Wardcraft Conveyor
Revised Stormwater Management Plan
Project #:1310488.1A
Sec. 09, T03N, R02W

Existing Conditions
Wardcraft Conveyor currently operates out of a 20,000 square foot building on the north side of King Road. A 10,000 square foot parking lot exists adjacent to the building. A paved access drive connects King Road to the parking area. There is additional gravel access to the rear of the building for truck deliveries. The remainder of the site is maintained lawn. There is a slope down on the east of the site which leads to several residential homes. We are aware that this residential area may have occasional groundwater or stormwater issues. The Wardcraft site existed prior to the development of the subdivision and no diversion of stormwater away from that subdivision was ever installed. A ditch is located on the north side of King Road within the right-of-way and flows easterly. There are no observable stormwater controls on the site. It appears that current stormwater sheet flows to lawn areas and percolates or flows down the access road to the ditch on the north side of King Road. Some runoff from the Wardcraft site may currently flow towards the residential area east of the site.

Proposed Construction
Wardcraft Conveyor is planning to construct a 12,750 square foot building addition and a 4,900 square foot parking lot addition. In addition Wardcraft is also considering a future 3,500 square foot office building addition and a 6,300 square foot office parking addition. In summary, 17,650 square feet of additional impervious area is being planned now, and an additional 9,800 square feet of possible future impervious area is also being considered. This stormwater management plan accounts for both planned impervious additions and future possible impervious additions so that stormwater improvements will not be necessary if the office and office parking additions are constructed.

Detention Requirements
The Jackson County Drain Commission Storm Water Management Policy states that detention of a 50-year frequency storm, assumed to be 2.5 inches of rain per hour for a 60 minute duration, be detained if an adequate outlet with limited capacity is available. The soil survey of the area indicates that an infiltration rate of 0.6 inches per hour is to be expected. Our calculations use half that rate as a rate of infiltration. We are proposing the use of a restricted outlet that releases 0.13 cfs/acre will be discharged to the ditch in King Road. Using the modified Chicago method, accounting for the new construction and the grass areas adjacent to the new construction, our calculations show that a detention volume of 5,161 cubic feet will be required.

WORKSHEET 7. Maximum Allowable Discharge and Detention Calculations

The Runoff Detention calculation is required for non-residential construction that results in an increase of impervious area greater than 1000 square feet

Purpose: Development typically includes impervious parking lots and roofs. Rain water that used to soak into the ground immediately runs off into storm sewers that were originally designed and installed to accommodate storm runoff from residential property. To assure that storm sewers are not overloaded, runoff from new development is limited.

PROJECT NAME:

SITE LOCATION:

Maximum Allowable Discharge[B]: _____ ft^3

Post-Development Conditions

Total Site Drainage Area[A]: _____ acres   **Impervious :** _____ acres
Existing "C": _____   **Pervious :** _____ acres

DURATION (min)	Rainfall Intensity 100-year Storm[C]			Average Coefficient[D]	100-year Runoff[E] (ft^3)	Permitted Outflow[F] (ft^3)	Required Storage[G] (ft^3)
	t(hr)	I(in/hr)	R(in)				
20	0.33	4.9 =	1.62				
30	0.5	3.85 =	1.93				
40	0.67	3.33 =	2.23				
50	0.83	2.83 =	2.35				
60	1	2.52 =	2.52				
90	1.5	1.92 =	2.88				
120	2	1.58 =	3.16				
24 hrs	24	0.23 =	5.52				

Pond Size Required (ft^3): _____

INSTRUCTIONS

A) SITE DRAINAGE AREAS shall be calculated in acres and divided into impervious and pervious areas.

B) MAXIMUM ALLOWABLE DISCHARGE (Q) (ft^3) shall be for a 2 yr, 24-hr storm

Q = C*I*A   C = 0.40 for Previously Develped areas
I=2.60 inches/hr   C = 0.15 for Previously Unevelped areas
A = Site Area in acres   or C = Design Value for storm system

C) Inches of rainfall, given for a 100 year storm, source: Rainfall Frequency Atlas of the Midwest by Floyd A. Huff and James R. Angel. Bulletin 71 (MCC Research Report 92-03). Midwestern Climate Center and Illinois State Water Survey. 1992.

D) AVERAGE COEFFICIENT for runoff, used for all durations, is calculated by the weighted average of pervious and impervious areas, using a pervious coefficient of 0.15 and an impervious coefficient of 0.90.

(ie: AVE COEF = (Impervious*0.90)+(Pervious*0.15)/Total Site Area)

E) Runoff: multiply the total site drainage area by the average coefficient then by inches of rainfall converted into feet, then by 43,560 to convert acres into square feet, result will be in cubic feet.

(ie: RUNOFF = DRAIN AREA*AVE COEF*(RAINFALL/12)*43560)
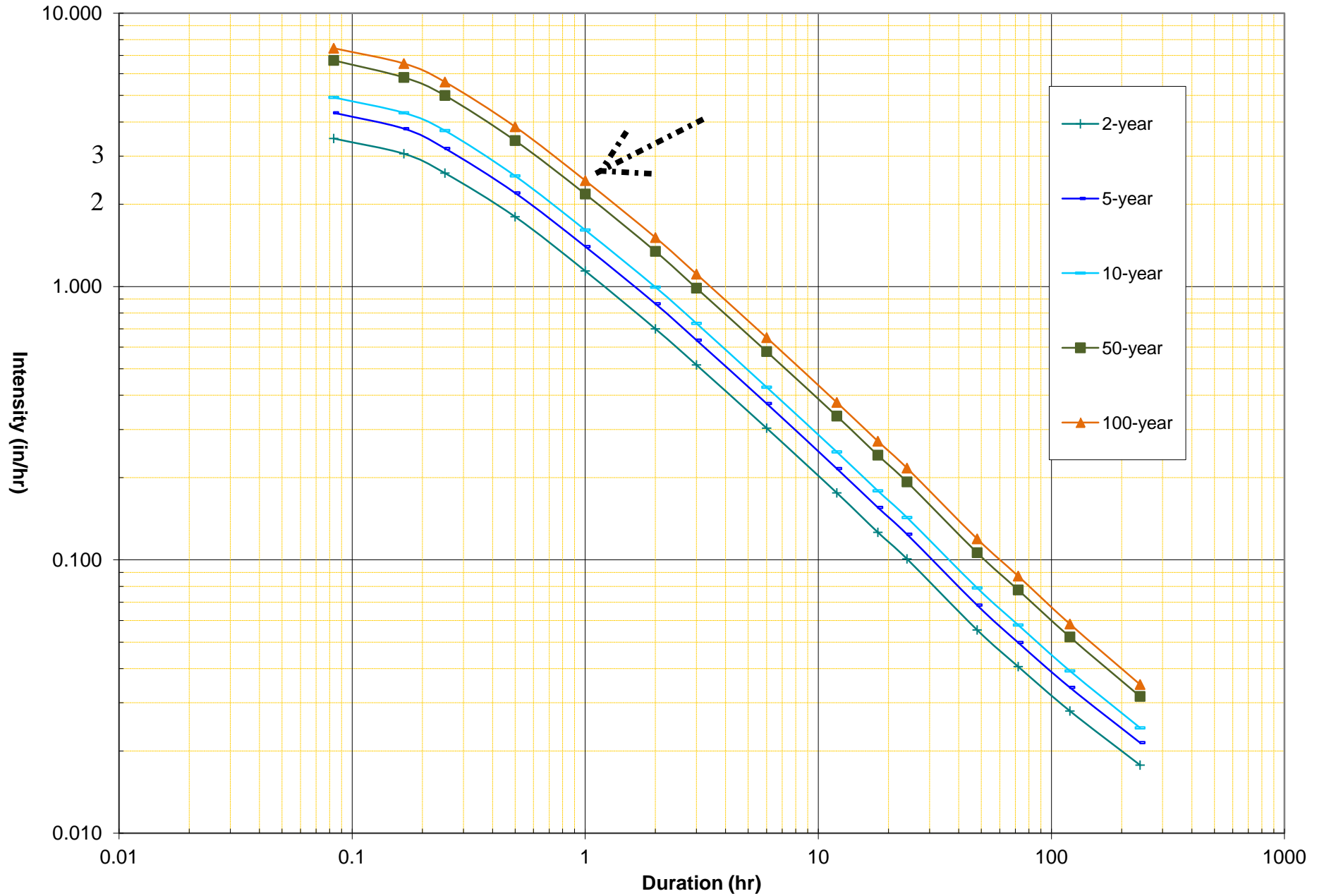
F) Permitted Outflow: Multiply maximum allowable outflow by time in hours, then by 3600

(ie: PERMITTED OUTFLOW = MAX ALLOWABLE DISCHARGE (FT^3/SEC)*TIME(HR)*3600(SEC/HR))

G) REQUIRED STORAGE: Subtract Permitted Outflow from 100-Year Runoff. Storage volume will increase to a peak and then decrease.

H) The Pond Size Required is the peak volume from the Required Storage column.

Rainfall IDF Curves
based on Huff and Angel Section 9

Intensity (in/hr) — vertical axis: 10.000, 3, 2, 1.000, 0.100, 0.010

Duration (hr) — horizontal axis: 0.01, 0.1, 1, 10, 100, 1000

Legend:
- 2-year
- 5-year
- 10-year
- 50-year
- 100-year

IDF Huff-Angel Data Huff-Angel Sec 9 Chart 1/24/2012

Proposed Detention Basins
Three local but connected detention basins are proposed to detain stormwater prior to a controlled release to the King Road ditch. The volumes of these basins are 425 cf, 1,327 cf and 4,578 cf for a total storage capacity of 6,330 cf. The three basins will be connected with 8-inch pipe at the bottom elevations of the basin so that they will remain dry.

Proposed Restricted Outlet
A perforated riser will be installed as the outlet structure to discharge a controlled flow to the King Road ditch. This riser will be an 8-inch pipe with two rows of four 1-inch diameter orifices for a total of 8 orifices. This will provide a discharge of 0.16 cfs to the King Road ditch.

Proposed Stormwater Diversion
In an effort to alleviate any impact of stormwater flowing to the east, to the residential area, we propose to construct a diversion swale to direct stormwater to the detention basin system rather than allowing it to sheet flow to the east towards the residential neighborhood.

Impact to Surrounding Properties
We understand that there is concern about stormwater or high groundwater in the neighborhood immediately east of the Wardcraft site. We feel that this proposal is the best solution to reduce that concern. First, creating a diversion prevents stormwater from flowing over ground closer to those homes. Second, allowing the stormwater to mover in a southerly direction to the King Road ditch and then easterly past the homes will reduce the impact on higher groundwater in the immediate vicinity of the homes. Retaining water on site would potentially mound the groundwater exacerbating the issue at these homes.

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STAGE - STORAGE CALCULATIONS

Project Name:	WARDCRAFT CONVEYOR	Prepared by: AQA
Project No.:	1310488.1A	Checked by: BTS
Basin Desc:	S BASIN (Left)	Date: 2/25/2014

STAGE/STORAGE CALCS

Base Elevation:			1011.50	Volume is calculated as the
Default Elevation Increment:		Varies		frustum of a cone:
Normal Water Level:			1011.50	$V=1/3h*(B1+B2+((B1xB2)^{0.5})$
Top Elevation:			1012.00	
Units (Acres or SFT):			SFT	

Elevation (ft)	Stage (ft)	Area (Sft)	Incremental Volume (Cft)	Cumulative Volume (Cft)
1011.50	0.00	729.000	0.000	0.000
1012.00	0.50	979.000	425.467	425.467
1013.00	1.50	0.000	0.000	0.000
1014.00	2.50	0.000	0.000	0.000
1015.00	3.50	0.000	0.000	0.000

	Total Volume Provided:	425.467	Cft

STAGE - STORAGE CALCULATIONS

Project Name:	WARDCRAFT CONVEYOR	Prepared by: AQA
Project No.:	1310488.1A	Checked by: BTS
Basin Desc:	S BASIN (Mid)	Date: 2/25/2014

STAGE/STORAGE CALCS

Base Elevation:		1011.00	Volume is calculated as the
Default Elevation Increment:		1.00	frustum of a cone:
Normal Water Level:		1011.00	**V=1/3h*(B1+B2+((B1xB2)^0.5)**
Top Elevation:		1012.00	
Units (Acres or SFT):		SFT	

Elevation (ft)	Stage (ft)	Area (Sft)	Incremental Volume (Cft)	Cumulative Volume (Cft)
1011.00	0.00	763.000	0.000	0.000
1012.00	1.00	1988.000	1327.534	1327.534
1013.00	2.00	0.000	0.000	0.000
1014.00	3.00	0.000	0.000	0.000
1015.00	4.00	0.000	0.000	0.000

	Total Volume Provided:	1327.534	Cft

STAGE - STORAGE CALCULATIONS

Project Name:	WARDCRAFT CONVEYOR	Prepared by: AQA
Project No.:	1310488.1A	Checked by: BTS
Basin Desc:	S BASIN (Right)	Date: 2/25/2014

STAGE/STORAGE CALCS

Base Elevation:		1010.50	Volume is calculated as the	
Default Elevation Increment:	Varies		frustum of a cone:	
Normal Water Level:		1010.50	$V=1/3h*(B1+B2+((B1xB2)^{0.5})$	
Top Elevation:		1012.00		
Units (Acres or SFT):		SFT		

Elevation (ft)	Stage (ft)	Area (Sft)	Incremental Volume (Cft)	Cumulative Volume (Cft)
1010.50	0.00	2111.000	0.000	0.000
1011.00	0.50	2733.000	1207.658	1207.658
1012.00	1.50	4052.000	3370.926	4578.585
1013.00	2.50	0.000	0.000	0.000
1014.00	3.50	0.000	0.000	0.000
1015.00	4.50	0.000	0.000	0.000

Total Volume Provided:	**4578.585**	**Cft**	

Project:	**Wardcraft Conveyor**	By: **AQA**
Project #:	**1310488.1A**	Date: **01/28/14**
Pond:	**Sount Basin**	Page: **BTS**

INLET CONTROL,PERFORATED RISER

(Restrictor Sizing - Inlet is Submerged, Free Outfall)

INPUT DATA:		
	Orifice Diameter:	1.00 inches
	Number of Rows of Orifices	2 Rows
	(leave as "0" to automatically calculate number of rows to HWL)	
	Row Vertical Spacing (Inv. to Inv.):	8.00 inches
	Number of Orifices per Row:	4 Orifice(s) per Row
	Lowest Orifice Invert Elevation:	1011.00 ft
	High Water Elevation:	1012.00 ft
	Coefficient of Discharge (Cd):	0.62

$$Q=CdA(2gH)^{0.5}$$

NOTE: Head (H) is measured to center of orifice.

OUTPUT:		
	Orifice Area:	0.00545 sft
	No. of Rows of Orifices to HWL	2
	Flow (Q):	**0.16** cfs

Row #	Invert El.	Head	Flow per Orifice	Flow per Row	Cumulative Flow
1	1011.00	0.96	0.027	0.106	0.106
2	1011.67	0.29	0.015	0.059	0.165
3	0.00	0.00	0.000	0.000	0.165
4	0.00	0.00	0.000	0.000	0.165
5	0.00	0.00	0.000	0.000	0.165
6	0.00	0.00	0.000	0.000	0.165
7	0.00	0.00	0.000	0.000	0.165
8	0.00	0.00	0.000	0.000	0.165
9	0.00	0.00	0.000	0.000	0.165
10	0.00	0.00	0.000	0.000	0.165
11	0.00	0.00	0.000	0.000	0.165
12	0.00	0.00	0.000	0.000	0.165
13	0.00	0.00	0.000	0.000	0.165
14	0.00	0.00	0.000	0.000	0.165
15	0.00	0.00	0.000	0.000	0.165
16	0.00	0.00	0.000	0.000	0.165
17	0.00	0.00	0.000	0.000	0.165
18	0.00	0.00	0.000	0.000	0.165
19	0.00	0.00	0.000	0.000	0.165
20	0.00	0.00	0.000	0.000	0.165
21	0.00	0.00	0.000	0.000	0.165
22	0.00	0.00	0.000	0.000	0.165
23	0.00	0.00	0.000	0.000	0.165
24	0.00	0.00	0.000	0.000	0.165

WARDCRAFT CONVEYOR EXHIBIT

PROP. PARKING

PROPOSED SWALE TO DIVERT EXISTING RUNOFF INTO DETENTION BASIN

EXISTING 1-STORY STEEL AND BRICK BUILDING

PROPOSED BLD. ADDITION

REDUCED STORMWATER IMPACT

PROPOSED DISCHARGE

NATURAL FLOW DIRECTION

EXISTING DITCH
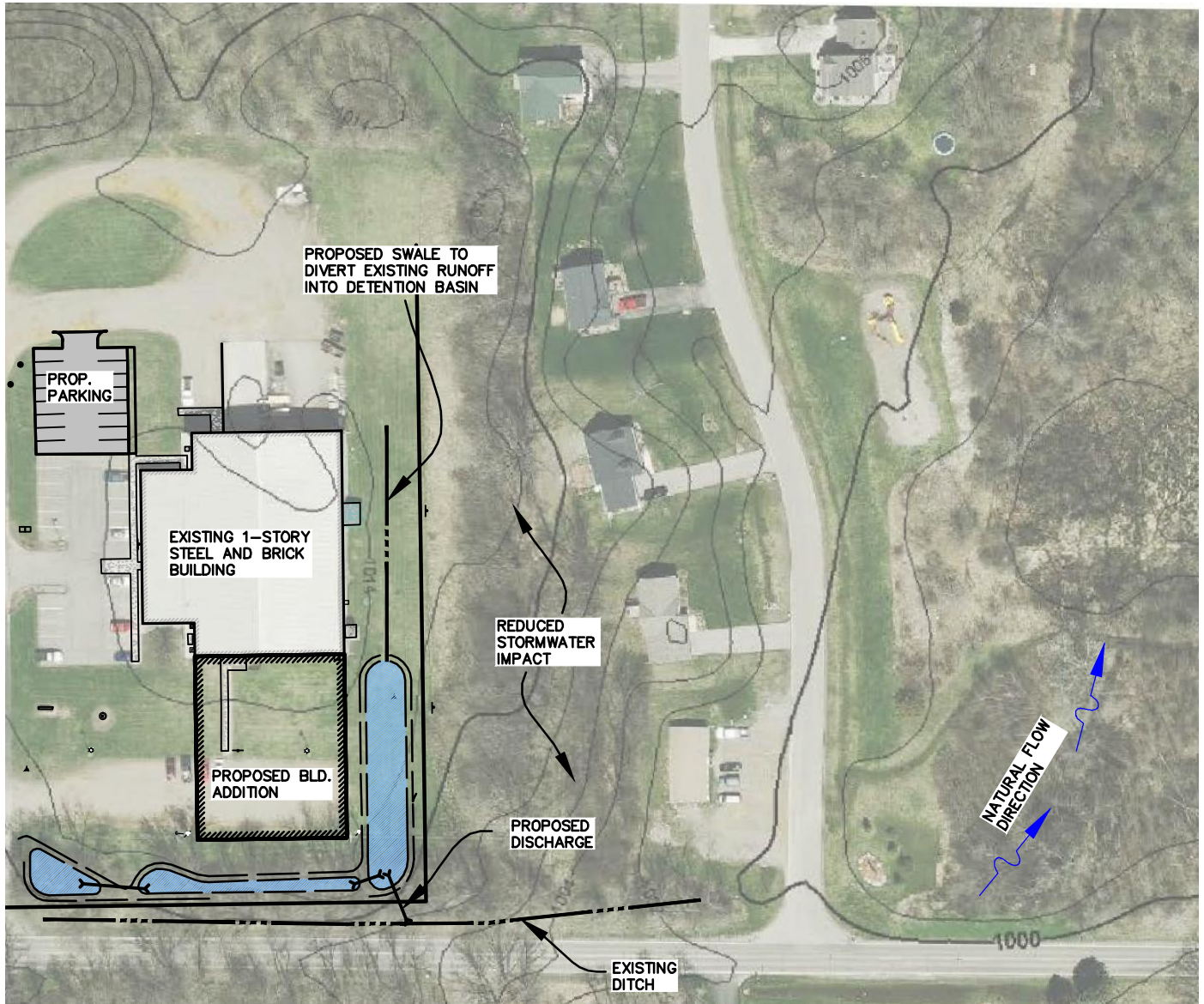
NOTE: ALL ROOF DRAINS WILL BE DISCHARGED TO DETENTION BASINS

SCALE: NTS

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FOR

WARDCRAFT CONVEYOR
1 WARDCRAFT DRIVE
SPRING ARBOR, MICHIGAN 49283

SECTION 09, T03S, R02W

| DATE 01−06−14 | DRAWN BY AQA |
| SHEET 1 OF 1 | JOB No. 1310488.1A |