

Stormwater Calculations

Regions Bank

3005 Highway K

O'Fallon, MO 63368

REVISED

November 7, 2017

The Roberts Group, PSC

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Project Description

Regions Bank proposes to build a new 6,597 sf bank building on a 1.62 acre site. The new building will have parking, a paved drive-thru, site lighting, and utilities. Storm water will be collected and routed to an existing storm sewer located in the mall road to Schnuck's. Drainage is piped west through an existing 27" pipe where it turns south and discharges to an existing detention facility.

Existing Drainage Conditions

The 1.62 acre site is a partially paved and vacant grassed lot. The site is 75% impervious. The site varies in elevation from 527 at the northwest corner down to elevation 522 at the southeast corner. Drainage is collected in a catch basin at the northeast corner and is piped through a 24" CPP to an existing junction box. The junction box picks up a 24" pipe from the east that collects water from a dental office. The remainder of the site discharges through a concrete flume to an existing catch basin located on the north side of the mall road. This catch basin receives a 24" CPP from the above junction box. Drainage is then routed south across the mall road through an existing 18" CMP to another catch basin. The total flow is then routed west through a 27" CMP to an existing catch basin. Flow from this catch basin is routed south to a detention facility.

Proposed Drainage Conditions

The new building and impervious areas are proposed to cover 1.01 acres of the 1.62 acre site. The site will be 62% impervious, a reduction of 13% from existing. Roof drains, yard drainage, and driveway drainage will be collected in a yard drain and to two new single street inlets. Two 12" CPP pipes will connect the new inlets. The second inlet will be installed over the existing 24" pipe that picks up drainage from the dental office. Drainage patterns on the remainder of the site should remain the same as existing as described above.

Post Development Drainage Calculations

The existing and proposed storm water collection system consisting of pipes and inlets was input into the *Stormwater Studio* software for analysis. Off and on-site drainage areas were created using the survey provided for the site. A drainage map was created. The map was used to assign PI values from the City's Ordinance, Section 405.230, to obtain flows. Once calculated, flow data for each catch basin was entered into *Stormwater Studio*. The program generates hydraulic data and profiles of the system for analysis, based on the Ordinance's 15 year design storm frequency criteria.

See attached drainage map. The following table of data shows the hydraulic data used for input into *Stormwater Studio*.

Table 1

Existing and Proposed Stormwater Collection System

Drainage Area	Area, ac.	Impervious area, ac.	Pervious Area, ac.	PI, impervious	PI, pervious	Q, cfs
1	0.53	0.38	0.15	3.85	1.87	1.74
2	0.27	0.15	0.12	"	"	0.80
3	0.16	0.16	-	"	"	0.62
4	0.25	0.24	0.01	"	-	0.94
5	0.16	-	0.16	"	"	0.30
6	0.18	0.17	0.01	"	"	0.67
7	0.68	0.46	0.22	"	"	2.18
8	0.18	0.18	-	"	"	0.69
9	0.22	0.22	-	"	"	0.85

The above flows in Table 1 were input into the software as known flows into the nodes, catch basins and grate inlets. The software calculated the hydraulic grade line throughout the existing and proposed components of the system. The following results were obtained as shown in Table 2.

Table 2

Existing and Proposed Stormwater Collection System

Hydraulic Grade Line Elevations

Pipe #	Status	Inlet type	Status	HGL elev. down, ft.	HGL elev. up, ft.	Surface elev. down, ft.	Surface elev. up, ft.	Freeboard, down, ft.	Freeboard up, ft.
1*	existing	curb	existing	514.95	516.86	523.45	519.47	8.50	2.61
2	existing	curb	existing	517.09	518.12	519.47	519.24	2.38	1.12
3	existing	Junction box	existing	518.47	518.48	519.24	522.44	0.77	3.96
4	existing	curb	proposed	518.59	518.61	522.44	522.60	3.85	3.99
5	proposed	curb	proposed	518.41	519.12	522.60	522.60	4.19	3.48
6	proposed	yard drain	proposed	519.10	520.38	522.60	523.00	3.31	2.62
7	existing	grate	existing	518.69	518.88	522.60	523.23	3.91	4.35
8	existing	grate	existing	518.61	519.12	522.44	521.97	3.83	2.85

*HGL established by normal depth

Water Quality

The City's drainage Ordinance, Section 405.245, allows for proprietary devices to be used for post – construction BMP's. It is proposed to use *ADS Flexstorm* filter inserts (BMP Group 4) in the proposed inlets. The water quality peak discharge for the two proposed single street inlets was calculated using the methodology found in the *Maryland Stormwater Design Manual, Appendix D.10*. See the drainage map, attached.

Area 3

A= 0.16 ac. impervious

$$WQ_v = [1.14 \text{ in. } (0.05+0.009(100\%)) (0.16 \text{ ac.})]/12$$

$$= 0.014 \text{ ac-ft.}$$

$$= 610 \text{ cf}$$

CN = 98

$I_A = 0.410$

$I_A/P = 0.041/ 1.14 \text{ in.}$

$$= 0.360$$

$T_c = 5 \text{ min.}$

$Q_u = 890 \text{ csm/in.}$

0.16 ac. = 0.00025 sq. mi.

$$Q_p = (890 \text{ csm/in.})(0.00025 \text{ sq. mi.})(1.14 \text{ in.}) (0.05+ 0.009)(100\%)$$

$$= \underline{0.24 \text{ cfs}}$$

Check filtration rate for large bag size, PC filter@50% max = 1.5 cfs > 0.24 cfs ->>> ok.

Area 4

A= 0.25 ac. (treat as all impervious)

$$WQ_v = [1.14 \text{ in. } (0.05+0.009(100\%)) (0.25 \text{ ac.})] /12$$

$$= 0.023 \text{ ac-ft.}$$

$$= 983 \text{ cf}$$

CN = 98

$I_A = 0.041$

$I_A/P = 0.041/ 1.14 \text{ in.}$

$= 0.036$

$T_c = 5 \text{ min.}$

$Q_u = 1000 \text{ csm/in.}$

$0.25 \text{ ac.} = 0.00039 \text{ sq. mi.}$

$Q_p = (1000 \text{ csm/in.})(0.00039 \text{ sq. mi.})(1.14 \text{ in.}) (0.05+ 0.009)(100\%)$

$= 0.42 \text{ cfs}$

Check filtration rate for large bag size, PC filter@50% max = 1.5 cfs > 0.42 cfs ->>> ok.

Filter Maintenance

The Flexstorm filter maintenance guidelines including the frequency of inspections, cleaning, repair, and/or replacement is shown on Sheet C2.3.

Conclusions

The proposed site has reduced the impervious surface from the previous use by 0.18 acre. This has reduced the stormwater volume for this site. Flows were calculated for the system including the two downstream pipes for the 15 year storm event. The data shows all but one inlet on the north side of the mall road meets the City freeboard requirements of 1 foot for existing and 2 foot for proposed. This inlet, a junction box, has only 0.77 ft. of freeboard and is due to the apparent under sizing of the existing 18" pipe (line #2) connected to it.

Post construction water quality requirements have been met by providing inlet filters in the two proposed curb inlets. The proposed filters have passed the testing requirements demonstrating they have the ability to reduce suspended solids and TPH to the limits specified in the NPDES Phase II permit. The filters will require period cleaning, repair, and/or replacement as recommended in the maintenance guidelines found on Sheet C2.3 of the Plans.

END

Storm Sewer Tabulation

Stormwater Studio 2017 v.2.0.0.52

Project Name: REGIONS BANK OF FALLON, MO

11-07-2017

Line ID	Length (ft)	Drng Area		Rational (C)	C x A		Tc		Intensity (in/hr)	Total Q (cfs)	Capacity (cfs)	Velocity (ft/s)	Line		Invert Elev		HGL Elev		Surface Elev		Line No
		Incr (ac)	Total (ac)		Incr	Total	Inlet (min)	Syst (min)					Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
EXIST.	251.00	0.00	0.00	0.00	0.00	0.00	0.0	7.71	0.00	8.92	14.63	3.86	27	0.76	513.68	515.59	514.95	516.86	523.45	519.47	1
EXIST.	51.00	0.00	0.00	0.00	0.00	0.00	0.0	7.53	0.00	8.07	4.29	4.57	18	0.57	515.59	515.88	517.09	518.12	519.47	519.24	2
EXIST.	20.00	0.00	0.00	0.00	0.00	0.00	0.0	7.37	0.00	6.70	45.48	2.20	24	4.04	515.88	516.69	518.47	518.48	519.24	522.44	3
EXIST.	84.00	0.00	0.00	0.00	0.00	0.00	0.0	4.12	0.00	4.96	17.80	1.86	24	0.62	516.69	517.21	518.59	518.61	522.44	522.60	4
REGIONS	30.00	0.00	0.00	0.00	0.00	0.00	0.0	1.15	0.00	1.42	5.04	4.22	12	2.00	518.01	518.61	518.41	519.12	522.60	522.60	5
REGIONS	70.00	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.00	0.80	4.64	3.57	12	1.70	518.81	520.00	519.10	520.38	522.60	523.00	6
EXIST.	181.00	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.00	2.30	17.79	2.08	24	0.62	517.21	518.33	518.69	518.88	522.60	523.23	7
EXIST.	245.00	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.00	1.74	20.23	1.84	24	0.80	516.69	518.65	518.61	519.12	522.44	521.97	8

Notes: Total Qs limited to inlet captured flows.

Project File: REGIONS BANK OF FALLON REVISED_11-7-17.sws

Energy Grade Line Calculations

Stormwater Studio 2017 v 2.0.0.52

Project Name: REGIONS BANK O'FALLON, MO

11-07-2017

Line No	Line Size (in)	Q (cfs)	Downstream							Length (ft)	Upstream							Pipe		Junction		
			Invert Elev (ft)	Depth (ft)	Area (sqft)	HGL Elev (ft)	Vel (ft/s)	Vel Head (ft)	EGL Elev (ft)		Invert Elev (ft)	Depth (ft)	Area (sqft)	HGL Elev (ft)	Vel (ft/s)	Vel Head (ft)	EGL Elev (ft)	n Value	Energy Loss (ft)	HGLa Elev (ft)	EGLa Elev (ft)	Energy Loss (ft)
1	27	8.92	513.68	1.27 ^a	2.31	514.95	3.86	0.23	515.18	251.00	515.59	1.27	2.31	516.86	3.87	0.23	517.09	0.024	1.913	516.91	517.14	0.05
2	18	8.07	515.59	1.50 ^a	1.77	517.09	4.57	0.32	517.41	51.00	515.88	1.50	1.77	518.12	4.57	0.32	518.44	0.024	1.027	518.19	518.51	0.07
3	24	6.70	515.88	2.00	3.14	518.47	2.13	0.07	518.54	20.00	516.69	1.79	2.96	518.48	2.26	0.08	518.56	0.013	0.017	518.53	518.61	0.06
4	24	4.96	516.69	1.90	3.08	518.59	1.61	0.04	518.63	84.00	517.21	1.40	2.34	518.61	2.12	0.07	518.68	0.013	0.047	518.63	518.70	0.02
5	12	1.42	518.01	0.40 [‡]	0.29	518.41	4.88	0.37	518.76	30.00	518.61	0.51 ²	0.40	519.12	3.57	0.20	519.31	0.013	0.138	519.12	519.31	0.00
6	12	0.80	518.81	0.29 [‡]	0.19	519.10	4.21	0.28	519.35	70.00	520.00	0.38 ²	0.27	520.38	2.93	0.13	520.51	0.013	0.280	520.38	520.51	0.00
7	24	2.30	517.21	1.48	2.49	518.69	0.92	0.01	518.70	181.00	518.33	0.55	0.71	518.88	3.23	0.16	519.05	0.013	0.342	518.99	519.15	0.10
8	24	1.74	516.69	1.92	3.10	518.61	0.56	0.00	518.61	245.00	518.65	0.47 ²	0.56	519.12	3.12	0.15	519.27	0.013	0.513	519.12	519.27	0.00

Notes: ^a Critical depth. ^b Normal depth. [‡] Supercritical.

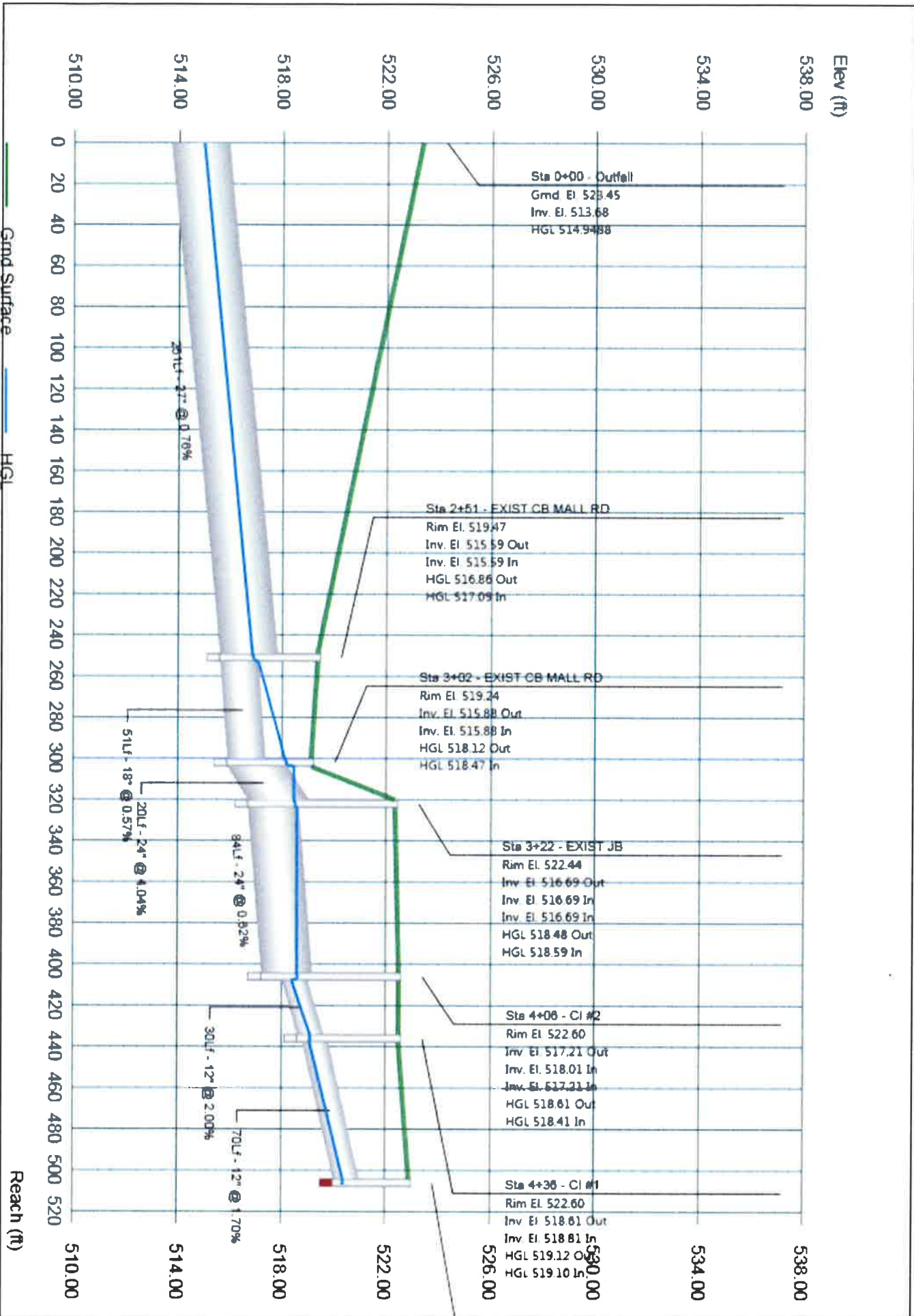
Project File: REGIONS BANK O'FALLONREVISED_11-7-17.sws

Profile View

Stormwater Studio 2017 v 2.0.0.52

Project Name: REGIONS BANK O'FALLON, MO

11-07-2017



Profile View

Stormwater Studio 2017 v 2.0.0.52

Project Name: REGIONS BANK O'FALLON, MO

11-07-2017

