ABSTRACT

Changes in land use have influence upon hydrology. This influence can been subdivided into direct and indirect influence of changes in land use upon hydrology. Direct influence comprises the influence of changes in land use upon evapotranspiration and degree of imperviousness and may thus lead to changes in groundwater recharge. Indirect influence upon hydrology comprises changes in water management arising from changes in land use, such as the water level in canals and ditches, groundwater drainage and irrigation.

This research examines the influence of changes in land use on water management, evapotranspiration and groundwater level. It begins with an evaluation of the scientific literature dealing with the relationship between land use and hydrology. This theoretical framework is used to investigate the effect of land use on hydrology from a quantitative outlook. The Land Use Scanner (VU et al, 2010) land use model coupled with a hydrological model named the Netherlands Hydrological Instrument (NHI, 2008a) was used for this purpose. The hydrological effects were investigated from the standpoint of two land use scenarios for 2040, namely the Global Economy (GE) scenario and the Regional Communities (RC) scenario.

This research had two goals. The first was to establish whether the Land Use Scanner could be coupled effectively with the NHI. The second was to use the Land Use Scanner coupled with the NHI to calculate the consequences of future land use upon evapotranspiration and groundwater.

The governing question of this research was: “To what extent do changes in land use influence hydrology?”

The results presented in this thesis demonstrate that it is possible to use the Land Use Scanner coupled with the NHI to establish the effect of changes in land use on hydrology. In order to be able to use the land use scenarios of the Land Use Scanner as input for the NHI, some data conversions had to be made and this entailed the making of some data translation choices. Although these conversions introduced some degree of uncertainty, they also provided new opportunities to employ land use scenarios from the Land Use Scanner for water-related issues.

The main conclusions that can be drawn from this study about the use of the Land Use Scanner coupled with the NHI are as follows:

- There is no direct match between some of the 23 land use categories included in the Land Use Scanner’s scenarios and the land use categories employed by the NHI. In these cases, it has been necessary to choose a category whose land use function characteristics were equivalent to those originally used by the Land Use Scanner.

- The Land Use Scanner's land use dataset differentiates between various types of urban areas. This offers an opportunity to differentiate between the degree of imperviousness levels in hydrological calculations for various categories of urban land use.
- Adjusting water management parameters connected to new land use is complex and merits further attention. The difficulty lies both in establishing which parameter values should be assigned to the new use and in the uncertainty of how water management will evolve in the future.

The main conclusions that can be drawn from this study about the effects of changes in land use on hydrology are as follows:

- The effects on the average highest groundwater level (GHG) and average lowest groundwater level (GLG) and evapotranspiration as a consequence of changes in land use are particularly noticeable at a local level. On a regional level the effects are marginal.
- The impact of scenarios for changes in land use lead to both decreases and increases in the GHG and GLG calculated in the lower-lying regions of the Netherlands. In the sandy soil areas of the higher-lying regions of the Netherlands a decrease in the GHG and GLG was mostly calculated.
- The greatest effects on the GHG, GLG and evapotranspiration are to be found in those areas where bare soil is replaced by a different category of land use or where another land use category is replaced with greenhouses or an urban area.
- There is a greater effect on the GHG and GLG as a result of changes in water management due to new land use (secondary effect) than there is through changes in evapotranspiration alone (primary effect).
- It is above all at a local level that hydrological consequences of changes in land use are comparable to the consequences of future scenarios where changes in land use, climate change and land subsidence are taken in combination.