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MODERNIZATION/REHABILITATION OF THE SECONDARY DRAINAGE INFRASTRUCTURE BY REPOSITIONING EXISTING CHANNELS AND BY ASSIGNING THE DUAL ROLE OF DRAINAGE-IRRIGATION

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Abstract

The paper deals with the need to modernize the existing secondary drainage infrastructure, in an effort to implement new water management strategies, in line with current needs, including a case study that proposes a solution in this sense, by designing a drainage-irrigation system based on the optimization and systematization of the agricultural surface taken into account, the efficiency of the water circuit and last but not least, the achievement of reduced water consumption. Drainage and irrigation systems represent an important element in the complex equation of agriculture, their management being able to make the difference between performance and failure, hence the importance of consolidating the optimal strategy regarding the design, modernization and ensuring their functionality. In geographical areas with excess humidity, it was necessary to build drainage systems to remove excess water from the land to make it arable, through land improvement works as support for agriculture, similar works executed in Romania between 1950-1989 which, especially due to its age, requires restoration/modernization. Considering the modernization of agricultural technologies, the introduction on a larger scale of a new mindset on more environmentally friendly agricultural systems, global climate changes, etc., the rehabilitation and modernization of the secondary infrastructure within the old drainage facilities is currently necessary and timely - drainage, where the technical conditions allow their transformation into complex drainage and irrigation facilities. The paper presents a case study in this sense, from which derives the need to make some legislative changes that will have to be made to facilitate the promotion of such complex facilities desiccation - drainage and irrigation.

Key words: *drainage-irrigation canals, repositioning, system modernization.*

INTRODUCTION

Land improvement plans in Romania it includes drainage - drainage plans, irrigation plans and soil erosion control. In some cases, there are also complex arrangements that include drainage - drainage and irrigation arrangements, drainage - drainage and soil erosion control arrangements or even drainage - drainage, irrigation, and soil erosion control arrangements.

In Romania, drying, draining and erosion control facilities are owned by ANIF (through the Territorial Branches for County Land Improvements), as well as key infrastructure (basic pumping stations, re-pumping stations and main canals/pipes) that serve the irrigation facilities. In most cases, the secondary irrigation infrastructure has been handed over to the Irrigation Water User Organizations for management.

MATERIALS AND METHODS

The studied area is a component part of the Teba-Timisat facilities (Figure 1). This is a facility located in the hydrographic basin of the Timis and Bega rivers. In terms of location, the Teba-Timisat drainage-drainage facility has the Bega Canal as its northern boundary, the Sag-Topolovat Complex as its eastern boundary, the Timis River and the settlements of Rudna-Giulvaz and Caraci as its southern boundary, and the border with Serbia as its western boundary. Commissioned in 1962 and completed between 1985 and 1987, the project serves an area of approximately 28,000 ha, of which 285 ha is closed drainage. The area is divided into three compartments: Dinias (with two drying units), Otelec (with two drying units) and Cruceni (with 8 drying units). For the case study, we narrowed the area to a portion of approximately 1000 ha from the 7144 ha within the Otelec Compartment, the Otelec Vest drainage unit that serves 2420 ha and has a pumping station-Otelec on the left bank-located on the Bega Canal on the left bank km 3+400, with desiccation destination consisting of 5 Brates 600 aggregates with a power of 132 kw and a flow rate of 1.1 m^3/s and 2 Flygt type pumps of 110 kw with a flow rate of 1.13 m^3/s (ANIF, 2024).

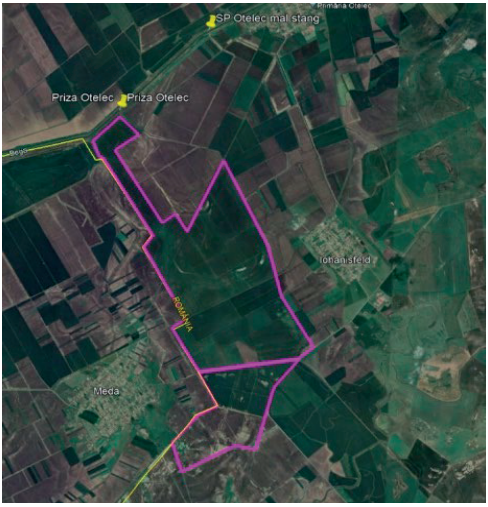

Figure 1. Study area

The drainage network in the studied area totals 45 km of drainage canals of all orders, which at the time of the study were in a deplorable technical condition, requiring restoration, unclogging and repairs/replacement of constructions related to the drainage-drainage arrangements (Figure 2).

The main causes have led to this situation are the lack of maintenance for three decades, the destruction or theft of some components from the constructions related to the arrangements and non-compliance with the exploitation regulations by the farmers with land in the respective area (non-compliance with the safety distance by agricultural works carried out in the immediate vicinity of the banks of the canals, by blocking the section of the canals in order to collect water used for diluting fertilizers and pesticides, by destroying weirs for the illegal sale of ferrous materials, by filling in sections of the canals in order to increase the surface of the cultivated land, etc.).

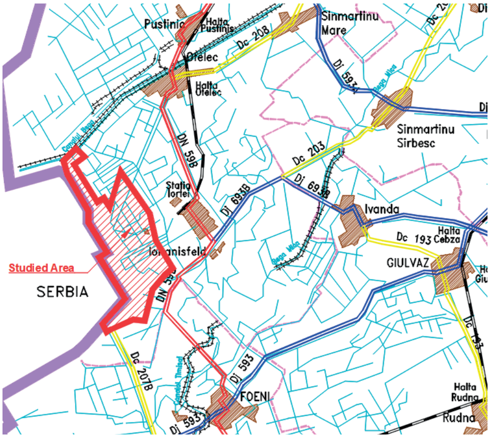

Figure 2. Area of interest, part of the Teba-Timisat improvement

The location of the respective part of the studied secondary drainage infrastructure within the entire complex, as well as the fact that in time a commercial company managed to merge the land in a proportion of 99% on approximately 1000 ha, intending to implement irrigation system projects for large-scale culture and for a hazelnut plantation, determined the initiation of studies for the modernization of the secondary infrastructure of the drainage-drainage and irrigation system.

The following key features were considered when designing:

1. The practice of efficient and modern agriculture will be operated with last-generation agricultural machinery characterized by large dimensions
2. The irrigation system for 2/3 of the surface is sprinkler with Ranger-type linear installations (Plot 1, with water source from the Bega Canal);
3. The irrigation system for 1/3 of the surface is drip fed from a retention basin with water source from boreholes and rainfall (Plot 2);
4. Systematization of soils through modelling, to eliminate micro-depressions and to ensure easier elimination of excess water from precipitation by reorganizing drainage slopes (Man, 2014).

Two options were taken into consideration:
1. Achieving the objectives by maintaining the position and configuration of the existing drainage-drainage channels in the original design of the secondary drainage-drainage infrastructure as it was conceived 60 years ago (in the design of the drainage-drainage facilities, the channels were mostly drawn approximately perpendicular on the line of the greatest slope or with an inclination compared to the level curves to carry out the gravitational evacuation of the surplus water from the respective land and the addition of new irrigation canals, integrated into the old system (Kagalkar, 2017).
2. Achieving the objectives with the repositioning of most of the existing channels (by respecting the names and respectively the geometric and hydraulic elements of the existing channels, without affecting ANIF's patrimony/inventory), the unclogging and/or re-profiling of those channels that do not require repositioning and the construction of new sections (Law 7, 1996; Law 107, 1996; Law 137, 1995; Law 138, 2004).

RESULTS AND DISCUSSIONS

Option 1

For Plot 1, the water source is the Bega Canal, through the gravity intake located at km 0 + 815 m on the left bank and, due to the fact that the water level in the Bega Canal is not constant, especially in the May-September period when irrigation is needed, the outlet being unusable during that period, through a pumping station with four heat pumps. Water for irrigation will be transported using part of the ANIF canals and newly designed canals, with a dual role of drainage and irrigation. Also, in order to preserve the old drainage network, it was necessary to design new hydrotechnical constructions (works of art), in order to be able to use the complex drainage-irrigation system.
Regarding the situation of the ANIF channels included in the system, some of them will be used during irrigation as water transport channels, some will be repositioned to optimize the system. As well as works on them, they almost entirely require unclogging and/or reprofiling. In order to harmonize the system as a whole with the mode of operation of the new agricultural machinery and modern irrigation installations, the exploitation roads and bridges were also redesigned, bringing - them in sizes that serve the new sizes and technologies. For the second plot (irrigation and drainage Hazelnut plantation 260 ha), the water source is obtained from the rainfall during rainy periods and through 4 shallow boreholes (up to 40 m) that pump water from the lower aquifer layer, in a retention basin, having the following characteristics:
- S = 2.5 ha, V=46000 m^2, land share = 77.40 m, razer share = 75.10 m;
- the average depth of water in the basin is 2 m;
- the inclination of the inner wall of 1:2;
- the elevation of the maximum water level 0.30 m below the elevation of the land;
- the level of the bottom of the basins is located 0.70 m (freezing depth) above water table level;
- the pool will be waterproofed with polyethylene film or geomembrane like this so that the upper aquifer layer is not affected both from a qualitative point of view and also from quantitative point of view.

The excavation volumes will be used to level the local micro depressions on the 263 ha site. The underground drip irrigation system expected to be used to ensure the plantation's water needs was chosen following the optimization (the economy of the water resource by reducing losses through evaporation/watering unproductive land and the direct supply of the reticular system, as well as the necessary fertilization through -a single operation-fertigation-), of the entire system.
The pumps for the four wells will be fed using electric submersible pumps and pumps with thermal or electric motors will be used to take the water from the basin to irrigate the plantation. The necessary electrical energy is obtained by connecting the system to the national electrical energy system, through the mains low voltage nearby. Excess rainwater from the soil will be removed through the existing channels in the secondary drainage system and will follow its designed course, being collected in the emissary, and transported to SP Cruceni, to be discharged into the Timis river. The presence of micro-depressions in the soil - the main cause of quasi-permanent

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puddles - requires the remodelling of the land through specific land improvement works, all the more necessary, considering that the area will be prepared for the implementation of an irrigation system (Figure 3). For this classic design model, the following were evaluated as elements that could bring more functionality and financial economy:

1. Reducing the number of hydrotechnical constructions and the necessary works of art;
2. Ensuring a better functionality of the drying system by drawing the drying channels in a straight linear format;
3. Creating optimal conditions for agrotechnical works by systematizing the soils, the straight channels offering regularly shaped soils in an overwhelming proportion;
4. Optimizing water management, maintenance and agrotechnical works.

Pursuing these objectives, a project was developed to reposition the old drainage canals with the integration of the irrigation canal system, resulting in a compact system of canals with the double role of drainage and irrigation, presented in the paper as "Option 2".

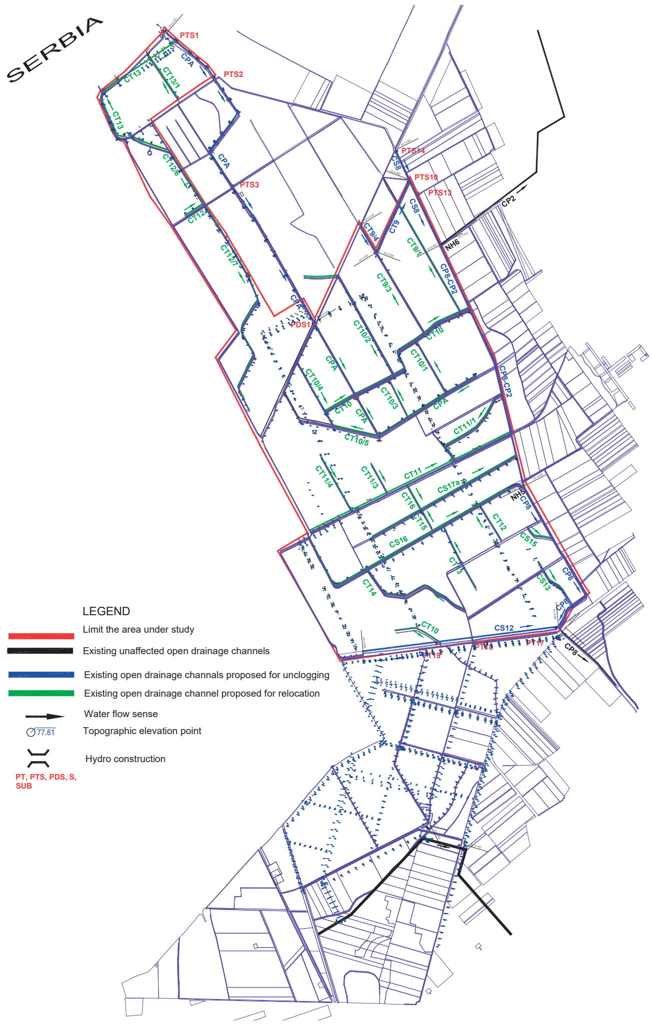

Figure 3. Design option 1

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Option 2

The need to find a second option also finds its logic in the current situation stemming from both the new EU policies regarding the CAP and the new direction towards the optimization and sustainability of agricultural practices: reduction of fossil fuel consumption, biodiversity, water management, conservation of natural elements, reduction of carbon emissions, elimination of implementation and exploitation expenses, etc. as well as from strictly pragmatic considerations (economic and resource management). The solution consists mainly in the repositioning of the existing drainage channels and the thickening of the network of drainage channels to ensure the maintenance of an appropriate water level. This new design solution not only improves the functioning of the entire secondary drainage system, but also assigns it the double role of drainage and irrigation, contributing to the efficiency of logistics and water management, not least, to the reduction of implementation, maintenance, and exploitation expenses. By construction, the new system resystematizes the soils in a way that facilitates specific agricultural technological operations, generating significant savings in time, fuel and money.

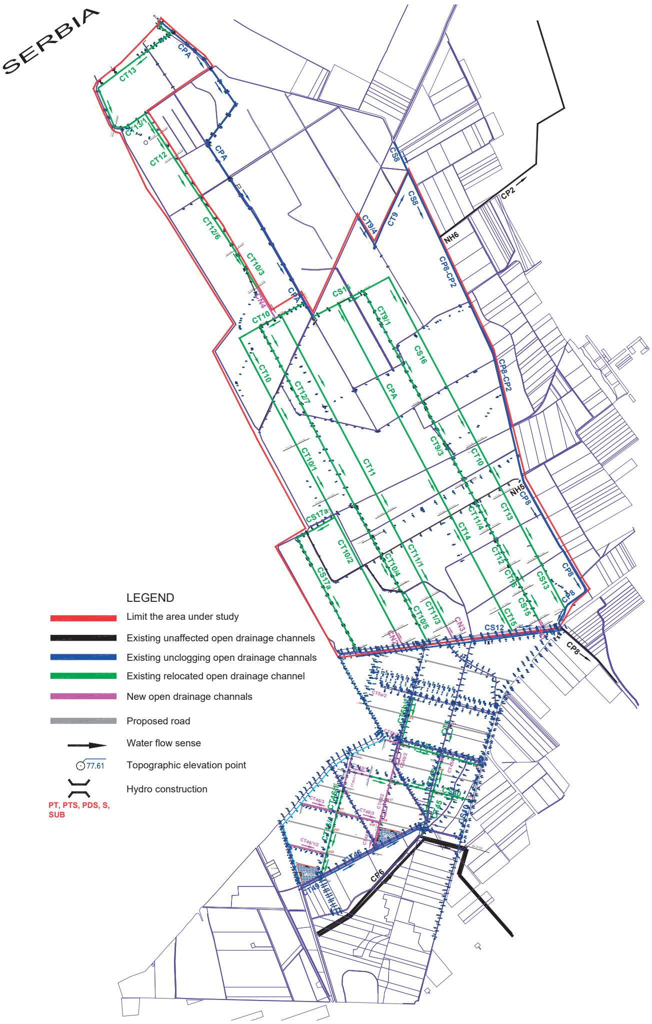

Figure 4. Design option 2

By using the rainwater captured in the drainage canals and led to the reservoir, to reintroduce it into the circuit, the additional pumping costs in the Timis River (in this case), through the Cruceni Pumping Station, are reduced. Powering the pumps for extracting water from the groundwater table will be done using green energy generated by a photovoltaic park to be built in the perimeter of the plantation (Figure 4).

The movement of water in channels, beds or partially filled pipes are examples of free-level movements. Generally, for current tubes with free level, the name "channels" is used, respectively the movement in the channels.

The main characteristic geometric and hydraulic elements are:

- S - the cross section of the current (flow section or live section);
- P - the wetted perimeter (the rigid boundary in contact with water in a cross-section of the current);

$$i = \sin\theta = -\frac{dz}{dl}$$

- the (geometric) slope of the eraser;

$$h = \mathrm{h}_v = \mathrm{h}_R = \mathrm{h}_n\cos\theta$$

where:
− h_R - normal on the bottom
− $h_n\cos\theta$ - vertical projection
− h_v- vertically

In normal technical conditions (slope $i = \sin\theta \leq 14$), $\cos\theta \geq 0.99$ which justifies the approximation introduced by equating the three depths.

In the following the notation "h" will be used, meaning $h_v, h_R\cos\theta$ *or* $h_n\cos\theta$, depending on the needs of the studied problem.

$$I_s = -\frac{d(h+z)}{dl}$$

- Q - the flow rate of the liquid stream;
- v - average speed (v = Q/s) of the current.

For this case study, only prismatic channels were considered, characterized by the fact that the section is constant for a constant depth along the channel.

$$\frac{dS}{dl} = 0$$

The general equations of the movement of liquid currents with a free level, in global form, for a current tube segment characteristic of free-level movements are:
- the energy transfer equation;
- the momentum transfer equation.

For the suitability of these equations for practical applications, the following notations and simplifications are considered:
a) enter the grades α and β representing the global non-uniformity coefficients of the speed distribution and their turbulent fluctuations:
b) is considered $\cos\theta = 1$, that is, the hypothesis small slopes (under 14%);
c) the braking influence of the free surface is neglected;
d) it is considered that the flow sections S_1 and S_2 are locally orthogonal to the streamlines.

With these observations the energy transfer equation becomes:

$$\frac{\alpha V_1^2}{2\mathrm{g}} + z_1 + h_1 = \frac{\alpha_2 V_2^2}{2\mathrm{g}} + z_2 + h_2 + h_{r12}$$

where:
- V_1, V_2 are the average velocities in the flow sections;
- S_1 and S_2 in the mean turbulent motion;
- h_{v12} represents the energy dissipated and transferred to produce turbulence in the control volume limited by the flow sections and is called the head loss (for turbulent mean motion).

The momentum transfer equation projected along the "l" direction becomes:

$$F(S_\Sigma) = \rho Q(\beta_1 V_1 - \beta_2 V_2) + \rho g z_1 S_1 - \rho g z_1 S_2 + G_i$$

where:
- $F(S_\Sigma)$ represents the action of the liquid on the rigid boundary S_Σ.

The continuity equation is added to these equations: Q = VS

Introducing the notations:
$i = -\frac{dz}{dl}$- called the geometric slope
$I_e = \frac{dh_r}{dl}$- called energy slope (specific dissipation on $\rho g Q$ and the unit of length)
$i_f = \frac{\tau_0}{\rho g R} = \frac{V_*^2}{gR}$ representing the friction slope

where:
- τ_0 wall tension,
- V_* friction speed,

- R the hydraulic radius.

The momentum transfer equation is obtained in the form:

$$i - i_f = \frac{i}{gS}\frac{d}{dl}\left(\beta\frac{Q^2}{S}\right) + \frac{1}{S}\frac{d}{dl}\left(z_g\right)$$

The differential forms of the fundamental equations can be put in a more convenient form in order to establish a relationship between the slopes i, i_f, I_e.

To this end it is noted that in the hypothesis of prismatic channels and considering the notations we get:

$$\frac{\partial S}{\partial l} = 0$$

and considering the notations we get:

$$i - I_e = \left(1 - \frac{\alpha Q^2 B}{gS^3}\right)\frac{dh}{dl}$$

$$i - i_f = \left(1 - \frac{\beta Q^2 B}{gS^3}\right)\frac{dh}{dl}$$

It is observed that in general $i \neq I_e \neq i_f$.

In the case of uniform motion, when h=const., so, dh/dl = 0, result:

$$i = I_e = i_f$$

that is, the energy slope (I_e), of friction (i_f) and geometric (i) they're the same.

In case of non-uniform movement

$$\frac{dh}{dl} \neq 0$$

generally, results:

$$i \neq I_e \quad \text{and} \quad i \neq i_f$$

As for the slopes I_e and i_f and they differ in general. It can be seen that they become equal if and only if the coefficients α and β they are equal. The relationship can be established between the two slopes:

$$i_f = I_e\frac{1 - \frac{\beta Q^2 B}{gS^3}}{1 - \frac{\alpha Q^2 B}{gS^3}} + \frac{i(\beta - \alpha)\frac{Q^2 B}{gS^3}}{1 - \frac{\alpha Q^2 B}{gS^3}}$$

However, in current practice it can be considered, with a very good approximation, $\beta = \alpha$, the two slopes i_f and I_e they can be considered practically equal even in the case of non-uniform movement.

Therefore, in contrast to uniform motion, in the case of non-uniform motions the relation:

$$i \neq I_e = i_f$$

It is possible to write based on these relationships:

$$I_e = i_f = \frac{V_*^2}{gR} = \left(\frac{V_*}{V}\right)^2\frac{V^2}{gR}$$

where:

- V is the average speed in the flow section.

Using the same notations as in the case of pipes, they are obtained for the energy slope I_e the two types of classical formulas:

- Darcy-type formulas:

$$I_e = \frac{\alpha}{\beta}\frac{V_*^2}{gR}$$

$$V = \sqrt{\frac{8g}{\lambda}}\sqrt{RI_e}$$

- Chezy type formulas:

$$I_e = \frac{1}{C^2}\frac{V^2}{R} = \frac{Q^2}{S^2C^2R}$$

$$V = C\sqrt{RI_e}$$

where:

- "λ" it is called the Darcy resistance coefficient,
- "C" the Chezy coefficient.

For the calculation of the coefficients λ and C formulas of the same type as in the case of pipes will be used. For λ a general formula of the Colebrook. White type is applied in which D will be substituted by 4R (this is due to the connection between the hydraulic radius R and the diameter D in the case of circular pipes D = 4R) and a correction coefficient "f" is introduced depending on the shape of the section transverse:

$$\frac{1}{\sqrt{\lambda}} = -2\log\left(\frac{2.51}{fR_e\sqrt{\lambda}} + \frac{k}{3.71f4\mathrm{R}}\right)$$

According to Bock, the shape coefficient f has the following expressions.

- for trapezoidal sections:

$$f = \left(1.629\frac{h}{b}\frac{1 + m\frac{h}{b}}{1 + 2\sqrt{1 + m^2}\frac{h}{b}}\right)^{0.25}$$

For the coefficient C, it is used as the most common formula:

$$C = \frac{1}{n}R^y$$

with:

$$\frac{y=1}{6} - afterManning - Stickler$$

$$y=2.5\sqrt{n} - 0.13 - 0.75\sqrt{R}\left(\sqrt{n} - 0.1\right)$$

- or the simplified formulas according to Pavlovski:

$$y=1.5\sqrt{n} \quad for \quad 0.1n \leq R < 1.0n$$

$$y=1.3\sqrt{n} \quad for \quad 1.0n \leq R < 3.0n$$

The equivalent roughness "k" in the Darcy formulas and the roughness coefficient "n" in the Chezy-type formulas are taken according to the nature of the channel walls (Wehry at al., 1982).

Currents with free level in permanent and uniform motion regime

Uniform movement with free level is achieved in artificial, rectilinear, and prismatic beds (channels, galleries, ditches, ditches, etc.)

According to the above, in the case of uniform motion, the relation occurs:

$$i = I_e = i_f$$

that is, the geometric, energy and friction slopes are identical. Considering the definition of the slope of the free surface and this is equal to the others.

Considering the particularities of uniform movement in the general calculation relations, the energy slope will be replaced by the geometric one:

$$I_e = i$$

In general, in technical applications, Chezy-type formulas are currently used:

$$V = C\sqrt{Ri}$$

Associating the continuity equation is obtained for the flow rate:

$$Q = VS = SC\sqrt{Ri}$$

$$R = \frac{S}{P}$$

The hydraulic radius is self-explanatory, and it is obtained:

$$Q = SC\sqrt{\frac{S}{P}i} = \frac{S^{\frac{3}{2}}}{P}C\sqrt{i}$$

By associating the Chezy formula, we obtain for the flow rate:

$$Q=SC\sqrt{Ri} = S\frac{1}{n}R^{y}\sqrt{Ri} = S\frac{1}{n}R^{y+\frac{1}{2}}\sqrt{i}$$

$$= S\frac{1}{n}\frac{S^{y+\frac{1}{2}}}{P^{y+\frac{1}{2}}}\sqrt{i} = \frac{1}{n}\frac{S^{y+\frac{3}{2}}}{P^{y+\frac{1}{2}}}\sqrt{i}$$

accordingly:

$$Q = \frac{1}{n}\frac{S^{1.5+y}}{P^{0.5+y}}\sqrt{i}$$

By replacing with the Manning relation, we get:

$$Q = \frac{1}{n}\frac{S^{\frac{5}{3}}}{P^{\frac{2}{3}}}\sqrt{i}$$

For the case of trapezoidal sections, it is observed that the area (S) and the wetted perimeter (P) can be expressed in the form:

$$S = bh + mh^2 = (\beta + m)h^2$$

$$P = b + 2\sqrt{1+m^2}h = \left(\beta + 2\sqrt{1+m^2}\right)h$$

Resulting by substitution:

$$Q = \frac{1}{n}\frac{(\beta+m)^{1.5+y}}{(\beta+m')^{1.5+y}}h^{2.5+y}\sqrt{i}$$

where with m' was noted:

$$m'=2\sqrt{1+m^2}$$

For example, the Drainage Channel - HCn 23343, identical to CT5 and the P14 bridge (Figure 5).

From the hydraulic calculation breviary carried out for the canals in the case study plot 2 (having the geometric and hydraulic elements shown in Table 1), and the related bridges, having the geometric elements (diameter, length, width) shown in Table 2.

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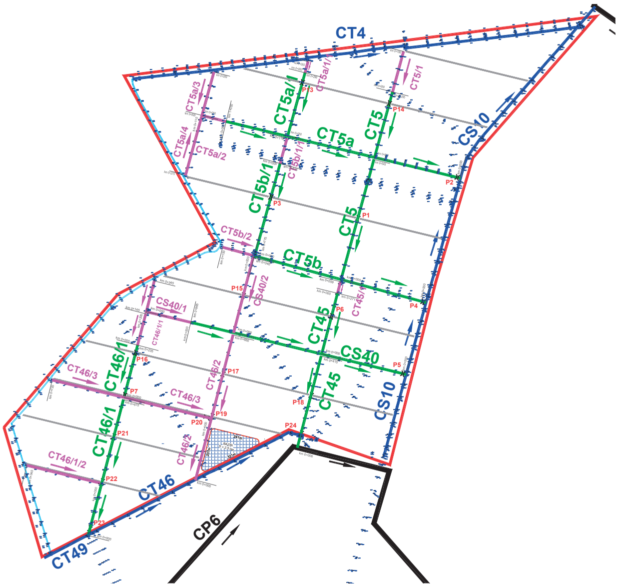

Figure 5. Plot 2 channel CT5, bridge P14

Table 1. Geometric and hydraulic elements

No	Channel name		L channel (m)	Channel section km to km	Confluence	Geometric elements			Hydraulic elements			Bright surface	Protection zone	Excavation/ Digging
	Cadastral	ANIF			channel	b(m)	m	I 0/00	h_{water} (m)	V (m/s)	Q (m^3/s)			
1	HCn 23343	CT5	545	0+000÷0+545	CT5b	0.5	1.5	0.6	0.15	0.17	0.02	2725	2180	2248
1'	HCn 23343	CT5	295	0+000÷0+295	CT5a	0.5	1.5	0.6	0.15	0.17	0.02	1475	1180	1217
2	HCn 2353	CT5a/1	286	0+000÷0+286	CT5a	0.5	1.5	0.8	0.2	0.2	0.03	1430	1144	1180
3	HCn 2341	CT5a	1050	0+000÷1+050	CS10	0.5	1.5	0.5	0.25	0.18	0.04	5250	4200	4331
4	HCn 2335/2	CT5b/1	416	0+000÷0+416	CT5b	0.5	1.5	0.8	0.2	0.2	0.03	2080	1664	1716
5	HCn 2337/1	CT5b	775	0+000÷0+775	CS10	0.5	1.5	0.5	0.25	0.18	0.04	3875	3100	3197
6	HCn 2335/2	CS40	965	0+000÷0+965	CS10	0.5	1.5	0.3	0.3	0.21	0.06	4825	3860	3981
7	HCn 2324	CT45	415	0+000÷0+415	CP6	0.5	1.5	0.8	0.2	0.2	0.04	2075	1660	1712
7'	HCn 2324	CT45	271	0+000÷0+271	CS40	0.5	1.5	0.8	0.2	0.2	0.04	1355	1084	1118
8	HCn 2297	CT46/1	615	0+000÷0+415	CT49	0.5	2	0.4	0.3	0.18	0.06	3997.5	2460	3229
8'	HCn 2297	CT46/1	235	0+000÷0+435	CT46/3	0.5	2	0.4	0.3	0.18	0.06	1527.5	940	1234
TOTAL												**30615**	**23472**	**25162**

Table 2. New bridges proposed

No	Bridge name	Channel name		km	Diameter (mm)	Geometric elements (m)	
		Cadastral	ANIF			Lang	Width
1	P13	CTa/1		0+242	600	5	5
2	P14	CT5		0+244	600	5	5
3	P15	CS40/2		0+171	600	5	5
4	P16	CT46/1		0+203	600	5	5
5	P17	CT46/2		0+478	600	5	5
6	P18	CT45		0+235	600	5	5
7	P19	CT46/2		0+289	600	5	5
8	P20	CT46/3		0+005	600	5	5
9	P21	CT46/1		0+445	600	5	5
10	P22	CT46/1		0+242	600	5	5
11	P23	CT46/1		0+005	600	5	5
12	P24	CT45		0+071	600	5	5

According to the theoretical foundations, the key curves were drawn up for the studied drainage channels. The results are shown in Figures 6 and 7 (Diagram D1 and D2).

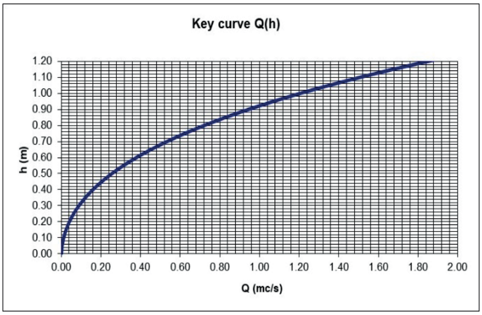

Figure 6. Diagram D1

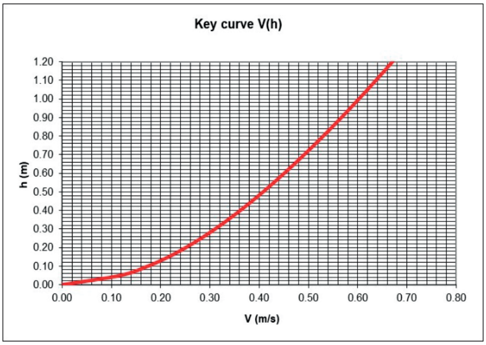

Figure 7. Diagram D2

For the designed flow of channel HCn 23343, identical to CT5 at the designed flow of Q = 0.02 m^3/s the obtained are presented in Table 3.

Table 3. Designed flow of channel HCn 23343

h	V	Q
(m)	(m/s)	(m^3/s)
0.13	0.22	0.02

Determination of the transport capacity of the proposed tubular bridges.

From the topographical studies as well as the data provided by the beneficiary, respectively the ANIF archive, the slope of the walkways, i = 0.0006, n = 0.021 and the recommendation to use tubular walkways DN 600 mm from PEID corrugated pipes result (Pelea, 2021).

For the diameter D = 0.60 m of the tube, by constructing the curves Q = Q(h), A = A(λ) and B = B(λ), we obtain Diagram D3 and D4 from Figures 8 and 9.

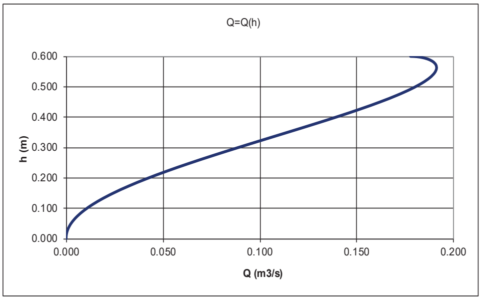

Figure 8. Diagram D3

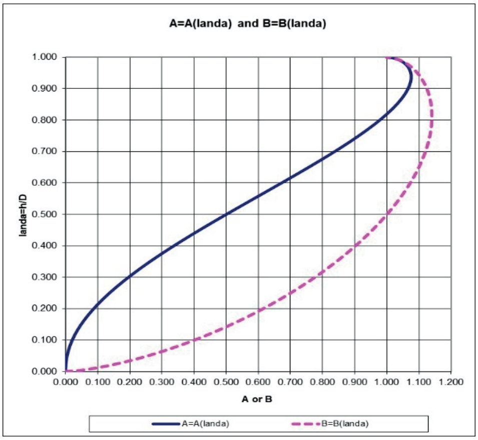

Figure 9. Diagram D4

The diagrams show the flow rates that can be discharged by the proposed tubular bridges with DN 600 mm from PEID corrugated pipes.

Q_{max} = 0.191 m^3/s at h = 0.56 m. The maximum capable flows far exceed the discharge flows of all channels in the studied site (both relocated and new proposed).

Figure 10 shows one of the dimensioned tubular floors as an example (plan view, sections, reinforcement, and the necessary materials).

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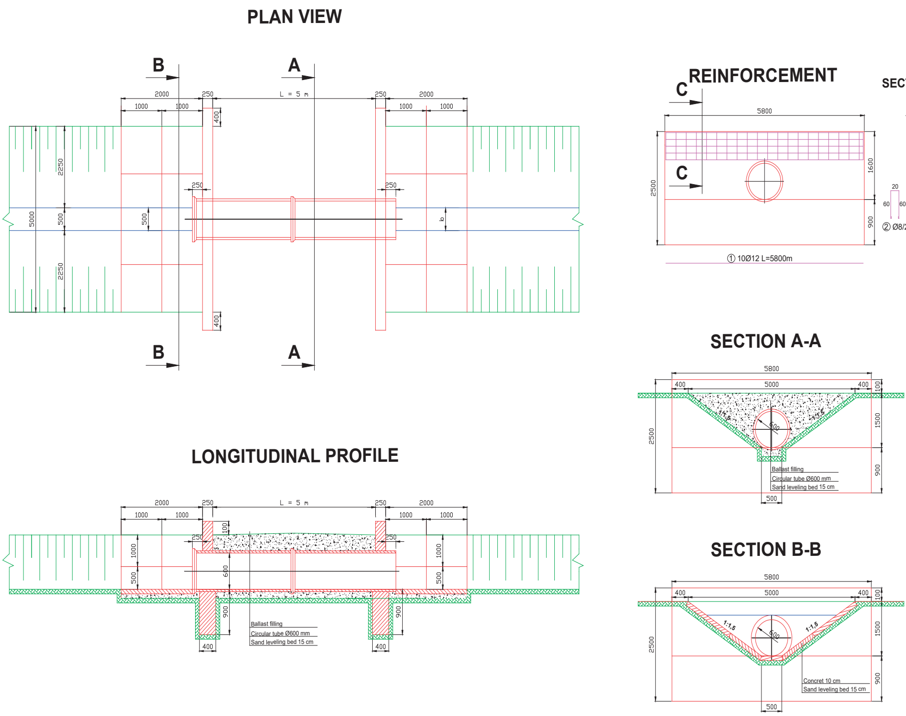

Figure 10. Plan view, sections, reinforcement and the necessary materials

CONCLUSIONS

Although from a technical and functional point of view, Option 2 is clearly superior to the classical option, it is currently facing some difficulties in implementation due to the impediments created by the legislation in force in Romania. This legal problem could be solved by a Government Decision allowing the repositioning of state-owned channels. In this sense, steps were taken, technical memos were presented both to the Ministry of Agriculture and to ANIF Bucharest, presenting solutions for regulation and proposals for procedures that would facilitate the implementation of the new systems of complex drainage-irrigation arrangements.

"Thus, throughout the Procedure reference will be made to the positioning/repositioning of drainage/irrigation channels in development areas with infrastructure improvements land administered by ANIF in the urban/extra-urban localities, for the purpose ensuring their functionality.

The positioning terminology will be used if the channel in question is not tabulated in the land registry system, and the repositioning terminology will be used if the channel in question is tabulated in the land registry, but the course is non-functional or prevents the development of the territory and/ or the urbanization of a site, effectively, and the repositioned course of this channel does not diminish the heritage of the Statute in terms of the inventoried surface.

The ANIF methodology for the issuance of regulatory documents provides for the issuance of approvals for the preparation of PUG, PUZ, PUD, technical approvals for the removal from the agricultural circuit of land located in the outskirts of the towns, technical approvals for obtaining the Construction Authorization for temporary construction works located in the outskirts localities, technical approvals for obtaining the Construction Authorization for the investment objectives located in the urban areas of the localities, technical agreements and specialized approvals." - excerpt from the answer received from MADR-ANIF, regarding

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the proposal to modify the procedure regarding the relocation of the ANIF drainage channels-28.12.2022.

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