources. As required, a Bank-accredited FM specialist will participate in the implementation support and supervision process.

5. The Bank team will assist the PCU in drafting the terms of reference of the M&E consultant and the specifications for procuring any monitoring equipment. For safeguards, the client will closely follow implementation of the EMFs, EMPs, RPFs, and RAPs through the following:

a. Ensure that the EMPs and RAPs have been prepared on time and disclosed with public consultations for all new locations, in line with the EMF and RPF.
b. All EMPs will be included in the respective bidding documents, both for construction and supervision. Contracts for construction and supervision will include provisions binding the hired party to implement the EMP measures and/or

supervise them, with adequate reporting submitted to the client and therefore to the Bank.

c. The Bank's environmental and social specialists will conduct regular implementation support and supervision of the EMF and RPF implementation, providing comments and inputs directly to the client, including site visits and on-the-spot checks with both the contractor and supervisor during ongoing works.

Table 4.1. Main Focus in Terms of Support to Implementation during Supervision Missions

Time	Focus	Skills Needed	Resource Estimate	Partner Role
First 3 years	• Mobilization of all TAs • Start of implementation of first contracts in Components 1, 2, 3 • Preparation of tender documents for the second set of contracts • Establishment of M&E	• Project management • Operational skills • Hydro-engineering • Hydrology/flood forecasting • Rural development • FM • Procurement (junior and senior staff) • Environmental/social safeguards (large team needed to supervise initial contracts; 2-4 specialists) • M&E	US$117,000	CEB will contribute towards mobilizing technical expertise
Second 3 years	• Continuation and completion of implementation of first set of contracts • Start of implementation of second set of contracts • Focus on quality of works and efficient implementation • Monitoring of relationships amongst employer, engineer, and contractor	• Project management • Operational skills • Hydro-engineering • Hydrology/flood forecasting • FM • Procurement (junior and senior staff) • Environmental/social safeguard (large team needed to supervise initial contracts; 2-4 specialists) • M&E	US$117,000	CEB will contribute towards mobilizing technical expertise
Last 2 years	• Completion of works and moving to defects liability period	• Project management • Operational skills • Hydroengineering skills • FM • Procurement (reduced team)	US$117,000	

		• Environmental/social safeguards (reduced team)		

Table 4.2. Skills Mix Required

Skills Needed	Number of Staff Weeks/Year	Number of Trips	Comments
TTL	10	4	HQ staff
Water resources specialist	10	4	HQ staff
Operational specialist	8	Local trips	Local staff
Procurement specialist	4	Local trips	HQ staff
FM specialist	4	Local trips	Local staff
Environmental specialist	6	4	HQ staff
Social development specialist	6	4	HQ staff

ANNEX 5: ECONOMIC AND FINANCIAL ANALYSIS[27]

REPUBLIC OF POLAND: ODRA-VISTULA FLOOD MANAGEMENT PROJECT

I. Introduction

1. *Most flood protection structures such as dikes and related assets in Poland are in poor shape.* The main Polish rivers, namely the Odra and the Vistula, are among Europe's largest rivers, and their catchment areas together cover well over 80 percent of the Polish territory. Despite various investments in the last century, flood events have persisted and are even worsening in severity. Floods in the upper part of these rivers are typical high-water floods, commonly occurring in spring and early summer driven by the precipitation patterns. The existing flood protection consists of passive dike systems of which the crest height was calculated to withstand high-water waves smaller than the one that was calculated to occur once in 100 years (1% chance of occurrence). While overtopping is the primary cause of flooding, dike bodies can be breached by lower flood waves when poorly designed, built or maintained. Regular rehabilitation and upgrading to preserve their functionality is required which is sometimes not done properly. As the basins have evolved into economic growth the increasing economic damages now warrant the costs of increased protection levels.

2. *Over the last 50 years, average annual flood losses in Poland have increased threefold.* One of the reasons for this rise is the overload of flood-prone areas with settlements, industrial parks, transport corridors, etc. Low temperatures in winter aggravate flood hazards and require control of ice-jams through an effective icebreaking operation to cut op the ice floes affecting the commercial Odra navigation. The Lower Odra is threatened by winter floods caused by ice floes as 8-9 percent of all days the river surface remains frozen. Ice floes damage and weaken dikes and other structures in and alongside the river. Sometimes, they build up into large ice dams that hinder the flow of water and effectively jam the river creating serious hazard. A recent forensic analysis of about 600 flood events in the past 27 years showed that the frequency and severity of flood events are increasing since the 1980s, caused by a combination of land use change and climate change at very local level; and that about 10 percent of the events is caused by ice jams.

3. *The Project would play a primary role in reducing the frequency and severity of flooding in the project area.* The project would provide three distinct areas with flood management infrastructure and related measures: (i) the Lower and Middle Odra; (ii) the Nysa Klodska valley, a large sub-basin of the Upper Odra; and (iii) the Upper Vistula. The population in the proximity of the proposed works and measures is estimated to be about 15.1 million, of which about 5.2 million are directly exposed to flood-related impacts, physically, economically and/or socially. The project would also further strengthen the national flood forecasting and operational capability (for existing and new infrastructure such as locks, weirs, barrages, reservoirs, etc.) of south Poland, through more advanced equipment and enhanced mathematical simulation models that would be able to inform decision-makers faster and more reliably about the need to evacuate and take precautionary measures.

[27] In this annex, EUR1=PLN4.16 is used.

II. Methodology

4. *A fundamental part of the economic appraisal is the estimation of the expected benefits to be attained by the project investments.* The main benefits quantified for this assessment are related to (i) the reduced *material* and *non-material* damages from flood hazards; (ii) induced economic activities including mining of aggregate; (iii) enhanced navigability of the Odra River; (iv) increased tourism due to improved safety conditions in the area; and (v) jobs created during the implementation of investments.

5. The reduced damages from floods were estimated based on the expected value of avoided Annual Average Damages (AAD) determined by the integration of a series of single event damages for a sequence of floods with progressively infrequent return periods. Maps of flooded areas were drawn separately for each flood risk area. The products of a parallel project, i.e. Flood Risk Management Plans, co-funded by the EU under the Operational Program Technical Assistance 2007-2013, were useful in modeling the flooded areas. Flood hazard areas were determined by water table ordinates, resulting from a mathematical hydraulic modeling using GIS, based on a digital terrain model (DTM). Flood hazard areas are presented as surface objects, with an assigned value of the likelihood of flooding. The flood hazard maps defined for this assessment included: (i) areas where the flooding likelihood is low and occurs once in 500 years (0.2 percent likelihood); (ii) areas where the flooding likelihood is medium and occurs once in 100 years (1 percent likelihood); and (iii) areas where the flooding likelihood is high and occurs once in 10 years (10 percent likelihood).

6. With the mentioned three flood scenarios the curves showing average damages under different probability of occurrence as shown in Figure 5-1 were estimated. The area under the flood loss probability curve can be expressed by the integral, which in turn corresponds to density of the standard normal distribution function. Using the principles of standardization, the calculation of the area under the normal curve over any section can be reduced to the calculation of the corresponding values of the cumulative distribution[28]. The total flood protection benefits were estimated by deducting the area under the loss probability curve for the 'with project' scenario (A) from the area under the loss probability curve for the 'without project' scenario (A+B). The assessment was based primarily on materials developed in the ISOK Project (IT System of the Country's Protection against Extreme Hazards)[29], carried out by a consortium of governmental and academic institutions (i.e, the National Water Management Authority (KZGW); the Institute of Meteorology and Water Management - National Research Institute (IMGW-PIB); the Head Office of Land Surveying and Cartography; the National Institute of Telecommunications - National Research Institute; and the Government Center for Security.)

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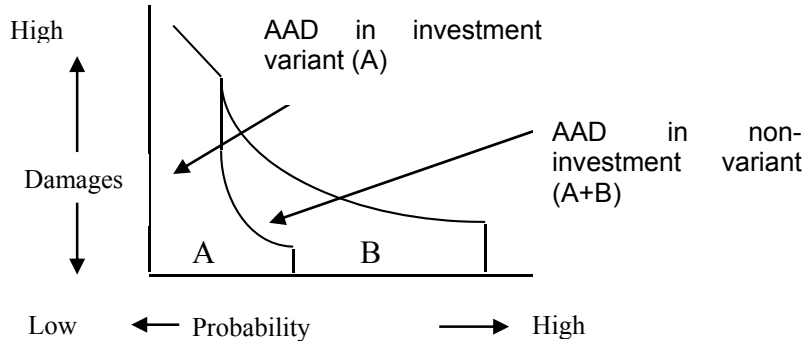
[28] Overview of the process of calculating the area under the curve can be found, among others, in the publication "Statystyka dla studentów kierunków technicznych i przyrodniczych (Statistics for the Students in Engineering and Natural Sciences)", Koronacki J., Mielniczuk J., Wydawnictwo Naukowo-Techniczne, Warsaw 2006.

[29] Based on www.isok.gov.pl; Regulation of the Minister of the Environment, the Ministry of Infrastructure and the Minister of Internal Affairs and Administration on the development of flood hazard maps and flood risk maps from 21st December 2012; Flood risk maps against the Flood Directive, Z. Kuczyński, Warsaw 2012.

Figure 5.1: Calculation of AAD



III. Project Costs

7. The Project cost is estimated at €1.14 billion including construction costs, land acquisition, resettlement costs, administration, supervision, taxes and physical and price contingencies. The estimates are based on the actual cost of construction of similar works of proper quality. In local currency the estimated costs amounts to PLN 4.74 billion, for the activities until project closure by 2023. Incremental investments in the Raba and San basins (subcomponents 3.C and 3.D) are due to be completed in the following five-year period 2023—2027 and would increase the total investments to about PLN 6.18 billion. As it is difficult to separate the economic effects of structures to be completed in the mentioned second period—since they are closely related to the overall flood protection structures—this assessment includes for these sub-components the costs and benefits from funds of both periods[30].

8. The annual O&M costs for the proposed structures were estimated at about €23 million per year for 2023 onwards. These costs are estimated at 0.5 percent of the value of the construction works which is the target value. This exceeds the percentage amounts made available so far from the Polish budget for maintaining the flood management structures. As part of the annual work program planning process, the Borrower will include O&M allocations to ensure these levels. This percentage is on the low side of what is generally considered adequate budget, however, comparison with the other EU member states suggest that this rate is still reasonable[31]. Depending on the asset registration, the annual recurrent budget for O&M is to be secured from the budgets of the RZGWs under the Ministry of Environment, or from the budget of the relevant ZMiUW, under the respective Regional Government (Voivodship). The ZMiUWs, in addition, receive earmarked budget for O&M from the State, i.e., from the Ministry of Agriculture, and from the Disaster Recovery Fund, Ministry of Administration and Digitization. The Implementing Agencies

[30] Under component 3.C and 3.D (passive and active flood protection in Raba and San basins) additional investments in the amount of US$0.28 billion (€0.256 billion) would be continued after 2023 under a different financing source.

[31] The German Ministry of Environment applies a range of 1-2% on asset value, depending on the type of infrastructure, lower for dikes and unmovable assets and higher for assets with electro-mechanical components such as barrages. Given that in Poland investment cost levels are comparable to those in Germany, but operational costs (primarily staffing expenditure) typically only half, a ratio of 0.5% is an acceptable estimate for Poland.

report that typically 1/3 to 2/3 of the technical need for O&M is covered. These budgets are prioritized to those assets that were financed by the Borrower EU funds; World Bank-funded assets would also receive this priority. The Early-warning system is funded partly under the IMGW budget and partly under the budget of the respective RZGWs.

9. Given the increasing frequency of flood hazards, the government, over the years, is also increasing the budget allocations to better operate and maintain the flood protection infrastructure. As the economy is expected to continue its growth, the additional fiscal burden to maintain and operate the new infrastructure from the time of completion of the works around 2020 or thereafter, can be, in principle, well accommodated in the growing budgets of the Implementing Agencies. The current reported levels of recurrent budgets are comparatively modest but not excessively so. However, the government should increase its alertness to the risk that under-investment for several years in a row may pose long-term hazards. The Flood Risk Management Plans would include incentives to induce higher budgets for this purpose.

10. For component 4, the early warning system (EWS), the annual operating cost was assumed at 2 percent of the investment in equipment and construction works. Also, the additional salary costs were included for running the new EWS system, together with charges for up to 20 people to be employed in the service departments and hydrological forecasting bureaus. The service life of buildings and equipment to be implemented under components 1 to 3 would cover a period of 50 years and the equipment to be installed under component 4 would cover a period of 25 years of operation. For the economic analysis, value added tax (VAT) and price contingencies were excluded from the costs, and a standard conversion factor of 0.9 was applied.

IV. Project Benefits

11. *Flood losses* were calculated for each of the estimated areas falling under the flood risk maps. The following land use classes defined in the Polish Regulation[32] were considered: (i) residential areas; (ii) industrial areas; (iii) communications; (iv) forests; (v) recreational areas; and (vi) agricultural land (arable land and grasslands). The actual damages of the 1997, 1998 and 2010 floods, together with affected land use classes were used to derive unit rates of flood damage in values per square meter or per ha of each land use class to establish expected AAD. Hydrodynamic simulation models were developed to provide water levels for floods with their respective return periods. Flood maps were then overlaid on the topography derived from digital terrain models, to estimate inundated areas and damages in simulated scenarios. Return periods were estimated using the "conventional probability method" (based on historic data at given points) and the "regional probability method" (also considering homogeneous parts of the basin, and giving more weight to the extreme flood). For residential and industrial areas loss values were obtained by comparing the value of assets with the degree of loss of assets dependent on the depth of the flood. The value of assets varies depending on the province were the hazard occurs. As the values of assets in the Regulation are presented in 2008 prices, the values were updated based on the corresponding index according to the Central Statistical Office (GUS).

[32] Regulation of the Minister of the Environment, the Ministry of Infrastructure and the Minister of Internal Affairs and Administration on the development of flood hazard maps and flood risk maps. January 22nd 2013.

12. *Damage to public infrastructure and facilities* included losses to municipal infrastructure, public buildings (schools, health facilities, etc.), facilities (roads, etc.) and loss of land. These damages usually make a significant contribution to the AAD. Data from the local public authorities and utilities were the main source for estimating these damages including publicly-owned structures like highways, bridges, irrigation schemes, embankments, infrastructure; and utilities' assets.

13. *Agricultural production losses* were estimated considering the existing cropping pattern of the respective area. The average revenue per crop (in PLN/ha) and the crop area for each province was based on data of the GUS in the period 2011-2014, including average prices of products, crop yields, crop areas, surface of arable land, etc. The weighted average crop values for each area were estimated taking 2014 prices. Assessment of the net financial effect of floods on crop yields and other agricultural activities during flood seasons allowed valuing the flood effects on these activities. Variable crop production expenditures were used in the assessment of losses valued at farm gate and adjusted to world prices to reflect the economic loss due to flooding. Eighty percent of the floods was assumed to occur in July, the rest in March—April.

14. *Non-material benefits of flood protection* include some very profound effects on peoples' lives. It has been found by many studies that increasing stress, fear of further floods, loss of control over the emergency situation, loss of memorabilia and health problems can represent a significant amount of the project's avoidable costs from floods. Czapinski (1997) found that the direct effects of the 1997 flood event included: increase in alcohol consumption, increase in suicide rates up 49 percent within all flooded areas and up to 76 percent in the most affected areas; and an increase in social conflict and aggression among the affected communities. Symptoms of traumatic stress were observed amongst some 15-20 percent of the affected people.

15. Studies indicate large differences in the estimated level of non-material losses in relation to material losses caused by floods. Some researchers believe that non-material losses in some cases are higher than material losses (Green Penning-Rowsell, 1989). Individual floods may, for example, involve minor material losses and cause the death of several people, or result in long-term interruption in industrial or agricultural production activities[33]. Surveys conducted in Britain in 2004 by Defra/EA (RPA /FHRC, 2004) demonstrated that the estimated value of avoiding the effects of floods in the form of health and stress amount to about £200 per household (2004 values). This estimation was taken as the starting point for valuing the non-material damages for this assessment, adjusting the methodology to the Polish settings[34]. Based on the number of persons to be covered by the proposed flood protection the non-material damages were estimated at PLN 40 million which is about 40 percent of the value of material damages as estimated in the area

[33] Such cases are described in the study: HR Wallingford, "Evaluating flood damages: guidance and recommendations on principles and methods", Flood site Guidelines, 6th Framework Programme of the European Community, January 2007, p. 152. The 'loss of life models', which include the characteristics of a given flood and the population at the risk of flooding, are also being worked out (Jonkman, 2002).

[34] Estimates developed for the Feasibility Study for the Modernization of the Wroclaw Floodway System in 2012 were followed. Willingness of the British to bear costs of avoiding flood effects was corrected by using the GDP per capita in Great Britain and Poland. The estimated Polish value for avoiding the effects of flooding (amounted to about PLN 388 per household in 2004 values) and was adjusted for inflation.

analyzed in the Study for the Wroclaw Floodway System. It can be assumed that 5 percent is the cost of stress, 15 percent is the cost of rescue operations, and 20 percent corresponds to other losses (interference in communication, interruption of business, etc.). It is a conservative estimate as it is not considering other potential non-material losses such as deaths or injuries of flood victims, and the rising cost of living in the areas affected by the floods.

16. *Induced economic benefits.* Other quantified benefits from the proposed project are those related with the Keynesian multiplier effect. The theory states that any government spending triggers other cycles of spending that increase employment and prosperity regardless of its form. This assessment assumed the multiplier at 2.5 as recommended for developed economies by the American National Bureau of Economic Research after analyzing the effects of governmental investments in 44 countries (20 developed and 24 developing economies) in the years 1960-2007[35]. The induced benefits were estimated using this multiplier and the average net profit for the Polish business investments which was estimated at 4.6 percent in the period from January to June 2014[36]. This approach for calculating induced economic benefits was used, among others, for the preparation of the Feasibility Study for the Project Modernization of the Wrocław Floodway System (2004). The methodology has been endorsed by the EC's Jaspers Office, which was confirmed in an Action Completion Note in November 2012 for the project.

17. *Benefits from tourism.* The proposed investment will also have an enabling environment for increasing the tourism income flowing into some of the proposed protected areas, as the risk of floods is reduced and the safety for tourists is increased. It was assumed that an additional 25 percent (10 percent for component 3.A) of the current number of tourists would be willing to visit the project areas. These benefits were quantified taking into account the current number of tourists per area and the cost of stay per day for the average traveler (approximately PLN 98)[37].

18. *Transport Benefits.* The proposed repair and improvement of river training structures on the border section of the Odra downstream to the estuary will enhance navigation conditions by making more uniform the water flow and transport conditions, as a consequence of measures to reduce the ice-jamming. The restoration of river training structures and raising of five bridges will enhance navigation conditions, increasing its safety and competitiveness. The Odra has a direct connection with the waterway system in the EU which could be conductive to reducing transport costs in trade exchange between Poland and EU countries. Costs in rail transport are on average 3 times higher than in inland water transport. For quantifying this benefit it was assumed that cargo transported on the Odra River (containers, construction materials, grains, etc.) will be increased by 50 percent. Benefits of PLN 32.17 million per year were estimated by multiplying the expected increase of transported cargo by the reduction in transport costs per ton/km through the river[38].

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[35] "How big (small?) are fiscal multipliers?", NBER Working Paper No. 16479, October 2010.
[36] "Financial results of companies not financed in the period of I - VI 2014", GUS, 22nd August 2014.
[37] Institute of Tourism, Domestic and Foreign Travels of Poles: http://www.intur.com.pl/polacy.php?o=5&t1=14
[38] The amount of cargo transported via Polish waterways in 2013 was 768,000 thousand ton-km (Transport of goods and passengers in 2013). It was assumed that the cargo transported on the Odra River is 80% of the total. The average cost of road transport was estimated at an average of PLN 128.75 per ton-km, while the waterway transport cost is on average PLN 22.26.

19. *Exploitation of aggregate mining*. The Project is expected to generate also benefits from the exploitation of gravel and other materials for construction in the proposed reservoir areas. It is estimated that around 4 Mm3 of gravel would be potentially available annually for extraction from the reservoirs valued at about PLN 100 million of gravel extraction (in period 2016-2027). Any potential negative impacts to the environment from this will be guided by the ESMF and respective EMPs.

20. *Early Warning System (EWS)*. The primary objective of EWS is to induce people in the face of an approaching catastrophe to take proper action to reduce the risk to life and property damage. For this to be possible, the time needed for an effective response is a highly critical element. Thanks to effective EWS, communities gain time to react moving to higher ground, out of the floodplain; elevating valuables to a higher floor or moving property such as cars outside of the floodplain; and/or building temporary walls with sandbags to keep water out of a structure or a property. As the warning time is increased, more items can be removed from or elevated in the structure. Hence, benefits of EWS are reduced material and non-material losses and induced economic benefits. Day's methodology was used in estimating these benefits[39]. Considering the expected outputs from component 4/ EWS[40], and especially the nature of the hazard and the size of damages caused by the flash flood events, a very precautionary approach was adopted for the purpose of this economic analysis and—as an effect of implementing the investment tasks—it was assumed that the warning time will be from 3h to 6h, on average, which corresponds with reduction of flood losses on an average level of about 10.5 percent (in accordance with Day's curve).

[39] The method proposed that the tangible benefit of a warning system could be estimated as a function of warning time due to the system. This predicts damage reduction in terms of percentage of maximum potential inundation damage as a function of the mitigation time. If the warning time is 0 h, the curve predicts that the flood warning system will provide no tangible benefit. If the warning time is 12 h, the Day curve predicts that the damage will decrease by 23%. The Day curve also suggests that no matter how great the warning time, the maximum possible reduction is about 35% of the total damage due to the flood. This is logical, as some property, including most structures, simply cannot be moved.

[40] Component 4 is expected to obtain the following effects: (i) forecasts prior to the occurrence of floods for mountainous and upland catchments (area of southern Poland, i.e. catchments of Upper Vistula and of Upper and Middle Odra) will be available about 12—24 hours before the event (the forecasts are currently not being provided; there only is access to approximate data in a form of a warning on the possibility of torrential rainfall); (ii) forecasts prior to the occurrence of floods for remaining areas of Poland will be available about 24—48 hours before the event (in this case the accuracy of these forecasts would be mainly improved); and, (iii) in case of "flash flood" events, a warning would be available 3—6 hours before the event (such forecasts are not available at the moment).

V. Economic Analysis

21. The economic analysis aims to establish whether the proposed project's contribution to future improvement in social and economic welfare of the communities in the area to be protected from flooding and to the national economy, would justify the significant costs proposed to be incurred. The assessment was carried out by comparing the incremental capital and operating costs required, with the expected incremental benefits expected to result from the implementation of the project. The evaluation considered a 50-year period and two different alternatives for the estimation of the results: using a discount rate of (i) 5 percent (following the Guide to Cost-Benefit Analysis of Investment Project, European Commission, 2008, as well as OECD guidance); and (ii) 10 percent (as the minimum usually applied by the World Bank for this type of analysis). A standard conversion factor of 90 percent was used for conversion from financial to economic values.

22. The economic feasibility of the project and of each of its main components was measured through estimation of the economic rate of return (ERR) and net present values (NPVs) based on the above described assumptions. As can be seen in Table 5.1, the estimated overall project ERR is 13.5 percent, which is well in excess of the long term opportunity cost of capital (OCC). The analysis also showed that all investments proposed for the project areas would have an impact that justifies the costs involved in the proposed studies. The experience with the ongoing Odra River Basin Flood Protection Project has shown that the government is committed to provide the budgets for investment as well as for proper O&M. The field inspections in the territories of the prospective PIUs of the project demonstrate that, in general, modest but reasonable resources are provided for the maintenance and functioning of the infrastructure, recognizing that current O&M budget levels cannot compensate for the funding shortages in the second half of the 20th century. However, with the expansion of the infrastructure, the need to increase the O&M budget is growing apace. Thus, the project is very likely to remain financially sustainable.

Table 5.1: Estimated Economic Indicators: ERR and Present Values (in PLN million)

	Present Value (5% discount rate)			NPV (10% discount rate)	ERR (%)
	Costs	Benefits	Net		
Component 1	1,046	2,423	1,376	270	13.5
1.1 - Flood protection - areas in Zachodniopomorskie Province	85	462	377	132	24.6
1.2 – Flood Protection - Middle and Lower Odra River	805	1,691	886	141	12.5
1.3 - Flood protection – Słubice city	144	270	126	8	10.7
Component 2 Flood protection - Nysa Kłodzka Valley	641	1,843	1,202	266	14.4
Component 3	1,148	3,114	1,966	446	15.5
3.1 Flood protection - Upper Vistula (incl. Kraków)	150	346	196	39	13.3
3.2 Flood Protection - Sandomierz - Tarnobrzeg	284	1,109	825	263	19.1
3.3. Flood Protection - Raba sub-basin	191	444	253	42	13.5
3.4. Flood Protection - San sub-basin	522	1,215	693	102	13.2
Component 4[41] Institutional strengthening and Enhanced Forecasting	560	935	375	33	11.1
Component 5	105		-105	-89	

[41] For the purpose of the economic analysis, the institutional strengthening activities were included under component 4.

Project Management and Studies					
Overall Project	3,499	8,314	4,815	926	13.5

VI. Sensitivity Analysis

23. A sensitivity analysis was carried out for the entire project for checking the strength of the economic performance indicators to changes in critical assumptions of the analysis. Variables were defined and tested for their impact on the performance indicators selecting variables which could affect with greatest deviations in the estimated impact indicator. The following assumptions were selected for testing variations and the sensitivity of the expected results: (i) investment costs; (ii) O&M costs; (iii) benefits from material and non-material avoided-flood damages; and (iv) the induced economic benefits. The Figure 5.2 presents the influence of changes (in percent) on the selected sensible variables over the project's ERR. The analysis shows that the estimated ERR is robust and not very sensitive to changes in costs and/or benefits: even a 30 percent increase in investment costs, or up to 40 percent reduction of expected benefits from avoided material flood damage would maintain the ERR above 10 percent.

VII. Project Fiscal Impact

24. Fiscal budgets for operation and maintenance (O&M) of flood protection structures are in Poland usually adequate but on the lower side of the common ranges. Table 5.2 below shows, by Implementing Agency, the ratio of confirmed available budgets for O&M in calendar year 2015 to the respective value of assets. On average this ratio is below 0.57 percent of the assets value.

25. However, taken over the long run, the recurrent budgets for the routine and regular O&M of flood protection facilities (thus, excluding major repairs and rehabilitation tasks) have been in general sufficient to ensure the sustainability of protection structures with a level of about 0.5 – 1 percent of the value of assets. Hence, taking into consideration the current practice concerning public funds allocations for this purpose in Poland, for the economic and financial analysis it has been assumed that the budgets for O&M would be about 0.5 percent of the value of assets.

26. The allocation of the public funds for O&M of flood protection structures depends on the policy guidance and levels proposed at the national level, which is subject to parliamentary analysis and negotiations every year. Several policy review documents and technical papers including economic analysis of sector projects co-funded by the International Financial Institutions recommend an increase of the current levels of funds available for O&M of the flood protection structures. The issue is attracting growing interest of national policy makers as well as awareness about the need for higher O&M allocations for existing and new facilities given the increased frequency and intensity of flood events.

27. The assumed 0.5 percent annual maintenance cost for the structures to be constructed under the proposed project amounts to only 0.007 percent of the total State Budget expenditure. Compared with the benefits expected to be generated by the protection investments in terms of avoided damages and other benefits, its incidence is very low being equivalent to about 4.7 percent of the benefits. It is expected that O&M allocations are due to slowly increase to further mitigate against risks from unexpected events. The fiscal impact of the investment and its recurrent costs is low.

Figure 5.2: Sensitivity of the project ERR to changes in major risk factors

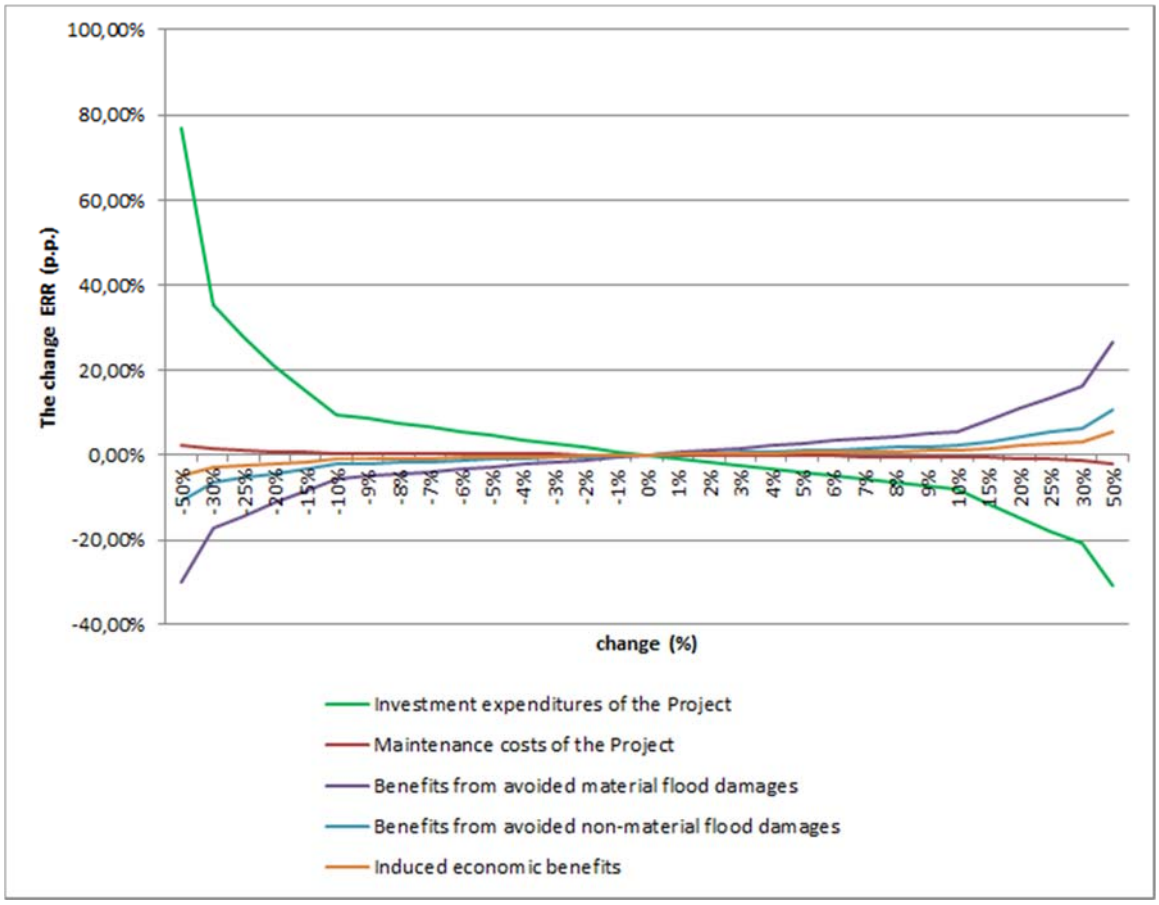
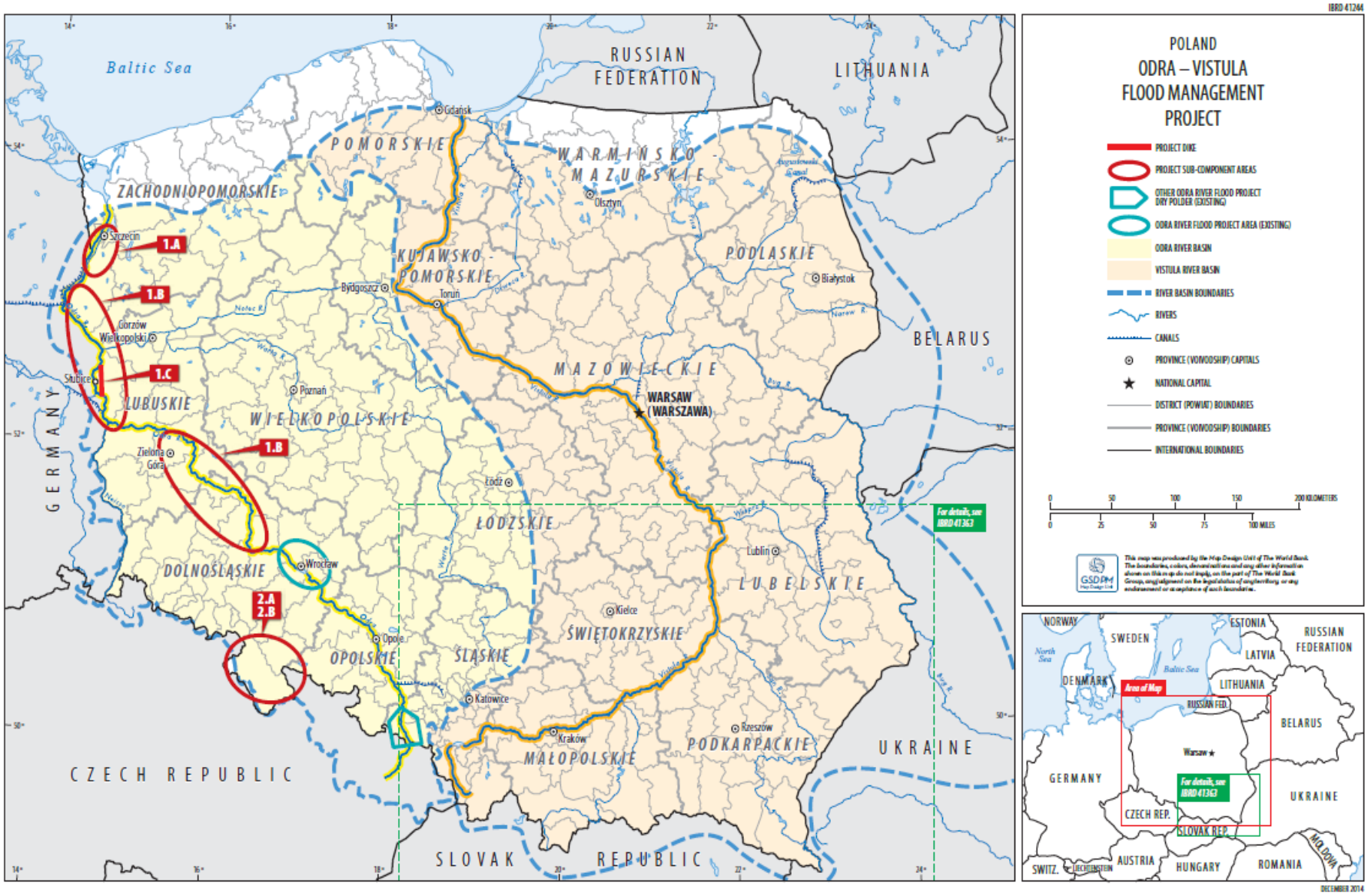


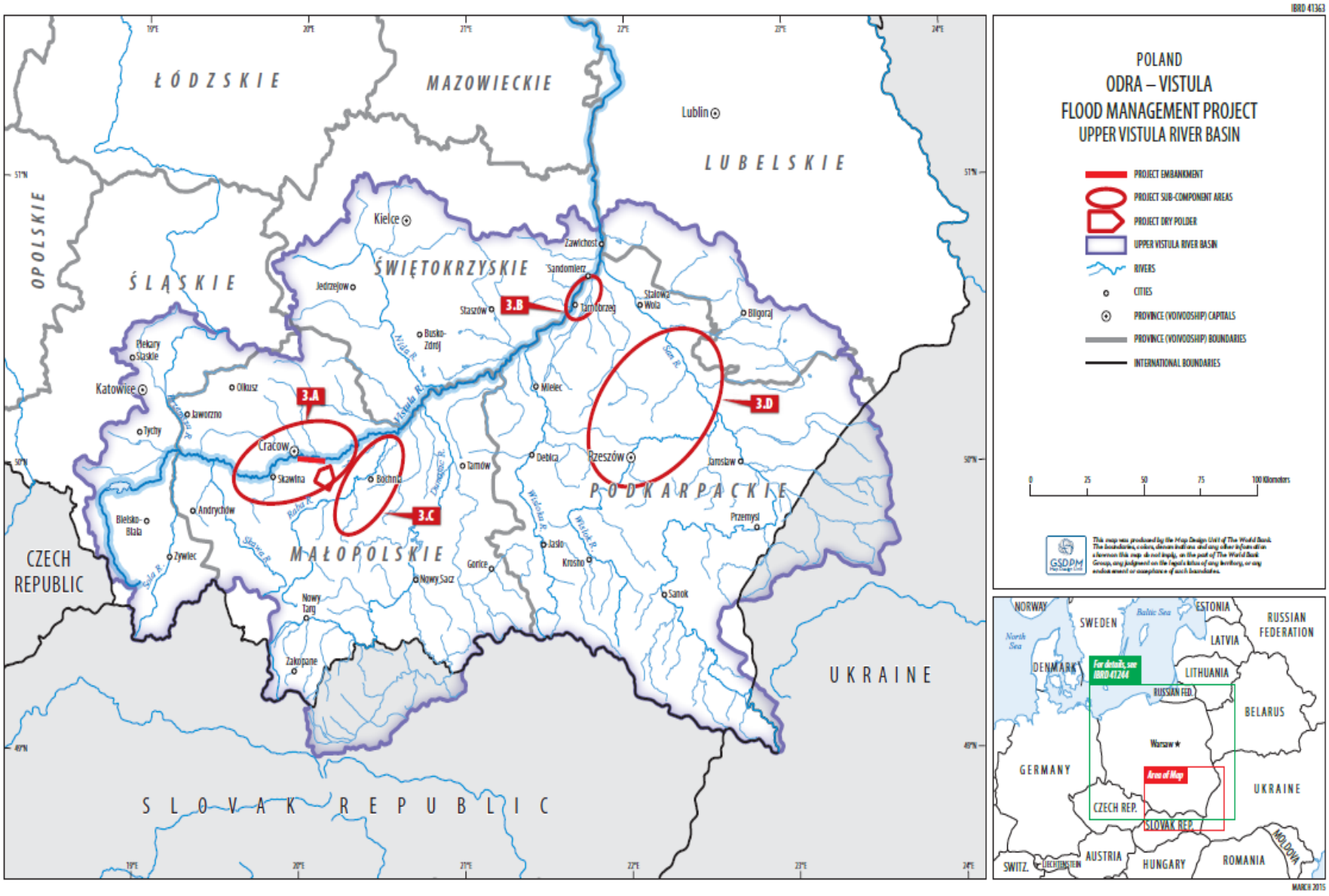
Table 5.2: Budget Allocations (2015) for O&M of Flood Protection Structures (PLN '000)

PIU	Asset value	Budget O&M	Budget O&M / Assets (%)
RZGW Wrocław	7 041 214	16 000	0.23
RZGW Kraków	6 269 411	3 460	0.06
RZGW Szczecin	841 210	165	0.02
Świentokrzyskie ŚZMiUW Kielce	267 573	4 104	1.53
Zachodniopomorskie ZZMiUW Szczecin	649 000	12 280*/32 000**	1.89*/4.93**
Lubuskie LZMiUW Zielona Góra	779 442	7 930	1.02
Dolnosłąskie DZMiUW Wrocław	900 118	10 156	1.13
Małopolskie MZMiUW Kraków	609 344	5 551	0.91
Podkarpackie PZMiUW Rzeszów	656 409	5 100*/23 000**	0.78*/3.55**
Total	**18 013 721**	**64 746**	**0.36*/0.57****

* current allocation
** planned allocation

ANNEX 6: MAPS
REPUBLIC OF POLAND: ODRA-VISTULA FLOOD MANAGEMENT PROJECT




IBRD 41363
POLAND
ODRA – VISTULA
FLOOD MANAGEMENT PROJECT
UPPER VISTULA RIVER BASIN
PROJECT EMBANKMENT
PROJECT SUB-COMPONENT AREAS
PROJECT DRY POLDER
UPPER VISTULA RIVER BASIN
RIVERS
CITIES
PROVINCE (VOIVODSHIP) CAPITALS
PROVINCE (VOIVODSHIP) BOUNDARIES
INTERNATIONAL BOUNDARIES
0 25 50 75 100 Kilometers
ŁÓDZSKIE
MAZOWIECKIE
LUBELSKIE
OPOLSKIE
ŚLĄSKIE
ŚWIĘTOKRZYSKIE
PODKARPACKIE
MAŁOPOLSKIE
CZECH REPUBLIC
SLOVAK REPUBLIC
UKRAINE
Lublin
Kielce
Sandomierz
Tarnobrzeg
Stalowa Wola
Biłgoraj
Jedrzejow
Staszów
Busko-Zdrój
Mielec
Tarnów
Dębica
Rzeszów
Jarosław
Przemyśl
Jasło
Krosno
Sanok
Gorlice
Nowy Sącz
Nowy Targ
Zakopane
Katowice
Olkusz
Jaworzno
Tychy
Cracow
Skawina
Bochnia
Andrychów
Bielsko-Biała
Żywiec
Piekary Śląskie
3.A
3.B
3.C
3.D
Vistula R.
San R.
Wisłoka R.
Wisłok R.
Dunajec R.
Raba R.
Skawa R.
Soła R.
Nida R.
Biała R.
NORWAY
SWEDEN
ESTONIA
LATVIA
LITHUANIA
RUSSIAN FEDERATION
BELARUS
DENMARK
GERMANY
POLAND
CZECH REP.
SLOVAK REP.
AUSTRIA
HUNGARY
ROMANIA
MOLDOVA
SWITZ.
LIECHTENSTEIN
UKRAINE
Warsaw
Area of Map
For details, see IBRD 41244
North Sea
Baltic Sea
MARCH 2015