WOODLAND HILLS PAVEMENT MANAGEMENT PROJECT
PROJECT ID: CEEN_2018CPST_006

by

Woodland Hills
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A Capstone Project 100% Completion Report

Submitted to

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Executive Summary

PROJECT TITLE: WOODLAND HILLS PAVEMENT MANAGEMENT PROJECT
PROJECT ID: CEEn_2018CPST_006
PROJECT SPONSOR: Woodland Hills City
TEAM NAME: Woodland Hills

The Woodland Hills Pavement Management Project consists of a study of the traffic pattern, current surface conditions, and potential surface treatments for three streets in the City of Woodland Hills, Utah. Assessment of roadway conditions as well as potential treatment recommendations are based on the Pavement Surface Evaluation and Rating (PASER) Manual and Rating System; the proposed Pavement Management System includes a GIS map of the city streets, approximate pricing estimates for both full replacement and pavement maintenance treatments, and a power point presentation which explains the possibilities for pavement management in the city.

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Introduction

The purpose of this project is to classify West Spring Drive, West Lake View Way, and Oak Drive streets in Woodland Hills according to its functional classification. In addition, an assessment of the current surface condition and potential improvements for these streets is provided to help Woodland Hills City manage its roadways more efficiently. This study was completed in three phases. Phase one focused on data collection of traffic volume and current surface conditions of West Spring Drive, West Lake View Way, and Oak Drive streets in Woodland Hills. The data was used to classify the streets according to their functional classification based on UDOT standards and to create a map in ArcGIS to facilitate the organization of data and the results of the roadway condition assessment. This ArcGIS file was also exported to compatible Google software such as Google Maps or Google Earth. In the second phase, potential roadway surface treatments of these three streets were evaluated and the best treatments were recommended for each specific pavement distress. The final stage consists of a report providing final recommendations for the city of Woodland Hills, including an optional website for the city's use to have access to said report and a special form created by the Capstone team. The form created provides an excellent source to aid the city in the long term; it includes a simple algorithm that evaluates the quality of the pavement of each street in Woodland Hills and registers the date of the evaluation, providing the current pavement rating according to the PASER manual. The form provides a user-friendly, long-term tool to aid preservation of a good pavement quality while offering the opportunity for every city resident to report pavement problems, and for quick, detailed evaluations to be performed by any public works city employee. A link to the online form is included in this report, as well as a link to the optional website created solely for the purpose of pavement evaluation at Woodland Hills and as a reporting tool. Additionally, this report includes a set of recommended treatments for the most common pavement distresses found on these three streets as well as an approximation of the cost per square yard or per square feet of these treatments.

Schedule

Phase 1: Data Collection (Due November 26th, 2018)

During Task 1, the Capstone team collected traffic data at 5 different locations in Woodland Hills, three located at the recommended sites, provided by the Public Works Director, and two other locations selected by the team: Woodland Hills Drive and Willow Reed Road. Additionally, the PASER system was used to evaluate the state of the pavement located along West Spring Drive (0.17 miles), West Lake View Way (0.38 miles), and Oak Drive (1.46 miles). A GIS map was created to record the surface condition of the roads. Lastly, the Capstone team collected cross-sectional data for the newer roads, or any cross sections available in the city, to understand the current state of the streets to be evaluated.

Phase 2: Data Evaluation (Due February 18th, 2018)

Based on the surface condition and movement count data collected, the Capstone team determined potential problems with the pavement surface at the streets under study using the PASER system, which includes a pavement condition rating for each street.

Phase 3: Recommendations (Due April 15th, 2018)

The Capstone team provides recommendations through a Pavement Management Plan, including the approximate time and funds needed to fix the roads studied and maintain them in appropriate state.

Assumptions & Limitations

Assumptions

As part of the methodology for this project, the Capstone team decided to make some traffic assumptions to collect data and project annual vehicular flow at minor roads in Woodland Hills for the Pavement Management Plan. The assumption is that over 75% of the traffic flows in the hours from 7:00 AM to 7:00 PM in Woodland Hills and that traffic behaves normally throughout the year, meaning that the traffic flows similarly during weekdays, with some exceptions on Monday and Friday traffic, and that Saturday and Sunday traffic varies greatly within the city. This fact also means that there are several different factors that can be developed by treating Monday, Tuesday through Thursday, Friday, Saturday, and Sunday as five separate groups which will behave differently. The different factors that can be derived by separating the traffic volume in these five groups cannot be calculated because of the limited annual data collected at Woodland Hills from the Utah Department of Transportation (UDOT), which has made limited data available. Similarly, monthly factors will not be used at all in this project.

Limitations

There were several limiting factors in this project, which are listed by order of importance below:

1. The Woodland Hills Pavement Management Plan project began later than expected because of lack of time by the Woodland Hills public director to meet with the Capstone team due to an emergency in the city. A fire that was burning southeast of the city forced many of the residents to evacuate and created time constrains for the public works director.
2. The definition of the scope was one of the greatest limiting factors in the project. At first, the project scope was too large to be accomplished in this capstone project. It would not be possible to create a comprehensive pavement management plan with the time limitations of this project. Instead of creating a comprehensive plan it was determined to reduce the scope to three streets in Woodland Hills for pavement analysis.
3. After the scope had been defined, there were some other limitations in traffic volume that could not be discarded. The AADT calculated is merely an approximation due to limited time in collecting traffic data. Unfortunately, the Capstone team did not use advanced equipment that counts data automatically for long periods of time. For this reason, the counts were completed manually.

Design, Analysis & Results

Introduction

The data collection process began with the video recordings at five different intersections in Woodland Hills. First, a map of Woodland Hills was created using ArcGIS Pro to input and process traffic and pavement data. Most of the traffic counts were intended to measure the traffic volume of minor streets even though most of the cameras were placed along a major road, which serves the main vehicle flow in Woodland Hills. The major road is Woodland Hills Drive, which, according to the Utah Department of Transportation (UDOT) is a minor collector (UDOT 2018). In order to produce accurate results, the Capstone team performed a traffic evaluation to understand the distribution of traffic in Woodland Hills. There is one more road in Woodland Hills which was hypothesized to be another minor collector. If the hypothesis was true, then different assumptions needed to be made to provide an accurate pavement management plan.

Resources Available

One of the mentors available to aid Capstone students in this project had traffic cameras available for the student's use. The Capstone team prepared the equipment and installed 5 cameras in the following locations:

1. Woodland Hills Drive (FA 3041) Mile Point (MP) 1.557 (F1)
2. Woodland Hills Drive (FA 3041) MP 1.329 (F2)
3. Woodland Hills Drive (FA 3041) MP 0.729 (F3)
4. Woodland Hills Drive (FA 3041) MP 0.182 (F4)
5. Willow Reed Road at a mid-block location. (L1)

Each location was assigned an ID, which is the letter and number at the end of each location description above. The first letter represents the type of road [Federal (F), or Local (L)], and each number represented the assumed traffic volume, where 1 is the location with the highest traffic volume and 4 is the location with the least volume.

Additionally, the Capstone team used UDOT's posted MPs at federal aid routes tool, to find the corresponding MPs and the name of the corridor in study (UDOT HRO).

Methodology

The Capstone team created spreadsheets to collect traffic volume in 15-minute intervals. At F1, and L1, the northbound and southbound movements were counted. At F2, F3, and F4, only the traffic flowing out of Woodland Hills Drive into the corresponding streets of study described in the introduction, where the pavement management plan can be applied. After the data were collected, the Capstone team analyzed the data to calculate daily volumes, peak hour factors (PHF), and average hourly volumes. These results were also compared to the current volumes available on UDOT's data portal (data.udot.utah.gov), which represent the volumes north of the corridor in study. However, since the exact volumes were not available, an approximation was made to understand the daily volumes based on the 12-hour counts. All the traffic volume data

was collected on a clear day of Wednesday October 10th 2018 from 7 AM to 7 PM. No precipitation was recorded throughout the day and there was no snow on the ground.

Furthermore, for the pavement surface condition assessment, the group performed a field visit to the streets under study. Distresses on the surface of the pavement were thoroughly and carefully observed and were assigned a rating number according to the Pavement Surface Evaluation and Rating (PASER) Manual. The PASER rating scale assign numbers from 1, meaning: "Failed Pavement with severe distress and extensive loss of surface integrity", to 10, meaning: "No Visible Distress". The majority of the streets evaluated presented moderate distresses on their surface so ratings from 3 to 9 were assigned. Figures 1 and 2 show common surface conditions found at the time of the field visit.

Figure 1. West Spring Drive Surface Condition.

Figure 2. West Spring Drive Surface Condition

Additionally, a dataset was downloaded from the Utah Automated Geographic Reference Center (AGRC) containing a shapefile representing road and highway centerlines for the state of Utah. All the Woodland Hills streets were selected and isolated, and a map and a table were created in ArcGIS Pro including the downloaded dataset and the data obtained on the field visit. Using this program allowed for a more convenient approach to visualizing the data and the location for each camera for the traffic volume study. Figures below show the map and table created on ArcGIS as well as the camera location and streets under study.

Figure 3. Woodland Hills Streets and Camera Location.

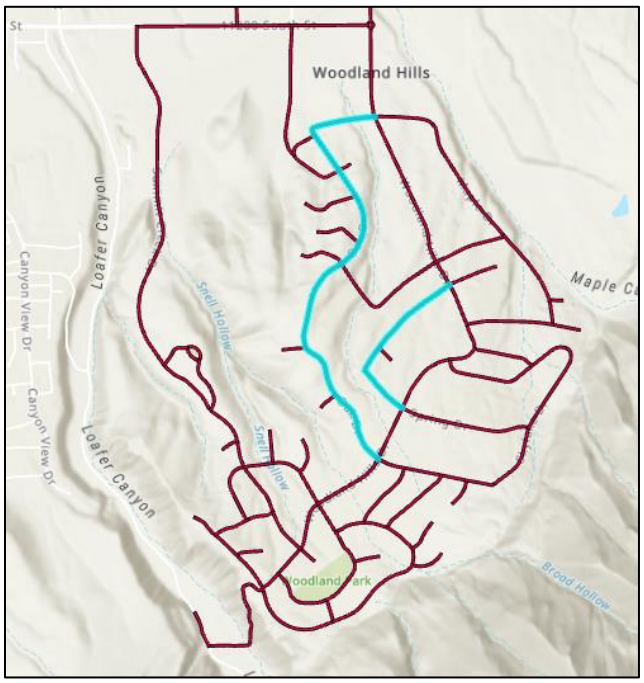
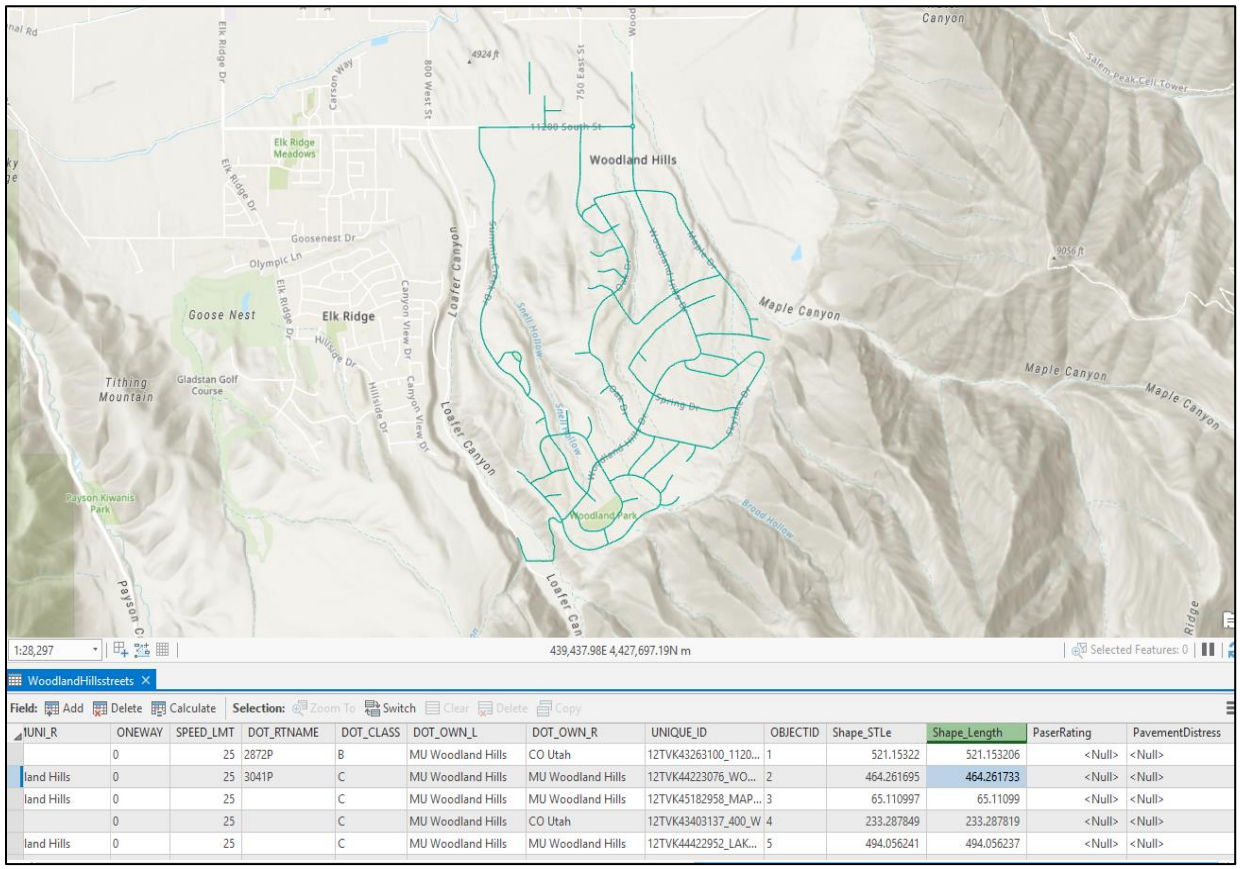


Figure 4. Location of Roads Selected for Pavement Data Collection



IUNI_R	ONEWAY	SPEED_LMT	DOT_RTNAME	DOT_CLASS	DOT_OWN_L	DOT_OWN_R	UNIQUE_ID	OBJECTID	Shape_STLe	Shape_Length	PaserRating	PavementDistress
	0	25	2872P	B	MU Woodland Hills	CO Utah	12TVK43263100_1120...	1	521.15322	521.153206	<Null>	<Null>
land Hills	0	25	3041P	C	MU Woodland Hills	MU Woodland Hills	12TVK44223076_WO...	2	464.261695	464.261733	<Null>	<Null>
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	0	25		C	MU Woodland Hills	CO Utah	12TVK43403137_400_W	4	233.287849	233.287819	<Null>	<Null>
land Hills	0	25		C	MU Woodland Hills	MU Woodland Hills	12TVK44422952_LAK...	5	494.056241	494.056237	<Null>	<Null>

Figure 5. ArcGIS Pro Map of Woodland Hills Streets and Table of Features.

Results

The traffic stream behaved almost as predicted. As shown on Table 1, the traffic volume flows at a higher density at F1 than anywhere else. L1, which was believed to be a potential minor collector turned out to be a local road. The daily volumes do not meet the criteria for L1 to be a minor collector since it is expected to serve less than 1,500 vehicles per day and its actual daily traffic volume ranges between 15-700 vehicles per day (FHWA 2013). Additionally, L1 is very short, which means it may not meet length criteria either; however, the length of the road was not taken into consideration for this functional classification. Table 1 shows a traffic volume summary for the streets under study.

Table 1. Traffic Volume Summary

ID	Total Volume (Veh/12-h)	Average Hourly Volume (Veh/Hour)	Peak Hour Volume (Veh)	Peak Hour	Peak Hour Factor (PHF)
F1	1854	158	202	4:45-5:45 PM	0.87
F2	150	13	20	9:00-10:00 AM	0.63
F3	117	10	19	2:00-3:00 PM	0.68
F4	22	2	6	9:45-10:45 AM	0.75
L1	196	17	30	5:45-6:45 PM	0.73

Pricing Estimates

The UDOT pricing averages available through the UDOT portal were used to estimate the cost of the replacement of a road and maintenance of a road. The file contains an average price UDOT paid for diverse services offered by private companies for the last 5 years. The latest averages from 2016, 2017 and 2018 were used to estimate the pricing of repairing or replacing the current roads in study at Woodland Hills. The estimated prices for repairing the current three roads are given in Table 2. Costs are given for mill and fill, overlay t1, and overlay t2. The total estimated cost of maintenance for the three streets given a mill and fill, overlay t1, and overlay t2 is also given. The cost of the asphalt slurry coat does not include the cost of crack seal since the linear footage of existing cracks is unknown. The pricing estimates for a maintained road versus a road that has not received any treatment can be seen in Figure 6.

Table 2. Price Estimates Per Street and Treatment Choice

Streets	Mill & Fill Cost	Overlay t1 Cost	Overlay t2 Cost	Asphalt Slurry Seal Coat
West Spring Drive	$37,275.27	$57,990.40	$71,604.00	N/A
West Lake View Way	N/A	N/A	N/A	$10,821.33
Oak Drive WB	$155,222.84	$144,243.12	$175,435.05	N/A
Total Cost for All Three Streets	$203,319.44	$213,054.85	$257,860.38	

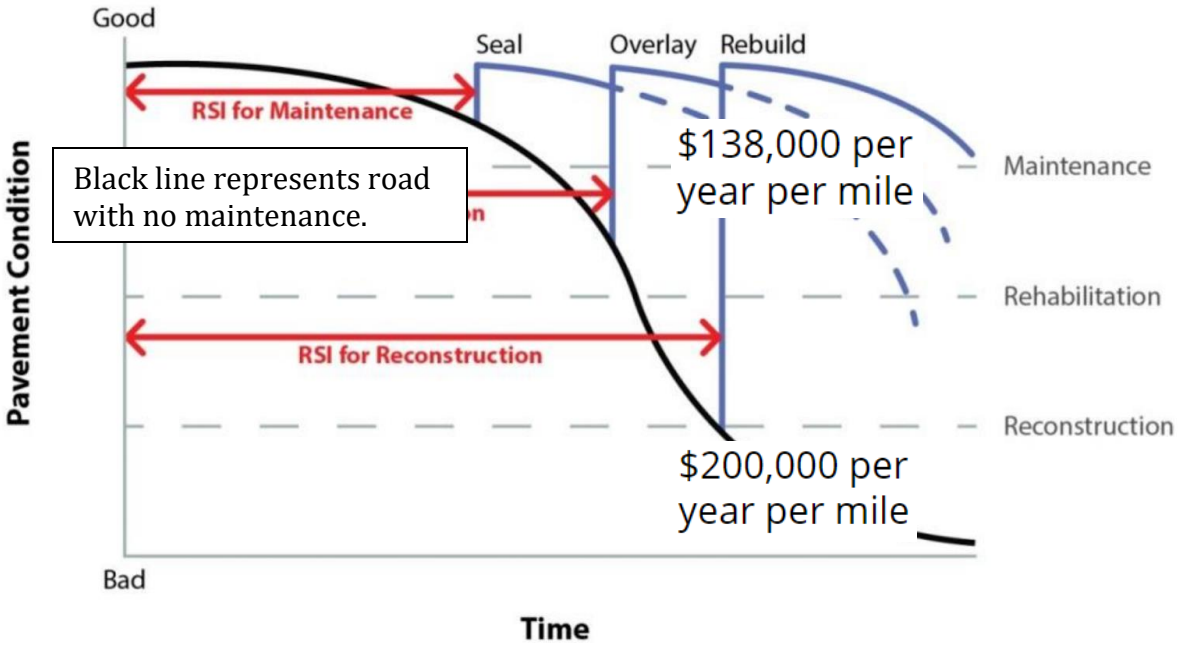

Figure 6. Price Estimates for a Maintained Road vs. Unmaintained Road

Recommendations/Summary

Taking into consideration the current traffic conditions, and the assumptions made in the assumptions section of this document, it is recommended to plan for the annual volumes shown in Table 4. Clearly the projected annual volumes need adjustment factors for each day and month of the year but they are not available yet for the city.

Table 3. Projected Annual Volumes

ID	Projected Volume (Veh/Year)	Truck Volume (Trucks/Year)	Passenger Car Volume (PC/Year)
F1	902280	13140	889140
F2	73000	13140	59860
F3	56940	11680	45260
F4	10707	0	10707
L1	95387	973	94413

It is recommended to create a clear pavement plan for every street in the city. Figure 6 shows a QR code linked to a google form that can be used by the city to evaluate the streets and keep track of the road conditions. Figure 7 shows a QR code linked to a website concept, designed specifically for the city of Woodland Hills, which provides access to multiple forms for both public and private use, and evaluations performed by the Capstone team. It is recommended that the city evaluates every street within its limits no later than the summer of 2019. If the evaluations are not done this current year, every year after may cause irreparable damages to the road that may lead to the need of reconstruction beyond the city's budget.

Figure 7. Google Form for Through Street Evaluation QR Code

Figure 8. Website Concept for Woodland Hills Pavement Evaluation QR Code

Lessons Learned

The following is a list of the challenges faced by the team as well as how the challenges were overcome:

- Woodland Hills's wildfires and flash flood advisories at the beginning of the project created inability to meet with public works director and define the scope of the project. Instead, this time was spent creating a GIS map of the streets in Woodland Hills and consulting with faculty advisors. Creating the GIS map and consulting with the faculty allowed for a more productive discussion with the public works director.
- Ensuring that the three streets were evaluated the same way was a challenge. It was decided to use the PASER manual to classify the streets. Each team member read the PASER manual before participating in street classification. The streets were classified in a systematic and uniform manner.
- After the cameras were brought back to the transportation lab and uploaded it was necessary to watch the videos and count the cars. Five cameras were setup and filmed for 12 hours each. This means that there was 60 hours of video to watch. It was a challenge to find time to watch the videos. The videos were watched at four times their normal speed turning the 60 hours into only 15 hours. This allowed the team to complete the study in a reasonable amount of time.
- Compiling the data into a single place was a challenge. It was decided that entering the data into an excel spreadsheet as well as the GIS map would be the most effective way of compiling the data. The GIS map will allow the city to see what the street classification is at different locations and the excel sheet will give the city easy access to the data.

Conclusions

Traffic data and pavement condition data has been collected and analyzed for West Spring Drive, West Lake View Way, and Oak Drive. The streets that have been analyzed showed considerable wear. All the streets inspected require some kind of pavement treatment in the near future. While it is out of the scope of this project to classify all of the streets in Woodland Hills, this project provided the city with a base template that can be used to classify the remaining streets, including an online form to aid them in the data collection process. This project will also provide the city a methodology that can be used to determine when to apply the correct treatment to the correct road at the correct time. When the right treatment is applied at the right time the life of the road is extended considerably. The extended life of the roadway reduces the cost of the road on the long run and provides a better level of service, adequate for the needs of the city.

Recommendations

It is recommended that the City of Woodland Hills plan for the annual traffic volume presented in Table 4. As stated above, the volumes predicted in Table 4 are based on assumptions and will only be included in the final report if they can be verified by another source. It is also recommended that the city become familiar with the PASER manual and begin to classify the remaining streets that are not being analyzed in this project. The classification of the streets in the city should be updated frequently. The classification of the streets can be done over an extended period. It is recommended that the public works director create a plan to classify the streets and to update the classifications annually. It is also recommended that the city use the results of the forms created as a general idea to their specific pavement problems within the city. It is best if an intern is hired to perform such types of evaluations and create proposals with the specific pavement improvements to be delivered at locations where they are needed. Lastly, it is of extreme importance that the city creates a pavement management plan that covers all the streets of the city for the next twenty years, preferably this year, including common cross sections for each type of road the city has and a scheduled maintenance for each road.

The following treatments are recommended for the streets evaluated:

Street (Mile Points)	**Recommendations**
Oak Drive Westbound (MP 0 – MP 0.25)	Mill and fill
Oak Drive Westbound (MP 0.25 – MP 0.50 or Vista Circle)	Thin lift overlay or a combination of crack seal and chip seal.
Oak Drive Westbound (MP 0.50 or Vista Circle – MP 1.0)	Seal coat when the overlay turns three years old.
Spring Drive	Mill and fill
Lake View Way	Asphalt slurry coat.

References:

Federal Highway Administration 2013, "Functional Classification Manual" *Table 3-6: VMT and Mileage Guidelines by Functional Classifications – Collectors and Locals p. 23.* Retrieved from: <https://www.fhwa.dot.gov/planning/processes/statewide/related/highway_functional_classifications/fcauab.pdf > Accessed on December 2018.

PASER Manual. Transportation Information Center, <www.apa-mi.org/docs/Asphalt-PASERManual.pdf> Accessed on October 2018
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Utah Department of Transportation (UDOT) 2018 "UDOT Data Portal" *AADT 2016* <http://data-uplan.opendata.arcgis.com/> Accessed on October 2018.

Utah Department of Transportation (UDOT) 2018 "UDOT Functional Class Map" *Route 3041* <https://www.arcgis.com/home/webmap/viewer.html?webmap=494d57208ea4464bb664ac2da38f9c91> Accessed on November 2018.