PETROL STATION VICINITY VULNERABILITY ASSESSMENT

GIS in City Fire Hazard

Petrol stations contain high concentrations of highly flammable substances. Fire and explosions may cause huge damage, injury and loss of human life. The authors show how GIS can help in assessing the vulnerability of the vicinity of filling stations.

The main causes of petrol filling stations catching fire include sparks from a vehicle or electrical short-circuit, cigarette lighting and reservoir leakage after earthquake and subsequent fire. For example, on September 28th 2005 in Dehradun, a suburb of New Delhi, a petrol tanker caught fire during emptying. A spark produced by a refilled scooter setting off caused the accident. A motorcycle near the tanker also caught fire and a car fuelled by LPG exploded. Two people were badly injured. This accident was reason for us to investigate the vulnerability of Dehradun, a municipality in Uttaranchal State north of New Dehli, to exploding petrol filling stations. It is an area of much recent building development and activity.

Underlying Data

The city of Dehradun accommodates a total of seventeen petrol stations, fourteen of them in and around the central business area, situated along four main roads carrying heavy traffic. Six petrol pumps are present on just one of these roads, all situated within 200m distance from the next. So if an explosion occurs many people may be injured or lose their lives. A rough estimate of the population living in the vicinity of a filling station is obtained by taking as rule of thumb 20% of the population residing within the 200m buffer zone around each petrol pump. The positions of the petrol filling stations were determined during field survey using GPS and marked on Ikonos satellite imagery. During field survey, building use within a radius of 200m around the petrol pumps was also determined and stored in a database. Five categories of building use are distinguished: residential, commercial, commercial/residential, institutional and medical. Since commercial buildings are mostly congested and more inflammable materials are present, their vulnerability is higher than that of other buildings. In the 200m buffer zones a total of 2,418 buildings were counted. Next, estimation was made of the population of each of the buffer zones; the total number is around 14,000 persons.

Classification Results

Both building density and population density are divided into three classes.

On the basis of building density, land use and population present within the 200m buffer zone, the zones around the petrol pumps are grouped into three categories: very hazardous, moderately hazardous and less hazardous. Four of the fourteen buffer zones appeared to be very hazardous, eight are moderately hazardous and two are less hazardous. In the four very hazardous zones the buildings are mainly used for commercial and commercial/residential purposes and are highly vulnerable to fire risk, whilst very high traffic volume increases this risk. Many buildings are vulnerable to explosions at two or more petrol filling stations.

Concluding Remarks

The method can be refined by including other parameters, such as wind direction, daytime and night-time population, number of vehicles on the road and level of risk to people residing in varying buffer zones (50m, 100m, etc).

Combined with map data such as streets, pipelines, buildings, residential areas, pipeline and storage facilities, emergency managers can use the method for purposes of mitigation, preparedness, response and possible recovery. GIS facilitates this process by allowing planners to view the appropriate combinations of spatial data.