

Chapter 8

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Delineation of Shoreline on the Basis of the Widawa and Dobra Rivers in Wrocław

1. Introduction

Internal seawater and inland surface water are the property of the State Treasury. Units of local government may own only public lentic water. Provisions of the Act dated 18.07.2001 (i.e. Journal of Laws of 2005, No. 239, item 2019, as amended) Water Law regulate the competence of state and local government administrative agencies in the field of shoreline delineation by way of a decision. The authority delineating the shoreline for border water and inland waterways is currently (since 1.01.2008) the Marshal of the Province, and for other water such as natural watercourses, lakes and other natural water reservoirs – the Starost or, in specific cases, the Mayor. The Marshal of the Province is obliged to keep, among others, the Water Register, whereas the President of the National Water Management Authority is in charge of keeping the Water Cadastre for the area of the state, taking into consideration the division into river basin areas, and the duty to keep such a cadastre for a water region is entrusted to the Director of the District Water Management Authority. The source of data for the Water Cadastre in the field of real property is the Register of Land and Buildings. Taking the foregoing into account, the Register of Land and Buildings should include descriptive and cartographic data of land covered by water. It is in the interests of public administration authorities to delineate the boundaries of real properties which constitute land covered by water owned by the State Treasury and units of local government. It seems necessary to regulate the issues of delineation of shorelines in the procedure to demarcate underwater land from other land, in accordance with the Water Law Act.

Hydrological Watershed Model have been used for decades in the hydrological science. The are at least three main classification schemes: 1. lumped vs. semi-

distributed and full-distributed models, 2. black-box vs. conceptual and physically-based models, and 3. deterministic vs. stochastic models (Beven 2001).

A description of the most widely used watershed models can be found in Singh (Singh 2006). Recent developments are in the direction of integrated models, which combine the classical rainfall – runoff models with channel flow for groundwater components.

Some hydrological models have already a groundwater component – the watershed model WaSim-ETH (Schulla, 1997, Jasper, Schulla), which includes a one-dimensional kinematic wave approach for the channel flow and a two-dimensional groundwater component. MIKE-SHE (Abbot *et al.* 1989, Graham *et al.* 2002) is a physically-based hydrological model accounting for all relevant hydrological processes in the catchment integrated with groundwater flow. The watershed model ArcEGMO has been coupled with the groundwater model MODFLOW (Sommer *et al.* 2002). The quasi-distributed watershed model SWAT (Arnold *et al.* 1993) based on the concepts of hydrological response units was coupled with MODFLOW.

This paper is aimed at presenting legal and technical problems related to the procedure to demarcate land occupied by lotic water from adjacent land. The above problems were addressed on the basis of demarcation of the area of the Widawa and Dobra Rivers in Wrocław. In order to achieve the objective of the study, field investigations were conducted. They consisted in assessing the method of shoreline delineation and in performing geodetic measurements of the area of lotic water of the above-mentioned rivers together with their demarcation from adjacent land of the inter-embankment zone. To ensure detailed delineation of the boundary, the measurements were performed on the basis of points of control. The measurements were carried out with the use of a GPS system receiver with the ASG-VRS type R8 measurement module. Calculations were made with a computer, according to the c-geo program. The performed measurements were an element of the procedure to demarcate land occupied by lotic water from adjacent land.

2. Delineation of shoreline

The shoreline provides information about the natural environment, which has a significant legal effect as regards, for example, real property management, and which has a spatial character, i.e. it refers to a specific location. The explicitness of location of information in space guarantees its association with a uniform spatial reference system, which within the boundaries of the country is the National Geodetic *Coordinates System* (Kucharzak, Kowalski 2009).

The essence of administrative settlements in the procedure to demarcate underwater land from other land is that the delineated shorelines are borderlines between real properties covered by such water and adjoining land properties. Land covered by inland surface water shall be understood as land which forms the bottom and shores of natural watercourses, lakes and other natural water reservoirs, within the boundaries of the shoreline, as well as land which belongs to

artificial water reservoirs, stages of fall and dammed-up lakes, which constitute land covered by surface water before creating dam facilities (Article 9 Section 1.4 of the Water Law Act).

The procedure to delineate the shoreline and the final administrative decisions of competent authorities are a special kind of real property demarcation with the participation of all interested parties (Wolny 2008). A legally valid decision is the basis for introducing changes in descriptive and cartographic data in the Register of Land and Buildings, which must meet the requirements of the provisions of the Geodetic and Cartographic Law.

The project to demarcate land covered by water from adjacent land shall be submitted to the authority approving the shoreline project by the applicant. The applicant shall be understood as every entity with a legal or factual interest, including owners of adjoining land properties, as well as competent authorities, including, for example: the President of the National Water Management Authority and the Director of the District Water Management Authority – in case of water significant for the shaping of water resources and flood protection, the Marshal of the Province and the Director of the Authority for Land Improvement and Water Facilities – in case of water significant for the regulation of hydrographic conditions for the needs of agriculture and in other cases not provided for in Points 1-3 Section 1 Article 11 of the Water Law.

The decision defining the shoreline should take into consideration the entire shore covered by the regulation project or its individual sections, and if the decision defines the shoreline of rivers, mountain streams and other watercourses, it should provide for both shores of a given watercourse section. If the procedure to delineate the shoreline is initiated by the owner of adjoining land property, then, in specific cases, the authority conducting the procedure may determine that it is sufficient to delineate the shoreline along the section which constitutes

the boundary with the said land property. In the water and legal procedure concerning formal delineation of physically existing shorelines it is usually not necessary to conduct hydrological examinations (hydrographic conditions) in areas adjoining the projected shoreline.

3. Principles of determining the course of shoreline

Pursuant to Article 15. 1., the shoreline for natural watercourses, lakes and other natural water reservoirs is the edge of the shore or the line of permanent grass growth, or the line determined according to average water level over at least the last 10 years.

The basis for delineating the shoreline is the project to demarcate land covered by water from adjacent land provided by the applicant, which usually includes:

- 1) description with the name of the applicant, their seat and address, the adopted method of delineating the projected shoreline, the legal status of the real properties covered by the project with the names of the owners,

their seat and address, and the hydrographic conditions in the areas adjoining the projected shoreline,

- 2) map of post-completion survey of regulation structures or updated copy of planimetric map at a scale of the inland water regulation project or at a scale of 1:5000 or 1:2000, including the following information:
 - a) fixed points of horizontal control related to the national network,
 - b) boundary of permanent grass growth,
 - c) edges of shores, alluviums, avulsions and islands,
 - d) suggested shoreline.

In accordance with the law, the following four principles of shoreline delineation can be distinguished:

1. If the edge of the shore is clearly defined – the shoreline shall run along this edge.
2. If the edge of the shore is not clearly defined – the shoreline shall run along the boundary of permanent grass growth; and if the boundary of permanent grass growth is located above the water level referred to in Section 1 – along the line of intersection of water surface at this level with adjacent land.
3. If water shores are regulated – the shoreline shall run along the line joining the outer edges of regulation structures; and in case of wicker plantations on land formed as a result of regulation – along the plantation boundary from the side of the land.
4. If the shoreline is not clearly defined and if there is no permanent grass growth – the shoreline shall be delineated according to average water level over at least the last 10 years.

If delineation of the shoreline is necessary for the creation of water facilities or the development of new beds for natural watercourses, the procedure to delineate the shoreline shall be conducted together with the procedure to issue a water permit.

If the shoreline is delineated in connection with natural permanent occupation by lotic water or seawater of land which does not belong to the water owner, the costs of the project shall be incurred by the water owner.

Land which was covered by water before creating the water facility shall be demarcated from other land, at the request of the water owner or the adjacent land owner, by virtue of a decision of the competent Starost performing a task in the field of government administration. In case of modernisation of the Register of Land and Buildings, such decisions shall be issued *ex officio*.

The above considerations reveal that shoreline delineation is a process combining elements of hydrology, geodesy and administration. At every stage of the procedure, one should pay attention to unique circumstances resulting from diversified character (Kucharzak, Kowalski 2009).

4. Demarcation of the area of the Widawa and Dobra Rivers from adjacent land

In the post-war period, virtually no geodetic measurements aimed at regulation of river beds were performed in Wrocław, except for the attempt to regulate the Odra River at the turn of the 20th and 21st centuries. In the period 2008-2009, land covered by water was demarcated from adjacent land for several rivers within the administrative boundaries of the city of Wrocław, including the Widawa and Dobra Rivers.

The name of the Widawa River derives from the proto-Slavic name 'vid' – to spin, to meander. The river has its source in the Twardogóra Hills and flows into the Odra River to the south of Wrocław. Along a specific section, it constitutes the administrative border of the city of Wrocław. The river, meandering along the Oleśnica Plain, has a bed which is almost entirely straightened and embanked within the boundaries of Wrocław. One of the tributaries of the Widawa River is the Dobra River, which flows into the Widawa River on the boundary of the districts of Psie Pole and Kłokoczyce in Wrocław.

The cadastral plots listed below have been marked off as a result of the legal procedure to demarcate land occupied by lotic water from adjacent land. The demarcation concerned real properties owned by the State Treasury, administered by the Lower Silesia Authority for Land Improvement and Water Facilities in Wrocław. The land owned by natural persons was not occupied by lotic water along the analysed river sections.

The procedure to demarcate the area of the Widawa River from the adjacent land was based on the edge of the bank, which was quite clearly defined along a considerable section of the river. According to the binding legal regulations, which were applied in this case, if the edge of the bank is clearly defined, the shoreline shall run along this edge. Table 1 presents cadastral plots which have been marked off as a result of the demarcation procedure.

The above data shows that the surface area of lotic water within some of the cadastral plots marked off from the inter-embankment zone is considerable. The demarcation procedure resulted in standardisation of entries in the Register of Land and Buildings due to the fact that the sites have been marked off in accordance with the factual circumstances, which formed the basis for handing them over to appropriate authorities. In consequence, the Lower Silesia Authority for Land Improvement and Water Facilities in Wrocław took over the area of surface water (Wp), and the remaining areas (Tr, Ł, Ps, Lz, Ls) are still administered by the Marshal of the Lower Silesia Province. The work contributed to the regulation of tax issues.

The cadastral maps and the specification of land-use changes (Fig. 1, 2) present one of the cases of geodetic separation which constitute the subject matter of the research conducted for the Dobra River in the cadastral district of Kłokoczyce within the framework of demarcation (Phot. 1, 2).

Table 1

List of cadastral plots which have been marked off as a result of demarcation of land occupied by water from adjacent land for the Widawa and Dobra Rivers in Wrocław

No.	Cadastral district	Map sheet	Cadastral number - Ws area	River name	Surface area of water – Ws	Surface area of other inter-embankment areas – Tr, Ps, Ł, Lz, Ls	Comments
1.	Kłokoczyce	1	29/2	Widawa River	0.1737 ha	0.1279 ha	Area marked off: area of the river and site Ps
2.	Polanowice	7	1/1	Widawa River	0.5583 ha	1.6523 ha	Area marked off: area of the river and sites Ł, Lz, Tr and N
3.	Polanowice	6	1/1	Widawa River	0.7478 ha	1.5890 ha	Area marked off: area of the river and sites Ł and Tr
4.	Sołtysovice	12	3/2	Widawa River	2.0397 ha	3.5043 ha	Area marked off: area of the river and sites Ps and Tr
5.	Sołtysovice	4	14/2	Widawa River	1.5196 ha	0.7710 ha	Area marked off: area of the river and sites Tr and W
6.	Świniary	2	8/3	Widawa River	0.6847 ha	0.1341 ha	Area marked off: area of the river and sites Tr and Ls
7.	Świniary	7	2/5	Widawa River	5.9304 ha	4.8265 ha	Area marked off: area of the river
8.	Kłokoczyce	6	35/2	Dobra River	0.0601 ha	0.4731 ha	Area marked off: area of the river and sites Tr and Ps
9.	In total:				11.7143 ha	13.0782 ha	

Source: own study

Abbreviations:

Ws – land under surface and lentic water

Tr – different grounds

Ps – permanent pastures

Ł – permanent meadows

Lz – tree-covered and shrubbed areas

Ls – woodland

N – wasteland

W – ditches



Phot. 1. View of the Dobra River in the demarcation area (photo by M. Heldak)



Phot. 2. View of the Dobra River in the demarcation area (photo by M. Heldak)

województwo **dolnośląskie**
 powiat **Miasto Wrocław**
 miejscowość **Wrocław**
 jednostka ewidencyjna **026401_1, M.Wrocław**
 obręb **0052, Kłokoczycze**

PROJEKT ROZGRANICZENIA GRUNTÓW POKRYTYCH WODAMI OD GRUNTÓW PRZYLEGLYCH

właściciel: SKARB PAŃSTWA Udział: 1/1
 władający: DOLNOŚLĄSKI ZARZĄD MELIORACJI I URZĄDZEŃ WODNYCH WE WROCŁAWIU
 WROCŁAW, ALEJA MATEJKI 5 Udział: 1/1

WYKAZ ZMIAN GRUNTOWYCH

Stan stary						Stan nowy						
Numer						Numer						
KW	Rejestr gruntów	AM	Działki	Rodzaj użytku	Powierzchnia	Bliższe określenie położenia	KW	Rejestr gruntów	AM	Działki	Rodzaj użytku	Powierzchnia
				PsIV	0,4336						PsIV	0,3111
				Wp	0,0597						Tr	0,0203
				Tr	0,0360	ul. Kłokoczycza	-	G.54	6	35/1	Razem:	0,3314
-	G.54	6	35	Razem:	0,5293							
											Wp	0,0597
						rzeka Dobra	-	G.54	6	35/2	Razem:	0,0597
											PsIV	0,1225
											Tr	0,0157
						ul. Kłokoczycza	-	G.54	6	35/3	Razem:	0,1382
OGÓŁEM					0,5293	OGÓŁEM					0,5293	

DZ 14173/08
 KERK 940/08-52

MAPA Z PROJEKTEM ROZGRANICZENIA GRUNTÓW POKRYTYCH WODAMI OD GRUNTÓW PRZYLEGLYCH
 skala 1:500

UWAGA:
 Granice działek powstałych w wyniku rozgraniczenia gruntów pokrytych wodami od gruntów przyległych oznaczono kolorem czerwonym
 Mapa zgodna z terenem w zakresie opracowania na dzień 30.09.2008

Wykonano w ... egzemplarzach
 Sporządził : Olgierd Kempa

Wrocław dn. 30.09.2008

Fig. 2. Sample specification of land-use changes within the framework of demarcation of land covered by water from adjacent land – the Dobra River in Wrocław

5. Conclusions

The regulation of the issues of shoreline delineation in the procedure to demarcate underwater land from other land is a very important problem. The procedure to delineate the river bank is subject to the provisions of the Water Law and it must meet the requirements of the provisions of the Geodetic and Cartographic Law, and, in addition, the general terms and conditions of the Code of Administrative Procedure and the Civil Code. Geodetic identification

of the shoreline based also on the provisions of the Water Law allows for its interaction with the cadastral data of land and buildings. It increases the importance and emphasises the legal features of the shoreline with all consequences thereof (entry in the Register of Land and Buildings, entry in the Land and Mortgage Registers). Not all legally accepted principles of shoreline delineation can be easily applied. If the edge of the shore is not clearly defined or if water shores are not regulated, and the shoreline is not distinct and there is no permanent grass growth, the shoreline is delineated according to average water level over at least the last 10 years. In practice, however, this principle is often difficult to apply due to lack of data on the average ten-year water.

The procedure to demarcate the Widawa and Dobra Rivers was aimed at separation of their current from the inter-embankment plots. The demarcation procedure resulted in standardisation of entries in the Register of Land and Buildings by assigning appropriate sites (Wp and Tr) to appropriate authorities. In consequence, the Lower Silesia Authority for Land Improvement and Water Facilities in Wrocław took over the area of surface water (Wp), and the remaining areas (Tr, Ł, Ps, Lz, Ls) are still administered by the Marshal of the Lower Silesia Province. The work contributed to the regulation of tax issues.

No significant technical difficulties have occurred in the course of field work.

Surface water- groundwater interaction is of great importance in many fields of ecohydrological science, water quantity and quality management problems as well as for ecologically oriented protection, mitigation and restoration projects. It is the link between river and groundwater system. Ecohydrological research is importance, but is so far mostly restricted to field observations or to modelling at the reach scale (Ruf 2007).

References

- Abbot M., Bathurst J.C., Cunge J.A., O'Connell P.E., Rasmussen J., 1989. An introduction to the European Hydrological System – Systeme Hydrologique Europeen, SHE, 1: History and philosophy of a physically based distributed modelling system, *Journal of Hydrology*, 87 (1-2).
- Abbot M., Bathurst J.C., Cunge J.A., O'Connell P.E., Rasmussen J., 1989. An introduction to the European Hydrological System – Systeme Hydrologique Europeen, SHE, 2: Structure of a physically-based, distributed modelling system, *Journal of Hydrology*, 87 (1-2).
- Act dated 17.05.1989 Geodetic and Cartographic Law (i.e. *Journal of Laws of 2005*, No. 240, item 2027, as amended).
- Arnold J.G.P., Allen M., Berndhardt G., 1993. A comprehensive surface groundwater flow model. *Journal of Hydrology* 142, 47-69.
- Beven K.J., 2001. *Rainfall-runoff modelling: the primer*. John Wiley, New York. 365.
- Graham D., Larsen O., Mike-She., 2002. Ein dynamisches Modellsystem für den vertikalen Austausch zwischen Grundwasser und Oberflächenwasser, *Beiträge zum Tag der Hydrologie, Suderburg*, 184-189.

- Jasper K., Schulla J. WaSim Model Homepage, <http://homepage.hispeed.ch/wasim/index.html>: download.
- Kucharzak S., Kowalski K., 2009. Geodetic Aspect of Shoreline Delineation. Water Management No. 9/2009. pp. 357-363 [In Polish].
- Ruf W., 2007. Numerical Modelling of Distributed River – Aquifer Coupling in an Alpine Floodplain. A dissertation submitted to ETH Zürich for the degree of Doctor of Science, Zürich, 218
- Singh V.P. (ed.), 2006. Watershed models. Taylor&Francis, Boca Raton, FL, 21-45.
- Schulla J., 1997. Hydrologische Modellierung von Flussgebieten zur Abschätzung der Folgen von Klimaänderungen. Zürcher Geographische Schriften, ETH, Zürich, 161.
- Sommer Th., Schmidt C., Klöcking, Pfützner B., 2002. Kopplung eines Grundwassermodells auf der Basis MODFLOW mit dem Einzugsgebietsmodell ArcEGMO. Beiträge zum Tag der Hydrologie, Suderburg.
- Water Law Act dated 18.07.2001 (i.e. Journal of Laws of 2005, No. 239, item 2019, as amended).
- Wolny B., 2008. Preparation of Geodetic Design Documentation for the Shoreline of Internal Seawater and Inland Surface Water. Geodetic Review, LXXX, 4: 15-22 [In Polish].

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