

B. NETWORK OF SCHOOLS

B1. Products of project "Optimization of the network of schools in Serbia"

The following products represent the final result of the one year project of the Optimization of the network of schools in Serbia:

- The current document on project results containing a description of the state of the network of schools and strategies and models for its optimization. The document is available in Serbian and English versions.
- Electronic version of the current document in Adobe Portable Document Format (PDF) in Serbian and English languages.
- School mapping exercise for all of Serbia's schools using GIS (Geographical Information System software).
- Modular, web-based educational information system integrating project database and GIS – both as a planning tool and for general access to all data by educational stakeholders. Multimedia database of Serbia's schools. (a list of all project material available in electronic form is given in Appendix F5)
- DVD presentation of project results.
- Off-line addition to project database
- Methodology for future data acquisition and its basic instruments. Proposal for future network monitoring (see Appendix F2 and F3).
- List of relevant parameters for decision making regarding the functioning of the network of schools (see Appendix F1).
- Municipality level case studies of optimization strategies.
- Follow up projects important to the implementation of the optimization models (see Appendix F4).
- The concept of network optimization (as opposed to network rationalization - see section C).
- Defining of applicable optimization models.
- Strategies of the optimization of pedagogical efficiency of the part of the network dealing with small rural schools.

B2. Current state of the network

The previous two sections gave us only the country level parameters associated with the size of the system being studied. A network is much more than a sum of nodes that make it up - the crucial aspect of a network is the inter connectedness of the individual nodes and even of agglomerations of nodes making up various sub-networks within the overall network.

In mathematics one focuses on the study of the topology of networks, e.g. the interconnections of the network's nodes. In our current problem of understanding the functioning of the network of schools that level of structure is not enough. For example, it is not enough to know that a satellite school is administratively connected to its central school, we also need to know what physical road connects the two, the quality of that road, if it is open throughout the year or depends on local weather conditions and finally we need to know the distance between the two schools. The addition of this kind of detail means that we are looking at geometry, a much richer structure than topology.

In our specific problem setting the

word geometry simply means that it will be necessary to track spatial distributions of the various educational, demographic and economic parameters gathered in our database. Spatial distributions mean geographic maps. The connection between geographic maps and databases is given by GIS (geographical information system) software.

It is said that a picture is worth a thousand words. This is particularly true in the case of the visualization of spatial distributions of data along a complex network. The reason is simple: Irrespective of the exponential growth of computer hardware and software, our eyes and brain still represent the best pattern recognition tool available. Having said that, in this section we will let a selection of thematic maps speak for us. The interrelations they uncover are often obvious to our eyes, or at worst they appear after only the briefest of comments.

Connection of schools to utilities

The first series of figures and maps will look at basic school infrastructure: quality of electrical hookup, availability of drinking water, types of toilets and waste facilities and the quality of the schools' telephone

connections.

Of the 1,096 central primary schools 977 have answered questions relating to their electrical power hookup. Of these, 688 schools said that they were connected to a city power grid (70.4%), another 262 central schools (26.8%) are connected to a local grid, but have a adequate power supply. Some central schools on local power grids, 26 of them (2.7%), list substantial problems with the quality of their electrical connection. Finally, 1 central school (0.1%) is without electrical power.

A similar situation exists as far as the availability of drinking water in school is concerned. A total of 982 central schools answered questions relating to drinking water. Of these- 637 (64.9%) are connected to a city water main, 254 (25.8%) are on a local water main, while 89 central schools (9.1%) get their water from a well or water pump. However, 2 central schools (0.2%) are without any access to drinking water.

Unlike the situation with electricity and drinking water, the matter of toilets and modes of waste disposal are critical. Here we have the following numbers: Of the 984 central schools that gave an answer to this

question 473 (48.1%) are connected to the city sewage. Another 96 (9.7%) are on a local sewage utility. 337 (34.3%) central schools have their own septic tank, while 78 (7.9%) central primary schools only have outhouses with no septic tank.

Now at us look at the 2,602 satellite schools. Of these 2,049 schools answered questions regarding electrical power. 710 (34.7%) of theses are connected to a city grid, 1,180 (57.6%) have a good connection to a local grid, 149 (7.3%) have problems with their connection, while 9 satellite schools (0.4%) have no electrical power.

The availability of drinking water in satellite schools is as follows - 2,053 schools answered this question, and of these 316 (15.4%) are on a city water main, 874 (42.6%) on a local main and 758 (36.9%) use a well or water pump. A large number of satellite schools, 105 of them (5.1%), have no access to drinking water.

The situation in satellite schools is much worse. Of the 2,062 such schools that filled out this item in the questionnaire 46 (2.2%) are on city sewage, 83 (4.0%) use a local sewage system and 782 (37.9%) have their own septic tank. The majority

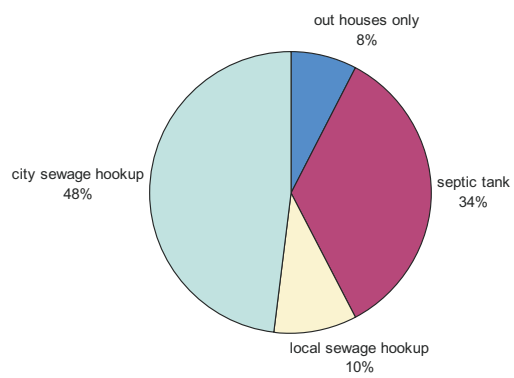
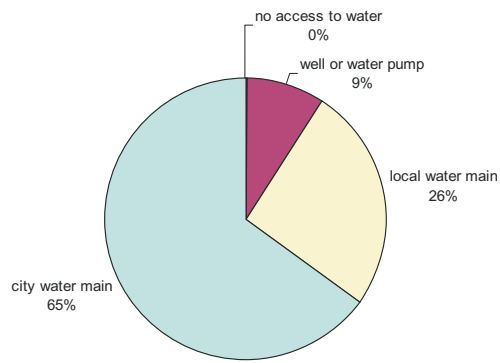
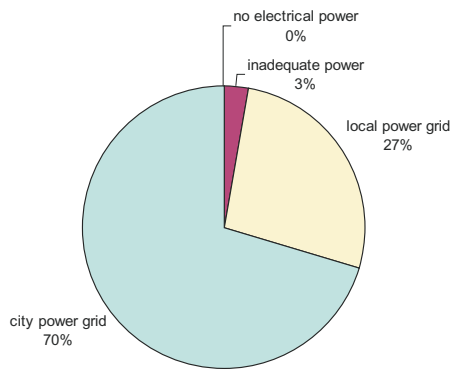


Figure 20:
Central schools: electrical power, drinking water, toilets and sewage.

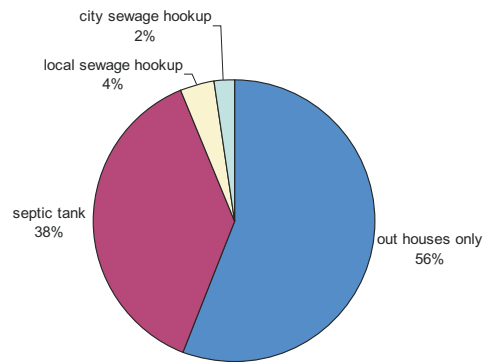
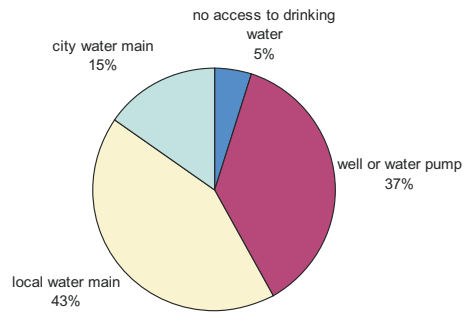
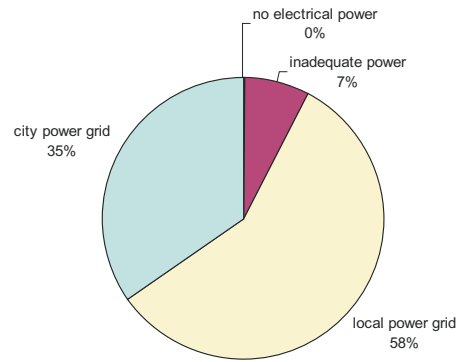


Figure 21:
Satellite schools: electrical power, drinking water, toilets and sewage.

of satellite schools, 1,151 (55.9%) of them, have only outhouses without a septic tank!

Figures 20 and 21 give a graphical depiction of the state of central and satellite schools with respect to these three parameters. As we can see, satellite schools are in a much worse situation in all parameters, but the situation with toilets is intolerable. This is the situation with regular primary schools. We next look at special schools. There are 98 special primary or secondary schools in our database. In general they are in a much better situation than the regular schools: 94.9% are on a city grid, 3.4% have adequate power on a local grid, while only 1.7% have problems with their local power connection. All special schools have electricity.

As with power supply, the situation in special schools with respect to drinking water is better than in regular schools. All of these schools have access to drinking water: 86.2% through a city water main, 12.1% through a local main and 1.7% use a well or water pump.

The situation with sewage and toilets is as follows: 81.1% of special schools are on a city sewage system,

3.4% on a local system, 12.1% have their own septic tank, while 3.4% special schools have only primitive outhouse toilets.

Another distinct class of schools are the art schools (music schools and ballet schools, both primary and secondary). There are 121 such schools in our database. In general they too are in a much better situation than regular primary schools. As far as power supply is concerned: 98.8% are on a city grid while 1.2% are on a local grid but have a quality power connection. No art schools have listed problems with electrical power. With respect to drinking water the numbers are as follows: 96.3% are on a city water main, 1.3% are on a local main, while 2.4% of art schools get their drinking water via a well or water pump. Finally, 87.6% of these schools are on a city sewage utility, 6.2% on a local utility, while 6.2% art schools use their own septic tank.

The last distinct category were the secondary schools. The 416 regular secondary schools in our database are in a much better situation than primary schools with respect to electrical power, drinking water and sewage connections. 98.4% of secondary schools are on a city grid, 1.0% are on an adequate local grid,

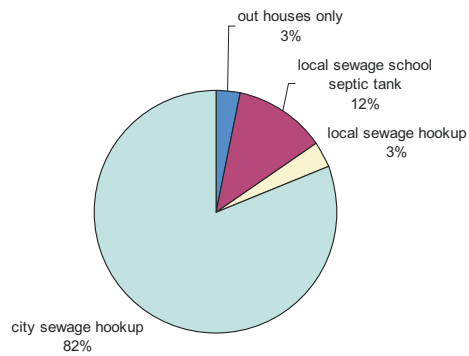
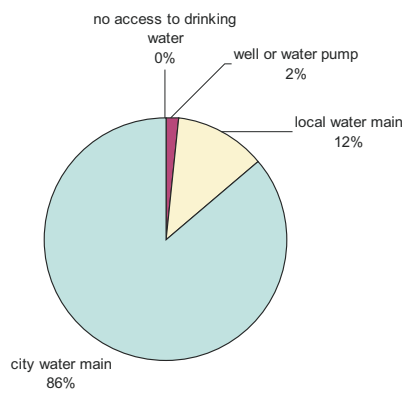
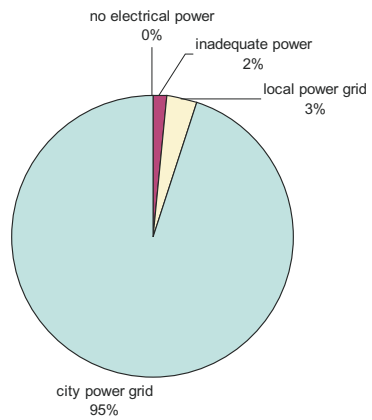


Figure 22:
Special schools: electrical power, drinking water, toilets and sewage.

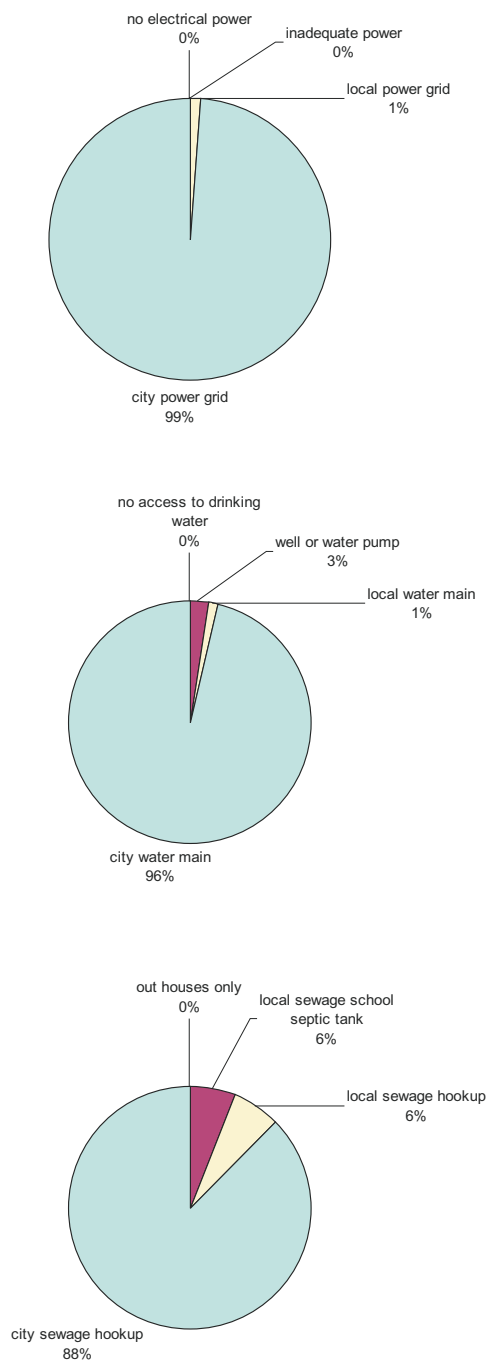


Figure 23:
Art schools: electrical power, drinking water, toilets and sewage.

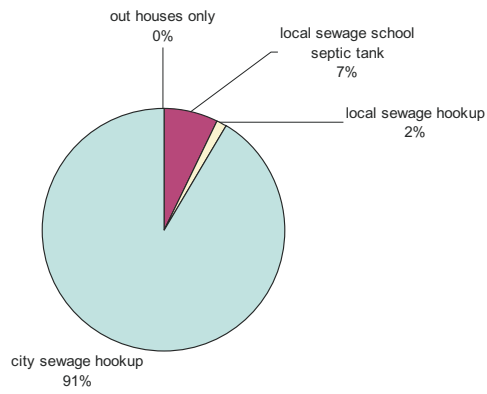
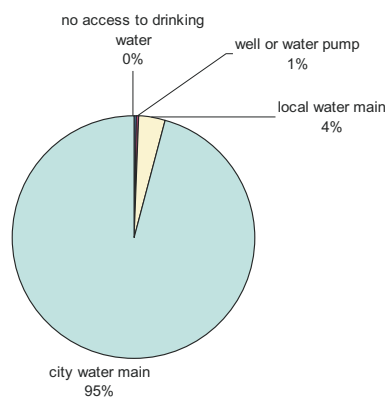
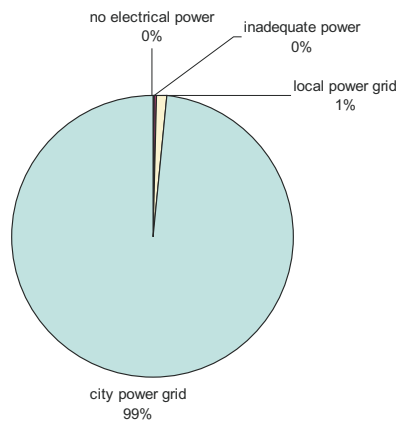


Figure 24:
Secondary schools: electrical power, drinking water, toilets and sewage.

0.3% have complained of having inadequate power and a further 0.3% of not having a power connection.

A similar situation may be found for drinking water. 95.7% are on a city main, 3.5% on a local main, 0.5% use wells or water pumps, while 0.3% of secondary schools are without any access to drinking water. As far as sewage connections, 91.3% secondary schools are on a city sewage system, 1.6% are on a local sewage system and 7.1% use their own septic tank.

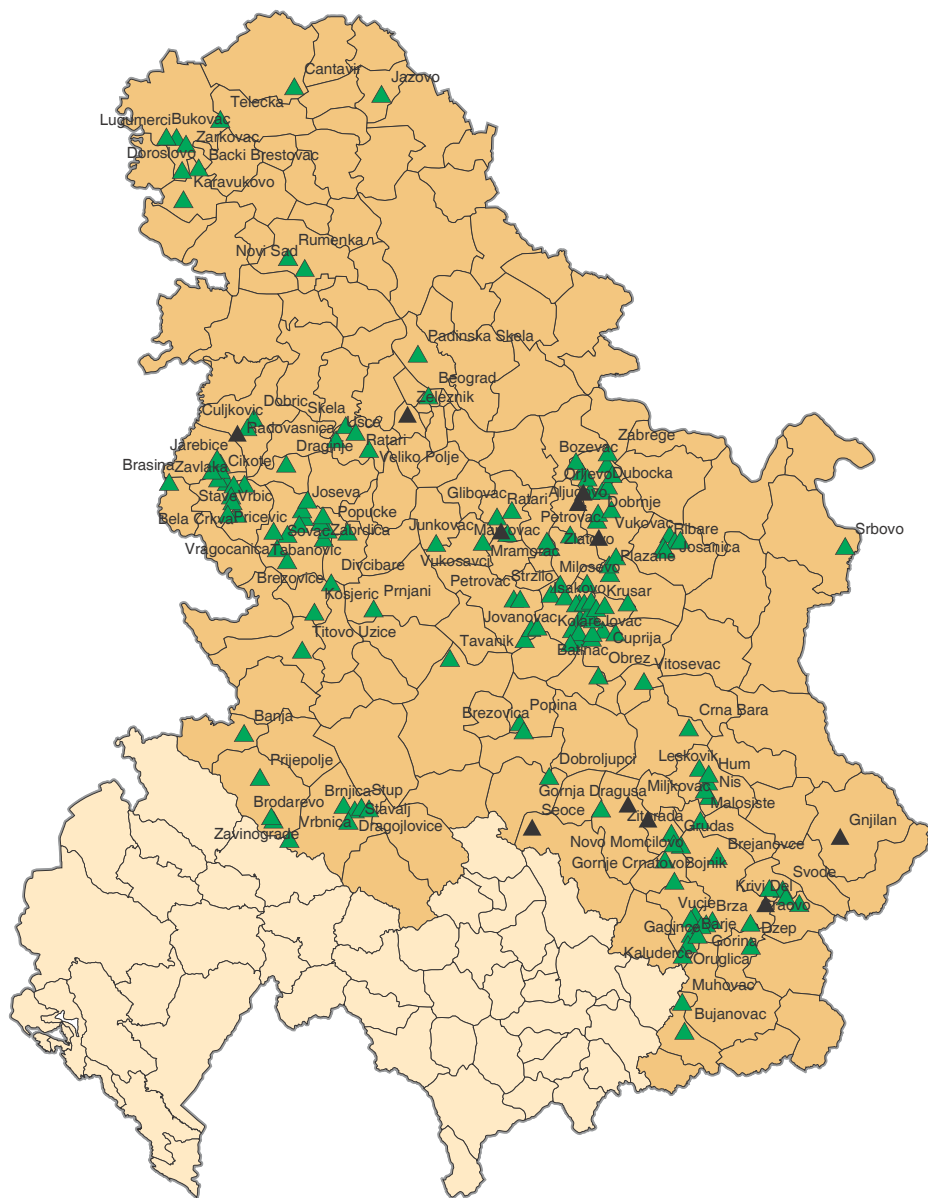
As we can see, the great majority of schools in Serbia do not have problems with electrical power. The ones with severe problems are shown in Map 1. Black triangles denote schools without electrical power while green triangles stand for schools with an inadequate power supply. Map 2 shows the locations of schools that have no access to drinking water.

From the previous two maps we see that electricity and drinking water are not significant problems. Still, there are no valid reasons why any school in Serbia should be in this situation. In all cases these schools are located in villages and towns which have both an adequate power hookup and sources of drinking water.

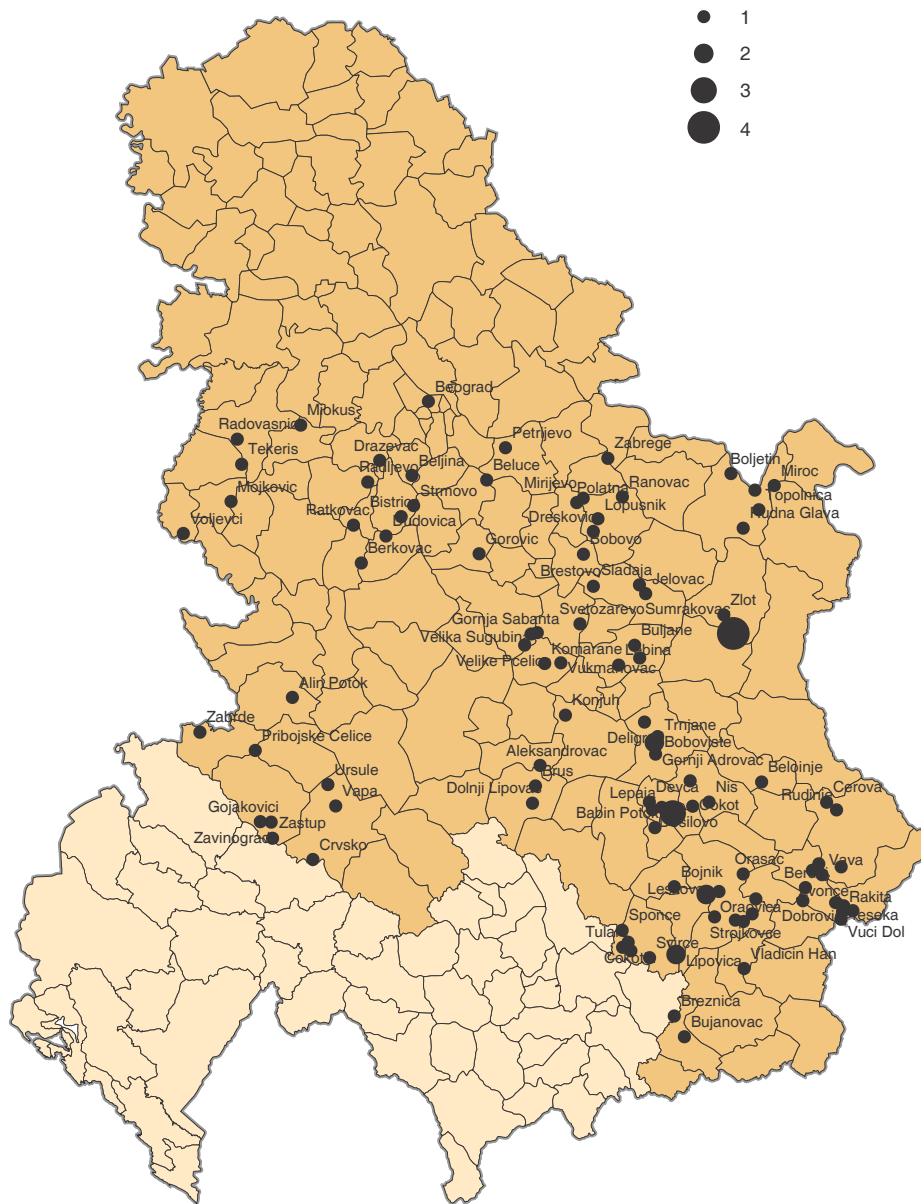
As we have seen in Figures 20-24 the real problem is with the schools' sewage facilities and toilets. All together this is a unbelievable situation, particularly for Serbia's satellite schools. Map 3 shows the spatial distribution of schools that have only outhouse toilets without septic tanks.

To a great degree the spatial distribution of these schools follows the past border between the Austro-Hungarian and Ottoman empires. Indeed, the prime source of such an abysmal score on one of the chief indicators of school hygiene is to be found in the past. This situation is the more intolerable when one looks at hygiene levels in the students homes. We believe that the Ministry of Education and the Ministry of Health need to conduct a systematic investigation of this important phenomenon. However, even without detailed data it is rather simple to convince oneself that the standards of hygiene in the students homes are way above those of their schools.

During the field visit part of this project we visited some of Serbia's smallest school. Many of these are in underdeveloped rural areas. The number of spot checks we made is certainly not statistically significant,



Map 1:
 Schools with electrical power problems. Black triangles denote schools without electricity, green triangles represent schools with an inadequate power hookup (2001/2002 school year).



Map 2:
 Schools without drinking water. Larger circles denote higher concentrations of such schools (2001/2002 school year).

still, in all cases we saw this huge discrepancy between school and home standards of hygiene.

The matter of school toilets in Serbia cries out for a solution. Luckily, this is a problem that can be solved in a matter of months. The price attached to the solution is something that Serbia need not ask donations for. We believe that it is pointless to talk about education reform, a complex and long lasting process, before solving this simple, yet important problem. We also believe that Serbia has no moral right to ask for financial help from abroad for its educational reform if it is not willing to immediately solve these kinds of problems. If Serbia wishes to be treated as a part of Europe it must emulate Europe's standards.

Our proposal is that the Ministry of Education go about defining a set of realistic standards with respect to this, as well as of ways for monitoring the compliance of schools with the new standards.

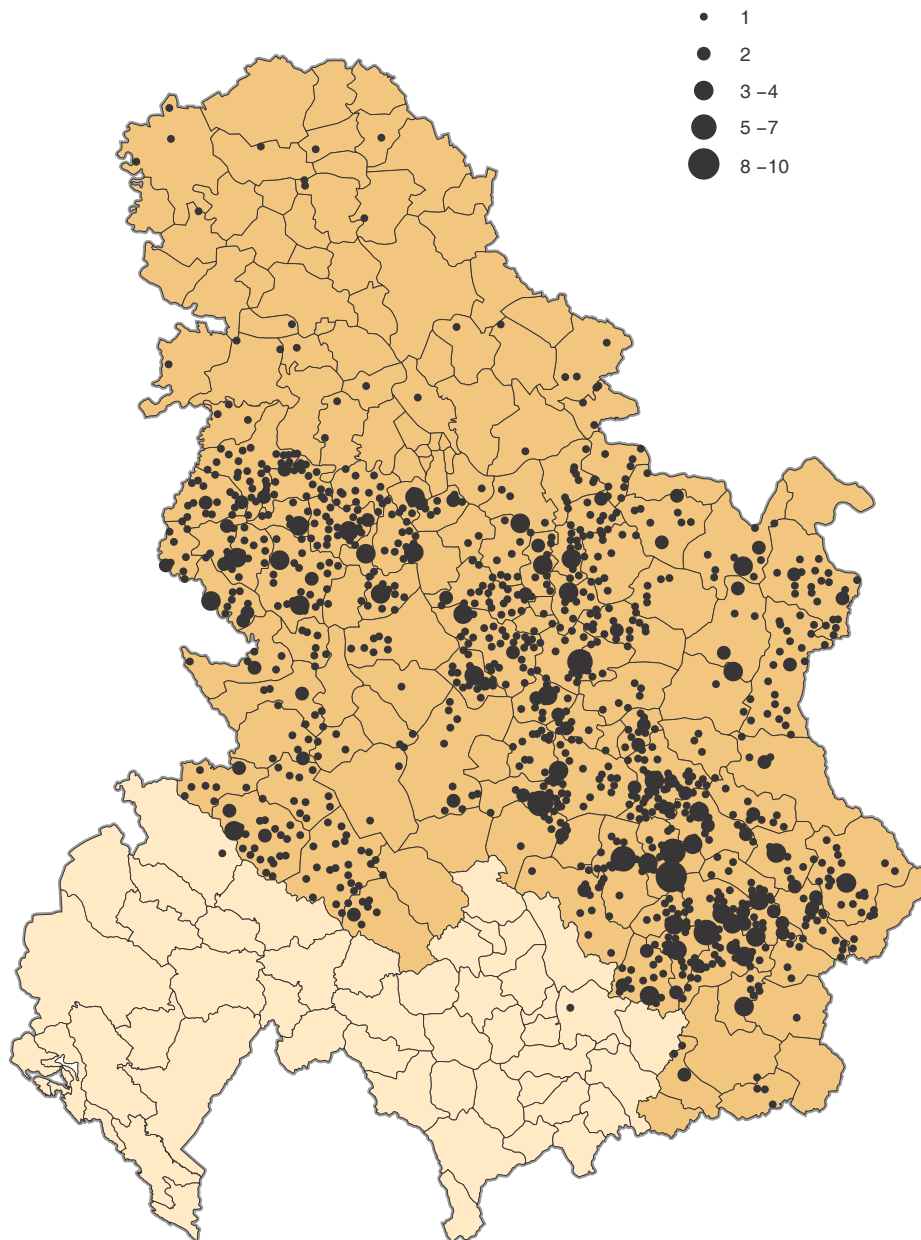
To some all of this may not seem to be such a problem. In fact, the majority of teachers and school administrators we talked with invariably did not see this as such a big deal. In fact, we believe that it is a big

deal. There is no clearer indication of the estrangement between local communities and their schools than the fact that the two abide by different sets of standards with respect to such a basic thing as hygiene.

These kind of schools are obviously not safe environments. What is even worse is that, instead of being institutions perceived to be playing a progressive role in their local communities, such schools automatically identify themselves with backward, regressive attitudes and mind sets. In fact, how can such schools have a positive attitude toward reform? How can they instill in their teachers, students and their parents the belief that positive change is possible?

Anyone who believes that the problem of school toilets has been overstated should look at the pictures in Appendix H. Facing a problem need not be palatable, but it is the first and most important step to solving it.

In the world we live in free and unlimited information exchange is a prerequisite, particularly for schools. Serbia is a poor country, and so things like access of schools to the Internet are still far from being universal. We will look at the state of



Map 3:
 Distribution of schools with only outhouse toilets, not possessing septic tanks. Larger circles denote higher concentrations of such schools (2001/2002 school year).