

Use TAMS-HydInfra
Suggested Repair Method
to develop an automated
Culvert Repair Cost Estimate

Statewide Pipe Repairs Cost Estimate

from TAMS-HydInfra Suggested Repair Report
could be automated

	A	B	C		H	I	L	R
1			Repair me		Contract average bid			Contract
2					Unit P		Contract	Total Cost
3	District	1	District	1		Cost		
4			CIPL			\$183,973	973	
5			Grout			\$77,387	387	
6			Jack			\$968,165	165	
7			Paved Invert			\$40,212	212	
8			Reset		\$2,4	\$323,374	374	
9			Slipline			\$1,552,383	383	
10			Trench		\$26,3	\$2,260,010	010	\$5,405,504
11	District	2						
12			CIPL					
13			Grout					
14			Jack					
15			Paved Invert					
16			Reset		\$2,4			
17			Slipline	45	3562	\$93.22	foot	\$365,255
18			Trench	21	1633	\$65.37	foot	\$726,406
19	District	3						
20			CIPL					\$518,691
21			Grout					\$23,009
22			Jack					\$1,025,585
23			Paved Invert					\$2,715
24			Reset					\$29,643
25			Slipline					\$393,043
26			Trench					\$915,860
								2010
								\$2,908,546

In 2010, HydInfra data with Suggested Repair Method was used to calculate costs for repair or replacement of MnDOT's bad pipes statewide, by D8 Johnston and Solsrud

TAMS-HydInfra Inspection finds bad culverts and suggests a repair method for each

- HydInfra Culvert Inventory and Inspection captures pipe traits:
 - Size
 - Shape
 - Material
 - Defects
 - Depth of cover
- Suggested Repair Method is an automated selection process that sorts bad pipes by traits to estimate types of repairs needed
- Costs could be applied to all HydInfra pipes based on the Suggested Repair. This was done in a spreadsheet in 2010, using ballpark costs.

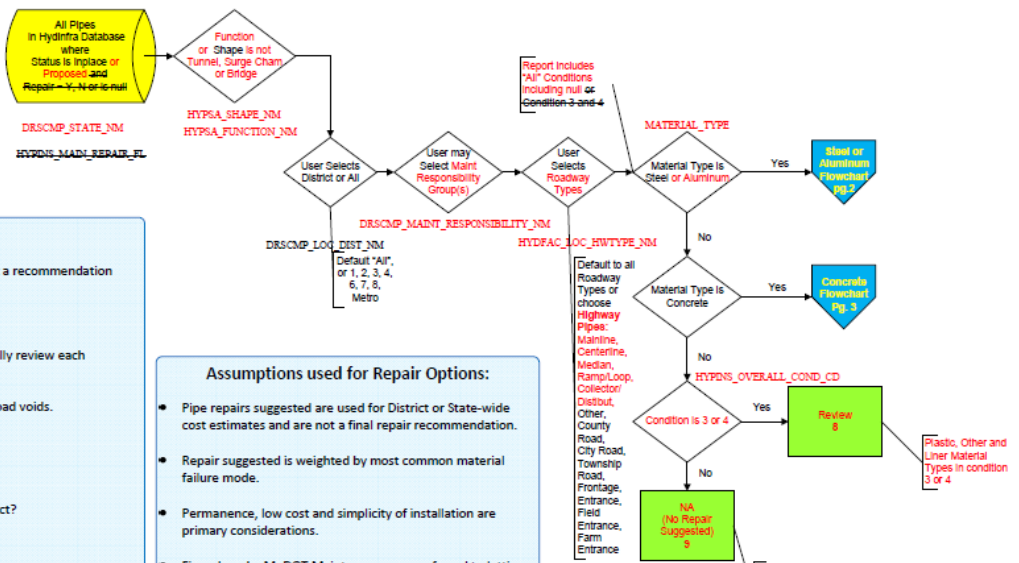
“Suggested Repair Method” selects bad culverts for 7 potential repairs

	A	B	C	D	E	F	G	H	J	K	L	M	S	X	Z
	Pipe	Route	BMP	Roadway	Current	Current	Inside	Inside	Pipe	Pipe	Total	Cover at	Inv Suggested Repair	Inspection	Overall
1	▼	▼	▼	▼	Pipe	Inside	Width	Height	Width	Height	Length	Upstream Road	▼	Date	Condition
		Number		Type	Shape	Material	(In)	(In)	(In)	(In)	(Ft)	Edge (Ft)			n
1358	2181552	MN23	174.0545	Centerline	Round	Corg. Steel (CSP)	24	24	24	24	75	8	Install Pipe - Trench	7/19/2017	4 - Severe
1361	384619	MN23	174.566	Centerline	Box	Concrete	48	72	36	60	75	8	Reset	7/19/2017	3 - Poor
1366	2304896	MN23	176.3186	Centerline	Box	Concrete	48	72	48	72	100	8	Reset	7/19/2017	2 - Fair
1367	2181741	MN23	176.3344	Mainline	Round	Concrete	30	30	24	24	80	15	Reset	7/19/2017	4 - Severe
1369	2181742	MN23	176.5738	Mainline	Round	Concrete	24	24	24	24	75	4	Joint Repair	5/9/2017	3 - Poor
1370	2181743	MN23	177.0911	Mainline	Round	Concrete	24	24			60	4	Reset	8/1/2017	4 - Severe
1371	2181744	MN23	178.1267	Mainline	Round	Concrete	24	24			80	4	Joint Repair	5/9/2017	3 - Poor
1375	2181745	MN23	178.9889	Mainline	Round	Concrete	24	24	24	24	100	15	Joint Repair	8/1/2017	3 - Poor
1382	2181734	MN23	180.6827	Mainline	Round	Concrete	24	24	24	24	200	15	Reset	8/1/2017	4 - Severe
1386	2181735	MN23	180.9052	Mainline	Round	Concrete	30	30	36	36	60	4	Reset	8/1/2017	3 - Poor
1505	2246391	MN23	196.2964	Centerline	Round	Corg. Steel (CSP)	24	24	24	24	400	15	Paved Invert	7/16/2018	4 - Severe
1536	2246346	MN23	199.2569	Median	Round	Concrete	18	18	18	18	10	4	Reset	7/16/2018	4 - Severe
1550	2304968	MN23	206.0624	Mainline	Round	Corg. Steel (CSP)	18	18	18	18	70	2	Reset	11/2/2017	3 - Poor
1562	2181608	MN23	208.0934	Mainline	Round	Concrete	30	30	30	30	172	4	Reset	11/2/2017	3 - Poor
1566	2181611	MN23	208.6363	Mainline	Round	Corg. Steel (CSP)	18	18	18	18	66	4	Paved Invert	11/2/2017	3 - Poor
1706	2246071	MN23	218.7151	Mainline	Round	Concrete	24	24	24	24	88	4	Reset	8/24/2016	3 - Poor
1726	2246072	MN23	219.7427	Mainline	Round	Concrete	30	30	30	30	60	4	Reset	9/5/2017	4 - Severe
1747	2246078	MN23	222.589	Mainline	Round	Concrete	24	24	24	24	66	4	Reset	9/6/2017	3 - Poor
1823	2246667	MN23	230.4245	Centerline	Round	Concrete	24	24	24	24	138	20	Joint Repair	7/16/2018	4 - Severe
1831	2246668	MN23	231.0052	Mainline	Round	Concrete	24	24	24	24	80	8	Joint Repair	7/16/2018	4 - Severe
1834	2246669	MN23	231.3603	Centerline	Round	Concrete	30	30	30	30	100	8	Joint Repair	9/4/2018	4 - Severe

Suggested Repair Method is calculated in a TAMS data field.

The sorting process for HydInfra Suggested Repair is described in this [flowchart](#)

Flowchart of HydInfra Report: Pipe Suggested Repair Method



- Consider many additional factors before repairing a pipe:
- 1) If you reduce the hydraulic capacity of the repaired pipe you may cause problems – get a recommendation from Hydraulics/WRE before you line or replace a pipe.
 - 2) Verify Pipe's size, shape, material, length before a doing a major repair.
 - 3) Compare the Field Recommended Repair to the Flowchart Suggested Repair and critically review each suggestion against the condition problems (inspection flags and measures).
 - 3) Additional work may be required with any repair method, especially mud-jacking the road voids.
 - 4) Soundness of road – can voids outside of the repaired pipe be adequately filled?
 - 5) Structural integrity – will the pipe be structurally sound after repair?
 - 6) Cost reduction by combining repairs – can several pipes be repaired together in a project?
 - 7) Local costs of repair methods may suggest a different repair method.
 - 8) Open trenching costs must include pavement cost except when part of a paving project.
 - 9) The scope of the construction project (re-construction, overlay, maintenance) may suggest choosing replacement over repair, or vice versa
 - 10) Traffic requirements – are lane closures required, or are they feasible?
 - 11) Right-of-Way – is the highway-owned work area sufficient for the repair method?
 - 12) Accessibility – Can equipment or materials needed for the repair method reach the pipe?
 - 13) Presence of large rocks prevents jacking – consult Materials Office for soils information.
 - 14) Other repair methods may be appropriate for any pipe, for example, "Joint Repair " may include internal bands, grouting, or other method.
 - 15) Pipes with Roadway Types "Entrance", "Township Road" or "City Road" might be open trenched, whereas Mainline, Centerline, Ramp/Loop, Collector/Distribut and County Roadway Types often may not be, due to traffic.
 - 16) Permit requirements – work with hydraulics to determine if any permits are required or conditions that need to be met.
 - 17) CIPP Liners cured with hot water may contain Styrene that has caused fish kills in streams. Capture all heated water used in resin-curing process and truck to a proper disposal site.

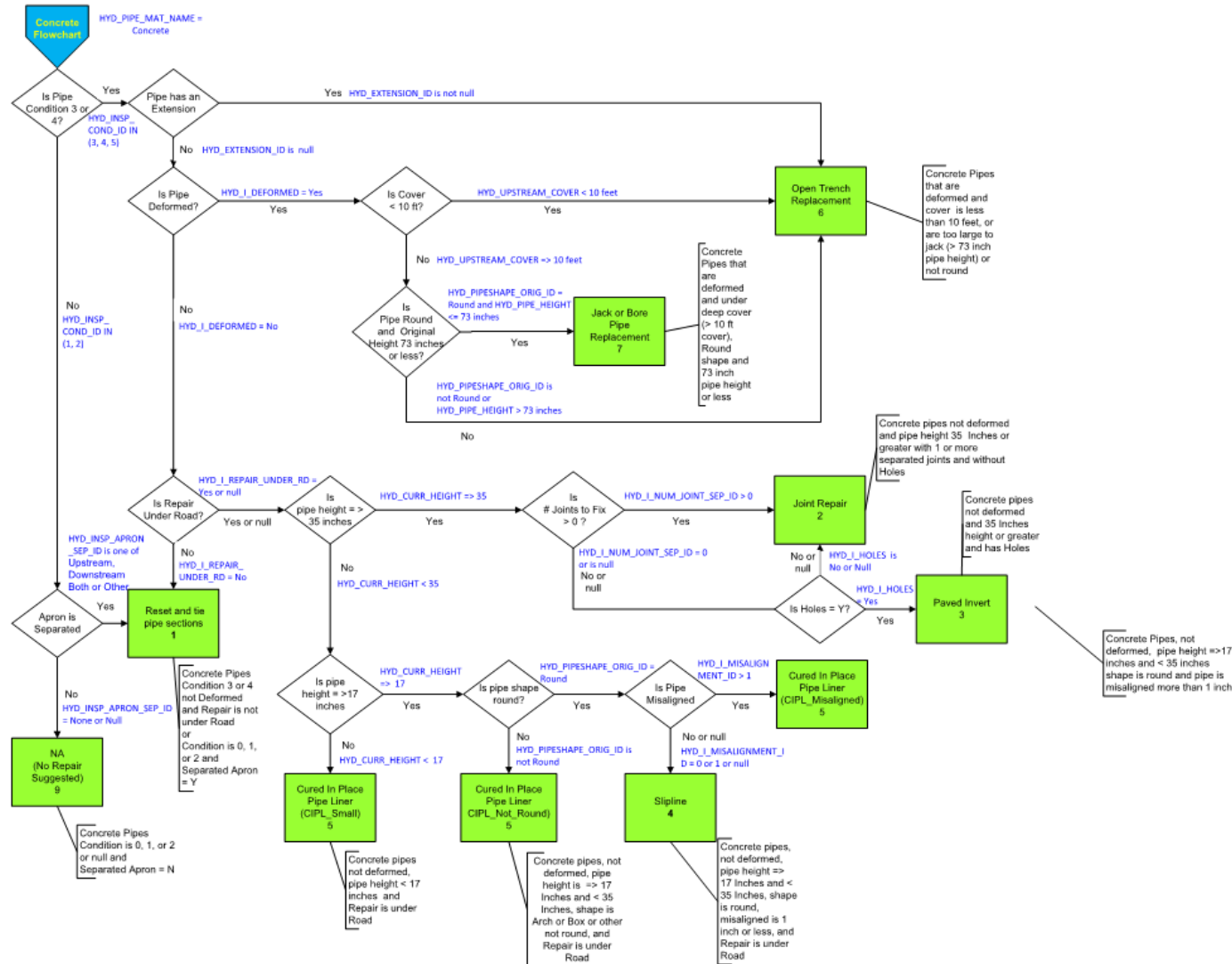
- ### Assumptions used for Repair Options:
- Pipe repairs suggested are used for District or State-wide cost estimates and are not a final repair recommendation.
 - Repair suggested is weighted by most common material failure mode.
 - Permanence, low cost and simplicity of installation are primary considerations.
 - Fixes done by MnDOT Maintenance are preferred to letting a contract.
 - Maintenance is equipped to do some repairs (like joint repair, paved invert, slipline, and reset end sections) but not others (like CIPP or Jack).
 - Contracts are required for Cured in Place Pipe Liner , open Trench replacement, or Jacking.
 - Reduction in diameter reduces hydraulic capacity. Sliplining reduces internal diameter more than cured in place liner or other methods, and limits its use.
 - In pipes less than 36" diameter (2.90 meters) difficulty of human access will favor sliplining or cured-in-place pipe liner over other methods.
 - Open trench replacement is least preferred for highways if traffic is disrupted and likely more expensive when repaving costs are included.
 - Pipes under deep cover are more difficult and expensive to open trench.

- ### Repair Methods:
- 1 = Reset (reset or replace end sections or apron)
 - 2 = ~~Grout~~ Joint Repair
 - 3 = Paved Invert
 - 4 = Slipline
 - 5 = CIPP (Cured In Place Pipe Liner)
 - 6 = Trench
 - 7 = Jack (or auger, ramming, drilling, bursting etc.)
 - 8 = Review (needs repair, no suggestion given)
 - 9 = NA (not applicable)



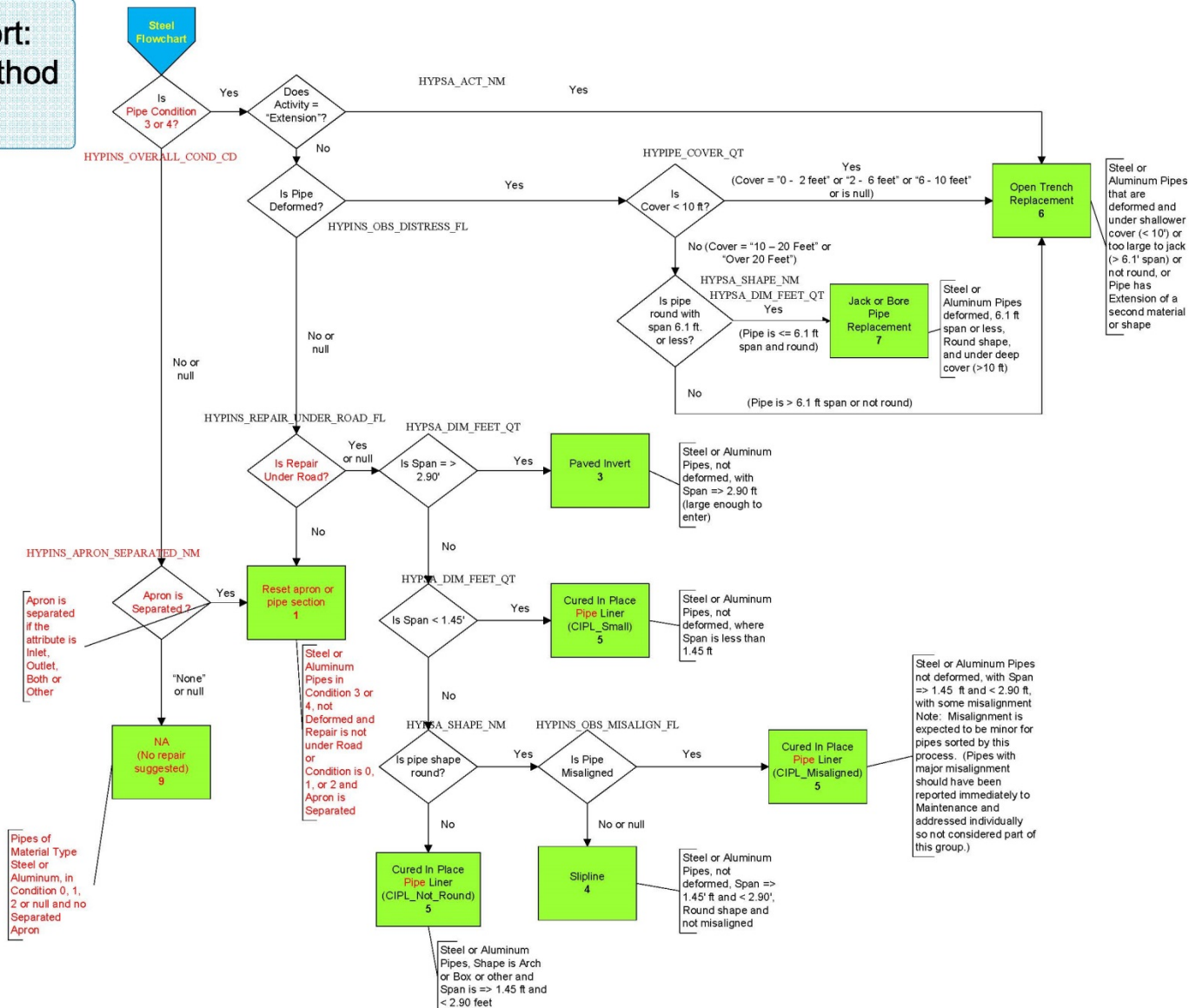
Concrete pipe Suggested Repair sorting process covers the most common Concrete pipe problems

TAMS-HydInfra Pipe Flowchart Repair Concrete Pipes



Suggested Repair for Corrugated Steel or Aluminum Culverts differs from Concrete

Flowchart of HydInfra Report: Pipe Suggested Repair Method Steel or Aluminum Pipes



MnDOT Maintenance captured [Culvert Repair Costs](#) that can be applied to Suggested Repairs. See 2014-2015 Summary

Average Estimated Maintenance Cost of Culvert Repair			
Repair Category	Culvert Categories	Number of Repairs	Average Repair Cost
Trench New Pipe	All	314	\$ 8,430
	Highway ¹		\$32,170
	Side ²		\$ 9,610
	Entrance ³		\$ 5,160
Slipline		47	\$12,570
Reset Apron and Pipe		66	\$ 3,000
Replace Apron and Pipe		52	\$ 3,000
Joint Repair		33	\$ 2,710
Pipe Extension		15	\$ 4,060
Hole Repair		4	\$ 2,000
Fill Void		6	\$ 1,020
Other		13	\$11,270
All Culvert Repairs		550	

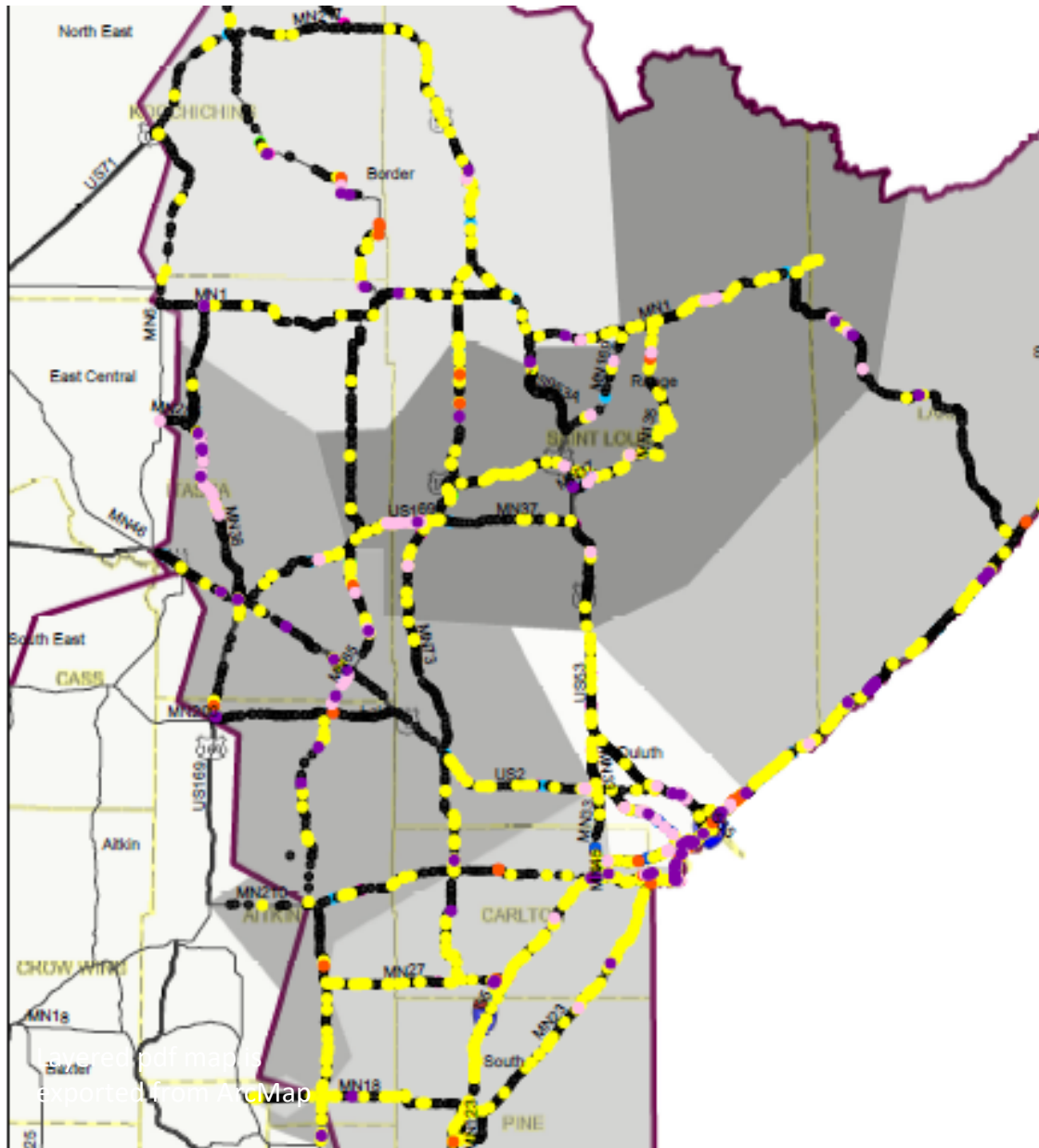
¹ Highway culverts include: centerline, mainline, median, CD and ramp-loop

² Side culverts include: city, county, township, frontage, cross-over

³ Entrances culverts include: entrance, farm entrance and field entrance

Culvert Repair Category is described in [Repair Made Examples with photos](#)

Separated Aprons are common in Concrete culverts. Suggested Repair is Reset, about \$3000 each*



“Reset” suggested repairs are shown as yellow dots.

*Cost per reset is from [2014 - 2015 Drainage Maintenance Data Summary \(PDF\)](#)

Big short-coming:

We don't have simple costs available for culvert repairs or installations done by construction contract.

TAMS still needs construction costs to automate repair cost estimates.