

Leon GOSAR  
Franc STEINMAN,  
Boris KOMPARE  
Primož BANOVEC

## Definition of settlement agglomerations in Slovenia according to water management aspects

### 1. Introduction

By accepting the European Union's legal order, Slovenia is obliged to fulfil various responsibilities, in the scope and proscribed time frame as other member states, unless negotiation allowed postponement. Since year 2000 the Water Framework Directive applies (in continuation WFD) [1] for the field of water and water management (in continuation WM), which is the responsibility of the Ministry for environment, physical planning and energy (MOPE). Based on the framework specified by the WFD, various other directives were proscribed, while the validity of some ceased. For the protection of water before pollution, conditions stipulated in the Urban Waste Water Treatment Directive (UWWTD) [2] have to be observed, in which standards and the dynamics for achievement are specified. Until December 2002 measures for meeting the conditions from the Directive were directed towards building new systems for treatment of wastewater. The new ordinance [3] also specifies conditions for utilities dealing with gathering and treating urban waste and atmospheric water, as well as certain elements concerning management of the entire system.

The Law on environmental protection [4] stipulates that sewerage systems and systems for water treatment are in the responsibility of local communities. At present there are 197 local communities in Slovenia. On the other hand the state's commitments to the EU is that it will adopt the legal order and fulfil its responsibilities from directives and other regulations. Besides the UWWTD, which deals with wastewater of urban origin, stipulations from the Directive on Integrated Pollution Prevention and Control Directive also have to be observed (in continuation IPPCD) [5]. Amongst other, this directive regulates burdening with wastewater, specifies limiting values of pollutants, as well as payment of ecological taxes because of water pollution.

In the Republic of Slovenia a system of taxation for water burdening has been in place since 1995 [6]. To a greater or lesser degree it was possible to redirect payment of taxes to the national budget into suitable investments grounded in confirmed programmes of infrastructure development, whose effect would be diminishing quantities of pollutants introduced to water. Consequentially intensive building began, both of sewage systems and plants for treatment of wastewater. At present the quantity of completed treatment plants or plants that will be completed in the next two years, amounts to approximately 500.000 pollution units.

Responsibilities stipulated in UWWTD are relatively demanding and the defined bench marks are precise, therefore, by applying an organised approach, the state has began with more accurate monitoring of systems for gathering waste water and efficient management of waste water treatment. To reach this goal, besides obligations concerning monitoring of these systems, the Ordinance [7] defines development of a national system of monitoring, which is a constitutive part of the National programme of sewage and treatment of waste and surface waters. Amongst other, the produced agglomeration structure in the Republic of Slovenia and other complementary elements also has to be tied to other expert guidelines concerning water management (e.g. water sources etc.).

The methodology for producing the National programme, whose contents are defined in the Ordinance, has to enable analysis of the present condition and production of procedures that can support the timeframe and financial programme needed for achieving the goal condition. Production of the national programme follows the following steps: Determining so-called pressures on water because of water pollution, whose hypothetical rationale in the methodology's first phase was, that they originate from settled areas or parts of settlements (their common name being »agglomerations«);

- Presentation of conditions (scope, effects etc.) of extant infrastructure for gathering and treating communal wastewater;
- Identification of needs for such infrastructure by noting areas where such infrastructure should be built, according to EU criteria;
- Production of an estimate of financial resources needed for the infrastructure's construction and preparation of an implementation programme.

Development of the model, later used for producing expert guidelines [8], was based on extant, maintained data registers in Slovenia, such as:

- Register of territorial units, where physical and attributive databases of all administrative territorial units are maintained (e.g. local communities, settlements, house numbers etc.).
- Central population register tied to the Register of territorial units.
- Register of protected areas of water resources, established by the Ministry for environment, planning and energy (in continuation MEPE), because additional demands apply to such areas.
- Register of sensitive areas (e.g. to eutrophication) established by MEPE, in which other additional demands have to be respected.

Parallel to linkages between data in extant registers, extensive gathering of data about methods was also undertaken, whereby methods were researched by which public agencies involved with gathering and treating wastewater and surface water, conduct their services (since these agencies can be organised in different ways by particular local communities), as well as authorised contractors for implementing public services. Thus data that stems for responsibilities of local authority was gathered for the whole Slovene territory, i.e. extant infrastructure for gathering and treating wastewater and methods of pertaining evidence keeping. Wherever suitable evidence was available and obtained as digital data, such data was also respected.



## 2. Defining settlement areas – agglomerations

Implementing tasks concerning water management is often tied to settlements, whereby water management is complemented with tasks of utilities management. A review of definitions of settlements shows that the same concept can have different meanings in different professions. The term settlement as used in the Register of territorial units, whose areas cover the whole national territory, proved to be inadequate for our purposes. Thus we had to devise criteria and a methodology, which could help in defining agglomerations from the water management perspective. Starting points were taken from UWWTD and on such criteria we defined, what agglomerations were in Slovenia.

»Agglomerations« are areas of settlements or their parts that form independent groups of one-hectare cells or unions of independent groups, which exceed determined (or stipulated) population concentrations and are uniformly settled. A settlement's territory, as defined in the Register of territorial units, is thus reduced only to the surface of the agglomeration, which contains only the settlement's built-up part with specified density. Any particular agglomeration is a basic unit, to which all standards of disposal and treatment of wastewater are linked. To comply with UWWTD, in all agglomerations that have higher settlement concentration, than specified by maximum or average number of inhabitants in a given agglomeration, proscribed levels of standard in proscribed time dynamics, have to be met. For established agglomerations (i.e. settlements), a programme of measures and monitoring of met harmonisation with UWWTD has to be prepared in the National programme.

The Ordinance <sup>[9]</sup> provides legal backing for determining agglomerations. For analytical purposes a grid of more than two million 100x100 meter cells covering all of Slovenia was drawn. From the evidence on permanent residence, population density for each one-hectare cell was defined. Because of such very tedious analytical and synthesising work with so many cells, a system of reduction and aggregation of cells was used (see figure 1). Such approach was justified in practise, when independent, sparsely populated hamlets (cells) were eliminated in the first step, the hypothesis being that they would not join into the larger group of connected cells, i.e. they would not be connected to a public sewer system.

By excluding remote cells, often with only one building, the first reduction was completed. Definition of agglomerations continued by linking cells with common edges (or even points – the corner). Thus we obtained 16.000 agglomerations containing more than one cell, which was still too many for further analysis. On the other hand, criteria from regulations states that only agglomerations with more than 50 inhabitants and population concentration in single hectare cells higher than 20 inhabitants, should be dealt with. According to such criteria 1970 agglomerations, with a population of 1.688.000 people, were listed in the National programme. Growth of included population, if we also consider increasingly less populated agglomerations, is shown in figure 2. In view of the population density in the agglomeration and number of inhabitants in the agglomeration, the curve starts on the á-axis and is defined by the share of the largest agglomeration (Ljubljana). Apparently, when dealing with agglomerations that have more than 50 inhabi-

tants per hectare, more than 80 % of Slovenia's population is included. In short, by managing 1970 agglomerations we could provide adequate utilities for wastewater treatment for 80 % of the population.

These agglomerations were presented to local communities for verification in graphical and attributive form. The goal was, above all, to establish common (between the state and local communities) and verified expert backing, which could be used to produce the programme of common activities. Feedback from local communities showed the following examples:

- Agglomerations were accepted by certain local communities, as presented;
- Local communities proposed joining agglomerations into larger groups (supra-systems). In this way functional links could be respected, because of common characteristics (e.g. same settlement) or joint infrastructure (e.g. joining different groups by common collector or transport canal or joined treatment of wastewater);
- Breaking up of agglomerations was proposed, because of possible tying into other agglomerations following different administrative arrangements (e.g. local community's boundary) or previously adopted or proposed solutions concerning wastewater management and treatment (e.g. geographical effects etc.).

Agglomerations that were verified by local communities (and utilities companies) are simultaneously the basic planning category for preparation of local development plans and pertaining (aggregate) development plans in the National programme. Since provided water supply and sewage, as well as wastewater treatment, are important conditions for planning new or additional settlement in agglomerations, development plans should be produced by local communities. These concepts should be introduced to the aggregate plan, thus clarifying met responsibilities taken on from EU directives on the national level.

## 3. Determining extant systems

The described procedures used to define agglomerations show only part of the issues, since they present only agglomeration pressures on natural resources, which are, according to WFD, water bodies defined by Slovene laws. Future work demanded the setting up of an inventory of all infrastructure needed for diminishing (preventing) such pressures, implying the establishment of a register of systems for collecting and treating wastewater. To obtain a review of the present condition in Slovenia an elaborate survey was conducted covering the whole Slovene territory, which included local communities and indirectly companies authorised to perform public utilities involved with sewage and treatment of wastewater. We obtained data on extant sewage systems in digital form. We could conclude the following:

- A larger part of agglomerations, in which collecting and treating wastewater is a priority, have at their disposal digital databases about extant sewage systems for collecting wastewater. In most they call them »cadasters«, but at first glance, there are problems in finding common denominators between them;
- Digital information is organised in different spatial information systems (mainly in AutoCad and ArcView format), but unfortunately in most submitted cases, documentation is not very good;



- Analysis of data (except for the routes of sewage itself) across the municipal boundaries is at present very difficult, mainly because of different systems used for management and monitoring physical data.

Joining the (digital) data about extant systems for gathering and treating wastewater was a demanding and elaborate task, also because of necessary individual communication with numerous subjects, specific physical circumstances, different approaches and delimitations between public services and local communities etc. The results are nevertheless very important, because it is possible to use them for gradual standardisation when dealing with expert and physical data and simultaneous establishment of an overview with monitoring of the whole infrastructure system for gathering and treating wastewater. Figure 3 shows results of analysis for one municipality (Radovljica). Three emergent types of agglomerations composed of 1-hectare rectangular cells are shown. With respect for population concentration empty cells for agglomerations, in which UWWTD doesn't proscribe special conditions, are also shown. Grey and darker cells show agglomerations where lax or stringent conditions are proscribed (deadlines etc.). Extant sewers, available in the given time section, are also shown.

The presented agglomerations enable various analyses and programming of measures. By applying expert knowledge first approximations of necessary domestic resources needed to meet UWWTD demands were calculated. After local communities verify these estimates and expert assessment of (suitability of) their programmes completed, expert guidelines for the National programme will be produced. From the gathered data and results about sewage and treatment of wastewater, it was possible to calculate first, rough estimates about needed interventions in infrastructure development in particular local communities and corresponding costs. However, since local communities and public utilities operators have better knowledge about real or detailed conditions, future financial estimates, which will include data from local communities, will be even more precise.

#### 4. Maintaining agglomerations and development

When using results obtained in the described fashion, one has to be aware that they were defined from the aspect of water management. Other disciplines can also use the described method with additional criteria and population densities and include other groups for analysis. Since the presented agglomerations will be the basis for managing communal hydro-technical matters, they can also be complemented with management of other utilities. Population densities used in the research are from a given time section, which is closely linked to conditions of the Central register of territorial units (CRTU). Therefore all the issues emerging from CRTU can be directly applied to agglomerations (e.g. differences in residence registration). On the other hand, the rather automated and uniformly proscribed procedure allows modernisation and improvements in defining agglomerations, according to new data in CRTU, i.e. the agglomeration database can be actively maintained. Changes of the agglomerations limits or pertaining descriptive data of course depends on migration or changes of permanent residence, which in Slovenia hasn't (yet) gained any significant dynamics.

Development aspects for given time frames usually aren't included in assessments of settlement conditions, which are the basis for defining agglomerations. However anyone attempting any development (e.g. housing estates, industrial zones etc.) has to invest in infrastructure. Besides the investors, supporting development projects, authorised managers of utilities infrastructure have to participate and prepare development plans for infrastructure concerning sewage and wastewater treatment (Figure 4). Thus access to other sources, needed to note events in the physical environment, is easier, as is forecasting of future development. Proposed new settlement should therefore be respected in agglomeration development, possibly by adding a special type of cell, which would show reserved spaces for development and increased population density in agglomerations. Transition to higher settlement categories (densities) could therefore be used to present areas of increased demand in infrastructure management, as proscribed by law.

Industrial polluters weren't included in the system for defining agglomerations for monitoring compliance to UWWTD conditions. These deficiencies are conditioned by regulations that deal with industrial polluters according to other procedures, both in the system of levies on wastewater and responsibilities of (prior) wastewater treatment. Integral protection of water in the National programme's next development phases will need a comprehensive control system of all sources of pollution and water treatment. Then, all industrial pollutants will also be integrated in the established system, thus enabling better control over the system for gathering and treating all excessively polluted wastewater.

Besides industrial polluters and settlements a large share of pollution can also be contributed by agriculture, tourism etc., which therefore have to be analysed alongside settlements in rural areas. Systemic integration of agricultural pollution into the comprehensive system of water pollution control is the second (benchmark) goal. To achieve this goal already established and maintained databases concerning agricultural economies will be integrated in the system, which were created as the foundation for implementing common agricultural policy in the EU.

#### 5. Conclusion

By integrating extant data, gathering of additional data and their joint multi-parameter analysis, we can gradually achieve a quality overview of the condition of infrastructure for gathering and treating wastewater, necessary development and financial resources for the field regulated by UWWTD. Preparation of the National programme is only the first step in monitoring and controlling the process of gathering, treatment of data on pollution sources and systems for protection of waters. The core data, formed in agglomerations, will have to be developed and maintained. Special care will be needed in data exchangeability, which will ensure further development and improvement with new (departmental) data, leading to a uniform, integral database. The long-term goal is a database, which can be used for support in decision-making about water protection. When this database will be complemented with hydrological and ecological modelling, almost optimal use of otherwise limited resources, will be possible. Achieving the known WFD goal, i.e. best condition of water bodies, elaborate work will have to be undertaken on other segments as well, such as water supply, protection before water etc.



Agglomerations were specifically defined for the National programme for gathering and treating wastewater, but in a very short time after the public presentation received wide acclaim and verification. Moreover, practitioners gave many suggestions and ideas, whose contents could be added and complement data on agglomerations. Thus the same agglomerations can be used for analysis, planning and optimisation of water supply systems, analysis of communal waste collection, civil defence tasks (e.g. landslides), as well as other needs where priorities are set in view of population numbers and settlement concentration in particular areas.

Furthermore, all »departmental needs« directly influence physical development and planning on the local, regional and national level. The presented agglomerations can be of benefit or used as basic data for modelling various development projects that combine physical data on settlement position and density, while simultaneously tying into other data, such as available potable water, roads network, commuting, monitoring and analysis of emissions and imissions, planning dedicated spaces (for evacuation, land-fills) for contingencies etc.

Further research will be directed to ensuring adequate procedures for maintaining the agglomeration's basic data structure. Furthermore, precision will be increased (in view of extant and future land use) and links to other databases managed, especially those directly stemming from or linking to settlement areas. Local communities can directly use the research results and gathered data when planning physical development and quality improvements to their living environments. Local communities can already access data on agglomerations on the MEPE web pages, which will, as the project contractor, also enable access to data needed for planning of various contents and by various subjects.

---

Leon Gosar, M.Sc., civil engineer; prof. dr. Franc Steinman, PhD, civil engineer; prof. dr. Boris Kompare, PhD, civil engineer; asist. prof. dr. Primož Banovec, Ph.D, civil engineer  
University of Ljubljana, Faculty of civil engineering and geodesy, Hydro-technical department Ljubljana  
E-mail: lgosar@fgg.uni-lj.si, pbanovec@fgg.uni-lj.si

#### Notes

- [1] Water Framework Directive
- [2] Urban Waste Water Treatment Directive, p. 40.
- [3] Ordinance on disposal and treatment of urban waste and atmospheric water, Official bulletin, No. 105/2002.
- [4] Law on environmental protection, Official bulletin No. 32/93.
- [5] Council Directive 96/61/EC, p. 26.
- [6] Ordinance on taxation for environmental burdening, Official bulletin No. 41/95, 44/95, 8/96, 124/2000, 49/2001.
- [7] Ordinance on disposal ..., Official bulletin No. 105/2002
- [8] Banovec P, Gosar L., Steinman F. (2002–2004).
- [9] Ordinance on disposal ..., Official bulletin No. 105/2002

#### Illustrations

**Figure 1:** Agglomerations are defined by 1 ha cells (by reduction and aggregation)

**Figure 2:** Increase in share of included population within the agglomerations when increasingly more increasingly less populated settled agglomerations are included (the section on the ordinate is given by the largest agglomeration, Ljubljana).

**Figure 3:** Image of three types of defined agglomerations, distinguished by different densities, with the applied grid of the existing sewage system (in a given time frame).

**Figure 4:** Schematic chart of the cyclical progress of work and participating subjects. The core (spatial and descriptive agglomeration data) is thus gradually completed and brought up to date.

For literature and sources turn to page 40.

Tadeja ZUPANČIČ STROJAN  
Marjan HOČEVAR

## Renewal of the Slovene housing stock in view of European spatial networks

### 1. Idea of sustainability

During the period of its conscious use, the idea of sustainable development has been losing its original explanatory charge. Much too often it is becoming a motto of disciplinary discourse, while its comprehensive note or multi-dimensionality (Scott, 1998), is falling to oblivion. Even in the sense of the concept *global-local*, whose understanding is often polarised or contradictory. Recollection of the chosen, e.g. global scale, cannot discard the local and vice versa. For instance, responsiveness to local conditions can become a global (Abel, 1997: 125, Hočevar, 2002), while local space does show numerous adapted fruits of cultural exchange. Redistribution of development trends in time demands its own condition, yet dynamic, but striving towards balance. The latter can be directed in three ways:

- a) Striving for uniformity of elements and connections (that often refrain from adapting to local circumstances),
- b) Attempts at equitable understanding of difference and variety;
- c) Balancing both.

European spatial policy makers are keeping themselves busy with the first alternative, while independent regional (even our Slovene one) are tackling the second approach. Europe of course responds, with e.g. structural funds. The Slovene response stays on the regional level, but is nevertheless open, at least when it comes to development balancing on various sub-regional and local levels.

What is therefore the nature of long-term social-spatial tendencies, which should be respected? What does the perspective of European integration and, in general, »globalisation« trends for renewal of the extant housing stock and landscape-settlement structure? How can probable development tendencies be balanced, with respect for cultural and social dimensions of sustainable development?