

Analysis of land exposed to the destructive activities of surface flowing waters^{*}

Agnieszka BIEDA and Elżbieta JASIŃSKA, Poland

Key words: real estate, river, change of river bed, cadastral boundaries, value of the property

SUMMARY

According to Polish law (Act of 2001 - Water Law) lands covered by surface flowing water belong to the Treasury. In case of change the boundary line and exceed the water current cadastral boundaries, land occupied by water becomes the property of the owner of water. The owner of the land occupied by flowing water is entitled to get compensation from the new owner.

Compensation for loss of land shall be determined on the basis of its market value. It is determined on the basis of the Act - about Real Estate Management (1997). Estimate it in accordance with the Generally National Valuation Standards, eligible property experts. It is the product of the unit value of the land (price per unit of surface area) and a plot of land separated during surveying and legal procedure to determine the shoreline (the demarcation of land occupied by water from adjacent land).

Aim of this study is to analyze the land located in the zone of erosion and accumulation of surface water flowing. Activity caused by water changes are significant economic consequences. The necessity of compensate can put a strain on the budget of the water owner, as well as result financial losses in property owners located in the vicinity. Changes in the surface of the land registry are related to changes in fees for property which incur their owners, ie property tax and in the case of agricultural land, as amended grants from the European Union.

The study was conducted within the metropolitan of Krakow (Liszki community, district of Krakow, Malopolska province). Way flows largest Polish river - Vistula.

^{*} This work has been made within scientific research program no. 15.11.150.137.

Analysis of land exposed to the destructive activities of surface flowing waters*

Agnieszka BIEDA and Elżbieta JASIŃSKA, Poland

1. INTRODUCTION

Real estate located near neighbourhood of streams and rivers are exposed to destructive activity. Flowing water can permanently annex lands situated in its directly neighbourhood. It will cause changes in cadastre and compensations for owners of occupied lands. Land occupied by flowing water through natural way becomes by operation of Polish law an ownership of the owner of water [Act, 2001]. Despite this fact legislator conceded, that to compensate such loss, will be fairly [Kowalski, 2010]. In fact, land is damaged by water, but it also starts performing action as river bed, serving the owner of water (in Poland, and owner of flowing water is the Treasury). The former owner of land is entitled to get compensation because of loss of the property of land. It is determined by comparison of factual status of land and its theoretical status, if damage would not happen. In practice, it is realized by comparison of current area of land with area of land before it was occupied by water. Determined by measurement area (during surveying-legal process of delimitation between lands under waters and adjoining lands) difference of areas is multiplied by individual value of land, defined by professional valuer [Ordinance, 2004].

2. OBJECT FOR RESEARCHES AND DATA FOR ANALYSES

Analyses have been carried out at territory of Liszki commune¹ (krakowski district, Malopolskie province). According to present rules of cadastre in Poland and to make cadastre more efficient, communes are partitioned into cadastral units. Boundaries of cadastral units suit to boundaries of towns and villages [Ordinance, 2001]. Dependencies between real estates have been researched at the areas of three cadastral units: Jeziorzany, Piekary and Sciejowice. They have been selected for researches because of their location. All are situated in the close neighbourhood of big river – Vistula River². It causes that real estates located in mentioned above cadastral units can be exposed on its destructive activity. Additionally, Liszki commune is a part of Krakow Agglomeration. Liszki commune is a unit directly neighbouring Krakow. It causes significant activity on real estate market. Location of selected cadastral units for analyses, in relation to Krakow and Vistula river, shows fig. 1.

* This work has been made within scientific research program no. 15.11.150.137.

¹ Commune is the smallest unit of administrative partition in Poland [Act, 1998].

² Vistula River is the biggest river in Poland



Fig. 1: Location of Jeziorzany, Piekary and Ściejowice cadastral units, in relation to Krakow and Vistula river.

Source: Own study

Basic data about analysed estates have been acquired from local surveying documentation centre³. A register of prices and values of estates cadastral maps in scale 1:2000, and also detailed maps in the same scale. The whole documentation exists in analogue type.

A register of prices and values of estates is run on the basis of [Ordinance, 2001]. It contains:

- transaction prices, recorded in authenticated deeds, delivered to cadastral office in order to insert changes in cadastre (for example: change of owner as an effect of purchase-sell contract),
- real estate values determined by professional valuers in valuation reports and abstracts from them are delivered to cadastral offices [Act, 1997].

Because subjects of registration are also:

- address of estate location,
- numbers of cadastral parcels,
- kind of estate (including agricultural, developed, undeveloped, building and dwelling),
- area of land estate,
- date of concluding authenticated deed or determination of estate value,
- other accessible data about estates and their components,

mentioned above register of prices and values of estates is a valuable source of information about estates, which can serve for creating estates database in order to analyse real estate market.

³ Documentation centre is a very important administrative surveying office in Poland, where all documentations, like surveying records, made by licensed surveyors are delivered and, in turn, accepted through decision. It means, that they are suitably accurate, corresponding with surveying regulations and up-to-date. There are three levels of documentation centres: local (district), regional and country ones. The local documentation centres perform their duties in some 380 districts in Poland. They are the most important for surveyors, who use mostly documentation kept there by means of computer technology, first of all.

Register which was at authors' disposal, contained information about transactions prices from the period: January 2008 to June 2011. It follows that, during the period of time of analysed 42 months, in the area of researched cadastral units, 92 purchase-selling transactions have been reported, including:

- 16 in Jeziorzany,
- 53 in Piekary,
- 23 in Ściejowice.

From register have been selected only transactions concerning such undeveloped parcels, which shapes could change as a result of erosion-accumulative activity of Vistula River.

At conventional analyse of market, maps serve only for determination of estate attributes. On the basis of them a valuer estimates for example: location of estate, estate access to utilities, access to means of transport, shape of parcel, etc. In such case, it is not necessary to transform maps to digital form. Yet, because the aim of the paper is also verification if changes of cadastral boundaries, caused by erosion-accumulative river activity in the analysed area have been occurred, maps were worked out in the way allowing using them in various types of spatial analyses. So, sheets of maps have been sequentially:

- scanned with suitably resolution (300 dpi),
- transformed from local coordinates of raster to compulsory coordinate country system (by affine transformation with error not more than 0.60 m),
- vectorized.

Yet, detailed map⁴, which contains also utilities, has not been prepared by this method. It only served for visual inspection, in order to determine estate access to utilities. Such obtained information about estates have been broadened by results of analysis of study plan⁵ of Liszki commune [Resolution, 2011] and analyses of land use plans [Resolution, 2007], [Resolution, 2010] and [Resolution, 2012]. These documents are, by operation of law [Act, 2003], public and accessible on commune website. In order to determine course of river bed, aerial photos taken in April 2009, have been used. Stereoscopic measurement of river bank enabled its better identification.

3. LANDS DESTINATION

According to Polish law [Act, 1997] estates can be valued only by licensed valuers. Such person must also select a suitable approach, method and techniques of estate valuation. Valuer must also take into account, particularly:

- aim of valuation,
- kind and location of estate,
- status of estate,
- accessible data about prices, incomes and features of similar estates,
- destination of valued estate in land use plan.

⁴ In Poland such map, made in scales of 1:500, 1:1000, 1:2000 and 1:5000 is called „basic” or „primary” map.

⁵ There are three levels of spatial planning in Poland: country, regional and local. The last is run in the area of commune. There are two planning documents made on local level: study plan (worked out at scales 1:10000 or 1:25000), showing general planned purposes and land use plan (worked out at large scales, for example 1:1000), showing these purposes in details. Study plan is prepared for the whole commune, and it is compulsory. Land use plan, in turn, is prepared on the basis of study plan. Land use plan makes local law and is the basis for all investments being carried out in the commune area.

Yet, one should remark, that [Act, 2003] allows possibility of lack of land use plan. Then, land destination can be determined on the basis of study plan or on the basis of other planning documents, accepted by Polish law⁶. Just at the moment, when being valuated estate is located in the area, where is no planning documents⁷, describing its possible destination, one should take into account factual manner of its use (recorded in cadastre). Liszki commune has both study plan and land use plans for cadastral units: Jeziorzany, Piekary and Ściejowice, so for performing correct analyse, one had to verify information contained in these documents. Parcels, which can be the subjects of payment of compensation as a result of destructive river activity, are located in the areas described as green areas of ecological and protected functions– „ZE”. Suitable parts of study plan and land use plan are shown on figures 2 and 3.



Fig. 2: Part of study plan of Liszki commune – cadastral unit Jeziorzany (scale 1:10000)
Source: [Resolution, 2011]












Fig. 3: Part of land use plan of Liszki commune – cadastral unit Jeziorzany (scale 1:2000)
Source: [Resolution, 2007]

Literal symbols used on maps shown on fig. 2 and 3, are consistent with table no 1, which contains their explanations.

⁶ Such document called “decision about conditions of land development” is issued by head of commune – in case of lack of land use plan. It stands for land use plan.

⁷ Such situation is, unfortunately, also possible in Poland.

Table. 1: Literal symbols applied on study plan (Fig. 2) and land use plan (Fig. 3)

Subject of symbol	Literal symbol	Colour of symbol used on plans
Lands of one family housing	MN	
Lands of commercial housing	U	
Lands of sport and recreation	US	
Agricultural lands	R	
Lands of farm housing	RM	
Lands threatened by flood	ZZ	
Lands of surface inland waters (rivers, lakes, ponds, streams, canals)	WS	
Lands of public roads	KD	
Waterworks	W	

Source: [Ordinance, 2003]

Since estates in database for comparison should have the same destination as estate being the subject of valuation (here: estate for which compensation is determined), at first estates having the same destination have been found in registers. There have been 4 sold estates found, located on lands classified as “ZE” – within analysed period of time (longer than time demanded by regulations). Basic parameters of transactions contains table 2.

Table 2: Parcels of destination „ZE”, which were subjects of transactions in analysed period of time

Date of selling	Cadastral unit	Area [m ²]	Unit price [PLN/m ²]
02.2008.	Piekary	2800	18
07.2008.	Jeziorzany	1016	133
08.2008.	Piekary	1100	9
09.2010.	Piekary	1000	20

Source: Own study

Four estates for comparison is definitely not enough in order to perform correct market analyse. Though three of them have similar areas, yet the date of their selling is remote, and significant differences in unit price disqualify them to use them for determination of probable compensation. One should also remark, that none of them is not located in protected zone created for Vistula River. There is a parcel shown on fig. 4, sold in September 2010. It is located in protected zone of so called “Potok Piekarski” (“Bakery Stream”), which is only direct tributary of Vistula.

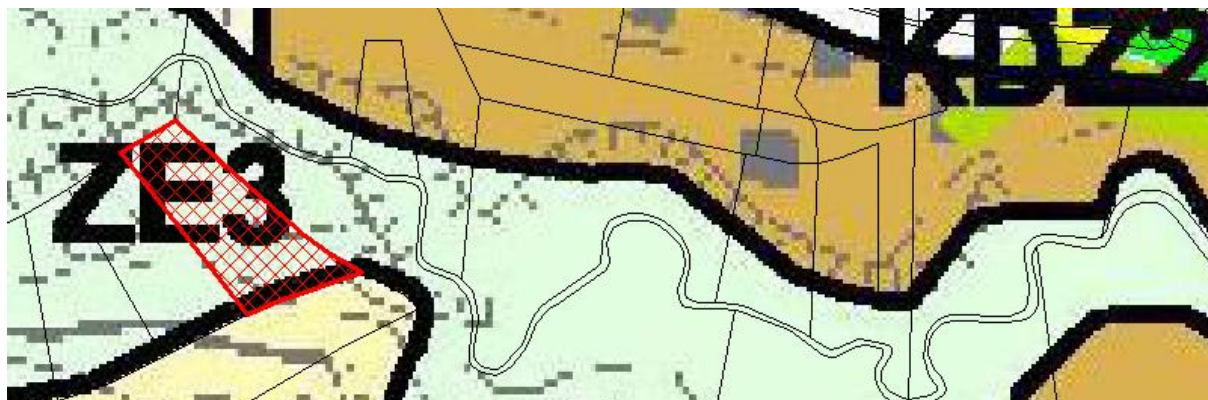


Fig. 4: Sold parcel (marked by red colour) against a background of study plan.

Source: Own study based on [Resolution, 2011]

The rest estates in database for comparison are located on lands described in land use plan as: „RM”, „R”, „MN” and „U”. Since there is lack in database estates of destination the same as valuated prospective estates, one can carry out valuation on the basis of data coming from lands of different types. This procedure is justified by [Ordinance, 2004].

4. ANALYSIS OF ESTATES MARKET

It is advised to have for comparison in database as a minimum, a dozen or so estates [Czaja, 2001], [Czaja, Parzych, 2007]. In collected set one can distinguish 4 groups of estates of various destination, which fulfil this condition. They are listed in table 3.

Table 3: Possible for separation subbasis, with number characteristic

Description of land destination	Number of estates	C_{min}	C_{max}	\hat{C}_J	σ_c	λ_c
RM	29	8 PLN	233 PLN	78 PLN	57 PLN	0.73
R	31	2 PLN	69 PLN	27 PLN	21 PLN	0.77
MN	17	17 PLN	300 PLN	104 PLN	77 PLN	0.74
U	11	1 PLN	244 PLN	77 PLN	81 PLN	1.04

Source: Own study

From table 3 results, that collected estates database, can not be used for valuation. Coefficient of dispersion, (λ), which is computed according formula

$$\lambda = \frac{\sigma_c}{\hat{C}_J}, \quad (1)$$

where:

σ_c – standard deviation of estate prices in database,

\hat{C}_J – medium unit price of estate in database,

should not exceed value of 0.15.

For notified sets, however, coefficients even more than 0.25, described as unacceptable [Czaja, 2001], have been obtained. In order to use collected information for determination of compensation, one should reject outliers data and then again verify database coherence. Thus, databases have been verified in order to fulfil two conditions:

- minimum number of estates in database – 11,
- coefficient of dispersion – 0.25.

It was not possible to fulfil them concurrently.

Corrected sub-database with their number characteristic, have been listed in tables 4 and 5.

Table 4: Corrected sub-database with their number characteristic – minimum 11 estates in database

Description of land destination	Number of estates	C_{\min}	C_{\max}	\hat{C}_J	σ_c	λ_c
RM	11	72 PLN	230 PLN	122 PLN	42 PLN	0.34
R	11	24 PLN	51 PLN	37 PLN	10 PLN	0.26
MN	11	58 PLN	216 PLN	121 PLN	52 PLN	0.43
U	11	1 PLN	244 PLN	77 PLN	81 PLN	1.04

Source: Own study

Table 5: Corrected sub-database with their number characteristic – coefficient of dispersion less than 0.25

Description of land destination	Number of estates	C_{\min}	C_{\max}	\hat{C}_J	σ_c	λ_c
RM	10	72 PLN	157 PLN	112 PLN	26 PLN	0.23
R	10	24 PLN	50 PLN	36 PLN	9 PLN	0.25
MN	6	92 PLN	216 PLN	160 PLN	40 PLN	0.25
U	4	150 PLN	244 PLN	178 PLN	38 PLN	0.21

Source: Own study

The only possibility for determination of compensation for estates located in zone of erosion-accumulative activity of Vistula River, will be reduction of one of mentioned above parameters.

After analysis of tables 3 and 4, it seems to be correct statement, that in the analysed area one can run valuation based on the sub-database of agricultural estates, containing 11 estates, with coefficient of dispersion is 0.26. In this place one should mention, that according to the authors, agricultural estates, will better represent green areas of ecological and protection functions. In both cases, there is no possibility to receive so called “building permit”. Additionally, from parcels located within „ZE” zones, their owners are rather not able to receive benefits. There are not used area, most often scrublands.

Prices of estates in database have been listed in table 6. And the problem of influence of mentioned attributes contained in database on estate value at researched market – is shown in table 7. Final values of weight parts have been approximated to 5%.

Table 6: Features of estates in database for valuation

Attribute	Attribute description, scaling
Time	Number of months passed from the date of the first transaction in database (0) to the date of transaction – for comparison
Location	Location of estate in the relation to the centre of town (from 1 to 2)
Transportation accessibility	Access to public road; asphalt road, unsurfaced road, dirt road or lack (from 1 to 2)
Surroundings	Neighbourhood of used estates; similarly, similarly with exceptions or differently (from 1 to 2).
Shape and topography	Shape: square, rectangular, not regular; topography: kind of gradient of surface (from 1 to 2)
Area	Area of estate [m ²].

Source: Own study

Table 7: Influence of attributes on estate value

	Time	Location	Transportation accessibility	Surroundings	Shape and topography	Area
Coefficient of absolute correlation	-0.65	-0.16	-0.09	-0.29	-0.38	-0.48
Square of coefficient of absolute correlation	0.4266	0.0267	0.0084	0.0836	0.1457	0.2336
Weight parts [%]	46	3	1	9	16	25
Final weight parts [%]	45	5	0	10	15	25

Source: Own study

Obtained final weight parts reflect trends on agricultural estate market within analysed period of time in the researched area. Increase of all attributes cause dropping of prices. One can remark, that:

- the most important proved to be attribute „time”, which clearly shows on dropping of prices of agricultural estates in the period of time from January 2008 to June 2011 – almost by half.
- for buyers there were also important attribute „area” (together with increasing area of estate, unit price decreases – it is more difficult to sell big estates, so their unit price must be less in order to encourage prospective buyers) and attribute „shape and topography” (most likely, it is much more easier to do some activities, connected with cultivation on parcels of extended shape, though they were subjectively estimated as worse),
- important, but not significantly, seems to be attribute „location” (it is understandable in times, when cultivations are fully mechanized) and attribute „surroundings” (together with dropping of prices differentiation of lands structure was to increase; yet it proved that buyers prefer situation, when in the neighbourhood of agricultural estate are other estates),
- analysis proved, that the less important is attribute „transportation accessibility” (equipment, needed to perform agricultural operations, is so hard, that it is not significant what road one must drive in order to come to parcel).

5. CHANGE OF BOUNDARIES COURSES

Being analysed part of Vistula riverbed quite clearly changed its location during last times. We speak here about changes, which one can observe from the moment of parcel boundaries measurements in the ‘70s of last century (from cadastral maps), in comparison with current situation visualised on aerial photos. Exemplary comparison compulsory boundaries with current situation is placed on fig. 5.



Fig. 5: Comparison cadastral boundaries with ortophotomap

Source: Own study

It is visible on fig. 5 parts of cadastral units Piekary and Ściejowice (vectorized up boundaries). Krakow is located on the other side of river. In this case river, changing its course, invaded lands located on eastern side of its riverbed. Area of Liszki commune has been significantly increased. On the other hand, it could happen something quite opposite situation. Vistula, with equal probability, could permanently occupy lands, adjoining to its other side. On the whole length of analysed segment of riverbed (about 4.5 km), river reduced area of only one parcel. Observed case has been shown on fig.6.



Fig. 6: Change of parcel area located in direct neighbourhood of Vistula

Source: Own study

It is cadastral parcel located in cadastral unit Ściejowice. Its area, determined by – created by authors, boundaries vector model – is about 40000 m². Observed change (marked on fig.6 by yellow colour) is 285 m². It does not make even 1% of previous area of parcel.

6. CONCLUSIONS

To sum up carried out analyses, one could remark, that estates located in cadastral unit Piekary are objects of turnover, most frequently. Authors think, that it has strong connection with location of town (it is located nearest Krakow) and with the fact, that just in this place is situated Krakow ring road exit. Ring road connects with A-4 motorway, which ultimately will run from Germany to Ukraine. Using A-4 motorway, one can easily get to John Paul IInd, Balice International Airport (it occupies the 2nd place, after Warsaw Airport, in respect of numbers of supported passengers and numbers of airplanes operations)

One should also remark, that obtained results of market analysis one can not apply for estates valuation, unfortunately. So, in order to determine correct compensations for lands permanently occupied by Vistula, database should be expanded. To do so, it is proposal to use registers prices and values from other cadastral units contained in Liszki commune or from adjoining communes. It would be correct, if these units were located on the same bank of river. Estate market on the southern part of Vistula is probably different. It corresponds with worse Krakow transportation accessibility. Database for evaluation one can also crate, including transactions which have not yet been input to register but it have been already submitted to suitable office. Professional valuers can inspect so called “evidences of cadastral changes”, including authenticated deeds of buying-selling contracts.

Probable compensations for lands permanently occupied by Vistula, at area of Liszki commune, would not be so high (there has only been one prospective change of parcel boundaries course). It is probably connected with the width of parcels being located under river. When present, compulsory boundaries were determined, they were established far from river banks. As a result of it, water will not them exceed for a long time. It is just the other way about the other side of river. In this place Vistula undercuts opposite bank, and it has been analysed in [Bieda, 2011].

REFERENCES

- [1] Bieda A.: *Weryfikacja granic administracyjnych prowadzonych wzdłuż rzek w aspekcie aktualizacji katastru*, The doctoral dissertation AGH, Krakow 2011, unpublished, Language: Polish, English title: *Verification of administrative boundaries run along rivers in terms of updating cadastre*
- [2] Czaja J.: *Metody szacowania wartości rynkowej i katastralnej nieruchomości*, KOMP-SYSTEM, Kraków, 2001. Language: Polish, English title: *Methods of valuation of estates market and cadastral value*
- [3] Czaja J., Parzych P.: *Szacowanie rynkowej wartości nieruchomości w aspekcie międzynarodowych standardów wyceny*, Stowarzyszenie Naukowe im. St. Staszica, Kraków, 2007 *Valuation of estates market value in aspect of international standards*
- [4] Kowalski K.: *Gospodarka nieruchomościami pokrytymi powierzchniowymi wodami płynącymi*, E-book, Wrocław, 2010 Language: Polish, English title: *Real estates management of lands covered by surface flowing waters*

- [5] Rozporządzenie Ministra Rozwoju Regionalnego i Budownictwa z dnia 29 marca 2001 r. w sprawie ewidencji gruntów i budynków (Dz. U. Nr 38 poz. 454) Language: Polish, English title: *Ordinance of Minister of Regional Development and Buildings Construction – about Register of Lands and Buildings*
- [6] Rozporządzenie Ministra Infrastruktury z dnia 26 sierpnia 2003 r. w sprawie wymaganego zakresu projektu miejscowego planu zagospodarowania przestrzennego (Dz. U. Nr 164 poz. 1587) Language: Polish, English title: *Ordinance of Minister of Infrastructure – about demanded range of project of land use plan*
- [7] Rozporządzenie Rady Ministrów z dnia 21 września 2004 r. w sprawie wyceny nieruchomości i sporządzania operatu szacunkowego (Dz. U. Nr 207, poz. 2109, z póź. zm.) Language: Polish, English title: *Ordinance of government – about valuation of property and appraisal report*
- [8] Uchwała nr XII/87/2007 Rady Gminy Liszki w sprawie miejscowego planu zagospodarowania przestrzennego gminy Liszki (Chrosna, Czulów, Kaszów, Rączna, Jeziorzany, Ściejowice i Piekary) Language: Polish, English title: *Resolution of Liszki Commune Board – in case of land use plan of Liszki commune*
- [9] Uchwała nr LVI/550/2010 Rady Gminy Liszki z dnia 8 listopada 2010 r. w sprawie zmiany miejscowego planu zagospodarowania przestrzennego gminy Liszki dla sołectw Chrosna, Czulów, Kaszów, Rączna, Jeziorzany, Ściejowice, Piekary Language: Polish, English title: *Resolution of Liszki Commune Board – in case of change of land use plan of Liszki commune*
- [10] Uchwała nr VI/36/2011 Rady Gminy Liszki z dnia 23 marca 2011 w sprawie uchwalenia studium uwarunkowań i kierunków zagospodarowania przestrzennego Gminy Liszki Language: Polish, English title: *Resolution of Liszki Commune Board – in case of study plan of Liszki commune*
- [11] Uchwała nr XXII/181/2012 Rady Gminy Liszki z dnia 20 września 2012 r. w sprawie zmiany miejscowego planu zagospodarowania przestrzennego gminy Liszki dla sołectw Chrosna, Czulów, Kaszów, Rączna, Jeziorzany, Ściejowice, Piekary Language: Polish, English title: *Resolution of Liszki Commune Board – in case of change of land use plan of Liszki commune for village administrator's office*
- [12] Ustawa z dnia 24 lipca 1998 roku o wprowadzeniu zasadniczego trójstopniowego podziału terytorialnego państwa (Dz. U. Nr 96, poz. 603) Language: Polish, English title: *Act – about introducing principal, three-stage partition of country territory*
- [13] Ustawa z dnia 21 sierpnia 1997 r. o gospodarce nieruchomościami (Dz. U. Nr 115 poz. 741, z póź. zm.) Language: Polish, English title: *Act – about real estate management*
- [14] Ustawa z 18 lipca 2001 roku – prawo wodne (Dz. U. Nr 115, poz. 1229, z póź. zm.), Language: Polish, English: *Act – Law of Water*
- [15] Ustawa z dnia 27 marca 2003 r. o planowaniu i zagospodarowaniu przestrzennym (Dz. U. Nr 80 poz. 717, z póź. zm.) Language: Polish, English title: *Act – about spatial planning and development*

CONTACTS

Ph. D. Agnieszka Bieda
AGH University of Science and Technology
30 Mickiewicza Av. C-4 building, room 303
30-059 Krakow
POLAND
Tel. + 48 12 617 22 67
Fax + 48 12 616 45 88
Email: bieda@agh.edu.pl
Web site: home.agh.edu.pl/~bieda

Ph. D. Elżbieta Jasińska
AGH University of Science and Technology
30 Mickiewicza Av. C-4 building, room 12
30-059 Krakow
POLAND
Tel. + 48 12 617 33 23
Fax + 48 12 616 45 88
Email: jasinska@agh.edu.pl
Web site: home.agh.edu.pl/~jasinska