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Construction variants for a Bydgoszcz bypass canal along the route of International Waterway E70

Abstract: The paper presents different variants for a Bydgoszcz bypass canal prepared based on the analysis of historical materials as well as contemporary environmental and economic factors. While preparing the concept, the following aspects were taken into account: land relief, current land-use patterns, nature protection forms, and inland waterway development plans, including the location of a multimodal port in the vicinity of Solec Kujawski. As a result of the conducted analysis, four variants of the bypass canal were established: two of them running north of and two south of Bydgoszcz. In addition, their environmental and infrastructural impact was preliminary assessed as well as their functional and spatial connections with the surroundings were analysed. Furthermore, measures aimed at executing the designed projects were suggested.

Keywords: Bydgoszcz Water Junction, Bydgoszcz Canal, Bypass Canal, International Waterway E70, Vistula–Oder waterway, inland water transport.

1. Introduction

The first plans of a waterway connection between the Vistula and the Oder date back to the 16th century (Winid, 1928), but it was only after the First Partition of Poland that the Prussians built a canal in the place of a former portage, i.e. a relatively short land section that divided the waterways (Gan, 1978). Construction works were commenced in spring 1773 and the canal was opened for navigation in September 1774. The strategic importance of that waterway caused a concern among European countries, including England and Russia, with regard to the perceived possibility that Prussia's power would increase considerably (Winid, 1928). The canal was upgraded several times and along with the canalisation of the Noteć and the Brda and the construction of the New Bydgoszcz Canal in 1910–1915, a waterway was created in the shape that has been preserved to date.

At present, the Vistula–Oder connection is part of the E70 international waterway, which connects Europort Rotterdam in the Netherlands with Klaipėda in Lithuania (European..., 1996). The Bydgoszcz Water Junction, being

a connection between the aforementioned E70 waterway and waterway E40 from the Baltic Sea to the Black Sea (Program..., 2006), is of key importance in the waterway network.

Pursuant to the provisions of the international AGN agreement (European..., 1996), waterways of international importance shall meet specific requirements regarding the navigability class (at least class IV). Classification of waterways in Poland is defined by the Regulation of the Council of Ministers on the classification of inland waterways (Rozporządzenie..., 2002). In accordance with this document, the Vistula–Oder waterway meets the parameters of merely class II along the sections of the canalised Brda, the Bydgoszcz Canal, the Noteć from the Drawa to the Warta, and the Warta. The Noteć River from the Bydgoszcz Canal to the Drawa has navigability class Ib.

Because the requirements of an international waterway are not met, it is necessary to upgrade the existing waterway. The modernization is included in strategic documents of the national level (Założenia..., 2016), but the manner of its execution has not been specified yet.

The upgrade of the Bydgoszcz section is crucial. Due to the current course of the waterway running through the city centre, the construction of a bypass canal was postulated already in the 1940s (Kunze, 1940; *Hafenplanung...*, 1941; *Vorläufiger...*, 1942). The concept of a Bydgoszcz bypass canal recurred many times in various options in the second half of the 20th century (Kanał..., 1976; *Modernizacja...*; 1981), but ultimately none of these plans has been implemented.

Because none of the historical concepts has been implemented, it becomes necessary to re-examine the possibility of routing the bypass canal of Bydgoszcz, taking into account

changes in environmental and economic conditions. New limitations and possibilities have emerged over time. The primary limitations include in particular the development of lands that were previously allocated for the canal's reserve and the establishment of new environmental protection areas that impose special caution when planning and executing projects likely to affect the environment. The possibilities, however, result from the whole economic and social environment and the waterway development plans, including the construction of a multimodal port with the suggested location between Bydgoszcz and Solec Kujawski, as described by M. Habel et al. (2014).

2. Research methods

The research was commenced with a search in the archives of the City's Urban Planning Office in Bydgoszcz and of the Bydgoszcz branch of the Kuyavian-Pomerania Spatial and Regional Planning Office in Włocławek, where key documents presenting the historical concepts of a Bydgoszcz bypass canal were acquired.

Furthermore, the content of the applicable strategic documents referring to the inland Vistula–Oder connection was examined and the contemporary engineering and planning solutions concerning waterways employed worldwide were studied.

Subsequently, the gathered data were compiled using the geographic information system software, which analysed the land cover and land use based on orthophotomaps from 2010 and 2013 (Orthophotomap, 2010-2013), the master plan for the city of Bydgoszcz (*Studium...*, 2009) and Corine Land Cover 2006 maps (*Corine...*, 2006). The analysis

included also forms of nature protection in accordance with the data from the General Directorate for Environmental Protection (*Forms...*, 2016). Analysis of the land relief was also of great importance. It was carried out on the basis of the digital terrain model NMT 100 acquired from the Centre for Land Survey and Cartographic Documentation (*Numeryczny...*, 2015).

Based on the comprehensive data analysis, conceptual routes of the bypass canal variants were determined. Subsequently, elevation profiles of the proposed variants were drafted based on the digital terrain model, and were graphically processed taking into account the land use forms and protected areas located along their routes.

The research was supplemented with field surveys carried out in October–November 2016.

3. Recommendations on the construction of a Bydgoszcz bypass canal

Taking into account the current conditions and considering the location of the canal within a land zone with a minimum width of 50 m, variants were prepared for both the northern and the southern route of the canal (Fig. 1). The adopted land reserve allows to consider the construction of the canal with the parameters of class V. In the case of variant N1, it is impossible

to achieve the parameters of a class higher than Va due to limitations of the curve radius, while in the remaining variants curve radii would permit us to achieve class Vb parameters.

Obviously also the upgrade of the remaining section of the Vistula–Oder waterway should be contemplated. The suggested manner of implementation consists in widening the navi-

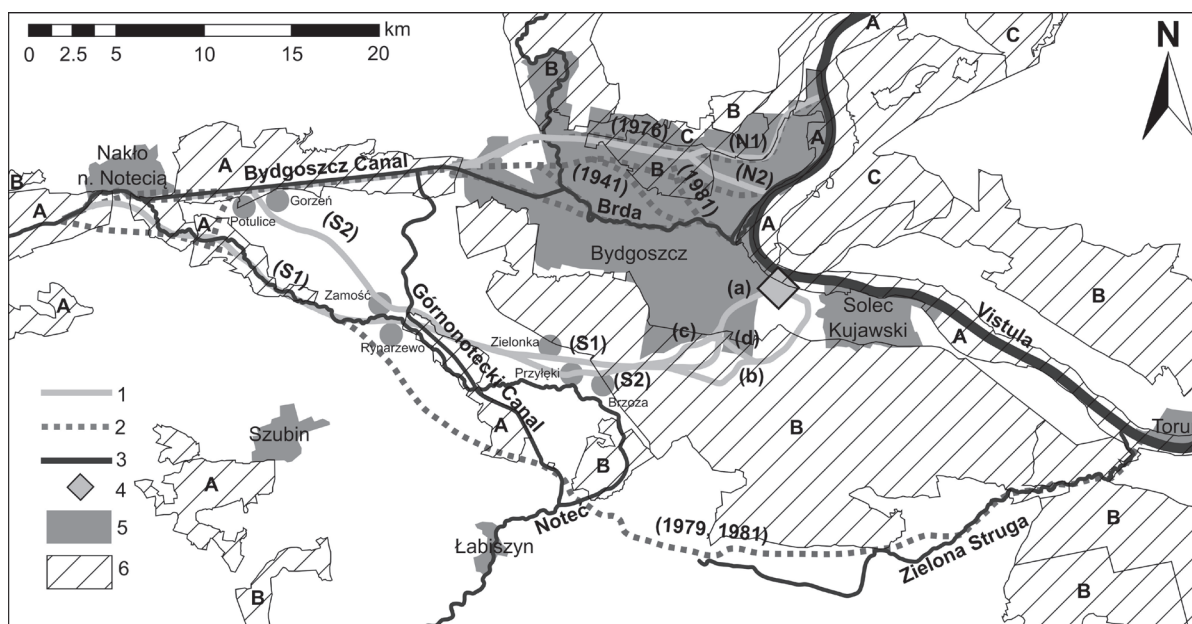


Figure 1. Suggested variants for Bydgoszcz bypass canals (prepared by the author)

1 – contemporary concepts (variant's designation in brackets), 2 – historical concepts, 3 – major water courses, 4 – planned multimodal port, 5 – urban areas, 6 – protected areas

gable route within the existing line, but preserving historic locks and building new ones nearby. Due to the historical importance of the Bydgoszcz Canal, supervised by a heritage conservation officer (Wykaz..., 2016), the lack

3.1. The northern canal

The northern bypass has been designed in two basic variants: N1 and N2 (Fig. 1). The course of variant N1 is similar to the concept from 1976. It has been adjusted, however, to reduce the necessary demolitions. The designed canal begins with an inlet on the Vistula River side, downstream of the Fordon district, and then runs towards the Myślęcinek escarpment. In order to bypass the Fordon district, it is assumed that the canal will be relocated towards the escarpment zone, including the possible necessity to adjust its geometry. After passing the Fordon district, its further route is the same as that of variant N2. It is relocated southwards relative to the concept of 1976 in order to bypass the infrastructure of the Forest Park for Culture and Leisure, which is part of the Bydgoszcz Northern Recreation Zone. Afterwards, the canal crosses the Brda River and bypasses the areas of infiltration ponds at the Czyżkówko water supply well site, runs towards the Osowa Góra district,

of consent to an adjustment of the route would mean having to build a lateral canal in the case of variants N1, N2 and S2, which, however, would cause far greater interference in the environment, especially in protected areas.

passes it and ties in the existing canal upstream of the Osowa Góra lock.

Variant N2 begins in the area designated by Germans in 1941. The inlet into the Vistula River is located at a grain silo downstream of the Brdyujście district. The initial section of the canal runs through the areas intended for the Academic Park of the University of Science and Technology. It also runs in the vicinity of the Oncology Centre, and then assumes the same course as variant N1 (Fig. 1).

In the case of the canal's section running through Osowa Góra, two alternatives have been proposed: the same route as in the concept of 1976 or a route bypassing some of the building developments in the east. In both instances, it is assumed that the canal will approach the escarpment in the Fordon district, including the possible adjustment of its geometry. However, demolitions in Osowa Góra are unavoidable, it is only their extent that varies.

Protected areas located along the route of the proposed canal are, in both variants, the Natura 2000 areas at the Vistula River and the Bydgoszcz Canal, the Area of the Protected Landscape of the Bydgoszcz Northern Recreation Zone in the middle section of the canal and, in the case of variant N1, the Vistula Landscape Park (Fig. 1).

Since the canal runs in a dense urban area, there are numerous intersections with the existing transport infrastructure, yet due to the dense road network, the continuity of certain commune roads along the route of the proposed canal is not crucial enough for the transportation network to necessitate the construction of bridges.

The longitudinal profiles of the terrain along the planned canal routes are presented in Figure 2. An alternative route through the Osowa Góra district (just like the 1976 variant) is presented for variant N1. Whereas it is sug-

gested that some of the district's building development is bypassed by variant N2. The length of the canal is 23.5 km for variant N1 and 19.5 km for variant N2. In both cases, the minimum terrain elevation is 28.0 m ASL, while the maximum one is 62.0 m ASL for variant N1 and 61.0 m ASL for variant N2. The presented terrain elevations do not allow for earth works related to the construction of the canal and are not the same as the water table level. In both variants, for the purpose of overcoming the difference in the water levels between the canal and the Vistula River, it is proposed to use a boat lift at the Vistula side and it is necessary to construct an aqueduct to cross the Brda River. In case of no interference with the existing summit level of the Bydgoszcz Canal, it will be necessary to construct the Osowa Góra lock on the northern canal. In variant N1, it will be necessary to construct a floodgate at the intersection of the Vistula levee in the Fordon district.

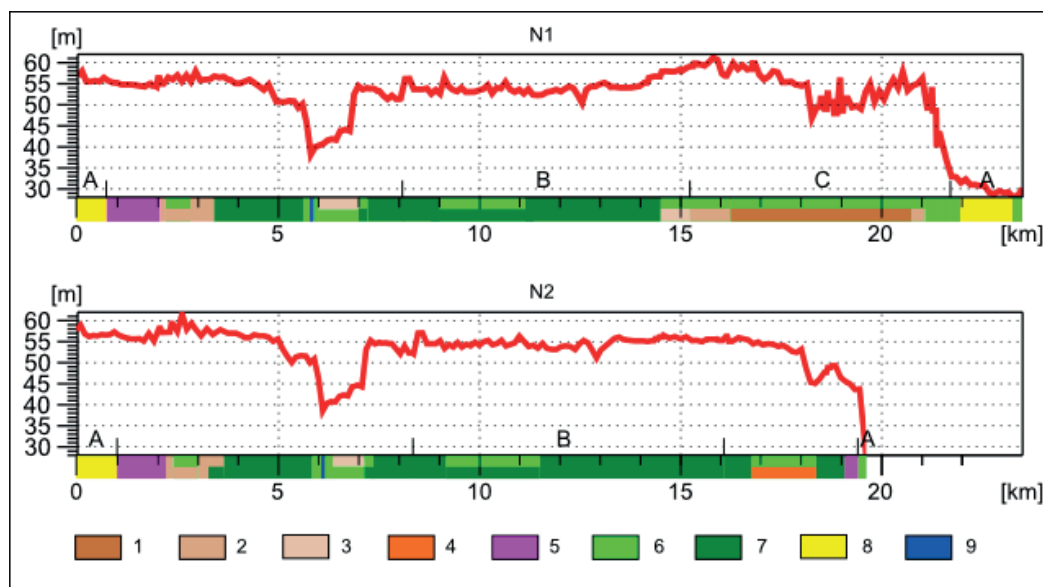


Figure 2. Longitudinal profiles [m ASL] of the proposed variants of the northern bypass canal in relation to the land use and forms of nature protection (prepared by the author)

A – Natura 2000 areas, B – Area of the Protected Landscape of the Bydgoszcz Northern Recreation Zone, C – Vistula Landscape Park, 1 – high density residential development, 2 – medium density residential development, 3 – low density residential development, 4 – supra-local service areas, 5 – industrial activity zones, 6 – park and landscape vegetation, and recreation areas, 7 – forests, 8 – agricultural areas, 9 – surface water

The northern canal is to be supplied with water from the Vistula River by means of pumps. The use of a boat lift will significantly reduce the demand for water. If a new lock in Osowa Góra is required, it is recommended to construct a water-efficient lock.

Experience proves (Lee, 2006) that the creation of a water course in an urban area

in compliance with the sustainable development principles contributes to a comprehensive regeneration of urban space, enhancing the quality of public space and creating a new dimension for social life, as well as improving the environmental conditions, through e.g. greater biodiversity.

The northern canal in Bydgoszcz should fall into the above-mentioned trend through urban connections with the functional zones of the city, introduction of high-quality architecture, and proper development of the canal zone. In the case of a bypass canal, the infrastructure should also be adapted to the tourist traffic of individuals and allow mooring, thus enabling

the development of tourist services at the canal. Undoubtedly, a boat lift and an aqueduct would be additional attractions.

In order to enhance the transport potential of the canal, it is proposed to consider the location of a multimodal port in the Osowa Góra district in the place of the planned connection of the northern canal with the Bydgoszcz Canal.

3.2. The southern canal

Variants of the southern bypass of Bydgoszcz have been designed to directly connect the canal with the planned multimodal port on the Vistula River between Bydgoszcz and Solec Kujawski.

Two main S1 and S2 variants, including a-d alternatives of the connection with the multimodal port, are proposed (Fig. 1). The alternatives result from the possibility that the canal ties in the port basin, both opposite the

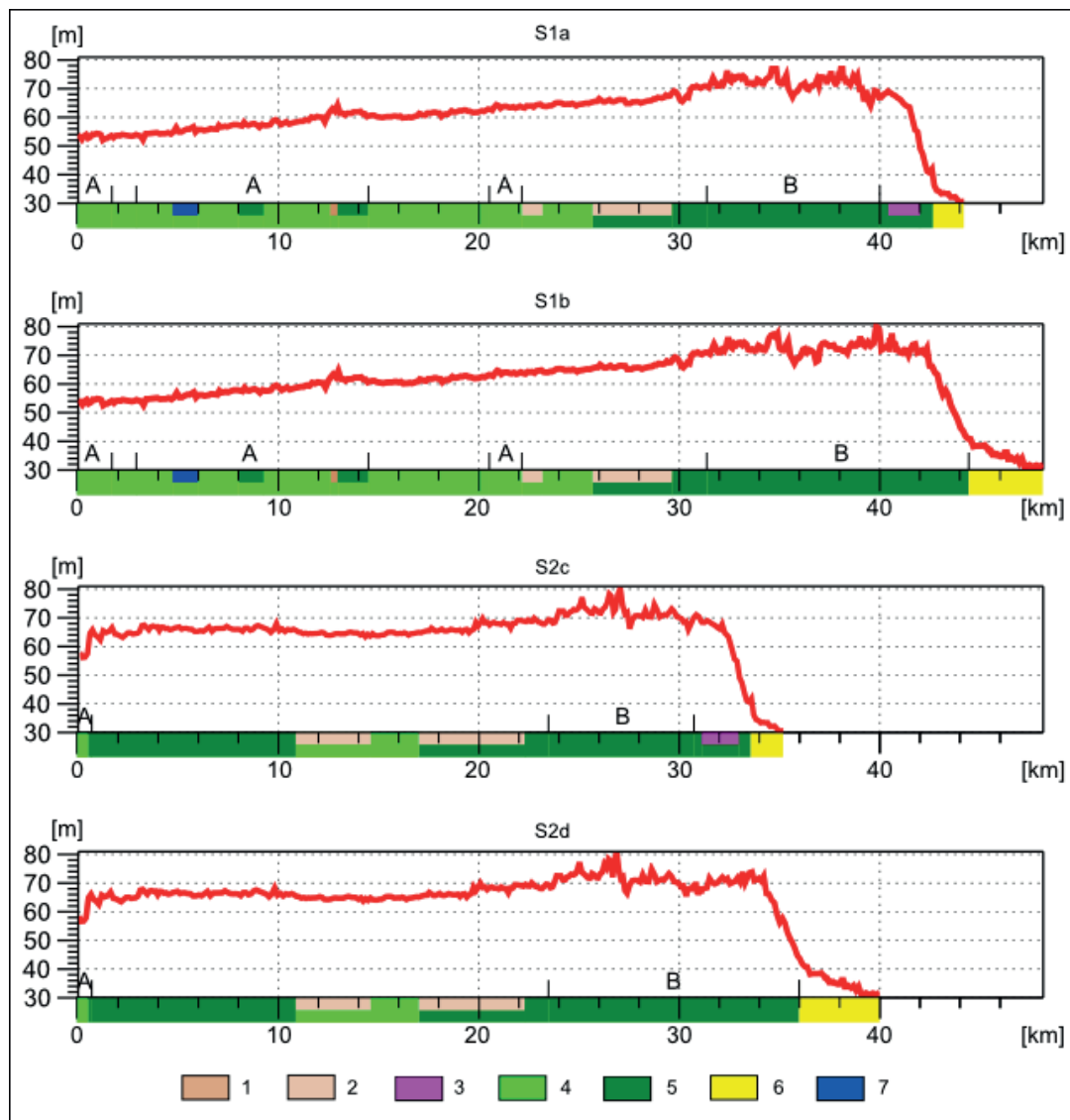


Figure 3. Longitudinal profiles [m ASL] of the proposed variants of the southern canal in relation to the land use and nature protection forms (prepared by the author)

A – Natura 2000 areas, B – Area of the Protected Landscape “Dunes of the Toruń-Bydgoszcz Basin”, 1 – medium density development, 2 – low density development, 3 – industrial activity zones, 4 – grasslands, 5 – forests, 6 – agricultural areas, 7 – surface water

entrance to the port from the Vistula side and towards the planned port expansion. It is also necessary to bypass the largest dune clusters in the Area of the Protected Landscape “Dunes of the Toruń-Bydgoszcz Basin” (in Polish: *Wydmy Kotliny Toruńsko-Bydgoskiej*).

In the further part, both variants (S1 and S2) point westwards and run in the vicinity of villages near Bydgoszcz: Brzozy, Przyłęk and Zielonki. Then, having reached the Noteć Meadows, the Noteć River and the Górno-notecki Canal near Zamość and Rynarzewo, variant S1 runs along the Noteć valley towards Nakło (as in the case of the southern bypass proposed at the turn of the 1970s and 1980s). Variant S2, on the other hand, runs towards the Bydgoszcz Canal and joins it between the villages of Gorzeń and Potulice.

In all variants, the initial section of the canal runs through the Area of the Protected Landscape “Dunes of the Toruń-Bydgoszcz Basin”. Variant S1 also runs through the Natura 2000 areas in the Noteć valley and one of the local nature conservation sites. Variant S2 was established in such a way that it bypasses as many protected areas as possible and, apart from the above-mentioned Area of the Protected Landscape, enters the Natura 2000 area only in the place where it connects with the Bydgoszcz Canal.

The longitudinal profiles of the suggested variants of the southern canal are presented in Figure 3. For each of the basic S1 and S2 variants, two alternatives of connections with the multimodal port are demonstrated: opposite the entrance to the port and towards the planned expansion. Of the variants presented, the longest one is S1b with a length of 48.2 km, while the shortest one is S2c with a length of 35.2 km. The minimum elevation is 30 m ASL at the inlet to the multimodal port basin, whereas the maximum one is 78 m ASL in vari-

ant S1a and 81 m ASL in the other variants. The maximum elevations are connected with the presence of dunes in the Area of the Protected Landscape “Dunes of Toruń-Bydgoszcz Basin”. As in the case of the northern canal profiles, the above elevations refer to the present terrain relief, excluding earth works, and are not equal to the water table level in the canal. The entrance to the summit level of the canal is proposed through a boat lift, and the exit towards the Noteć in the S1 variant or the Bydgoszcz Canal in the S2 variant – through locks.

The southern canal would be supplied with water from the Vistula River by pumps. Water-efficient locks are recommended also in this case. In addition, with a barrage constructed in Solec Kujawski, it will be possible to connect the system supplying the summit level of the canal with the system sending water for the purpose of irrigating the Kujawy region, which – in accordance with the Province Development Plan (Plan Zagospodarowania..., 2003) – is characterised by favourable environmental conditions for agriculture development with simultaneous water deficits in the growing season.

All of the proposed variants of the southern canal run mainly through areas with a low population density, yet also in this case it will be possible to use the waterway for tourism purposes, provided it is equipped with appropriate infrastructure. Since the southern canal completely bypasses Bydgoszcz, it will not be used by residents to the same extent as the northern canal and its importance will be primarily in the sector of transport. In comparison to the northern variant, the construction of the southern bypass means that the parameters of the Vistula–Oder waterway will immediately increase at a longer section, however, it will not be possible to use its potential without an upgrade of the further section of the waterway.

4. Summary and conclusions

The Vistula–Oder waterway is characterised by a considerable transport potential but its current parameters meet at most the requirements of navigability class II. In order to tap its potential as international waterway E70, it is necessary to upgrade it to the parameters of at least class IV.

The Bydgoszcz section, which runs i.a. via the Brda River through the dense building development of the historical city centre, is of crucial importance to the upgrade of the Vistula–Oder connection. If the current route is preserved, it would be necessary to interfere

with the river and the development to a large extent, which necessitates the analysis of the possibility of bypassing the city of Bydgoszcz.

Two primary variants of the northern canal, N1 and N2, and of the southern canal, S1 and S2, were presented, with the possibility of alternative routes along the most problematic sections, such as building development areas or larger dunes.

The variants vary in the extent of environmental impact, the necessity of changing the existing infrastructure, the possibilities of functional and spatial connections with the city and the planned multimodal port.

In addition to implementing the strategic and economic interest of Poland by providing a transport route of international importance, the northern and the southern canals contribute to the regional development through different ways. The northern channel is primarily aimed at direct enhancement of Bydgoszcz's

potential, which consequently will affect the regional development, according to the polarisation and diffusion model. Whereas the southern canal leads the development directly to the region, but the city itself will not reap such considerable benefits therefrom.

Apart from the mass transport of goods, it will be possible to use the canals for tourism purposes. The proposed hydraulic engineering structures, i.e. the boat lift and the aqueduct above the Brda River in the northern variant, will be unquestionable attractions.

Regardless of the ultimately selected variant, planning and organisational measures should be taken as soon as possible to secure or prepare a reserve for the investment project. Due to the importance of the undertaking, it is also advisable to take legal measures in the form of a Special Act to accelerate and simplify the procedures of its implementation and to eliminate potential constraints.

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References

- Corine Land Cover, 2006. European Environment Agency <http://www.eea.europa.eu/data-and-maps/data/clc-2006-vector-data-version-3> [access 11.12.2016].
- European Agreement on Main Inland Waterways of International Importance (AGN), 1996. United Nations Economic Commission for Europe, Geneva.
- Forms of nature protection, 2016. General Directorate for Environmental Protection <https://www.gdos.gov.pl/access-to-geospatial-data> [access 11.12.2016].
- Gan J.W., 1978. Z dziejów żeglugi śródlądowej w Polsce, Książka i Wiedza, Warszawa [In Polish].
- Habel M., Rabant H., Babiński Z., Szatten D., Marciniak Ż., Gierszewski P., 2014. Determinants of locating multimodal port on the lower Vistula River in the vicinity of Bydgoszcz, *Logistyka* 6, 4411-4420 [In Polish with English abstract].
- Hafenplanung Bromberg Übersichtsplan, 1941. Reichsgau Danzig-Westpreussen, unpublished work [In German].
- Kanał obejściowy m. Bydgoszczy na drodze wodnej Wisła-Odra, Studium koncepcyjne, 1976. Centralne Biuro Studiów i Projektów Budownictwa Wodnego "Hydroprojekt", Gdańsk, unpublished work [In Polish].
- Kunze H.J., 1940. Ein neues Kanalprojekt?, *Deutsche Rundschau Bromberg* 175, 6 [In German].
- Lee I.K., 2006. Cheong Gye Cheon Restoration Project, a revolution in Seoul, Seoul Metropolitan Government, Seoul.
- Modernizacja drogi wodnej Wisła-Odra w rejonie m. Bydgoszczy, Studium koncepcyjne, 1981. Centralne Biuro Studiów i Projektów Budownictwa Wodnego "Hydroprojekt", Gdańsk, unpublished work [In Polish].
- Numeryczny model terenu NMT 100, 2015. Centralny Ośrodek Dokumentacji Geodezyjnej i Kartograficznej, <http://www.codgik.gov.pl/index.php/darmowe-dane/nmt-100.html> [access 11.12.2016] [In Polish].

- Ortophotomap, 2010-2013. Head Office of Geodesy and Cartography, <http://www.geoportal.gov.pl/uslugi/usluga-przegladania-wms> [access 11.12.2016].
- Plan Zagospodarowania Przestrzennego Województwa Kujawsko-Pomorskiego, 2003. Kujawsko-Pomorskie Biuro Planowania Przestrzennego i Regionalnego we Włocławku, Włocławek, unpublished work [In Polish].
- Program Rewitalizacji i Rozwoju Bydgoskiego Węzła Wodnego, 2006. Miejska Pracownia Urbanistyczna w Bydgoszczy, Bydgoszcz, unpublished work [In Polish].
- Rozporządzenie Rady Ministrów z dnia 7 maja 2002r. W sprawie klasyfikacji śródlądowych dróg wodnych, Dziennik Ustaw Rzeczypospolitej Polskiej Nr 77 z dnia 18 czerwca 2002 r. Warszawa [In Polish].
- Studium uwarunkowań i kierunków zagospodarowania przestrzennego miasta Bydgoszczy, 2009. Miejska Pracownia Urbanistyczna w Bydgoszczy, Bydgoszcz, unpublished work [In Polish].
- Vorläufiger Raumordnungsplan der Stadt Bromberg, 1942. Bromberg Stadtbauamt, Bromberg, unpublished work [In German].
- Winid W., 1928. Kanał Bydgoski, Wydawnictwo Kasy im. Mianowskiego Instytutu Popierania Nauki, Warszawa [In Polish].
- Wykaz zabytków nieruchomych wpisanych do rejestru zabytków – stan na 30 września 2016 r., Narodowy Instytut Dziedzictwa, Warszawa [In Polish].
- Założenia do planów rozwoju śródlądowych dróg wodnych w Polsce na lata 2016 – 2020 z perspektywą do roku 2030, 2016. Załącznik do uchwały nr 79 Rady Ministrów z dnia 14 czerwca 2016 r., Monitor Polski z dnia 22 lipca 2016r. Poz. 711, Warszawa [In Polish].