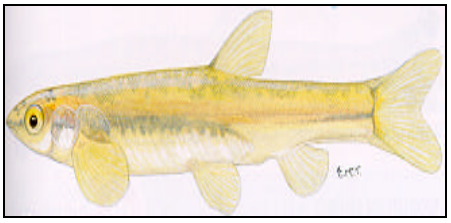
MINNOWS GET THEIR FREE WAY

SAVED FROM EXTINCTION ON THE N4 MAPUTO CORRIDOR



South African National Roads Agency Limited

1. Introduction

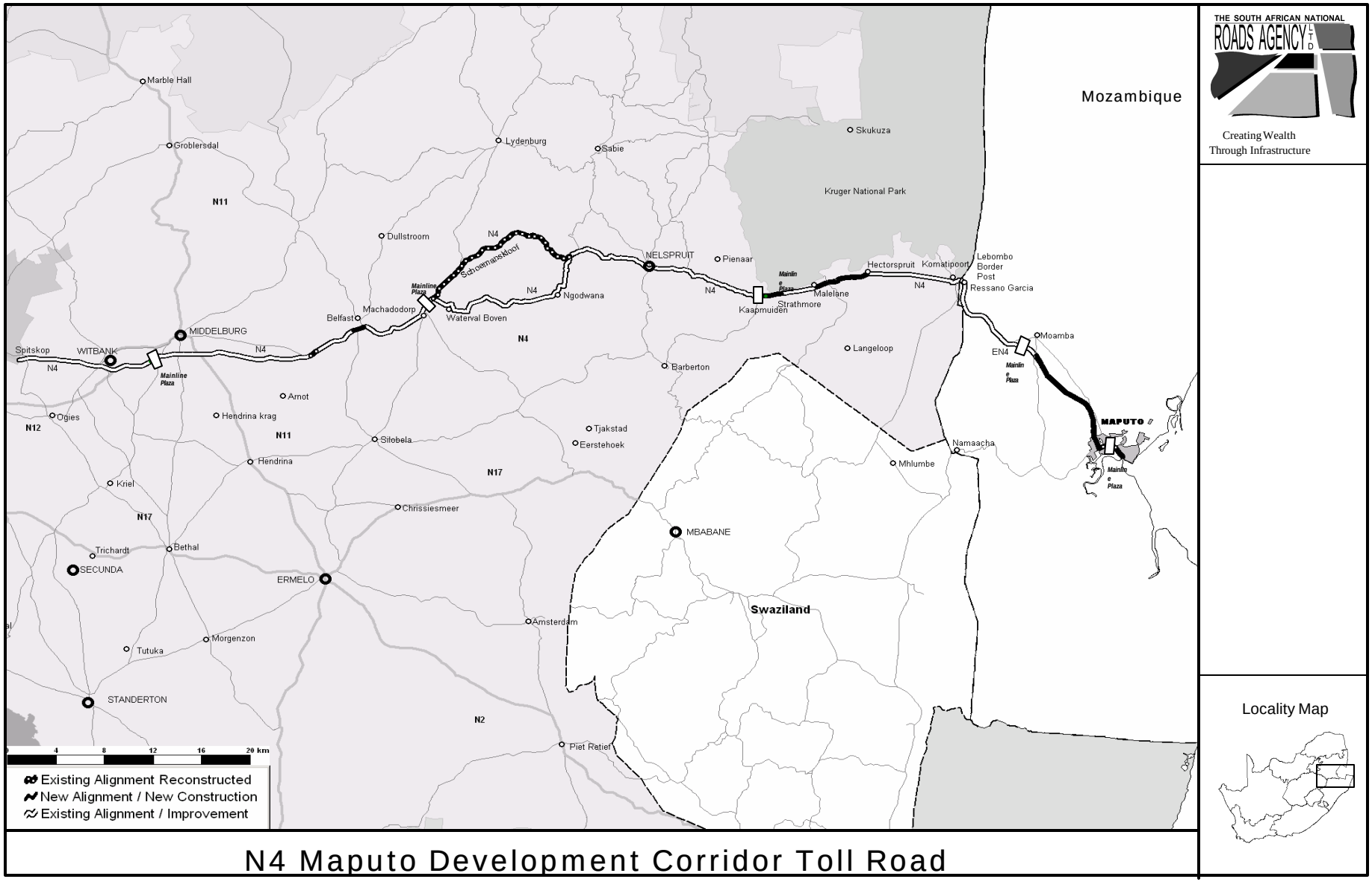
One of the many challenges facing engineers, is to plan, design, construct and operate a road in harmony with the environment. Engineers have been attempting to do this for many years and have seldom achieved the ideal. Yet, achieving the ideal should always be the aim! Roads are a socio-economic provider. They are also essential to eco-tourism and provide access to those seeking renewal from nature, such as the National Route 4, particularly the route through Schoemanskloof in the Mpumalanga Province. See figure A.

The N4 through Schoemanskloof passes over the Elands River, home to the rare and endangered minnow. The endangered fish, scientifically known as the *Kneria auriculata* , is on the red data list. This gives them the same endangered classification as the rhino! The planning of the National Route 4 through Schoemanskloof raised the question: How to change the construction design of the N4 Toll Route to accommodate this endangered fish species while catering for the usual practical constraints? This project represents an achievement, a balanced integration of practical engineering requirements and conservation of the environment. Considerable effort was expended to protect the minnow, without compromising public safety.

The South African National Roads Agency Limited (SANRAL) regards this project as a typical example of how a roads project was planned and built in harmony with the environment. The SANRAL's philosophy is that environmental input into design and construction could only be successful if environmental specifications are to be adhered to throughout the contract and not compromised for the sake of time and money.

2. Introduction to the Project

In April 1997, the first South African toll concession, the N4 Maputo Development Corridor Toll Road was signed. The Concession Contract between a private sector company and SANRAL, entailed the design, building, operation and maintenance of the National Route 4 from the Mpumalanga Border to Maputo in Mozambique. The



N4 Maputo Development Corridor Toll Road

Figure A

vision behind the project was to enhance and extend the existing development corridor to Maputo as a basis for creating economic growth and global competitiveness, whilst at the same time supporting reconstruction and development efforts in South Africa and Mozambique on an integrated and cooperative basis and within the confines of environmental sustainability.

One of the goals of the implementation of the Maputo Development Corridor is to ensure environmental sustainability by developing policies, strategies and frameworks that encompass a holistic, participatory and integrated approach to environmental management.

3. Profile of Minnows

The minnow's head is smooth, rounded and its mouth ventral or tadpole-like. Its body is translucent brown with flecks and blotches on the upper body. A thin dark mid-lateral line appears on the trunk and caudal peduncle and a dark spot at the base of the pectoral and pelvic fins can be seen. The body attains 70 mm in total length. See figure B.

Figure B: The minnow (*Kneria auriculata)*

The minnow *Kneria auriculata* belongs to the family Kneriidae. When frightened, kneriids may secrete an "alarm" pheromone (Schreckstoff) similar to that of cyprinids.

3.1 Distribution

The minnow is found in upland streams of lower Zambezi, Pungwe, Buzi and Save River in Zimbabwe and Mozambique. A relict southern pocket occurs, in the Crocodile (Incomati system), Mpumalanga. See figure C.

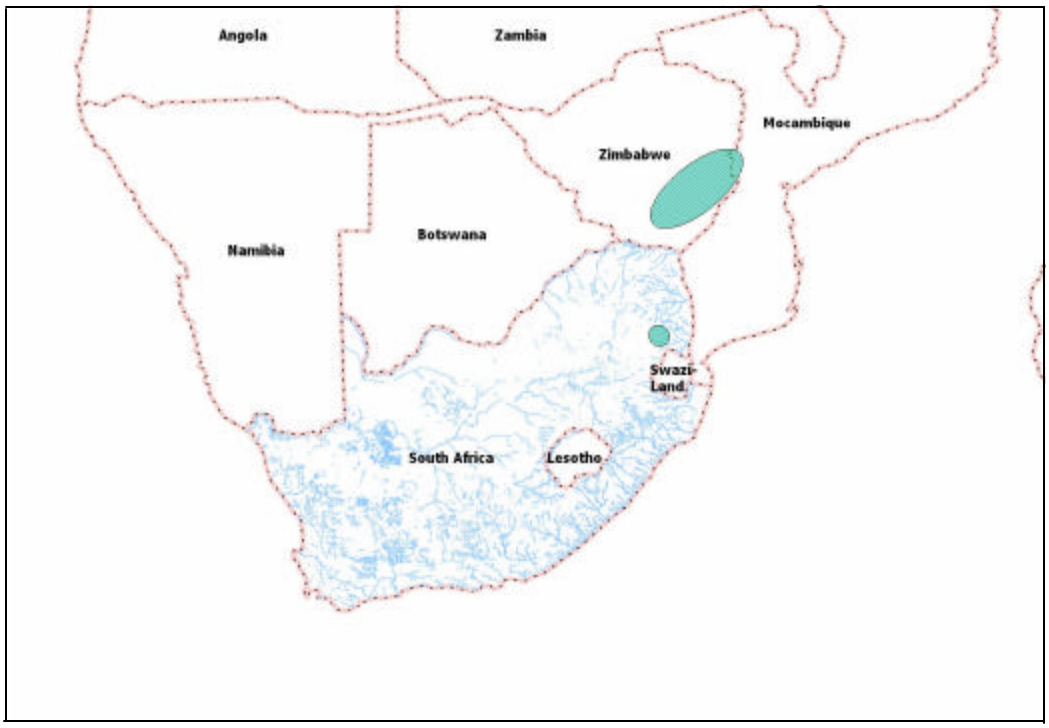


Figure C: The distribution of the minnow in Southern Africa

Shoals occur in pools of small, clear, silt-free, rocky streams. Minnows are reported to breathe air and to climb over damp rocks and up the sides of waterfalls during migrations. Its scrapes diatoms, algae and detritus from rock surfaces and also takes small aquatic insects such as mayfly nymphs and midge larvae. Minnows mature after a year and may live for two or three years and breeding takes place in spring and summer.

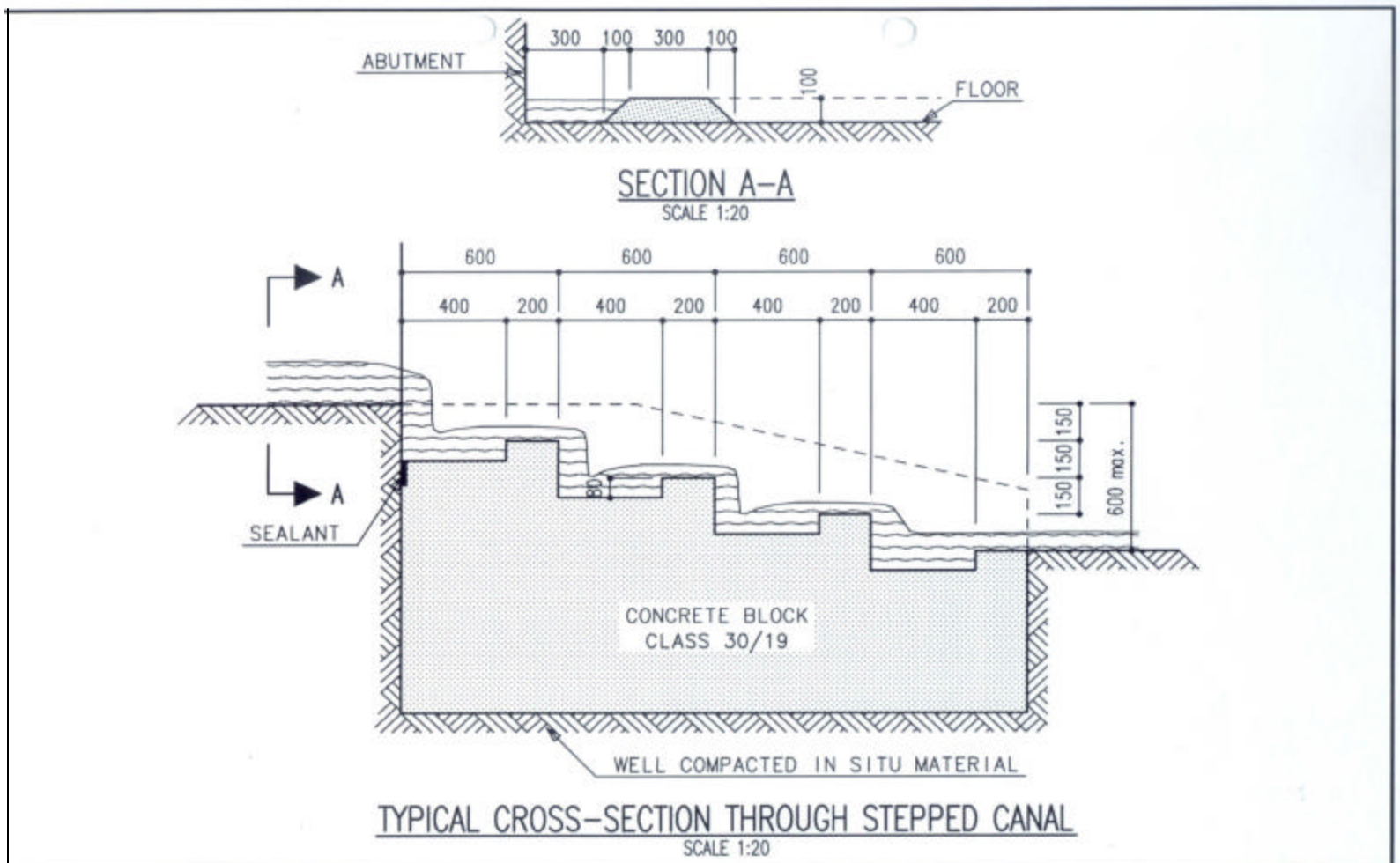
4. How the minnow was saved from extinction in South Africa

The *Kneria auriculata* swim upstream to breed. A bridge in the middle of a river causes and obstruction to the fish's natural migration route. The fact that the bridge floors are usually higher than the actual river level, makes it near impossible for the fish to pass these hurdles. Blocking off the flow of water would have resulted in the local extinction of the species.

The rare minnows were saved from extinction due to the clever and unique bridge design by the N4 Maputo Development Corridor Toll Road construction team, in their commitment to ensure that the few shoals of tiny fish could continue swimming alongside the highway. The companies had to re-design bridges over four tributaries of the Elands River to prevent the fish from being dammed in restricted waters.

To accommodate the rare little fish, unique fish ladders were constructed to provide access to the fish across bridge floors. The fish bridges were designed to allow the fish to 'climb' approximately 1 m to reach the bridge floor from the actual river. See figure D and E.

Figure D: The unique fish ladder



FISH LADDERS
SECTION 6N

Fig E

Once on the actual bridge floor the little fish faced additional challenges. Since the fish is very small and the water accelerate over the concrete floors, the fish would normally have problems swimming over the distance of more than 20 meters under these conditions. Special attenuation blocks were designed (see figure F, G), taking the fish size and the swimming ability into account. Based on the design, the attenuation blocks were spaced on the bridge floors, providing shelter for the tired fish swimming through the accelerated waters.

Figure F: Attenuation block

Figure G: Attenuation blocks in water

Detailed monitoring after construction confirmed that the little fish could successfully pass through the man-made obstacles and that the designed mitigation measures were successful in accommodating the little minnows. Proof once again that nature and man can work together!

Figure H: The fish ladder and attenuation block

Figure I: The fish ladder blends in with the environment

Figure J: A close view of the fish ladder

5. Total Environmental Cost

Construction costs due to environmental controls are difficult to assess as it is not always clear what costs are part of a "normal" civil contract and what are regarded as "environmental costs". However, it is estimated that R15 million to R20 million was spent on adjusted engineering design due to environmental considerations. However, the SANRAL regards this cost as an investment for future generations to enjoy the scenic route.

6. Conclusion

To provide and manage a sustainable national road network that minimise the cost of road transport, promotes economic growth and enhances the quality of life of all South Africans, the South African National Roads Agency Limited recognises that it needs to be sensitive towards the environment and be able to make responsible

decisions regarding the environment. The N4 project is a prototype project and example of how development needs were balanced with the needs of the environment. No costs were spared in the conservation of the minnow. Today, this route is regarded as a valuable scenic route in the country, attracting many tourists to the region.

Bibliography

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2. Information from comments from Mr E van der Lith, Environmental Manager, SBB, Pretoria, 7 April 2004.