APPENDIX A

MICHIGAN FREIGHT PLAN
TRUNKLINE PROJECT LIST DEVELOPMENT

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INTRODUCTION

The Trunkline Freight Project List is a listing of current and future MDOT projects that have significant impact to the overall improvement of the Michigan freight network. The list is developed from a comprehensive analysis, which uses a weighted scoring methodology of freight improvement selection criteria. The list is then reviewed and approved by the Freight Plan Review Committee, a team of MDOT professionals who have expertise in freight movement and planning. The review ensures each job listed has a direct correlation with the improvement of the freight system. The analysis, which is the basis of the project list, is detailed in the proceeding document.

The following analysis was conducted to determine the potential impact of a highway project on the movement of freight.

The analysis uses a combination of three software systems: Administrative Customizable Reporting System (ACRS) - used to extract phase level details from the MAP database, ESRI ArcMap software suite – used for analyzing spatially sensitive information, and MS Excel – used for compiling information and formatting. Together, these three systems were used to compile the 2013 Trunkline Freight Project List.

This document details the analysis, work flow from phase level attribute extraction, to analysis, to final product, and should be referenced from an intermediate Geographic Information System (GIS), ACRS, and Microsoft Excel user's standpoint.

STEP 1
Retrieving Phase Level Data

The MAP database is used to store phase level budgeting, scoping, and scheduling for MDOT trunkline jobs. Step 1 involves extraction of this data through ACRS using a standardized reporting query. This data is then exported in a format that can be used by ArcMap for analysis.

ACRS PHASE LEVEL EXTRACTION

Program by Obligation Detail report

– Parameters:

- Report Type – Statewide
- Date – By FY: 2013, 2014, 2015, 2016, 2017, 2018
- Job Type – Trunkline
- Job Control – Let Status & Non-Let Status
- Phase Type – Construction
- Phase Status – Active, Programmed
- Finance Code – All
- Templates – Bridge – Big Bridge, Bridge – Replacement & Rehabilitation, Capacity Improvement, Congestion Mitigation & Air Quality, Intelligent Transportation Systems, New Roads, Road – Capital Preventive Maintenance, Road – Rehabilitation & Reconstruction, Traffic & Safety – Safety Programs, Traffic & Safety – Signals, Trunkline Modernization.

– After the report is generated, export it by Physical Reference and save it in an .XLS (Excel) file format.

The ACRS export provides a listing of jobs and its associated physical reference number(s). Once imported into Arc, these jobs can be spatially referenced for analysis.

STEP 2
Importing Data into ArcMap

Step 2 involves collecting and loading pertinent information for analysis. To protect the data integrity, be sure to use the latest version of each dataset, as information can vary greatly from version to version.

SHAPEFILES

- All_Roads_Route – This dataset is used to linear reference projects to the road network.
- mdot_bridge – This dataset is used to extract bridge structure numbers.
- MAP21_NHS – This dataset is used to determine if a project lies on the NHS system.
- Sufficiency_CAZNet – This dataset was provided as a combined file, but is typically a separate Sufficiency and CAZNetwork dataset. This dataset is used to extract COHS and commercial-related traffic information.
- Act51_Cities – This dataset is used to determine if projects lie within an Act 51-participating city.
- Pavement_Condition_File – This dataset is used to determine the road RSL values associated with each project.
- Top100_Crash_Locations – This dataset is used to see if a project impacts a Michigan top 100 crash location. The dataset was provided by Traffic and Safety in Excel format and needs to be referenced.
- FPM_Bottleneck_Congestion – This dataset is used to see if projects overlay major freight bottlenecks. Data received from American Transportation Research Institute.
- MI_E_NHS_IMConnectors – This dataset is used to see if MDOT projects overlay any intermodal connector routes. Data received from the Department of Transportation. A definition query of “NHS” = 8 needs to be applied to get the connectors.
- FHWA_Major_Freight_Corridors – This dataset is used to see if MDOT projects overlay any major freight corridors. Data digitized from FHWA static maps.

TABLES

- ACRS Excel export – Load the Excel table directly into ArcMap.
- MBRS Statewide – This spreadsheet is received from the bridge program. It is used to identify bridge carried routes.

STEP 3
Data Preparation

LINEAR REFERENCING

The ACRS Excel export will need to be linear reference twice: once to obtain polyline features and a second time to obtain point features.

Linear referencing parameters for polyline features:

- Input Route Features – All_Roads_Route
- Route Identifier Field – PR
- Input Event Table – ACRS table export
- Route Identifier Field – pr_num
- Event Type – LINE
- From-measure Field – pr_beg_mp
- To-Measure Field – pr_end_mp
- Layer Name or Table View – Name it what you want
- Offset Field (optional) – N/A
- Check "Generate a field for locating errors (optional)"
- Run the procedure

Once ArcMap generates the linear referenced layer view, it should be exported as a Shapefile. This does two things:

1. It creates a permanent data layer that can be saved and manipulated at a later time.
2. It speeds up ArcMap performance by clearing the temp data from its virtual memory.

   – Open the shapefile attribute table and navigate to the ArcMap generated field: LOC_ERROR. (Select by attributes: "LOC_ERROR" = 'ROUTE NOT FOUND')

   - Delete the selected records, as they were rather miscoded or given the 999… designation for region/statewide jobs. In either case, these jobs will be filtered out.

   – Select by attributes: "LOC_ERROR" = 'ZERO LENGTH EXTENT'

   - Export these records to a new table (.txt or .dbf) before deleting them.

STEP 3
Data Preparation

Add the ZERO LENGTH EXTENT table of records to the map and linear reference them according to these parameters:

- Input Route Features – All_Roads_Route
- Route Identifier Field – PR
- Input Event Table – ACRS table export
- Route Identifier Field – pr_num
- Event Type – POINT
- From-measure Field – pr_beg_mp
- To-Measure Field –
- Layer Name or Table View – Name it what you want
- Offset Field (optional) – N/A
- Check "Generate a field for locating errors (optional)"

This create a job polyline layer (comprised mostly of road jobs) and a point layer (comprised mostly of bridge jobs).

ADDING SCORING FIELDS

There are a number of fields that need to be added to both the polyline and point datasets in order to complete the analysis (field names and data type are denoted below). The field names do not have to appear exactly as below (will need to be truncated anyway because of field length restrictions associated with .shp files), but they should appear in the same order to reduce work later on.

Table 3.0

Field	Data Type
CADT	Short Integer
%CADT	Short Integer
LOS	Short Integer
Commodity Value	Short Integer
Commodity Tonnage	Short Integer
Intermodal Connectors	Text
FPM Bottleneck Congestion	Text
Major Freight Corridor	Text
Act51 Participating Community	Short Integer
Match	Short Integer
NHS	Text
RSL	Short Integer
Total Funding	Short Integer
Top100 Crash Locations	Short Integer
COHS Type	Text

STEP 4
Data Analysis

The data analysis section details the scoring categories, weights, and ranges for the fields referenced in Table 3.0. It also provides a complete set of steps to complete the analysis.

TRUCK TRAFFIC (MAX POINTS: 50)

Fields Populated: CADT, % CADT, LOS

Datasets Used: Polyline and Point features, Sufficiency_CAZNet

Table 4.0

	5	10	15	20
CADT 1-1000	X			
CADT 1001-4000		X		
CADT 4001-8000			X	
CADT 8000+				X
%CADT 0-5%	X			
%CADT 6-10%		X		
%CADT 11-15%			X	
%CADT 15%+				X
	1	5	10	
LOS A,B,C	X			
LOS D		X		
LOS E,F			X	

Steps for completing analysis:

1. Perform a Definition Query on the Sufficiency_CAZNet dataset for each of the field requirements listed in column 1 of Table 4.0. This will provide the road segments for each range. Perform steps 2 and 3 for each Definition Query.
2. Perform a Select By Location with the following parameters:
   a. Selection method: Select features from.
   b. Target layer(s): Select either linear referenced polyline or point layer feature. Perform this analysis on both, but because they are two different geometry types, they cannot be selected simultaneously.
   c. Source layer: Sufficiency_CAZNet.
   d. Spatial selection method: If the dataset is a point feature, select “Target layer(s) features intersect the Source layer feature.” If the dataset is a polyline, select “Target layer(s) features share a line segment with the Source layer feature.”
   e. Click apply and run the procedure.
3. Populate the selected records with the corresponding points for that given query (detailed with an X on Table 4.0).

STEP 4
Data Analysis

GOODS MOVEMENT (MAX POINTS: 20)

Fields Populated: Commodity Tonnage, Commodity Value

Datasets Used: Polyline and Point features, Sufficiency_CAZNet

Table 4.1

	1	3	7	10
Commodity Tonnage 0k-10k	X			
Commodity Tonnage 0k-50k		X		
Commodity Tonnage 50k-90k			X	
Commodity Tonnage 90k+				X
Commodity Value 0-$12.5M	X			
Commodity Value $12.5-$50M		X		
Commodity Value $50M-$125M			X	
Commodity Value $125+M				X

Steps for completing analysis:

1. Perform a Definition Query on the Sufficiency_CAZNet dataset for each of the field requirements listed in column 1 of Table 4.1. This will provide the road segments for each range. Perform steps 2 and 3 for each Definition Query.
2. Perform a Select By Location with the following parameters:
    a. Selection method: Select features from.
    b. Target layer(s): Select either linear referenced polyline or point layer feature. Perform this analysis on both, but because they are two different geometry types, they cannot be selected simultaneously.
    c. Source layer: Sufficiency_CAZNet.
    d. Spatial selection method: If the dataset is a point feature, select “Target layer(s) features intersect the Source layer feature.” If the dataset is a polyline, select “Target layer(s) features share a line segment with the Source layer feature.”
    e. Click apply and run the procedure.
3. Populate the selected records with the corresponding points for that given query (detailed with an X on Table 4.1).

SYSTEM PRESERVATION (MAX POINTS: 10)

Fields Populated: RSL (Remaining Service Life)

Datasets Used: Polyline and Point features, Pavement Condition File

Table 4.2

Years/Points	1	3	7	10
RSL 0-3				X
RSL 4-7			X	
RSL 8-11		X		
RSL 12+	X			

Steps for completing analysis:

1. Perform a Definition Query on the Pavement_Condition_File dataset for each of the field requirements listed in column 1 of Table 4.2. This will provide the road segments for each range. Perform steps 2 and 3 for each Definition Query.
2. Perform a Select By Location with the following parameters:
    a. Selection method: Select features from.
    b. Target layer(s): Select either linear referenced polyline or point layer feature. Perform this analysis on both, but because they are two different geometry types, they cannot be selected simultaneously.
    c. Source layer: Pavement_Condition_File.
    d. Spatial selection method: If the dataset is a point feature, select “Target layer(s) features intersect the Source layer feature.” If the dataset is a polyline, select “Target layer(s) features share a line segment with the Source layer feature.”
    e. Click apply and run the procedure.
3. Populate the selected records with the corresponding points for that given query (detailed with an X on Table 4.2).

STEP 4
Data Analysis

SAFETY (MAX POINTS: 5)

Fields Populated: Top100 Crash Locations

Datasets Used: Polyline and Point features, Top100_Crash_Locations

Table 4.3

Crash Indicator/ Points	0	5
Top 100 Crash Locations (Y)		X
Top 100 Crash Locations (N)	X	

Steps for Completing Analysis:

1. Perform a Select By Location with the following parameters:
    a. Selection method: Select features from.
    b. Target layer(s): Select either linear referenced polyline or point layer feature. Perform this analysis on both, but because they are two different geometry types, they cannot be selected simultaneously.
    c. Source layer: Top100_Crash_Locations.
    d. Spatial selection method: If the dataset is a point feature, select "Target layer(s) features intersect the Source layer feature." If the dataset is a polyline, select "Target layer(s) features share a line segment with the Source layer feature."
    e. Click apply and run the procedure.
2. Populate the selected records with the corresponding points for that given query (detailed with an X on Table 4.3).

FINANCIAL INVESTMENT (MAX POINTS: 15)

Fields Populated: Match, Total Funding

Datasets Used: Polyline and Point features

Table 4.4

Project Cost/Points	1	3	7	20
Project Cost 0-$1M	X			
Project Cost $1-$10M		X		
Project Cost $10-$100M			X	
Project Cost $100M+				X
Match Indicator/Points	0	5		
Local Match (Y)		X		
Local Match (N)	X			

Steps for completing Project Cost analysis:

1. Open the polyline or point attribute table.
2. Select By Attributes: “est_tot_fund_amt” = (enter SQL statement for the Project Cost ranges listed in column 1 of table 4.4).
3. Enter the corresponding point amount for each selected query.

Steps for completing Local Match analysis:

1. Open the polyline or point attribute table.
2. Select By Attributes: “est_lcl_fund_amt” <>0.
3. Enter the corresponding point amount for the query.

TIER 1 PROJECT SELECTION (BASE CRITERIA FOR TIER 1 PROJECTS)

Fields Populated: Intermodal Connectors, FPM Bottleneck Congestion, Major Freight Corridor, NHS

Datasets Used: Polyline and Point features, FHWA_Major_Freight_Corridors, FPM_Bottleneck_Congestion, MI_E_NHS_IMConnectors, MAP21_NHS

Steps for Completing Analysis:

1. Perform a Select By Location with the following parameters:
   a. Selection method: Select features from.
   b. Target layer(s): Select either linear referenced polyline or point layer feature. Perform this analysis on both, but because they are two different geometry types, they cannot be selected simultaneously.
   c. Source layer: (Note: You will only choose one at a time) FHWA_Major_Freight_Corridors, FPM_Bottleneck_Congestion, MI_E_NHS_IMConnectors, MAP21_NHS.
   d. Spatial selection method: If the dataset is a point feature, select “Target layer(s) features intersect the Source layer feature.” If the dataset is a polyline, select “Target layer(s) features share a line segment with the Source layer feature.”
   e. Click apply and run the procedure.
2. For each selection you will enter “Y” in the proper field. A project will make the Tier 1 list if at least one of these criteria was met.

STEP 4
Data Analysis

COHS TYPE

Fields Populated: COHS

Datasets Used: Polyline and Point features

Table 4.4

Corridor of Highest Significance
National
Statewide
Regional
Local
Local Match (N)

Steps for Completing Analysis:

1. Perform a Definition Query on the Sufficiency_CAZNet dataset for each of the field requirements listed in Table 4.5. This will provide the road segments for each corridor. Perform steps 2 and 3 for each Definition Query you perform.
2. Perform a Select By Location with the following parameters:
    a. Selection method: Select features from.
    b. Target layer(s): Select either your linear referenced polyline or point layer feature. Perform this analysis on both, but because they are two different geometry types, types, they cannot be selected simultaneously.
    c. Source layer: Sufficiency_CAZNet.
    d. Spatial selection method: If the dataset is a point feature, select “Target layer(s) features intersect the Source layer feature.” If the dataset is a polyline, select “Target layer(s) features share a line segment with the Source layer feature.”
    e. Click apply and run the procedure.
3. Populate the selected records with the corresponding corridor (spelled out) for that given query.

BRIDGE CARRIED ROUTES

Since bridge work is sometimes referenced to the interstate or highway system rather than the actual carried route, an additional step for bridge work is required to identify the impact to freight movement. The goal is to identify bridges that carry and improve major freight routes, rather than those that pass over it.

Fields Added through Spatial Join: All fields from the MBRS Statewide spreadsheet

Datasets Used: Point features, mdot_bridge, MBRS Statewide

Steps for Completing Analysis:

1. Using the mdot_bridge layer, perform a Join with the MBRS Statewide table using the following parameters:
    a. What do you want to join to this layer?: Join attributes from a table
    b. Choose the field in this layer that the join will be based on: STRU1
    c. Choose the table to join to this layer, or load the table from disk: MBRS Statewide
    d. Choose the field in the table to base the join on: structure
2. Perform a Spatial Join that will bring the Point feature job information together with the MBRS carried route data. Use the following parameters:
    a. Target Features: Point feature
    b. Join Features: mdot_bridge (this dataset was joined with MBRS)
    c. Output Feature Class: Assign a useful name
    d. Join Operation: JOIN_ONE_TO_ONE
    e. Keep All Target Features: Check the box
    f. Match Option: Intersect
    g. Search Radius: None

After completing the spatial join, the phase level bridge information should now include MBRS route carried information.

STEP 5
Exporting Data to Excel

The last step involves exporting the analysis work to an Excel workbook for formatting. Scores also will be added up for each job and corresponding PR sections and averaged. The average along with the job description will give a good indication of the impact of the project on the freight network.

FROM ARCMAP

1. Open the attribute tables for the polyline and point features and export each as a text file.

IN EXCEL

1. Open the text file(s) in Excel (you will need to open two workbooks). The file type is comma delimited.
2. Clean up any broken lines that may have been a result poor data entry.
3. Merge the two spreadsheets post-cleanup by copying and pasting (make sure column headings reside in the same column locations).
4. Add a total column and enter mathematical function (=sum(cell ranges)) to add the point columns from the ArcMap analysis.
5. Add a new column for deriving PR segment averages, two methods:
    a. Use a pivot table to group and average PR segment totals.
    b. Sort jobs by job number and manually average the segments. This should be done only if specific formatting of the spreadsheet is needed, as it is very time consuming.
7. This list will be further reviewed by MDOT's Office of Finance, which will select projects that are in alignment with the goals and objectives established by MDOT and the State of Michigan.
8. Below is a list of columns that are kept for the final project list:
    a. Fiscal Year
    b. Tier
    c. Region
    d. Route
    e. Location
    f. Work Description
    g. COHS Type
    h. Estimated Total Funding

FINAL REMARKS

The final output of this analysis provides a firm starting ground for project selection. It gives a good indication of the potential impact a job may have on the improvement of the freight network by examining the current conditions of its location. The only drawback is that it cannot accurately assess the actual work being performed. Template categories were used to mitigate this issue, but the project variance, even within the templates, is still too great to thoroughly assess the freight-related impacts of each project. For this reason, the list is further reviewed by MDOT's Office of Finance for final approval.

MICHIGAN
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Supplement to the 2035 MI Transportation Plan