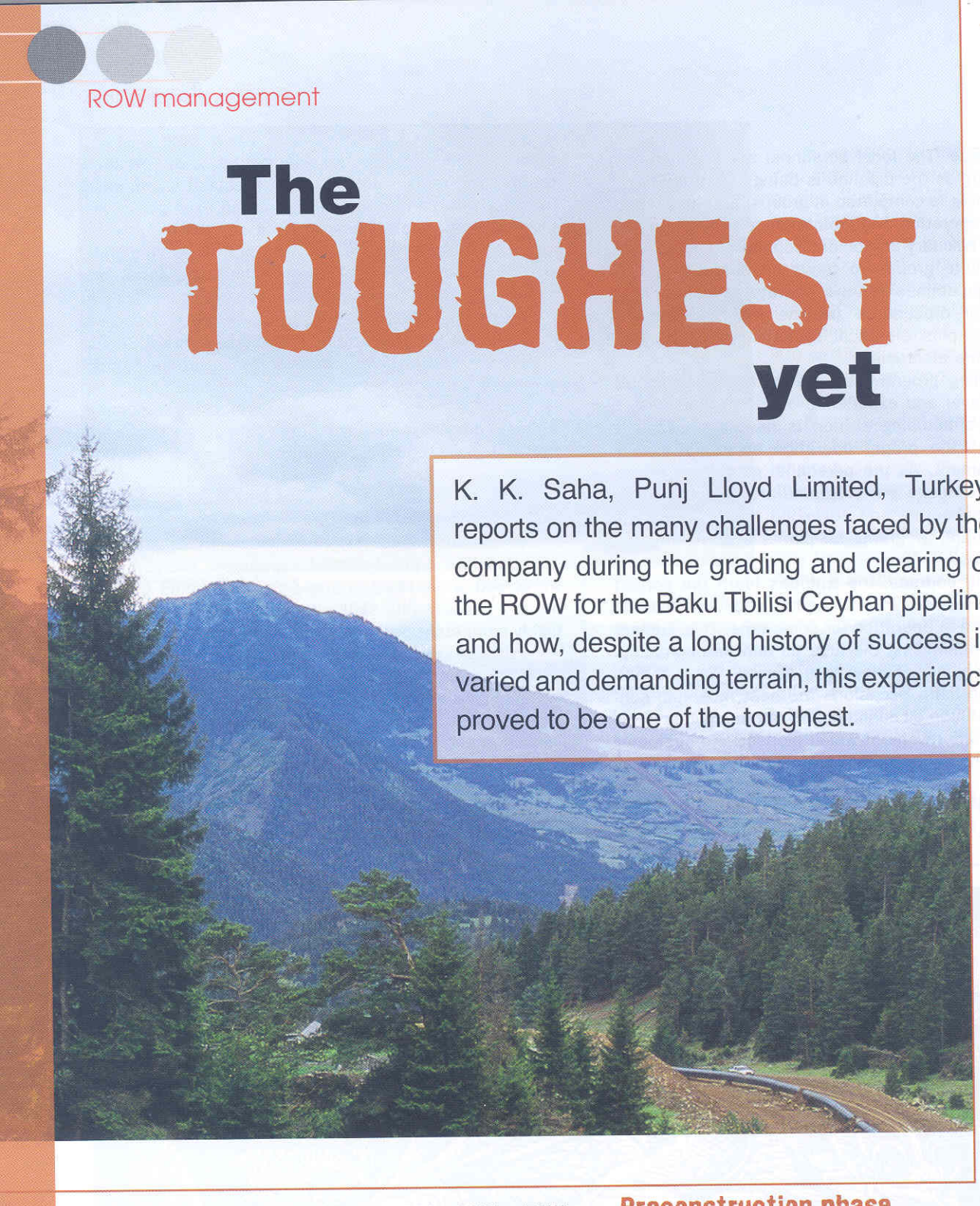
The TOUGHEST yet

K. K. Saha, Punj Lloyd Limited, Turkey, reports on the many challenges faced by the company during the grading and clearing of the ROW for the Baku Tbilisi Ceyhan pipeline and how, despite a long history of success in varied and demanding terrain, this experience proved to be one of the toughest.



The clearing and grading of the Right Of Way (ROW) was one of the most important and challenging activities of the Baku Tbilisi Ceyhan pipeline project. The ROW was spread over 334 km and had an elevation difference of 2078 m within a stretch of 160 km in the Taurus mountains of Turkey. In Georgia, the elevation difference was 850 m within a stretch of 14 km in the South Caucasian mountains. The ROW passed through lowland area, agricultural land, rocky and steep mountains, canals, rivers, motorways, highways, roads, seismic faults, dense forests, environmentally sensitive areas, archaeological areas and villages. PLL JV had undertaken construction of this prestigious pipeline with sensitive innovation and expertise.

Clearing and grading phases

The activity was carried out in two phases - preconstruction and construction. These are as follows:

Preconstruction phase

Firstly, a preconstruction survey was carried out and divided into the following major activities.

A detailed survey identified the pipeline route, steep slopes, elevations and the type of terrain, major and minor river crossings, major and minor road crossings, high voltage and low voltage electrical line crossings, irrigation channels and canal crossings, settlements around the pipeline route, possible rerouting to reduce construction difficulties and potential risks, feasibility study and special construction strategies.

It was also imperative to carry out an environmental survey, to verify the ecologically sensitive areas. Other major aspects that the survey would highlight included endemic species of flora and fauna on the ROW, sensitive forest areas with types and number of trees, plants, birds, types of fish, tortoise and other animals in environmentally

Figure 1. Waste collected and segregated from the ROW.

Figure 2. The ROW through the Taurus mountains in Turkey.

sensitive areas. A due diligence survey was conducted to identify any contamination on the ROW, location of quarries for suitable backfilling material and environmental hazards.

An archaeological survey was deemed necessary to identify archaeological ruins dating back to the Roman or Byzantine period. Had important, historical sites been uncovered as a result of this investigation, the pipeline may have faced rerouting.

A detailed geological survey was carried out to identify the soil type, rock types, strata of subsoil, depth of topsoil, water table, as well as the location and nature of faults.

Possible access roads to the ROW were identified for the transportation of pipes, construction equipment, materials and vehicle movement, where there were no roads or to avoid sensitive areas or settlements.

An indepth study was carried out to identify the number, size, type and other details of the nearest village or settlements; the head of villages, the number and location of schools within 5 km, construction personnel, land owners or land users, cultural and agricultural information, and useful water sources for the inhabitants, etc.

A preliminary risk assessment was carried out to identify potential risks during preconstruction and construction phases, the aim of this assessment was also to avoid or reduce potential risks through alternative routes, potential risks on using access roads, risks on the ROW such as steep slopes, use of explosives at rocky areas, water courses, special crossings, electrical crossings,

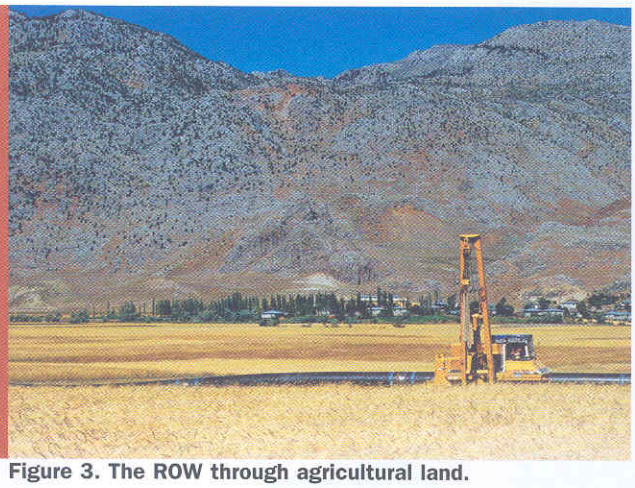


Figure 3. The ROW through agricultural land.

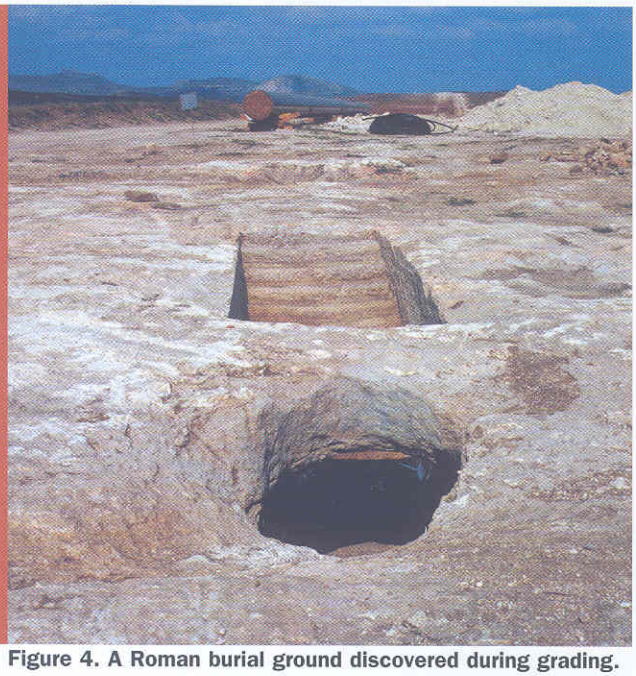


Figure 4. A Roman burial ground discovered during grading.

Figure 5. Preservation of top soil with geotextile in ecologically sensitive areas.

transportation hazards, statutory and legal requirements. In addition, the number, type and location of hospitals in case of emergency, or common diseases formed a part of the assessment.

Research was carried out to identify the various authorities and their administrative boundaries. These included village road, highway, expressway, telephone, water and other pipeline authorities, as well as irrigation, electrical, forest, land, cultural, environmental and social authorities, river and dam authorities, traffic, labour and administrative authorities.

Construction phase

On completion of the preconstruction survey a detailed report was compiled and various procedures and method statements were prepared for the construction work. The engineering, construction, environmental, social, health and safety aspects were highlighted in the procedures and method statements of clearing and grading.

Project awareness and training were provided to all employees. Identification cards and passports for work were issued for entering the ROW. All drivers were provided defensive and off-road driving and were also issued with passports in order to enter the ROW.

A site access protocol was formed with the agreement of the client, Botas. The protocol highlighted all necessary documents and requirements relating to construction, social, environmental, archaeological, permits, engineering, project awareness, training, health and safety for entering the ROW prior to all clearing and grading activity. After obtaining approval for the access-to-site protocol, a construction survey was carried out in detail for the construction of access roads to the ROW.

Once these access roads had been constructed, the mobilisation of necessary equipment for clearing and grading activity started according to the project execution plans, procedures and precautions against specific risk assessment for each identified road. Prior to mobilisation, all equipment and vehicles were checked with respect to health and safety, ensuring they adhered to risk assessment requirements and all were issued with passports to drive onto the ROW.

Clearing the ROW

Clearing of the ROW started according to the approved procedure. Depending on terrain and environmental requirements, various methodologies were applied. Special attention was given to the ecologically sensitive areas, steep slopes, agricultural land, crossings, archaeological areas, seismic fault crossings, human settlement areas and forest areas.

New roads were constructed for access to the ROW in mountain areas. Preventive action was taken prior to commencing activity. Permits from authorities such as village, forest, electrical and environmental representatives were taken prior to starting work.

The removal of unwanted or extra material was carried out according to the agreed procedure and statutory requirements. Necessary permission was taken from the authorities to remove debris from the ROW, transport it and then have it dumped in specified locations.

Grading begins

After clearing of the ROW, appropriate equipment for grading was mobilised with experienced and trained crew. From a predetermined depth, topsoil, where available, was removed

Figure 7. Work in progress on steep slopes.

Figure 6. A panoramic view of the ROW.

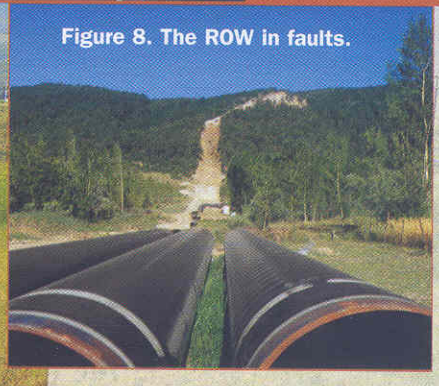


Figure 8. The ROW in faults.

and preserved on one side of the ROW and subsoil on the other side. Depending on the type of terrain and geological characteristics, various methodologies were applied for grading of the ROW. A simple grading operation was carried out by removing and preserving the top soil with the help of graders in agricultural and forest lands. Controlled blasting was carried out by using explosives in rocky areas and rock breakers were employed in rocky, archaeologically sensitive areas. Special grading operations were used in ecologically sensitive areas where topsoil was preserved within geo-textile to keep the seeds and roots of endemic species intact. No grading was carried out in some ecologically sensitive areas where wooden logs were used during construction to reduce the damage to the top soil.

From the engineering and ecological point of view, Punj Lloyd was careful to use hot bends on steep slopes. Extra land was acquired and graded in certain special areas such as crossings, steep slopes and hilly areas to facilitate storing pipes, movement and operation of equipment. Importance was given to the depth of grading and graded materials, keeping provision for restoration and reinstatement later. Archaeologists, zoologists, botanists and other environmental specialists supervised the clearing and grading activity. The project team discovered some archaeological areas during this activity and informed the ministry of culture about the findings. Representatives of the authorities were engaged in some special operations such as transportation of explosives and blasting activities.

The impact on normal life

The social management strategy of the company aimed at regular and transparent communication between the project and local settlements and vice-versa, which was fundamental to building positive relationships between them, with the goal of preventing dependence between the settlements and the project.

Before starting the clearing and grading activity, the project team held meetings with the Village head (Muhtar), landowners and land users. The Community Relations team had the responsibility of explaining the boundaries of the construction area, and what to do and not to do on the ROW before, during and after construction. They explained the nature of work and the meaning of land entry protocol. In addition, the team advised the villagers not to cultivate or enter the ROW until they get their land back in its original condition. Once they understood the implications, an agreement was signed.

Information was given to the villagers about the start date of construction, how and where the construction team would start, marking of the ROW, and when the villagers could use their land after construction activities. After informing them about construction activities, questions and feedback were recorded by the Community Relations team. Notification sheets, workers' code of conduct, a toll frewe phone number and mailing address were communicated and posted at appropriate places.

The effect of traffic

The project team explained how the additional traffic on the project and its duration would impact the settlements and livestock. Slide shows were presented to explain the stages of construction activities, transportation of heavy equipment and their use, action to be taken to mitigate the effects of the additional traffic and minimise the number of accidents. A short film about the importance of using seat belts was shown to the locals. Additionally, traffic safety awareness training programmes were implemented for directly affected or traffic affected schools. Different community safety awareness programmes were imparted for all levels of students, primary and high school.

Community commitment

As a commitment to the community, the project team recruited all unskilled workers from the nearby villages. Recruitment of semi-skilled and skilled personnel was prioritised from local, district, province and national levels. Recruitment details, interviews, and Punj Lloyd's methods of recruiting unskilled and skilled workers, were given to the settlers. The project team gave information about our working conditions, salary, working hours, accommodation, transportation, duration of work and feedback or complaints.

At the meetings held with the village women, the impact of the project on women and children was elaborated. They were advised to keep their children away from all construction areas and heavy equipment. In the eventuality of an emergency, an emergency toll free number was prominently displayed and a procedure was explained to them.

Conclusion

The variety of terrain encountered on the Baku Tbilisi Ceyhan pipeline was unprecedented in the history of Punj Lloyd. Having experienced working in Siberian and Middle Eastern deserts, Indonesian swamps, Malaysian rainforest and the Western Ghats of India, the company's seasoned pipeliners thought they had seen it all. However, the challenges overcome during grading and clearing of the ROW in Turkey and Georgia will never be forgotten by them.