BAJ

Tender submission

Project: Mars Lander/Rover

Tender Evaluation: BAJ

Client: Curtin's The Avengineers

Date: 12/04/2017

Revision: C

Adam Saou Salah
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Jaci Brunning
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Executive Summary

This tender has been created by BAJ in response to the designs and criteria set by the client Curtin's The Avengineers. BAJ have created this document with the purpose of analysing the designs, specifications and method in creating the prototype and replying to the criteria. BAJ believes that Curtin's The Avengineers excel over other companies in technical and skilful designs and our company highly postulates that we would be able to produce a Mars rover that exceeds the quality and standard intended by the client.

Our company kindly and strongly recommends that the client holds this tender in high regards as the criteria set by the client has been substantially met and extensive evidence has been provided. The client questioned about the previous qualifications of the company regarding working with machinery. The members of BAJ have previous woodwork and metalwork experience and evidence has been provided that two of our members have completed an advanced level of these courses. BAJ members have experience with operating dangerous machinery and this has allowed the company to maintain a safe and efficient standard in construction.

BAJ has also shown its initiative and organisational skills by acquiring the machinery, tools and materials required to construct the prototype. The workspace required to construct the prototype has also been made accessible to the company and evidence of the company's preparational skills has been provided.

Accessibility to convenience and hardware stores is important in the unlikely case that a piece of equipment fails or breaks and BAJ has shown that travel time is quick and easy as one member can travel to a convenience or hardware store in less than 10 minutes. Evidence has also been provided that each member has a license or a public transport 'SmartRider' and that each member can reach each other in less than 30 minutes. Efficiency is important in industry and BAJ excels in efficiency and proficiency to benefit the client.

BAJ would like to reassure that we as the company tendering to the client would like to take full responsibility for and replace any errors, breakages or failures of any equipment, materials or tools that might occur during the construction and/or testing phase. Our company is committed to providing a Mars rover that excels all expectations and this is our proof for doing so.

BAJ is a proud company that excels in proficiency, efficiency and communication. Our staff are highly trained and understands the values we follow as a company. Our company hopes to show the client what can achieve together and that we can maintain our reputation by constructing the prototype within the desired time-frame. Only the highest quality will be accepted and we believe that our company will be able to exceed the client's expectations.

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1.0 Introduction

This document is BAJ's tender submission in response to the Stage 1 Design Package created by Curtin's The Avengineers. The document reviews the Stage 1 Design Package and answers the Tender Evaluation Criteria outlined by the client.

2.0 Design Package Review

A Design Package review is conducted to make sure that BAJ have a thorough understanding of the Stage 1 Design Package Curtin's The Avengineers have submitted.

2.1 Understanding of Design

Referencing Curtin's The Avengineers' Stage 1 Design Package as Appendix E.1, there will be a summary of the design. In terms of the overall complexity of the designs and difficulty to construct the Mars rover, it is rather simple. As shown in the Exploded view (DRAW_4-5) of Appendix E.1 the main body is a wooden plank of length 220mm, there are 2 holes drilled through each side of the body and a straw is placed through each hole to act as a sleeve for the metal rod axles. The stubby holder is glued onto the front end of the wooden plank and then later duct taped around the stubby holder to act as a support for the water bottle.

The wheels are the most complex part of the construction process. To paraphrase the Wheel Construction method in Appendix E.1, the can must be cut into thirds and two slits must be cut into the top or bottom end of the can so that they can connect and then be duct taped to hold. A cut is then placed through the bottom end of the can and the axle is placed through the hole. This occurs with the other wheel and axle and then the wheels are glued to the axles to hold. The wheels with the axles attached are then placed through the inside of the straws that were sleeved into the wooden plank. The wheels that aren't connected to the axle must now be ensembled in the same fashion as before. The wheels are then glued to the axles again so that they remain secure.

As mentioned before, the difficulty of the construction process is rather low. The low difficulty of the construction process means that the designers of Curtin's The Avengineers did an exemplary job in simplifying the design of the Mars rover and this makes the job easier for the contractors that will be undertaking the construction of their design. The design of the rover is sturdy and looks like it should be able to withstand the 1 metre drop as its mainframe is wooden, however, there are a few concerns, suggestions and improvements that will be conveyed in '2.3 Concerns and Suggestions.'

2.2 Client Brief Compliance

The assignment handbook as shown in Appendix F.1 outlines the requirements designers must follow when designing the Mars rover. It is BAJ's responsibility to ensure that Curtin's The Avengineers have correctly complied with the briefs' requirements.

The design criteria as shown in ‘Appendix A – Client Testing & Compliance forms’ of Appendix F.1 has 8 constraints that must be abided by the designers. In reference to Appendix E.1, BAJ will assess Curtin’s The Avengineers compliance with the brief.

The client has met the constraint ‘Capable of carrying cargo’ as the rover has a stubby holder glued and sticky taped to it which can carry a water bottle (the cargo) in it.

The client has met the constraint ‘Condition of cargo can be assessed remotely’ as the cargo is easily visible and accessible from a metre away. There is nothing blocking the cargo and the stubby holder keeping the water bottle in place does not interfere with viewing the cargo either.

The client has met the constraint ‘Capable of free-wheeling’ as the aluminium cans wrapped in a smooth layer of duct tape should allow for the wheels to roll freely down the 30 degree slope without too much friction to slow it down.

The client has met the constraint ‘Footprint fits within A3 paper’ as the dimensions of an A3 sheet of paper is 420mm x 297mm and the design specifications dimension the prototype at 270 mm x 250mm as shown in Appendix E.1 ‘Top View’ (DRAW_4-4).

The client has met the constraint ‘Height less than 210mm’ as the diameter of the aluminium wheels is 65mm, the height of the wooden plank is 30mm and the length of the stubby holder is 74mm as shown in Appendix E.1 ‘Side View’ (DRAW_4-3). The length (diameter) of the aluminium wheels overlaps with the length of the stubby holder and the wooden plank meaning that the height of the prototype is not directly 169mm but less than that. This means that the height of the prototype is less than 210mm therefore meeting the constraint.

The client has met the constraint ‘At least 2 axles’ as the Exploded View (DRAW_4-5) in Appendix E.1 clearly shows that the rover uses 2 metal rods as axles.

The client has met the constraint ‘Theoretical cost less than $30’ as the Bill of Materials in Appendix E.1 shows that the total cost of materials is $27.17 and therefore under the price limit of this assignment.

The client has met the constraint ‘3D printed parts cost less than 25% theoretical’ as the client has not used 3D printing at all which means that the total cost was $0 and therefore they meet the constraint.

Curtin’s The Avengineers have managed to meet the constraints of all criteria presented to them in in ‘Appendix A – Client Testing & Compliance forms’ of Appendix F.1. The client has shown exemplary designing skills and the prototype fits the criteria perfectly. Even though the design was very well done, BAJ will still convey some concerns and provide some

suggestions and improvements that can be made for the prototype in the next section '2.3 Concerns and Suggestions.'

2.3 Concerns and Suggestions

BAJ would like to express two of the concerns that were brought up during the review stage of Curtin's the Avengineers' Stage 1 Design Package. The first concern is the lack of mass at the back of the rover. As shown in the Side View drawing (DRAW_4-3) of Appendix E.1, the centre of mass is near the front of the rover as the stubby holder and the water bottle were allocated near the front of the rover. This can be dangerous because the rover is moving forward and falling at an angle of 30 degrees below the horizontal, this means that the rover will continue to move forward "head first" at the ground meaning that the front of the rover will take most of the impact and could potentially break to some extent. BAJ would like to suggest that the weight of the stubby holder and the water bottle must be calculated so that masses (or weights) that are a bit heavier than the weight of the water bottle and stubby holder can be placed near the back of the rover. This means that the rover will slightly fall back during the vertical drop and land on all its wheels so that the brunt of the force will placed upon the wheels rather than the front of the rover where the cargo is.

The second concern directly relates to the first concern. The second concern is the suspension of the Mars rover. While the aluminium wheels do a satisfactory job of shock absorbing the force so that the cargo remains unharmed, we do not want the wheels themselves to bust either. BAJ recommends a sturdier material for wheels such as polypropylene. Polypropylene is a versatile plastic used in everyday items such as containers and chairs. These items do not tend to break from dropping from a reasonable height either. Bunnings Warehouse sells polypropylene fixed plate wheels for $2.20 each which would come up to a grand total of $8.80 for 4 wheels. This is not unreasonable as according to the Bill of Materials in Appendix E.1, a 10 pack of aluminium cans comes out to $6. So it's only $2.80 more for a more safer and sturdier alternative. This would also still fit within the $30 price limit for the designers but would more importantly substantially improve the safety of the rover.

3.0 Criteria

In this section of the tender submission, BAJ responds to the Tender Evaluation Criteria formulated in Curtin's The Avengineers' Design Package. Please note the questions will be presented in italics and the response will be presented in normal text.

3.1 Experience and Qualifications

Do any of your team members have any professionally recognized skills and/or qualifications which may be relevant to the construction of a small model consisting of wood, metal, and plastic? E.g. Cert 2 in Woodwork

All our members have completed woodwork or metalwork experience in the past even if it was basic. The basics of woodwork and metalwork in high school covers quite a lot of theory and practice required to construct items (in this case the Mars rover). Two of our members Joseph Archer and Jack Ghasseb, have completed year 10 woodwork and metalwork as shown in Appendix A.4, this means that they have completed an advanced level of theoretical and practical work involving construction and using materials. One of our members, Joseph Archer, obtained his white card (work health and safety course) in February 2016 which is used in construction as shown in Appendix A.1.

Do any of your team members have prior experience in interpreting technical drawings and/or reading step-by-step procedures, even in a non-professional scenario?

BAJ has a skilled technical drawing team consisting of a few members who have excellent previous experience. On our designer team, Jaci Brunning oversaw the AutoCAD designs as shown in the BAJ Design Package Appendix A.2. Another member, Joseph Archer, completed an 'Engineering Drawing and Computer Aided Design' unit at ECU which was an equivalent unit to Curtin's 'Engineering Graphics' and passed with an exemplary score of 85% as shown in Appendix A.3.

Do any of your team members have prior experience safely operating machinery such as Drop Saws, Drill Presses, Ban Saws, Hand Drills and/or other power tools?

BAJ members have all had practical experience in the past with using operating machinery in metalwork and woodwork classes in high school. However, two of our members, Jack Ghasseb and Joseph Archer, have taken advanced metalwork and woodwork classes in year 10 (2014), refer to Appendix A.4. These courses included used operating machinery such as drop saws, drill presses and hand drills.

Do any of your team members have prior experience in manual processing of wood and or/plastic? E.g. the use of sandpaper, wood/plastic/super glue, hand saws and/or production of wooden/plastic models?

Like mentioned above, all BAJ members have had practical experience with metalwork and woodwork in high school. This includes using manual processing materials such as the ones listed above. As provided in Appendix A.4, Jack Ghasseb and Joseph Archer, have used these

materials at a higher level than the other members of the group as they have completed year 10 woodwork and metalwork courses.

3.2 Access to Equipment

Do any of your team members have access to power tools within their homes which they are able to use including the following: Drill Presses, Ban Saws, Hand Drills, Hand Saws, fractional drill bits (~6.5mm) etc.?

The members of BAJ have access to many of the listed power tools such as a drill press, hand drill, fractional drill bits and hand saws as shown in Appendix B.1. The fractional drill bits are available in difference widths (1mm to 10mm, including 6.5mm), please refer to Appendix B.2.

Do any of your team members have access to manual processing tools within their homes which they are able to use including the following: sandpaper, wood/plastic/super glue, scissors, hand file?

The members of BAJ have access to all the manual processing tools listed above. If any extra materials are required we are more than happy to source them ourselves with our own financial resources.

Do any of the above specified members have an accessible area, such as a workshop, in their home where they can safely use the above tools.

BAJ members have access to a workshop which is spacious and more than safe enough to construct the Mars rover as shown in Appendix B.3. The members of BAJ are perfectly fine with working together in this environment.

Do any of your team members have access to any of the following recycled materials:
- *375mL Aluminium Cans*
- *Clear Tape*
- *Stubby Holders*
- *Wooden planks/blocks more than 22cm long and 9cm wide.*
- *Super Glue*

BAJ members have access to all of the listed materials. It is the company's responsibility to source the materials so even if we didn't have all of the required materials we would still source them and pay for them using our own financial resources. We are committed to making this construction process as smooth as possible for both client and contractor.

3.3 Accessibility

Do any of your team members have access to a hardware store (e.g. Bunnings Warehouse), less than 10 minutes away by any conventional mode of transport?

One of our members, Adam Saou Salah, who lives in Midland has access to a Bunnings Warehouse store approximately four minutes away by car as shown in Appendix C.1.

Do any of your team members have access to a general store (e.g. Coles, Woolworths), less than 10 minutes away by any conventional mode of transport?

One of our members, Adam Saou Salah, who lives in Midland has access to a Woolworths and Coles store approximately one and two minutes away respectively by car as shown in Appendix C.2.

Do any of your team members have access to a vehicle, a driver's license, and the ability to freely use this vehicle to travel to the locations listed above? Do any of your team members have daily access to public transport?

All members of BAJ either hold a valid driver's license or have access to public transport through the use of a SmartRider. This means every member of BAJ is able to travel to a hardware or general store as listed above. Please refer to Appendix C.3 for proof of access to a SmartRider.

Do any of your team members live within 30 minutes of each other by any conventional mode of transport?

The members of BAJ all live a relatively large distance away from each other. However, the company has a means of fairness and simplicity by using Perth City as a central HUB for determining time-distance away from each other. This means that most of the BAJ members do live within 30 minutes of each other by car, train or bus as the distance between Perth City and their own homes is within the allocated time of 30 minutes. As proof, Appendix C.4 shows the time-distance from Perth to Carine. The time from Perth to Carine is 24 minutes and falls within the 30-minute timeframe. It is expected that all BAJ members can easily reach Perth from their own homes by any conventional form of transport.

3.4 Liability and Other Considerations

Are your team members willing to take responsibility for, and potentially pay for, any damage to materials during the construction or testing process. i.e. if materials were broken/faulty, would you replace them as oppose to attempting to use them in the construction?

The members of BAJ are willing to take responsibility for any damaged materials during the construction and testing process. The company is also willing to pay for and replace any damaged materials during the construction and testing phase. It is the company's

responsibility to provide the best finished product for our client and we are one-hundred percent committed to doing so.

Do you consider your team able to complete the construction of the model more than 6 hours before the deadline?

BAJ is more than capable of completing the construction of the model more than 6 hours before the deadline. Proof of BAJ's Stage 1 Design Package submission is in Appendix D.1. Please note that the Design Package was submitted later than 6 hours before the deadline. This is because finishing touches were being made to the package by both the contractors and the designers to maximise the quality of the work being submitted. BAJ believes that work should be set to an exemplary standard and this is what was shown through our hard-working ethic.

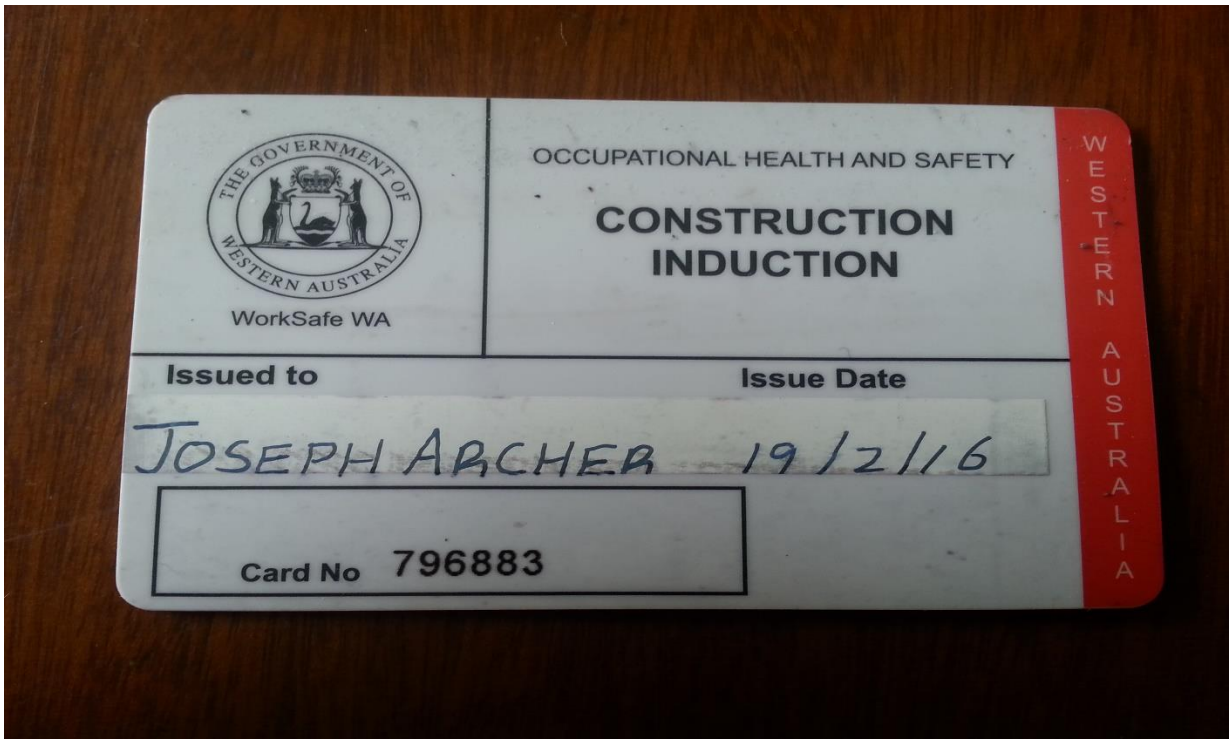
Are there any other limitations imposed on your team or team members which would affect the construction process that you would be willing to disclose?

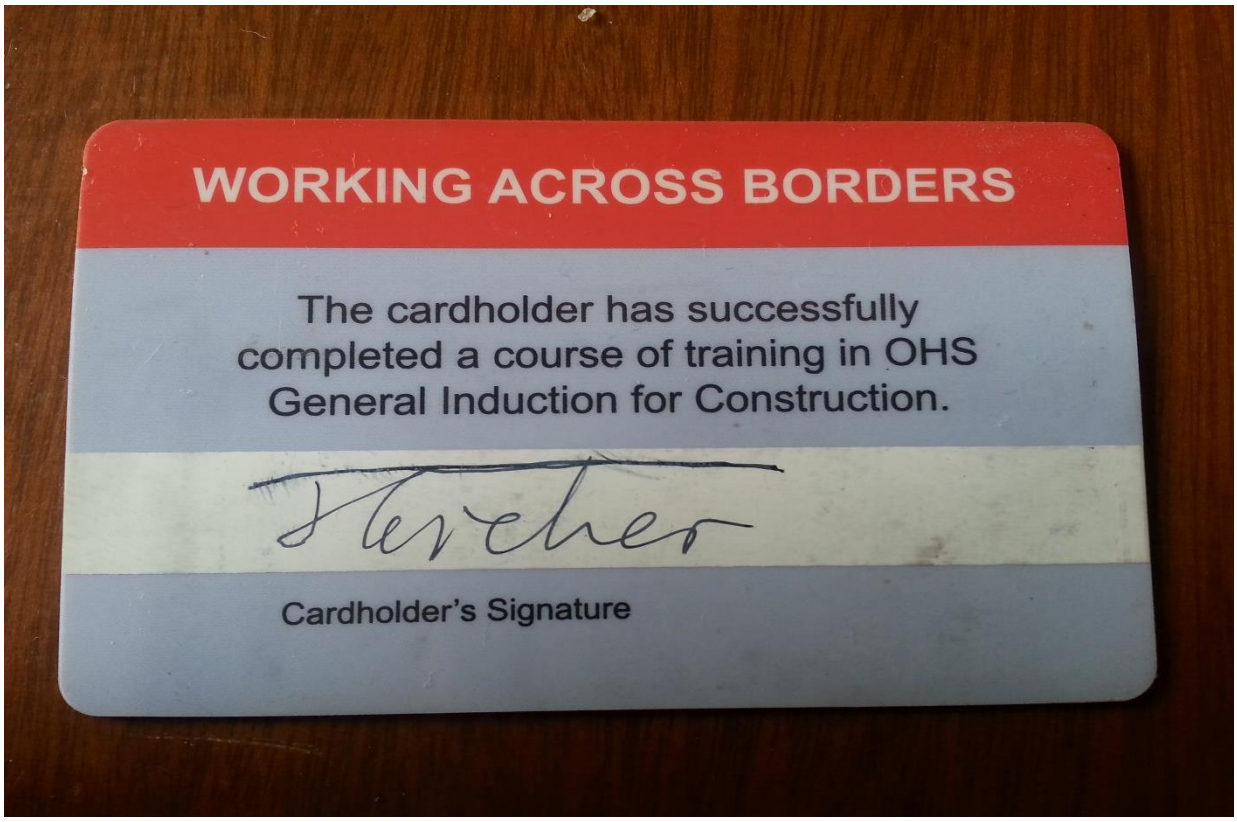
There are no limitations that would affect the construction process of the Mars rover. The members of BAJ are all in good condition and are not affected by any diseases or health restrictions.

APPENDICES

4.0 Appendix A.1 – OHS Construction Induction White Card

Construction White card obtained by Joseph Archer in February 2016.





5.0 Appendix A.2 – BAJ Design Package

A link (via Google Drive) to the BAJ Design package which contains the technical drawings created by Jaci Brunning.

https://drive.google.com/open?id=0BwlO387_VYwDSjlKbTExMmFpZ1U

6.0 Appendix A.3 – Joseph Archer ECU Academic Transcript

Academic transcript of Joseph Archer at ECU showing the completion of the Engineering Drawing and Computer Aided Design unit with a score of 85%.

EDITH COWAN UNIVERSITY
WESTERN AUSTRALIA

STATEMENT OF ACADEMIC RECORD

This official University Statement of Academic Record is issued without alteration or erasure. The Statement is on secure paper which includes a blind emboss and an embedded silver foil of the University crest in the lower right hand corner. The face of the document has a blue background and the name of the University is repeated in small print. When scanned or photocopied the embossed logo will not appear and the words "PHOTO COPY" appear prominently across the document.

14/07/2016

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10422914

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Course: Y45 Bachelor of Engineering (Mechanical) Honours

CRICOS 083184M

Unit Code	Unit Title	Year/Semester		Result	CP
ENM1102	Engineering Drawing and Computer Aided Design	161	85	HIGH DISTINCTION	15
ENS1154	Introduction to Engineering	161	74	DISTINCTION	15
ENS1162	Electrical Engineering 1A	161	84	HIGH DISTINCTION	15
MAT1236	Calculus 1	161	83	HIGH DISTINCTION	15

Credit Points: 60
Period WAM: 0
Course WAM: 81.5

7.0 Appendix A.4 – BAJ Company CV

Link (via Google Drive) to the BAJ Company CV which provides evidence of the qualifications and education of the company.

https://drive.google.com/open?id=0BwlO387_VYwDNU5HMk5lXzNZaU0

8.0 Appendix B.1 – Power Tools

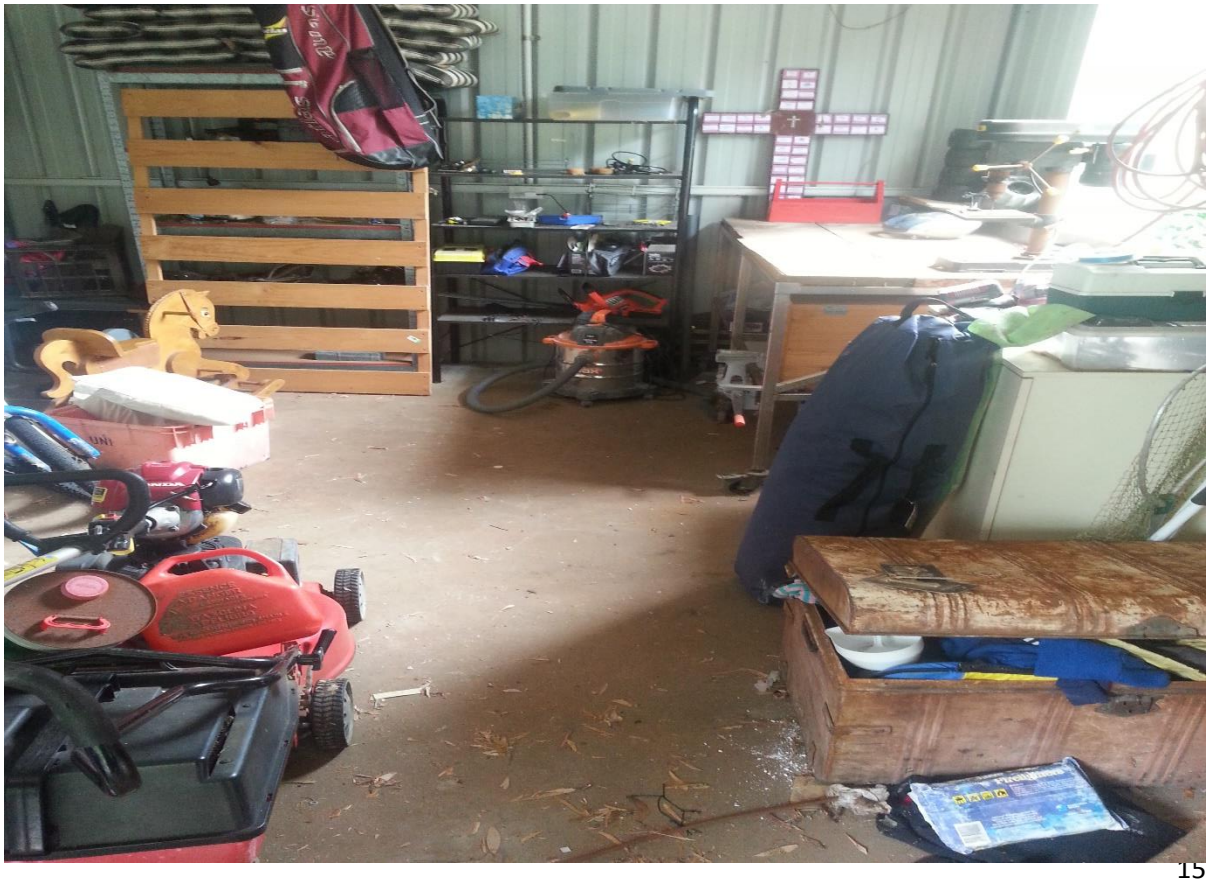
Power tools available to BAJ.

9.0 Appendix B.2 - Fractional Drill Bits

Metric fractional drill bits available to BAJ. Includes 6.5mm width.

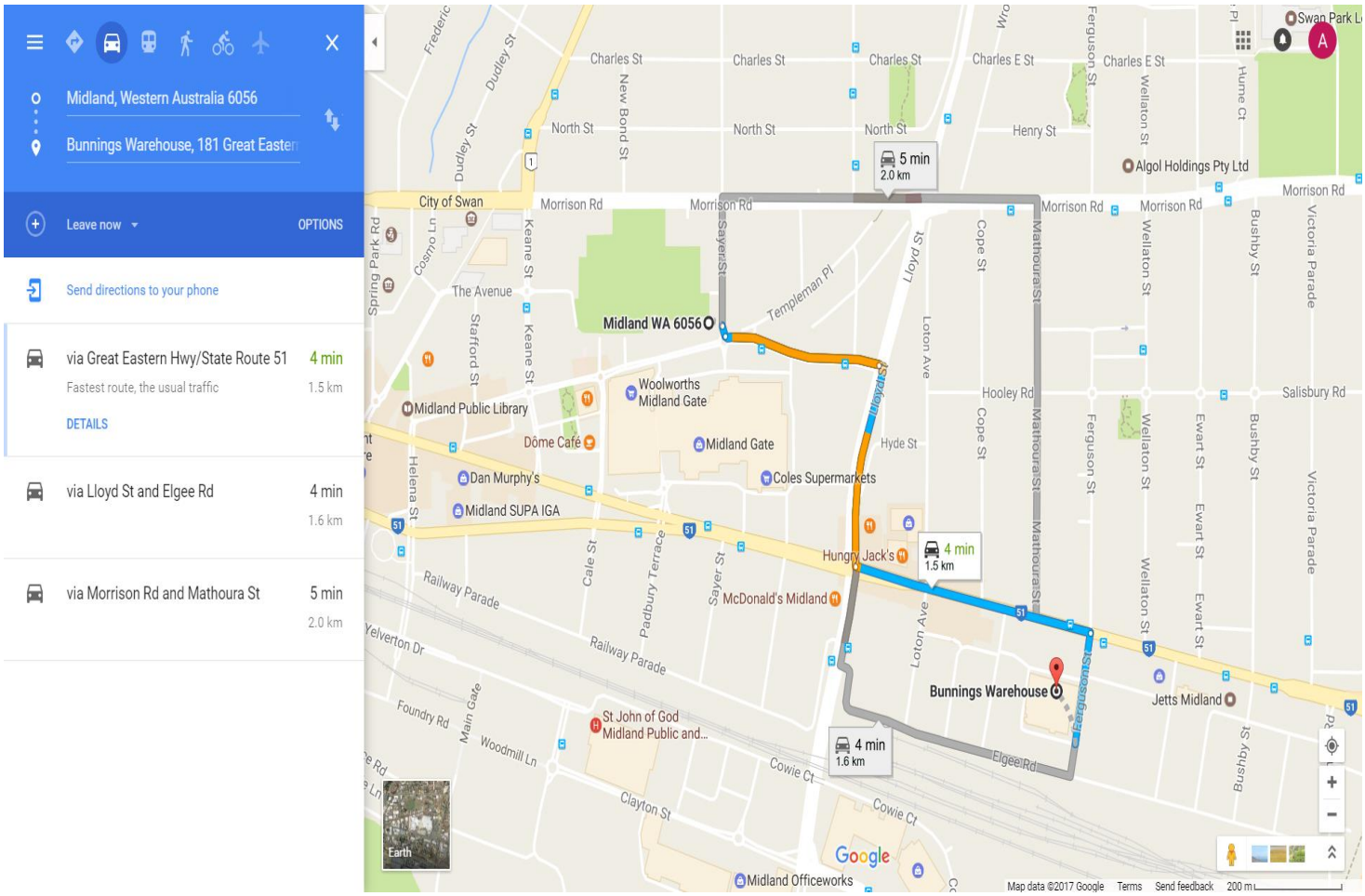
10.0 Appendix B.3 - Workspace

Workshop available to BAJ.



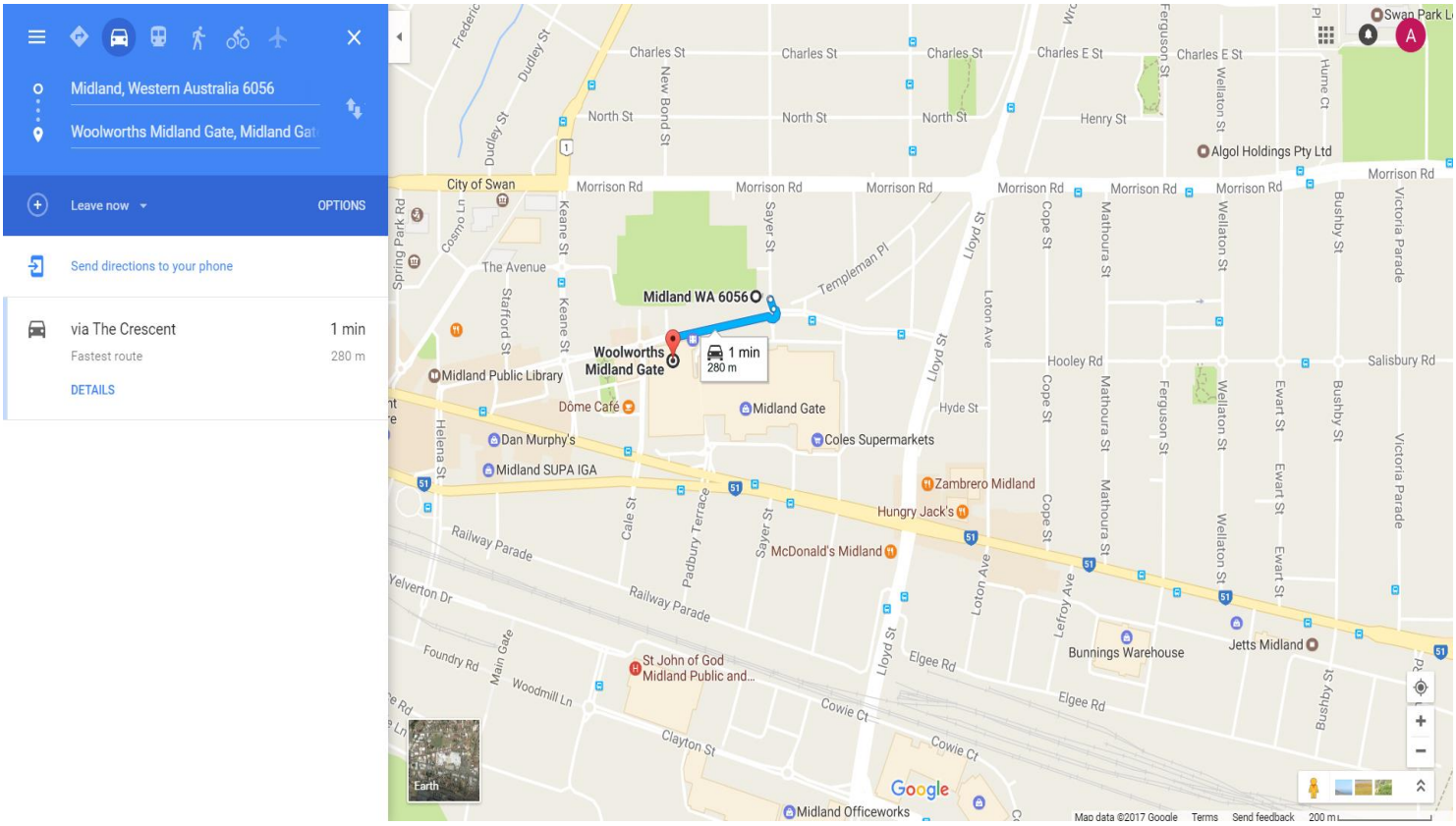
11.0 Appendix C.1 – Travel time to Bunnings Warehouse Midland

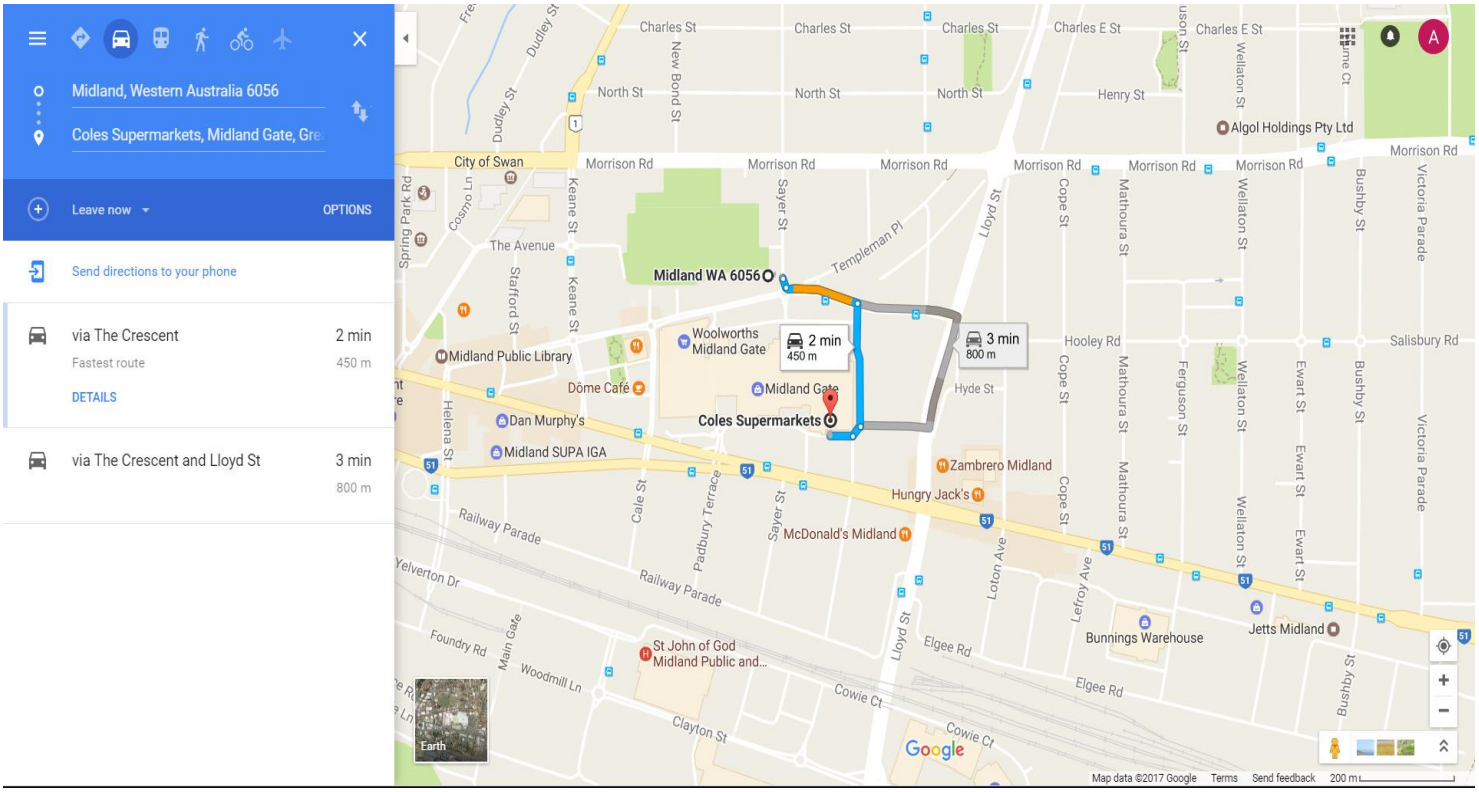
Map showing the time-distance from Central Midland to Bunnings Warehouse Midland is approximately 4 minutes.



12.0 Appendix C.2 – Travel time To Woolworths/Coles Midland

Map showing the time-distance from Central Midland to Woolworths/Coles Midland is approximately 1 and 2 minutes respectively.



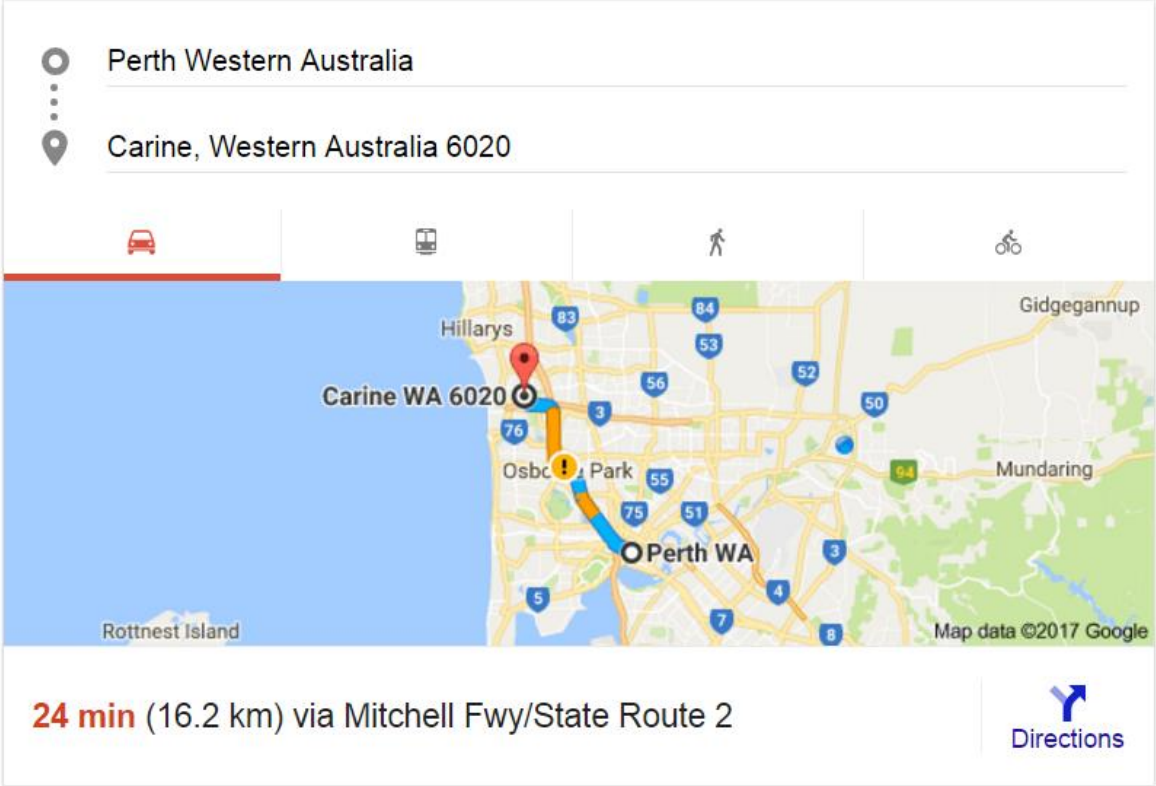


13.0 Appendix C.3 – SmartRider

Image showing a SmartRider which is used for access to discounted public transport fares.

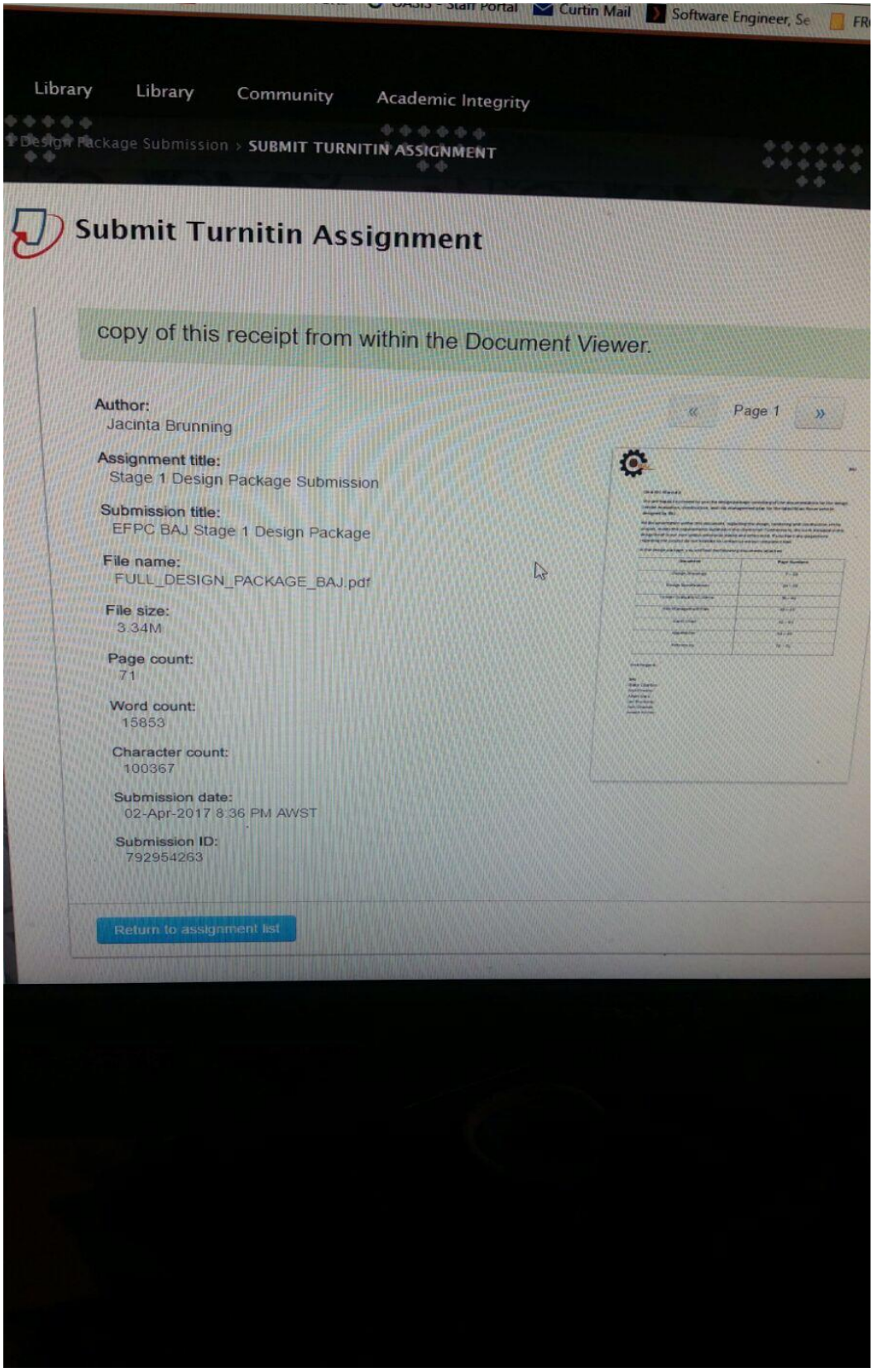
14.0 Appendix C.4 – Travel time example from Perth to Carine

Map showing that the time-distance from Perth to Carine falls within the 30-minute time-frame.



15.0 Appendix D.1 – BAJ's Stage 1 Design Package Submission Time

Image showing proof of the submission time of BAJ's Stage 1 Design Package at 8:36pm on Sunday April 2nd 2017.



16.0 Appendix E.1 – Curtin's The Avengineers' Design Package

A link (via Google Drive) to the Stage 1 Design Package submitted by Curtin's The Avengineers.

https://drive.google.com/open?id=0BwlO387_VYwDTjl4c0hYSDItcDg

17.0 Appendix F.1 – Assignment Handbook

Link (via Google Drive) to the Engineering Foundations - Principles and Communications Assignment Handbook.

https://drive.google.com/open?id=0BwlO387_VYwDYjE4SHU1XzRaNGM