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Department: Roads and Transport
GAUTENG PROVINCE

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CONSULTING ENGINEERING SERVICES FOR THE REHABILITATION OF EIGHT STRUCTURES IN THE TSHWANE REGION WITHIN THE GAUTENG PROVINCE

REPORT: BRIDGE REHABILITATION REPORT

BRIDGES: B59 and B649

February 2017

REVISIONS 0 Draft

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1. INTRODUCTION

The Gauteng department of roads and transport appointed KBK Engineers for consulting engineering services for the rehabilitation of eight structures in the Tshwane region within the Gauteng province. The contract commencement date was February 2016. The scope of the works includes the following: Detailed assessment and design report, tender documentation, site inspection, tender period and tender evaluation, administration and monitoring of the works contract, additional duties (if applicable), materials quality control for the construction and construction phase.

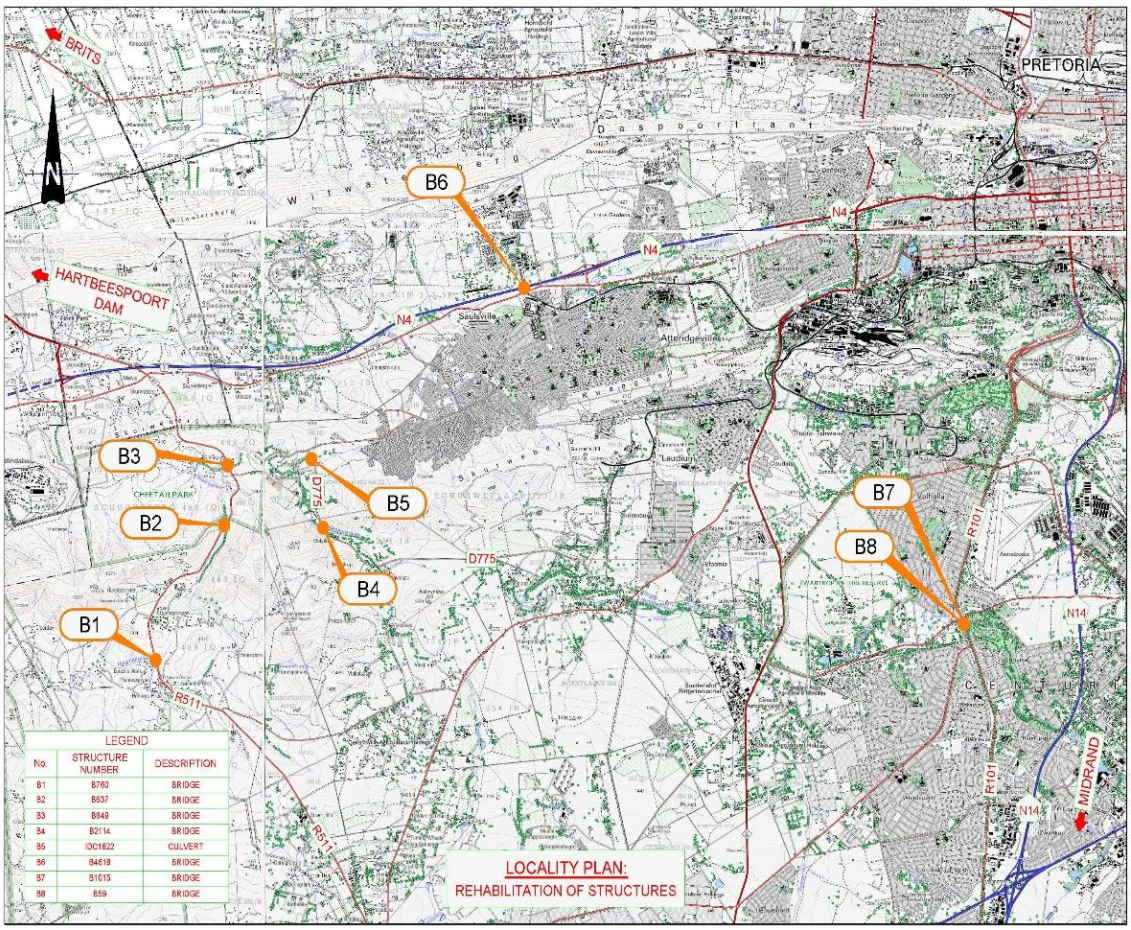


Figure 1: Locality plan for the 8 structures

2. BACKGROUND

The structures that require rehabilitation are scattered around the Tshwane regional district in the Gauteng province. Bridge 59 is found adjacent bridge 1015 along Road R101 (P1-2) passing through the Zwartkops residential suburb. Bridges, 649 are found along provincial RoadR511 (P249), south-west of Atteridgeville. Township. A locality plan of the eight structures is included as ***Figure 1*****.**

During 2012 and 2013, bridges and culverts in the Gauteng Province were inspected as part of the SANRAL bridge network inspection project. A defects based system was used in these inspections, defects are rated using the DER (D= degree of defect, E=extent of defect and R=relevancy of defect) methodology rating system. All bridges and major culverts are inspected in detail every five to six years, and any repair works prioritised in terms of risk. The Bridge management system employs the overall condition index (OCI) to measure the soundness of bridge structures, and to identify the need for maintenance. GPDRT's management system aims to ensure the safety of the travelling public on bridges and major culverts. The above mentioned bridges was identify as structures needed rehabilitation.

3. REHABILITATION OF THE STRUCTURES

3.1 Bridge 59

3.1.1 Location of the bridge

Bridge 59 is located along old Pretoria Road (R101/P1-2), at km 11.93, to the south of the Tshwane Regional District. The bridge is on the northbound carriageway of P1-2 (R101) and spans over the Hennops River. Locality plan provided as **Figure 2**. The bridge structure was built in 1891; the bridge structure according to the National Heritage Resources Act of 1999 is classified as a heritage bridge since it's more than 60 years old.

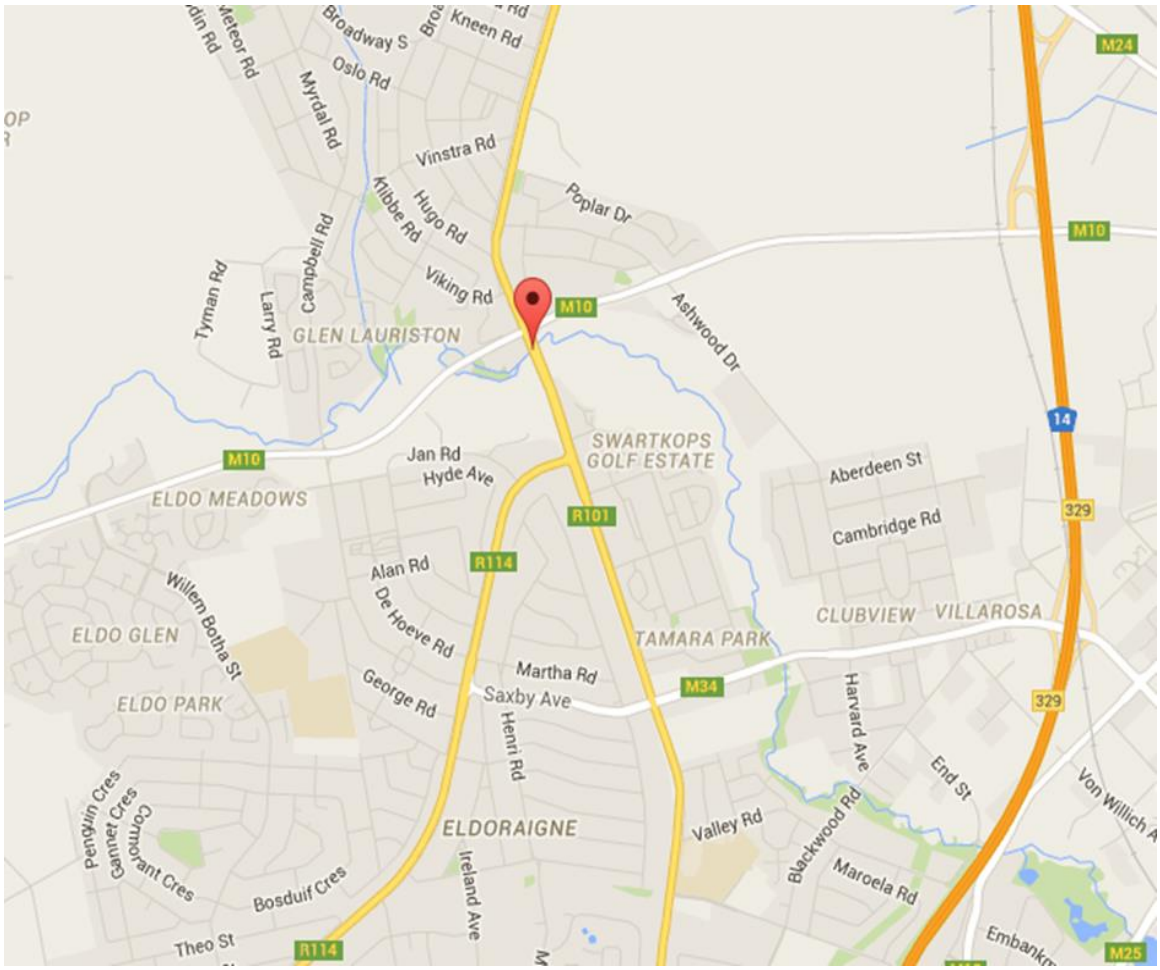


Figure 2: Locality plan B59

3.1.2 Description of the bridge

The bridge comprised of a Lettice truss girder structure with a reinforced concrete deck. The superstructure is supported by two stone masonry abutments. The total bridge width is 7.10 meters, total length 23.20 meters and abutment height of 4 meters. The approach to the bridge is 5.7 meters wide and has a narrow sidewalk for pedestrians. The bridge was built in 1891 and its distinct feature is that the structural connection is made up of rivet type fastenings. No as-built drawings are available for this bridge.


3.1.3 Defects and condition of the bridge

A detailed inspection of all the structures was conducted by KBK to ascertain the condition of the bridge and to quantify the scope of the works. The defects noted below have a degree rating of 3.0 or close to 4.0 and the sections would require urgent attention:

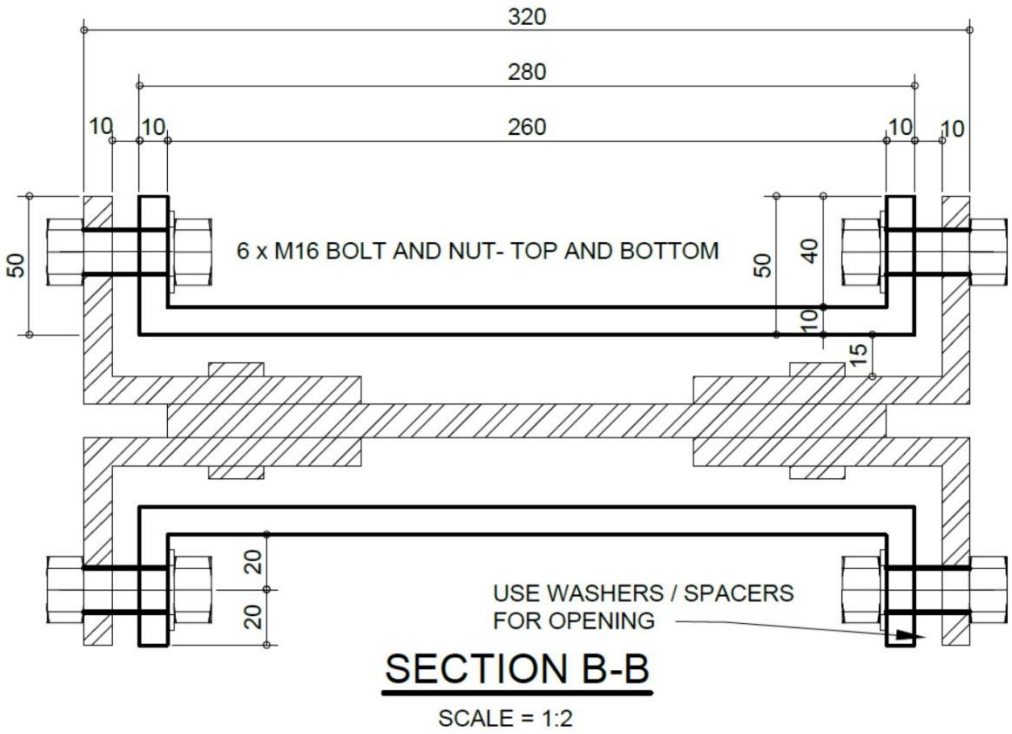
Defect	Photo
Majority of the steel structure has corroded	
Visible accidental Impact damage of truss member. The sight of bridge members in this state of distress could increase the public concern	
Erosion on steel side walk	

Defect	Photo
Exposed steel structure at approaches leaves the superstructure vulnerable to impact	
Drainage scuppers blocked	
Handrails missing and damaged due to impact	
Deteriorated expansion Joints	

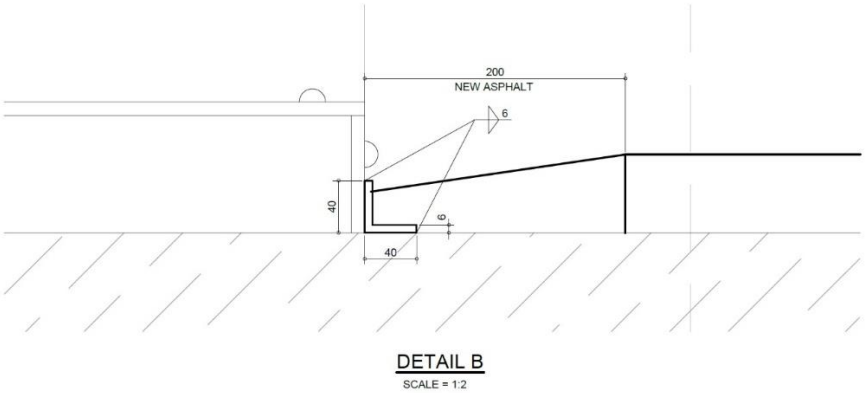
3.1.4 Recommendations

The following Remedial work are approved:

- General clean up with **Low pressure (HP)** waterjet to remove staining on masonry walls.
- Removal of corrosion and old paint with Sand blasting, apply protective coating to all steel components including bearings with a multiple coats matching the colour used for the original construction.
- Restore vertical member (see drawing below and attached) with impact damage to its original geometry using heat straightening techniques and strengthen by adding a new member of 280 x 50 plate channel section.



- Repair the eroded steel sidewalks using 40 x 40 angle Iron (see sketch below).



- Design and construct new concrete end-block to protect the steel structure at the approaches. New concrete end-block to be curved, and similar to the end-block for Bridge 1015, and guardrails to be connected to the end blocks
- Clearing of drainage scuppers
- Replace handrails with similar type to preserve the historical appearance of the bridge structure
- Replace existing expansion joints with new asphaltic plug joint
- Clean debris from bearing seal
- Patch asphalt surface

The preliminary construction drawings are attached in Appendix A

.

3.2 Bridge 649

3.2.1 Location of the bridge

Bridge 649 is at km 13.8 along the R511 (P249) positioned to the west of the Tshwane regional district near the community of Atteridgeville. Road R511 (P249) is a class 3 secondary road that functions as an important link between Sandton and the surrounding communities. The road has a 3.0m lane in each direction, no shoulders and 2 × 0.8m sidewalks. The bridge has a north/south orientation and spans over the Hennops River. The bridge structure was built in 1940.
Locality plan provided as Figure 3.

Safety is a critical issue on this portion of the road. Bridge 649 is considered to be high risk structure, reasons for this status include that the bridge width is substandard as the bridge doesn't have enough lanes to accommodate traffic flow in both directions. Road P249 has 1× 3.0m lane in each direction, no shoulder and 2 × 0.8m raised sidewalks. Aggravating the situation is the 500mm height difference between the road and the sidewalks. The road is not wide enough to accommodate traffic in both directions, particularly a truck and a small vehicle or two trucks passing the same point going in different directions. Numerous accidents have occurred on this porting of the road. The 60% loss of handrails on this bridge is due to accidental impact.

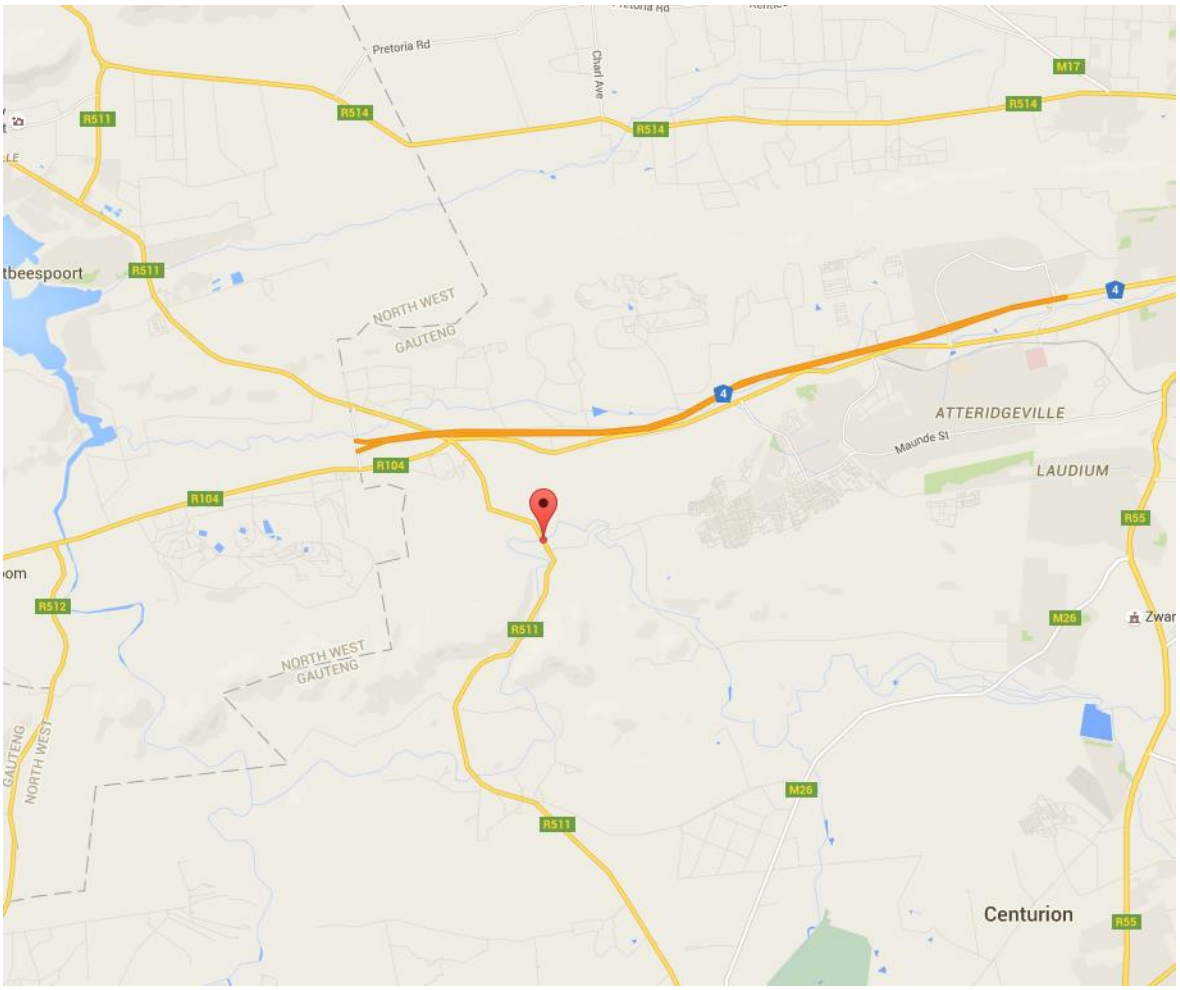


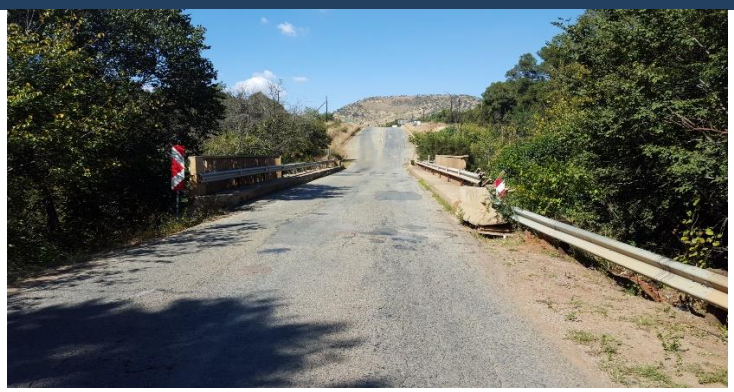
Figure 3: Locality plan Bridge 649

3.2.2 Description of the bridge

Bridge 649 is an arch (filled) type river bridge that has one span with an overall span length of 18.1 m. The concrete deck was cast in-situ and has no skew angle. The bridge has an arch span rise of 6m, 2.5m springing thickness and 0.33m crown thickness. The original handrails was removed some time ago and replaced with precast concrete handrails. As-built drawings are available for this bridge.


3.2.3 Defects noted on site

A detail inspection of the structures was conducted by KBK to ascertain the condition of the bridge and to quantify the scope of the works. The defects noted below have a degree rating of 3.0 or close to 4.0 and the sections would require urgent attention:

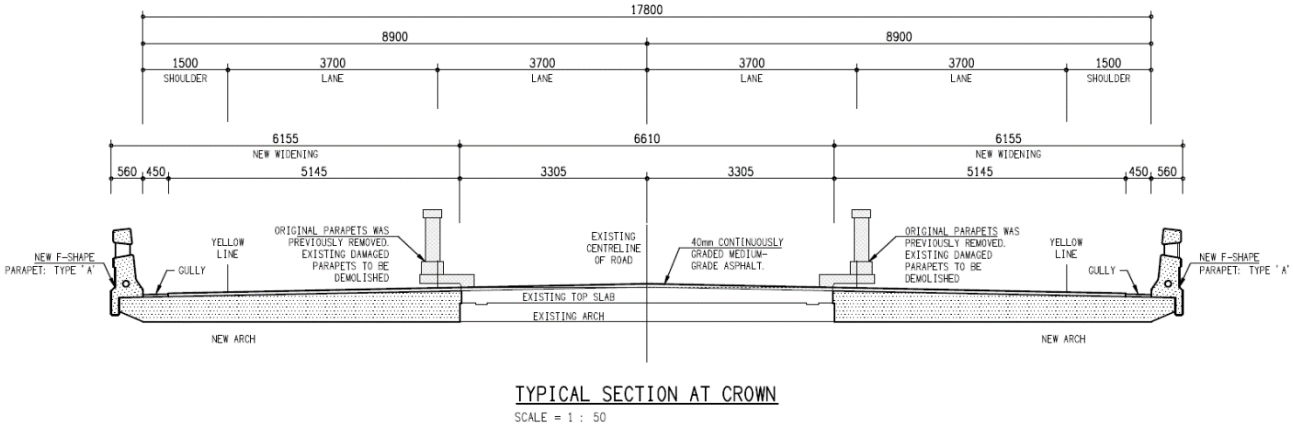
Defect	Photo
Safety is a major concern on this bridge, the bridge is too narrow and it cannot accommodate traffic in both directions	
Handrails damaged by vehicle impact as the bridge is too narrow	
Guardrails not connected to the end-blocks on all four sides	

Defect	Photo
Edge of side walk not properly aligned with the road	
High side walk	
Over grown vegetation	

3.2.4 Remedial work Recommended

Based on the defects noted during the field inspections, the approved remedial work for Bridge 649 are as follows:

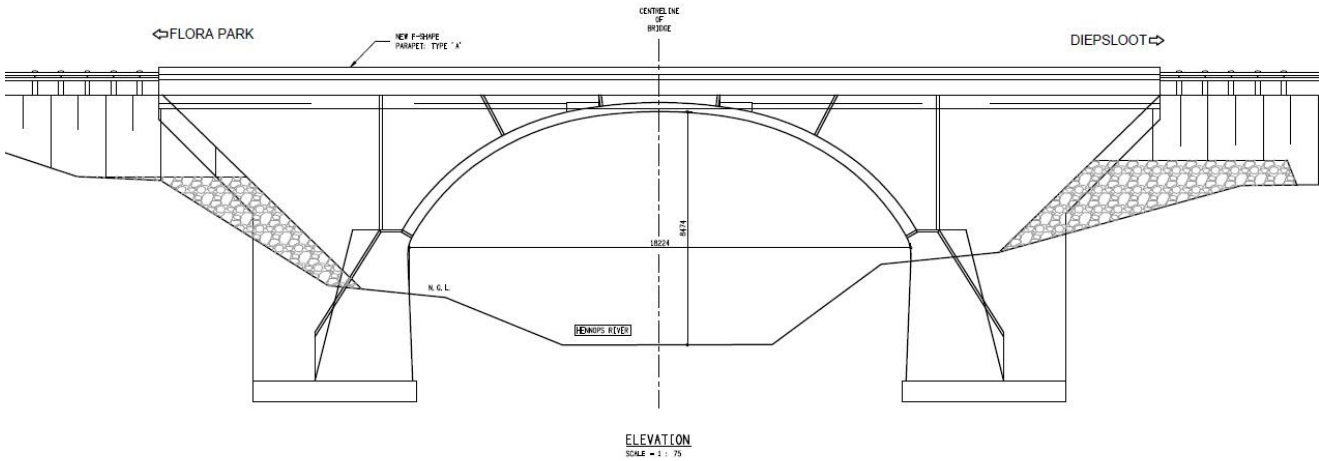
Widening the bridge on both sides with 6.155m to accommodate wider lanes and sidewalks. The approved cross-section will comprise of 2 × 3.7m lanes in each direction and 2 × 1.5m sidewalks (See dimensions below).



TYPICAL SECTION AT CROWN
SCALE = 1 : 50

Only the handrails and a small portion of the original deck will be demolished to accommodate the new arch structure that will be constructed both sides of the existing bridge. The new extensions will match the existing structure side walls that contain the road fill and therefor will have a similar elevation view.

Preliminary Hydraulic calculations show that the bridge have sufficient capacity for a flood with a return period of 1:50 years. No scoured ore erosion damage were



ELEVATION

observed. Stone pitching will be constructed to protect the road fill similar to the existing protection.

It is expected that the foundations will be on the same level as the existing and will also match the existing foundation in size.

The new f-shape parapets will be constructed on the new bridge and back to back guardrails will be connected to the new end blocks.

The following minor work will also be constructed:

- Introduce down chutes on both sides of the road way to direct storm water to the river.
- Cut overgrown vegetation under the bridge.
- Minor spalling and crack repairs to the existing structure.

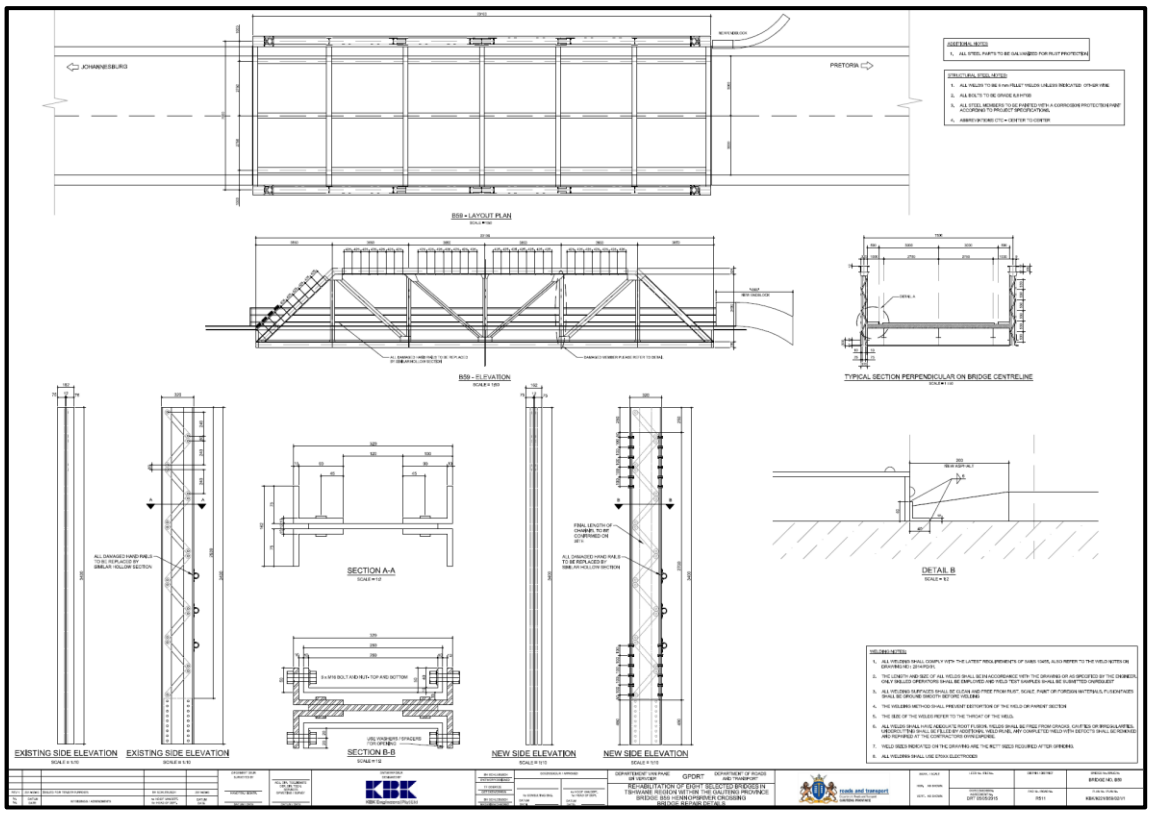
The new widened section shall comply with the latest standards of Gauteng Department of Roads and Transport. The preliminary construction drawings are attached in Appendix B

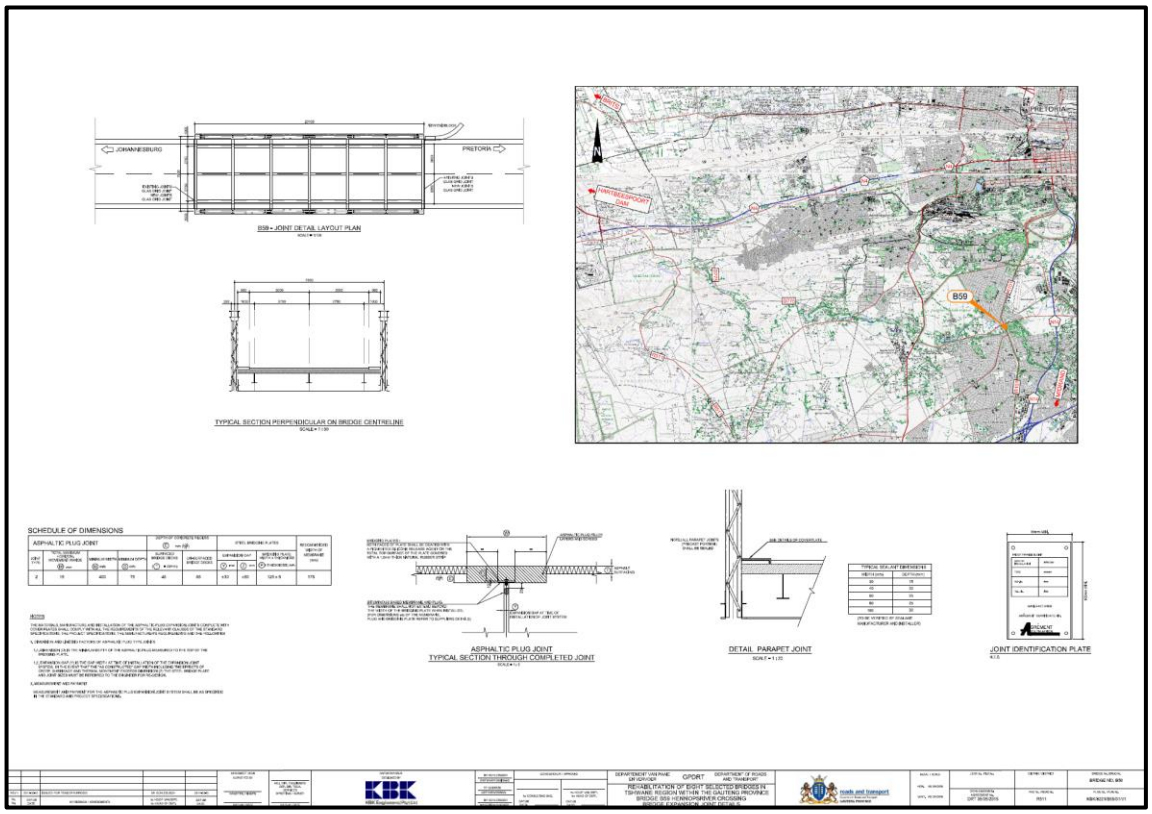
4. APPLICABLE DESIGN STANDARDS AND REQUIREMENTS

Design codes:

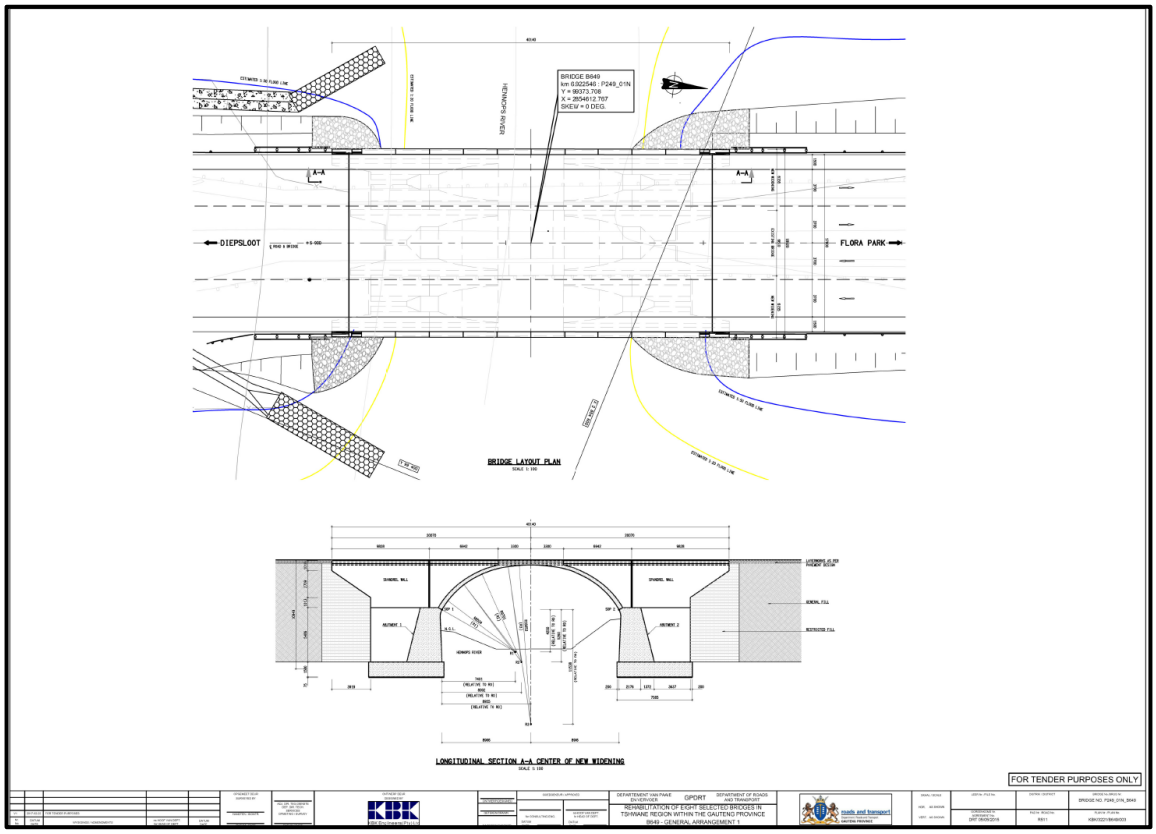
A. Code of Practice for the Design of Highway Bridges and Culverts in South Africa – TMH 7 Parts 1 & 2. (As amended in 1988)
B. Code of Practice for the Design of Highway Bridges and Culverts in South Africa – TMH 7 Part 3.
C. Code of Procedure for the Planning and Design of Highway and Road Structures in South Africa – February 2002.
D. Design loads: NA, NB 36 and NC 30 x 5 x 40 as per the codes above.
E. Design and detailing of all structural elements will be in accordance to TMH 7 – Part 3 and SANRAL 'Code of Procedure for the Planning and Design of Highway and Road Structures in South Africa' – February 2002.

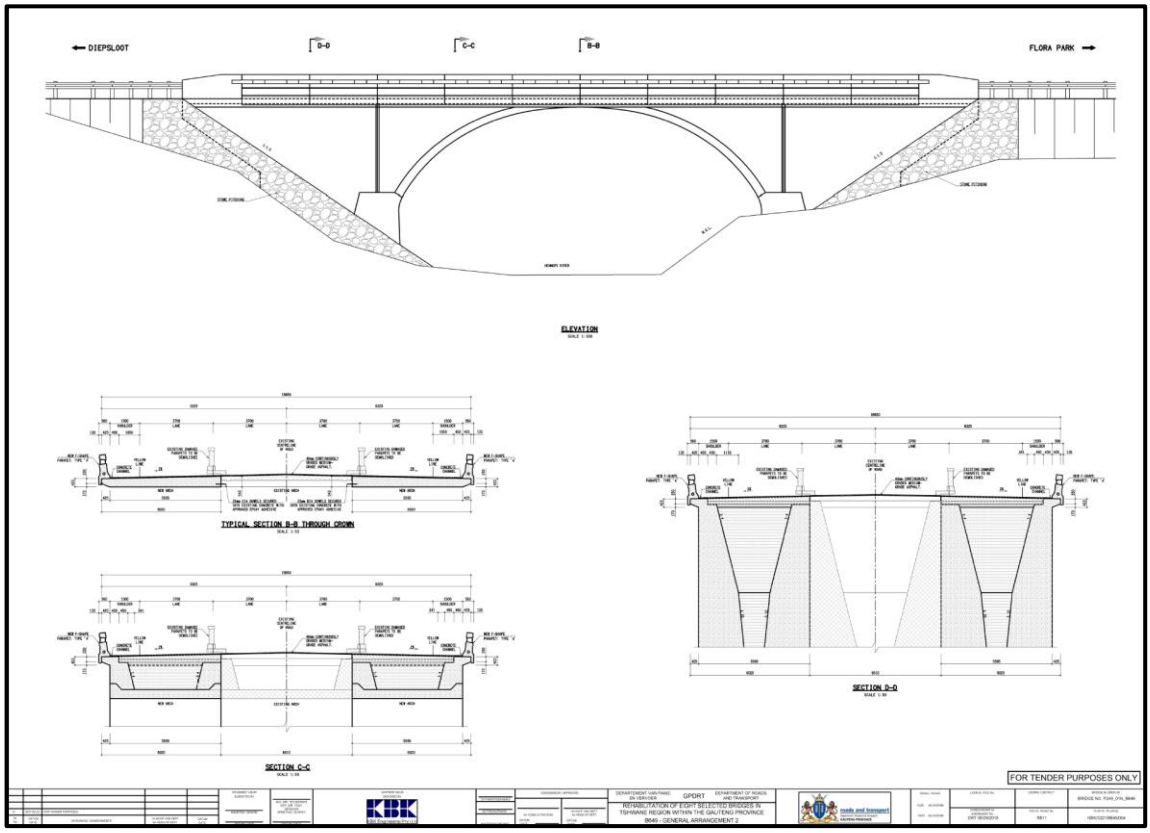
ANNEXURE A
BRIDGE B59 DETAIL REPAIR DRAWINGS




JOHANNESBURG
PRETORIA
B59 + JOINT DETAIL LAYOUT PLAN
TYPICAL SECTION PERPENDICULAR ON BRIDGE CENTRELINE
B59
SCHEDULE OF DIMENSIONS
ASPHALTIC PLUG JOINT
ASPHALTIC PLUG JOINT
TYPICAL SECTION THROUGH COMPLETED JOINT
DETAIL PARAPET JOINT
JOINT IDENTIFICATION PLATE

ANNEXURE B
BRIDGE B649 GENERAL ARRANGEMENT DRAWINGS




DIEPSLOOT
D-D
C-C
B-B
FLORA PARK
ELEVATION
TYPICAL SECTION B-B THROUGH CROWN
SECTION C-C
SECTION D-D
FOR TENDER PURPOSES ONLY
GPDRT
REHABILITATION OF EIGHT SELECTED BRIDGES IN TSHWANE REGION WITHIN THE GAUTENG PROVINCE
B649 - GENERAL ARRANGEMENT 2
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