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ELABORATION OF THE ENVIRONMENTAL CERTIFICATE OF THE PONDS, BASED ON THE DATA OF BASIN ADMINISTRATION OF WATER RESOURCES OF THE SOUTH BUG

The paper considers the urgent problem of the elaboration of the environmental certificate of the ponds. UML-model of environmental certificate of ponds is suggested, it enables to classify and integrate all the necessary data in a single document for the solution of various ecological and hydrological problems. The application of certificate model will reduce expenses and will facilitate the analysis of the ponds state.

Key words: UML-model, environmental certificate of the pond, monitoring of the surface water reservoirs.

Nowadays the problem, dealing with the conditions of use and control of rental payment of water reservoirs users, especially ponds, located in the basin of the South Bug river is very important task to be solved. The ponds in Vinnytsia Region are mainly used for fish farming and recreation needs. Usage of ponds is registered by rent contracts, that promotes maintaining water – development facilities in appropriate technical conditions, provides their reliable operation during floods and freshets. Greater part of engineering facilities are in lease of legal and natural persons. The problem of water facilities certification is very important for efficient planning of water facilities operation modes, determination of risk degree and technical state of engineering facilities.

To provide proper operation of engineering facilities certificates of the ponds are created; using these certificates it is possible to carry out the assessment of technical states of the ponds, elaborate measures aimed at prevention of emergency situations and recommendations regarding adoption of precautionary measures, etc.

Problem set-up

The certificate of ecological object is a document, containing basic information regarding the given object. In order to assess the ecological state of the river basin and develop measures aimed at rational usage, protection of water and restoration of water resources the certificate is composed, in accordance with the procedure, determined by the Cabinet of Ministers of Ukraine [1].

All the information concerning the water object is contained in water-economic certificate of the pond, the certificate comprises the passport of the pond and explanatory note. The passport of the pond consists of 1-3 pages and the volume of explanatory note may reach forty pages. Explanatory note contains the detail description of the information that is to be included in the certificate.

Differentiation of water objects is carried out by means of their certification. Certification of water object--- it is the set of state measures, aimed at regulation of water objects usage, their protection from the pollutions, blockage, depletion, prevention of harmful impact of waters and liquidation of harmful consequences, improvement of water objects state.

Legislation of Ukraine does not give the exact definition of water-economic certificate but in accordance with the Decree of the Cabinet of Ministers of Ukraine «About the approval of certificates of rivers drafting and the Order of bank strips of water ways establishment and their nsage», April, 14, 1997 № 347, the definition and the structure of pond certificate can be elaborated and established. The certificate of the pond is the registration document, containing the information regarding basic parameters of the pond and integrated water power development (area, volume, width, length, availability of embankment, etc).

The passport of the pond is a unified set of basic data regarding hydrolycity, physical-geographical characteristics, usage of natural resources, ecological situation and elaboration of

recommendations, aimed at the increase of ecological system stability [2].

As a rule, water-economic certificate of water object is drafted for the object (ponds), taken on lease for fish farming. It must contain information concerning the rules of object operation . Water-economic certificate for water object are elaborated by specialized planning and designing organizations.

The problem of water object certification is of great importance for efficient planning of water object operation modes, determination of the degree of risk and technical state of hydro facilities.

In order to provide reliable operation and prevent emergency in accordance with the decision of the Council of National Security and Defense of Ukraine of February 16, 2010, local authorities are to make inventory and certification of objects and structures, including hydro engineering facilities. That is why, elaboration of ecological certificate of the pond, that would contain all the necessary data for its operation, that would facilitate the work both of public service, especially of Basin Administration, and of pond owner, is very important problem. Rather often, while solution of various ecological, hydrological and economic problems, connected with water objects, there appears the necessity to apply to the certificate of the pond. We suggest the list of problems, the solution of which requires the information from the certificate of the pond:

1. Morphological indices (the area of the pond S, m^2; the length of the water reservoir L, m; the width of the pond B, m):

$$B_{evr} = \frac{S}{L},$$ (1)

where S – is the area of the water surface; L – is the length of the pond

2. Winding coefficient m – degree of the coastal strip development, relation of coastal strip length to the circumference length of the circle that has the area that is equal to the area of the pond:

$$m = \frac{l}{2\sqrt{\pi S}},$$ (2)

where l – is the length of coastal strip; S – is the area of water surface.

3. Volume of the water in the pond W, m^3, can be determined by the map of isobaths, using «method of prisms» [1]. This volume is calculated by the formula

$$W = \frac{S_0 + S_1}{2}h + \frac{S_1 + S_2}{2}h + \frac{S_2 + S_3}{2}h + \ldots + \frac{S_{n-1} + S_n}{2}h + \Delta W,$$ (3)

where $S_0, S_1, S_2, \ldots, S_n$ – are areas, limited by separate isobaths; h – is the height of prisms; ΔW – is the volume, formed between the area of the latter, the deepest isobath and the point of pond bottom with maximum depth, determined by the formula:

$$\Delta W = \frac{1}{3}S_n(h_{max} - h_n),$$ (4)

where h_{max} – is maximum depth of the pond in meters; h_n – is the depth of the deepest isobath; S_n – is the area of the latter (the deepest) isobath.

4. Average depth of the water reservoir h_{cp}, m, is determined by the formula:

$$h_{cp} = \frac{W}{S},$$ (5)

where W – is the volume of water reservoir; S – is the area of water surface.

5. For approximate calculations of the highest water levels, m, of ponds formula is used:

$$\Delta\overline{H} = \beta\sqrt{\frac{A}{S}}, \tag{6}$$

where $\Delta\overline{H}$ – is average long-term raise of water level; cm; β – is the coefficient, determined as a result of observations on neighboring water reservoirs with close relations of morphological characteristics and run-off mode from water reservoirs; A – is the area of water intake of the pond, km^2, S – is the area of pond water surface, km^2;

6. The rent for the usage of the pond for fish farming:

$$\Pi_{op} = \sum_{i=1}^{n} S_i \times k_i, \tag{7}$$

where S – is the area of the ith pond, ha; k_i – is the coefficient of the rent, that depends on the location of the pond,Hrs...

Depending on the type of the pond, its hydro facilities, method of usage and location, the list of paragraphs in water economic certificate will change. That is why, the problem appears to elaborate ecological certificate of the pond, that would allow to solve main problems and would contain the list of characteristics, that would fit for any pond, irrespective of its size, designation or other parameters.

Formalization of the ecological certificate of ponds

Having analyzed regulatory legal base, concerning ponds, paper variants of water economic certificates, we determined that ecological certificate of ponds is complex and versatile, it is the set of documents, containing complete information about object.

For the elaboration of new model not only legislate acts were taken into account but also the certificates, elaborated by planning and designing organizations. For the solution of the problems, put forward, unified information model of the ponds has been constructed.

Formalization of key classes of the notions has been realized in the following way:

– information model of ecological certificate of the ponds (V_p):

$$V_p = U_v + P_{st} + P_z, \tag{8}$$

where: V_p – is ecological certificate of the pond: U_v – is legal information; P_{st} – is the certificate of the pond; P_z – is explanatory note.

$$U_v = Z_v + P_z + P_v + P_g, \tag{9}$$

where: Z_v – is general information (first name, family name, location, village council, region); P_z land property rights (date of contract signature, term of validity, rent payment); P_v – property right for water object (date of contract signature, term of validity, rent payment); P_g – property right for hydrostructure (date of contract signature, term of validity, rent payment).

$$P_{st} = O_p + G_v, \tag{10}$$

where: O_p – are basic parameters (catchment area, real pond level marks (RPL), marks of normal pond level (NPL), minimal mark, area of the pond at NPL, area of the pond at RPL, length of the pond, width of the pond average, width of the pond maximal, width of the pond minimal, average depth of the pond); G_v – integrated hydrostructure (dam, dikes, water outlet, explanatory note, general provisions, calculation of minimal losses, water economic calculation, maximum water discharge, schedule of water discharge from the pond time determination, curve of water level dependence, cross – section profile along flood – plain of the river, characteristic of integrated

hydrostructure). Hlaving investigated regulatory documents and analyzed the elaborated certificates, we developed UML – model of the ecological certificate of ponds [Fig 1].
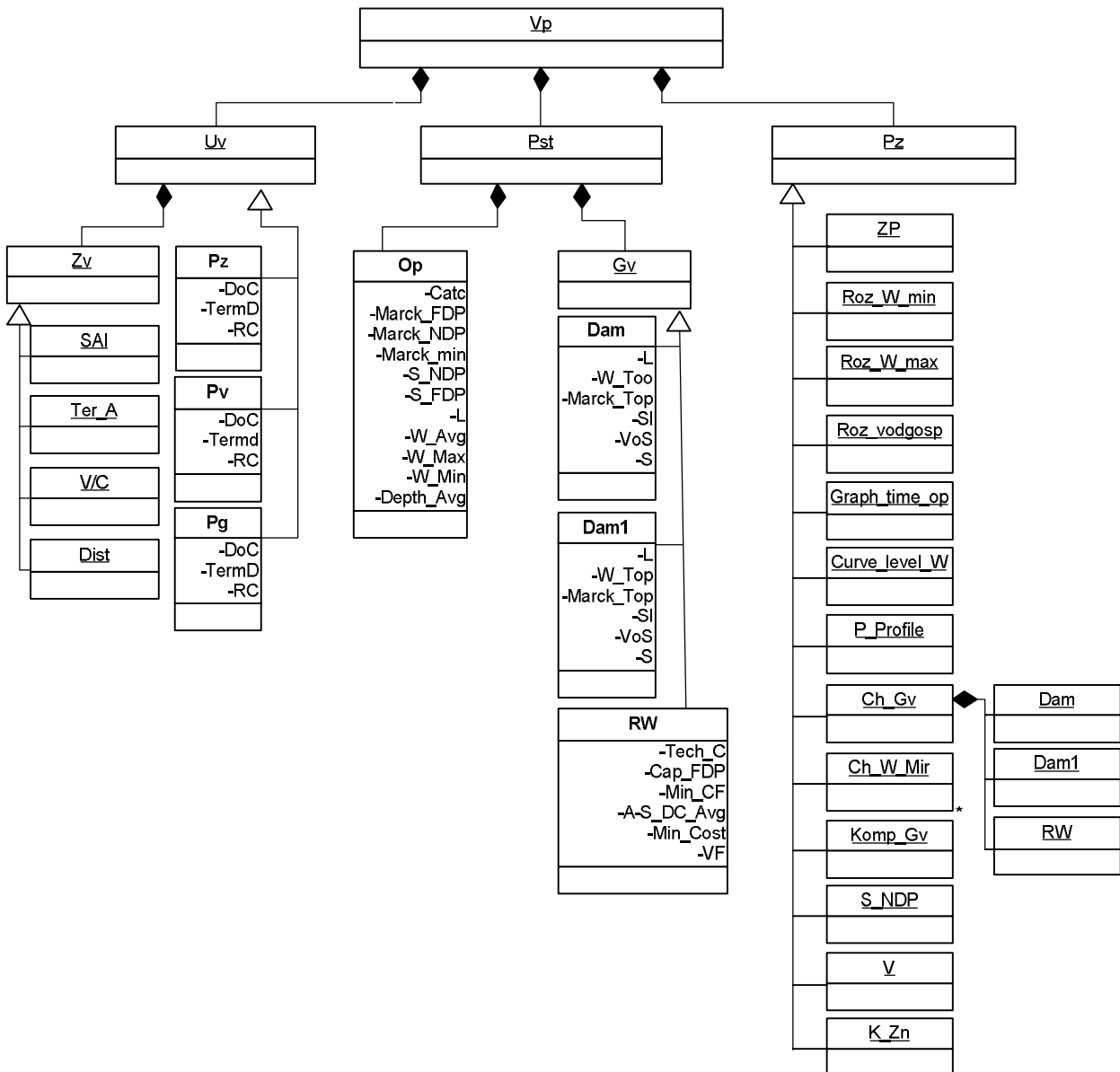

Fig. 1 UML-model of ecological certificate of the pond

The given model consists of basic blocks, needed for complete characteristic of ponds. Arrows indicate connections between corresponding blocks. These characteristics were written by means of symbols.

Testing of ecological certificate model for identification of the ponds of Vinnytsia Region

For theoretic substantiation of the model we suggest to elaborate on the basis of the already elaborated model ecological certificates for the ponds of Vynnytsia Region using the algorithm, shown in Fig. 2.
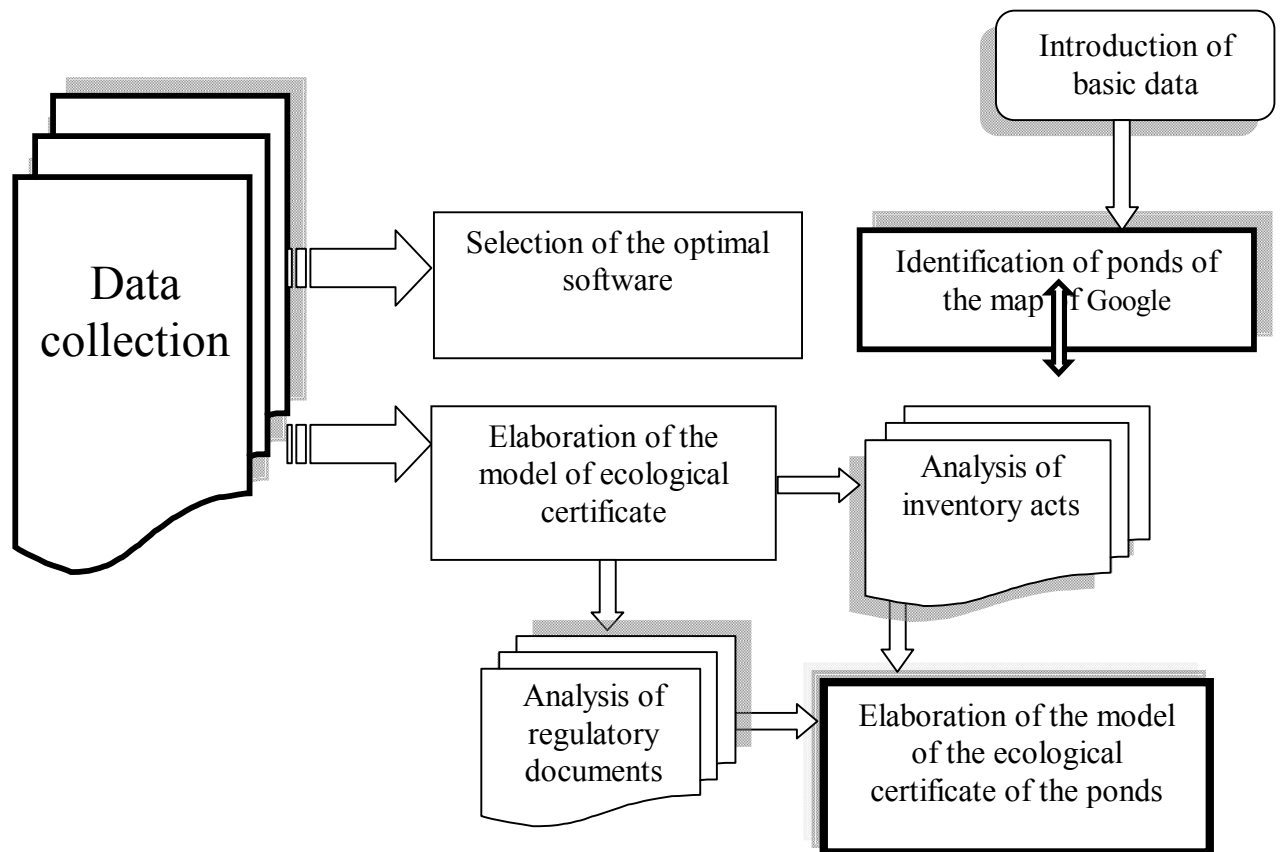
Fig. 2. Algorithm of the elaboration of ecological certificates for the ponds

In accordance with the suggested algorithm, on the basis of data of Basin Administration of water resources of the South Bug river, the information regarding the leased ponds of Vinnytsia Region was collected, leaseholders on the territory of Vinnytsia Region were classified by the Inventory Acts of water objects and hydro-engineering structures.

For the investigation all the ponds are taken, in the process of algorithm execution 1605 ponds are marked on Google maps and information, used by Basin Administration of the South Bug river in the process of control, is registered [3].

By means of Google Maps our own profile was created, it enabled to mark on the map and satellite images of the Earth the ponds of Vinnytsia Region (Fig. 3).
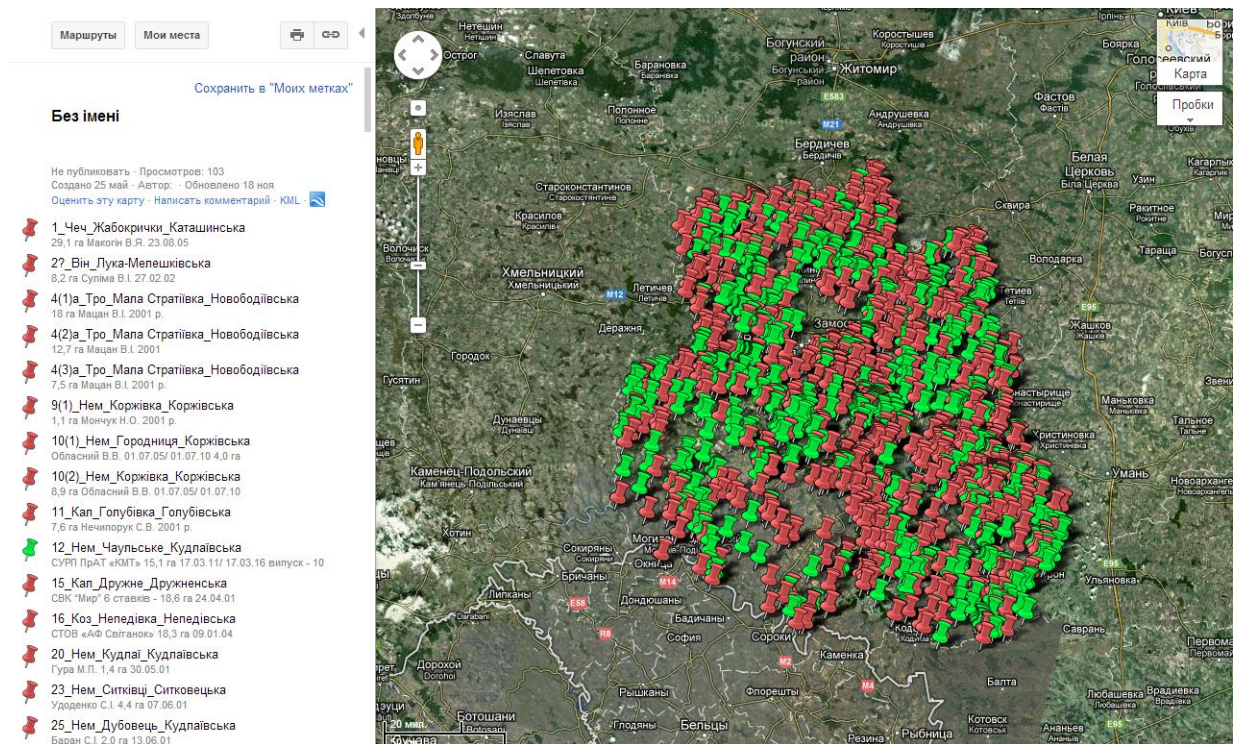
Fig. 3. Ponds of Vinnytsia Region on the map and on satellite photographs Google

By means of additional functions of «My labels» profile, the ponds were not only identified but their basic parameters, name, area and location (within the limits of or outside the settlement) (Fig. 4) were indicated.
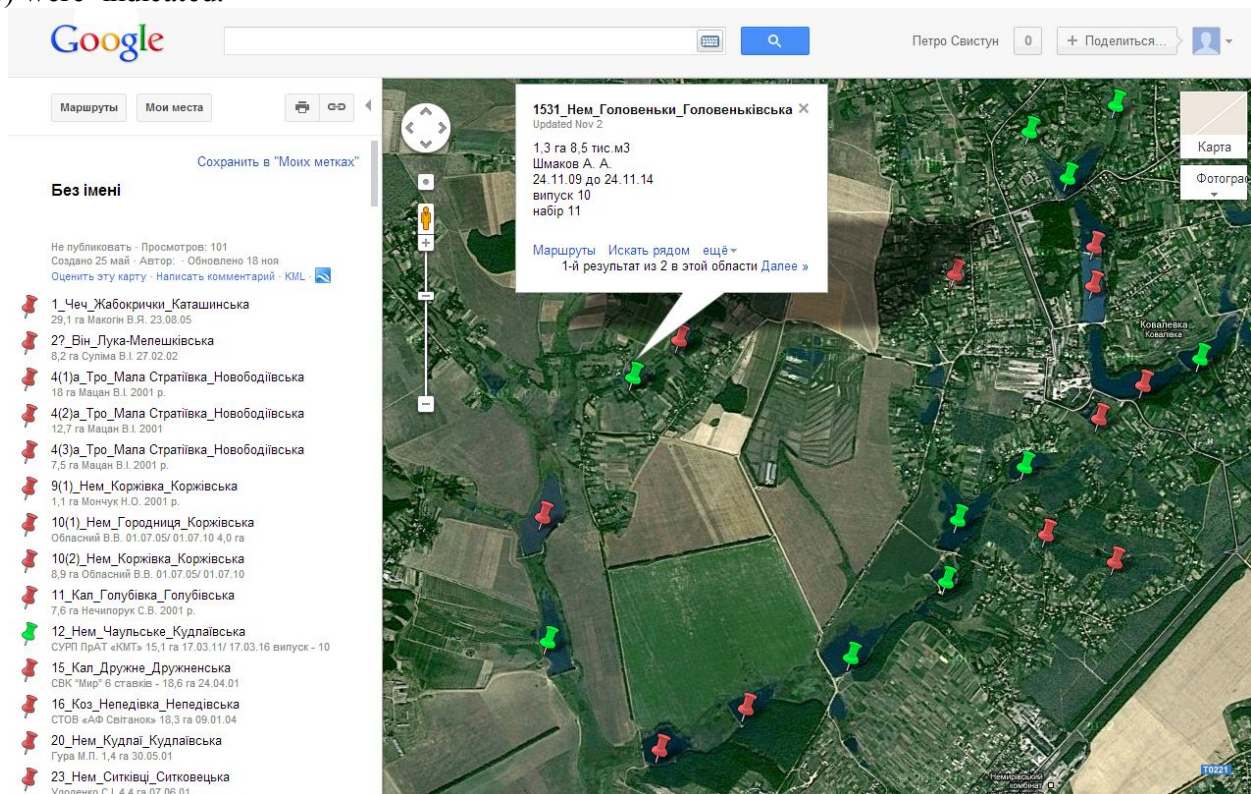

Fig. 4. Ponds of Vinnytsia Region with the indicated information

Google maps are rather convenient for identification of ponds, however, there exists the

possibility of information loss, since the information is on Google server, which may become the victim of hackers attacks, that is why, the work is being carried out, regarding the transfer of the above-mentioned into off-line mode.

Conclusions

The paper suggests new model of ecological certificate of the ponds, that differs from existing models by its complexity, that enables to obtain more important information in one document.

The novelty of this development is in the grouping of the characteristics, necessary for proper functioning and monitoring of the ponds. Since the available variants of the certificates exist only in paper form and separately (in different organizations, dealing with monitoring and control of ponds), we may assume that new model has been suggested , on the basis of which new method of the control over water objects has been formulated. This development enables to obtain more useful information grouped and consolidated in one ecological certificate. Its usage will reduce the expenses and will facilitate the analysis of the ponds.

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