City of Lawrence Douglas County
PLANNING \& DEVELOPMENT SERVICES
Updated:
9/ 24/ 12 @ 11:30am
Added communications for the following items:
Item 1 - CUP for Penny Sand Pit at N 1500 Rd \& E 1850 Rd
Item 2 - Rezoning 1674 N 1000 Rd
Misc Item 1 - Text Amendment Initiation
9/ 21/ 12 @ 5:00pm
Added staff memo, revised staff report, \& communications for:
Item 1 - CUP for Penny Sand Pit at N 1500 Rd \& E 1850
Added communications for Item 4E - Preliminary Plat for Former Farmland I ndustries
9/ 19/ 12 @ 4:45pm
${ }^{* *}$ The Wednesday, September $26^{\text {th }}$ Planning Commission meeting has been cancelled**
LAWRENCE-DOUGLAS COUNTY METROPOLITAN PLANNI NG COMMI SSI ON CI TY HALL, 6 EAST $6^{\text {TH }}$ STREET, CI TY COMMI SSI ON MEETI NG ROOM
AGENDA FOR PUBLIC \& NON-PUBLIC HEARI NG ITEMS
SEPTEMBER 24 \&-26, 2012 6:30-10:30 PM

## GENERAL BUSI NESS:

## PLANNI NG COMMI SSI ON MI NUTES

Receive and amend or approve the minutes from the Planning Commission meeting of August 20, 2012.

## COMMITTEE REPORTS

Receive reports from any committees that met over the past month.

## COMMUNI CATI ONS

a) Receive written communications from the public.
b) Receive written communications from staff, Planning Commissioners, or other commissioners.
c) Receive written action of any waiver requests/determinations made by the City Engineer.
d) Disclosure of ex parte communications.
e) Declaration of abstentions from specific agenda items by commissioners.

## ITEM NO. 1 CONDI TI ONAL USE PERMIT FOR PENNY SAND PIT; N 1500 RD \& E 1850 RD (MKM)

CUP-12-00099: Consider a Conditional Use Permit for sand excavation and extraction for Penny Sand Pit, approximately 434 acres located on the NE Corner of N 1500 Road \& E 1850 Road. Submitted by Landplan Engineering, for William Penny \& Van LLC, property owners of record. Joint meeting with Eudora Planning Commission.

## ITEM NO. 2 A TO R-T; 31 ACRES; 1674 N 1000 RD (MKM)

Z-12-00098: Consider a request to rezone approximately 31 acres from County A (Agriculture) to County R-T (Rural-Tourism Business), located at 1674 N 1000 Rd. Submitted by Mid-American Association for Autistic Training and Research (MAATR), for Marcus and Sandra Patton, property owners of record.

## ITEM NO. 3 VARI ANCE FOR GRAND ADDI TI ON NO. 2; 3400 \& 3401 ALDRI CH ST (SLD)

MS-12-00092: Consider a variance associated with the Minor Subdivision for Grand Addition No. 2, from the 150' right-of-way requirements in section 20-810 (e)(5) for an arterial street, Kasold Drive, to remain at 100', and from section 20-811 (c) to require a sidewalk on the south side of Aldrich Street. A four-lot division located at 3400 and 3401 Aldrich Street. Submitted by Dean Grob for J erry Willis, Grand, LLC, property owners of record.

## ITEM NO. 4A I-4 \& VC TO UR-FP; 31.7 ACRES; N OF K-10 BETWEEN GREENWAY CIR \& E 1575 RD (SMS)

Z-12-00119: Consider a request to rezone approximately 31.7 acres (and adjacent railroad $\mathrm{r}-\mathrm{o}-\mathrm{w}$ ) from I-4 (Heavy Industrial) and VC (Valley Channel) Districts to UR-FP (Urban Reserve - Floodplain Overlay) District, located in the NE1/4 \& NW1/4 Sec 4-13-20 (Former Farmland Industries property, N of K-10 between Greenway Circle \& E 1575 Rd). Initiated by City Commission on 8/7/12.

## ITEM NO. 4B I-4 TO UR; 170.4 ACRES; N OF K-10 BETWEEN GREENWAY CIR \& E 1575 RD (SMS)

Z-12-00120: Consider a request to rezone approximately 170.4 acres (and adjacent railroad $\mathrm{r}-\mathrm{o}-\mathrm{w}$ ) from I-4 (Heavy Industrial) District to UR (Urban Reserve) District, located in the NE1/4 \& NW1/4 Sec 4-13-20 (Former Farmland Industries property, N of K-10 between Greenway Circle \& E 1575 Rd). Initiated by City Commission on 8/7/12.

## ITEM NO. 4C I-4, I-1, A, \& CC200 TO IG; 170.7 ACRES; N OF K-10 BETWEEN GREENWAY CIR\&E1575 RD (SMS)

Z-12-00121: Consider a request to rezone approximately 170.7 acres (and adjacent highway r-o-w) from I-4 (Heavy Industrial), I-1 (Limited Industrial), A (Agricultural) County Districts and CC200 (Community Commercial Center) City District to IG (General Industrial) District, located in the NW1/4 \& SW1/4 Sec 4-13-20 (Former Farmland Industries property, N of K-10 between Greenway Circle \& E 1575 Rd). Initiated by City Commission on 8/7/12.

## ITEM NO. 4D I-1, B-1, A, \& I G TO IM; 59 ACRES; N OF K-10 BETWEEN GREENWAY CIR \& E 1575 RD (SMS)

Z-12-00122: Consider a request to rezone approximately 59.0 acres (and adjacent highway r-o-w) from I-1 (Limited Industrial), B-1 (Neighborhood Business); A (Agricultural) [County Districts] and IG (General Industrial) District to IM (Medium Industrial) District, located in the SE1/4 Sec 5-13-20 \&

SW1/4 Sec 4-13-20 (Former Farmland Industries property, N of K-10 between Greenway Circle \& E 1575 Rd). Initiated by City Commission on 8/7/12.

NON-PUBLIC HEARI NG ITEM:

## ITEM NO. 4E PRELI MI NARY PLAT FOR FORMER FARMLAND INDUSTRI ES; N OF K-10 BETWEEN GREENWAY CIR\&E1575 RD (SMS)

PP-12-00101: Consider a Preliminary Plat for the Former Farmland Industries property, an industrial subdivision containing 20 lots, 4 tracts and 4 greenway tracts. The property is located N of $\mathrm{K}-10$ between Greenway Circle \& E 1575 Rd. Submitted by Bartlett \& West, for City of Lawrence, property owner of record.

## RESUME PUBLI C HEARI NG:

## ITEM NO. 4F SPECI AL USE PERMIT FOR WESTAR SUBSTATI ON; N OF K-10 BETWEEN GREENWAY CI R \& E 1575 RD (SMS)

SUP-12-00100: Consider a Special Use Permit for a Westar substation to provide electricity to the Former Farmland Industries property and surrounding properties. The property is located N of K-10 between Greenway Circle \& E 1575 Rd. Submitted by Bartlett \& West for Westar Energy. The City of Lawrence is the property owner of record.

## MI SCELLANEOUS NEW OR OLD BUSI NESS

## MI SC NO. 1 TEXT AMENDMENT I NI TI ATI ON

Information Item: The City Commission, at their August 21, 2012 meeting, initiated the text amendments noted in the attached memo. Staff will work to draft the code language and place each amendment on a future Planning Commission agenda.

Consideration of any other business to come before the Commission.

## ADJ OURN

## CALENDAR

| August |  |  |  |  |  |  |  | 2012 |  |  |  |  |  |
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## PCCM Meeting:

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| October |  |  |  |  |  |  |  |  | 2012 |  |  |  |
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## PLANNI NG COMMI SSI ON MEETI NG

August 20, 2012
Meeting Minutes DRAFT

## August 20, 2012 - 6:30 p.m.

Commissioners present: Belt, Blaser, Britton, Culver, Hird, Lamer, Liese, von Achen
Staff present: McCullough, Stogsdill, Day, Larkin, Leininger, M. Miller, Stoddard, Ewert

## MI NUTES

Receive and amend or approve the minutes from the Planning Commission meeting of July 23, 2012.
Motioned by Commissioner Hird, seconded by Commissioner Culver, to approve the July 23, 2012 Planning Commission minutes.

Motion carried 7-0-1 with Commissioner Belt abstaining.

## COMMITTEE REPORTS

Receive reports from any committees that met over the past month.
Commissioner Blaser said the Metropolitan Planning Organization (MPO) met last week and reviewed the Transportation Improvement Program (TIP). He said the funding for Cottonwood Inc, Bert Nash, Douglas County Senior Services, and Independence Inc were added for transportation. He also stated volunteers were needed for the annual bicycle/pedestrian count in September.

## EX PARTE / ABSTENTIONS / DEFERRAL REQUEST

- No ex parte.
- Abstentions:

Commissioners Britton and von Achen both said they would abstain from Item 5.

ITEM NO. 1 CONDITI ONAL USE PERMIT FOR CREEKWOOD LAWN; 1753 N 700 RD (SLD)

CUP-12-00030: Consider a Conditional Use Permit for a truck storage facility for Creekwood Lawn, located at 1753 N 700 Road. Submitted by Shelby Franklin, property owner of record. Joint meeting with Baldwin City Planning Commission.

## STAFF PRESENTATI ON

Ms. Sandra Day presented the item.

## APPLI CANT PRESENTATI ON

Mr. Shelby Franklin was present for questioning.

## PUBLI C HEARING

No public comment.

## COMMISSION DISCUSSI ON

Commissioner Hird said he was concerned with limiting the duration of Conditional Use Permits, particularly where a business was trying to obtain financing for an activity. He said a Conditional Use Permit that could expire prior to the end of the term of financing could become problematic from a banking standpoint. He said he would support the staff recommendation but in general was very reluctant to endorse a Conditional Use Permit with a short fuse on it.

Mr. Franklin said he was requesting the Conditional Use Permit due to financing reasons. He said the five year time duration was doable.

## ACTION TAKEN

Motioned by Commissioner Blaser, seconded by Commissioner Hird to approve the Conditional Use Permit for a Truck/Equipment Storage Facility and forwarding of it to the County Commission with a recommendation for approval, based upon the findings of fact presented in the body of the staff report, and subject to the following conditions:

1. Provision of a note on the face of the site plan stating, "The Conditional Use Permit shall expire on December 31, 2017."
2. Provision of a revised site plan to include the following changes:
a. Show proposed electrical service to the existing building.
3. The applicant shall obtain from Douglas County a building permit as a condition of continued operation.
4. The applicant shall provide a revised site plan drawing to include the following information:
a. The limits of the floodplain need to be clearly shown and labeled on this site plan.
b. Note identifying the base flood elevation.
c. Note listing the floodplain panel number.
d. Note showing the current effective date (08-05-2010).
5. The applicant shall obtain from Douglas County a local floodplain development permit.
6. The applicant shall provide the following information for submission to the State Historic Preservation Officer:
a. Cover letter requesting review by the SHPO under K.S.A. 75-2724
b. Written description of the project
c. Location map showing the listed property and the location of the project
d. Photos of the site and photos of the view to and from the listed property

Unanimously approved 8-0.

PC Minutes 8/20/12 DRAFT
ITEM NO. 2 I G TO CS; . 25 ACRES; 444-446 LOCUST ST (MJ L)

Z-12-00020: Consider a request to rezone approximately . 25 acres from IG (General Industrial) to CS (Strip Commercial), located at 444-446 Locust Street. Submitted by Tiburcio J. Reyes Sr., property owner of record.

## STAFF PRESENTATI ON

Ms. Michelle Leininger presented the item.

## APPLI CANT PRESENTATI ON

Mr. Tiburcio Reyes was present for questioning.

## PUBLI C HEARING

No public comment.

## ACTION TAKEN

Motioned by Commissioner von Achen, seconded by Commissioner Britton, to approve the request to rezone approximately . 25 acres, from IG (General Industrial) District to CS (Commercial Strip) District based on the findings presented in the staff report and forwarding it to the City Commission with a recommendation for approval.

Unanimously approved 8-0.

PC Minutes 8/20/12 DRAFT
ITEM NO. 3 PRD \& CO TO RM24; 11.93 ACRES; 525 CONGRESSI ONAL DR (SLD)
Z-12-00029: Consider a request to rezone approximately 11.93 acres from PRD (Planned Residential Development) and CO (Office Commercial) to RM24 (Multi-Dwelling Residential), located at the northwest corner of W. $6^{\text {th }}$ Street and Congressional Drive and currently addressed as 525 Congressional Drive. Submitted by Paul Werner Architects, for M \& I Regional Properties LLC, property owner of record.

## STAFF PRESENTATI ON

Ms. Sandra Day presented the item.

## APPLI CANT PRESENTATI ON

Mr. Paul Werner, Paul Werner Architects, agreed with the staff report and was present for any questions.

## PUBLI C HEARING

No public comment.

## ACTION TAKEN

Motioned by Commissioner Lamer, seconded by Commissioner Belt, to approve the request to rezone approximately 11.93 acres, from PD [Village Meadows]-Planned Residential Development District and CO (Commercial Office) to RM24 (Multi-Dwelling Residential) District based on the findings presented in the staff report and forwarding it to the City Commission with a recommendation for approval.

Unanimously approved 8-0.

## PC Minutes 8/20/12 DRAFT

## ITEM NO. 4 PRELI MI NARY PLAT FOR GATEWAY ADDI TI ON; 880 HWY 40 (MKM)

PP-5-6-12: Consider a Preliminary Plat for Gateway Addition, a 6 lot subdivision containing approximately 146 acres, located at 880 Hwy 40 (NW quadrant of the intersection of W. $6^{\text {th }} \mathrm{St} / \mathrm{Hwy}$ 40 \& Kansas Hwy 10 (K-10). Submitted by Landplan Engineering, for Hanover Place, L.C. and Tanglewood, L.C., property owners of record.

## STAFF PRESENTATI ON

Ms. Mary Miller presented the item.
Commissioner Liese asked if the Planning Commission should consider the League of Women Voters recommendations.

Ms. Miller said the Planning Commission could take them into account.

## APPLI CANT PRESENTATI ON

Mr. Chris Storm, Landplan Engineering, was present for questioning.

## PUBLIC COMMENT

Mr. Shane Kahle said overall he was pleased with the meetings with staff to work on the project. He said the neighbors still had a few concerns such as the true defined buffer space, the type of buffering that would be used, hours of construction, and the impact of the day to day routine. He felt it was a positive project as long as the neighbors concerns were taken into consideration.

Commissioner Belt asked if Mr. Kahle was asking for more time and input or if he was satisfied with the current version of the plat.

Mr. Kahle felt more time was always better. He wanted to be sure the neighbors concerns were adequately addressed.

## COMMISSI ON DISCUSSI ON

Commissioner Belt asked what would happen with the plat if the project did not move forward.
Mr. McCullough said this was just a preliminary plat and there were other development steps. He said the rezoning would have to be approved by City Commission first. He stated the mayor and City Commission have been very vocal in wanting to know they have a specific project before development approval. He said at some point the land would be platted and zoned regardless of what the project was.

Commissioner von Achen inquired about access to homes.
Ms. Miller said there was a temporary cul-de-sac to the north that serves the houses and it would be removed when Aldersgate was constructed to the area.

Commissioner von Achen inquired about increased traffic.
Mr. McCullough said that was a concern the neighbors raised and there wasn't a perfect answer other than staff would look at any and every tool possible, but that traffic could not be restricted on a public road to the north. He said the intention was to do everything possible to deter traffic away from that property to the north.

Commissioner von Achen inquired about the Baldwin Creek change of alignment.
Mr. McCullough said it was an intermittent creek that does not have water in it all the time. He said it was an engineered system so it would not be seen until, and if, it opens up in certain areas. He said it was discussed opening it up as it reaches the property and then flowing into the detention/retention pond.

Mr. Storm said he had been working closely with the City Stormwater Engineer on the sizing and planning for the stormwater. He said it would be difficult to have an open channel due to the location of gas lines but that they were still in the process of looking at it.

Commissioner von Achen inquired about the distance that the creek would run underground.
Mr. Storm said somewhere around 1,500 feet. He said they were making sure it was properly sized so there would not be concerns with flooding.

Commissioner Blaser inquired about any costs to the church.
Mr. McCullough said KDOT was currently designing that stretch of $6^{\text {th }}$ Street and that negotiation would primarily be between the church and KDOT.

Commissioner Culver applauded the neighbors for continuing to voice their input and applauded staff in working with the neighborhood and developers. He also thanked the developers for being willing to adjust the plan to address concerns.

## ACTION TAKEN

Motioned by Commissioner Culver, seconded by Commissioner Blaser, to approve the Gateway Addition Preliminary Plat subject to the following conditions:

1. Provision of a revised plat with the following changes:
a. Addition of a note stating that additional right-of-way or easement for Hwy 40/W. $6^{\text {th }}$ Street will be dedicated with the final plat if it is determined to be necessary for planned KDOT improvements.
b. Show access restriction along Hwy 40/W. $6^{\text {th }}$ Street along all of the frontage not identified as access points.
c. Show the following access restrictions on Aldersgate: 300 ft from the perpendicular curb face of an intersecting arterial street and 250 ft from the perpendicular curb face of an intersecting collector or local street.
d. Address to the City Utility Engineer's satisfaction the technical comments provided by the City Utility Engineer in relation to water lines and sanitary sewer improvements.
2. Provision of a revised DSSA with the revisions noted in the staff report, per City Utilities Engineer approval.

Commissioner Hird said he would vote in favor of the motion but was concerned about the adequacy of egress and ingress for the project. He hoped it could be addressed as the project moved forward. He also agreed with Commissioner Culver's comment about the neighbors working hard with staff and developers in a cooperative manor.

Commissioner von Achen said she would vote in favor but was concerned about Horizon 2020 stating non-structural or natural approaches should be used for stormwater management systems design. She did not feel that was being done with this project.

Commissioner Lamer said he would vote in favor but had concerns about the channelization of the stream and encasement of the stream. He said he would like to see staff come back and explain at some point what alternatives were considered for this project.

Mr. McCullough said it was not atypical in a non-residential development to do exactly what was proposed with this project with an engineered solution to stormwater. He said laying down impervious materials would generate an increase in runoff and it would need to be accounted and accommodated for. He said this type of engineered encased structure was a common way to resolve issues. He said there were other green infrastructure ways to resolve issues. He said with this project the engineered solution was a concept that allowed for parking at the site and that parking was an element that would be needed. He said this solution was a way to accommodate both parking and stormwater.

Commissioner Britton asked if this approach was inconsistent with the Horizon 2020 language Commissioner von Achen mentioned.

Mr. McCullough said they try and meet the Horizon 2020 goals and policies when possible. He mentioned next month they would see a plat for the former Farmland Industries where they had the luxury of having the space available to do some unique green infrastructure in terms of stormwater. He said even grass and water was still an engineered structure, just not encased with parking over the top. He did not feel it was inconsistent because the Codes allow for it.

Unanimously approved 8-0.

ITEM NO. 5 TEXT AMENDMENT TO THE LAND DEVELOPMENT CODE; HOSPI TAL USE (SLD)

TA-12-00023: Consider a Text Amendment to the City of Lawrence Land Development Code to amend uses in the Hospital (H) District, to change all P uses (Permitted Uses), except for the Hospital Use, to A uses (Accessory Uses) to identify the Hospital use as the only principal use in this district and all other uses allowed in this district to be accessory to the this principal use. Requested by Lathrop \& Gage LLP, on behalf of Lawrence Memorial Hospital. Initiated by City Commission on August 14, 2012.

## STAFF PRESENTATI ON

Ms. Sandra Day presented the item.

## APPLI CANT PRESENTATI ON

Mr. David Waters, Lathrop \& Gage LLP, was present for questioning.

## PUBLI C HEARING

No public comment.

## COMMISSION DISCUSSION

Commissioner Blaser asked if they were initiating or taking action.
Mr. McCullough said City Commission initiated the text amendment and that Planning Commission would make a recommendation.

Commissioner Culver asked if there were any existing sites with the permitted use that would have a negative impact to change it to an accessory use.

Mr. McCullough said the Hospital use was only allowed in the H district and that there was only one property zoned Hospital. He said some of the uses being changed to accessory were permitted in other districts but that the Hospital use was only permitted in the Hospital district.

Commissioner Belt inquired what the advantage to changing to passive recreation would be.
Mr. McCullough said there would need to be a request for the Hospital district and that would be with the request for a new hospital within the community. He said the hospital was the primary use. He said it was unique and not the typical zoning. He said in this scenario any request with the H district would come along with community discussion about a hospital use.

Commissioner Hird said he had no problem with the proposed text amendment but wished Lawrence Memorial Hospital would have used a local attorney for the local hospital.

## ACTION TAKEN

Motioned by Commissioner Hird, seconded by Commissioner Blaser, to approve the proposed text amendment and forward the recommendation for approval of TA-12-00023 to the Land Development Code to the City Commission with a recommendation for approval.

Motion carried 6-0-2, with Commissioners Britton and von Achen abstaining.

## PC Minutes 8/20/12 DRAFT

ITEM NO. 6 REDEVELOPMENT PLAN; $\mathbf{9}^{\text {TH }} \&$ NEW HAMPSHIRE ST
Consider making a finding that the Redevelopment Plan for the proposed redevelopment at $9^{\text {th }}$ and New Hampshire is consistent with the City's comprehensive plan.

## STAFF PRESENTATI ON

Commissioner Belt said he had an ex parte conversation with Ms. Leslie Soden before the meeting.
Ms. Diane Stoddard, Assistant City Manager, presented the item.
Commissioner Liese inquired about what they should be focusing on.
Mr. McCullough said Ms. Stoddard's report outlined the specific scope of Planning Commission's responsibility which was land use and Horizon 2020 policies as they relate to downtown development.

Mr. Bill Fleming, Treanor Architects, said they scaled back the height of the building to accommodate some of the neighborhood requests.

## PUBLI C HEARING

Ms. Leslie Soden, President of East Lawrence Association, said height and public financing were the main concerns of the neighborhood. She said Historic Resources Commission has denied this three times as damaging the historic environs of the North Rhode Island National Historic District. She said a petition was distributed in the Spring and in one week they gathered 179 signatures supporting Historic Resources Commission's decision that the building was too tall. She said Horizon 2020 specifically says sensitivity shall be given to important architectural historical elements. She said the League of Women Voters letter discussed public financing and the East Lawrence Association was also opposed to public financing for the project. She said public financing for a chain hotel that created temporary construction jobs and low wage part-time service jobs was not something public financing should be used for. She said millions of public financing already went into Oread Hotel so creating a competing publically financed hotel was a bizarre form of economic development. She stated if a business plan could not succeed without public finance than most people would change the business model so that it would work. She did not feel public financing to guarantee a return on investment was not an appropriate use of public funding.

Commissioner Liese asked if they were talking about the district tonight, not a specific project.
Mr. McCullough said the redevelopment plan had to be detailed enough so that they had enough information to judge whether it met the Comprehensive Plan. He said they knew a lot about the mixed use building and knew enough about the Salvation Army and Arts Center site to know how it would likely develop. He said Planning Commission needed to look at the development plan and policies and then move forward with their finding. He stated Historic Resources Commission had a narrow view and made a determination which stands as damaging the environs of the North Rhode Island District. He said past that the process involves an appeal to City Commission. He said City Commission had a different look at historic issues and had to make determinations based on the feasibility of the project and whether there were feasible and prudent alternatives to the project. He said that project ran its course with City Commission and they found there were no feasible and prudent alternatives so the project was allowed to move forward to this point. He said Planning Commission needed to look at the project overall with that information and decisions made.

Ms. K.T. Walsh, East Lawrence Neighborhood Association, asked if they were discussing the development proposal from $9^{\text {th }}$ Street south. She asked if they were ignoring the north side completely tonight.

Mr. McCullough said yes.

## COMMISSION DISCUSSI ON

Commissioner Hird said Planning Commissions job was not to decide whether this should receive public funding because that was not within their purview. He said Planning Commissions scope was to decide whether the project, including the architectural aspects, was consistent with Horizon 2020. He said there were three references to Horizon 2020 in the staff report. He wondered why the portion Ms. Soden cited, regarding the architectural aspect, was not in the staff report.

Ms. Soden said it was in the staff report.
Commissioner Belt said in the staff report there was a bit of a liability disclaimer in terms of focusing Planning Commission on a specific charge. He wondered if they would see more of these in the future because it would simplify the report and remind them of what they are doing every time.

Mr. McCullough said typically Planning Commissions charge was broader than this.
Commissioner Britton inquired about Horizon 2020 and project financing.
Mr. McCullough said there were encouragements of using incentives but it doesn't necessarily get into details about which one to use.

Commissioner Britton asked who was offering the incentives.
Mr. McCullough said in this case it would be the City offering an incentive package for the new hotel.
Commissioner Britton asked if the sentiment was still that the financing scenario for this project did not fall under those kinds of incentives.

Mr. McCullough said it could.
Commissioner Britton asked if they should be looking at this being an appropriate incentive.
Mr. McCullough said he did not know he would go to that great of detail with it, he did not think that was what this was saying. He did not believe that Planning Commission was to judge whether this was the appropriate incentive to use. He said what was highlighted in the policy was that incentives were appropriate for certain types of development and that City Commission was entertaining the incentives.

Commissioner Britton said when he originally read in the staff report 'Offer appropriate incentives for desired tourism development'he assumed that this development would be preserving downtown.

Mr. McCullough said of the three items listed under Conformance with the Comprehensive Plan the other two were directly linked to the physical redevelopment plan. He said the development was a mixed-use development and was infill.

Commissioner Liese said he saw Commissioner Britton's point but he read it differently. He read it as Horizon 2020 saying it was good to offer appropriate incentives. He felt it was up to the legislatures to decide if the incentives were appropriate. He said the concept was one they should be thinking about not the dollars.

Commissioner Britton said he thought they read number three the same way. He said he read it whether the development offered incentives, not whether the City's incentives were appropriate.

Commissioner Blaser asked for clarification on what was considered an extended stay hotel.
Mr. Fleming said it generally had a few more amenities, such as refrigerator, stove, or kitchenette area so that people could prepare meals in the room if they wanted to. He said the idea was for people to stay typically 30 days or more.

Commissioner Blaser said an extended stay hotel was not something he would consider as a draw for tourism, especially since most tourists would not stay for 30 days.

Mr. McCullough said a big part of the TIF redevelopment plan was the Arts Center development that was supported by the policy of looking for ways to encourage tourism. He said the extended stay hotel would support tourism.

Commissioner Hird did not think it was within their purview to decide if financing was appropriate or not. He said it was important to him that it was an infill development because he would rather have an extended stay hotel in downtown where the people would be dining and shopping to support downtown, as opposed to being on the western fringes of the city. He said he was not convinced it was a tourist destination but considering it in conjunction with the first two standards that it supports downtown and was an infill development, it was persuasive that it was in conformance with the long term plan. He said he would leave it up to City Commission to debate the merits of financing. He stated given the narrow scope of Planning Commission he would support the staff recommendation.

## ACTION TAKEN

Motioned by Commissioner Hird, seconded by Commissioner Blaser, to make a finding that the proposed plan for the redevelopment of the south portion of the Ninth and New Hampshire Project is consistent with the comprehensive general plan, Horizon 2020.

Commissioner Liese said they didn't know that it wouldn't encourage tourism and felt it could be a less expensive alternative to the Oread Hotel which may be desirable to tourists.

Mr. Fleming said they did a consultant study which provided data and assumptions. He said the data was based on a room rate of about $\$ 93$ a night.

Commissioner Liese said that would be about the same as the Oread Hotel.
Commissioner Belt asked if there were any other extended stay hotels in Lawrence.
Mr. Fleming said the Eldridge Hotel had a few extended stay type rooms.
Commissioner Liese asked who wrote in the staff report that an extended stay property would be a new product for Lawrence.

Ms. Stoddard said she drafted that language.
Commissioner Blaser said the new hotel by Hallmark Cards had all the same amenities that Mr. Fleming described as being in an extended stay.

Commissioner von Achen asked Ms. Stoddard to comment about the concern from the historical perspective of this hotel and the position the City was taking on it.

Ms. Stoddard said there were very specific legal steps that the City took. She said City Commission made a finding that there were no reasonable and prudent alternatives to the developer's proposal related to that site. She said in general City Commission was very cognizant of the historic nature of downtown and preserving downtown as a whole. She said they have been favorable toward the project as it relates to the first two items stated in the staff report. She said bringing additional development downtown would create a synergy of people to shop and utilize restaurants which would create economic activity for the long term and help preserve the community.

Commissioner Lamer addressed the three points in the staff report. He said preserving downtown as a mixed-use activity center was accomplished by this project. He said part of the key to having a mixed-use activity center was increasing the levels of density so he supported the project for that reason. He also felt it conformed to the comprehensive plan. He felt this was an appropriate location for infill. He said regarding appropriate incentives he did consider the incentive package put before the City. He said to his understanding it was a pay-as-you-go tax increment financing tool which was different than if they had come forward with some other type of incentive request such as a real property tax abatement.

Commissioner Culver asked if the two areas to the north and south would be treated independently ongoing.

Ms. Stoddard said there would be an overarching redevelopment agreement that would address the entire district. She said the only thing that would happen with having them on two different time frames was that the developer had an incentive to wait until they were ready to proceed with the north project, in a closer timeframe, before they would bring a redevelopment plan forward. She said the 20 year clock on the tax increment financing district would begin when a redevelopment was approved by City Commission. She said one could be on a 20 year tract and the other on a separate 20 year tract, a few years apart from each other.

Commissioner Culver said based on the relevant items presented in the staff report he would support the motion because he felt it conformed to the comprehensive plan.

Commissioner Britton said he was sensitive and sympathetic to Ms. Soden’s concerns but felt accommodations had been made even if they were not to everybody's satisfaction. He felt the financing incentives were appropriate as discussed by Commissioner Lamer. He said he would support the motion.

Commissioner Blaser said he agreed with everything that had been said but felt the incentives were to attract tourism, not to incent the developer. He said a small grocery store would be a larger incentive for downtown. He said he would support the motion.

Commissioner Liese thanked Ms. Soden for voicing her opinion this evening. He said he would support the motion based on the comments already made by Commissioner Lamer.

Commissioner Belt said he appreciated the neighborhood, applicant, and staff efforts to make sure this was the best possible project, specifically on the south side.

Unanimously approved 8-0.

## MI SCELLANEOUS NEW OR OLD BUSI NESS

Consideration of any other business to come before the Commission.
Commissioner Liese asked the Planning Commissioners to check the Mid-Month calendar for dates and topics and that they were mandatory meetings.

## ADJ OURN 8:40pm

## 2012

LAWRENCE-DOUGLAS COUNTY METROPOLITAN PLANNI NG COMMI SSI ON MI D-MONTH \& REGULAR MEETI NG DATES



## Memorandum

City of Lawrence
Planning \& Development Services

## TO: Planning Commission

CC: Scott McCullough, Director of Planning and Development Services Sheila Stogsdill, Assistant Planning Director

FROM: Mary Miller, City/ County Planner

Date: September 21, 2012
RE: ITEM NO. 1: CONDITI ONAL USE PERMIT FOR PENNY SAND PIT; N 1500 RD \& E 1850 RD (MKM)
For September 24, 2012 Planning Commission meeting

Two errors were identified in the staff report for the CUP referenced above. Changes have been made and the corrected staff report placed in the Planning Commission agenda packet. The following changes were made to Section VI of the report (Page 10):

1. The applicant's response to the factor "RELATIVE GAIN TO THE PUBLIC HEALTH, SAFETY AND WELFARE BY THE DESTRUCTION OF THE VALUE OF THE PETITIONER'S PROPERTY AS COMPARED TO THE HARDSHIP IMPOSED UPON THE INDIVIDUAL LANDOWNERS" was corrected. Staff had inserted the wrong response for this question. The corrected response is:
"No identifiable gain will result by denial of this request; no identifiable hardship will result from its approval."
2. The first paragraph in Section VI was revised. This paragraph incorrectly noted that the subject property was located outside the Eudora Wellhead Protection Zone. The property had been identified as being within the western reaches of the Protection Zone on Page 7 of the staff report, under the heading "Proposed Uses" and in Figure 3. The revised language is:
"Evaluation of the relative gain weighs the benefits to the community-at-large vs. the benefit of the owners of the subject property. There are many factors to consider when locating a sand pit, and this location meets the geographic criteria of being outside the FAA 10,000 ft wildlife mitigation area, has good access to the arterial roadway system, and is in a lowly populated area. Denial of the request for a Conditional Use Permit would affect the individual landowner by prohibiting the use of the property for the off-river sand dredging pit. "

# PLANNI NG COMMI SSI ON REPORT <br> Regular Agenda Joint Meeting with Eudora Planning Commission 

PC Staff Report
09/24/12 (Corrected)
ITEM NO. 1: CONDI TI ONAL USE PERMIT FOR PENNY SAND PIT; N 1500 RD \& E 1850 RD (MKM)

CUP-12-00099: Consider a Conditional Use Permit for sand excavation and extraction for Penny Sand Pit, approximately 434 acres located on the NE Corner of N 1500 Road \& E 1850 Road. Submitted by Landplan Engineering, for William Penny \& Van LLC, property owners of record. Joint meeting with Eudora Planning Commission.

STAFF RECOMMENDATION: Staff recommends approval of the Conditional Use Permit for Penny Sand Pit and forwarding it to the Board of County Commissioners with a recommendation for approval based on the findings of fact found in the body of the staff report subject to the following conditions:

1) The approval is contingent upon the issuance of all State and/or Federal permits which are required for this operation including the Army Corps of Engineers.
2) An agreement designating responsibility for the ongoing maintenance of the berms to the property owner shall be executed and recorded with the Register of Deeds prior to the release of the CUP plans to the Zoning and Codes Office. A copy of the agreement shall be provided to the Planning Office for the file.
3) A copy of the easement for the off-site access drive shall be provided to the Planning Office for the file prior to the release of the CUP plans to the Zoning and Codes Office.
4) The applicant shall obtain a Flood Plain Development Permit from the Director of Zoning and Codes prior to the release of the CUP plans.
5) The reclamation plan shall be revised with the following changes prior to release of the CUP plans:
a. The plan shall note the requirement that the lake that is being created will have a varied shoreline and will appear natural in appearance.
b. The plan shall note that the intended use of the lake, when mining and reclamation is complete, is to be a recreational feature.
c. The plan shall note the maximum slope of the lake shoreline for a specified depth to insure that the slopes are of a grade that it would be possible for a person or animal that accidentally entered the lake to exit.
d. The plan shall explain the sequential nature of the reclamation process; that overburden produced in one phase will be used to reclaim previously excavated areas.
e. The reclamation plan shall note that topsoil will be placed over the overburden in areas that are to be reclaimed as farmland, shoreline, or berms. If topsoil is to be stockpiled and stored it must be vegetated to prevent erosion.
6) The applicant shall submit a revised CUP plan with the following changes:
a) A detailed landscaping plan for the buffer area surrounding the McElwee house will be submitted.
b) The Book and Page number of the recorded easement for the off-site access road shall be noted on the CUP plan.
c) The ownership shall be noted as Van, LLC as well as Penny's Concrete Inc. on the CUP plan.
d) The on-site residential structure on the east side of the property will be shown on the CUP plan as on the reclamation plan.
e) If stockpiling of overburden is to occur on the subject property, the CUP or operation plan should note the maximum height and approximate location. The stockpiles should be placed as far from the existing residences as possible.
f) List the following CUP conditions on the plan:
i. Hours of operation are 6:30 AM to 6:30 PM, Monday through Friday. No removal, transfer, or placement of overburden is permitted outside these operating hours; however dredging and extraction of sand may exceed these hours when necessary.
ii. The approval for this Conditional Use is valid for 30 years. An extension request for the CUP must be submitted prior to the expiration date or a new CUP application must be submitted. The Zoning and Codes office shall conduct 5 year administrative reviews to insure compliance with the CUP, operation, and reclamation plans.
iii. The only exterior lighting in the areas to be excavated will be the headlights on the dredge.
iv. The scale house, processing plant, sediment pond, and stockpile area, approved with CUP-2-2-79, will be used to serve the subject property.
v. Sales of overburden, topsoil, sand or aggregate products will occur only on the portion of the property that contains the scale house on the CUP plan.
vi. Truck traffic will utilize Noria Road (E 1750 Road), and is restricted from using N 1500 Road or E 1850 Road.
vii. The applicant shall work with the Army Corps of Engineers to determine how the existing wetlands on the property will be treated. Prior to any excavation in Phase 21, the applicant will provide documentation to the Planning Office on the wetlands indicating whether the wetlands will be maintained on site or if they will be mitigated elsewhere. If the wetlands will be maintained on site, the operation plan will be revised to include the protection measures and the property owner shall submit a revised CUP plan for administrative review/approval of the wetland setbacks. If the wetlands are to be mitigated, a revised CUP plan shall be submitted to note the removal of the wetlands.
7) The following improvements to nearby roads and intersections shall be completed per the County Engineer's approval before issuance of a permit for the Conditional Use :
a. Realignment of the entrance to the sand facility so that it opposes the Noria Road intersection at N 1500 Road.
b. Pavement of a 100 ft long section of the site access drive just north of N 1500 Road, as recommended in the TIS.
c. Reconstruction of pavement in the Noria Road (E 1750 Road)/N 1500 Road intersection. The existing surfacing is likely a crushed rock base that has been chip sealed. This will not stand up to the increased truck traffic crossing N 1500 Road.
d. Construction of an eastbound right turn lane on Route 442 ( N 1400 Road) at Route 1057 ( E 1900 Road). This is mentioned as a desirable improvement in the TIS. Pavement on the existing shoulder at this location is not adequate for the projected amount of truck traffic.

## Reason for Request:

"The owner wishes to conduct sand excavation, extraction and processing operations on the subject property in conjunction with the existing agricultural uses."

## KEY POI NTS

- Per Section 12-319-4.11 of the Zoning Regulations for the Unincorporated Territory of Douglas County, mining and excavation uses are permitted in the A and V-C Districts when approved as a Conditional Use.
- The area is encumbered with floodplain including the regulatory floodway and floodway fringe of the Kansas River.
- Previous Conditional Use Permits were approved for the river dredging operation to the north and northwest of the subject property. The Conditional Use Permits are not being combined with this request; however, the processing plant and access drive on the property with the previous Conditional Use Permits will be utilized. These previous Conditional Use Permits are discussed in more detail later in the report.


## ATTACHMENTS

A - Public Communications received prior to printing of this staff report.
B - Traffic Impact Study and Addendum
C - Plans
D - Ground Water Report

## DESCRIPTION OF USE

The applicant is requesting a Conditional Use Permit to allow pit dredging on the subject property. The applicant has an existing Conditional Use Permit for river dredging in the property along the river, north of the subject property [CUP-2-2-79] and a CUP was approved for river dredging on the property to the west owned by David and Carmiletta Penny. The applicant has been operating the two river dredging operations and intends to utilize the access drive which was constructed for the river dredging facilities. The intent is also to use the same processing plant, currently located in the middle of the existing stockpiles; however, it will be moved to the subject property in the location marked on the CUP plan after the first few phases. The reclamation plan indicates that portions of the property will be reclaimed for agricultural uses and the remainder will be reclaimed as a lake.

## ASSOCI ATED CASES/ OTHER ACTI ON REQUI RED

- Approval of Conditional Use Permit by Board of County Commissioners.
- Conditional Use Permit Plan released to the Zoning and Codes Office.
- Issuance of permit for the Conditional Use by the Zoning and Codes Office following application and determination that all conditions have been met.


## PUBLI C COMMENT RECEI VED PRIOR TO PRINTI NG

- August $9^{\text {th }}$ phone call from Carl McElwee, adjacent property owner listing the following concerns with the project: 1) unstability of the river bank, 2) possible pollution of the aquifer, and 3) loss of prime agricultural soils.
- Staff met with Carl McElwee on August $31^{\text {st }}$ to discuss his concerns with the CUP. Mr. McElwee provided a letter and reference material which is included in Attachment A.
- Petition from nearby property owners on September 17th in opposition to the sand pit.
- Letter from David Penny, president of Master's Dredging Company, requesting deferral. This letter is included in Attachment A.
- Letter from Carl McElwee on September $18^{\text {th }}$ in opposition to the deferral request, Attachment A.


## GENERAL I NFORMATI ON

Current Zoning and Land Use:

Surrounding Zoning and Land Use:

V-C (County- Valley-Channel), F-W (Floodway Overlay) and F-F (Floodway Fringe Overlay) Districts; rural residential and agriculture.

To the west:
V-C (Valley-Channel), and F-W (Floodway Overlay) Districts; rural residential and agriculture.
To the north:
V-C (Valley-Channel), and F-W (Floodway Overlay) Districts; river dredging operation approved with CUP-2-279 and the Kansas River.
To the east:
V-C (Valley-Channel), F-W (Floodway Overlay) and F-F (Floodway Fringe Overlay) Districts; rural residential and agriculture.
To the south:
V-C (Valley-Channel), and F-F (Floodway Fringe Overlay) Districts; rural residential and agriculture.
(Figure 1)

## Site Summary:

Subject Property:
Proposed Buildings:
Off Street Parking Required:
Off Street Parking Provided:

465 acres
No new buildings are being proposed.
1 space per 2 employees. 4 employees/ 2 spaces are required.
2 spaces provided on property to north, included within CUP-2-2-79.


Figure 1a. Zoning in the area.
Figure 1b. Land use in the area.

## I. ZONI NG AND USES OF PROPERTY NEARBY

The subject property contains approximately 465 acres and is located northwest of the intersection of N 1500 and E 1900 Roads in portions of Sections 25, 26, 35, and 36 in Township 12 South, Range 20 East.

The nearby area is zoned V-C (Valley Channel), a protective zoning district that was created prior to the construction of Clinton Dam and development of the FEMA Flood Insurance Rate Maps for property which was prone to flooding. The V-C District permits the following limited land uses: agricultural land uses, public or private commercial recreational facilities and structures, open space, and farm dwellings provided a minimum area of 5 acres per dwelling unit is provided. Per Section 12-319-4.05, mining, extraction, and excavation of raw materials in the V-C District require approval of a Conditional Use Permit (CUP) and approval of a reclamation plan. Land uses in the area include rural residences, agricultural land uses, and mining/excavation land uses approved with CUPs. Conditional Use Permits which have been approved in this area for sand dredging are listed below and the areas included are shown in Figure 2.

- A Conditional Use Permit application, CUP-2-2-79, for river dredging was submitted in 1979 for the area north of the subject property. Planning Commission voted to recommend approval at their April 25, 1979 meeting.
- A Conditional Use Permit application, CUP-1-3-91, was submitted in 1991 for approximately 130 acres located to the west of the subject property to permit river dredging along the shore and pit dredging on the remainder. The Planning Commission voted to recommend approval of the river dredging at their March 27, 1991 meeting but voted to recommend denial of the pit operation at their May 22, 1991 meeting. The minutes indicated the vote for denial was based primarily on concerns with the possibility of contamination of ground water and local wells and the possibility of the pit accelerating the changing of the river's course.
- Various extensions were approved for CUP-1-3-91 and a new file number, CUP-3-3-01, was assigned in 2001 for that extension. On December 17, 2001, the County Commission approved a 5 year extension of the CUP through December 31, 2006. CUP-1-3-91 expired as the Corps of Engineer permit was issued after the expiration date of Dec. 31, 2006.
- CUP-06-04-08 was submitted in 2008 to replace the expired CUP-1-3-91. Planning Commission voted to recommend approval at their August meeting. County Commission approved the CUP on September 17, 2008. The CUP will expire December 31, 2012 unless a new Army Corps of Engineers permit is obtained and approved by the Zoning and Codes Director.


Figure 2. Approximate area included in CUPs for sand dredging in the area. Previously approved CUPs outlined in red, subject property in black.

Staff Finding - The area is zoned V-C (Valley Channel) and portions are encumbered by the Regulatory Floodway and the Regulatory Floodway Fringe. The predominate land uses in the area are agriculture, mining and extraction, and rural residential. The proposed land use, mining and excavation, is permitted in the V-C District and has been approved in the area.

## II. CHARACTER OF THE AREA

The subject property is located east of the City of Lawrence and is outside of, and adjacent to, the Urban Growth Area boundary. This is an agricultural area with scattered rural residences. Natural features in the area include the Kansas River, which borders the area to the north and is the dividing line between Douglas and Leavenworth Counties; riparian woodlands along the Kansas River; floodplain; and high quality agricultural soils. The property has good access to the transportation network through N 1500 Road, which is classified as a minor collector on the Major Thoroughfares Map. N 1500 Road connects E $15^{\text {th }}$ Street with County Route 1061 (E 2200 Road), both classified as minor arterials.

Staff Finding - This is predominately an agricultural area with scattered rural residences, floodplain, and natural resources in the form of sand reserves and high quality agricultural soils. N 1500 Road, a minor collector, provides a connection through the area to minor arterials to the east and west.

## III. SUITABILITY OF SUBJECT PROPERTY FOR THE USES TO WHICH IT HAS BEEN RESTRICTED

Applicant's response:
"A Conditional Use Permit (CUP) was granted to Dunbar in 1979 for removal of sand from the river bank. The original permit covered an area approximately 114 acres gross in size which is approximately located in the northwest corner of the CUP request. The mining is a use that is allowed in V-C (Valley Channel)."

## Existing Uses

Uses allowed in the V-C District include farms, truck gardens, orchards, nurseries, grazing, hunting and fishing, public or private commercial recreation facilities and structures, preserves, reservations and other similar open uses, and farm residences when located on a minimum of 5 acres. Mining and excavation activities are permitted as a Conditional Use. A Conditional Use requires approval though a public review process. Section 12-319 of the County Zoning Regulations states:

> "Recognizing that certain uses may be desirable when located in the community, but that these uses may be incompatible with other uses permitted in a district, certain conditional uses listed in Section 12-319-4 below, when found to be in the interest of the public health, safety, morals and general welfare of the community may be permitted, except as otherwise specified, in any district from which they are prohibited."

The property is partially encumbered by the Regulatory Floodway and Regulatory Floodway Fringe. Per Section 12-328 of the County Zoning Regulations, the purpose of the floodplain management regulations is to protect individuals and property from flood hazards or flooding by providing for the orderly and safe development of the floodplain for the most advantageous uses which are consistent with the health, safety, and welfare of the general public. Any development in the area requires review and issuance of a floodplain development permit by the Zoning and Codes Office.

## Proposed Uses

The property has many features which suit it well for the mining and excavation use which is being requested. It is located adjacent to the Kansas River in an area with sand reserves and has good access to the major transportation network. The property is located at the western reaches of the Eudora Wellhead Protection Zone and is outside the FAA $10,000 \mathrm{ft}$ Wildlife Mitigation Area. (Figure 3) Conditional Use Permits for river dredging have been approved for the property to the north and an off-site access drive was constructed to accommodate this facility. There is little residential development in the area; however, 4 residences are within very close proximity to the area proposed to be pit mined with 2 of these being located on the subject property. The area is not served by a rural water district, but relies on well water. Care must be taken through the approval and operation process to minimize any negative impacts to the nearby residences.

The subject property is located in a large contiguous area of high quality agricultural soils. (Figure 4) There is a conflict between the two natural resources in that the removal of the underground sand deposits will remove the high quality soils in this location. The fact that sand reserves are typically located near the river, and often within the floodplain makes it difficult to avoid locating in areas with high quality soils.

Staff Finding - The property is well suited to the agricultural and residential uses to which it has been restricted by the V-C Zoning District. The property is also suited to the Conditional Use of mining and excavation provided that appropriate measures are taken to minimize negative impacts on nearby residences. A policy decision for the Commission would be a decision regarding the competing natural resources in the area: high quality agricultural soils and off-river sand reserves.


Figure 3. Eudora Wellhead Protection Zone and FAA Wildlife Mitigation Area.


Figure 4. High Quality Agricultural Soils in the area. Subject property outlined.
IV. LENGTH OF TIME SUBJ ECT PROPERTY HAS REMAI NED VACANT AS ZONED

Staff Finding - The V-C District permits limited development of agricultural, recreational uses or farm residences. The property has been used for farming and 2 farm residences were constructed on the property in the early 1900s. There has been no other development on the subject property.

## V. EXTENT TO WHICH REMOVAL OF RESTRI CTI ONS WILL DETRI MENTALLY AFFECT NEARBY PROPERTY

## Applicant's Response:

"No detriment to nearby properties will occur. This CUP request maintains existing agricultural uses on the land while adding employment and revenue opportunities in northeast Douglas County. The Corps of Engineers regulate the mining activity on the river along with several other governmental agencies which require permits."

The proposed use will produce permanent changes in the area. Agricultural uses will continue as mining occurs by phase; however, eventually all phases will be mined. The reclamation plan shows some areas being returned to farmland, particularly around the residence on the east side of the property and the area in the northwest corner of the subject property adjacent to the Kansas River and the rest being reclaimed as a lake. An access drive installed for an earlier CUP will be utilized and this will have direct access to a paved road.

Sand pits have the possibility to detrimentally affect nearby properties through the following:

- Stockpiles: Overburden, topsoil, and finished products of sand and aggregate will be stockpiled on the area. The placement, height, and maintenance of stockpiles to prevent dust pollution are important considerations to reduce any negative impact. The applicant indicated that overburden would be used primarily to construct the perimeter berms and for reclamation of previously excavated phases. If stockpiling of overburden is proposed on the subject property, the CUP plan should note the maximum height and location. The stockpiles should be kept as far from the existing residences as possible to reduce visual impact.
- Ground water: As mentioned earlier, properties in this area are not served by public water and must rely on well water. The mining will occur above and below the water table. It would be important to study any impact the mining activity could have on the quality of ground water and the quantity available to nearby wells. The applicant provided a study on the impact of the mining activity on groundwater. The study looked at wells which are registered with Division of Water Resources, Kansas Department of Agriculture. It is important to note that some wells in the area were installed prior to the requirement to register. The study was prepared by Carl E. Nuzman, P.E., P.HG, a consulting engineer and hydrogeologist. The following are excerpts taken from the study:
a. The report provided the following information on the quantity of water available for the wells: "A well can decrease in yield due to biological fouling and lack of property maintenance but unless the static water level has a substantial decline reducing the saturated thickness, the yield available from the aquifer remains constant." (Page 5, Nuzman report.)
b. And the following recommendation in relation to the McElwee well: "The C. McE/wee domestic well is up-gradient from the sand pit and down-gradient from the Kansas River. Although the property is about 5 acres in area, it is recommended that the set back of the pit mining be 300 feet from his property line. The radius of influence of the domestic well is less than 300 feet and will not be adversely affected by the sandpit." (page 8, Nuzman report.)
c. Regarding the impact of the sand pit on the quantity of water available for other wells in the area: "Sand pits beneficially support the yield of wells that are down-gradient from a pit that is within the area of influence of a well. "(Page 8, Nuzman report.)
d. "Due to the hydraulic gradient of the valley aquifer system and recharge to the aquifer from rainfall, the aquifer flow to the City wells is from the west-southwest. The Penny sand pit will be a half mile north of the capture zone of the City wells and will have no influence on the Eudora public water supply wells." (page 7, Nuzman report)

The report recommended that a 300 ft setback be maintained between the property boundary of any residence out parcel and the active dredging of sand from the pit and concluded that the proposed sand pit lake that will be developed will have no effect on the McElwee wells, Public Wholesale Water Supply District No. 25 or the City of Eudora's wells or water supply. The applicant provided a revised CUP plan with the 300 ft setback shown.

- River channel: Concern was raised that allowing the pit mining to occur so close to the river could accelerate a change in the river channel, especially during flood events. The river is naturally working to change its channel in this location. Wakefield Dort, a retired KGS professor, examined the channel changes in the Kansas River and Carl McElwee provided an excerpt of one of his publications in his materials. Staff contacted a hydrologist with the USGS (United States Geological Survey) Midwest Division, Kyle E Juracek, for his opinion on the impact of the dredging operation and pit on the river channel. Mr. Juracek indicated that the location of a lake could result in channel change in the event of a flood but pointed out that the river channel may change as a result of a flooding event even without a lake in close proximity. Riprap including large pieces of concrete and smaller infill pieces has been placed on the Kansas River shore to stabilize it since the river dredging operation began.
- Visual impact: To minimize the visual impact on nearby properties, particularly the residential properties that are in close proximity to the mining area, it is necessary to establish welllandscaped buffers and to place limits on the location and height of stockpiled materials. The Operation Plan indicates that excess overburden and topsoil might be sold. To minimize activity near these residences, sales should be by delivery only or occur on the northern area where the scale house is shown on the CUP. The reclamation plan should provide details about the lake which is to be created, showing the approximate boundaries, and shape. Development of a lake that is an attractive natural feature could be a positive impact on the area.
- Traffic: The applicant provided a Traffic Impact Study (TIS) and addendum which are included with this report as Attachment B. The TIS estimated that on a high production day as many as 200 trucks a day could be expected ( 400 truck trips as these would be round trips). The increase in truck traffic that would result from the sand plant expansion would be 20 trucks a day ( 40 trip-ends, 20 in and 20 outbound trips). The applicant's consultant provided an amended TIS which explains that the traffic generation estimated in the original TIS assumed that the river dredging operation and the sandpit operation would be occurring concurrently. The applicant indicated that the primary reason for the expansion of the plant is to switch over the river dredging to off-river pit dredging maintaining its current rate of sand distribution at approximately $1,000(+/-)$ tons on an average day. The TIS indicates that all truck traffic will utilize Noria Road, and will not use N 1500 Road; this should be listed as a condition on the CUP plan. When the sand pit dredging operation replaces the river dredging the estimated number of trucks serving the site will be around 40 trucks per day. The consultant also clarified that the 200 trucks per day estimate was based on a high productivity day, 5000 tons, which may still occur but on a very infrequent basis.

Based on this information, traffic can be assumed to be about 40 trucks a day on an average day and up to 200 trucks a day on a high productivity day.

These documents were provided to the County Engineer for review, and also to the City Engineer as some of the roads used to access the plant lie within the City of Lawrence. The County Engineer recommended the following improvements to nearby roads and intersections to accommodate the increased traffic associated with the sand pit:
a. Realignment of the entrance to the sand facility so that it opposes the Noria Road intersection at N 1500 Road.
b. Pavement of a 100 ft long section of the site access drive just north of N 1500 Road, as recommended in the TIS.
c. Reconstruction of pavement in the Noria Road (E 1750 Road)/N 1500 Road intersection. The existing surfacing is likely a crushed rock base that has been chip sealed. This will not stand up to the increased truck traffic crossing N 1500 Road.
d. Construction of an eastbound right turn lane on Route 442 ( N 1400 Road) at Route 1057 (E 1900 Road). This is mentioned as a desirable improvement in the TIS. Pavement on the existing shoulder at this location is not adequate for the projected amount of truck traffic.

These changes shall be noted as conditions of approval which must be met before the Conditional Use Permit is issued.

- Activity: A sand pit operation includes the removal of overburden with heavy equipment, the dredging of sand, processing and sale of the sand/aggregate products, and reclamation activities. These activities could have an impact on surrounding properties due to lighting or noise. The operation plan indicates that typical hours of operation will be Monday through Friday from 6:30 AM to 6:30 PM. There may be extenuating circumstances which would require operation on Saturdays or for dredging to occur beyond the regular hours of operation due to the nature of the construction business. The operation of the dredge should be low impact as the 4 headlights that are on the dredge provide the only lighting when operating at night and the dredge operates relatively quietly. It should be noted as a condition of approval that no removal, transfer, or placement of overburden which requires heavy equipment would be permitted outside these operating hours. This will serve to keep the higher intensity uses within the regular business hours.

Staff Finding - Potential negative impacts the proposed use could have on nearby properties include the noise and activity associated with the mining, reduced visual appeal created by stockpiles of overburden or topsoil, impacts on well water, and traffic. Conditions should be placed the CUP to minimize potential negative impacts on nearby properties.

## VI. RELATIVE GAIN TO THE PUBLIC HEALTH, SAFETY AND WELFARE BY THE DESTRUCTION OF THE VALUE OF THE PETITIONER'S PROPERTY AS COMPARED TO THE HARDSHI P I MPOSED UPON THE I NDI VI DUAL LANDOWNERS

## Applicant's Response: <br> "No identifiable gain will result by denial of this request; no identifiable hardship will result from its approval."

Evaluation of the relative gain weighs the benefits to the community-at-large vs. the benefit of the owners of the subject property. There are many factors to consider when locating a sand pit, and this location meets the geographic criteria of being outside the FAA $10,000 \mathrm{ft}$ wildlife mitigation area, has good access to the arterial roadway system, and is in a lowly populated area. Denial of the
request for a Conditional Use Permit would affect the individual landowner by prohibiting the use of the property for the off-river sand dredging pit.

Denial of the CUP request may benefit the area property owners by preventing the proposed mining activity and possible negative impacts. Denial may benefit the public by retaining the high quality soils. Denial may also detrimentally affect the public in that it will prohibit production of sand and aggregate materials from a local source. With the recent move away from river dredging, appropriate locations for pit mining must be found.

Staff Finding - Denial of the CUP would result in a hardship to the applicant and public in that it would prohibit the applicant from operating a sand pit to produce sand and aggregate products from local reserves. Denial of the CUP may benefit the public at large by maintaining the high quality soils which are present. To weigh the benefit the denial of the CUP would have on the public, protection of high quality soils, versus the impact it would have, loss of potential sand and aggregate production from a local source, it is necessary to choose between these two natural resources in this location.

## VII. CONFORMANCE WITH THE COMPREHENSI VE PLAN

The subject property is not located within an identified urban growth area. The comprehensive plan recommends that agricultural uses continue to be the predominant land use within the areas of the county beyond the designated urban growth areas. Uses permitted in the rural area should continue to be limited to those which are compatible with agricultural production and uses. The mining activity and the resultant lake would be compatible with agricultural production and uses.

Chapter 16 Policy 2.7 "Encourage the protection of High Quality Agricultural Land in Douglas County for current and future agricultural use." (page 16-15, Horizon 2020)
This policy contains the following 4 steps to encourage the protection of High Quality Agricultural Land:

- Including the protection of High Quality Agricultural Land as a key assumption in the sector planning process.
- Establishing tools to protect High Quality Agricultural Land for farming and make its protection economically feasible for the land owner.
- Maintaining an inventory of High Quality Agricultural Land in Douglas County and track the amount lost to urbanization.
- Encourage and develop policies that support agri- and eco-tourism.


## Chapter 16: Resource Management

"This section encourages the responsible use of marketable natural resources within Douglas County through proper extraction and reclamation methods. They are essential to sustainable development activity, primarily in the form of low cost raw materials, such as sand, gravel, timber, oil, gas, and stone, etc." (page 16-21, Horizon 2020)

The Comprehensive Plan recommends both the encouragement of the protection of High Quality Agricultural Land and the responsible use of marketable natural resources.

Staff Finding - The proposed use is in general conformance with the recommendations in the Comprehensive Plan; however, it is proposing the use of marketable natural resources rather than the protection of High Quality Agricultural Land.

## STAFF REVI EW

As discussed earlier, there are two approved Conditional Use Permits for river dredging in this area, CUP-2-2-79 and CUP-06-04-08. CUP-06-04-08 replaced an expired Conditional Use Permit, CUP-1-391, which had requested both river and pit mining for the area to the west of the subject property (Figure 2). The river dredging request was approved but the pit dredging request was denied. CUP-2-2-79 was approved for the property to the north of the subject property. The processing plant, scale house and stockpiles are currently located on this property. The scale house and stockpiles would remain in this location; however, the processing plant would be located to the east onto the property within the current CUP in later phases of excavation. An easement was dedicated in 1979 for the access drive and this access drive will continue to provide access for the subject property. A copy of this easement shall be provided to the Planning Office for the file.

Most of the neighbor's concerns were addressed in an earlier section of this report dealing with possible negative impacts to surrounding properties; however, another concern was raised regarding the perpetual maintenance of the berms in the future to insure that stormwater runoff does not enter the lake. Staff recommends that an agreement placing the responsibility for the perpetual maintenance of the berms on the property owner should be executed and recorded with the Register of Deeds prior to the release of the CUP permit.

Wetlands are present on the subject property as shown on the CUP plan. The applicant's intention is to either protect the wetlands or mitigate them off-site; however, the decision has not been made at this time. The applicant shall work with the Army Corps of Engineers to determine how the existing wetlands on the property will be treated. Prior to any excavation occurring in the phase adjacent to the phase containing the wetlands, the applicant should provide documentation to the Planning Office indicating the plans for the wetlands, whether they will be maintained on site or if they will be mitigated elsewhere. If the wetlands are to be maintained, the operation plan should be revised to include the protection measures and the revised plan should be submitted to the Planning Office for administrative approval of the wetland setbacks and protection measures.

The applicant indicated that their long term plan for the area is to reclaim the areas to farmland as shown on the reclamation plan and to create a lake for recreational use in the remainder. A note should be added to the reclamation plan which indicates that the lake will be contoured with a more natural shape than the rectangular shape shown on the plan and to note the intended use following reclamation.

The previously approved CUP restricted sand pit access on E 1810 Road to employees and required customers and commercial trucks to use the established access drive. A note to this effect should be included on the CUP plan.

Due to the nature of mining and excavation uses, the approval time frames are typically for 30 years. This allows time for the mining, excavation and reclamation of the land. An extension request may be submitted to the Planning Office for public hearing before the Planning Commission and action by the County Commission. The Zoning and Codes office shall conduct 5 year reviews to insure compliance with the CUP, operation, and reclamation plans.

The applicant explained the mining process will begin with excavation of the overburden in Phase 1 and the dredge will be moved in for removal of sand when possible. A picture of the dredge and the processing plant is included in Figure 5. The mine is to be sequentially reclaimed which means that that earlier phases will be in the reclamation process as later phases are being excavated. The first few phases are planned to be reclaimed as farm land so overburden from later phases will be placed in the area to be reclaimed. Topsoil will then be applied and vegetation planted. As they move
through the phases the overburden will be excavated and placed within the previously created pit. Overburden will also be used to create the perimeter berms which will keep stormwater runoff from surrounding areas from entering the lake. This is an important step is preventing pollution of ground water. There may be some incidental sales of excess overburden or topsoil but this would occur on the property with the scale house. All stockpiling of finished material will occur on the area designated on CUP-2-2-79. A note should be added to the plan that states that the area shown on CUP-2-2-79 with the scale house, processing plant, sediment pond, and stockpile area will also be used to serve the subject property and CUP.


Figure 5a. Picture of processing plant which will remain on the north portion of the property.


Figure 5b. Picture of dredge which will be used for mining operations.

## Public Communications

Public Communications included with this staff report in Attachment A include a letter from adjacent land owner, Carl McElwee, expressing his concerns with the possible impact the proposal may have on the area; a petition signed by neighbors in opposition to the project; a request for deferral from adjacent property owner, Dave Penny, and a letter of opposition to the deferral request from Carl McElwee. The concerns raised in Carl McElwee's letter have been discussed throughout this staff report. Staff does not typically make recommendations when deferrals are requested, but the letters have been provided for the Commission's consideration.

## J oint Hearing

County Resolution No 80-5 established the policy that a joint hearing be held for requests within 3 miles of the incorporated cities in Douglas County so that the County Commission would have the benefit of both Planning Commissions' recommendations. The subject property is approximately 2 miles west of the Eudora City Limits; therefore, a joint meeting is being held between the Lawrence/Douglas-County Metropolitan Planning Commission and the City of Eudora Planning Commission and their recommendations will be forwarded to the Board of County Commissioners.

## Conclusion

Approval of a Conditional Use can be tailored to address specific issues such as intensity or frequency of use, include time limitations, and provide screening requirements. The recommended conditions respond to the specific nature of this request. The sand pit, as conditioned, should be compatible with nearby land uses.

## Lawrence Douglas County Metropolitan Planning Office

6 East 6th Street, P.O. Box 708, Lawrence, KS 66044

Planning Staff:
My name is Carl McElwee and I live at 1564 E. 1850 Rd. I have lived at this location since 1975 (37 years this November). I am writing this letter to object to the Conditional Use Permit (CUP) that Penny Sand Co. has applied for near my house. This CUP asks permission to surround my house on 3 sides with a pit mining operation for sand removal. This would completely change my immediate surroundings which I have enjoyed for so long. If allowed this CUP would subject me and my family to dramatically increased industrial activity, including noise, dust, and environment destruction. This will undoubtedly dramatically affect my property values.

The affected area has some interesting Douglas County history associated with it. It was obtained very early by the Altenbernd family. Penny Sand has acquired much of the land as elder Altenbernds have died. On the land currently owned by Penny and covered under this CUP there exist two historic houses. One is an early stone homestead house and one is a classic two story farm stead that dates to approximately 1910. There is no mention of what will become of these structures in the CUP. I hope they will be preserved and that this CUP will not be allowed to detract from their historic value. My house was also built by an Altenbernd. As best we can tell it was built in about 1919 and is a classic Craftsman Bungalow style. My wife and I have lived here 37 years and raised our two children here. We do not want to see this environment affected by an ugly and destructive sand mining operation.

This will create a huge strip mining operation that will severely impact the local environment. Naturally, I am opposed to the CUP because of the impact on my property. However, I would like to lay out some scientific reasons why this CUP should be denied. I am a retired Geology Professor from KU and have spent a 35 year career there studying groundwater. I have worked extensively at a research site in the Kansas River Valley just northeast of the Lawrence Airport. So I am qualified to comment on the scientific aspects of the situation.

My scientific bases for opposing this CUP are as follows:
(1) The river bank in the vicinity of this proposed pit mining operation is unstable and has moved considerably over recent times, as shown by the work of Dr. Dort of the KU Geology Department. I have included copies of pertinent pages of his work. It shows that this area is unstable and the river is trying to make a straighter course, cutting off the existing meander. If pit mining is allowed in this area, in times of flood the chances of a dramatic river channel change is magnified greatly. An open pit with a small buffer
region from the river in the vicinity of this unstable bend would make it easy for the flooding river to make a sudden change in direction.
(2) On this proposed 434 acre pit mining site, the majority of the area is covered by some of the highest quality soils as defined by the US Department of Agriculture. I have included a USDA Soil Report and some pages from the 1977 Douglas County Soils Survey to support this. It seems very short sighted to produce sand for short term gain and lose the potential for significant food and fiber production indefinitely. You will notice that the USDA report shows this area as being rated as poor for sand production. This is probably because of the large amount of overburden (unusable soil, silt and clay) that must be removed. I have included three well drilling logs that show 23-24 feet of soil, silt and clay exist in the vicinity of my property. Removing this much overburden will create a very environmentally difficult situation. The spoil piles must be dealt with, not allowing runoff into the river. At the same time surface runoff must not be allowed into the pit because of possible pollution of the aquifer. There is great potential for operational missteps to create environmental problems. We have all seen the detrimental effects of strip mining elsewhere; I hope we can avoid them here.
(3) Opening this pit operation will expose one of the most prolific aquifers in this region to potential pollution. The very sand that they desire to excavate is the material that forms this prolific aquifer. I have included a few pages from a Kansas Geological Survey Bulletin by Fader that shows the characteristics of this aquifer. In general, groundwater in the aquifer moves down the valley from West to East. This aquifer is a magnificent resource that must be protected and preserved for the future. It is capable of producing vast amounts of water for irrigation and public water supply. In the future water may be one of our most valued resources. The alluvial material (loose material, soil, silt, clay, sand) in the river valley varies in depth, but about 70 feet is a good average number. The better sand is near the bottom, so the mining will proceed to the bedrock (harder material). The better sand near the bottom is also the main aquifer of the river valley. The overlying soil, silt, and clay protect the aquifer from surface pollutants. By removing this overburden the aquifer is exposed to potential pollution from surface runoff and anything that is spilled into the pit. In particular, my well would be very close to the proposed pit mine and could be affected by the operation, as could several other neighboring house wells. Just down the valley about $15 / 8$ miles lies the Eudora Public Water Supply Well Field (See enclosed map); it could also be affected by the proposed pit mining operation. I do not believe that Penny Sand Co. can guarantee that no pollution will occur. Penny Sand Co will tell us that they will engineer solutions that will prevent any pollution or problems; however, I do not think the risk of a potential engineering failure is appropriate. After the 30 year CUP has finished the pit will remain, who will continue to maintain the site and guarantee aquifer integrity?

Thank you for your consideration. If I may answer any questions, please contact me.
Carl McElwee
1564 E. 1850 Rd.
Lawrence, KS 66046 785-843-4164 cmcelwee@ku.edu

# Ground Water in the Kansas River Valley Junction City to Kansas City, Kansas 

By

Stuart W. Fader





1564 E 1850 Rd Lawrence,Ks. 66046

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1 April 76
SE corner
0-5 black soil
5-23 gray brown clay
23-28 med coarse said
28-38 coarse sad
38-42 green sand
42 gray clay stringer?
$42-50$ green sa
50 hand - (boulders?)
50-66 green sand
66 Sight brown limestme

CarlAcElwee's Sucres
$300^{\prime} \mathrm{N}$ of SE corner
0-4 black soil
4-23 brown clay
23-38 pink-brown same 38-54 green sand 54 crunchy boulders?? 54-65 green sand 65 light brown limeston

## SOIL SURVEY OF

## Douglas County, Kansas



United States Department of Agriculture
Soil Conservation Service
In cooperation with
Kansas Agricultural Experiment Station

Table 2.-Yields per acre of crops and pasture
[All yields were estimated for a high level of management in 1974. Only arable soils are listed]

${ }^{1}$ Animal-unit-month (AUM) is a term used to express the carrying capacity of pasture. It is the amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for a period of 30 days.
${ }^{2}$ This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.
(10)

DOUGLAS COUNTY, KANSAS -


United States Department of Agriculture

Natural
Resources
Conservation
Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

## Custom Soil Resource Report for <br> Douglas County, Kansas

Sand Pit Site



## Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://soils.usda.gov/sqi/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app? agency=nrcs) or your NRCS State Soil Scientist (http://soils.usda.gov/contact/ state_offices/).
Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.
Information about soils is updated periodically. Updated information is available through the NRCS Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the official soil survey information.
The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means
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## How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.
Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the
individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soillandscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.
While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

## Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map (Sand Pit Site)


## MAP LEGEND

| Area of Interest（AOI） |  | $\infty$ | Very Stony Spot |
| :---: | :---: | :---: | :---: |
|  | Area of Interest（AOI） | $\psi$ | Wet Spot |
| Soils |  | － | Other |
|  | Soil Map Units |  |  |
|  |  | Special Line Features |  |
| Special Point Features |  | 之 | Gully |
| ＊） | Blowout |  |  |
| 区 | Borrow Pit | $\cdots$ | Short Steep Slope |
|  |  | － | Other |
| ※ | Clay Spot |  |  |
| － | Closed Depression | Political Features |  |
|  |  | $\bigcirc$ | Cities |
| X | Gravel Pit | Water Features |  |
| $\therefore$ | Gravelly Spot | $\sim$ | Streams and Canals |
| （1） | Landfill | Transportation |  |
| 人 | Lava Flow | ＋＋ | Rails |
| Sasay | Marsh or swamp | N－ | Interstate Highways |
| 人 | Mine or Quarry | $\sim$ | US Routes |
| （\％） | Miscellaneous Water | $\approx$ | Major Roads |
| （9） | Perennial Water | $\sim$ | Local Roads |
| $\checkmark$ | Rock Outcrop |  |  |
| ＋ | Saline Spot |  |  |
| $\because$ | Sandy Spot |  |  |
| $\overline{=}$ | Severely Eroded Spot |  |  |
| $\diamond$ | Sinkhole |  |  |
| 3） | Slide or Slip |  |  |
| $\varnothing$ | Sodic Spot |  |  |
| 三 | Spoil Area |  |  |
| 0 | Stony Spot |  |  |

## MAP INFORMATION

Map Scale： $1: 10,100$ if printed on A size $\left(8.5^{\prime \prime} \times 11^{\prime \prime}\right)$ sheet．
The soil surveys that comprise your AOI were mapped at 1：24，000．

Warning：Soil Map may not be valid at this scale．
Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement．The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale．

Please rely on the bar scale on each map sheet for accurate map measurements．

Source of Map：Natural Resources Conservation Service Web Soil Survey URL：http：／／websoilsurvey．nrcs．usda．gov Coordinate System：UTM Zone 15N NAD83

This product is generated from the USDA－NRCS certified data as of the version date（s）listed below．

Soil Survey Area：Douglas County，Kansas Survey Area Data：Version 8，Nov 30， 2010

Date（s）aerial images were photographed：6／15／2006
The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps．As a result，some minor shifting of map unit boundaries may be evident．

# Map Unit Legend (Sand Pit Site) 

| Douglas County, Kansas (KS045) |  |  |  |
| :--- | :--- | ---: | ---: |
| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
| 7035 | Eudora-Bismarckgrove fine sandy loams, overwash, <br> occasionally flooded | 61.6 | $16.5 \%$ |
| 7089 | Stonehouse-Eudora fine sandy loams, overwash, <br> occasionally flooded | 12.1 | $3.2 \%$ |
| 7123 | Eudora silt loam, rarely flooded | 48.9 | $13.1 \%$ |
| 7127 | Eudora-Kimo complex, overwash, rarely flooded | 240.6 | $64.5 \%$ |
| 9995 | Sand Pits | 10.0 | $2.7 \%$ |
| Totals for Area of Interest | $\mathbf{3 7 3 . 1}$ | $\mathbf{1 0 0 . 0 \%}$ |  |

## Map Unit Descriptions (Sand Pit Site)

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.
A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.
Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.
The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic
classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a soil series. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into soil phases. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A complex consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.
An association is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. AlphaBeta association, 0 to 2 percent slopes, is an example.

An undifferentiated group is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.
Some surveys include miscellaneous areas. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

## Douglas County, Kansas

## 7035-Eudora-Bismarckgrove fine sandy loams, overwash, occasionally flooded

## Map Unit Setting

Elevation: 750 to 980 feet
Mean annual precipitation: 31 to 47 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 175 to 215 days

## Map Unit Composition

Eudora and similar soils: 55 percent
Bismarckgrove and similar soils: 25 percent
Minor components: 0 percent

## Description of Eudora

## Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Coarse-silty alluvium

## Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
( 0.60 to $2.00 \mathrm{in} / \mathrm{hr}$ )
Depth to water table: More than 80 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Available water capacity: High (about 11.1 inches)
Interpretive groups
Land capability (nonirrigated): 2w
Ecological site: Loamy Lowland (PE 30-37) (R106XY013KS)

## Typical profile

0 to 7 inches: Fine sandy loam
7 to 14 inches: Silt loam
14 to 40 inches: Silt loam
40 to 48 inches: Silt loam
48 to 80 inches: Very fine sandy loam

## Description of Bismarckgrove

Setting
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty alluvium

## Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high ( 0.20 to $0.60 \mathrm{in} / \mathrm{hr}$ )
Depth to water table: More than 80 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Available water capacity: High (about 10.6 inches)
Interpretive groups
Land capability (nonirrigated): 2 w
Ecological site: Loamy Lowland (PE 30-37) (R106XY013KS)

## Typical profile

0 to 6 inches: Fine sandy loam
6 to 14 inches: Silty clay loam
14 to 19 inches: Silty clay loam
19 to 29 inches: Silt loam
29 to 44 inches: Silt loam
44 to 80 inches: Stratified loamy fine sand to fine sandy loam

## Minor Components

## Aquolls

Percent of map unit: 0 percent
Landform: Depressions, drainageways, hillslopes
Down-slope shape: Concave
Across-slope shape: Concave

## 7089—Stonehouse-Eudora fine sandy loams, overwash, occasionally flooded

## Map Unit Setting

Elevation: 750 to 980 feet
Mean annual precipitation: 31 to 47 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 175 to 215 days

## Map Unit Composition

Stonehouse and similar soils: 50 percent
Eudora and similar soils: 30 percent
Minor components: 0 percent

## Description of Stonehouse

## Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium

## Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to $5.95 \mathrm{in} / \mathrm{hr}$ )
Depth to water table: More than 80 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Available water capacity: Low (about 5.4 inches)

## Interpretive groups

Land capability (nonirrigated): 4s
Ecological site: Sandy Lowland (PE 30-37) (R106XY023KS)

## Typical profile

0 to 9 inches: Fine sandy loam
9 to 23 inches: Loamy fine sand
23 to 31 inches: Stratified loamy sand
31 to 45 inches: Stratified fine sand
45 to 71 inches: Stratified sandy loam
71 to 80 inches: Stratified loamy fine sand

## Description of Eudora

## Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Coarse-silty alluvium

## Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high ( 0.60 to $2.00 \mathrm{in} / \mathrm{hr}$ )
Depth to water table: More than 80 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Available water capacity: High (about 11.1 inches)

## Interpretive groups

Land capability (nonirrigated): 2w
Ecological site: Loamy Lowland (PE 30-37) (R106XY013KS)

## Typical profile

0 to 7 inches: Fine sandy loam
7 to 14 inches: Silt loam
14 to 40 inches: Silt loam
40 to 48 inches: Silt loam
48 to 80 inches: Very fine sandy loam

## Minor Components

## Aquolls

Percent of map unit: 0 percent
Landform: Depressions, drainageways
Down-slope shape: Concave
Across-slope shape: Concave

## 7123—Eudora silt loam, rarely flooded

## Map Unit Setting

Elevation: 800 to 1,050 feet
Mean annual precipitation: 31 to 47 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 175 to 215 days

## Map Unit Composition

Eudora and similar soils: 85 percent
Minor components: 0 percent

## Description of Eudora

## Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Coarse-silty alluvium

## Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
( 0.60 to $2.00 \mathrm{in} / \mathrm{hr}$ )
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Available water capacity: High (about 11.8 inches)

## Interpretive groups

Land capability (nonirrigated): 1
Ecological site: Loamy Lowland (PE 30-37) (R106XY013KS)

## Typical profile

0 to 7 inches: Silt loam
7 to 14 inches: Silt loam
14 to 40 inches: Silt loam
40 to 48 inches: Silt loam
48 to 80 inches: Very fine sandy loam

## Minor Components

## Aquolls, ponded

Percent of map unit: 0 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave

## Aquolls

Percent of map unit: 0 percent
Landform: Depressions, drainageways, hillslopes
Down-slope shape: Concave
Across-slope shape: Concave

## 7127-Eudora-Kimo complex, overwash, rarely flooded

## Map Unit Setting

Elevation: 400 to 1,200 feet
Mean annual precipitation: 31 to 47 inches
Mean annual air temperature: 52 to 59 degrees $F$
Frost-free period: 175 to 215 days

## Map Unit Composition

Eudora and similar soils: 60 percent
Kimo and similar soils: 30 percent
Minor components: 5 percent

## Description of Eudora

## Setting

Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Coarse-silty alluvium

## Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high ( 0.60 to $2.00 \mathrm{in} / \mathrm{hr}$ )
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water capacity: Very high (about 12.2 inches)
Interpretive groups
Land capability (nonirrigated): 2w
Ecological site: Loamy Lowland (PE 30-37) (R106XY013KS)

## Typical profile

0 to 12 inches: Silt loam
12 to 72 inches: Silt loam

## Description of Kimo

## Setting

Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey over loamy alluvium

## Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high ( 0.06 to $0.20 \mathrm{in} / \mathrm{hr}$ )
Depth to water table: About 22 to 26 inches
Frequency of flooding: Rare
Frequency of ponding: Occasional
Available water capacity: High (about 11.4 inches)
Interpretive groups
Land capability (nonirrigated): 2w
Ecological site: Loamy Lowland (PE 30-37) (R106XY013KS)

## Typical profile

0 to 6 inches: Silty clay loam
6 to 28 inches: Silty clay
28 to 60 inches: Silt loam

## Minor Components

Wabash
Percent of map unit: 5 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Other vegetative classification: CLAY LOWLAND (PE30-37) (106XY004KS_1)

## 9995—Sand Pits

Map Unit Setting
Mean annual precipitation: 31 to 47 inches
Frost-free period: 175 to 215 days
Map Unit Composition
Pits, sand: 100 percent

## Soil Information for All Uses

## Soil Reports

The Soil Reports section includes various formatted tabular and narrative reports (tables) containing data for each selected soil map unit and each component of each unit. No aggregation of data has occurred as is done in reports in the Soil Properties and Qualities and Suitabilities and Limitations sections.

The reports contain soil interpretive information as well as basic soil properties and qualities. A description of each report (table) is included.

## Construction Materials

This folder contains a collection of tabular reports that present soil interpretations related to sources of construction materials. The reports (tables) include all selected map units and components for each map unit, limiting features and interpretive ratings. Construction materials interpretations are tools designed to provide guidance to users in selecting a site for potential source of various materials. Individual soils or groups of soils may be selected as a potential source because they are close at hand, are the only source available, or they meets some or all of the physical or chemical properties required for the intended application. Example interpretations include roadfill, sand and gravel, topsoil and reclamation material.

## Source of Sand and Gravel (Sand Pit Site)

This table gives information about the soils as potential sources of gravel and sand. Normal compaction, minor processing, and other standard construction practices are assumed.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. Only the likelihood of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material. The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the Unified classification of the soil), the thickness of suitable material, and the content of rock fragments. If the bottom layer of the soil contains sand or gravel, the soil is considered a likely source regardless of thickness. The assumption is that the sand or gravel layer below the depth of observation exceeds the minimum thickness. The ratings are for the whole soil, from the surface to a depth of about 6 feet.

The soils are rated good, fair, or poor as potential sources of sand and gravel. A rating of good or fair means that the source material is likely to be in or below the soil. The bottom layer and the thickest layer of the soils are assigned numerical ratings. These ratings indicate the likelihood that the layer is a source of sand or gravel. The number 0.00 indicates that the layer is a poor source. The number 1.00 indicates that the layer is a good source. A number between 0.00 and 1.00 indicates the degree to which the layer is a likely source.

Information in this table is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil between the surface and a depth of 5 to 7 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.
The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.
Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this table. Local ordinances and regulations should be considered in planning, in site selection, and in design.

## Report-Source of Sand and Gravel (Sand Pit Site)

[Onsite investigation may be needed to validate the interpretations in this table and to confirm the identity of the soil on a given site. The numbers in the value columns range from 0.00 to 0.99 . The larger the value, the greater the likelihood that the bottom layer or thickest layer of the soil is a source of sand or gravel]

| Source of Sand and Gravel- Douglas County, Kansas |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Map symbol and soil name | Pct. of map unit | Potential as a source of gravel |  | Potential as a source of sand |  |
|  |  | Rating class and limiting features | Value | Rating class and limiting features | Value |
| 7035-Eudora-Bismarckgrove fine sandy loams, overwash, occasionally flooded |  |  |  |  |  |
| Eudora | 55 | Poor |  | Poor |  |
|  |  | Bottom layer | 0.00 | Bottom layer | 0.00 |
|  |  | Thickest layer | 0.00 | Thickest layer | 0.00 |
| Bismarckgrove | 25 | Poor |  | Poor |  |
|  |  | Bottom layer | 0.00 | Bottom layer | 0.00 |
|  |  | Thickest layer | 0.00 | Thickest layer | 0.00 |


| Source of Sand and Gravel- Douglas County, Kansas |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Map symbol and soil name | Pct. of map unit | Potential as a source of gravel |  | Potential as a source of sand |  |
|  |  | Rating class and limiting features | Value | Rating class and limiting features | Value |
| 7089-Stonehouse-Eudora fine sandy loams, overwash, occasionally flooded |  |  |  |  |  |
| Stonehouse | 50 | Poor |  | Fair |  |
|  |  | Bottom layer | 0.00 | Thickest layer | 0.03 |
|  |  | Thickest layer | 0.00 | Bottom layer | 0.13 |
| Eudora | 30 | Poor |  | Poor |  |
|  |  | Bottom layer | 0.00 | Bottom layer | 0.00 |
|  |  | Thickest layer | 0.00 | Thickest layer | 0.00 |
| 7123-Eudora silt loam, rarely flooded |  |  |  |  |  |
| Eudora | 85 | Poor |  | Poor |  |
|  |  | Bottom layer | 0.00 | Bottom layer | 0.00 |
|  |  | Thickest layer | 0.00 | Thickest layer | 0.00 |
| 7127-Eudora-Kimo complex, overwash, rarely flooded |  |  |  |  |  |
| Eudora | 60 | Poor |  | Poor |  |
|  |  | Bottom layer | 0.00 | Bottom layer | 0.00 |
|  |  | Thickest layer | 0.00 | Thickest layer | 0.00 |
| Kimo | 30 | Poor |  | Poor |  |
|  |  | Bottom layer | 0.00 | Bottom layer | 0.00 |
|  |  | Thickest layer | 0.00 | Thickest layer | 0.00 |
| 9995-Sand Pits |  |  |  |  |  |
| Pits, sand | 100 | Not rated |  | Not rated |  |

## Source of Sand and Gravel (Sand Pit Site)

This table gives information about the soils as potential sources of gravel and sand. Normal compaction, minor processing, and other standard construction practices are assumed.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. Only the likelihood of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material. The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the Unified classification of the soil), the thickness of suitable material, and the content of rock fragments. If the bottom layer of the soil contains sand or gravel, the soil is considered a likely source regardless of thickness. The assumption is that the sand or gravel layer below the depth of observation exceeds the minimum thickness. The ratings are for the whole soil, from the surface to a depth of about 6 feet.

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# HISTORICAL CHANNEL CHANGES OF THE KANSAS RIVER 

## AND ITS MAJOR TRIBUTARIES

## WAKEFIELD DORT, JR.





## Lawrence Douglas County Metropolitan Planning Office

6 East 6th Street, P.O. Box 708, Lawrence, KS 66044

Planning Staff:
As interested property owners, we are writing this letter to object to the Conditional Use Permit (CUP) that Penny Sand Co. has applied for near 1500N and 1850E. This CUP asks permission for a pit mining operation for sand removal. This would completely change the agricultural setting of the area. If allowed, this CUP would subject the area to dramatically increased industrial activity, including noise, dust, and environment destruction. We ask that you deny the CUP for the following reasons:
(1)The affected area has some interesting Douglas County history associated with it and contains some historic houses.
(2) The river bank in the vicinity of this proposed pit mining operation is unstable and has moved considerably over recent times. If pit mining is allowed in this area, in times of flood the chances of a dramatic river channel change is magnified greatly.
(3) On this proposed 434 acre pit mining site, the majority of the area is covered by some of the highest quality soils as defined by the US Department of Agriculture. It seems very short sighted to produce sand for short term gain and lose the potential for significant food and fiber production indefinitely.
(4)There is a large amount of overburden (unusable soil, silt and clay) that must be removed (typically 23-24 feet). Removing this much overburden will create an environmental nightmare
(5) Opening this pit operation will expose one of the most prolific aquifers in this region to potential pollution. This aquifer is a magnificent resource that must be protected and preserved for the future.
(6)Several neighboring house wells could be affected by this pit. Just down the valley about $15 / 8$ miles lies the Eudora Public Water Supply Well Field; it could also be affected by the proposed pit mining operation.

Thank you for your consideration of our concerns.

Penny Sand Pit Petition


Penny Sand Pit Petition


# The Master's Dredging Company, Inc. 

## Dredging Contractors

P.O. Box 9, Lawrence, KS 66044
(913) 583-3335

September 12, 2012

Mr. Bruce Liese<br>Chairman, Lawrence-Douglas County Planning Commission 6 East 6 ${ }^{\text {th }}$ Street<br>Lawrence, Kansas 66044

Dear Mr. Liese,


We have a CUP for a sand plant operation approved in 1991 on land about 1.5 mitesnortheast of the intersection of Noria Road and North 1500 Road. At the time of the 1991 approval of our CUP we had applied for both a Kansas River operation and a sand pit operation on the land where our sand plant was located. At the time, the zoning board did not feel that there was a need for both operations and gave me a choice between the two. I choose the river operation. Under a sand plant lease arrangement, Pennys Concrete has been producing sand from our river permit for over 17 years.

With a pending Corps of Engineer decision to halt both ours and Pennys' river permits, Pennys Concrete (1) terminated their lease agreement with us and (2) applied for zoning of an off-river sand pit operation. In light of this we are renewing our CUP zoning application for an off-river sand pit on land immediately adjacent to the Pennys Concrete's application for a CUP permit for off river sand pit operation. We are presently applying for a CUP for an off-river sand pit operation.

In light of the fact that Pennys Concrete and we have nearly identical CUP applications on adjacent lands, I would like to request that the zoning board defer consideration of Pennys Concrete's application and that the zoning board would consider both Pennys' and our CUP applications concurrently. I would appreciate your passing on this request to the rest of your zoning board, the planning staff, and county commissioners. If you have any questions, feel free to email me at ( davidpenny@theaquaticgroup.com ) or call me: 913-583-3335 (office, but please do not leave a message) or 785-218-8800 (cell, leave a message if you do not get me).


## Lawrence Douglas County

Metropolitan Planning Office
6 East 6th Street,
P.O. Box 708,

Lawrence, KS 66044
Planning Commission:
I would like to object to the request in David Penny's letter from The Masters Dredging Company, Inc. to defer consideration of the Penny Sand CUP from the Sept. 24 meeting. I and other land owners have worked to prepare for that meeting and would like to see our concerns addressed in a timely manner.

I have a long scheduled previous commitment Oct 15-25 and will be out of town. I ask the Planning Commission to please not schedule any meetings on this issue during my absence.

Thank you for your consideration. If I may answer any questions, please contact me.

Sincerely,


Carl McElwee
1564 E. 1850 Rd.
Lawrence, KS 66046 785-843-4164 cmcelwee@ku.edu


## Traffic Impact Study

## for

## Penny Sand Plant Expansion

1-1/2 mile Northeast of the Intersection of Noria Road and N 1500 Road

Douglas County, Kansas

Prepared for
Landplan Engineering, PA

> Prepared
> By

## $\overrightarrow{\square I F}=$ MGineering Solutions

Serving Communities Through Excellence
Kansas - Missouri - Michigan - California


Mehrdad Givechi, PE, PTOE July 2012

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## Introduction

## Proposed Development

The existing "Penny Sand Extraction" facility - located next to Kansas River approximately 1-1/2 miles northeast of the intersection of Noria Road (E 1750 Rd.) and N 1500 Road in Douglas County, Kansas - comprises approximately 114 acres. Under the proposed plan, the site will be expanded to include an additional sand excavation area of approximately 351 acres for a total site area of approximately 465 acres (See Location Map, Figure 1 of Appendix I). Access to the site, as shown on the Site Plan (Figure 2 of Appendix I), will remain unchanged at its current location at the intersection of Noria Road and N 1500 Road (i.e. north leg of the intersection).

The facility will be open for operation on weekdays and some Saturdays (approximately 250 days a year) between the hours of 6:30 a.m. and 6:30 p.m., staffed by as many as four (4) employees.

According to the Horizon 2020 (Map 4-2), the site is FEMA designated "Floodway" and "Floodway Fringe".

## Existing Nearby Developments

Currently, the vast majority of the land in the proximity of the site is undeveloped with the exception of

- "East Hills Business Park" located on the west side of Noria Road approximately $2 / 3$ miles south of N 1500 Road; and
- A few scattered residential dwelling units in the study area.


## Purpose

The purpose of this study is to:

1. Evaluate the existing operating conditions of traffic along the anticipated route that site-generated trucks will utilize to access the site including the intersections of
a. Noria Road and N 1500 Road;
b. Noria Road and DG CO 442 (Old K-10);
c. DG CO 442 (Old K-10) and DG CO 1057 (E 1900 Rd); and

## d. The interchange of K-10 and DG CO 1057 (E 1900 Rd).

2. Assess impact of the trips generated by the proposed expansion of the sand facility on the above mentioned intersections and roadway network; and
3. Recommend off-site improvements needed (if any) as the result of this expansion.

## Data Collection and Summary

In order to assess the impact of traffic generated by the expansion of the existing sand facility in the study area, field observations and traffic counts (including truck traffic) were conducted. The following paragraphs summarize the results of data collection efforts for this project.

## Roadway Network Geometric \& Operating Characteristics

In the vicinity of the development site, as illustrated in Figure 3 of Appendix I,

- N. 1500 Road is a two-way, two lane roadway that runs east/west approximately 1.4 miles south of the development site. This roadway extends west and becomes $15^{\text {th }}$ Street at approximately $1-3 / 4$ miles west of Noria Road as it enters the city limits of Lawrence. Some of the other roadway characteristics for N 1500 Road include:
o Asphalt pavement with uneven surface west of E 1810 Road turning into gravel road east of there.
o No shoulders.
o An active railroad crossing (with gate and signal) approximately 1.3 miles west of Noria Road (just west of E 1625 Road).
o Posted speed limit of 40 mph , changing to 30 mph west of E 1625 Road where railroad crossing is located.
o Posted weight limit sign of "5 Tons" for commercial vehicles for both directions of travel.
o East of Noria Road, it is designated as "Rural Minor Collector" on the County's T2030 Major Thoroughfare Map. This designation changes to "Minor Arterial" for the segment west of Noria Road.
o West of Noria Road, it serves as a commuter route between Lawrence and both, Eudora and "East Hills Business Park".
- Noria Road (E. 1750 Road) is a two-way, two lane roadway that runs north/south along east side of "East Hills Business Park" connecting N 1500 Road to DG CO 442 (Old K-10) and K-10 Highway. Some of the other characteristics of this roadway include:
o An active railroad crossing (with gate and signal) approximately $1 / 2$ mile south of Noria Road.
o Concrete pavement with 6' paved shoulders north of the railroad track. Asphalt pavement with 4' shoulders south of the railroad track.
o Posted speed limit of 45 mph between Noria Road and DG CO 442 (old K10), with an advisory speed limit sign of 35 mph along the curve south of DG CO 442.
o Designated as "Minor Arterial" on the County's T2030 Major Thoroughfare Map.
o It serves as a commuter route between Lawrence and both Eudora and "east Hills Business Park".
- DG CO 442 (Old K-10) is a two-way, two lane roadway that runs east/west approximately 1 mile south of Noria Road and goes through city of Eudora to the east. Other roadway characteristics include:
o Asphalt pavement with uneven surface and unpaved 4'-6' shoulders.
o Posted speed limit of 45 mph within the city limits (near Noria Road), changing to 55 mph in the county (west of Eudora).
o Between Noria Road and Eudora, it is designated as "Minor Arterial" on the County's T2030 Major Thoroughfare Map.
o West of Eudora, this roadway serves as a commuter route between Eudora and both, Lawrence and "East Hills Business Park".
- DG CO 1057 is a two-way, two lane roadway running north/south crossing DG CO 442 at approximately 1.5 miles east of Noria Road providing a main connection to K-10 Highway. Other roadway characteristics include:
o Asphalt pavement with unpaved 2'-4' shoulders.
o Posted speed limit of 45 mph .
o Designated as "Minor Arterial" on the County's T2030 Major Thoroughfare Map.
- All intersections in the study area have one lane on each approach except for the:
o Intersection of DG CO 1057 and DG CO 442, which has a dedicated northbound right-turn lane with approximately 175' of storage and a dedicated westbound left-turn lane with approximately 110' of storage; and o Intersection of Noria Road and DG CO 442, which has a dedicated westbound right-turn lane with 175' of storage; and a channelized northbound right turnout.


## Manual Traffic Counts

Currently, the "East Hills Business Park" is the main trip generator in the study area and will most likely dictate the time periods during which traffic on the adjacent roadway network reaches its peak. As part of this study, therefore, vehicular turning movement counts (including truck traffic) were conducted at the intersections under study during the time periods when shift changes for the "East Hills Business Park" occur.

Currently the shifts change at 6:30, 7:00 and 7:30 in the morning and 2:30, 3:00 and 3:30 in the afternoon. Therefore, for the purpose of this analysis, turning movement counts were conducted from 6:00 to 9:00 a.m. and 2:00 to 5:00 p.m. on typical weekdays (July $11^{\text {th }}, 12^{\text {th }}$ and $17^{\text {th }}, 2012$ ). The results, as summarized in Appendix III and illustrated in Figures 4 and 5 of Appendix I, indicate that

- Morning peak occurs between 7:30 and 8:30 a.m. for all vehicles including truck traffic; and
- Afternoon peak occurs between 4:00 and 5:00 p.m. for all vehicles, and between 3:00 and 4:00 p.m. for truck traffic.
- At the intersection of Noria Road and N 1500 Road, the predominant movements are eastbound right-turn and northbound left-turn with no truck traffic on N 1500 Road.
- At the intersection of Noria Road and DG CO 442, the predominant movements are southbound left-turn and westbound right-turn. The predominant truck movements,
however, are northbound through ( $31 \%$ to $46 \%$ ) and southbound left-turn ( $7 \%$ to $16 \%)$.
- At the intersection of DG CO 442 and DG CO 1057, the predominant movements are eastbound and westbound through. The predominant truck movements, however, are eastbound right-turn (19\% to $31 \%$ ) and northbound right-turn (unusually high at $27 \%$ to $60 \%$ ).
- At the interchange of K-10 and DG CO 1057, the predominant movements are southbound right-turn (at the north ramps) and eastbound left-turn (at the south ramps). The predominant truck movements, however, are southbound left-turn ( $20 \%$ to $32 \%$ ) and eastbound left-turn (unusually high at $25 \%$ to $34 \%$ ), both at the south ramps.
- Field observations indicate that loaded trucks, leaving the existing sand plant, take Noria Road south to DG CO 442 (Old K-10), then east to DG CO 1057, then south to K-10 interchange, then east to their destinations. After their delivery, the trucks head back to the sand plant using K-10 Highway, then north on Noria Road straight to the plant entrance off of N 1500 Road.


## NOTES:

1. During the time period traffic counts were being conducted for this study, there was a paving project near Eudora that generated a large number of truck traffic. Loaded trucks, carrying asphalt material, got to the job site from west using K-10 Highway to access DG CO 1057 at the interchange, then head north to DG CO 442 (Old K-10), then east to Eudora. Empty trucks left the job site using Church Street south to K-10 Highway, then west to the asphalt plant. This construction activity resulted in an skew in the normal truck traffic pattern in the study area, which caused the heavy truck movement for the eastbound left-turn movement at the interchange and northbound right-turn movement at the intersection of DG Co 1057 and DG CO 442.
2. DG CO 1057, approximately $1 / 2$ mile south of the $K$ - 10 interchange, has been closed to traffic for a bridge replacement project. This also affected the through traffic on DG CO 1057 south of the interchange.

## Evaluation of the Existing Operating Conditions

A volume/capacity analysis (using methodologies outlined in the 2000 Highway Capacity Manual (HCM) published by the Transportation Research Board) was conducted to determine the level-of-service (LOS) for all movements at the intersections under study during the afternoon peak-hour of a typical weekday.

Level-of-service, as defined in the HCM, describes the quality of traffic operating condition and ranges from " $A$ " to " $F$ ", with LOS "A" representing the best (most desirable with minimum delay) conditions and LOS "F" the worst (severely congested with excessive delays). The following chart outlines the level-of-service criteria for unsignalized and signalized intersections.

| Level-Of-Service | Control Delay for <br> Unsignalized Intersections <br> (seconds/vehicle) | Control Delay for <br> Signalized Intersections <br> (seconds/vehicle) |
| :---: | :---: | :---: |
| A | $0-10$ | $0-10$ |
| B | $>10-15$ | $>10-20$ |
| C | $>15-25$ | $>20-35$ |
| D | $>25-35$ | $>35-55$ |
| E | $>35-50$ | $>55-80$ |
| F | $>50$ | $>80$ |

The results of analysis, as shown in Appendix II and summarized in Figure 6 of Appendix I, indicate that, under the existing conditions, all movements at all intersections in the study area operate at LOS "B" or higher during both morning and afternoon peak-hours of a typical weekday.

## Trip Generation Analysis

Typically, trips generated by a proposed development are estimated using trip generation rates suggested by the Institute of Transportation Engineers, Trip Generation Manual, $8^{\text {th }}$ Edition. Since the Manual does not have information for land use type "Sand Plant", the following procedure was used for analysis:

- For the sand processing component of this development, the number of trucks generated by this site was estimated based on the following assumptions:
o With the proposed new expansion, the plant is anticipated to distribute as much as 5,000 tons of sand on a most productive day.
o $80 \%$ of trucks serving the site will be Tractor Trailers each with a maximum load capacity of $25-30$ tons. The remaining $20 \%$ will be tandem trucks each hauling between 15 and 18 tons. This is equivalent to an average truck load of approximately 25 tons.
o Assuming a high productive day (5,000 tons of distribution), the estimated number of trucks serving the site will be around 200 trucks/day, which equates to a total of 400 trip-ends (two-way trips) per day.
o Hauling time varies for different plants. Truckers going to the same plant have different lap times. The only time that trucks tend to arrive somewhat simultaneously is first thing in the morning when a plant opens. Their departure from the plant, however, is not simultaneous due to individual loading times. Other times throughout the day, truck traffic to/from the plant is spread out randomly over the 12-hours of operation (6:30 a.m. to 6:30 p.m.). For analysis purposes, it is assumed that peakhour truck traffic will be approximately $12 \%$ of the daily truck traffic, which is approximately 48 trip-ends ( 24 inbound and 24 outbound) during the morning peak-hour of operation.
o To account for the existing traffic in/out of the site (i.e. current operation of the sand plant), a truck count survey was conducted during the time period when turning movement counts were being conducted. The results, as summarized in Figure 5 of Appendix I, indicate that the existing sand processing facility generates 8 trip-ends ( 4 inbound and 4 outbound)
during the morning peak-hour, and 9 trip-ends (5 inbound and 4 outbound) during the afternoon peak-hour.
- For the office component of this development, no increase in number of employees are anticipated, hence no additional trips will be generated by the office component.

Using above mentioned assumptions, the net increase in number of trips resulted by the proposed sand plant expansion will be approximately 40 trip-ends ( 20 inbound and 20 outbound) during both morning and afternoon peak-hours of a typical weekday - all truck traffic.

## Analysis Time Period

An overview of the existing traffic volumes in the study area and their peak characteristics, in conjunction with estimated trips generated from the proposed development, indicate that the most critical peak period will likely occur during morning peak-hour of a typical weekday. Therefore, the morning peak-hour is selected as the analysis time period for this study. In addition, afternoon peak-hour is also analyzed.

## Trip Distribution and Assignment Analysis

As mentioned earlier, field observations indicate that all truck traffic generated by the existing sand operation head south on Noria Road, thence east on DG CO 442, thence south on DG CO 1057 to access K-10 Highway and head east. Based on the information provided by the applicant, the vast majority of the new trips generated by the site expansion will also follow the same patterns. Figures 7 and 8 of Appendix I illustrate trip distribution patterns and assignment for the site-generated trips, respectively. Note that a small portion of the trips ( $\sim 5 \%$ ) are assigned to go west on K-10 (at the interchange) to represent occasional trips to the west.

## Impact Assessment

## Volume/Capacity Analysis

An evaluation of the "Existing + Proposed Development" traffic conditions (using HCS2000 methodology mentioned earlier) indicates that LOS for all movements at all intersections under study remain unchanged at " B " or higher during both morning and afternoon peakhours of a typical weekday. The results, as shown in Appendix II and illustrated in Figures 9 and 10 of Appendix I, indicate that traffic generated from the proposed facility expansion will not have a negative impact on the capacity of the roadway networks in the study area.

## Dedicated Turn-Lane Analysis

Using the guidelines for both right-turn and left-turn treatments at unsignalized intersections (as listed in Appendix IV) indicate that, from traffic volume stand point, no new dedicated turn lanes are required at any intersections in the study area.

Under the existing conditions, during the critical analysis period (morning peak-hour of a typical weekday), approximately $17 \%$ of the eastbound traffic at the intersection of DG CO 442 and DG CO 1057 consists of heavy trucks - all of which negotiate right turn at this location. The proposed expansion for the sand plant will significantly increase the heavy truck traffic for this movement to as high as $\sim 42 \%$ of the total eastbound movement. Because of their low power/acceleration ratio, not having a dedicated eastbound right-turn lane may interfere with the through traffic creating a safety concern. It is, therefore, desirable (as a safety measure) that a dedicated eastbound right-turn lane be provided at this location to keep the large number of heavy trucks out of the main traffic flow on DG CO 442.

## Summary \& Recommendations

The results of this impact analysis indicate that the proposed "Penny Sand Plant Expansion" will have minimal impact on the capacity of the roadway network in the study area with no degradation of level-of-service at any locations under study (LOS of "B" or higher).

From safety stand point, however, the following improvements are desirable:

1. Pave a 100 ' long section of the site access, just north of $N 1500$ Road, to keep gravel from being tracked, by site-generated trucks, onto the intersection.
2. Provide a dedicated eastbound right-turn lane on DG CO 442 (Old K-10) at its intersection with DG CO 1057 (E 1900 Rd). The minimum storage length for this turn lane should be 150' in order to accommodate two (2) tractor trailer and two passenger cars. This is a desirable safety measure to keep loaded heavy trucks (having low power/acceleration ratio) out of the main traffic flow. Under the existing conditions, there is a 12' wide paved area for a length of approximately 140 ' that is not marked as a traffic lane rather has white crosshatch pavement marking along its entire length. This area can potentially be utilized to create the subject right-turn lane.
3. Pavement condition along certain segments of the roadway network in the study area should be evaluated to determine if it can withstand the increase in heavy truck traffic resulted by the proposed sand plant expansion.

## APPENDIX I

Results of Trip Distribution and Assignment Analysis


- Intersections under study

Figure 1
Location Map










## APPENDIX II

Results of Highway Capacity Analysis
Using

## Synchro 7 Software

## EXISTING CONDITIONS






|  | 4 |  |  | 1 |  |  | 4 | $\uparrow$ |  |  | $\downarrow$ | $\checkmark$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations |  | $\uparrow$ |  | \% | $\uparrow$ |  |  | $\uparrow$ | 「 |  | \$ |  |
| Volume (veh/h) | 0 | 20 | 26 | 57 | 93 | 0 | 11 | 1 | 15 | 0 | 0 | 0 |
| Sign Control |  | Free |  |  | Free |  |  | Stop |  |  | Stop |  |
| Grade |  | 0\% |  |  | 0\% |  |  | 0\% |  |  | 0\% |  |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 22 | 28 | 62 | 101 | 0 | 12 | 1 | 16 | 0 | 0 | 0 |
| Pedestrians |  |  |  |  |  |  |  |  |  |  |  |  |
| Lane Width (tt) |  |  |  |  |  |  |  |  |  |  |  |  |
| Walking Speed (tt/s) |  |  |  |  |  |  |  |  |  |  |  |  |
| Percent Blockage |  |  |  |  |  |  |  |  |  |  |  |  |
| Right turn flare (veh) |  |  |  |  |  |  |  |  | 7 |  |  |  |
| Median type |  | None |  |  | None |  |  |  |  |  |  |  |
| Median storage veh) |  |  |  |  |  |  |  |  |  |  |  |  |
| Upstream signal (tt) |  |  |  |  |  |  |  |  |  |  |  |  |
| pX, platoon unblocked |  |  |  |  |  |  |  |  |  |  |  |  |
| VC , conflicting volume | 101 |  |  | 50 |  |  | 261 | 261 | 36 | 270 | 275 | 101 |
| $\mathrm{vC1}$, stage 1 conf vol |  |  |  |  |  |  |  |  |  |  |  |  |
| $\mathrm{vC2}$, stage 2 conf vol |  |  |  |  |  |  |  |  |  |  |  |  |
| vCu, unblocked vol | 101 |  |  | 50 |  |  | 261 | 261 | 36 | 270 | 275 | 101 |
| tC , single (s) | 4.1 |  |  | 4.1 |  |  | 7.1 | 6.5 | 6.3 | 7.1 | 6.5 | 6.2 |
| $\mathrm{tC}, 2$ stage (s) |  |  |  |  |  |  |  |  |  |  |  |  |
| tF (s) | 2.2 |  |  | 2.2 |  |  | 3.5 | 4.0 | 3.4 | 3.5 | 4.0 | 3.3 |
| p0 queue free \% | 100 |  |  | 96 |  |  | 98 | 100 | 98 | 100 | 100 | 100 |
| cM capacity (veh/h) | 1491 |  |  | 1557 |  |  | 671 | 618 | 1025 | 651 | 607 | 954 |
| Direction, Lane \# | EB 1 | WB 1 | WB 2 | NB 1 | SB 1 |  |  |  |  |  |  |  |
| Volume Total | 50 | 62 | 101 | 29 | 0 |  |  |  |  |  |  |  |
| Volume Left | 0 | 62 | 0 | 12 | 0 |  |  |  |  |  |  |  |
| Volume Right | 28 | 0 | 0 | 16 | 0 |  |  |  |  |  |  |  |
| cSH | 1491 | 1557 | 1700 | 1500 | 1700 |  |  |  |  |  |  |  |
| Volume to Capacity | 0.00 | 0.04 | 0.06 | 0.02 | 0.00 |  |  |  |  |  |  |  |
| Queue Length 95th (tt) | 0 | 3 | 0 | 1 | 0 |  |  |  |  |  |  |  |
| Control Delay (s) | 0.0 | 7.4 | 0.0 | 9.4 | 0.0 |  |  |  |  |  |  |  |
| Lane LOS |  | A |  | A | A |  |  |  |  |  |  |  |
| Approach Delay (s) | 0.0 | 2.8 |  | 9.4 | 0.0 |  |  |  |  |  |  |  |
| Approach LOS |  |  |  | A | A |  |  |  |  |  |  |  |
| Intersection Summary |  |  |  |  |  |  |  |  |  |  |  |  |
| Average Delay |  |  | 3.0 |  |  |  |  |  |  |  |  |  |
| Intersection Capacity Utilization |  |  | 19.8\% |  | CU Level | f Service |  |  | A |  |  |  |
| Analysis Period (min) |  |  | 15 |  |  |  |  |  |  |  |  |  |


|  | $\prime$ |  |  | $\checkmark$ | $\bullet$ |  | 4 | 4 | $p$ |  | $\dagger$ | $\downarrow$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations |  | \$ |  | \% | $\hat{}$ |  |  | $\uparrow$ | F |  | ${ }_{4}$ |  |
| Volume (veh/h) | 1 | 92 | 52 | 35 | 51 | 1 | 10 | 1 | 58 | 0 | 2 | 2 |
| Sign Control |  | Free |  |  | Free |  |  | Stop |  |  | Stop |  |
| Grade |  | 0\% |  |  | 0\% |  |  | 0\% |  |  | 0\% |  |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 1 | 100 | 57 | 38 | 55 | 1 | 11 | 1 | 63 | 0 | 2 | 2 |
| Pedestrians |  |  |  |  |  |  |  |  |  |  |  |  |
| Lane Width (tt) |  |  |  |  |  |  |  |  |  |  |  |  |
| Walking Speed (tts) |  |  |  |  |  |  |  |  |  |  |  |  |
| Percent Blockage |  |  |  |  |  |  |  |  |  |  |  |  |
| Right turn flare (veh) |  |  |  |  |  |  |  |  | 7 |  |  |  |
| Median type |  | None |  |  | None |  |  |  |  |  |  |  |
| Median storage veh) |  |  |  |  |  |  |  |  |  |  |  |  |
| Upstream signal (ft) |  |  |  |  |  |  |  |  |  |  |  |  |
| pX, platoon unblocked |  |  |  |  |  |  |  |  |  |  |  |  |
| vC, conflicting volume | 57 |  |  | 157 |  |  | 265 | 263 | 128 | 295 | 291 | 56 |
| $\mathrm{vC1}$, stage 1 conf vol |  |  |  |  |  |  |  |  |  |  |  |  |
| vC2, stage 2 conf vol |  |  |  |  |  |  |  |  |  |  |  |  |
| vCu , unblocked vol | 57 |  |  | 157 |  |  | 265 | 263 | 128 | 295 | 291 | 56 |
| tC, single (s) | 4.1 |  |  | 4.1 |  |  | 7.2 | 6.5 | 6.5 | 7.1 | 6.5 | 6.2 |
| tC, 2 stage (s) |  |  |  |  |  |  |  |  |  |  |  |  |
| tF (s) | 2.2 |  |  | 2.2 |  |  | 3.6 | 4.0 | 3.5 | 3.5 | 4.0 | 3.3 |
| p0 queue free \% | 100 |  |  | 97 |  |  | 98 | 100 | 93 | 100 | 100 | 100 |
| cM capacity (veh/h) | 1548 |  |  | 1423 |  |  | 654 | 624 | 861 | 596 | 603 | 1011 |
| Direction, Lane \# | EB 1 | WB 1 | WB 2 | NB1 | SB 1 |  |  |  |  |  |  |  |
| Volume Total | 158 | 38 | 57 | 75 | 4 |  |  |  |  |  |  |  |
| Volume Left | 1 | 38 | 0 | 11 | 0 |  |  |  |  |  |  |  |
| Volume Right | 57 | 0 | 1 | 63 | 2 |  |  |  |  |  |  |  |
| cSH | 1548 | 1423 | 1700 | 1025 | 755 |  |  |  |  |  |  |  |
| Volume to Capacity | 0.00 | 0.03 | 0.03 | 0.07 | 0.01 |  |  |  |  |  |  |  |
| Queue Length 95th (ft) | 0 | 2 | 0 | 6 | 0 |  |  |  |  |  |  |  |
| Control Delay (s) | 0.1 | 7.6 | 0.0 | 9.7 | 9.8 |  |  |  |  |  |  |  |
| Lane LOS | A | A |  | A | A |  |  |  |  |  |  |  |
| Approach Delay (s) | 0.1 | 3.1 |  | 9.7 | 9.8 |  |  |  |  |  |  |  |
| Approach LOS |  |  |  | A | A |  |  |  |  |  |  |  |
| Intersection Summary |  |  |  |  |  |  |  |  |  |  |  |  |
| Average Delay |  |  | 3.2 |  |  |  |  |  |  |  |  |  |
| Intersection Capacity Utilization |  |  | 28.7\% |  | ICU Level | f Service |  |  | A |  |  |  |
| Analysis Period (min) |  |  | 15 |  |  |  |  |  |  |  |  |  |


|  | 4 |  |  |  |  | 4 |  | 4 | $>$ | $\checkmark$ | $\downarrow$ | $\downarrow$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations |  |  |  |  | \$ |  |  | $\uparrow$ |  |  | F |  |
| Volume (veh/h) | 0 | 0 | 0 | 0 | 0 | 19 | 0 | 29 | 0 | 0 | 24 | 76 |
| Sign Control |  | Stop |  |  | Stop |  |  | Free |  |  | Free |  |
| Grade |  | 0\% |  |  | 0\% |  |  | 0\% |  |  | 0\% |  |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 0 | 0 | 0 | 0 | 21 | 0 | 32 | 0 | 0 | 26 | 83 |
| Pedestrians |  |  |  |  |  |  |  |  |  |  |  |  |
| Lane Width (tt) |  |  |  |  |  |  |  |  |  |  |  |  |
| Walking Speed (tts) |  |  |  |  |  |  |  |  |  |  |  |  |
| Percent Blockage |  |  |  |  |  |  |  |  |  |  |  |  |
| Right turn flare (veh) |  |  |  |  |  |  |  |  |  |  |  |  |
| Median type |  |  |  |  |  |  |  | None |  |  | None |  |
| Median storage veh) |  |  |  |  |  |  |  |  |  |  |  |  |
| Upstream signal (ft) |  |  |  |  |  |  |  |  |  |  |  |  |
| pX, platoon unblocked |  |  |  |  |  |  |  |  |  |  |  |  |
| vC, conflicting volume | 120 | 99 | 67 | 99 | 140 | 32 | 109 |  |  | 32 |  |  |
| vC1, stage 1 conf vol |  |  |  |  |  |  |  |  |  |  |  |  |
| $\mathrm{vC2}$, stage 2 conf vol |  |  |  |  |  |  |  |  |  |  |  |  |
| vCu , unblocked vol | 120 | 99 | 67 | 99 | 140 | 32 | 109 |  |  | 32 |  |  |
| tC, single (s) | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 | 4.1 |  |  | 4.1 |  |  |
| tC, 2 stage (s) |  |  |  |  |  |  |  |  |  |  |  |  |
| tF (s) | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 | 2.2 |  |  | 2.2 |  |  |
| p0 queue free \% | 100 | 100 | 100 | 100 | 100 | 98 | 100 |  |  | 100 |  |  |
| cM capacity (veh/h) | 839 | 791 | 996 | 883 | 751 | 1042 | 1482 |  |  | 1581 |  |  |
| Direction, Lane \# | WB 1 | NB 1 | SB 1 |  |  |  |  |  |  |  |  |  |
| Volume Total | 21 | 32 | 109 |  |  |  |  |  |  |  |  |  |
| Volume Left | 0 | 0 | 0 |  |  |  |  |  |  |  |  |  |
| Volume Right | 21 | 0 | 83 |  |  |  |  |  |  |  |  |  |
| cSH | 1042 | 1482 | 1700 |  |  |  |  |  |  |  |  |  |
| Volume to Capacity | 0.02 | 0.00 | 0.06 |  |  |  |  |  |  |  |  |  |
| Queue Length 95th (ft) | 2 | 0 | 0 |  |  |  |  |  |  |  |  |  |
| Control Delay (s) | 8.5 | 0.0 | 0.0 |  |  |  |  |  |  |  |  |  |
| Lane LOS | A |  |  |  |  |  |  |  |  |  |  |  |
| Approach Delay (s) | 8.5 | 0.0 | 0.0 |  |  |  |  |  |  |  |  |  |
| Approach LOS | A |  |  |  |  |  |  |  |  |  |  |  |
| Intersection Summary |  |  |  |  |  |  |  |  |  |  |  |  |
| Average Delay |  |  | 1.1 |  |  |  |  |  |  |  |  |  |
| Intersection Capacity Utilization |  |  | 15.9\% |  | CU Level | f Service |  |  | A |  |  |  |
| Analysis Period (min) |  |  | 15 |  |  |  |  |  |  |  |  |  |


|  | 4 |  |  | $\dagger$ |  |  | 4 | $\dagger$ |  |  | $\downarrow$ | $\checkmark$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations |  |  |  |  | ¢ |  |  | $\uparrow$ |  |  | F |  |
| Volume (veh/h) | 0 | 0 | 0 | 1 | 0 | 5 | 2 | 63 | 0 | 0 | 58 | 35 |
| Sign Control |  | Stop |  |  | Stop |  |  | Free |  |  | Free |  |
| Grade |  | 0\% |  |  | 0\% |  |  | 0\% |  |  | 0\% |  |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 0 | 0 | 1 | 0 | 5 | 2 | 68 | 0 | 0 | 63 | 38 |
| Pedestrians |  |  |  |  |  |  |  |  |  |  |  |  |
| Lane Width (tt) |  |  |  |  |  |  |  |  |  |  |  |  |
| Walking Speed (tt/s) |  |  |  |  |  |  |  |  |  |  |  |  |
| Percent Blockage |  |  |  |  |  |  |  |  |  |  |  |  |
| Right turn flare (veh) |  |  |  |  |  |  |  |  |  |  |  |  |
| Median type |  |  |  |  |  |  |  | None |  |  | None |  |
| Median storage veh) |  |  |  |  |  |  |  |  |  |  |  |  |
| Upstream signal (tt) |  |  |  |  |  |  |  |  |  |  |  |  |
| pX, platoon unblocked |  |  |  |  |  |  |  |  |  |  |  |  |
| VC , conflicting volume | 160 | 155 | 82 | 155 | 174 | 68 | 101 |  |  | 68 |  |  |
| $\mathrm{vC1}$, stage 1 conf vol |  |  |  |  |  |  |  |  |  |  |  |  |
| vC2, stage 2 conf vol |  |  |  |  |  |  |  |  |  |  |  |  |
| vCu, unblocked vol | 160 | 155 | 82 | 155 | 174 | 68 | 101 |  |  | 68 |  |  |
| tC , single (s) | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.4 | 4.1 |  |  | 4.1 |  |  |
| tC, 2 stage (s) |  |  |  |  |  |  |  |  |  |  |  |  |
| tF (s) | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.5 | 2.2 |  |  | 2.2 |  |  |
| p0 queue free \% | 100 | 100 | 100 | 100 | 100 | 99 | 100 |  |  | 100 |  |  |
| cM capacity (veh/h) | 800 | 736 | 978 | 811 | 718 | 947 | 1491 |  |  | 1533 |  |  |
| Direction, Lane \# | WB 1 | NB 1 | SB 1 |  |  |  |  |  |  |  |  |  |
| Volume Total | 7 | 71 | 101 |  |  |  |  |  |  |  |  |  |
| Volume Left | 1 | 2 | 0 |  |  |  |  |  |  |  |  |  |
| Volume Right | 5 | 0 | 38 |  |  |  |  |  |  |  |  |  |
| cSH | 921 | 1491 | 1700 |  |  |  |  |  |  |  |  |  |
| Volume to Capacity | 0.01 | 0.00 | 0.06 |  |  |  |  |  |  |  |  |  |
| Queue Length 95th ( t ) | 1 | 0 | 0 |  |  |  |  |  |  |  |  |  |
| Control Delay (s) | 8.9 | 0.2 | 0.0 |  |  |  |  |  |  |  |  |  |
| Lane LOS | A | A |  |  |  |  |  |  |  |  |  |  |
| Approach Delay (s) | 8.9 | 0.2 | 0.0 |  |  |  |  |  |  |  |  |  |
| Approach LOS | A |  |  |  |  |  |  |  |  |  |  |  |
| Intersection Summary |  |  |  |  |  |  |  |  |  |  |  |  |
| Average Delay |  |  | 0.4 |  |  |  |  |  |  |  |  |  |
| Intersection Capacity Utilization |  |  | 15.2\% |  | CU Level | f Service |  |  | A |  |  |  |
| Analysis Period (min) |  |  | 15 |  |  |  |  |  |  |  |  |  |


|  | 4 |  |  |  |  |  |  |  | 4 | 7 | $\checkmark$ | $\frac{1}{\downarrow}$ | $\downarrow$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Movement | EBL | EBT | EBR | WBL |  | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations |  | $\uparrow$ |  |  |  |  |  |  | $\uparrow$ |  |  | $\uparrow$ |  |
| Volume (veh/h) | 41 | 0 | 0 | 0 |  | 0 | 0 | 0 | , | 0 | 19 | 3 | 0 |
| Sign Control |  | Stop |  |  |  | Stop |  |  | Free |  |  | Free |  |
| Grade |  | 0\% |  |  |  | 0\% |  |  | 0\% |  |  | 0\% |  |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 |  | 0. 92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 45 | 0 | 0 | 0 |  | 0 | 0 | 0 | 2 | 0 | 21 | 3 | 0 |
| Pedestrians |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Lane Width (tt) |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Walking Speed (tts) |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Percent Blockage |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Right turn flare (veh) |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Median type |  |  |  |  |  |  |  |  | None |  |  | None |  |
| Median storage veh) |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Upstream signal (ft) |  |  |  |  |  |  |  |  |  |  |  |  |  |
| pX, platoon unblocked |  |  |  |  |  |  |  |  |  |  |  |  |  |
| vC, conflicting volume | 47 | 47 | 3 | 47 |  | 47 | 2 | 3 |  |  | 2 |  |  |
| vC1, stage 1 conf vol |  |  |  |  |  |  |  |  |  |  |  |  |  |
| $\mathrm{vC2}$, stage 2 conf vol |  |  |  |  |  |  |  |  |  |  |  |  |  |
| vCu , unblocked vol | 47 | 47 | 3 | 47 |  | 47 | 2 | 3 |  |  | 2 |  |  |
| tC, single (s) | 7.4 | 6.5 | 6.2 | 7.1 |  | 6.5 | 6.2 | 4.1 |  |  | 4.4 |  |  |
| tC, 2 stage (s) |  |  |  |  |  |  |  |  |  |  |  |  |  |
| tF (s) | 3.8 | 4.0 | 3.3 | 3.5 |  | 4.0 | 3.3 | 2.2 |  |  | 2.5 |  |  |
| p0 queue free \% | 95 | 100 | 100 | 100 |  | 100 | 100 | 100 |  |  | 99 |  |  |
| cM capacity (veh/h) | 871 | 833 | 1081 | 944 |  | 833 | 1082 | 1619 |  |  | 1444 |  |  |
| Direction, Lane \# | EB 1 | NB 1 | SB 1 |  |  |  |  |  |  |  |  |  |  |
| Volume Total | 45 | 2 | 24 |  |  |  |  |  |  |  |  |  |  |
| Volume Left | 45 | 0 | 21 |  |  |  |  |  |  |  |  |  |  |
| Volume Right | 0 | 0 | 0 |  |  |  |  |  |  |  |  |  |  |
| cSH | 871 | 1700 | 1444 |  |  |  |  |  |  |  |  |  |  |
| Volume to Capacity | 0.05 | 0.00 | 0.01 |  |  |  |  |  |  |  |  |  |  |
| Queue Length 95th (ft) | 4 | 0 | 1 |  |  |  |  |  |  |  |  |  |  |
| Control Delay (s) | 9.4 | 0.0 | 6.5 |  |  |  |  |  |  |  |  |  |  |
| Lane LOS | A |  | A |  |  |  |  |  |  |  |  |  |  |
| Approach Delay (s) | 9.4 | 0.0 | 6.5 |  |  |  |  |  |  |  |  |  |  |
| Approach LOS | A |  |  |  |  |  |  |  |  |  |  |  |  |
| Intersection Summary |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Average Delay |  |  | 8.1 |  |  |  |  |  |  |  |  |  |  |
| Intersection Capacity Utilization |  |  | 17.9\% |  | CU Lev | evel o | Service |  |  | A |  |  |  |
| Analysis Period (min) |  |  | 15 |  |  |  |  |  |  |  |  |  |  |







|  | 4 |  |  | 1 |  |  | 4 | $\uparrow$ |  |  | $\downarrow$ | $\checkmark$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations |  | $\uparrow$ |  | \% | $\uparrow$ |  |  | $\uparrow$ | 「 |  | \$ |  |
| Volume (veh/h) | 0 | 20 | 46 | 57 | 93 | 0 | 31 | 1 | 15 | 0 | 0 | 0 |
| Sign Control |  | Free |  |  | Free |  |  | Stop |  |  | Stop |  |
| Grade |  | 0\% |  |  | 0\% |  |  | 0\% |  |  | 0\% |  |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 22 | 50 | 62 | 101 | 0 | 34 | 1 | 16 | 0 | 0 | 0 |
| Pedestrians |  |  |  |  |  |  |  |  |  |  |  |  |
| Lane Width (tt) |  |  |  |  |  |  |  |  |  |  |  |  |
| Walking Speed (tt/s) |  |  |  |  |  |  |  |  |  |  |  |  |
| Percent Blockage |  |  |  |  |  |  |  |  |  |  |  |  |
| Right turn flare (veh) |  |  |  |  |  |  |  |  | 7 |  |  |  |
| Median type |  | None |  |  | None |  |  |  |  |  |  |  |
| Median storage veh) |  |  |  |  |  |  |  |  |  |  |  |  |
| Upstream signal (tt) |  |  |  |  |  |  |  |  |  |  |  |  |
| pX, platoon unblocked |  |  |  |  |  |  |  |  |  |  |  |  |
| VC , conflicting volume | 101 |  |  | 72 |  |  | 272 | 272 | 47 | 280 | 297 | 101 |
| $\mathrm{vC1}$, stage 1 conf vol |  |  |  |  |  |  |  |  |  |  |  |  |
| $\mathrm{vC2}$, stage 2 conf vol |  |  |  |  |  |  |  |  |  |  |  |  |
| vCu, unblocked vol | 101 |  |  | 72 |  |  | 272 | 272 | 47 | 280 | 297 | 101 |
| tC , single (s) | 4.1 |  |  | 4.1 |  |  | 7.1 | 6.5 | 6.3 | 7.1 | 6.5 | 6.2 |
| $\mathrm{tC}, 2$ stage (s) |  |  |  |  |  |  |  |  |  |  |  |  |
| tF (s) | 2.2 |  |  | 2.2 |  |  | 3.5 | 4.0 | 3.4 | 3.5 | 4.0 | 3.3 |
| p0 queue free \% | 100 |  |  | 96 |  |  | 95 | 100 | 98 | 100 | 100 | 100 |
| cM capacity (veh/h) | 1491 |  |  | 1528 |  |  | 660 | 609 | 1011 | 640 | 590 | 954 |
| Direction, Lane \# | EB 1 | WB 1 | WB 2 | NB 1 | SB 1 |  |  |  |  |  |  |  |
| Volume Total | 72 | 62 | 101 | 51 | 0 |  |  |  |  |  |  |  |
| Volume Left | 0 | 62 | 0 | 34 | 0 |  |  |  |  |  |  |  |
| Volume Right | 50 | 0 | 0 | 16 | 0 |  |  |  |  |  |  |  |
| cSH | 1491 | 1528 | 1700 | 967 | 1700 |  |  |  |  |  |  |  |
| Volume to Capacity | 0.00 | 0.04 | 0.06 | 0.05 | 0.00 |  |  |  |  |  |  |  |
| Queue Length 95th (tt) | 0 | 3 | 0 | 4 | 0 |  |  |  |  |  |  |  |
| Control Delay (s) | 0.0 | 7.5 | 0.0 | 10.1 | 0.0 |  |  |  |  |  |  |  |
| Lane LOS |  | A |  | B | A |  |  |  |  |  |  |  |
| Approach Delay (s) | 0.0 | 2.8 |  | 10.1 | 0.0 |  |  |  |  |  |  |  |
| Approach LOS |  |  |  | B | A |  |  |  |  |  |  |  |
| Intersection Summary |  |  |  |  |  |  |  |  |  |  |  |  |
| Average Delay |  |  | 3.4 |  |  |  |  |  |  |  |  |  |
| Intersection Capacity Utilization |  |  | 19.8\% |  | CU Level | f Service |  |  | A |  |  |  |
| Analysis Period (min) |  |  | 15 |  |  |  |  |  |  |  |  |  |




|  | 4 |  |  | $\dagger$ |  |  | 4 | $\dagger$ |  |  | $\downarrow$ | $\downarrow$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations |  |  |  |  | $\uparrow$ |  |  | $\uparrow$ |  |  | F |  |
| Volume (veh/h) | 0 | 0 | 0 | 1 | 0 | 24 | 2 | 64 | 0 | 0 | 77 | 36 |
| Sign Control |  | Stop |  |  | Stop |  |  | Free |  |  | Free |  |
| Grade |  | 0\% |  |  | 0\% |  |  | 0\% |  |  | 0\% |  |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 0 | 0 | 1 | 0 | 26 | 2 | 70 | 0 | 0 | 84 | 39 |
| Pedestrians |  |  |  |  |  |  |  |  |  |  |  |  |
| Lane Width (tt) |  |  |  |  |  |  |  |  |  |  |  |  |
| Walking Speed (tt/s) |  |  |  |  |  |  |  |  |  |  |  |  |
| Percent Blockage |  |  |  |  |  |  |  |  |  |  |  |  |
| Right turn flare (veh) |  |  |  |  |  |  |  |  |  |  |  |  |
| Median type |  |  |  |  |  |  |  | None |  |  | None |  |
| Median storage veh) |  |  |  |  |  |  |  |  |  |  |  |  |
| Upstream signal (tt) |  |  |  |  |  |  |  |  |  |  |  |  |
| pX, platoon unblocked |  |  |  |  |  |  |  |  |  |  |  |  |
| VC , conflicting volume | 203 | 177 | 103 | 177 | 197 | 70 | 123 |  |  | 70 |  |  |
| $\mathrm{vC1}$, stage 1 conf vol |  |  |  |  |  |  |  |  |  |  |  |  |
| $\mathrm{vC2}$, stage 2 conf vol |  |  |  |  |  |  |  |  |  |  |  |  |
| vCu, unblocked vol | 203 | 177 | 103 | 177 | 197 | 70 | 123 |  |  | 70 |  |  |
| tC , single (s) | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.4 | 4.1 |  |  | 4.1 |  |  |
| $\mathrm{tC}, 2$ stage (s) |  |  |  |  |  |  |  |  |  |  |  |  |
| tF (s) | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.5 | 2.2 |  |  | 2.2 |  |  |
| p0 queue free \% | 100 | 100 | 100 | 100 | 100 | 97 | 100 |  |  | 100 |  |  |
| cM capacity (veh/h) | 733 | 715 | 952 | 784 | 698 | 945 | 1464 |  |  | 1531 |  |  |
| Direction, Lane \# | WB 1 | NB 1 | SB 1 |  |  |  |  |  |  |  |  |  |
| Volume Total | 27 | 72 | 123 |  |  |  |  |  |  |  |  |  |
| Volume Left | 1 | 2 | 0 |  |  |  |  |  |  |  |  |  |
| Volume Right | 26 | 0 | 39 |  |  |  |  |  |  |  |  |  |
| cSH | 938 | 1464 | 1700 |  |  |  |  |  |  |  |  |  |
| Volume to Capacity | 0.03 | 0.00 | 0.07 |  |  |  |  |  |  |  |  |  |
| Queue Length 95th ( t ) | 2 | 0 | 0 |  |  |  |  |  |  |  |  |  |
| Control Delay (s) | 9.0 | 0.2 | 0.0 |  |  |  |  |  |  |  |  |  |
| Lane LOS | A | A |  |  |  |  |  |  |  |  |  |  |
| Approach Delay (s) | 9.0 | 0.2 | 0.0 |  |  |  |  |  |  |  |  |  |
| Approach LOS | A |  |  |  |  |  |  |  |  |  |  |  |
| Intersection Summary |  |  |  |  |  |  |  |  |  |  |  |  |
| Average Delay |  |  | 1.2 |  |  |  |  |  |  |  |  |  |
| Intersection Capacity Utilization |  |  | 16.2\% |  | CU Level | f Service |  |  | A |  |  |  |
| Analysis Period (min) |  |  | 15 |  |  |  |  |  |  |  |  |  |




## APPENDIX III

Summary of Peak-Hours Traffic Counts

- All Vehicles
- Trucks Only


# Turning Movement Counts (All Vehicles ) 

Intersection of Noria Rd \& N 1500 Rd
Morning Peak-Hours
Sunny, Hot

File Name : Noria \& N 1500 -eam
Site Code : 1
Start Date : 7/11/2012
Page No : 1

|  | Sand Plant Driveway From North |  |  |  |  | N1500 Rd From East |  |  |  |  | Noria Rd From South |  |  |  |  | N 1500 Rd <br> FromWest |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Int. Total |
| 06:00 AM | 1 | 0 | 0 | 0 | 1 | 0 | о | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 6 | 11 | 0 | 0 | o | 11 | 18 |
| 06:15 AM | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 10 | 0 | 11 | 21 | 2 | 0 | o | 23 | 35 |
| 06:30 AM | o | o | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 2 | o | 1 | 21 | 0 | 22 | 19 | 1 | 1 | o | 21 | 45 |
| 06:45 AM | o | 1 | 0 | o | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 20 | 0 | 21 | 32 | 3 | 0 | 0 | 35 | 58 |
| Total | 1 | 1 | 0 | 0 | 2 | o | 3 | 1 | 0 | 4 | 1 | 2 | 57 | 0 | 60 | 83 | 6 | 1 | o | 90 | 156 |


| 07:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 18 | 0 | 18 | 11 | 0 | 0 | 0 | 11 | 30 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 07:15 AM | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 0 | 0 | 32 | 0 | 32 | 20 | 1 | 0 | 0 | 21 | 55 |
| 07:30 AM | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 4 | 0 | 1 | 26 | 0 | 27 | 26 | 0 | 0 | 0 | 26 | 57 |
| 07:45 AM | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 2 | 0 | 0 | 40 | 0 | 40 | 49 | 3 | 0 | 0 | 52 | 95 |
| Total | 0 | 1 | 0 | 0 | 1 | 1 | 7 | 1 | 0 | 9 | 0 | 1 | 116 | 0 | 117 | 106 | 4 | 0 | 0 | 110 | 237 |


| 08:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 3 | 1 | 1 | 27 | 0 | 29 | 19 | 2 | 0 | 0 | 21 | 53 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 08:15 AM | 0 | 1 | 0 | 0 | 1 | 1 | 2 | 1 | 0 | 4 | 1 | 0 | 24 | 0 | 25 | 28 | 2 | 0 | 0 | 30 | 60 |
| 08:30 AM | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 3 | 18 | 0 | 22 | 18 | 2 | 0 | 0 | 20 | 44 |
| 08:45 AM | 0 | 3 | 0 | 0 | 3 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 20 | 0 | 20 | 19 | 0 | 0 | 0 | 19 | 43 |
| Total | o | 5 | o | o | 5 | 1 | 7 | 1 | 0 | 9 | 3 | 4 | 89 | 0 | 96 | 84 | 6 | 0 | 0 | 90 | 200 |


| Grand Total | 1 | 7 | 0 | 0 | 8 | 2 | 17 | 3 | 0 | 22 | 4 | 7 | 262 | 0 | 273 | 273 | 16 | 1 | 0 | 290 | 593 |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| Apprch \% | 12.5 | 87.5 | 0 | 0 |  | 9.1 | 77.3 | 13.6 | 0 |  | 1.5 | 2.6 | 96 | 0 |  | 94.1 | 5.5 | 0.3 | 0 |  |  |
| Total \% | 0.2 | 1.2 | 0 | 0 | 1.3 | 0.3 | 2.9 | 0.5 | 0 | 3.7 | 0.7 | 1.2 | 44.2 | 0 | 46 | 46 | 2.7 | 0.2 | 0 | 48.9 |  |

## Turning Movement Counts (All Vehicles )

Intersection of Noria Rd \& N 1500 Rd Morning Peak-Hours
Sunny, Hot

File Name : Noria \& N 1500 -eam
Site Code : 1
Start Date : 7/11/2012
Page No : 2

|  | Sand Plant Driveway From North |  |  |  |  | N 1500 Rd From East |  |  |  |  | Noria Rd From South |  |  |  |  | N 1500 Rd FromWest |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Int. Total |
| Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Peak Hour for Entire Intersection Begins at 07:30 AM |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 07:30 AM | 0 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 4 | 0 |  | 26 | 0 | 27 | 26 | 0 | 0 | 0 | 26 | 57 |
| 07:45 AM | 0 |  | 。 | 。 | 1 | 0 | 1 | 1 | 0 | 2 | 0 | 0 | 40 | 0 | 40 | 49 | 3 | 0 | 0 | 52 | 95 |
| 08:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 3 | 1 | 1 | 27 | 0 | 29 | 19 | 2 | 0 | 0 | 21 | 53 |
| 08:15 AM | 0 | 1 | 0 | 0 | 1 | 1 | 2 | 1 | 0 | 4 | 1 | 0 | 24 | 0 | 25 | 28 | 2 | 0 | 0 | 30 | 60 |
| Total Volume | 0 | 2 | 0 | 0 | 2 | 1 | 10 | 2 | 0 | 13 | 2 | 2 | 117 | 0 | 121 | 122 | 7 | 0 | 0 | 129 | 265 |
| \%App. Total | 0 | 100 | 0 | 0 |  | 7.7 | 76.9 | 15.4 | 0 |  | 1.7 | 1.7 | 96.7 | 0 |  | 94.6 | 5.4 | 0 | 0 |  |  |
| PHF | . 000 | . 500 | . 000 | . 000 | . 500 | . 250 | . 625 | . 500 | . 000 | . 813 | . 500 | . 500 | . 731 | . 000 | . 756 | . 622 | . 583 | . 000 | . 000 | . 620 | . 697 |

# Turning Movement Counts (All Vehicles ) 

Intersection of Noria Rd \& N 1500 Rd
Afternoon Peak-Hours
Sunny, Hot

File Name : Noria \& N 1500 -epm
Site Code : 1
Start Date : 7/11/2012
Page No : 1

|  | Sand Plant Driveway From North |  |  |  |  | N 1500 Rd From East |  |  |  |  | Noria Rd From South |  |  |  |  | N 1500 Rd FromWest |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Int. Total |
| 02:00 PM | 1 | 2 | 0 | 0 | 3 | 0 | 2 | 0 | 0 | 2 | 0 | 0 | 19 | 0 | 19 | 13 | 3 | 1 | 0 | 17 | 41 |
| 02:15 PM | o | 1 | 0 | 0 | 1 | o | 0 | o | 0 | 0 | 1 | 1 | 9 | 0 | 11 | 19 | 2 | 0 | 0 | 21 | 33 |
| 02:30 PM | o | 0 | o | o | 0 | о | 2 | 1 | 0 | 3 | 1 | 1 | 15 | 0 | 17 | 24 | 3 | 0 | 0 | 27 | 47 |
| 02:45 PM | o | 1 | o | 0 | 1 | о | 1 | o | 0 | 1 | 1 | 0 | 16 | 0 | 17 | 16 | 3 | 0 | 0 | 19 | 38 |
| Total | 1 | 4 | o | o | 5 | o | 5 | 1 | 0 | 6 | 3 | 2 | 59 | 0 | 64 | 72 | 11 | 1 | 0 | 84 | 159 |


| 03:00 PM | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 29 | 0 | 30 | 19 | 0 | 0 | 0 | 19 | 50 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 03:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 0 | 0 | 28 | 0 | 28 | 17 | 2 | 0 | 0 | 19 | 49 |
| 03:30 PM | 0 | 1 | 0 | 0 | 1 | 0 | 3 | 1 | 0 | 4 | 0 | 3 | 52 | 0 | 55 | 26 | 4 | 0 | 0 | 30 | 90 |
| 03:45 PM | 0 | 1 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 2 | 0 | 2 | 20 | 0 | 22 | 25 | 2 | 0 | 0 | 27 | 52 |
| Total | 0 | 3 | 0 | 0 | 3 | o | 7 | 1 | 0 | 8 | 0 | 6 | 129 | 0 | 135 | 87 | 8 | 0 | 0 | 95 | 241 |


| 04:00 PM | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | o | 0 | 0 | o | 27 | 0 | 27 | 23 | 4 | 1 | o | 28 | 60 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 04:15 PM | 1 | 0 | 0 | 0 | 1 | 0 | 4 | 0 | 0 | 4 | 0 | o | 14 | 0 | 14 | 35 | 4 | 0 | 0 | 39 | 58 |
| 04:30 PM | 0 | 2 | 0 | 0 | 2 | 0 | 2 | o | o | 2 | 1 | 1 | 53 | o | 55 | 25 | 1 | 0 | - | 26 | 85 |
| 04:45 PM | 1 | 0 | 0 | 0 | 1 | 0 | 3 | 1 | o | 4 | o | o | 23 | 0 | 23 | 47 | 2 | 0 | о | 49 | 77 |
| Total | 2 | 7 | 0 | 0 | 9 | 0 | 9 | 1 | 0 | 10 | 1 | 1 | 117 | 0 | 119 | 130 | 11 | 1 | 0 | 142 | 280 |


| Grand Total | 3 | 14 | 0 | 0 | 17 | 0 | 21 | 3 | 0 | 24 | 4 | 9 | 305 | 0 | 318 | 289 | 30 | 2 | 0 | 321 | 680 |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| Apprch \% | 17.6 | 82.4 | 0 | 0 |  |  | 0 | 87.5 | 12.5 | 0 |  | 1.3 | 2.8 | 95.9 | 0 |  | 90 | 9.3 | 0.6 | 0 |  |
| Total \% | 0.4 | 2.1 | 0 | 0 | 2.5 | 0 | 3.1 | 0.4 | 0 | 3.5 | 0.6 | 1.3 | 44.9 | 0 | 46.8 | 42.5 | 4.4 | 0.3 | 0 | 47.2 |  |

## Turning Movement Counts (All Vehicles )

Intersection of Noria Rd \& N 1500 Rd Afternoon Peak-Hours

File Name : Noria \& N 1500 -epm
Sunny, Hot
Site Code : 1
Start Date : 7/11/2012
Page No : 2

|  | Sand Plant Driveway From North |  |  |  |  | N 1500 Rd From East |  |  |  |  | Noria Rd From South |  |  |  |  | N 1500 Rd FromWest |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Int. Total |
| Peak Hour Analysis from 02:00 PM to 04:45 PM - Peak 1 of 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Peak Hour for Entire Intersection Begins at 04:00 PM |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 04:00 PM | 0 |  | 。 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27 | 0 | 27 | 23 |  |  | 0 | 28 | 60 |
| 04:15 PM | 1 | 0 | 0 | 0 | 1 | 0 | 4 | 0 | 0 | 4 | 0 | 0 | 14 | 0 | 14 | 35 | 4 | 0 | 0 | 39 | 58 |
| 04:30 PM | 0 | 2 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 2 | 1 | 1 | 53 | 0 | 55 | 25 | 1 | 0 | 0 | 26 | 85 |
| 04:45 PM | 1 | 0 | 0 | 0 | 1 | 0 | 3 | 1 | 0 | 4 | 0 | 0 | 23 | 0 | 23 | 47 | 2 | 0 | 0 | 49 | 77 |
| Total Volume | 2 | 7 | 0 | 0 | 9 | 0 | 9 | 1 | 0 | 10 | 1 | 1 | 117 | 0 | 119 | 130 | 11 | 1 | 0 | 142 | 280 |
| \% App. Total | 222 | 77.8 | 0 | 0 |  | 0 | 90 | 10 | 0 |  | 0.8 | 0.8 | 98.3 | 0 |  | 91.5 | 7.7 | 0.7 | 0 |  |  |
| PHF | . 500 | . 350 | . 000 | . 000 | . 450 | . 000 | . 563 | . 250 | . 000 | . 625 | . 250 | . 250 | . 552 | . 000 | . 541 | . 691 | . 688 | . 250 | . 000 | . 724 | . 824 |

# Turning Movement Counts (All Vehicles ) 

Intersection of Noria Rd \& DG CO 442
File Name : CR 442 \& Noria-eam
Morning Peak-Hours
Site Code : 2
Start Date : 7/12/2012
Page No : 1

| Groups Printed Unshifted |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Noria Rd <br> From North |  |  |  |  | DG CO 442 <br> From East |  |  |  |  | Noria Rd From South |  |  |  |  | FromWest |  |  |  |  |  |
| Start Time |  | Thru | Left |  | App. Total | Right |  | Left |  | App. Total | Right | Thru |  |  | App. Total |  |  |  |  | App. Total | Int. Total |
| 06:00 AM | 0 | 4 | 2 | 0 | 6 | 13 | 0 | 1 | 0 | 14 | 1 | 6 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 27 |
| 06:15 AM | 0 | 3 | 3 | 0 | 6 | 11 | 0 | 0 | 0 | 11 | 1 | 9 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 27 |
| 06:30 AM | 0 | 3 | 5 | 0 | 8 | 22 | 0 | 2 | 0 | 24 | 5 | 16 | 0 | 0 | 21 | 0 | 0 | 0 | 0 | 0 | 53 |
| 06:45 AM | 0 | 0 | 8 | 0 | 8 | 27 | 0 | 2 | о | 29 | 8 | 28 | 0 | 0 | 36 | 0 | 0 | 0 | 0 | 0 | 73 |
| Total | 0 | 10 | 18 | 0 | 28 | 73 | 0 | 5 | 0 | 78 | 15 | 59 | 0 | 0 | 74 | 0 | 0 | 0 | 0 | 0 | 180 |
| 07:00 AM | 0 | 5 | 8 | 0 | 13 | 23 | 0 | 4 | 0 | 27 | 4 | 17 | 0 | 0 | 21 | 0 | 0 | 0 | 0 | 0 | 61 |
| 07:15 AM | 0 | 0 | 11 | 0 | 11 | 29 | 0 | 2 | 0 | 31 | 5 | 17 | 0 | 0 | 22 | 0 | 0 | 0 | 0 | 0 | 64 |
| 07:30 AM | 0 | 3 | 4 | o | 7 | 42 | o | 5 | - | 47 | 2 | 16 | 0 | o | 18 | 0 | o | o | - | 0 | 72 |
| 07:45 AM | 0 | 4 | 6 | o | 10 | 25 | 0 | 7 | о | 32 | 8 | 37 | 0 | 0 | 45 | 0 | 0 | 0 | 0 | 0 | 87 |
| Total | 0 | 12 | 29 | 0 | 41 | 119 | 0 | 18 | 0 | 137 | 19 | 87 | 0 | 0 | 106 | 0 | 0 | 0 | 0 | 0 | 284 |
| 08:00 AM | 0 | 2 | 10 | 0 | 12 | 26 | 0 | 3 | 0 | 29 | 7 | 25 | 0 | 0 | 32 | 0 | 0 | 0 | 0 | 0 | 73 |
| 08:15 AM | 0 | 6 | 11 | 0 | 17 | 26 | 0 | 1 | 0 | 27 | 5 | 20 | 0 | 0 | 25 | 0 | 0 | 0 | 0 | 0 | 69 |
| 08:30 AM | 0 | 10 | 4 | o | 14 | 18 | o | 6 | - | 24 | 2 | 14 | 0 | 0 | 16 | 0 | o | o | 0 | 0 | 54 |
| 08:45 AM | 0 | 6 | 6 | o | 12 | 5 | o | 8 | о | 13 | 1 | 17 | 0 | ○ | 18 | 0 | o | 0 | 0 | 0 | 43 |
| Total | 0 | 24 | 31 | o | 55 | 75 | 0 | 18 | o | 93 | 15 | 76 | 0 | 0 | 91 | 0 | 0 | 0 | o | 0 | 239 |
| Grand Total | 0 | 46 | 78 | o | 124 | 267 | 0 | 41 | o | 308 | 49 | 222 | 0 | o | 271 | 0 | 0 | 0 | 0 | o | 703 |
| Apprch \% | 0 | 37.1 | 62.9 | 0 |  | 86.7 | 0 | 13.3 | 0 |  | 18.1 | 81.9 | 0 | 0 |  | 0 | 0 | 0 | 0 |  |  |
| Total \% | 0 | 6.5 | 11.1 | 0 | 17.6 | 38 | 0 | 5.8 | 0 | 43.8 | 7 | 31.6 | 0 | 0 | 38.5 | 0 | 0 | 0 | 0 | 0 |  |

# Turning Movement Counts (All Vehicles ) 

Intersection of Noria Rd \& DG CO 442
Morning Peak-Hours
Sunny, Hot

File Name : CR 442 \& Noria-eam
Site Code : 2
Start Date : 7/12/2012
Page No : 2

|  | Noria Rd From North |  |  |  |  | DGCO442 <br> From East |  |  |  |  | Noria Rd From South |  |  |  |  | From West |  |  |  |  | Int. Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time |  | Thru | Left |  | App. Total | Right |  | Left |  | App. Total | Right | Thru |  |  | App. Total |  |  |  |  | App. Total |  |
| Peak Hour Analysis From 06:00 AM to 08:45 AM- Peak 1 of 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Peak Hour for Entire Intersection Begins at 07:30 AM |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 07:30 AM | 0 | 3 | 4 | 0 | 7 |  | 0 | 5 | 0 | ${ }^{4}$ | 2 | 16 | 0 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 72 |
| 07:45 AM | 0 | 4 | 6 | 0 | 10 | 25 | 0 |  | 0 | ${ }^{32}$ | \% | 37 | 0 | 0 | 45 | 0 | 0 | 0 | 0 | 0 | 87 |
| 08:00 AM | 0 | 2 | 10 | 0 | 12 | 26 | 0 | 3 | 0 | 29 | 7 | 25 | 0 | 0 | 32 | 0 | 0 | 0 | 0 | 0 | 73 |
| 08:15 AM | 0 | 6 | 11 | 0 | 17 | 26 | 0 | 1 | 0 | 27 | 5 | 20 | 0 | 0 | 25 | 0 | 0 | 0 | 0 | 0 | 69 |
| Total Volume | 0 | 15 | 31 | 0 | 46 | 119 | 0 | 16 | 0 | 135 | 22 | 98 | 0 | 0 | 120 | 0 | 0 | 0 | 0 | 0 | 301 |
| \%App. Total | 0 | 32.6 | 67.4 | 0 |  | 88.1 | 0 | 11.9 | 0 |  | 18.3 | 81.7 | 0 | 0 |  | 0 | 0 | 0 | 0 |  |  |
| PHF | . 000 | . 625 | . 705 | . 000 | . 676 | . 708 | . 000 | . 571 | . 000 | . 718 | . 688 | . 662 | . 000 | . 000 | . 667 | . 000 | . 000 | . 000 | . 000 | . 000 | . 865 |

# Turning Movement Counts (All Vehicles ) 

Intersection of DG CO 442 \& Noria Rd
File Name : CR 442 \& Noria-epm Afternoon Peak-Hours

Site Code : 2
Start Date : 7/12/2012
Page No : 1

| Groups Printed- Unshifted |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Noria Road From North |  |  |  |  | DG CO442 <br> From East |  |  |  |  | Noria Road From South |  |  |  |  | FromWest |  |  |  |  |  |
| Start Time |  | Thru | Left |  | App. Total | Right |  | Left |  | App. Total | Right | Thru |  |  | App. Total |  |  |  |  | App. Total | Int. Total |
| 02:00 PM | 0 | 9 | 9 | 0 | 18 | 16 | 0 | 7 | 0 | 23 | 7 | 2 | 0 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 50 |
| 02:15 PM | 0 | 6 | 14 | 0 | 20 | 14 | 0 | 3 | 0 | 17 | 7 | 10 | 0 | 0 | 17 | 0 | 0 | 0 | 0 | 0 | 54 |
| 02:30 PM | 0 | 12 | 18 | 0 | 30 | 14 | 0 | 6 | 0 | 20 | 6 | 4 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 60 |
| 02:45 PM | 0 | 5 | 19 | 0 | 24 | 8 | 0 | 8 | 0 | 16 | 5 | 7 | 0 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 52 |
| Total | 0 | 32 | 60 | 0 | 92 | 52 | 0 | 24 | 0 | 76 | 25 | 23 | 0 | 0 | 48 | 0 | о | 0 | 0 | 0 | 216 |


| 03:00 PM | 0 | 5 | 32 | 0 | 37 | 9 | 0 | 4 | 0 | 13 | 5 | 3 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 58 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 03:15 PM | 0 | 3 | 16 | 0 | 19 | 19 | 0 | 6 | 0 | 25 | 2 | 12 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 58 |
| 03:30 PM | 0 | 24 | 30 | o | 54 | 11 | o | 3 | o | 14 | 5 | 7 | o | o | 12 | o | 0 | 0 | 0 | 0 | 80 |
| 03:45 PM | 0 | 7 | 23 | o | 30 | 7 | 0 | 5 | o | 12 | 5 | 8 | 0 | o | 13 | - | 0 | 0 | 0 | 0 | 55 |
| Total | 0 | 39 | 101 | 0 | 140 | 46 | 0 | 18 | 0 | 64 | 17 | 30 | 0 | 0 | 47 | o | 0 | 0 | 0 | 0 | 251 |


| 04:00 PM | 0 | 24 | 34 | 0 | 58 | 20 | 0 | 4 | 0 | 24 | 5 | 4 | 0 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 91 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 04:15 PM | o | 13 | 33 | o | 46 | 19 | 0 | 4 | 0 | 23 | 5 | 11 | o | 0 | 16 | 0 | 0 | o | 0 | 0 | 85 |
| 04:30 PM | 0 | 23 | 36 | 0 | 59 | 13 | 0 | 2 | 0 | 15 | 8 | 9 | 0 | 0 | 17 | o | 0 | 0 | 0 | 0 | 91 |
| 04:45 PM | 0 | 12 | 43 | 0 | 55 | 11 | 0 | 2 | 0 | 13 | 4 | 8 | 0 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 80 |
| Total | 0 | 72 | 146 | 0 | 218 | 63 | 0 | 12 | 0 | 75 | 22 | 32 | 0 | 0 | 54 | o | 0 | 0 | 0 | 0 | 347 |



## Turning Movement Counts (All Vehicles )

Intersection of DG CO 442 \& Noria Rd Afternoon Peak-Hours
Sunny, Hot

File Name : CR 442 \& Noria-epm
Site Code : 2
Start Date : 7/12/2012
Page No : 2

|  | Noria Road From North |  |  |  |  | DGCO442 <br> From East |  |  |  |  | Noria Road From South |  |  |  |  | From West |  |  |  |  | Int. Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time |  | Thru | Left |  | App. Total | Right |  | Left |  | App. Total | Right | Thru |  |  | App. Total |  |  |  |  | App. Total |  |
| Peak Hour Analysis From 02:00 PM to 04:45 PM - Peak 1 of 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Peak Hour for Entire Intersection Begins at 04:00 PM |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 04:00 PM | 0 | ${ }_{24}$ | ${ }^{3}$ | 。 | ${ }^{88}$ | ${ }^{20}$ | 0 |  | - | ${ }^{24}$ | 5 | 4 | 0 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 91 |
| 04:15 PM | 0 | 13 | 33 | 0 | 46 | 19 | 0 | 4 | 0 | 23 | 5 | 11 | 0 | 0 | 16 | 0 | 0 | 0 | 0 | 0 | 85 |
| 04:30 PM | 0 | 23 | 36 | 0 | 59 | 13 | 0 | 2 | 0 | 15 | 8 | 9 | 0 | 0 | 17 | 0 | 0 | 0 | 0 | 0 | 91 |
| 04:45 PM | 0 | 12 | 43 | 0 | 55 | 11 | 0 | 2 | 0 | 13 | 4 | 8 | 0 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 80 |
| Total Volume | 0 | 72 | 146 | 0 | 218 | 63 | 0 | 12 | 0 | 75 | 22 | 32 | 0 | 0 | 54 | 0 | 0 | 0 | 0 | 0 | 347 |
| \% App. Total | 0 | 33 | 67 | 0 |  | 84 | 0 | 16 | 0 |  | 40.7 | 59.3 | 0 | 0 |  | 0 | 0 | 0 | 0 |  |  |
| PHF | . 000 | . 750 | . 849 | . 000 | . 924 | . 788 | . 000 | . 750 | . 000 | . 781 | . 688 | . 727 | . 000 | . 000 | . 794 | . 000 | . 000 | . 000 | . 000 | . 000 | . 953 |

# Turning Movement Counts (All Vehicles ) 

Intersection of CO Rd 442 \& CO Rd 1057
Morning Peak-Hours
Sunny, Hot
Other:

File Name: CR 442 \& CR 1057-eam
Site Code : 3
Start Date : 7/17/2012
Page No : 1

|  | E 1900 Rd <br> From North |  |  |  |  | DG CO442 From East |  |  |  |  | DG CO 1057 From South |  |  |  |  | DG CO442 <br> FromWest |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Int. Total |
| 06:00 AM | 1 | 0 | 0 | 0 | 1 | 0 | 15 | 6 | 0 | 21 | 2 | 0 | 2 | 0 | 4 | 5 | 2 | 0 | 0 | 7 | 33 |
| 06:15 AM | 0 | o | о | 0 | 0 | 0 | 14 | 8 | 0 | 22 | 2 | o | 0 | o | 2 | 1 | 3 | o | o | 4 | 28 |
| 06:30 AM | 0 | 0 | о | 0 | 0 | 0 | 37 | 15 | 0 | 52 | 2 | 0 | 1 | 0 | 3 | 10 | 3 | 0 | 0 | 13 | 68 |
| 06:45 AM | 0 | о | о | 0 | 0 | 0 | 15 | 15 | 0 | 30 | 5 | 1 | 2 | o | 8 | 5 | 4 | о | о | 9 | 47 |
| Total | 1 | 0 | 0 | 0 | 1 | 0 | 81 | 44 | 0 | 125 | 11 | 1 | 5 | 0 | 17 | 21 | 12 | 0 | 0 | 33 | 176 |
| 07:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 11 | 0 | 29 | 3 | 0 | 3 | 0 | 6 | 8 | 11 | 0 | 0 | 19 | 54 |
| 07:15 AM | 0 | o | - | 0 | 0 | 0 | 23 | 16 | 0 | 39 | 5 | o | 5 | o | 10 | 3 | 2 | o | o | 5 | 54 |
| 07:30 AM | 0 | o | о | 0 | 0 | 0 | 16 | 8 | 0 | 24 | 5 | 1 | 10 | 0 | 16 | 6 | 3 | о | 0 | 9 | 49 |
| 07:45 AM | 0 | o | о | 0 | 0 | 0 | 20 | 18 | 0 | 38 | 4 | 0 | 7 | o | 11 | 4 | 2 | о | o | 6 | 55 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 77 | 53 | 0 | 130 | 17 | 1 | 25 | 0 | 43 | 21 | 18 | 0 | 0 | 39 | 212 |
| 08:00 AM | 0 | 3 | о | 0 | 3 | 0 | 16 | 6 | 0 | 22 | 5 | o | 6 | 0 | 11 | 8 | 3 | 0 | 0 | 11 | 47 |
| 08:15 AM | 0 | 1 | о | 0 | 1 | 1 | 12 | 5 | 0 | 18 | 8 | 1 | 5 | 0 | 14 | 1 | 11 | о | 0 | 12 | 45 |
| 08:30 AM | 0 | 0 | о | 0 | 0 | 1 | 7 | 2 | 0 | 10 | 8 | о | 2 | 0 | 10 | 2 | 6 | о | 0 | 8 | 28 |
| 08:45 AM | 0 | 1 | 1 | 0 | 2 | 0 | 4 | 9 | 0 | 13 | 4 | о | 1 | 0 | 5 | 3 | 6 | о | о | 9 | 29 |
| Total | 0 | 5 | 1 | 0 | 6 | 2 | 39 | 22 | 0 | 63 | 25 | 1 | 14 | 0 | 40 | 14 | 26 | 0 | 0 | 40 | 149 |
| Grand Total | 1 | 5 | 1 | 0 | 7 | 2 | 197 | 119 | 0 | 318 | 53 | 3 | 44 | 0 | 100 | 56 | 56 | 0 | 0 | 112 | 537 |
| Apprch \% | 14.3 | 71.4 | 14.3 | 0 |  | 0.6 | 61.9 | 37.4 | 0 |  | 53 | 3 | 44 | 0 |  | 50 | 50 | 0 | 0 |  |  |
| Total \% | 0.2 | 0.9 | 0.2 | 0 | 1.3 | 0.4 | 36.7 | 22.2 | 0 | 59.2 | 9.9 | 0.6 | 8.2 | 0 | 18.6 | 10.4 | 10.4 | о | 0 | 20.9 |  |

## Turning Movement Counts (All Vehicles )

Intersection of CO Rd 442 \& CO Rd 1057
Morning Peak-Hours
Sunny, Hot
Other:

File Name: CR 442 \& CR 1057-eam
Site Code : 3
Start Date : 7/17/2012
Page No : 2

|  | E 1900 Rd From North |  |  |  |  | DG CO442 <br> From East |  |  |  |  | DG CO 1057 <br> From South |  |  |  |  | DG CO442 <br> From West |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Int. Total |
| Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Peak Hour for Entire Intersection Begins at 06:30 AM |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 06:30 AM | 0 | 0 | 0 | 0 | 0 | 0 |  | 15 | 0 |  | 2 | 0 | 1 | 0 | 3 |  | 3 | 0 | 0 | 13 |  |
| ¢0.45am | 。 | - |  |  | - |  | ${ }^{15}$ | ${ }^{15}$ | 。 | ${ }^{30}$ | 5 | 1 | 2 | 0 | 8 | 5 | 4 | 0 | 0 | 9 | 47 |
| 07:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 11 | 0 | 29 | 3 | 0 | 3 | 0 | 6 | 8 | 11 | 0 | 0 | 19 | 54 |
| 07:15 AM | 0 | 0 | 0 | 0 | 0 | 0 | 23 | 16 | 0 | 39 | 5 | 0 | 5 | 0 | 10 | 3 | 2 | 0 | 0 | 5 | 54 |
| Total Volume | 0 | 0 | 0 | 0 | 0 | 0 | 93 | 57 | 0 | 150 | 15 | 1 | 11 | 0 | 27 | 26 | 20 | 0 | 0 | 46 | 223 |
| \% App. Total | 0 | 0 | 0 | 0 |  | 0 | 62 | 38 | 0 |  | 55.6 | 3.7 | 40.7 | 0 |  | 56.5 | 43.5 | 0 | 0 |  |  |
| PHF | . 000 | . 000 | . 000 | . 000 | . 000 | . 000 | . 628 | . 891 | . 000 | . 721 | . 750 | . 250 | . 550 | . 000 | . 675 | . 650 | . 455 | . 000 | . 000 | . 605 | . 820 |

# Turning Movement Counts (All Vehicles ) 

Intersection of CO Rd 442 \& CO Rd 1057
Afternoon Peak-Hours
Sunny, Hot

File Name: CR 442 \& CR 1057-epm Site Code : 3
Start Date : 7/17/2012
Page No : 1

|  | E 1900 Rd. <br> From North |  |  |  |  | DG CO442 <br> From East |  |  |  |  | DG CO 1057 From South |  |  |  |  | DG CO442 FromWest |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Int. Total |
| 02:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 6 | 0 | 17 | 14 | 1 | 2 | 0 | 17 | 5 | 9 | 0 | 0 | 14 | 48 |
| 02:15 PM | 1 | 1 | 2 | 0 | 4 | 0 | 7 | 6 | 0 | 13 | 14 | 0 | 1 | 0 | 15 | 4 | 12 | 0 | 0 | 16 | 48 |
| 02:30 PM | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 6 | 0 | 26 | 15 | 0 | 0 | 0 | 15 | 2 | 15 | 1 | 0 | 18 | 59 |
| 02:45 PM | o | 0 | 0 | 0 | 0 | o | 11 | 5 | o | 16 | 11 | 0 | 3 | 0 | 14 | 0 | 10 | 0 | 0 | 10 | 40 |
| Total | 1 | 1 | 2 | o | 4 | o | 49 | 23 | o | 72 | 54 | 1 | 6 | o | 61 | 11 | 46 | 1 | 0 | 58 | 195 |


| 03:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 8 | 0 | 17 | 14 | 0 | 2 | 0 | 16 | 10 | 22 | 0 | 0 | 32 | 65 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 03:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 8 | 0 | 23 | 9 | 0 | 3 | 0 | 12 | 1 | 11 | 0 | 0 | 12 | 47 |
| 03:30 PM | 0 | o | o | o | 0 | 0 | 11 | 9 | o | 20 | 13 | 1 | 0 | 0 | 14 | 10 | 22 | 0 | 0 | 32 | 66 |
| 03:45 PM | 0 | 0 | o | o | 0 | 0 | 12 | 3 | o | 15 | 10 | 3 | 2 | 0 | 15 | 6 | 18 | 0 | 0 | 24 | 54 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 47 | 28 | 0 | 75 | 46 | 4 | 7 | 0 | 57 | 27 | 73 | 0 | 0 | 100 | 232 |


| 04:00 PM | 0 | 1 | 0 | 0 | 1 | 0 | 14 | 8 | o | 22 | 15 | 0 | 2 | 0 | 17 | 16 | 18 | 0 | 0 | 34 | 74 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 04:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 7 | o | 16 | 15 | 0 | 5 | 0 | 20 | 11 | 21 | 0 | 0 | 32 | 68 |
| 04:30 PM | 1 | o | o | o | 1 | 1 | 16 | 11 | o | 28 | 15 | 1 | 1 | o | 17 | 18 | 32 | o | o | 50 | 96 |
| 04:45 PM | 1 | 1 | 0 | o | 2 | 0 | 12 | 9 | o | 21 | 13 | 0 | 2 | 0 | 15 | 7 | 21 | 1 | 0 | 29 | 67 |
| Total | 2 | 2 | 0 | 0 | 4 | 1 | 51 | 35 | 0 | 87 | 58 | 1 | 10 | 0 | 69 | 52 | 92 | 1 | 0 | 145 | 305 |


| Grand Total | 3 | 3 | 2 | 0 | 8 | 1 | 147 | 86 | 0 | 234 | 158 | 6 | 23 | 0 | 187 | 90 | 211 | 2 | 0 | 303 | 732 |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| Apprch \% | 37.5 | 37.5 | 25 | 0 |  | 0.4 | 62.8 | 36.8 | 0 |  | 84.5 | 3.2 | 12.3 | 0 |  | 29.7 | 69.6 | 0.7 | 0 |  |  |
| Total \% | 0.4 | 0.4 | 0.3 | 0 | 1.1 | 0.1 | 20.1 | 11.7 | 0 | 32 | 21.6 | 0.8 | 3.1 | 0 | 25.5 | 12.3 | 28.8 | 0.3 | 0 | 41.4 |  |

## Turning Movement Counts （All Vehicles ）

Intersection of CO Rd 442 \＆CO Rd 1057
Afternoon Peak－Hours
Sunny，Hot

File Name：CR 442 \＆CR 1057－epm
Site Code ： 3
Start Date ：7／17／2012
Page No ： 2

|  | E 1900 Rd． <br> From North |  |  |  |  | DG CO442 <br> FromEast |  |  |  |  | DG CO 1057 <br> From South |  |  |  |  | DG CO442 <br> From West |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time | Right | Thru | Left |  | App．Total | Right | Thru | Left |  | App．Total | Right | Thru | Left |  | App．Total | Right | Thru | Left |  | App．Total | Int．Total |
| Peak Hour Analysis From 02：00 PM to 04：45 PM－Peak 1 of 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Peak Hour for Entire Intersection Begins at 04：00 PM |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 04：00 PM | 0 |  | － | 。 | 1 | － | ${ }^{1}$ | ${ }^{8}$ |  | 22 | ${ }^{15}$ | 0 | 2 | 0 | 17 | 16 | 18 | 0 | 0 | 34 | 74 |
| 04：15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 7 | 0 | 16 | 15 | 0 |  | 0 | ${ }^{20}$ | 11 | ${ }^{1}$ | 。 | 。 | 3 | $\propto$ |
| ${ }_{\text {onama }}$ | 1 | 0 | 0 | 0 | 1 | 1 | 16 | 11 | 0 | 28 | 15 | 1 | 1 | 0 | 17 | 18 | 32 | 0 | 0 | 50 | 96 |
| 04：45 PM | 1 | 1 | 0 | 0 | 2 | 0 | 12 | 9 | 0 | 21 | 13 | 0 | 2 | 0 | 15 | 7 | 21 | 1 | 0 | 29 | 67 |
| Total Volume | 2 | 2 | 0 | 0 | 4 | 1 | 51 | 35 | 0 | 87 | 58 | 1 | 10 | 0 | 69 | 52 | 92 | 1 | 0 | 145 | 305 |
| \％App．Total | 50 | 50 | 0 | 0 |  | 1.1 | 58.6 | 40.2 | 0 |  | 84.1 | 1.4 | 14.5 | 0 |  | 35.9 | 63.4 | 0.7 | 0 |  |  |
| PHF | ． 500 | ． 500 | ． 000 | ． 000 | ． 500 | ． 250 | ． 797 | ． 795 | ． 000 | ． 777 | ． 967 | ． 250 | ． 500 | ． 000 | ． 863 | ． 722 | ． 719 | ． 250 | ． 000 | ． 725 | ． 794 |

## Turning Movement Counts (All Vehicles )

Interchange of K-10 \& E 1900 Rd (North Ramps)
Morning Peak-Hours
Sunny, warm

File Name : K10-N Ramps-eam
Site Code : 4
Start Date : 7/12/2012
Page No : 1

Groups Printed- Unshifted

|  | E1900 Rd/ DG CO 1057 <br> From North |  |  |  |  | K-10 (WB Off Ramp) From East |  |  |  |  | E 1900 Rd / DG CO 1057 From South |  |  |  |  | K-10 (WB On Ramp) FromWest |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time | Right | Thru |  |  | App. Total | Right | Thru | Left |  | App. Total |  | Thru | Left |  | App. Total |  |  |  |  | App. Total | Int. Total |
| 06:00 AM | 9 | 5 | 0 | 0 | 14 | 0 | 0 | 1 | 0 | 1 | 0 | 3 | 0 | 0 | 3 | o | 0 | 0 | 0 | 0 | 18 |
| 06:15 AM | 2 | 2 | 0 | 0 | 4 | 0 | 0 | o | 0 | 0 | 0 | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 7 |
| 06:30 AM | 3 | 2 | 0 | 0 | 5 | 1 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 8 |
| 06:45 AM | 10 | 3 | 0 | 0 | 13 | 1 | 0 | 0 | 0 | 1 | 0 | 8 | 0 | 0 | 8 | - | 0 | 0 | 0 | 0 | 22 |
| Total | 24 | 12 | 0 | 0 | 36 | 2 | 0 | 1 | 0 | 3 | 0 | 16 | 0 | 0 | 16 | o | 0 | 0 | 0 | 0 | 55 |


| 07:00 AM | 16 | 6 | 0 | 0 | 22 | 2 | 0 | 0 | 0 | 2 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 29 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 07:15 AM | 20 | 8 | 0 | o | 28 | 6 | 0 | o | o | 6 | 0 | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 37 |
| 07:30 AM | 20 | 6 | 0 | o | 26 | 5 | o | o | o | 5 | 0 | 11 | 0 | o | 11 | 0 | o | o | 0 | 0 | 42 |
| 07:45 AM | 20 | 4 | 0 | 0 | 24 | 6 | 0 | о | 0 | 6 | 0 | 10 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 40 |
| Total | 76 | 24 | 0 | 0 | 100 | 19 | 0 | о | 0 | 19 | 0 | 29 | 0 | 0 | 29 | 0 | 0 | 0 | 0 | 0 | 148 |


| 08:00 AM | 13 | 5 | 0 | 0 | 18 | 1 | 0 | 1 | 0 | 2 | 0 | 9 | 0 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 29 |
| ---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $08: 15 \mathrm{AM}$ | 14 | 6 | 0 | 0 | 20 | 1 | 0 | 0 | 0 | 1 | 0 | 12 | 1 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 34 |
| $08: 30 \mathrm{AM}$ | 12 | 2 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 18 |
| $08: 45 \mathrm{AM}$ | 16 | 0 | 0 | 0 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 23 |
| Total | 55 | 13 | 0 | 0 | 68 | 2 | 0 | 1 | 0 | 3 | 0 | 31 | 2 | 0 | 33 | 0 | 0 | 0 | 0 | 0 | 104 |



## Turning Movement Counts (All Vehicles )

Interchange of K-10 \& E 1900 Rd (North Ramps)
File Name : K10-N Ramps-eam
Morning Peak-Hours
Site Code : 4
Sunny, warm
Start Date : 7/12/2012
Page No : 2

|  | E 1900 Rd / DG CO 1057 <br> From North |  |  |  |  | K-10 (WB Off Ramp) From East |  |  |  |  | E1900 Rd/ DG CO 1057 <br> From South |  |  |  |  | K-10 (WB On Ramp) FromWest |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time | Right | Thru |  |  | App. Total | Right | Thru | Left |  | App. Total |  | Thru | Left |  | App. Total |  |  |  |  | App. Total | Int. Total |
| Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Peak Hour for Entire Intersection Begins at 07:00 AM |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 07:00 AM | 16 | 6 | 0 | 0 | 22 | 2 | 0 | 0 | 0 | 2 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 29 |
| 07:15 AM | ${ }^{20}$ |  | 。 |  |  | 6 | 0 | 0 | 0 | 6 | 0 | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 37 |
| 07:30 AM | 20 | 6 | 0 | 0 | 26 | 5 | 0 | 0 | 0 | 5 | 0 | 11 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 42 |
| 07:45 AM | 20 | 4 | 0 | 0 | 24 | 6 | 0 | 0 | 0 | 6 | 0 | 10 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 40 |
| Total Volume | 76 | 24 | 0 | 0 | 100 | 19 | 0 | 0 | 0 | 19 | 0 | 29 | 0 | 0 | 29 | 0 | 0 | 0 | 0 | 0 | 148 |
| \% App. Total | 76 | 24 | 0 | 0 |  | 100 | 0 | 0 | 0 |  | 0 | 100 | 0 | 0 |  | 0 | 0 | 0 | 0 |  |  |
| PHF | . 950 | . 750 | . 000 | . 000 | . 893 | . 792 | . 000 | . 000 | . 000 | . 792 | . 000 | . 659 | . 000 | . 000 | . 659 | . 000 | . 000 | . 000 | . 000 | . 000 | . 881 |

## Turning Movement Counts (All Vehicles )

Interchange of K-10 \& E 1900 Rd (N Ramps)
Afternoon Peak-Hours
Sunny, Hot

File Name : K10-N Ramps-epm
Site Code : 4
Start Date : 7/17/2012
Page No : 1

Groups Printed- Unshifted

|  | E1900 Rd/ DG CO 1057 <br> From North |  |  |  |  | K-10 (WB Off Ramp) From East |  |  |  |  | E 1900 Rd / DG CO 1057 From South |  |  |  |  | K-10 (WB On Ramp) FromWest |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time | Right | Thru |  |  | App. Total | Right | Thru | Left |  | App. Total |  | Thru | Left |  | App. Total |  |  |  |  | App. Total | Int. Total |
| 02:00 PM | 7 | 7 | 0 | 0 | 14 | 2 | 0 | 1 | 0 | 3 | 0 | 18 | 0 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 35 |
| 02:15 PM | 5 | 5 | 0 | 0 | 10 | 1 | 0 | о | 0 | 1 | 0 | 12 | 2 | 0 | 14 | o | 0 | 0 | 0 | 0 | 25 |
| 02:30 PM | 6 | 3 | 0 | 0 | 9 | 0 | 0 | 3 | 0 | 3 | 0 | 14 | 0 | 0 | 14 | 0 | o | 0 | 0 | 0 | 26 |
| 02:45 PM | 5 | 0 | 0 | о | 5 | 2 | 0 | 1 | 0 | 3 | 0 | 11 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 19 |
| Total | 23 | 15 | 0 | 0 | 38 | 5 | 0 | 5 | 0 | 10 | 0 | 55 | 2 | 0 | 57 | 0 | 0 | 0 | 0 | 0 | 105 |


| 03:00 PM | 9 | 11 | 0 | 0 | 20 | 2 | 0 | 0 | 0 | 2 | 0 | 14 | 1 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 37 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 03:15 PM | 8 | 1 | o | o | 9 | 3 | o | 0 | o | 3 | o | 9 | 1 | 0 | 10 | 0 | o | 0 | 0 | 0 | 22 |
| 03:30 PM | 6 | 10 | 0 | 0 | 16 | 1 | 0 | 1 | 0 | 2 | 0 | 17 | 0 | 0 | 17 | 0 | o | 0 | 0 | 0 | 35 |
| 03:45 PM | 8 | 7 | 0 | 0 | 15 | 3 | 0 | 0 | 0 | 3 | 0 | 11 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 29 |
| Total | 31 | 29 | 0 | 0 | 60 | 9 | 0 | 1 | 0 | 10 | o | 51 | 2 | 0 | 53 | 0 | o | 0 | 0 | 0 | 123 |


| 04:00 PM | 7 | 15 | 0 | 0 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 19 | 0 | 0 | 19 | 0 | 0 | 0 | 0 | 0 | 41 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 04:15 PM | 9 | 10 | o | o | 19 | 2 | 0 | o | o | 2 | o | 15 | o | 0 | 15 | 0 | o | o | 0 | 0 | 36 |
| 04:30 PM | 11 | 23 | 0 | 0 | 34 | 0 | 0 | 0 | 0 | 0 | 0 | 16 | 1 | 0 | 17 | 0 | 0 | 0 | 0 | 0 | 51 |
| 04:45 PM | 8 | 10 | 0 | 0 | 18 | 3 | 0 | 1 | 0 | 4 | 0 | 13 | 1 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 36 |
| Total | 35 | 58 | 0 | 0 | 93 | 5 | 0 | 1 | 0 | 6 | 0 | 63 | 2 | 0 | 65 | o | 0 | 0 | 0 | 0 | 164 |



## Turning Movement Counts (All Vehicles )

Interchange of K-10 \& E 1900 Rd (N Ramps)
Afternoon Peak-Hours
Sunny, Hot

File Name : K10-N Ramps-epm
Site Code : 4
Start Date : 7/17/2012
Page No : 2

|  | E1900 Rd/ DG CO 1057 <br> From North |  |  |  |  | K-10 (WB Off Ramp) From East |  |  |  |  | E 1900 Rd / DG CO 1057 <br> From South |  |  |  |  | K-10 (WB On Ramp) FromWest |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time | Right | Thru |  |  | App. Total | Right | Thru | Left |  | App. Total |  | Thru | Left |  | App. Total |  |  |  |  | App. Total | Int. Total |
| Peak Hour Analysis From 02:00 PM to 04:45 PM - Peak 1 of 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Peak Hour for Entire Intersection Begins at 04:00 PM |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 04:00 PM | 7 | 15 | 0 | 0 | 22 | 0 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 |  | $\bigcirc$ | 。 | 0 | 。 | - | ${ }^{1}$ |
| ${ }^{\text {canspm }}$ | , |  |  |  | ${ }^{19}$ | 2 |  |  |  | 2 | - | ${ }_{15}$ | - | - | ${ }^{15}$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | - | $\bigcirc$ | ${ }^{6}$ |
| osasom |  | ${ }^{23}$ |  |  | 34 | 0 | 0 | 0 | 0 | 0 | 0 | 16 | 1 | 0 | 17 | 0 | 0 | 0 | 0 | 0 | 51 |
| 04:45 PM | 8 | 10 | 0 | 0 | 18 | 3 | 0 | 1 | 0 | 4 | 0 | 13 | 1 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 36 |
| Total Volume | 35 | 58 | 0 | 0 | 93 | 5 | 0 | 1 | 0 | 6 | 0 | 63 | 2 | 0 | 65 | 0 | 0 | 0 | 0 | 0 | 164 |
| \%App. Total | 37.6 | 62.4 | 0 | 0 |  | 83.3 | 0 | 16.7 | 0 |  | 0 | 96.9 | 3.1 | 0 |  | 0 | 0 | 0 | 0 |  |  |
| PHF | . 795 | . 630 | . 000 | . 000 | . 684 | . 417 | . 000 | . 250 | . 000 | . 375 | . 000 | . 829 | . 500 | . 000 | . 855 | . 000 | . 000 | . 000 | . 000 | . 000 | . 804 |

## Turning Movement Counts (All Vehicles )

Interchange of K-10 \& E 1900 Rd (South Ramps)
File Name : K10-S Ramps-eam
Morning Peak-Hours
Sunny, Warm
Site Code : 4
Start Date : 7/12/2012
Page No : 1

|  | E 1900 Rd / DG CO 1057 <br> From North |  |  |  |  | K-10 (EB On Ramp) From East |  |  |  |  | E 1900 Rd / DG CO 1057 <br> From South |  |  |  |  | K-10 (EB Off Ramp) From West |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time |  | Thru | Left |  | App. Total |  |  |  |  | App. Total | Right | Thru |  |  | App. Total | Right | Thru | Left |  | App. Total | Int. Total |
| 06:00 AM | 0 | 3 | 3 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 3 | 0 | 3 | 10 |
| 06:15 AM | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | o | 0 | 2 | o | 0 | o | 2 | o | 0 | 3 | 0 | 3 | 7 |
| 06:30 AM | 0 | o | 2 | 0 | 2 | 0 | 0 | 0 | o | 0 | 0 | o | 0 | o | 0 | o | 0 | 2 | 0 | 2 | 4 |
| 06:45 AM | 0 | 1 | 2 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 7 | 0 | 7 | 11 |
| Total | 0 | 4 | 9 | 0 | 13 | 0 | 0 | 0 | o | 0 | 3 | 1 | 0 | o | 4 | o | 0 | 15 | 0 | 15 | 32 |


| 07:00 AM | 0 | 0 | 6 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 5 | 11 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 07:15 AM | 0 | 0 | 8 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 11 |
| 07:30 AM | 0 | 1 | 5 | 0 | 6 | 0 | 0 | 0 | o | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 10 | 0 | 10 | 17 |
| 07:45 AM | 0 | 0 | 4 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 10 | 14 |
| Total | 0 | 1 | 23 | 0 | 24 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 28 | 0 | 28 | 53 |


| 08:00 AM | 0 | 1 | 5 | 0 | 6 | 0 | 0 | 0 | o | 0 | 0 | o | 0 | o | 0 | 0 | 0 | 9 | 0 | 9 | 15 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 08:15 AM | 0 | 1 | 5 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 12 | 0 | 12 | 19 |
| 08:30 AM | - | 1 | 1 | o | 2 | 0 | o | o | o | 0 | 1 | o | 0 | o | 1 | o | 0 | 4 | o | 4 | 7 |
| 08:45 AM | 0 | 0 | o | o | 0 | 0 | 0 | o | o | 0 | 0 | o | 0 | o | 0 | 1 | o | 7 | o | 8 | 8 |
| Total | 0 | 3 | 11 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 1 | 0 | 32 | 0 | 33 | 49 |


| Grand Total | 0 | 8 | 43 | 0 | 51 | 0 | 0 | 0 | 0 | 0 | 4 | 3 | 0 | 0 | 7 | 1 | 0 | 75 | 0 | 76 |
| ---: | ---: | ---: | ---: | ---: | ---: | :--- | :--- | :--- | :--- | :--- | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| Apprch \% | 0 | 15.7 | 84.3 | 0 |  | 134 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Total \% |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

## Turning Movement Counts (All Vehicles )

Interchange of K-10 \& E 1900 Rd (South Ramps)
File Name : K10-S Ramps-eam
Morning Peak-Hours
Site Code : 4
Sunny, Warm
Start Date : 7/12/2012
Page No : 2

|  | E 1900 Rd / DG CO 1057 <br> From North |  |  |  |  | K-10 (EB On Ramp) From East |  |  |  |  | E1900 Rd / DG CO 1057 <br> From South |  |  |  |  | K-10 (EB Off Ramp) FromWest |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time |  | Thru | Left |  | App. Total |  |  |  |  | App. Total | Right | Thru |  |  | App. Total | Right | Thru | Left |  | App. Total | Int. Total |
| Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Peak Hour for Entire Intersection Begins at 07:30 AM |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 07:30 AM | 0 |  |  | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 1 | 0 | 0 | 10 | 0 | 10 | 17 |
| 07:45 AM | 0 | 0 | 4 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 10 | 14 |
| 08:00 AM | 0 | 1 | 5 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 0 | 9 | 15 |
| 08:15 AM | 0 | 1 | 5 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 12 | 0 | 12 | 19 |
| Total Volume | 0 | 3 | 19 | 0 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 0 | 0 | 41 | 0 | 41 | 65 |
| \% App. Total | 0 | 13.6 | 86.4 | 0 |  | 0 | 0 | 0 | 0 |  | 0 | 100 | 0 | 0 |  | 0 | 0 | 100 | 0 |  |  |
| PHF | . 000 | . 750 | . 950 | . 000 | . 917 | . 000 | . 000 | . 000 | . 000 | . 000 | . 000 | . 500 | . 000 | . 000 | . 500 | . 000 | . 000 | . 854 | . 000 | . 854 | . 855 |

## Turning Movement Counts (All Vehicles )

Interchange of K-10 \& E 1900 Rd (S Ramps)
File Name : K10-S Ramps-epm
Afternoon Peak-Hours
Site Code : 4
Start Date : 7/17/2012

| Groups Printed- Unshifted |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $\begin{gathered} \hline \text { E } 1900 \text { / DG CO } 1057 \\ \text { From North } \\ \hline \end{gathered}$ |  |  |  |  | K-10 (EB On Ramp) From East |  |  |  |  | $\begin{gathered} \text { E } 1900 \text { / DG CO } 1057 \\ \text { From South } \end{gathered}$ |  |  |  |  | K-10 (EB Off Ramp) FromWest |  |  |  |  |  |
| Start Time |  | Thru | Left |  | App. Total |  |  |  |  | App. Total | Right | Thru |  |  | App. Total | Right | Thru | Left |  | App. Total | Int. Total |
| 02:00 PM | 0 | 2 | 6 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 17 | 0 | 17 | 26 |
| 02:15 PM | 0 | 0 | 5 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 4 | 1 | o | 12 | o | 13 | 22 |
| 02:30 PM | 0 | 2 | 4 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 14 | 0 | 14 | 21 |
| 02:45 PM | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 0 | 11 | 12 |
| Total | 0 | 5 | 15 | 0 | 20 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 6 | 1 | 0 | 54 | 0 | 55 | 81 |


| 03:00 PM | 0 | 0 | 11 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 15 | 0 | 15 | 27 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 03:15 PM | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 4 | 0 | 0 | 8 | 0 | 8 | 13 |
| 03:30 PM | o | o | 11 | 0 | 11 | 0 | o | 0 | o | 0 | 0 | 0 | o | o | 0 | 0 | o | 17 | 0 | 17 | 28 |
| 03:45 PM | 0 | 1 | 6 | 0 | 7 | 0 | 0 | 0 | o | 0 | 0 | 0 | 0 | o | 0 | 2 | 0 | 11 | 0 | 13 | 20 |
| Total | 0 | 1 | 29 | 0 | 30 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 0 | 0 | 5 | 2 | 0 | 51 | 0 | 53 | 88 |


| 04:00 PM | 0 | 0 | 15 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 19 | 0 | 19 | 34 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 04:15 PM | 0 | 0 | 10 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 3 | 1 | 0 | 13 | 0 | 14 | 27 |
| 04:30 PM | 0 | 0 | 23 | 0 | 23 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 0 | 0 | 16 | 0 | 16 | 41 |
| 04:45 PM | 0 | 4 | 7 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 1 | 0 | 12 | 0 | 13 | 26 |
| Total | 0 | 4 | 55 | 0 | 59 | 0 | 0 | 0 | 0 | 0 | 2 | 5 | 0 | 0 | 7 | 2 | 0 | 60 | 0 | 62 | 128 |


| Grand Total | 0 | 10 | 99 | 0 | 109 | 0 | 0 | 0 | 0 | 0 | 7 | 11 | 0 | 0 | 18 | 5 | 0 | 165 | 0 | 170 |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | :--- | :--- | :--- | :--- | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| Apprch \% | 0 | 9.2 | 90.8 | 0 |  | 297 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Total \% |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

## Turning Movement Counts (All Vehicles )

Interchange of K-10 \& E 1900 Rd (S Ramps)
File Name : K10-S Ramps-epm
Afternoon Peak-Hours
Site Code : 4
Sunny, Hot
Start Date : 7/17/2012
Page No : 2

|  | E1900 / DG CO 1057 <br> From North |  |  |  |  | K-10 (EB On Ramp) From East |  |  |  |  | E1900 / DG CO 1057 <br> From South |  |  |  |  | K-10 (EB Off Ramp) FromWest |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time |  | Thru | Left |  | App. Total |  |  |  |  | App. Total | Right | Thru |  |  | App. Total | Right | Thru | Left |  | App. Total | Int. Total |
| Peak Hour Analysis From 02:00 PM to 04:45 PM - Peak 1 of 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Peak Hour for Entire Intersection Begins at 04:00 PM |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 04:00 PM | 0 | 0 | 15 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  | 0 | ${ }^{19}$ | ${ }^{3}$ |
| ${ }^{\text {ounspm }}$ |  |  |  |  |  |  |  |  |  | - |  |  | 0 | 0 | 3 | 1 | 0 | 13 | 0 | 14 | 27 |
| 04:30 PM | 0 | 0 | 23 | 0 | 23 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 0 | 0 | 16 | 0 | 16 | 41 |
| 04:45 PM | 0 | 4 | 7 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 1 | 0 | 12 | 0 | 13 | 26 |
| Total Volume | 0 | 4 | 55 | 0 | 59 | 0 | 0 | 0 | 0 | 0 | 2 | 5 | 0 | 0 | 7 | 2 | 0 | 60 | 0 | 62 | 128 |
| \% App. Total | 0 | 6.8 | 93.2 | 0 |  | 0 | 0 | 0 | 0 |  | 28.6 | 71.4 | 0 | 0 |  | 3.2 | 0 | 96.8 | 0 |  |  |
| PHF | . 000 | . 250 | . 598 | . 000 | . 641 | . 000 | . 000 | . 000 | . 000 | . 000 | . 500 | . 625 | . 000 | . 000 | . 583 | . 500 | . 000 | . 789 | . 000 | . 816 | . 780 |

## Turning Movement Counts

 (Trucks Only )Intersection of Noria Rd \& N 1500 Rd Morning Peak-Hours
Sunny, Hot

File Name : Noria \& N 1500 -eam-truck
Site Code : 1
Start Date : 7/11/2012
Page No : 1

***BREAK ***

| 07:30 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 07:45 AM | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | o | 0 | 1 | 0 | 0 | 1 | 0 | o | 0 | 0 |


| 08:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 08:15 AM | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | o | 0 | 0 | 0 | 1 |
| 08:30 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 3 |
| 08:45 AM | 0 | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | o | 0 | 0 | 0 | 3 |
| Total | 0 | 4 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 8 |
| Grand Total | 0 | 6 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 6 | 0 | 1 | 0 | 0 | 1 | 13 |
| Apprch \% | 0 | 100 | 0 | 0 |  | 0 | 0 | 0 | 0 |  | 0 | 100 | 0 | 0 |  | 0 | 100 | 0 | 0 |  |  |
| Total \% | 0 | 46.2 | 0 | 0 | 46.2 | 0 | 0 | 0 | 0 | 0 | 0 | 46.2 | 0 | 0 | 46.2 | 0 | 7.7 | 0 | 0 | 7.7 |  |

## Turning Movement Counts

 (Trucks Only )Intersection of Noria Rd \& N 1500 Rd Morning Peak-Hours
Sunny, Hot
File Name: Noria \& N 1500 -eam-truck
Site Code : 1
Start Date : 7/11/2012 Page No : 2

|  | Sand Plant Driveway From North |  |  |  |  | N 1500 Rd From East |  |  |  |  | Noria Rd <br> From South |  |  |  |  | N 1500 Rd FromWest |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Int. Total |
| Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Peak Hour for Entire Intersection Begins at 08:00 AM |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 08:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 08:15 AM | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 08:30 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 3 | 0 | 0 | 0 | - | 。 |  |
| 0.45sm | - | 3 | - | - | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| Total Volume | 0 | 4 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 8 |
| \%App. Total | 0 | 100 | 0 | 0 |  | 0 | 0 | 0 | 0 |  | 0 | 100 | 0 | 0 |  | 0 | 0 | 0 | 0 |  |  |
| PHF | . 000 | . 333 | . 000 | . 000 | . 333 | . 000 | . 000 | . 000 | . 000 | . 000 | . 000 | . 333 | . 000 | . 000 | . 333 | . 000 | . 000 | . 000 | . 000 | . 000 | . 667 |

## Turning Movement Counts

 (Trucks Only )Intersection of Noria Rd \& N 1500 Rd Afternoon Peak-Hours Sunny, Hot

File Name : Noria \& N 1500 -epm-truck
Site Code : 1
Start Date : 7/11/2012
Page No : 1

| Groups Printed- Unshifted |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Sand Plant Driveway From North |  |  |  |  | N 1500 Rd From East |  |  |  |  | Noria Rd From South |  |  |  |  | N 1500 Rd FromWest |  |  |  |  |  |
| Start Time | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Int. Total |
| 02:00 PM | 0 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| *** BREAK *** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 02:30 PM | 0 | 0 | 0 | 0 | o | 0 | 0 | 0 | 0 | o | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | o | 1 |
| *** BREAK *** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Total | 0 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 3 |


| 03:00 PM | 0 | 1 | 0 | 0 | 1 | o | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 3 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| *** BREAK *** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 03:30 PM | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 3 |
| 03:45 PM | 0 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 3 |
| Total | 0 | 4 | 0 | 0 | 4 | o | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 9 |
| 04:00 PM | 0 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| *** BREAK *** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 04:30 PM | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 |
| 04:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| Total | 0 | 3 | 0 | 0 | 3 | 0 | 0 | o | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 5 |



## Turning Movement Counts

 (Trucks Only )Intersection of Noria Rd \& N 1500 Rd Afternoon Peak-Hours

File Name : Noria \& N 1500 -epm-truck
Sunny, Hot
Site Code : 1
Start Date : 7/11/2012 Page No : 2

|  | Sand Plant Driveway From North |  |  |  |  | N 1500 Rd From East |  |  |  |  | Noria Rd From South |  |  |  |  | N 1500 Rd FromWest |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Int. Total |
| Peak Hour Analysis From 02:00 PM to 04:45 PM - Peak 1 of 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Peak Hour for Entire Intersection Begins at 03:00 PM |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 03:00 PM | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 |  | $\bigcirc$ | 0 | 0 | - | - |  |
| $03: 15 \mathrm{PM}$ $03: 30 \mathrm{PM}$ | - | ${ }_{1}$ | - | : | ${ }_{1}$ | : | : | : | - | $\bigcirc$ | - | 2 0 2 | - | : | 2 0 2 | : | $\bigcirc$ | : | : | $\bigcirc$ | 3 |
| ${ }_{\text {casmbm }}$ | - |  | - | - | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 3 |
| Total Volume | 0 | 4 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 9 |
| \%App. Total | 0 | 100 | 0 | 0 |  | 0 | 0 | 0 | 0 |  | 0 | 100 | 0 | 0 |  | 0 | 0 | 0 | 0 |  |  |
| PHF | . 000 | . 500 | . 000 | . 000 | . 500 | . 000 | . 000 | . 000 | . 000 | . 000 | . 000 | . 625 | . 000 | . 000 | . 625 | . 000 | . 000 | . 000 | . 000 | . 000 | . 750 |

# Turning Movement Counts (Trucks Only ) 

Intersection of Noria Rd \& DG CO 442
Morning Peak-Hours
Sunny, Hot

File Name: CR 442 \& Noria-eam-truck
Site Code : 2
Start Date : 7/12/2012
Page No : 1


| 07:00 AM | 0 | 0 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | o | 0 | 0 | 0 | 0 | 4 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 07:15 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| 07:30 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 |
| 07:45 AM | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 2 | 0 | 0 | 2 | - | 0 | 0 | 0 | 0 | 4 |
| Total | 0 | 0 | 4 | 0 | 4 | 0 | 0 | 2 | 0 | 2 | 1 | 5 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 12 |


| 08:00 AM | 0 | 0 | o | o | 0 | 0 | 0 | o | o | 0 | o | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 3 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 08:15 AM | 0 | 1 | 4 | 0 | 5 | 0 | 0 | 0 | о | 0 | 0 | 4 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 9 |
| 08:30 AM | o | 0 | 0 | 0 | 0 | 0 | 0 | o | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 08:45 AM | 0 | 0 | o | 0 | 0 | o | 0 | o | о | 0 | o | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| Total | o | 1 | 4 | o | 5 | o | o | o | o | o | o | 10 | 0 | o | 10 | o | 0 | o | 0 | o | 15 |



## Turning Movement Counts

 (Trucks Only )Intersection of Noria Rd \& DG CO 442
Morning Peak-Hours
File Name: CR 442 \& Noria-eam-truck
Sunny, Hot
Site Code : 2
Start Date : 7/12/2012
Page No : 2

|  | Noria Rd From North |  |  |  |  | DG CO442 <br> From East |  |  |  |  | Noria Rd From South |  |  |  |  | FromWest |  |  |  |  | Int. Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time |  | Thru | Left |  | App. Total | Right |  | Left |  | App. Total | Right | Thru |  |  | App. Total |  |  |  |  | App. Total |  |
| Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Peak Hour for Entire Intersection Begins at 07:30 AM |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 07:30 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 |
| 07:45 AM | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 4 |
| 08:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 3 |
| 08:15 AM | 0 | 1 | 4 | 。 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 9 |
| Total Volume | 0 | 1 | 5 | 0 | 6 | 0 | 0 | 2 | 0 | 2 | 0 | 10 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 18 |
| \% App. Total | 0 | 16.7 | 83.3 | 0 |  | 0 | 0 | 100 | 0 |  | 0 | 100 | 0 | 0 |  | 0 | 0 | 0 | 0 |  |  |
| PHF | . 000 | . 250 | . 313 | . 000 | . 300 | . 000 | . 000 | . 500 | . 000 | . 500 | . 000 | . 625 | . 000 | . 000 | . 625 | . 000 | . 000 | . 000 | . 000 | . 000 | . 500 |

# Turning Movement Counts (Trucks Only ) 

Intersection of DG CO 442 \& Noria Rd
Afternoon Peak-Hours
Sunny, Hot

File Name: CR 442 \& Noria-epm-truck
Site Code : 2
Start Date : 7/12/2012
Page No : 1

|  | Noria Road From North |  |  |  |  | DG CO442 <br> From East |  |  |  |  | Noria Road From South |  |  |  |  | FromWest |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time |  | Thru | Left |  | App. Total | Right |  | Left |  | App. Total | Right | Thru |  |  | App. Total |  |  |  |  | App. Total | Int. Total |
| 02:00 PM | 0 | 0 | 4 | 0 | 4 | 0 | o | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| 02:15 PM | 0 | 0 | о | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 4 |
| 02:30 PM | 0 | 1 | 1 | 0 | 2 | 0 | o | 0 | - | 0 | о | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 3 |
| 02:45 PM | 0 | 1 | 3 | o | 4 | 0 | 0 | o | 0 | 0 | 0 | 1 | 0 | o | 1 | 0 | 0 | 0 | 0 | o | 5 |
| Total | 0 | 2 | 8 | o | 10 | 0 | 0 | 1 | o | 1 | o | 6 | o | o | 6 | 0 | 0 | o | 0 | o | 17 |


| 03:00 PM | 0 | 1 | 2 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 4 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 03:15 PM | 0 | 0 | 1 | o | 1 | 1 | o | 0 | o | 1 | 0 | 2 | 0 | o | 2 | o | o | 0 | - | 0 | 4 |
| 03:30 PM | 0 | o | 3 | o | 3 | 0 | o | o | o | 0 | 0 | 3 | 0 | o | 3 | o | o | o | - | 0 | 6 |
| 03:45 PM | 0 | 1 | 4 | 0 | 5 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 7 |
| Total | 0 | 2 | 10 | 0 | 12 | 2 | 0 | 0 | 0 | 2 | 0 | 7 | 0 | 0 | 7 | 0 | o | o | o | 0 | 21 |


| 04:00 PM | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 04:15 PM | 0 | 0 | 1 | 0 | 1 | 0 | o | 0 | o | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 04:30 PM | 0 | 1 | 1 | o | 2 | 0 | o | 0 | о | 0 | 0 | 1 | 0 | o | 1 | 0 | 0 | 0 | o | 0 | 3 |
| 04:45 PM | 0 | 0 | 1 | o | 1 | 0 | o | 0 | о | 0 | O | o | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Total | 0 | 1 | 5 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 7 |


| Grand Total | 0 | 5 | 23 | 0 | 28 | 2 | 0 | 1 | 0 | 3 | 0 | 14 | 0 | 0 | 14 | 0 | 0 | 0 |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| Apprch \% | 0 | 0 | 0 | 45 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Total \% |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

## Turning Movement Counts

 （Trucks Only ）Intersection of DG CO 442 \＆Noria Rd Afternoon Peak－Hours
Sunny，Hot

File Name：CR 442 \＆Noria－epm－truck
Site Code ： 2
Start Date ：7／12／2012
Page No ： 2

|  | Noria Road From North |  |  |  |  | DG CO442 <br> From East |  |  |  |  | Noria Road From South |  |  |  |  | FromWest |  |  |  |  | Int．Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time |  | Thru | Left |  | App．Total | Right |  | Left |  | App．Total | Right | Thru |  |  | App．Total |  |  |  |  | App．Total |  |
| Peak Hour Analysis From 02：00 PM to 04：45 PM－Peak 1 of 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Peak Hour for Entire Intersection Begins at 03：00 PM |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 03：00 PM | 0 |  | 2 | 。 | 3 | － | － | 0 | 。 | － | $\bigcirc$ | 1 | 。 | 0 | 1 | － | 0 | 0 | 。 | － | 4 |
| ${ }^{\text {casP5M }}$ |  |  | 1 |  |  |  | 0 | 0 | 0 |  | 0 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 4 |
| 03：30 PM | 0 | 0 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 6 |
| 03：45 PM | 0 | 1 | 4 | 0 | 5 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 7 |
| Total Volume | 0 | 2 | 10 | 0 | 12 | 2 | 0 | 0 | 0 | 2 | 0 | 7 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 21 |
| \％App．Total | 0 | 16.7 | 83.3 | 0 |  | 100 | 0 | 0 | 0 |  | 0 | 100 | 0 | 0 |  | 0 | 0 | 0 | 0 |  |  |
| PHF | ． 000 | ． 500 | ． 625 | ． 000 | ． 600 | ． 500 | ． 000 | ． 000 | ． 000 | ． 500 | ． 000 | ． 583 | ． 000 | ． 000 | ． 583 | ． 000 | ． 000 | ． 000 | ． 000 | ． 000 | ． 750 |

## Turning Movement Counts (Trucks Only )

Intersection of CO Rd 442 \& CO Rd 1057
Morning Peak-Hours
Sunny, Hot
Other:

File Name: CR 442 \& CR 1057-eam-truck Site Code : 3
Start Date : 7/17/2012
Page No : 1

|  | E 1900 Rd <br> From North |  |  |  |  | DG CO 442 From East |  |  |  |  | DGCO 1057 From South |  |  |  |  | DG CO442 <br> FromWest |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Int. Total |
| 06:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | 3 |
| 06:15 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | o | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| 06:30 AM | 0 | 0 | o | 0 | 0 | 0 | o | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 4 | 4 |
| 06:45 AM | 0 | 0 | о | 0 | 0 | 0 | о | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | 4 |
| Total | o | o | o | 0 | o | 0 | o | 1 | 0 | 1 | o | o | 0 | 0 | o | 11 | 0 | 0 | 0 | 11 | 12 |
| 07:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | o | o | 0 | 0 | o | 0 | o | 0 | 0 | 3 | 0 | 0 | 0 | 3 | 3 |
| *** BREAK *** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 07:30 AM | 0 | o | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| 07:45 AM | 0 | 0 | о | 0 | 0 | 0 | 0 | 0 | 0 | o | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 2 |
| Total | o | o | o | 0 | o | o | o | o | 0 | o | 0 | o | o | o | o | 6 | 0 | 0 | 0 | 6 | 6 |


| 08:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 4 | 0 | 0 | 0 | 4 | 5 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 08:15 AM | 0 | 0 | 0 | о | 0 | o | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 4 |
| 08:30 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | o | 0 | 0 | 4 | 0 | 0 | 0 | 4 | 2 | 0 | 0 | 0 | 2 | 6 |
| 08:45 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | о | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 2 |
| Total | 0 | 0 | 0 | 0 | o | 0 | 0 | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 9 | 8 | 0 | 0 | 0 | 8 | 17 |


| Grand Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 9 | 0 | 0 | 0 | 9 | 25 | 0 | 0 | 0 | 25 | 35 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Apprch \% | 0 | 0 | 0 | 0 |  | 0 | 0 | 100 | 0 |  | 100 | 0 | 0 | 0 |  | 100 | 0 | 0 | 0 |  |  |
| Total \% | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.9 | 0 | 2.9 | 25.7 | 0 | 0 | 0 | 25.7 | 71.4 | 0 | 0 | 0 | 71.4 |  |

## Turning Movement Counts

 （Trucks Only ）Intersection of CO Rd 442 \＆CO Rd 1057
Morning Peak－Hours
Sunny，Hot
Other：

File Name：CR 442 \＆CR 1057－eam－truck Site Code ： 3
Start Date ：7／17／2012
Page No ： 2

|  | E 1900 Rd From North |  |  |  |  | DG CO442 <br> From East |  |  |  |  | DG CO 1057 <br> From South |  |  |  |  | DG CO442 <br> FromWest |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time | Right | Thru | Left |  | App．Total | Right | Thru | Left |  | App．Total | Right | Thru | Left |  | App．Total | Right | Thru | Left |  | App．Total | Int．Total |
| Peak Hour Analysis From 06：00 AM to 08：45 AM－Peak 1 of 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Peak Hour for Entire Intersection Begins at 07：45 AM |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 07：45 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 2 |
| 08：00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |  | 0 | 0 | 0 | 4 | 5 |
| ${ }_{\text {cosam }}$ | － | － | 0 | － | － | － | 0 | 0 | － | － |  | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 。 | － | 4 |
| 0830am | － | 0 | 0 | 。 | － | 0 | 0 | 0 | － | 0 | 4 | 。 | 。 | 0 | 4 | 2 | 。 | 0 | 0 | 2 | 6 |
| Total Volume | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 9 | 8 | 0 | 0 | 0 | 8 | 17 |
| \％App．Total | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |  | 100 | 0 | 0 | 0 |  | 100 | 0 | 0 | 0 |  |  |
| PHF | ． 000 | ． 000 | ． 000 | ． 000 | ． 000 | ． 000 | ． 000 | ． 000 | ． 000 | ． 000 | ． 563 | ． 000 | ． 000 | ． 000 | ． 563 | ． 500 | ． 000 | ． 000 | ． 000 | ． 500 | ． 708 |

## Turning Movement Counts (Trucks Only )

Intersection of CO Rd 442 \& CO Rd 1057
Afternoon Peak-Hours
Sunny, Hot

File Name: CR 442 \& CR 1057-epm-truck Site Code : 3
Start Date : 7/17/2012 Page No : 1

|  | E 1900 Rd. <br> From North |  |  |  |  | DG CO442 <br> From East |  |  |  |  | DG CO 1057 <br> From South |  |  |  |  | DG CO442 FromWest |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Int. Total |
| 02:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | о | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | o | 1 | 3 |
| 02:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 1 | 0 | 5 | 3 | o | 0 | o | 3 | 8 |
| 02:30 PM | 0 | o | 0 | 0 | 0 | 0 | о | 0 | - | 0 | 4 | o | 0 | 0 | 4 | 0 | o | 0 | o | 0 | 4 |
| 02:45 PM | 0 | o | 0 | o | 0 | 0 | 0 | 0 | 0 | o | 5 | 0 | o | 0 | 5 | 0 | o | 0 | 0 | 0 | 5 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | o | 15 | o | 1 | 0 | 16 | 4 | o | 0 | o | 4 | 20 |


| 03:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | 4 | 0 | 0 | 0 | 4 | 7 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 03:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 4 | 1 | 0 | 0 | 0 | 1 | 5 |
| 03:30 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 5 |
| 03:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 3 | 0 | 0 | 0 | 3 | 5 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 14 | 8 | 0 | 0 | 0 | 8 | 22 |


| $04: 00 \mathrm{PM}$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 6 | 4 | 0 | 0 | 0 | 4 | 10 |
| ---: | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| $04: 15 \mathrm{PM}$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 1 | 0 | 0 | 0 | 1 |  |
| $04: 30 \mathrm{PM}$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 3 | 2 | 1 | 0 | 0 | 3 | 6 |
| $04: 45 \mathrm{PM}$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 3 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16 | 0 | 1 | 0 | 17 | 7 | 1 | 0 | 0 | 8 | 25 |



## Turning Movement Counts

 (Trucks Only )Intersection of CO Rd 442 \& CO Rd 1057
Afternoon Peak-Hours
Sunny, Hot

File Name: CR 442 \& CR 1057-epm-truck Site Code : 3
Start Date : 7/17/2012 Page No : 2

|  | E 1900 Rd. From North |  |  |  |  | DG CO442 <br> From East |  |  |  |  | DG CO 1057 <br> From South |  |  |  |  | DG CO442 <br> From West |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Right | Thru | Left |  | App. Total | Int. Total |
| Peak Hour Analysis From 02:00 PM to 04:45 PM - Peak 1 of 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Peak Hour for Entire Intersection Begins at 03:45 PM |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 03:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 3 | 0 | 0 | 0 | 3 | 5 |
| 04:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 6 | 4 | 0 | 0 | 0 | 4 | 10 |
| 04:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 1 | 0 | 0 | 0 | 1 | 6 |
| 04:30 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 3 | 2 | 1 | 0 | 0 | 3 | 6 |
| Total Volume | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 0 | 1 | 0 | 16 | 10 | 1 | 0 | 0 | 11 | 27 |
| \%App. Total | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |  | 93.8 | 0 | 6.2 | 0 |  | 90.9 | 9.1 | 0 | 0 |  |  |
| PHF | . 000 | . 000 | . 000 | . 000 | . 000 | . 000 | . 000 | . 000 | . 000 | . 000 | . 625 | . 000 | . 250 | . 000 | . 667 | . 625 | . 250 | . 000 | . 000 | . 688 | . 675 |

## Turning Movement Counts

 (Trucks Only )Interchange of K-10 \& E 1900 Rd (North Ramps)
Morning Peak-Hours
Sunny, warm

File Name : K10-N Ramps-eam-truck
Site Code : 4
Start Date : 7/12/2012
Page No : 1

| Groups Printed- Unshifted |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | E 1900 Rd / DG CO 1057 From North |  |  |  |  | K-10 (WB Off Ramp) From East |  |  |  |  | E1900 Rd / DG CO 1057 From South |  |  |  |  | K-10 (WB On Ramp) FromWest |  |  |  |  |  |
| Start Time | Right | Thru |  | trucks | App. Total | Right | Thru | Left | trucks | App. Total |  | Thru | Left | trucks | App. Total |  |  |  |  | App. Total | Int. Total |
| 06:00 AM | 0 | 0 | 0 | 0 | o | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | o | 1 |
| *** BREAK *** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 07:00 AM | 0 | 0 | 0 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| *** BREAK *** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 07:30 AM | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 4 |
| 07:45 AM | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 4 |
| Total | 0 | 0 | 0 | 7 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 12 |


| 08:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | o | 0 | 0 | 0 | 0 | 4 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 08:15 AM | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 8 |
| 08:30 AM | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 4 |
| 08:45 AM | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 2 |
| Total | 0 | 0 | 0 | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 12 | 0 | 0 | 0 | 0 | 0 | 18 |



## Turning Movement Counts （Trucks Only ）

Interchange of K－10 \＆E 1900 Rd（North Ramps）
Morning Peak－Hours
Sunny，warm

File Name：K10－N Ramps－eam－truck
Site Code ： 4
Start Date ：7／12／2012
Page No ： 2

|  | E1900 Rd／DG CO 1057 <br> From North |  |  |  |  | K－10（WB Off Ramp） From East |  |  |  |  | E1900 Rd／DG CO 1057 <br> From South |  |  |  |  | K－10（WB On Ramp） FromWest |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time | Right | Thru |  | trucks | App．Total | Right | Thru | Left | trucks | App．Total |  | Thru | Left | trucks | App．Total |  |  |  |  | App．Total | Int．Total |
| Peak Hour Analysis From 06：00 AM to 08：45 AM－Peak 1 of 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Peak Hour for Entire Intersection Begins at 07：30 AM |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 07：30 AM | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 4 |
| 07：45 AM | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 4 |
| 08：00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 4 |
| 08：15 AM | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 | － | 。 | 。 | 。 | － | 8 |
| Total Volume | 0 | 0 | 0 | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 14 | 0 | 0 | 0 | 0 | 0 | 20 |
| \％App．Total | 0 | 0 | 0 | 100 |  | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 100 |  | 0 | 0 | 0 | 0 |  |  |
| PHF | ． 000 | ． 000 | ． 000 | ． 500 | ． 500 | ． 000 | ． 000 | ． 000 | ． 000 | ． 000 | ． 000 | ． 000 | ． 000 | ． 700 | ． 700 | ． 000 | ． 000 | ． 000 | ． 000 | ． 000 | ． 625 |

## Turning Movement Counts (Trucks Only )

Interchange of K-10 \& E 1900 Rd (N Ramps)
Afternoon Peak-Hours
Sunny, Hot

File Name : K10-N Ramps-epm-truck
Site Code : 4
Start Date : 7/17/2012
Page No : 1

|  | E 1900 Rd / DG CO 1057 <br> From North |  |  |  |  | K-10 (WB Off Ramp) From East |  |  |  |  | E 1900 Rd / DG CO 1057From South |  |  |  |  | K-10 (WB On Ramp) FromWest |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time | Right | Thru |  | trucks | App. Total | Right | Thru | Left | trucks | App. Total |  | Thru | Left | trucks | App. Total |  |  |  |  | App. Total | Int. Total |
| 02:00 PM | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 5 |
| 02:15 PM | 0 | o | 0 | 3 | 3 | 0 | о | о | 1 | 1 | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 7 |
| 02:30 PM | 0 | 0 | 0 | 0 | 0 | 0 | о | о | 0 | 0 | 0 | 0 | o | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 5 |
| 02:45 PM | 0 | о | 0 | 0 | 0 | 0 | о | о | 0 | o | 0 | 0 | 0 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 4 |
| Total | 0 | o | 0 | 5 | 5 | 0 | 0 | o | 1 | 1 | o | 0 | 0 | 15 | 15 | 0 | 0 | 0 | 0 | 0 | 21 |


| 03:00 PM | 0 | 0 | 0 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 8 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 03:15 PM | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 4 |
| 03:30 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 6 |
| 03:45 PM | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 5 |
| Total | 0 | 0 | 0 | 8 | 8 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 14 | 14 | 0 | 0 | 0 | 0 | 0 | 23 |


| 04:00 PM | 0 | 0 | 0 | 5 | 5 | 0 | o | o | o | 0 | o | 0 | o | 4 | 4 | 0 | o | 0 | o | 0 | 9 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 04:15 PM | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | o | 0 | 0 | 0 | o | 5 | 5 | 0 | o | 0 | o | 0 | 6 |
| 04:30 PM | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | o | 0 | 0 | 0 | o | 4 | 4 | 0 | o | 0 | o | 0 | 6 |
| 04:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | o | 0 | 0 | o | 0 | 2 | 2 | 0 | o | 0 | о | 0 | 2 |
| Total | 0 | 0 | 0 | 8 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 15 | 0 | 0 | 0 | 0 | 0 | 23 |



## Turning Movement Counts

 （Trucks Only ）Interchange of K－10 \＆E 1900 Rd（N Ramps）
Afternoon Peak－Hours
Sunny，Hot

File Name ：K10－N Ramps－epm－truck
Site Code ： 4
Start Date ：7／17／2012
Page No ： 2

|  | E 1900 Rd／DG CO 1057 <br> From North |  |  |  |  | K－10（VB Off Ramp） From East |  |  |  |  | E1900 Rd／DG CO 1057 <br> From South |  |  |  |  | K－10（WB On Ramp） FromWest |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time | Right | Thru |  | trucks | App．Total | Right | Thru | Left | trucks | App．Total |  | Thru | Left | trucks | App．Total |  |  |  |  | App．Total | Int．Total |
| Peak Hour Analysis From 02：00 PM to 04：45 PM－Peak 1 of 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Peak Hour for Entire Intersection Begins at 03：30 PM |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 03：30 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  |  | 0 | 0 | 0 |  |  | 。 | 0 | 0 | 。 | － | 6 |
| ${ }_{\text {casma }}$ | 。 | 0 | 。 | ${ }^{3}$ | ${ }^{3}$ | 。 | － | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | 。 | $\bigcirc$ | － | ${ }_{2}$ | ${ }_{2}$ | 。 | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | 5 |
| asomp | 。 | － | 。 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 9 |
| 04：15 PM | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 6 |
| Total Volume | 0 | 0 | 0 | 9 | 9 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 16 | 16 | 0 | 0 | 0 | 0 | 0 | 26 |
| \％App．Total | 0 | 0 | 0 | 100 |  | 0 | 0 | 0 | 100 |  | 0 | 0 | 0 | 100 |  | 0 | 0 | 0 | 0 |  |  |
| PHF | ． 000 | ． 000 | ． 000 | ． 450 | ． 450 | ． 000 | ． 000 | ． 000 | ． 250 | ． 250 | ． 000 | ． 000 | ． 000 | ． 800 | ． 800 | ． 000 | ． 000 | ． 000 | ． 000 | ． 000 | ． 722 |

## Turning Movement Counts

 (Trucks Only )Interchange of K-10 \& E 1900 Rd (South Ramps)
Morning Peak-Hours
Sunny, Warm

File Name : K10-S Ramps-eam-truck
Site Code : 4
Start Date : 7/12/2012
Page No : 1

Groups Printed- Unshifted


| 07:00 AM | 0 | 0 | 0 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| *** BREAK *** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 07:30 AM | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 4 |
| 07:45 AM | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 4 |
| Total | 0 | 0 | 0 | 7 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 12 |


| 08:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 4 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 08:15 AM | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 8 |
| 08:30 AM | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 4 |
| 08:45 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| Total | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 12 | 17 |



## Turning Movement Counts (Trucks Only )

Interchange of K-10 \& E 1900 Rd (South Ramps)
Morning Peak-Hours
Sunny, Warm

File Name : K10-S Ramps-eam-truck
Site Code : 4
Start Date : 7/12/2012
Page No : 2

|  | E1900 Rd/ DG CO 1057 <br> From North |  |  |  |  | K-10 (EB On Ramp) From East |  |  |  |  | E1900 Rd / DG CO 1057 <br> From South |  |  |  |  | K-10 (EB Off Ramp) FromWest |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time |  | Thru | Left | trucks | App. Total |  |  |  |  | App. Total | Right | Thru |  | trucks | App. Total | Right | Thru | Left | trucks | App. Total | Int. Total |
| Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Peak Hour for Entire Intersection Begins at 07:30 AM |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 07:30 AM | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 4 |
| 07:45 AM | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 4 |
| 08:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 4 |
| 08:15 AM | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 8 |
| Total Volume | 0 | 0 | 0 | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 14 | 20 |
| \% App. Total | 0 | 0 | 0 | 100 |  | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 100 |  |  |
| PHF | . 000 | . 000 | . 000 | . 500 | . 500 | . 000 | . 000 | . 000 | . 000 | . 000 | . 000 | . 000 | . 000 | . 000 | . 000 | . 000 | . 000 | . 000 | . 700 | . 700 | . 625 |

## Turning Movement Counts (Trucks Only )

Interchange of K-10 \& E 1900 Rd (S Ramps)
Afternoon Peak-Hours
Sunny, Hot

File Name : K10-S Ramps-epm-truck
Site Code : 4
Start Date : 7/17/2012
Page No : 1

|  | $\begin{gathered} \hline \text { E } 1900 \text { / DG CO } 1057 \\ \text { From North } \\ \hline \end{gathered}$ |  |  |  |  | K-10 (EB On Ramp) From East |  |  |  |  | $\text { E1900 / DG CO } 1057$ <br> From South |  |  |  |  | K-10 (EB Off Ramp) From West |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time |  | Thru | Left | trucks | App. Total |  |  |  |  | App. Total | Right | Thru |  | trucks | App. Total | Right | Thru | Left | trucks | App. Total | Int. Total |
| 02:00 PM | 0 | 0 | 0 | 1 | 1 | 0 | o | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 4 |
| 02:15 PM | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | o | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 6 |
| 02:30 PM | 0 | o | 0 | 0 | 0 | 0 | 0 | 0 | o | 0 | o | 0 | 0 | 0 | 0 | 0 | o | 0 | 5 | 5 | 5 |
| 02:45 PM | 0 | о | 0 | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | o | 0 | о | 0 | 4 | 4 | 4 |
| Total | 0 | 0 | 0 | 4 | 4 | 0 | o | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 15 | 19 |


| 03:00 PM | 0 | 0 | 0 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 8 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 03:15 PM | o | o | o | 1 | 1 | o | 0 | o | o | 0 | o | 0 | o | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 4 |
| 03:30 PM | o | o | o | 0 | 0 | o | 0 | o | o | 0 | o | - | o | o | 0 | 0 | o | o | 5 | 5 | 5 |
| 03:45 PM | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 5 |
| Total | 0 | 0 | 0 | 8 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 14 | 22 |


| 04:00 PM | 0 | 0 | 0 | 5 | 5 | 0 | o | o | o | 0 | o | 0 | o | o | 0 | o | o | o | 4 | 4 | 9 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 04:15 PM | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | o | 0 | 0 | 0 | o | o | 0 | 0 | o | o | 5 | 5 | 6 |
| 04:30 PM | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | o | 0 | 0 | 0 | o | o | 0 | 0 | o | o | 4 | 4 | 6 |
| 04:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | o | 0 | 0 | o | 0 | 0 | 0 | 0 | o | 0 | 2 | 2 | 2 |
| Total | 0 | 0 | 0 | 8 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 15 | 23 |



## Turning Movement Counts

 （Trucks Only ）Interchange of K－10 \＆E 1900 Rd（S Ramps）
Afternoon Peak－Hours
Sunny，Hot

File Name ：K10－S Ramps－epm－truck
Site Code ： 4
Start Date ：7／17／2012
Page No ： 2

|  | E1900／DG CO 1057 <br> From North |  |  |  |  | K－10（EB On Ramp） <br> FromEast |  |  |  |  | $\text { E } 1900 \text { / DG CO } 1057$ <br> From South |  |  |  |  | K－10（EB Off Ramp） <br> From West |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Start Time |  | Thru | Left | trucks | App．Total |  |  |  |  | App．Total | Right | Thru |  | trucks | App．Total | Right | Thru | Left | trucks | App．Total | int．Total |
| Peak Hour Analysis From 02：00 PM to 04：45 PM－Peak 1 of 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Peak Hour for Entire Intersection Begins at 03：45 PM |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 03：45 PM | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 5 |
| 04：00 PM | 0 | 0 | 0 |  |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 |  |
| ${ }^{0.158 m}$ | 。 | 。 | － |  | 1 | 。 | － | 。 |  | － | 0 | 0 | 0 | 0 | － | 0 | 0 | 0 |  | 5 | 6 |
| 04：30 PM | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 6 |
| Total Volume | 0 | 0 | 0 | 11 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 15 | 26 |
| \％App．Total | 0 | 0 | 0 | 100 |  | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 100 |  |  |
| PHF | ． 000 | ． 000 | ． 000 | ． 550 | ． 550 | ． 000 | ． 000 | ． 000 | ． 000 | ． 000 | ． 000 | ． 000 | ． 000 | ． 000 | ． 000 | ． 000 | ． 000 | ． 000 | ． 750 | ． 750 | ． 722 |

## APPENDIX IV

## Crash History <br> (Source: Douglas County)

## APPENDIX V

## Guidelines for Right-Turn \& Left-Turn Treatments at <br> Unsignalized Intersections

# GUIDELINES FOR RIGHT-TURN TREATMENTS AT UNSIGNALIZED INTERSECTIONS AND DRIVEWAYS 

Tanweer Hasan

Robert W. Stokes
Kansas State University
Manhattan, Kansas


May 1996
K-TRAN
A COOPERATIVE TRANSPORTATION RESEARCH PROGRAM BETWEEN:
KANSAS DEPARTMENT OF TRANSPORTATION
THE KANSAS STATE UNIVERSITY
THE UNIVERSITY OF KANSAS

Table 7.1 Right-turn treatment guidelines for two-lane highways. ${ }^{2}$ (Turning speed $=15 \mathrm{mph}$ )

| Roadway <br> DDHV <br> (vph) | Roadway Operating Speed (mph) |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 40 |  | 45 |  | 50 |  | 55 |  | 60 |  | 65 |  |
|  | Lane | Taper | Lane | Taper | Lane | Taper | Lane | Taper | Lane | Taper | Lane | Taper |
| 200 |  |  |  | 83 | 73 | 30 | 35 | 14 | 20 | 8 | 15 | 7 |
| 300 | 5ise |  | 120 | 40 | 41 | 19 | 24 | 9 | 15 | 7 | 12 | 6 |
| 400 | 200 | 85 | 52 | 27 | 30 | 14 | 19 | 8 | 12 | 6 | 11 | 5 |
| 600 | 50 | 27 | 26 | 13 | 20 | 9 | 14 | 6 | 10 | 5 | 9 | 4 |
| 800 | 25. | 12 | 16 | 8 | 15 | 7. | 11 | 5 | 9 | 4 | 8 | 3 |
| 1000 | 14 | 8 | 12 | 5 | 11 | 5 | 9 | 4 | 8 | 3 | 7 | 3 |
| 1200 | 10 | 6 | 9 | 4 | 9 | 4 | 8 | 4 | 7 | 3 | 7 | 3 |

[^0]

## NCHRP Synthesis 225

## Lefitum Treaments at intersections

## A Syiniesis of hifinay lactice



Guidelines for Left-turn Lane at Unsignalized Intersection - Two-lane Roadway


Guidelines for Left-turn Lane at Unsignalized Intersection - Four-lane, Undivided Roadway


Guídelines for Left-turn Lane at Unsignalized Intersection - Two-lane Roadway


Guidelines for Left-turn Lane at Unsignalized Intersection - Four-lane, Divided Roadvay

FIGURE 5 ITE guidelines for left-turn lanes. (18)

$\begin{array}{ll}\text { Re: } & \text { Penny Sand Plant Expansion, Addendum No. } 1 \\ & \text { Between Lawrence and Eudora, Douglas County, KS }\end{array}$

This memo is prepared as an Addendum No. 1 to Traffic Impact Study for "Penny Sand Plant Expansion" dated $7 / 23 / 12$ to re-evaluate impact of the traffic generated by this development, using the new information provided by the applicant as summarized in the following paragraphs:

1. The original TIS report dated $7 / 23 / 12$ was prepared based on the "worst case scenario" when the proposed sand facility would potentially distribute approximately 5,000 tons of sand on a highly productive day (a very rare event). Based on the new information provided by the applicant, the primary reason for the proposed expansion of the plant (from 114 acres to 465 acres) is to switch over the sand excavation area from the river-side to the in-land side, maintaining its current rate of sand distribution at approximately $1,000(+/-)$ tons on an average day (based on most recent 7-year average) for foreseeable future. It is, however, to be noted that as the economy improves, a higher distribution rate will be likely as demand goes up with the absolute maximum rate of 5,000 tons a day (a very rare event) as described and studied in the original TIS dated 7/23/12.
2. As mentioned in the original TIS, N. 1500 Road has posted weight limit signs of 5 tons on both sides of Noria Road and is not a designated truck route. Currently, all

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site-generated trucks use Noria Road to access the site. Under the proposed development plan, all site-generated trucks will maintain the same route to access the site and will not be using N. 1500 Road.
3. The original TIS dated $7 / 23 / 12$ states that, currently, the facility is staffed by 4 employees and no increase in the number of employees is anticipated. Based on the new information provided by the applicant, the number of current employees is 8 and expected to increase to 10.

## Traffic Impact Reassessment

Using the average distribution rate of 1,000 tons/day following the same analogy mentioned in the original TIS, the estimated number of trucks serving the site will be around 40 trucks/day with 5 trucks/peak-hour - equivalent to 10 truck trip-ends/peak-hour ( 5 inbound and 5 outbound). Comparing this number to that generated by the existing sand plant ( 8 truck trip-ends, 4 inbound and 4 outbound) results in an increase of 2 truck trip-ends/peak-hour (1 inbound and 1 outbound) - a nominal increase in truck traffic, none of which will be impacting N. 1500 Road except at the access point to the site.

Using the ITE trip generation rates for the office component of the site (ITE Land Use Code 715) indicates that the increase in the number of employees ( 2 new people) will likely result in 2 new trip-ends (all passenger cars) during the peak-hour of a typical weekday - a nominal increase in passenger car traffic with insignificant impact on the roadway network.

Re-evaluation of the operating conditions of traffic in the study area, given the new information, indicates that, during the critical peak-hour of a typical weekday when the plant is operating under average conditions, the increase in the number of trucks and passenger cars is insignificant with nominal impact on the roadway network.
In light of the new information provided by the applicant and the traffic impact reassessment:

#  

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1. It is still desirable that $100^{\prime}$ long section of the site access, just north of N. 1500 Road be paved as listed in the original TIS under improvement \#1.
2. The need for a dedicated eastbound right-turn lane on Route 442 (Old K-10) at its intersection with Route 1057 (as listed under improvement \#2 in the original TIS) becomes less relevant because the increase in truck traffic will be nominal for a foreseeable future. As time goes by and economy improves with higher demand for sand distribution, the increase in site-generated truck traffic should be studies to reassess the need for this turn lane.
3. As stated in the original TIS, under improvement \#3, pavement conditions along certain segments of the roadway network should be evaluated to determine if they can withstand heavy truck loads. This was merely suggested based on a cursory visual field observation and is not the result of a formal pavement analysis and/or evaluation. It should be noted that pavement analysis and/or evaluation is beyond the scope of a typical traffic impact study.


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## GENERAL

With the current restrictions which The Corps of Engineers has placed on dredging sand from the Kansas River, many river dredging operations have had their permits suspended or restricted, and will be forced to terminate their dredging operations. Although the Kansas River is being restricted for the dredging of sand, the need for this raw material for construction and development continues. Throughout the river valley / river channel sand is one of the natural resources available for local mining.

## Extraction Process

Overburden Removal: A location will be selected for the first stage of sand removal. This location is referenced on the Site Plan as Phase 1. Within this location, topsoil and overburden are removed to expose the sand deposit by means of appropriate earthmoving equipment. Overburden is defined as any earthen material lying above the aggregates. Topsoil and overburden will be used to grade the site as necessary. Excavation will be no closer than 50 feet from any property line. Overburden will be retained for use in reclamation with any excess materials stockpiled and available for resale.

Extraction: Excavation will continue until the water table is exposed. At this point. the material will be dredged from the pit, pumped to the processing plant.

## Material Processing:

As sand is extracted, it is pumped to the plant for processing. Through plant processing, sand will be sorted by particle size and blended to make a quality product that can be used in concrete, asphalt, ice control, masonry, glass, insulation or specifications provided for a particular project.

The processing plant uses water from the excavated lake to wash sand over a series of screens separating the material into different classifications of material. The processing plant contains vibrating screens with various size of openings. After the material is sorted, these materials will be stockpiled via radial stackers or front end loaders. Pea gravel, river rock will also be stockpiled.

Water used during the operations will be diverted either to a sedimentation pond where solids suspended in these waters can settle out or in the event the material is of a coarser nature will return directly to the excavated lake.

With wet processing, we would expect minimal dust to be created during the process. Dust exposure is monitored by Mine Safety Health Administration to assure minimal risks to our employees and therefore also to surrounding areas.

Noise levels are monitored, as well, by MSHA for assurance the decibel levels do not exceed the safety standards.

## Material Handling

Finished material is conveyed to stockpiles consisting of various grades fine aggregates. The primary stockpiles are generally $30-40$ feet tall. Stockpiles will vary in height. The material will be transported by trucks. The trucks are loaded either by a conveyor / bin or a front end loader, weighed to assure the truck weight is approximately the requested weight or within the legal gross tagged weight, ticketed and then travel to their destination.

Existing access roads will be maintained to promote drainage thus preventing excessive erosion or tracking of mud onsite or offsite. The approximate location of existing access roads, stockpiles, scalehouse and main entrance are shown on the Site Plans.

## Reclamation

Reclamation for an off-river dredging operation occurs over the entire lifespan of the operation as the excavated lake reaches its limits. Reclamation involves the restoration of the perimeter of the mining site, leaving a permanent body of water. The reclamation plan will include the placement of fill material along the bank to create a uniformly sloped and stabilized bank to create an area that can be vegetated and maintained. Reclamation plans must be submitted, approved and annually monitored by the State Conservation Commission.

Phased excavation schedules have been provided on the Site Plan. These schedules are approximations and will vary due to the economic demand, the variability of the deposits and the desire to maintain the current agriculture as long as feasibly possible. Similarly, an approximate reclamation schedule has been provided on the Reclamation Plan. Annual reporting to the State Conservation Commission monitors "affected" acreage and any changes to the reclamation plan.

Since reclamation is performed when the excavated lake has reached its limits for the specific phase, it is not uncommon for the first reclamation to occur up to 10 years following the beginning of the operation.

When extraction operations at this site are complete, the final reclamation will include the restoration of all remaining banks, the removal of the processing plant, scalehouse, scales and all other associated equipment and buildings from the site. The processing plant and stockpile areas may be returned to agricultural land or other uses that will be beneficial to the property or owner.

## Local, State and Federal Requirements

Penny's will adhere to all applicable State and Federal Requirements / Regulations. Each required State and Federal permit for this project, will be obtained prior to the commencing of operations which the specific permit regulates. As these permits are obtained, copies will be submitted to the Douglas County Planning Department.

## U.S. Army Corps of Engineers:

Clean Waters Act - The U.S. Army Corps of Engineers requires a Section 404 Permit for the discharge of dredged or fill materials into the Waters of the U.S. (regulated rivers, streams, lakes, wetland areas, etc.). This facility is an off-river operation and does not discharge into Waters of the U.S. An official wetland delineation has not been performed for this site. There exists potential wetland areas within the project boundaries, which have been delineated based on aerial photography and site visits. All operations are designed to have no impact on the potential wetland areas. A 50 -foot buffer has been provided to ensure the project does not encroach upon potential wetland areas. Therefore, a permit application will not be filed with the U.S. Army Corps of Engineers as pertaining to Section 404 of the Clean Waters Act.

Excavation Near a Levee - There are no levees along the Kansas River near this project, therefore, there will be no excavation within the Critical Area of the levee and no permitting will be required.

## Kansas Department of Agriculture - Division of Water Resources:

Water Structures - DWR Water Structures Section requires that, per K.A.R. 5-43-5 of the Rules and Regulations (K.S.A. 82a-012 to 305a), a minimum setback of 50 feet be maintained from the bank of a channel to any sand dredging operations located outside the channel of any stream. A natural riparian buffer currently exists between the northern boundary of the project and the Kansas River. The minimum width of this buffer is approximately 300 feet. The buffer is to remain intact undisturbed.

Water Appropriation - DWR Water Appropriation Section requires an Application for Approval to Change the Place of Use, The Point of Diversion or the Use Made of the Water under an Existing Water Right. There will be no new uses or change of uses of water rights associated with this project. DWR Water Appropriation Section requires permits for all sand and gravel pits in townships where the net average annual potential for net evaporation is greater than 18 inches per year. The potential net evaporation for this site is approximately 6 inches per year; therefore, this permit will not be required. DWR also requires a Notice of Intent to Open or Expand a Sand or Gravel Pit Operation. This NOI has been requested.

Floodplain Management - DWR Floodplain Management Section will require a permit for the placement of fill within the floodplain per K.A.R. 5-45 of the Rules and Regulations (K.S.A. 24-126). All permanent fills and unconsolidated mass storage stockpiles located within the floodway require approval from the Chief Engineer with 'no-rise" certification.

## Kansas Department of Health and Environment:

Stormwater and Erosion Protection - An erosion control plan for construction will be filed with KDHE and a permit will be required under the Kansas General Permit for Stormwater Runoff Associated with Construction Activities. An application for permit will be filed following approval of the Conditional Use Permit.

Because of the industrial nature of the project, a permit will be required for all stormwater runoff originating from an industrial activity. Penny's will develop and implement a Stormwater Pollution Prevention Plan for the site, to be reviewed and approved by KDHE. An application for permit has been requested.

The predominance of stormwater from onsite will drain back into the water body created by the extraction process. Stormwater from offsite shall be conveyed to the existing wetland areas, as occurs in the existing condition, and will only be allowed to enter the excavation pond during flooding events.

Water - Currently Penny's is permitted for an onsite well used for irrigation. When it is time for the plugging or elimination of this well, the KDHE Bureau of Water - Geology Section will be contacted and the proper paperwork will be filed.

Fugitive Dust - Penny's will utilize water trucks and apply dust suppressants to control fugitive dust within the site as needed. However, since the product processed in this operation is drawn from a body of water, the typical need for dust suppressant in minimal.

## State Conservation Commission:

Mining Permit/License - The proposed site is subject to the "Surface Mined Land Conservation and Reclamation Act", K.S.A. 49-602 et seq. Penny's holds License No. 95-064, which must be renewed annually. The current license expires December 31, 2012.

Mine Registry - As required by State law, this site will be registered with the SCC prior commencing with the mining process. Penny's will file an application to register the site as a mine site with the SCC following approval of the CUP.

Reclamation Bonding - As required by State law, license holders are required to post a bond or other acceptable financial security to the SCC and a Reclamation Plan, detailing the post-mining land use and the reclamation process, must be filed and approved by the SCC prior to any mining taking
place on the proposed mine. The bond application / letter of credit will be filed with the SCC upon approval of the CUP.

## Department of Wildlife and Parks:

Action Permit - A request will be made to the Kansas Department of Wildlife and Parks for an environmental review of the site for potential endangered species or critical habitats. Based on the findings of the review, the need for an action permit will be determined. KDWP may also request additional review from the Department of the Interior or the U.S. Fish and Wildlife Service.

## Environmental Protection Agency:

Spill Prevention, Control and Countermeasure Plan - Penny's may maintain a fuel tank for fueling loaders used for the loading of sand into trucks. Fuel for the dredge will not be stored onsite. Fueling of the dredge will be performed by fuel stored offsite. Other fuel or petroleum-based products used for generators or maintenance will occur in amounts smaller than 55 gallons, which is the minimum container size that that is required to be documented in an SPCC Plan. Overall, the amount of petroleum-based materials stored at this site will not exceed the levels (1,320 gallons) required by the EPA for implementing an SPCC Plan.

Operation Times: Typically hours of operation would be Monday - Friday 6:30 AM - 6:30 PM. There may be extenuating circumstances which would require Penny's to maintain operating hours on Saturdays or to extend the normal hours of operation due to the nature of the construction business. Many clients, including State agencies and City governments require construction activities to be completed at odd hours for the safety of the general public. Weather conditions and / or the necessity to provide materials for the hazardous conditions as it relates to snow and ice to state and local agencies may also result in the need to extend hours of operation. Projects / contracts may have such stringent completion dates and / or penalties for exceeding working days it would necessitate the extension of hours of operation.

Overburden Placement: During the initial stage of the operation, overburden removed from the excavation area will be used in raising the grade of the processing plant and scalehouse areas and for berms as required. As the excavated lake pond expands into future stages, overburden will be stockpiled at locations deemed beneficial to the reclamation effort, sold, or used to restore the banks of the body of water established by the previous stages.

Operation Life Expectancy: Based upon current economic conditions, the expected life of this project would be 30+ years.

Plan of Response to a Major Flooding Event: Penny's will prepare a plan of action, which would be implemented immediately upon notification that a flood event may occur. The plan will include the removal of all equipment, materials and bulk fuel that is not stationary. The scalehouse, scales and processing plant will remain. Non-stationary items that will be removed will include, but are not limited to, loaders, vehicles, fuel supplies, generators, and any electronic equipment or office materials in the scalehouse.

Power and Fuel Supply: The scalehouse and processing plant will be electrically powered by the Westar Energy lines. The dredge will be diesel-powered. The site fuel supply for the loader and/or generators will be limited to 1,000 gallons. The fuel will be stored in an aboveground storage tank with secondary containment. The fuel pump will be controlled with a power switch located within the scalehouse. The pump will be turned off during non-business hours. Dredge fueling will be performed by fuel from offsite.

Stormwater Runoff: All stormwater falling around the scalehouse, processing plant or stockpiles will be kept on site. The site will be completely non-discharging, with no stormwater leaving the site. Stormwater from offsite shall be conveyed to the existing wetland areas, as occurs in the existing condition, and will only be allowed to enter the excavated lake during flooding events. Any increases in stormwater runoff due the increased impervious surfaces will be substantially offset by the storage capabilities of the excavated lake.



# Evaluation of Penny's Concrete and Sand LLC, Proposed Sand Pit Operation on Ground Water 

 For the Lawrence FacilityFor<br>Penny's Concrete and Sand LLC<br>23400 West 82 ${ }^{\text {nd }}$ Street Shawnee, Kansas

## By

Carl E. Nuzman, P.E., P.Hg. Consulting Engineer/Hydrogeologist<br>3314 NW Huxman Road<br>Silver Lake, KS 66539

Phone 7852249929

September 12, 2012

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# Evaluation of Penny's Concrete and Sand LLC, Proposed Sand Pit Operation on Ground Water for the Lawrence Facility 

## 1. INTRODUCTION

A study and evaluation was made of the aquifer characteristics of the Kansas River Valley alluvial sediments in the vicinity between Lawrence, KS and Eudora to determine if any detrimental effects will occur to the existing wells in the vicinity of the proposed sand mining operation. Penny Concrete and Sand proposes to establish a pit to mine sand located in the East $1 / 2$, and the $\mathrm{NE}^{1 / 4}$ of the NW $1 / 4$ of Section 35 excluding two outparcels, the West 60 acres of the West $1 / 2$ of the NW $1 / 4$ of Section 36, and a portion of the $\mathrm{SE}^{1 / 4}$ of the $\mathrm{SE}^{1 / 4}$ of Section 26, all in Township 11 South, Range 20 East in Douglas County, Kansas. Shown on Exhibit A is the conditional use permit (CUP) area where the proposed sand pit is located and wells registered with the Division of Water Resources Kansas Department of Agriculture.

## 2. GEOLOGIC SETTING

A study was made by Alvin E. Dufford of the Quaternary Geology and Ground-Water Resources of the Kansas River Valley between Bonner Springs and Lawrence. The results of his work were published by the University of Kansas for the Kansas Geological Survey in Bulletin 130, Part 1, in 1958. The Wakarusa River hugs the south edge of the valley while the Kansas River stays close to the north edge of the valley, narrowing as the valley approaches Eudora from the west.

The Kansas River valley has a general eastward slope of about 3 feet per mile with low dissected hills bounding the flood plain on both sides. The Kansas River valley alluvium merges with the Wakarusa River valley alluvium near the center of Section 10, Twp 13 South, Range 20 East in Douglas County, Ks. The valley alluvium that comprises the aquifer consists principally of sand but contains lenses of both coarser and finer material. Generally, the saturated thickness of the aquifer is about 40 to 50 feet thick in the deepest part of the valley but thins to about 20 feet in the vicinity in the saturated thickness, in the proposed sand mining operation. Bed roc elevation in the area was defined by Stuart W. Fader in Ground Water in the Kansas River Valley, Junction City to Kansas City, Kansas in Bulletin No. 206, Part 2.

Well logs of selected wells in the area are given in Appendix I from the WWC-5 forms filed with the Kansas Geological Survey water well log file in Lawrence, KS. Exhibit B, is a geologic west to east cross-section along North 1500 Road showing the geology profile in that area. Static
water levels given on the well log reports do not reflect average conditions of the aquifer. Static water levels can vary several feet with changes in precipitation in the area. The static water levels will be higher during periods of normal or above normal precipitation and will decline during periods of drought. Static water levels given in the WWC-5 reports may not have been allowed to completely stabilize after pumping.

## 3. HYDROLOCIC SITUATION

The Eudora area has a humid continental climate. Normally, more than $70 \%$ of the annual precipitation falls during the growing season from April through September. Precipitation during this period is usually from thunderstorms (high intensity rainfall of brief duration) in the evening and early morning hours. The mean hourly wind speed is about 10 miles per hour usually from the south or southwest, and the sun usually shines more than $60 \%$ of the daylight hours.

The Kansas River which flows in an easterly direction is the principal stream in the area. The Army Corps of Engineers normally maintains a minimum desirable stream flow of 1,000 cubic feet per second at the DeSoto gaging station on the Kansas /river. The Wakarusa River is hydrologically an important tributary stream because it is a major source of recharge to the alluvial aquifer, especially in the vicinity of major well fields.

## 4. SAFE YIELD ANALYSIS

The safe yield available for appropriation from an unconfined aquifer at a specific location is determined by the amount of average annual precipitation that becomes recharge to the aquifer occurring within the area of consideration by the Chief Engineer of the Division of Water Resources, Kansas Department of Agriculture. The area of consideration means the portion of the aquifer area that lies within a 2 -mile radius from the proposed point of interest, which is the geo-center of the proposed sand pit.

Although a safe yield analysis is not required for a sand pit operation in the Kansas River Basin by the Division of Water Resources, Kansas Department of Agriculture, such an appraisal was made to identify all registered ground water appropriators within a two (2) mile radius of the proposed sand pit operation. There were 15 identified ground water users some of which have multiple water rights on file. All wells registered are given in Appendix II with the well information followed by the owner and their address.

Based on established recharge rate of 9.2 inches per year by the Division of Water Resources, the safe yield for the 2-mile circle comprising and effective area of 6,350 acres is $4,868.33$ acre-feet.

The prior appropriations certified in the circle are $4,305.78$ acre-feet, with the added permitted appropriated water totaling 5,429.45 acre feet. Only wells 7 and 9 of the City of Eudora are at the edge of 2-mile circle from the geo-centroid of the proposed Penny sand pit.

The City of Eudora's total appropriation of $699 \mathrm{ac}-\mathrm{ft}$ or 227.77 MGY for municipal appropriation including future water use for population growth was used in the model given in Exhibits E and F. The maximum authorized diversion rate or pumping in one day is 1.4 million gallons per day. Exhibits E and F show the proposed Penny sand pit will not affect the City of Eudora wells in any way. The over appropriation of water in the area is up-gradient from the City wells and serves to intercept any ground water contamination that may exist in the capture zone of the City of Eudora wells identified in Exhibit F.

## 5. AQUIFER PROPERTIES

You do not get water from a well. A well is a stabilized hole in the ground to gain access to water bearing material called an aquifer. The yield of an aquifer is controlled by the permeability of the geologic formation and the saturated thickness of that permeable formation. The yield of a well can never be greater than that of the aquifer and usually less depending upon the efficiency of well construction and development. A well can decrease in yield due to biological fouling and lack of proper maintenance but unless the static water level has a substantial decline reducing the saturated thickness, the yield available from the aquifer remains constant.

Data from the WWC-5 report for City Well No 8, shown in Appendix I was used to estimate the properties of the aquifer. The reported drawdown was 4 feet after 11 hours of pumping at 521 gallons per minute (gpm). These values give a well specific capacity of $130 \mathrm{gpm} /$ foot of drawdown when constructed. This value is used to estimate the transmissivity of the aquifer which is estimated to be $220,000 \mathrm{gpd} / \mathrm{ft}$. Utilizing the 25 feet of well screen installed which is less than the formation thickness; the calculated formation permeability is $8,800 \mathrm{gpd} / \mathrm{ft}^{2}$, a very good formation value. Typical average value of formation permeability for the Kansas River valley alluvium is about $5,000 \mathrm{gpd} / \mathrm{ft}^{2}$, with a maximum value observed of $10,000 \mathrm{gpd} / \mathrm{ft}^{2}$. Additional data was found for City wells No. 6 and No. 7. The original specific capacity for well No. 6 was $101.7 \mathrm{gpm} /$ foot of drawdown. The estimated formation transmissivity of the aquifer at well No. 6 location is $172,900 \mathrm{gpd} / \mathrm{ft}$. The original well specific capacity for well No. 7 was $126.8 \mathrm{gpm} / \mathrm{ft}$ which gives an estimated formation transmissivity of $215,600 \mathrm{gpd} / \mathrm{ft}$. An average transmissivity value of $210,000 \mathrm{gpd} / \mathrm{ft}$ was used to model the aquifer in Exhibits 6 and 7. This value under estimates the transmissivity in the deeper portions of the aquifer and over estimates the transmissivity near the boundaries of the aquifer. The $210,000 \mathrm{gpd} / \mathrm{ft}$ is in the same range that was determined by S. W. Fader in Bulletin No. 206, part 2, figure 7.

When a well is pumped, the pump energy creates a partial vacuum that causes a cone of depression to develop around the bore hole. The bore hole for the construction of Well No. 8 was reported to be 42 inches which gives a well radius of 1.75 feet. Using the formation transmissivity value of $220,000 \mathrm{gpd} / \mathrm{ft}$, the drawdown per log cycle was calculated to be 1.0 foot for a pumping rate of 325 gpm , which is the maximum authorized pumping rate established for well No. 6 . This information was then plotted on a semi-log plot to obtain the radius of influence for well 6 , well 7 and well 8 , Reference Exhibit C. The zero ( 0 ) drawdown for wells $6 \& 7$ was 2,400 feet and 2,100 feet for well 8 . Drawdown values of less than 1 foot are considered insignificant since annual variations of static water level may vary more than 2 feet in a year due to weather conditions. The 1 -foot drawdown occurs at a radius from about 130 to 260 feet for each of the wells shown in Exhibit C. The basic assumptions in the calculations for Exhibit C assume the world is flat and the aquifer properties are ideal. The approximate 1,000 feet distance between City wells minimizes the mutual interference effects from simultaneous pumping of these wells.

## 6. AQUIFER WATER YIELD AND AREA OF WATER CAPTURE

Simple model system was developed using the analytical-element method often used in modeling well-head protection. The State Geological Survey of Kansas had experienced geologists investigate the Kansas River valley geology and ground water resources from Bonner Springs to the vicinity of Manhattan. The reach of special interest is contained in Bulletin 130, Part 1, Quaternary Geology and Ground-Water Resources of Kansas River Valley between Bonner Springs and Lawrence, Kansas. At that time, the Kansas Geological Survey had their own small drilling rig in which to drill test holes. Many of the data points used in the model were from this work dated back to the 1940's and 1950's.

Figure 3 in Bulletin 130, Part 1 is the basis for the development of Exhibit D, a generalized static water table of the area of interest. In the 1950's there was little or no large pumpage in this area of interest which gives a good representation of pre-development conditions for the aquifer. Since the measurements upon which Figure 3 was based occurred over a period of years, exact replication of the water level elevations was not possible. Using statistical analysis, a very reasonable simulation of the water table gradient was obtained.

The model was then used to simulate the probable maximum pumping rate of 1.4 million gallons per day to obtain the area of direct influence of the City of Eudora well field. You will note that the area of 1 foot drawdown for the City of Eudora's peak pumpage is not circular but somewhat egg shaped extending more up-gradient to the west than to the east. Average annual pumping rate is estimated at $60 \%$ of peak day rate. Thus the development of the drawdown simulated in Exhibit E is a representation of the maximum drawdown expected in the future.

A feature of the model called particle tracking was then used to plot the movement of water in the aquifer to each of the four wells shown in Exhibit F. Based on the maximum allowable pumpage of 227.77 MGY authorized by the City's water rights on file with the Division of Water Resources, the travel time of water in the aquifer was calculated. The time period selected was 25 years. Each little collar around the straw like flow path lines represents one (1) year of flow. Due to the hydraulic gradient of the valley aquifer system and recharge to the aquifer from rainfall, the aquifer flow to the City wells is from the west-southwest. The Penny sand pit will be a half mile north of the capture zone of the City wells and will have no influence on the Eudora public water supply wells.

## 7. WELL-HEAD PROTECTION STUDY

The City's concern in regard to protecting the future quality of water from their well field must focus on the area in the immediate vicinity of the wells and to the west of the wells.

In so far as contaminants in the aquifer, the water movement is from west to east in a downgradient direction. The estimated travel time of water in the Kansas River alluvium aquifer, based on the general formation transmissivity and land surface gradient is about 0.7 feet/day or 8.4 inches per day, a very slow migration rate.

Several potential contamination sources, given in Appendix III, have been identified that could potentially threaten the water quality of the Eudora well field:
a. Septic tanks at the several domestic residences in the vicinity are each a potential threat to the water quality of the City wells.
b. To the east of Well No. 6 near the point of stagnation is or was a cattle feeding operation with livestock present as shown in Appendix III.
c. Chemical fertilizer and herbicides applied to corn planted next to the wells as shown next to Well No. 6 in Appendix III, are a potential threat of contamination to the City wells. This threat of contamination is increased with irrigation, especially on sandy soils. Major portions of Hall and Merrick Counties in Nebraska have nitrates nearly double that of the KDHE and EPA regulations for Nitrates in public water supply due to irrigation and chemigation of corn on sandy loam soils similar to the alluvial soils shown in Bulletin 206, Part 2, Ground Water in the Kansas River Valley Junction City to Kansas City, Kansas by Stuart W. Fader. The Newman Terrace clay loam soils offer more protection of the aquifer from fertilizers.
d. Abandoned wells or old domestic wells that were drilled long ago with thin wall casing that have corroded through the years and were not grout sealed, can allow
storm water runoff to flow directly into the aquifer resulting in direct contamination to the City wells. Such a well may exist west of Eudora Well No. 7 as shown in Appendix III, under the old windmill tower.

The C. McElwee domestic well is up gradient from the sand pit and down-gradient from the Kansas River. Although the property is about 5 acres in area, it is recommended that the set back of the pit mining be 300 feet from his property line. The radius of influence of the domestic well is less than 300 feet and will not be adversely affected by the sandpit.

## 8. SAND PIT OPERATION

The static water level elevation in the sand pit will be about the same as the water surface elevation in the Kansas River. Sand pit lakes that are within the effective radius of influence of a water well support the water production from a well during drought conditions due to the increase of lake water storage which is 5 times greater than the water storage yield capacity of the aquifer itself. This storage yield effect is applicable to any unconsolidated aquifer. Sand pits beneficially support the yield of wells that are down-gradient from a pit that is within the area of influence of a well.

Water pumped by the sand dredge is piped to the sand separator, and then water is diverted to a sediment pond, and returned to the sand pit. Storm water runoff from local precipitation is diverted around the pit. Berms and a grass swale will be provided on the west and south sides of the sand pit for the diversion of local storm water runoff.

## 9. CONCLUSION

The City of Olathe was concerned about their well field more than 20 years ago when Penny Concrete and Sand proposed to open a pit next to their well field. This consultant was contacted by the City of Olathe and reviewed the situation. It was recommended to the City of Olathe at that time to maintain at least 500 feet of aquifer intact between the sand pit and any well. The sand pit shown in Appendix III, directly up-gradient from the Olathe wells has never caused any contamination to their wells. Since that time, more studies have been made both in Kansas and other states and no significant contamination of an aquifer has been attributed to a sand pit in unconsolidated alluvial aquifers.

Present regulations require 200 feet separation between a surface water source and a well to allow normal biological activity of surface water to be filtered before entering the well. It is recommended that a 300 foot set-back be maintained between the property boundary of any
residence out parcel and the active dredging of sand from the pit. The recommended set back from all road right-of way is 100 feet.

It was found in this study that the proposed Penny sand pit lake that will eventually be developed in this study area will have absolutely no effect on the McElwee wells, Public Wholesale Water Supply District No. 25 or City of Eudora's wells or water supply. The threat of contamination does exist to Public Water Supply wells, but not from the proposed Penny sand mining operation, but from adjacent property to their wells.

## EXHIBITS

A. Penny Sand Lawrence Facility - Area Plan
B. West to East Geologic Cross-Section along N 1500 Road
C. Distance-Drawdown Semi-Log Plot of Eudora's Wells No's 6, 7, \& 8
D. Generalized Static Water Table in Area (From KGS Bull. 130, Part 1)
E. Eudora Wells Drawdown at Peak Day Pumpage of 1.4 MGD
F. Groundwater Flow Paths to Eudora Wells at 227.77 MGY Pumpage

# Evaluation of Penny's Concrete and Sand LLC, Proposed Sand Pit Operation on Ground Water 

For the Lawrence Facility

For


23400 West $82^{\text {nd }}$ Street
Shawnee, Kansas

By

Carl E. Nuzman, P.E., P.Hg.
Consulting Engineer/Hydrogeologist
3314 NW Huxman Road
Silver Lake, KS 66539


Phone 7852249929

September 12, 2012






Exhibit E:
Eudora Wells - Drawdown at
Peak Day Pumpage of 1.4 MGD .
 Legend
(2) $\begin{aligned} & \text { Water Table Drawdown } \\ & \text { Contour ntitenal } 0.5 \text { feet }\end{aligned}$


IW. DW. Registered Irrigation or Domestic Well




## APPENDICES

I. Selected WWC-5 Water Well Logs in Study Area
II. KDA, Division of Water Resources, Safe Yield Analysis Data
III. Potential Pollution Sources in the Area
IV. Carl E. Nuzman, Resume' and Personal Information

## APPENDIX I.

Selected Water Well Logs from the Kansas Geological Survey Well Log Library for Sections 34, 35, and 36 in Twp 12 South Rng 20 East, Sections 1, 2, 3, 11, and 12 in Twp 13 South Rng 20 East, Section 31 in Twp 12 South, Rng 21 East, and Sections 5 and 6 in Twp 13 South, Rng 21 East, all in Douglas County Kansas.


TYPE OF SCREEN OR PERFORATION MATERIAL:


7 CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was $\boxtimes$ constructed, $\square$ reconstructed, or $\square$ plugged under my jurisdiction and was completed on (mo/day/year) _ 10/01/09 _ and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. 185 ... This Water Well Record was completedgn (mp/day/year) ... 10/06/09
under the business name of Clarke Well \& Equipment, Inc.
by (signature) . in
INSTRUCTIONS: Use typewriter or ball point pen. PLEASE PRESS FIRMLY and PRINT clearly. Please fill in blanks and check the correct answers. Send three copies (white, blue, pink) to Kansas Department of Health and Environment, Bureau of W ater, Geology Section, 1000 SW Jackson St., Suite 420, Topeka, Kansas $66612-1367$. Telephone 785-296-5522. Send one copy to WATER WELL OWNER and retain one for your records. Include fee of $\$ 5.00$ for each constructed well. Visit us at hitp://www.kdheks.gov waterwell index.html.

Kansas Department of Health and Environment-Division of Environment (Water well Contractors) Topeka, Kansas 66620 Topeka, Kansas 66620

9520599 N8.97063 NE NE


Forward the white, blue and pink copies to the Department of Health and Environment

$$
B R<764 \quad D=787
$$

WATER WELL RECORD
KSA 82a-1201-1215
$95.20596 \quad 38.96880$

Kansas Department of Health and Environment-Division of Environment (Water well Contractors) Topeka, Kansas 66620


Forward the white, blue and pink copies to the Department of Health and Environment

| 1 | LOCATION OF WATER WELL: | Fraction |  |  |  |  |  | Section Number | Township Number |  |  | Range Number |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | ounty: Douglas | NW | 1/4 | SW | 1/4 | NE | 1/4 | 35 | T | 12 | S | R | 20E | E/W |

Distance and direction from nearest town or city street address of well if located within city?

## $\frac{1}{2}$ East of Lawrence

## WATER WELL OWNER: Carl McElwee



1564 E 1850 Rd
Lawrence, K. 66046

Board of Agriculture, Division of Water Resources Application Number:

CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed. (2) reconstructed, or (3) plugged under my jurisdiction and was
 Water Well Contractor's Licence No 182 $\qquad$ This Water Well Record was completed on (mo/da under the business name of Strader Drilling. Co., Inc.


 records. Fee of $\$ 5.00$ for each constructed well.

WATER WELL RECORD Form WWC-5 KSA 82a-1212
1 LOCATION OF WATER WELL:
Township Number

| Fraction |  |  |  | Section Number |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| SW | $1 / 4$ | SW | $1 / 4$ | NE | $1 / 4$ | 36 | Range Number County: Douglas nearest town or city street address of well if lo

$1 \frac{1}{2}$ west, $1 \frac{1}{2}$ north of Eudora
Distance and direction from nearest town or city street address of well if located within city?
James Waller
1964 N. 1550 Rd.
Eudora, KS 66025
Board of Agriculture, Division of Water Resourc Application Number:


5 TYPE OF BLANK CASING USED:

| 1 Steel | $3 \mathrm{RMP}(\mathrm{SR})$ |
| :--- | :--- |
| 2 PVC | 4 ABS | Depth(s) Groundwater Encountered 1....

1... . . . . . . . . . .ft. 2 .
ft. 3. WELL'S STATIC WATER LEVEL . . $24.1 . .$.
Pump test data: Well water was ft. below land surface measured on mo/day/y
hours pumping $9 \% .06 / 96$ Est. Yield 40 grm: Well water was Bore Hole Diameter . . 12.". . . in. to . . . . . . . . . . . . . . .ft., and. . . . . . . . . . . . . . . . in. to . . . . . . . . . . . . . . . $\begin{array}{clll}\text { WELL WATER TO BE USED AS: } & 5 \text { Public water supply } & 8 \text { Air conditioning } \\ 1 \text { Domestic } & 3 \text { Feedot } & 6 \text { Oil field water supply } & 9 \text { Dewatering }\end{array}$ 11 Injection well 12 Other (Specify below) 4 DEPTH OF COMPLETED WELL.
ft. after
hours pumping Was a chemical/bacteriological sample submitted to Department? Yes...........No............ If yes, mo/day/yr sample was si mitted

| 5 Wrought iron <br> 6 Asbestos-Cement <br> 7 Fiberglass |  |
| :---: | :---: |
|  |  |
|  |  |

8 Concrete tile
9 Other (specify below)
CASING JOINTS: Glued . X. . Clamped .

Welded . . . . . . . . . . . . . . ft., Dia
.in. to . . . . . . . . . . . .ft., Dia
in. to
.

$$
=
$$

Blank casing diameter . . . . . . 5.". . . . in. to . . . $0-30$.
Casing height above land surface.......24".".......in., weight . .... 2.82

.258
TYPE OF SCREEN OR PERFORATION MATERIAL:
1 Steel
3 Stainless steel
2 Brass 4 Galvanized steel

SCREEN OR PERFORATION OPENINGS ARE:

| 1 Continuous slot | 3 Mill slot |
| :--- | :--- |
| 2 Louvered shutter | 4 Key punched |

5 Gauzed wrapped
7 Torch cut
SCREEN-PERFORATED INTERVALS: From. .
ft. to . . . 40 .
ft., From
ft. to.


## 6 GROUT MATERIAL: 1 Neat cement

2 Cement grout
3 Bentonite 4 Other
ft., From.
Grout Intervals: From. ..... 4....ft. to ... 24 .
What is the nearest source of possible contamination:

| $\frac{1 \text { Septic tank }}{2 \text { Sewer lines }}$ | 4 Lateral lines | 5 Cess pool |
| :--- | :--- | :--- |
| 3 Watertight sewer lines | 6 Seepage pit | 8 Pit privy |
|  |  | 9 Feedyage lagoon |

. ft. to. . . . . . . . . ft., from 10 Livestock pens
n. . . . . 11 Fuel storage
12 Fertilizer storage 13 Insecticide storage How many feet? 200'

## Direction from well? <br> north

| FROM | TO | LITHOLOGIC LOG | FROM |
| ---: | ---: | :--- | :--- |
| 0 | 4 | TOP Soil |  |
| 4 | 15 | Clay-Brown-Silty |  |
| 15 | 33 | Fine Sand-Brown |  |
| 33 | 39 | FS-CS-Med Gravel-Brown |  |
| 39 | 40 | FS-CS-Med Gravel-Blue |  |
|  |  |  |  |
|  |  |  |  |

[^1] of Health and Environment, Bureau of Water, Topeka, Kansas 66620-0001. Telephone: 913-296-5545. Send one to WATER WELL OWNER and retain one for your records.


## 6 CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and wa

 and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No.
 name of STPAder DRLG CO, ICe by (signature)
7 LOCATE WELLS LOCATION
WITH
BOX:


# ${ }^{1}$ mile north $2 \frac{1}{2}$ miles west of Eudora 1919 N. 1500Rd. Eudora 66025 

## WATER WELL OWNER: Virginia Strong

| RR\#, St. Address, Box \# <br> City, State, ZIP Code | $:$ Lawrence, KS. 66049 | Board of Agriculture, Division of Water Resources <br> Application Number: |
| :--- | :--- | :--- |

3 LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX: 4 DEPTH OF COMPLETED WELL. . 52 . . . . . . . . . .ft. ELEVATION
 Depth(s) Groundwater Encountered 1. . . . . . . . . . . . . . . . . ft. 2. .
ft. 3.
. ft. WELL'S STATIC WATER LEVEL . . 27. . . . . ft. below land surface measured on mo/day/yr ...6.-21-2001. Pump test data: Well water was . . . . . . . . . . . ft. after . . . . . . . . . . . . . . hours pumping . . . . . . . . . . . gpm Est. Yield . 5.0 . . . . . .gpm: Well water was ft. after hours pumping gpm Bore Hole Diameter. . 12 . . . . . . in. to . . .ft., and.

| WELL WATER TO BE USED AS: | 5 Public water supply | 8 Air conditioning |  |
| :---: | :--- | :--- | :--- |
| $\frac{1 \text { Domestic }}{2 \text { Irrigation }}$ | 3 Feedlot | 6 Industrial field water supply | 9 Dewatering |
|  | 7 Domestic (lawn \& garden) | 10 Monitoring well |  |

11 Injection well 12 Other (Specify below)

Was a chemicalbacteriological sample submitted to Department? Yes. . . . . . No. . X. . ; If yes, mo/day/yrs sample was submitted
-

5 TYPE OF BLANK CASING USED:
1 Steel 3 RMP (SR)

$$
2 \mathrm{PVC} \quad 4 \mathrm{ABS}
$$

Blank casing diameter . . . . $5 . .$. . .

| 5 Wrought iron | 8 Concrete tile |
| :--- | :--- |
| 6 Asbestos-Cement | 9 Other (specify below) |
| 7 Fiberglass |  |

7 Fiberglass

CASING JOINTS: Glued. .X. . . Clamped
Welded
Threaded.

Casing height above land surface. . . 24 . . . . . . . in., weight . . . . . . . 2. 82
TYPE OF SCREEN OR PERFORATION MATERIAL:

| 1 Steel | 3 Stainless steel | 5 Fiberglass |
| :--- | :--- | :--- |
| 2 Brass | 4 Galvanized steel | 6 Concrete tile |

.
in. to
258

$\begin{array}{r}2 \\ \text { SCR } \\ 1 \\ \\ \hline\end{array}$
SCREEN OR PERFORATION OPENINGS ARE:
1 Continuous slot 3 Mill slot

4 Key punched
36
From. .
27
From. .
$\frac{7 P V C}{8 R M P ~(S R)}$
9 ABS
tile $\quad 9$ ABS
5 Gauzed wrapped
6 Wire wrapped
7 Torch cut
$52 \ldots . .$. . ft.
ft. to . . . . . . 5 ?
. ft., From






8 Saw cut
1 None (open hole) 9 Drilled holes 10 Other (specify)

10 Asbestos-cement
11 Other (specify)
12 None used (open hole)
.ft., From .
7 Pit privy
8 Sewage lagoon
9 Feedyard

10 Livestock pens
11 Fuel storage
12 Fertilizer storage 16 Other (specify below)

How many feet? 210
3 Watertight sewer lines
Direction from well? West

| FROM | TO | LITHOLOGIC LOG | FROM | TO | PLUGGING INTERVALS |
| :--- | :--- | :--- | :--- | :--- | :--- |
| 0 | 10 | brown silt |  |  |  |
| 10 | 18 | brown clay |  |  |  |
| 18 | 28 | brown silt |  |  |  |
| 28 | 30 | brown fine sand course sand |  |  |  |
| 30 | 38 | brown fine sand |  |  |  |
| 38 | 40 | brown fine sand course sand med gravel |  |  |  |
| 40 | 41 | blue clay |  |  |  |
| 41 | 52 | grey fine sand |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and was completed on (mo/day/year) . 6-21-2001. Water Well Contractor's Licence No. . 182. . . . . . . . . . . . . ..... . and this record is true to the pest of my knowledge and belief. Kansas under the business name of Strader Drilling Co. . Inc.

[^2] Environment, Bureau of Water, Topeka, Kansas 66620-0001. Telephone 785-296-5524. Send one to WATER WELL OWNER and retain one for your records. Fee of $\$ 5.00$ for each constructed well.


CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and $n$ completed on (mo/day/year) .........2-15-93 Water Well Contractor's License No. .... 182.
and this record is true to the best of my knowledge and belief. Kans under the business name of STRADER DRILIIING CO., INC.
by (signature)


INSTRUCTIONS: Use typewriter or ball point pen. PLEASE PRESS FIRMLY and PRINT clearly. Please fill in blanks, underline or circle the correct answers. Send top three copies to Kansas Department of Health and Environment, Bureau of Water, Topeka, Kansas 66620-0001. Telephone: $913-296-5545$. Send one to WATER WELL OWNER and retain one for your records.

WATER WELL RECORD Form WWC-5 KSA 82a-1212


CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and was completed on (mo/day/year) . . . . . . . $2 / 24 / .98 \ldots \ldots \ldots \ldots \ldots \ldots \ldots$ and this record is true to the best of my knowledge and belief. Kansas


INSTRUCTIONS: Use typewriter or ball point pen. PLEASE PRESS FIPMLY and PRINT clearly. Please fill in blanks, underline or circle the correct answers. Send top three copies to Kansas Department of Health and Environment, Bureau of Water, Topeka, Kansas 66620-0001. Telephone: 913-296-5545. Send one to WATER WELL OWNER and retain one for your records.

$95.14157 \quad 38.93148$
 Fraction WATER WELL RECORD

YONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and we completed on (mo/day/year) . . . . . . . . . . 8-23-91 Water Well Contractor's License No. . . . . 182 under the business name of STRADER DRILLING CO. This Wa



## E

Est. Yield
Pump test data: Well water was
50
f. ELEVATION:

ft. after
hours pumping
gpm
ft. after ............... hours pumping
.gpm
f. and
in. to
ft
WELL WATER TO BE USED ĀS: 5 Public water suply
8 Air conditioning ${ }^{11}$ Injection well
9 Dewatering
12 Other (Specify below)
2 Irrigation 4 industrial 7 Lawn and garden (domestic) 10 Monitoring well
Was a chemical/bacteriological sample submitted to Department? Yes ...... No X .... If yes, mo/day/yr sample was submitted

| 5 TYPE OF BLANK CASING USED: |  |
| :---: | :---: |
| 1 Steel | 3 RMP (SR) |
| 2 | 4 ABS |

Blank casing diameter
28 in. to
30

| 5 | Wrought Iron | 8 Concrete tile |  |
| :--- | :--- | :--- | :--- |
| 6 | Asbestos-Cement | 9 | Other (specify below) |
| 7 | Fiberglass | $\ldots$ |  |

CASING JOINTS: Glued X..... Clamped
Welded
Threaded

## Casing height above land surface 24

 in., weight …-....-16.-15in. to .................., Dia
in. to

## TYPE OF SCREEN OR PERFORATION MATERIAL:

1 Steel
3 Stainless steel
2 Brass
4 Galvanized steel

SCREEN OR PERFORATION OPENINGS ARE:
1 Continuous słot
3 Mill slot
2 Louvered shutter
4 Key punched

5 Fiberglass
7 PVC
lbs.ft. Wall thickness or gauge No.
.500

CCREEN-PERFORATED INTERVALS: From

6 Concrate tile
8 RMP (SR)
10 Asbestos-cement
11 Other (specify)
12 None used (open hole)


| FROM | TO | CODE | LITHOLOGIC LOG | FROM | TO | PLUGGING INTERVALS |
| :---: | :---: | :---: | :--- | :--- | :--- | :--- |
| 0 | 3 | Surface |  |  |  |  |
| 3 | 24 |  | Clay |  |  |  |
| 24 | 35 |  | Sand \& gravel |  |  |  |
| 35 | 50 |  | Large gravel |  |  |  |
| 50 | 51 |  | shale |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

ICONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) Constructed, (2) reconstructed, or (3) plugged under my jurlsdiction and was
completed on (mo/day/yr) 5-13-07
Water Well Contractor's License No.
under the business name of

## 554

 and this record is true to the best of my knowledge and belief. Kansas This Water Well Record was completed on (mo/day/yr) .-13-30-07[^3]
Hater Well
Database
Query

Scan of WWC5 Form


## Kansas Geological Survey

Comments to webadmin@kgs.ku.edu

WATEP, WELL RECORD Form WWC-5 KSA 82a-1212 ID No.


Distance and direction from nearest town or city street address of well if located within city?
mile northwest of Lecompton
2 WATER WELL OWNER: Mark Neis

| RR\#, St. Address, Box \# | 12775 County Line Rd. |
| :--- | :--- |
| City, State, ZIP Code | : Eudora, Ks. 66025 |

Board of Agriculture, Division of Water Resources Application Number:
3 LOCATE WELL'S LOCATION WITH|
ft.

## Water Well Disinfected? Yes $X$ No <br> No

Was a chemical/bacteriological sample submitted to Department? Yes. . . . . . . No. . X. . . ; If yes, mo/day/yrs sample was sub

8 Concrete tile
9 Other (specify below)
CASING JOINTS: Glued. . X . . Clamped.
Welded
Threaded.
in. to . . . . . . . . . . . . .t., Dia . . . . . . . . . . . . . . in. to . . . . . . . . . . . . . .ft., Dia . . . . . . . . . . . . . .in. to . . . . . . . . . . . . . . .f

C
8 RMP (SR)
9 ABS
SCREEN OR PERFORATION OPENINGS ARE:

| 1 Continuous slot | 3 Mill slot |
| :--- | :--- |
| 2 Louvered shutter | 4 Key punched |

5 Gauzed wrapped
6 Wire wrapped
7 Torch cut
SCREEN-PERFORATED INTERVALS: From. . . 50
ft. to .
. . . . . . .
$63 \ldots .$. ft., From
11 None (open hole)

AN "X" IN SECTION BOX:


5 TYPE OF BLANK CASING USED: 1 Steel 3 RMP (SR) 2 PVC 4 ABS
Blank casing diameter . . . $16 \ldots \ldots$ in. to
.ft., Dia


Casing height above land surface. . . . . $24 . \ldots . .$. . . in., weight . . . . . . . 1.5 . 54.
TYPE OF SCREEN OR PERFORATION MATERIAL:

| 1 Steel | $\frac{3 \text { Stainless steel }}{2 \text { Brass }}$ |
| :--- | :--- |
| 4 Galvanized steel |  |

5 Fiberglass
6 Concrete tile
bs./ft. Wall thickness or gauge No. 50.0

GRAVEL PACK INTERVALS:
From. . . . . . . . . . . . . . . ft. to . . . . . . . . . . . . . . . ft., From . . . . . . . . . . . . . . . . . . . ft. to. . . . . . . . . . . . . . . . . . . ft
From. . . 25.5.
From. . . . . . . . . . . . . . . . . ft. to . . . . . . . . . . . . . . . ft., From . . . . . . . . . . . . . . . . . . . ft. to. . . . . . . . . . . . . . . . . . . . ft

6 GROUT MATERIAL: 1 Neat cement
Grout Intervals: From. . Q ......... ft. to ... 2.5 .
What is the nearest source of possible contamination:

| 1 Septic tank | 4 Lateral lines | 7 Pit privy |
| :--- | :--- | :--- |
| 2 Sewer lines | 5 Cess pool | 8 Sewage lagoon |
| 3 Watertight sewer lines | 6 Seepage pit | 9 Feedyard |

.ft., From . . . . . . . . . . . . .ft. to.


## 3 Bentonite

Saw cut
9 Drilled holes
10 Other (specify)
$\qquad$
63 ...f.f. from . . . . . . . . . . . . . . . . . . . . ft. to. . . . . . . . . . . . . . . . . . . . . . . .

4 Other .
.ft., From
ft. to.
10 Livestock pens 14 Abandoned water well

11 Fuel storage
12 Fertilizer storage 13 Insecticide storage 10 Asbestos-cement 11 Other (specify) 12 None used (open hole)

Direction from well?
How many feet?

| FROM | TO | LITHOLOGIC LOG | FROM | TO | PLUGGING INTERVALS |
| :--- | :--- | :--- | :--- | :--- | :--- |
| 0 | 11 | brown silty clay |  |  |  |
| 11 | 18 | brown silt |  |  |  |
| 18 | 22 | brown fs-cs |  |  |  |
| 22 | 27 | brown fs-cs-med-pea |  |  |  |
| 27 | 33 | grey fine sand |  |  |  |
| 33 | 35 | blue clay |  |  |  |
| 35 | 38 | grey fs-cs-med grave1 |  |  |  |
| 38 | 42 | blue clay |  |  |  |
| 42 | 49 | fs-cs-med-some pea |  |  |  |
| 49 | 54 | fs-cs-med-pea |  |  |  |
| 54 | 55 | blue clay |  |  |  |
| 55 | 58 | fs-cs-med-pea |  |  |  |
| 58 | 63 | fs-cs-med-pea. $\frac{1}{2} \times 3 / 4$ |  |  |  |
| 3 |  | grey limestone |  |  |  |

CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and was completed on (mo/day/year) . 12-1.4-20.01. . . . . . . . . . . . . . . . . . . . . . . . . . . and this record is true to the best of my knowledge and belief. Kansa
 under the business name of Strader Drilling co., Inc.

## WATER WELL RECORD Form WWC-5 KSA 82a-1212



CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed) (2) reconstructed, or (3) plugged under my jurisdiction and was
 Water Well Contractor's License No. ... IO 2 under the business name of LAYNE CHRISTENSEN COMPANY


INSTRUCTIONS: Use typewriter or ball point pen. PLEASE PRESS FIRMLY and PRINT clearly. Please fill in blanks, underline or circle the correct answers. Send top three copies to Kansas Department of Health and Environment, Bureau of Water, Topeka, Kansas 66620-0001. Telephone: $913-296-5545$. Send one to WATER WELL OWNER and retain one for your records.

## APPENDIX II.

# Kansas Department of Agriculture, Division of Water Resources, <br> Safe Yield Analysis Data 

WIMAS Water Right Development - Map Centered on ( $\mathrm{E}^{1} / 2$ ) 35-12S-20E


In

来
This map was created by WIMAS on 9/12/2012 7:49:21 AM

Water Rights and Points of Diversion Within 2.00 miles of point defined as:
2940 ft N and 1320 ft W of the SE Corner of Section 35, T 12S, R 20E
Located at: 95.153247 West Longitude and 38.964996 North Latitude GROUNDWATER ONLY


| Total Net Quantities Authorized: | Direct | Storage |  |
| :--- | ---: | ---: | ---: |
| Total Requested Amount (AF) $=$ | .00 | .00 |  |
| Total Permitted Amount $(\mathrm{AF})=$ | 907.66 | .00 |  |
| Total Inspected Amount $(\mathrm{AF})=$ | 216.01 | .00 |  |
| Total Pro_Cert Amount (AF) $=$ | .00 | .00 |  |
| Total Certified Amount (AF) $=$ | 4305.78 | .00 |  |
| Total Vested Amount (AF) $=$ | .00 | .00 |  |
| TOTAL AMOUNT | $(\mathrm{AF})=$ | 5429.45 | .00 |

An * after the source of supply indicates a pending application for change for the file number

## APPENDIX III.

## Potential Pollution Sources in the Area

1. Septic tank drain fields and cesspools especially in sandy loam soils can be a potential contamination source of the aquifer. Kansas Department of Health and Environment requires all public water supply ells to have at least 20 feet of grout sealed casing at the top of the well to prevent contamination and entry of flow into the well. However, most older domestic wells do not have grout seals to a safe depth below surface thus becoming a potential sources of contamination of the aquifer. There is supposed to be 100 feet separation between a septic tank drain field and a domestic well on a property.
2. Cattle or other livestock feeding operation can be a source of pollution to an aquifer, depending on the soil type and depth to static water level, especially if located within the effective radius of influence of a well. The effective radius of influence of a well is dependent upon the pumping rate of the well and aquifer characteristics. Domestic wells have a small effective radius of influence usually less than 50 feet. The effective radius of influence can be one thousand feet or more for an irrigation well or other large capacity well.
3. Chemical fertilizer and herbicides applied to corn planted next to the wells as shown next to Eudora Well No. 6 is a potential threat of contamination to the City wells. This threat of contamination is increased with irrigation, especially on sandy soils. Major portions of Hall and Merrick Counties in Nebraska have nitrates nearly double that of the KDHE and EPA regulations for Nitrates in public water supply due to irrigation and chemigation of corn on sandy loam soils similar to the alluvial soils shown in Bulletin 206, Part 2, Ground Water in the Kansas River Valley Junction City to Kansas City, Kansas by Stuart W. Fader. The Newman Terrace clay loam soils offer more protection of the aquifer from fertilizer.
4. Abandoned wells or old domestic wells that were drilled long ago with thin wall casing that have corroded through the years and were not grout sealed, can allow storm water runoff to flow directly into the aquifer resulting in direct contamination to the City wells. Such a well may exist west of Eudora Well No. 7 under the old windmill tower in the picture.

## WICHITA SAND PIT STUDY

Sedgwick County Department of Environmental Resources organized and conducted much of the efforts to determine which sand pits to study in more detail. The study group obtained assistance from the U.W. Bureau of Reclamation in drilling and installing three (3) monitoring wells around each of six (6) sites selected for study. Funds were obtained for the U.S. Geological Survey to sample and analyze surface water from the pits, ground water from the monitoring wells, and pit bottom sediment at four (4) sites located at the northwest edge of Wichita. The USGS analyzed the water samples for 18 physical and chemical properties, five (5) bacteriological values, 40 inorganic constituents, 118 pesticides and degradate compounds, and 134 organic compounds other than pesticides. The USGS analyzed the bottom sediments for five (5) physical and chemical properties, 45 inorganic constituents, and 32 organic compounds. The four pits in the Phase I sampling were; Barefoot Bay, Ridge Port, Mooring, and Cropland. Later two south pits were sampled which were; Kingston Cove and Pine Bay Estates.

Maize retention pond/ground-water pit is used for storage of storm water runoff. A special sampling of the storm water flow into the pit was made by others within 30 minutes of when flow commenced and within one to two hours following a storm event. The TDS of the storm water flow was very low at 49 to $111 \mathrm{mg} / \mathrm{L}$ when compared to the computed values in the analysis of data of 46 to $83 \mathrm{mg} / \mathrm{L}$ by the Kansas Geological Survey. Organic compounds found in the runoff water of concern was Alachlor at $3.8 \mu \mathrm{~g} / \mathrm{L}$ in the first June 2007 runoff sample, Alachlor of $3.0 \mu \mathrm{~g} / \mathrm{L}$ in the second June 2007 sample. The drinking water MCL for Alachlor is $2 \mu \mathrm{~g} / \mathrm{L}$. However, in the October 2007 pond sample Alachlor was significantly reduced by sunlight and bacterial activity of the pond. The Maize detention pond appears to be an effective means of removing storm water runoff with high bacteria content from the Big Slough waterway.

Storm water runoff into the sand pits does contribute to ground water recharge. The study showed no significant evidence of contamination of ground water by storm water runoff into the pits. The key word is significant contamination. Trace levels of some organics and mineral constituents such as iron, manganese and the ammonium ion were detected in the down gradient monitoring wells in slightly greater concentrations than the up gradient monitoring wells. On the contrary, most organic contaminants were reduced by the sunlight and bacterial activity existing within the sand pit lakes. Bacterial levels were never greater than the level recommended by KDHE for body contact.

Although some of the pits had piped storm water runoff into the pits from streets, broad width flow ways with grass filtering would capture silt and other contaminants prior to entering the ponds or pits. Road side drainage ditches may have a broad width overflow channels into nearby pits temporarily storing the storm water surge allowing orderly flow through natural water courses. The long term accumulation of silts, sediments and other solids will eventually restrict the recharge to the ground water system as has occurred at the Sedgwick County Zoo pit.

Residential areas have the greater potential for ground water contamination than rural areas. However, the spring runoff from corn fields with atrazine must be bounded by grass filter strips and flows need to be routed in grass waterways to capture sediments with atrazine attached.

# Hydraulic Impacts of Quarries and Gravel Pits 

Prepared by
J>A. Green, J.A. Pavlish, R.G. Merritt, ans J.L. Leete
Minnesota Department of Natural Resources
Division of Waters

2005

The Division of Waters, MDNR studied three sand pits in the report, two of which were in saturated alluvial sediments and one was above the water table. The conclusion of this study was that sand mining had minimal impact on aquifer water levels. In one sand pit, ground water temperature changes were noted but were not consistent.






## APPENDIX IV.

## RESUME' AND PERSONAL INFORMATION

| Name: | Carl E. Nuzman, P.E., P.Hg. |
| :--- | :--- |
|  | 3314 NW Huxman Road |
|  | Silver Lake, KS 66539 |
| Position: | Consulting Engineer / Hydrogeologist |

Phone: (785) 5824054
Cell: (785) 2249929
cnuzman@embarqmail.com

## Academic and Professional Certifications:

Master of Science in Water Resources Engineering, Department of civil Engineering, University of Kansas, 1955.
Bachelor of Science in Agricultural Engineering, Kansas State University, 1053.
Professional Engineer, first licensed in Kansas in 1962, KS-4481. Formerly licensed in the following states: MO-E12525, IA-6334, SC-4099, FL-15102, AL-16858, AZ-23209, IL-062043392, IN-PE-60880547, LA-23209, MS-10041, MI-33050, NE-E-12525, NC-15121, NM10625, OH-E-51179, OK-15653, TN-018707, VA-0402-018380, and WI-E-25841.
Professional Hydrogeologist, Certified in 1986 by the American Institute of Hydrology, P.,Hg385.

## Professional Positions:

- Consultant - 1997 to Present
- Layne GeoSciences, Inc. Mission Woods, KS, Vice-president and Principal Hydrologist 1988 to 1997
- Groundwater Management, Inc. Kansas city, KS, Vice President and Chief Hydrologist, 1985 to 1988
- Layne Western Company, Inc. Hydrology Division Manager and Chief Hydrologist 1970 to 1985
- Layne Western Company, Inc. Kansas City, MO, Sales Engineer 1967 to 1970
- Kansas Water Resources Board, Topeka, KS, Hydrologist III 1966
- Kansas State Board of Agriculture, Division of Water Resources, Topeka, KS, Assistant Engineer 1957 to 1965


## Specialized Competence:

- Surface and ground water hydrology
- Project management and supervision
- Water well treatment and rehabilitation/ground water quality
- Well and well field design and construction
- Modeling of ground water aquifers
- Water treatment and distribution piping
- Injection well design and operation
- Water pumps and associated equipment including suction flow control devices


## Applicable Experience:

Mr. Nuzman has extensive experience in the areas of ground water modeling, water well and well field design and construction, water well treatment and rehabilitation, and soil and ground water remediation. He served at technical advisor to the Attorney General of Kansas in working with the U.S.Geological Survey Analog Model labsatatory in Phoenix, AZ in doing the first model work of the Equus Beds aquifer north of Wichita in 1961. He was the first to model the Ogallala aquifer in SW Kansas using the passive element, steady state, electric analog model technique in 1966.

After joining Layne Western in 1967, he has conducted numerous water well pumping tests, aquifer modeling projects and well field design and construction for multiple Cities and Companies throughout the United States and in some foreign countries. He has consulted on deep disposal wells and designed a ground water recharge facility. He has provided the foundation dewatering design for numerous construction projects. He has provided expert testimony on a variety of hydrologic issues. He has prepared specifications and bidding documents for both municipal and industrial well construction, pumps and controls for a variety of projects.

## Publications:

- Nuzman, Carl E. (1989) "Well Hydraulic Flow concept", Published in Recent advances in Ground-Water Hydrology, by the American Institute of hydrology pgs 72-77.
- Nuzman, Carl E. (1978, revised 1985) "Ground-Water and Well Efficiency" Published by Doerr metal Products, Larned, KS pgs 67.
- Winslow, John D. and C. E. Nuzman, (1966): "Electric Analog Model of the Kansas River alluvium in the vicinity of Topeka, Kansas", Kansas Geological Survey. Lawrence, KS.
- Contributor to the "Handbook of Ground-Water Development", by Roscoe Moss Company, Los Angeles, CA on Well Rehabilitation. 1990.
- Contributing author "Ground-Water Development handbook M-21" and contributed to the revised edition of Manual M-21 by the American Water Works Association, Denver, CO.
- Other technical papers and numerous client reports of study have been made.


## Inventions:

- Co-inventor of a filament wound fiber glass water well screen;
- Inventor of an In-situ Ground Water Treatment System, assigned to Layne Western Company, Inc;
- Co-inventor of a patent of a non-vortexing passive pump intake strained for boiling water reactor nuclear power plants and used on other water resource applications.


## Professional Societies:

- American Society of Biological and Agricultural Engineers
- American Society of Civil Engineers
- American Geophysical Union
- American Institute of Hydrology
- American Water Works Association
- National Ground Water Association
- National Society of Professional engineers
- Kansas Society of Professional Engineers



## Comments on the Carl Nuzman report:

"Evaluation of Penny's Concrete and Sand LLC, Proposed Sand Pit Operation on Ground Water"

By<br>Carl D. McElwee, Ph.D<br>Emeritus Professor<br>Geology Department<br>University of Kansas<br>Lawrence, KS

September 18, 2012

## Introduction

Mr. Nuzman has brought together a considerable amount of data regarding the proposed project. He is a respected member of the scientific community studying groundwater. As is always the case, the data must be interpreted and analyzed to draw conclusions. I would like to point out some places where the data may be interpreted and analyzed in an alternate and reasonable manner to arrive at different conclusions. In addition, I would like to bring out some other points that need to be considered in evaluating the possible impact of this pit mining operation.

## Groundwater Gradient direction

The gradient of groundwater is the driving force that causes it to move.
Mr.Nuzman mainly uses the water level data of Kansas Geological Survey (KGS) Bulletin 130, Part 1. The generalized static water table map that he uses (Exhibit D) gives too much weight to water moving down the Wakarusa River Valley (which joins the Kansas River Valley just south of the proposed sand pit). This distorts his ground water gradient and leads to the conclusion given in Exhibit F that the capture zone for the Eudora Well Field is south of the proposed pit.

On the other hand, if one considers the newer report KGS Bulletin 206, Part 2, it shows that the Kansas River is the major force and that water moves down the valley generally from west to east more or less parallel to the valley walls. The resulting groundwater gradient and flow direction is shown in Figure 1 below. This data shows that water will move from the proposed sand pit to the Eudora Well Field. I have done calculations of capture curves (area of groundwater capture in a given time by the well) and travel times based on work that I published in Ground Water (McElwee, 1991, A copy of that paper has been supplied to the DG CO Planning Office). That work shows that the minimum travel time between the proposed sand pit and the Eudora Well Field could be about 5.5 years. In addition, the 6 and 8 year capture curves significantly overlie the proposed sand pit, as shown in Figure 2 below. Details of this work are given in Appendix I.



Figure 2.
Both of the KGS reports referred to are old and can't be relied on for absolute numbers. However, they do allow us to reach some general conclusions. In addition, there is a lot of variability in the aquifer (things change with space and time). So, the conclusion must be that one can't state with certainty that the proposed sand pit will have no effect on the Eudora Well Field. Of course there are many other private wells that are down-gradient from the proposed sand pit and much closer that could also be affected.

## Effect of Pit on Water Levels and Quality in Aquifer

Mr. Nuzman states on page 8 that "The static water level elevation in the sand pit will be about the same as the water surface elevation in the Kansas River." That is probably true if the pit is close to the river. This means that the water level in the aquifer will be lowered around the pit, because the water levels in the aquifer are generally a little higher than the river level. This could negatively affect some nearby wells. Mr. Nuzman also states that "Sand pits beneficially support the yield of wells that are down-gradient from a pit that is within the area of influence of a well." In other words the well would be pumping water from the pit. This means
that the quality of the well water would depend on the quality of the water in the pit. In general, the quality of surface water in rivers and lakes is much poorer than the quality of groundwater. So there is the potential for pollution.

If this pit is allowed, a huge deep lake (about 70 feet deep on average) will be created. This will be a flow-through lake, which means that groundwater from upgradient will flow in one side of the lake and flow out the down-gradient side of the lake. The net result is a continual mixing of the groundwater and the surface water from the pit, which then continues to flow down the valley in the aquifer to the next user of the groundwater.

As the well drilling logs in Mr. Nuzman's reports shows, the overburden (soil, silt, and clay) that must be removed to access the sand is substantial. It is in the range of 15-23 feet in most places, in some areas less and some areas more. However, most logs in the vicinity of the proposed sand pit indicate about 23 feet of overburden to be dealt with. This is a major logistics problem that must be dealt with while keeping any surface runoff out of the pit. There is the potential for pollution from surface runoff. This overburden material has been the filter material to keep pollutants out of the deeper aquifer, removing it exposes the aquifer. The resulting piles of surficial material may contain fertilizer and pesticide residue and daughter products from their decay. Apparently, the plan is to emplace at least some of this material back into the pit. If this is done, the overburden material should be extensively tested for possible pollutants before such use.

Mr. Nuzman mentions that a few investigations have been made on the effect of sand pits on groundwater quality and that they have not shown any significant human health effect. However, one can't infer from these few studies that there will never be a problem. In fact, at least one of those studies (KGS OFR 2008-4) did come to the conclusion that there was a measurable interconnection between the sand pit waters and the local aquifer and that there was a potential for pollution. The following is a direct quote from the conclusions of that study.

[^4]direction of the ground-water flow at the study sites. The evidence for connection between the surface and ground waters at the two southern Wichita sites is not as strong as for the four northwest Wichita sites. However, distribution of some constituents and chemical properties do fit the general pattern of entrance of pit water into the ground water. This would be expected to occur most prominently when surface runoff into the pits increases the hydraulic gradient between the pit surface and ground-water levels. Thus, stormwater runoff containing contaminants can enter ground water through the sand pits and impact ground-water quality"

## Effect of Pit on the River System

Material has previously been provided that shows the river bank in the vicinity of this proposed sand pit is unstable and has moved over time. Geologic history tells us this river will move again, we just don't know when. During a flood event the river could change course and breach the proposed sand pit. This would have a dramatic effect on the river system. Since the sand pit is deep (about 70 feet) and the river is very shallow, the pit would capture the bed load of the river and cause the river to become unstable. This would result in deepening the channel upstream (head cutting) and degradation of the channel downstream. It would take years for the river to reach a new stable equilibrium. Pits should not be allowed in areas where pit capture is a possibility.

## Conclusions

I have shown that a reasonable interpretation of the available groundwater data indicates that the proposed sand pit could indeed have an effect on the Eudora Well Field and other local wells. The net effect will be a flow-through lake that mixes up-gradient aquifer water with sand pit water and sends it down-gradient into the aquifer and further down the valley. This behavior has been documented in studies of sand pits and aquifers. So, the conclusion is that any pollution must be prevented. The huge amount of overburden produced and its handling could be a source of pollution. Finally, the unstable nature of the river bank in this area makes it possible that the sand pit could capture the river during high flows and cause a channel change. If this were to happen, the river bed would be unstable for years until a new equilibrium was reached.

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## Resume

Name: CARL D. McELWEE
Telephone: 785-864-2728 (Geology Dept. Office)
785-843-4164 (Home)
Present Address: $\quad 1564$ E. 1850 Rd.
Lawrence, Kansas 66046 USA

## Education:

B.A., William Jewell College, Physics, 1965
M.A., The University of Kansas, Physics, 1967

Ph.D., The University of Kansas, Physics, 1971

## Professional Experience:

Professor of Geology, The University of Kansas, Lawrence, Kansas, 1997-2009, now retired.
Senior Scientist, Special Projects/Office of the Director, Kansas Geological Survey, The University of Kansas, Lawrence, Kansas, 1998-2002.

Senior Scientist, Mathematical Geology Section, Kansas Geological Survey, The University of Kansas, Lawrence, Kansas, 1987-1998.

Senior Scientist, Geophysics and Geochemistry Section, Kansas Geological Survey, The University of Kansas, Lawrence, Kansas, 1986-1987.

Associate Scientist, Geohydrology Section and Geophysics and Geochemistry Section, Kansas Geological Survey, The University of Kansas, Lawrence, Kansas, 1974-1986.

Geophysicist, Texaco Inc., Bellaire, Texas, 1970-1974.

## Honors, Memberships, and Affiliations:

NSF Undergraduate Research Grant (2 years, 1963-1965)
Graduation with Honors, William Jewell College (1965)
NSF Traineeship for Graduate Work (4 years, 1965-1969)
Mobil Oil Fellowship (1 year, 1969-1970)
Sabbatical leave awarded for groundwater research in The Netherlands (Aug.-Dec., 1984)

Sabbatical leave awarded for groundwater research in the United Kingdom (Jan.- May, 1993)
Center for Teaching Excellence Outstanding Graduate Teaching Award, Dept. of Geology, Univ. of Kansas, 2001.

Sabbatical leave awarded to start writing a book on groundwater modeling, Fall Semester 2002.
Leo M. \& Robert M. Orth Water Resources Scholarship, Dept. of Geology, 2008

## Present Major Scientific Interests:

Theoretical description of flow systems • Characterization of aquifer heterogeneity by field, laboratory, and modeling activities • Model studies of groundwater availability in Kansas • Sensitivity of groundwater models to variations in transmissivity and storage - Modeling of chemical quality of groundwater systems • Application of seismic techniques to groundwater exploration and evaluation

## Professional Journal Articles

McElwee, C.D., and Yukler, M.A., 1978, Sensitivity of groundwater flow models with respect to variations in transmissivity and storage: Water Resources Research, v. 14, no. 3, p. 451.

McElwee, C.D., 1980, Theis parameter evaluation from pumping tests by sensitivity analysis: Ground Water, v. 18, no. 1, p. 56.

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McElwee, C.D., 1985, A model study of salt-water intrusion to a river using the sharp interface approximation: Ground Water, v. 23, no. 4, p. 465.

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## Appendix I.

This calculations presented here is based on work I did and published back in 1991 in the Ground Water journal. I have supplied to the Planning Department a copy of that article for reference. This work shows that the minimum travel time from the Penny sand pit to the Eudora Well Field is about 5.5 years. This is from the closest point of the pit to the center of the well field. I have also calculated the 6 and 8 year capture curves for the Eudora Well field. The work shows that these capture curves include significant portions of the proposed pit.

The important parameters are as follows:
K - hydraulic conductivity - I used $1000 \mathrm{ft} /$ day. This is a measure of how fast water moves in the aquifer. The Nuzman report uses data from a well test on Eudora No. 8 and reports $8800 \mathrm{gpd} / \mathrm{ft} 2$, which is $1176 \mathrm{ft} /$ day. This also agrees with data I have personally collected from the Kansas River Valley.

I - Hydraulic gradient (slope) of the ground water system - I used .0005, which is about 5 ft in 2 miles. Bulletin 130, Part 1 and Bulletin 206, part 2 from the Kansas Geological Survey show head maps of the area in question that support this number.
$\mathrm{qo}=-\mathrm{KI}=-0.5 \mathrm{ft} /$ day - average Darcy velocity in the aquifer - Multiplying the above two values gives this result.

B - Effective saturated thickness of aquifer - I used 30 feet. Although the aquifer has greater saturated thickness, the upper part is much finer material and has much less hydraulic conductivity. I have seen this consistently in my field work.
n - effective porosity (a measure of the pore space that water flows through) - I used 0.15 which is an average value suggested by the work of Bull 260, and also is consistent with my field work.

Q - Pump rate of the Eudora Well Field - I used 83425 ft3/day which is the approved water right of 227.77 MGY or about 433gpm.

These parameters can be used to calculate the average travel times and capture curves for parcels of water moving under the influence of the natural groundwater flow system and the influence of the pumping in the Eudora Well Field. The details of the background material to arrive at the formulas used in the following pages are given in the above referenced Ground Water article. The pages that follow show the capture curves for 6 and 8 years and the average minimum travel time between the sand pit and the Eudora Well Field. A capture curve outlines the area of groundwater that will flow to the pumping well in a given amount of time.



| 6 yr . Capture Curve Data |  |
| :---: | :---: |
| X(Ft) | $\mathrm{Y}(\mathrm{Ft})$ |
| $8.8508 \mathrm{E}+02$ | $0.0000 \mathrm{E}+00$ |
| $7.8145 \mathrm{E}+02$ | -5.1844E+02 |
| $6.7783 \mathrm{E}+02$ | -7.2470E+02 |
| $5.7420 \mathrm{E}+02$ | -8.7735E+02 |
| $4.7057 \mathrm{E}+02$ | -1.0015E+03 |
| $3.6694 \mathrm{E}+02$ | -1.1069E+03 |
| $2.6331 \mathrm{E}+02$ | -1.1989E+03 |
| $1.5969 \mathrm{E}+02$ | -1.2804E+03 |
| $5.6059 \mathrm{E}+01$ | -1.3536E+03 |
| -4.7568E+01 | -1.4198E+03 |
| -1.5120E+02 | -1.4802E+03 |
| $-2.5482 \mathrm{E}+02$ | -1.5357E+03 |
| $-3.5845 \mathrm{E}+02$ | -1.5867E+03 |
| $-4.6208 \mathrm{E}+02$ | -1.6340E+03 |
| -5.6571E+02 | -1.6778E+03 |
| -6.6933E+02 | -1.7187E+03 |
| -7.7296E+02 | -1.7568E+03 |
| -8.7659E+02 | -1.7925E+03 |
| $-9.8022 \mathrm{E}+02$ | -1.8259E+03 |
| -1.0838E+03 | -1.8573E+03 |
| -1.1875E+03 | -1.8869E+03 |
| -1.2911E+03 | -1.9147E+03 |
| -1.3947E+03 | -1.9410E+03 |
| -1.4984E+03 | -1.9659E+03 |
| $-1.6020 \mathrm{E}+03$ | -1.9894E+03 |
| -1.7056E+03 | -2.0117E+03 |
| -1.8092E+03 | -2.0328E+03 |
| $-1.9129 \mathrm{E}+03$ | -2.0529E+03 |
| -2.0165E+03 | -2.0720E+03 |
| $-2.1201 \mathrm{E}+03$ | -2.0901E+03 |
| $-2.2238 \mathrm{E}+03$ | -2.1074E+03 |
| $-2.3274 \mathrm{E}+03$ | -2.1239E+03 |
| $-2.4310 \mathrm{E}+03$ | -2.1396E+03 |
| $-2.5346 \mathrm{E}+03$ | -2.1546E+03 |
| -2.6383E+03 | -2.1689E+03 |
| $-2.7419 \mathrm{E}+03$ | -2.1825E+03 |
| $-2.8455 \mathrm{E}+03$ | -2.1956E+03 |
| -2.9491E+03 | -2.2081E+03 |
| $-3.0528 \mathrm{E}+03$ | -2.2200E+03 |
| -3.1564E+03 | -2.2314E+03 |
| -3.2600E+03 | -2.2423E+03 |


| $-3.3637 \mathrm{E}+03$ | $-2.2527 \mathrm{E}+03$ |
| :--- | :--- |
| $-3.4673 \mathrm{E}+03$ | $-2.2627 \mathrm{E}+03$ |
| $-3.5709 \mathrm{E}+03$ | $-2.2722 \mathrm{E}+03$ |
| $-3.6745 \mathrm{E}+03$ | $-2.2813 \mathrm{E}+03$ |
| $-3.7782 \mathrm{E}+03$ | $-2.2899 \mathrm{E}+03$ |
| $-3.8818 \mathrm{E}+03$ | $-2.2982 \mathrm{E}+03$ |
| $-3.9854 \mathrm{E}+03$ | $-2.3060 \mathrm{E}+03$ |
| $-4.0891 \mathrm{E}+03$ | $-2.3135 \mathrm{E}+03$ |
| $-4.1927 \mathrm{E}+03$ | $-2.3206 \mathrm{E}+03$ |
| $-4.2963 \mathrm{E}+03$ | $-2.3272 \mathrm{E}+03$ |
| $-4.3999 \mathrm{E}+03$ | $-2.3335 \mathrm{E}+03$ |
| $-4.5036 \mathrm{E}+03$ | $-2.3394 \mathrm{E}+03$ |
| $-4.6072 \mathrm{E}+03$ | $-2.3449 \mathrm{E}+03$ |
| $-4.7108 \mathrm{E}+03$ | $-2.3500 \mathrm{E}+03$ |
| $-4.8144 \mathrm{E}+03$ | $-2.3547 \mathrm{E}+03$ |
| $-4.9181 \mathrm{E}+03$ | $-2.3590 \mathrm{E}+03$ |
| $-5.0217 \mathrm{E}+03$ | $-2.3628 \mathrm{E}+03$ |
| $-5.1253 \mathrm{E}+03$ | $-2.3662 \mathrm{E}+03$ |
| $-5.2290 \mathrm{E}+03$ | $-2.3691 \mathrm{E}+03$ |
| $-5.3326 \mathrm{E}+03$ | $-2.3715 \mathrm{E}+03$ |
| $-5.4362 \mathrm{E}+03$ | $-2.3733 \mathrm{E}+03$ |
| $-5.5398 \mathrm{E}+03$ | $-2.3746 \mathrm{E}+03$ |
| $-5.6435 \mathrm{E}+03$ | $-2.3753 \mathrm{E}+03$ |
| $-5.7471 \mathrm{E}+03$ | $-2.3754 \mathrm{E}+03$ |
| $-5.8507 \mathrm{E}+03$ | $-2.3747 \mathrm{E}+03$ |
| $-5.9544 \mathrm{E}+03$ | $-2.3733 \mathrm{E}+03$ |
| $-6.0580 \mathrm{E}+03$ | $-2.3712 \mathrm{E}+03$ |
| $-6.1616 \mathrm{E}+03$ | $-2.3681 \mathrm{E}+03$ |
| $-6.2652 \mathrm{E}+03$ | $-2.3642 \mathrm{E}+03$ |
| $-6.3689 \mathrm{E}+03$ | $-2.3592 \mathrm{E}+03$ |
| $-6.4725 \mathrm{E}+03$ | $-2.3531 \mathrm{E}+03$ |
| $-6.5761 \mathrm{E}+03$ | $-2.3458 \mathrm{E}+03$ |
| $-6.6797 \mathrm{E}+03$ | $-2.3372 \mathrm{E}+03$ |
| $-6.7834 \mathrm{E}+03$ | $-2.3272 \mathrm{E}+03$ |
| $-6.8870 \mathrm{E}+03$ | $-2.3156 \mathrm{E}+03$ |
| $-6.9906 \mathrm{E}+03$ | $-2.3024 \mathrm{E}+03$ |
| $-7.0943 \mathrm{E}+03$ | $-2.2873 \mathrm{E}+03$ |
| $-7.1979 \mathrm{E}+03$ | $-2.2702 \mathrm{E}+03$ |
| $-7.3015 \mathrm{E}+03$ | $-2.2510 \mathrm{E}+03$ |
| $-7.4051 \mathrm{E}+03$ | $-2.2293 \mathrm{E}+03$ |
| $-7.5088 \mathrm{E}+03$ | $-2.2051 \mathrm{E}+03$ |
| $-7.6124 \mathrm{E}+03$ | $-2.1781 \mathrm{E}+03$ |
| $-7.7160 \mathrm{E}+03$ | $-2.1480 \mathrm{E}+03$ |


| $-7.8196 \mathrm{E}+03$ | $-2.1145 \mathrm{E}+03$ |
| :--- | :--- |
| $-7.9233 \mathrm{E}+03$ | $-2.0773 \mathrm{E}+03$ |
| $-8.0269 \mathrm{E}+03$ | $-2.0360 \mathrm{E}+03$ |
| $-8.1305 \mathrm{E}+03$ | $-1.9903 \mathrm{E}+03$ |
| $-8.2342 \mathrm{E}+03$ | $-1.9396 \mathrm{E}+03$ |
| $-8.3378 \mathrm{E}+03$ | $-1.8833 \mathrm{E}+03$ |
| $-8.4414 \mathrm{E}+03$ | $-1.8209 \mathrm{E}+03$ |
| $-8.5450 \mathrm{E}+03$ | $-1.7515 \mathrm{E}+03$ |
| $-8.6487 \mathrm{E}+03$ | $-1.6740 \mathrm{E}+03$ |
| $-8.7523 \mathrm{E}+03$ | $-1.5871 \mathrm{E}+03$ |
| $-8.8559 \mathrm{E}+03$ | $-1.4891 \mathrm{E}+03$ |
| $-8.9596 \mathrm{E}+03$ | $-1.3913 \mathrm{E}+03$ |
| $-9.0632 \mathrm{E}+03$ | $-1.2478 \mathrm{E}+03$ |
| $-9.1668 \mathrm{E}+03$ | $-1.0945 \mathrm{E}+03$ |
| $-9.2704 \mathrm{E}+03$ | $-9.0492 \mathrm{E}+02$ |
| $-9.3741 \mathrm{E}+03$ | $-6.4783 \mathrm{E}+02$ |
| $-9.4777 \mathrm{E}+03$ | $0.0000 \mathrm{E}+00$ |
| $-9.3741 \mathrm{E}+03$ | $6.4783 \mathrm{E}+02$ |
| $-9.2704 \mathrm{E}+03$ | $9.0492 \mathrm{E}+02$ |
| $-9.1668 \mathrm{E}+03$ | $1.0945 \mathrm{E}+03$ |
| $-9.0632 \mathrm{E}+03$ | $1.2478 \mathrm{E}+03$ |
| $-8.9596 \mathrm{E}+03$ | $1.3913 \mathrm{E}+03$ |
| $-8.8559 \mathrm{E}+03$ | $1.4891 \mathrm{E}+03$ |
| $-8.7523 \mathrm{E}+03$ | $1.5871 \mathrm{E}+03$ |
| $-8.6487 \mathrm{E}+03$ | $1.6740 \mathrm{E}+03$ |
| $-8.5450 \mathrm{E}+03$ | $1.7515 \mathrm{E}+03$ |
| $-8.4414 \mathrm{E}+03$ | $1.8209 \mathrm{E}+03$ |
| $-8.3378 \mathrm{E}+03$ | $1.8833 \mathrm{E}+03$ |
| $-8.2342 \mathrm{E}+03$ | $1.9396 \mathrm{E}+03$ |
| $-8.1305 \mathrm{E}+03$ | $1.9903 \mathrm{E}+03$ |
| $-8.0269 \mathrm{E}+03$ | $2.0360 \mathrm{E}+03$ |
| $-7.9233 \mathrm{E}+03$ | $2.0773 \mathrm{E}+03$ |
| $-7.8196 \mathrm{E}+03$ | $2.1145 \mathrm{E}+03$ |
| $-7.7160 \mathrm{E}+03$ | $2.1480 \mathrm{E}+03$ |
| $-7.6124 \mathrm{E}+03$ | $2.1781 \mathrm{E}+03$ |
| $-7.5088 \mathrm{E}+03$ | $2.2051 \mathrm{E}+03$ |
| $-7.4051 \mathrm{E}+03$ | $2.2293 \mathrm{E}+03$ |
| $-7.3015 \mathrm{E}+03$ | $2.2510 \mathrm{E}+03$ |
| $-7.1979 \mathrm{E}+03$ | $2.2702 \mathrm{E}+03$ |
| $-7.0943 \mathrm{E}+03$ | $2.2873 \mathrm{E}+03$ |
| $-6.9906 \mathrm{E}+03$ | $2.3024 \mathrm{E}+03$ |
| $-6.8870 \mathrm{E}+03$ | $2.3156 \mathrm{E}+03$ |
| $-6.7834 \mathrm{E}+03$ | $2.3272 \mathrm{E}+03$ |
| -2 |  |


| -6.6797E+03 | $2.3372 \mathrm{E}+03$ |
| :---: | :---: |
| -6.5761E+03 | $2.3458 \mathrm{E}+03$ |
| -6.4725E+03 | $2.3531 \mathrm{E}+03$ |
| -6.3689E+03 | $2.3592 \mathrm{E}+03$ |
| -6.2652E+03 | $2.3642 \mathrm{E}+03$ |
| -6.1616E+03 | $2.3681 \mathrm{E}+03$ |
| -6.0580E+03 | $2.3712 \mathrm{E}+03$ |
| -5.9544E+03 | $2.3733 \mathrm{E}+03$ |
| -5.8507E+03 | $2.3747 \mathrm{E}+03$ |
| -5.7471E+03 | $2.3754 \mathrm{E}+03$ |
| -5.6435E+03 | $2.3753 \mathrm{E}+03$ |
| -5.5398E+03 | $2.3746 \mathrm{E}+03$ |
| -5.4362E+03 | $2.3733 \mathrm{E}+03$ |
| -5.3326E+03 | $2.3715 \mathrm{E}+03$ |
| $-5.2290 \mathrm{E}+03$ | $2.3691 \mathrm{E}+03$ |
| $-5.1253 \mathrm{E}+03$ | $2.3662 \mathrm{E}+03$ |
| $-5.0217 E+03$ | $2.3628 \mathrm{E}+03$ |
| -4.9181E+03 | $2.3590 \mathrm{E}+03$ |
| -4.8144E+03 | $2.3547 \mathrm{E}+03$ |
| -4.7108E+03 | $2.3500 \mathrm{E}+03$ |
| -4.6072E+03 | $2.3449 \mathrm{E}+03$ |
| -4.5036E+03 | $2.3394 \mathrm{E}+03$ |
| -4.3999E+03 | $2.3335 \mathrm{E}+03$ |
| -4.2963E+03 | $2.3272 \mathrm{E}+03$ |
| -4.1927E+03 | $2.3206 \mathrm{E}+03$ |
| -4.0891E+03 | $2.3135 \mathrm{E}+03$ |
| -3.9854E+03 | $2.3060 \mathrm{E}+03$ |
| -3.8818E+03 | $2.2982 \mathrm{E}+03$ |
| $-3.7782 \mathrm{E}+03$ | $2.2899 \mathrm{E}+03$ |
| -3.6745E+03 | $2.2813 \mathrm{E}+03$ |
| -3.5709E+03 | $2.2722 \mathrm{E}+03$ |
| -3.4673E+03 | 2.2627E+03 |
| -3.3637E+03 | $2.2527 \mathrm{E}+03$ |
| -3.2600E+03 | $2.2423 E+03$ |
| -3.1564E+03 | $2.2314 \mathrm{E}+03$ |
| -3.0528E+03 | $2.2200 \mathrm{E}+03$ |
| -2.9491E+03 | $2.2081 \mathrm{E}+03$ |
| -2.8455E+03 | $2.1956 \mathrm{E}+03$ |
| -2.7419E+03 | $2.1825 \mathrm{E}+03$ |
| -2.6383E+03 | $2.1689 \mathrm{E}+03$ |
| -2.5346E+03 | $2.1546 \mathrm{E}+03$ |
| -2.4310E+03 | $2.1396 \mathrm{E}+03$ |
| -2.3274E+03 | $2.1239 \mathrm{E}+03$ |


| $-2.2238 \mathrm{E}+03$ | $2.1074 \mathrm{E}+03$ |
| ---: | ---: |
| $-2.1201 \mathrm{E}+03$ | $2.0901 \mathrm{E}+03$ |
| $-2.0165 \mathrm{E}+03$ | $2.0720 \mathrm{E}+03$ |
| $-1.9129 \mathrm{E}+03$ | $2.0529 \mathrm{E}+03$ |
| $-1.8092 \mathrm{E}+03$ | $2.0328 \mathrm{E}+03$ |
| $-1.7056 \mathrm{E}+03$ | $2.0117 \mathrm{E}+03$ |
| $-1.6020 \mathrm{E}+03$ | $1.9894 \mathrm{E}+03$ |
| $-1.4984 \mathrm{E}+03$ | $1.9659 \mathrm{E}+03$ |
| $-1.3947 \mathrm{E}+03$ | $1.9410 \mathrm{E}+03$ |
| $-1.2911 \mathrm{E}+03$ | $1.9147 \mathrm{E}+03$ |
| $-1.1875 \mathrm{E}+03$ | $1.8869 \mathrm{E}+03$ |
| $-1.0838 \mathrm{E}+03$ | $1.8573 \mathrm{E}+03$ |
| $-9.8022 \mathrm{E}+02$ | $1.8259 \mathrm{E}+03$ |
| $-8.7659 \mathrm{E}+02$ | $1.7925 \mathrm{E}+03$ |
| $-7.7296 \mathrm{E}+02$ | $1.7568 \mathrm{E}+03$ |
| $-6.6933 \mathrm{E}+02$ | $1.7187 \mathrm{E}+03$ |
| $-5.6571 \mathrm{E}+02$ | $1.6778 \mathrm{E}+03$ |
| $-4.6208 \mathrm{E}+02$ | $1.6340 \mathrm{E}+03$ |
| $-3.5845 \mathrm{E}+02$ | $1.5867 \mathrm{E}+03$ |
| $-2.5482 \mathrm{E}+02$ | $1.5357 \mathrm{E}+03$ |
| $-1.5120 \mathrm{E}+02$ | $1.4802 \mathrm{E}+03$ |
| $-4.7568 \mathrm{E}+01$ | $1.4198 \mathrm{E}+03$ |
| $5.6059 \mathrm{E}+01$ | $1.3536 \mathrm{E}+03$ |
| $1.5969 \mathrm{E}+02$ | $1.2804 \mathrm{E}+03$ |
| $2.6331 \mathrm{E}+02$ | $1.1989 \mathrm{E}+03$ |
| $3.6694 \mathrm{E}+02$ | $1.1069 \mathrm{E}+03$ |
| $4.7057 \mathrm{E}+02$ | $1.0015 \mathrm{E}+03$ |
| $5.7420 \mathrm{E}+02$ | $8.7735 \mathrm{E}+02$ |
| $6.7783 \mathrm{E}+02$ | $7.2470 \mathrm{E}+02$ |
| $7.8145 \mathrm{E}+02$ | $5.1844 \mathrm{E}+02$ |
| $8.8508 \mathrm{E}+02$ | $0.0000 \mathrm{E}+00$ |
|  |  |


| 8 y yr. Capture Curve Data |  |
| :--- | ---: |
| X(Ft) | $\mathrm{Y}(\mathrm{Ft})$ |
| $8.8516 \mathrm{E}+02$ | $0.0000 \mathrm{E}+00$ |
| $7.5519 \mathrm{E}+02$ | $-5.7893 \mathrm{E}+02$ |
| $6.2523 \mathrm{E}+02$ | $-8.0688 \mathrm{E}+02$ |
| $4.9526 \mathrm{E}+02$ | $-9.7403 \mathrm{E}+02$ |
| $3.6530 \mathrm{E}+02$ | $-1.1087 \mathrm{E}+03$ |
| $2.3533 \mathrm{E}+02$ | $-1.2220 \mathrm{E}+03$ |
| $1.0536 \mathrm{E}+02$ | $-1.3199 \mathrm{E}+03$ |
| $-2.4604 \mathrm{E}+01$ | $-1.4059 \mathrm{E}+03$ |


| -1.5457E+02 | -1.4824E+03 |
| :---: | :---: |
| -2.8454E+02 | -1.5510E+03 |
| -4.1450E+02 | -1.6130E+03 |
| -5.4447E+02 | -1.6694E+03 |
| -6.7444E+02 | -1.7210E+03 |
| -8.0440E+02 | -1.7683E+03 |
| -9.3437E+02 | -1.8118E+03 |
| -1.0643E+03 | $-1.8521 \mathrm{E}+03$ |
| -1.1943E+03 | -1.8893E+03 |
| -1.3243E+03 | -1.9240E+03 |
| -1.4542E+03 | $-1.9562 \mathrm{E}+03$ |
| -1.5842E+03 | -1.9863E+03 |
| -1.7142E+03 | -2.0144E+03 |
| -1.8441E+03 | $-2.0408 \mathrm{E}+03$ |
| -1.9741E+03 | $-2.0655 \mathrm{E}+03$ |
| -2.1041E+03 | -2.0887E+03 |
| -2.2340E+03 | -2.1106E+03 |
| -2.3640E+03 | -2.1313E+03 |
| -2.4940E+03 | -2.1507E+03 |
| -2.6239E+03 | -2.1692E+03 |
| -2.7539E+03 | -2.1866E+03 |
| $-2.8839 \mathrm{E}+03$ | -2.2031E+03 |
| -3.0138E+03 | -2.2188E+03 |
| -3.1438E+03 | -2.2337E+03 |
| $-3.2738 \mathrm{E}+03$ | $-2.2479 \mathrm{E}+03$ |
| $-3.4037 \mathrm{E}+03$ | -2.2614E+03 |
| $-3.5337 \mathrm{E}+03$ | $-2.2742 \mathrm{E}+03$ |
| $-3.6637 \mathrm{E}+03$ | -2.2865E+03 |
| -3.7936E+03 | -2.2982E+03 |
| $-3.9236 \mathrm{E}+03$ | -2.3093E+03 |
| -4.0536E+03 | -2.3200E+03 |
| -4.1835E+03 | -2.3302E+03 |
| -4.3135E+03 | -2.3399E+03 |
| -4.4435E+03 | -2.3493E+03 |
| -4.5734E+03 | -2.3582E+03 |
| -4.7034E+03 | -2.3668E+03 |
| -4.8334E+03 | -2.3750E+03 |
| -4.9633E+03 | $-2.3829 \mathrm{E}+03$ |
| -5.0933E+03 | -2.3904E+03 |
| -5.2233E+03 | -2.3976E+03 |
| $-5.3532 \mathrm{E}+03$ | -2.4046E+03 |
| $-5.4832 \mathrm{E}+03$ | $-2.4112 \mathrm{E}+03$ |
| -5.6132E+03 | -2.4175E+03 |


| -5.7431E+03 | -2.4236E+03 |
| :---: | :---: |
| -5.8731E+03 | -2.4293E+03 |
| -6.0031E+03 | -2.4348E+03 |
| -6.1330E+03 | -2.4401E+03 |
| $-6.2630 E+03$ | $-2.4450 \mathrm{E}+03$ |
| -6.3930E+03 | -2.4497E+03 |
| -6.5229E+03 | $-2.4540 \mathrm{E}+03$ |
| -6.6529E+03 | -2.4581E+03 |
| -6.7829E+03 | $-2.4619 \mathrm{E}+03$ |
| $-6.9128 \mathrm{E}+03$ | $-2.4653 \mathrm{E}+03$ |
| $-7.0428 \mathrm{E}+03$ | $-2.4684 \mathrm{E}+03$ |
| -7.1728E+03 | $-2.4712 \mathrm{E}+03$ |
| -7.3027E+03 | -2.4735E+03 |
| -7.4327E+03 | $-2.4755 \mathrm{E}+03$ |
| -7.5627E+03 | -2.4769E+03 |
| -7.6926E+03 | $-2.4779 \mathrm{E}+03$ |
| -7.8226E+03 | $-2.4784 \mathrm{E}+03$ |
| -7.9526E+03 | $-2.4782 \mathrm{E}+03$ |
| -8.0825E+03 | -2.4774E+03 |
| -8.2125E+03 | $-2.4758 \mathrm{E}+03$ |
| -8.3425E+03 | -2.4734E+03 |
| -8.4724E+03 | -2.4701E+03 |
| -8.6024E+03 | $-2.4657 E+03$ |
| -8.7324E+03 | $-2.4602 \mathrm{E}+03$ |
| -8.8623E+03 | $-2.4534 \mathrm{E}+03$ |
| -8.9923E+03 | $-2.4451 \mathrm{E}+03$ |
| -9.1223E+03 | -2.4351E+03 |
| -9.2522E+03 | $-2.4234 E+03$ |
| -9.3822E+03 | $-2.4095 E+03$ |
| -9.5122E+03 | -2.3934E+03 |
| -9.6421E+03 | $-2.3746 \mathrm{E}+03$ |
| -9.7721E+03 | -2.3530E+03 |
| -9.9021E+03 | -2.3281E+03 |
| -1.0032E+04 | -2.2995E+03 |
| -1.0162E+04 | -2.2669E+03 |
| -1.0292E+04 | -2.2297E+03 |
| -1.0422E+04 | -2.1874E+03 |
| -1.0552E+04 | -2.1393E+03 |
| -1.0682E+04 | -2.0848E+03 |
| -1.0812E+04 | $-2.0230 \mathrm{E}+03$ |
| -1.0942E+04 | $-1.9528 \mathrm{E}+03$ |
| -1.1072E+04 | $-1.8730 \mathrm{E}+03$ |
| -1.1202E+04 | -1.7819E+03 |


| -1.1332E+04 | -1.6775E+03 |
| :---: | :---: |
| -1.1462E+04 | -1.5568E+03 |
| -1.1592E+04 | -1.4155E+03 |
| -1.1722E+04 | -1.3905E+03 |
| -1.1852E+04 | -1.0325E+03 |
| -1.1982E+04 | -7.4132E+02 |
| -1.2111E+04 | $0.0000 \mathrm{E}+00$ |
| -1.1982E+04 | $7.4132 \mathrm{E}+02$ |
| -1.1852E+04 | $1.0325 \mathrm{E}+03$ |
| -1.1722E+04 | $1.3905 \mathrm{E}+03$ |
| -1.1592E+04 | $1.4155 \mathrm{E}+03$ |
| -1.1462E+04 | $1.5568 \mathrm{E}+03$ |
| -1.1332E+04 | $1.6775 \mathrm{E}+03$ |
| -1.1202E+04 | $1.7819 \mathrm{E}+03$ |
| -1.1072E+04 | $1.8730 \mathrm{E}+03$ |
| -1.0942E+04 | $1.9528 \mathrm{E}+03$ |
| -1.0812E+04 | $2.0230 \mathrm{E}+03$ |
| $-1.0682 \mathrm{E}+04$ | $2.0848 \mathrm{E}+03$ |
| -1.0552E+04 | $2.1393 \mathrm{E}+03$ |
| -1.0422E+04 | $2.1874 \mathrm{E}+03$ |
| -1.0292E+04 | $2.2297 \mathrm{E}+03$ |
| -1.0162E+04 | $2.2669 \mathrm{E}+03$ |
| -1.0032E+04 | $2.2995 \mathrm{E}+03$ |
| -9.9021E+03 | $2.3281 \mathrm{E}+03$ |
| -9.7721E+03 | $2.3530 \mathrm{E}+03$ |
| -9.6421E+03 | $2.3746 \mathrm{E}+03$ |
| -9.5122E+03 | $2.3934 \mathrm{E}+03$ |
| -9.3822E+03 | $2.4095 \mathrm{E}+03$ |
| -9.2522E+03 | $2.4234 \mathrm{E}+03$ |
| -9.1223E+03 | $2.4351 \mathrm{E}+03$ |
| -8.9923E+03 | $2.4451 \mathrm{E}+03$ |
| -8.8623E+03 | $2.4534 \mathrm{E}+03$ |
| -8.7324E+03 | $2.4602 \mathrm{E}+03$ |
| -8.6024E+03 | $2.4657 \mathrm{E}+03$ |
| -8.4724E+03 | $2.4701 \mathrm{E}+03$ |
| -8.3425E+03 | $2.4734 \mathrm{E}+03$ |
| -8.2125E+03 | $2.4758 \mathrm{E}+03$ |
| -8.0825E+03 | $2.4774 \mathrm{E}+03$ |
| -7.9526E+03 | $2.4782 \mathrm{E}+03$ |
| -7.8226E+03 | $2.4784 \mathrm{E}+03$ |
| -7.6926E+03 | $2.4779 \mathrm{E}+03$ |
| -7.5627E+03 | $2.4769 \mathrm{E}+03$ |
| -7.4327E+03 | $2.4755 \mathrm{E}+03$ |


| -7.3027E+03 | $2.4735 \mathrm{E}+03$ |
| :---: | :---: |
| -7.1728E+03 | $2.4712 \mathrm{E}+03$ |
| -7.0428E+03 | $2.4684 \mathrm{E}+03$ |
| -6.9128E+03 | $2.4653 \mathrm{E}+03$ |
| $-6.7829 E+03$ | $2.4619 \mathrm{E}+03$ |
| -6.6529E+03 | $2.4581 \mathrm{E}+03$ |
| $-6.5229 E+03$ | $2.4540 \mathrm{E}+03$ |
| $-6.3930 E+03$ | $2.4497 \mathrm{E}+03$ |
| -6.2630E+03 | $2.4450 \mathrm{E}+03$ |
| -6.1330E+03 | $2.4401 \mathrm{E}+03$ |
| -6.0031E+03 | $2.4348 \mathrm{E}+03$ |
| -5.8731E+03 | $2.4293 \mathrm{E}+03$ |
| -5.7431E+03 | $2.4236 \mathrm{E}+03$ |
| -5.6132E+03 | $2.4175 \mathrm{E}+03$ |
| -5.4832E+03 | $2.4112 \mathrm{E}+03$ |
| -5.3532E+03 | $2.4046 \mathrm{E}+03$ |
| $-5.2233 E+03$ | $2.3976 \mathrm{E}+03$ |
| -5.0933E+03 | $2.3904 \mathrm{E}+03$ |
| -4.9633E+03 | $2.3829 \mathrm{E}+03$ |
| -4.8334E+03 | $2.3750 \mathrm{E}+03$ |
| -4.7034E+03 | $2.3668 \mathrm{E}+03$ |
| -4.5734E+03 | $2.3582 \mathrm{E}+03$ |
| -4.4435E+03 | $2.3493 \mathrm{E}+03$ |
| -4.3135E+03 | $2.3399 \mathrm{E}+03$ |
| -4.1835E+03 | $2.3302 \mathrm{E}+03$ |
| -4.0536E+03 | $2.3200 \mathrm{E}+03$ |
| -3.9236E+03 | $2.3093 \mathrm{E}+03$ |
| -3.7936E+03 | $2.2982 \mathrm{E}+03$ |
| -3.6637E+03 | $2.2865 \mathrm{E}+03$ |
| -3.5337E+03 | $2.2742 \mathrm{E}+03$ |
| -3.4037E+03 | $2.2614 \mathrm{E}+03$ |
| -3.2738E+03 | $2.2479 \mathrm{E}+03$ |
| -3.1438E+03 | $2.2337 \mathrm{E}+03$ |
| $-3.0138 \mathrm{E}+03$ | $2.2188 \mathrm{E}+03$ |
| -2.8839E+03 | $2.2031 \mathrm{E}+03$ |
| -2.7539E+03 | $2.1866 \mathrm{E}+03$ |
| -2.6239E+03 | $2.1692 \mathrm{E}+03$ |
| -2.4940E+03 | $2.1507 \mathrm{E}+03$ |
| -2.3640E+03 | $2.1313 \mathrm{E}+03$ |
| -2.2340E+03 | $2.1106 \mathrm{E}+03$ |
| -2.1041E+03 | $2.0887 \mathrm{E}+03$ |
| -1.9741E+03 | $2.0655 \mathrm{E}+03$ |
| -1.8441E+03 | $2.0408 \mathrm{E}+03$ |


| $-1.7142 \mathrm{E}+03$ | $2.0144 \mathrm{E}+03$ |
| ---: | ---: |
| $-1.5842 \mathrm{E}+03$ | $1.9863 \mathrm{E}+03$ |
| $-1.4542 \mathrm{E}+03$ | $1.9562 \mathrm{E}+03$ |
| $-1.3243 \mathrm{E}+03$ | $1.9240 \mathrm{E}+03$ |
| $-1.1943 \mathrm{E}+03$ | $1.8893 \mathrm{E}+03$ |
| $-1.0643 \mathrm{E}+03$ | $1.8521 \mathrm{E}+03$ |
| $-9.3437 \mathrm{E}+02$ | $1.8118 \mathrm{E}+03$ |
| $-8.0440 \mathrm{E}+02$ | $1.7683 \mathrm{E}+03$ |
| $-6.7444 \mathrm{E}+02$ | $1.7210 \mathrm{E}+03$ |
| $-5.4447 \mathrm{E}+02$ | $1.6694 \mathrm{E}+03$ |
| $-4.1450 \mathrm{E}+02$ | $1.6130 \mathrm{E}+03$ |
| $-2.8454 \mathrm{E}+02$ | $1.5510 \mathrm{E}+03$ |
| $-1.5457 \mathrm{E}+02$ | $1.4824 \mathrm{E}+03$ |
| $-2.4604 \mathrm{E}+01$ | $1.4059 \mathrm{E}+03$ |
| $1.0536 \mathrm{E}+02$ | $1.3199 \mathrm{E}+03$ |
| $2.3533 \mathrm{E}+02$ | $1.2220 \mathrm{E}+03$ |
| $3.6530 \mathrm{E}+02$ | $1.1087 \mathrm{E}+03$ |
| $4.9526 \mathrm{E}+02$ | $9.7403 \mathrm{E}+02$ |
| $6.2523 \mathrm{E}+02$ | $8.0688 \mathrm{E}+02$ |
| $7.5519 \mathrm{E}+02$ | $5.7893 \mathrm{E}+02$ |
| $8.8516 \mathrm{E}+02$ | $0.0000 \mathrm{E}+00$ |

Wells X (map in)

| -0.25 | 0.25 | -440 | 440 |
| :--- | ---: | ---: | ---: |
| -0.25 | -0.25 | -440 | -440 |
| 0.25 | 0.25 | 440 | 440 |

Wells Y (map in)

Wells X (ft) -440 440

Wells $Y$ (ft)

440
-440
440

| Pit X (map in) | Pit Y (map in) | Pit X (ft) | Pit Y (ft) |
| ---: | ---: | ---: | ---: |
| -5 | 0.25 | -8800 | 440 |
| -6.5 | 0.25 | -11440 | 440 |
| -6.5 | 3.25 | -11440 | 5720 |
| -5 | 3.25 | -8800 | 5720 |
| -5 | 0.25 | -8800 | 440 |

# Capture Zones for Simple Aquifers 

by Carl D. McElwee ${ }^{\text {a }}$


#### Abstract

The protection and cleanup of aquifers is a matter of high priority for all states and the federal government. One concept that is receiving increased attention is that of wellhead protection. Capture zones showing the area influenced by a well within a certain time are useful for both aquifer protection and cleanup. If hydrodynamic dispersion is neglected, a deterministic curve defines the capture zone. Analytical expressions for the capture zones can be derived for simple aquifers. However, the capture zone equations are transcendental and cannot be explicitly solved for the coordinates of the capture zone boundary. Fortunately, an iterative scheme allows the solution to proceed quickly and efficiently even on a modest personal computer. Three forms of the analytical solution must be used in an iterative scheme to cover the entire region of interest, after the extreme values of the $\mathbf{x}$ coordinate are determined by an iterative solution. The resulting solution is a discrete one, and usually $\mathbf{1 0 0 - 1 0 0 0}$ intervals along the $\mathbf{x}$-axis are necessary for a smooth definition of the capture zone. The presented program is written in FORTRAN and has been used in a variety of computing environments. No graphics capability is included with the program; it is assumed the user has access to a commercial package. The superposition of capture zones for multiple wells is expected to be satisfactory if the spacing is not too close. Because this program deals with simple aquifers, the results rarely will be the final word in a real application. However, the program is useful as a first phase in developing wellhead protection or aquifer cleanup schemes.


## Introduction

The protection and cleanup of aquifers is a matter of high priority for all states and the federal government, as evidenced by the large number of laws and regulations that have been established in recent years. One concept that is receiving increased attention is wellhead protection, where certain potentially polluting activities are banned or regulated within an area that would affect a well within a certain time period. In terms of aquifer cleanup, one would like to know what area of an aquifer will be influenced by a discharge well within a certain time period. These areas are commonly referred to in the literature as capture zones. If hydrodynamic dispersion is neglected, a deterministic curve (sharp front) can be used to define the capture zone. Because real-world aquifers are very complex, exhibiting heterogeneity, anisotropy, and other complicating factors, the calculation of realistic capture zones is difficult. Possible techniques range from simple analytical methods to complex numerical procedures.

The calculation of sharp front movement for wells in infinite aquifers dates at least to Muskat (1937). More

[^5]recently, Bear and Jacobs (1965) have investigated the movement of water bodies injected into isotropic homogeneous aquifers with uniform regional flow by analytical methods. Most ground-water texts present a steady-state analytical solution for the ground-water divide in an isotropic homogeneous aquifer with one pumping well located in a uniform regional flow field (see for example Todd, 1980, pp. 121-123); this corresponds to an infinite-time capture zone. Javandel et al. (1984, pp. 175-204) present semianalytical methods for calculating pathlines and time-related capture zones for multiple wells in simple aquifers (isotropic, homogeneous, uniform thickness, uniform regional flow, and steady state). However, their computer program is rather complex. EPA (1990) has recently sponsored development of a program to calculate wellhead protection areas (WHPA); but again the program is fairly complex. Javandel and Tsang (1986) propose infinite-time capture zone curves as a tool for aquifer cleanup; again, they use analytical methods for simple aquifers. A few authors have utilized numerical methods to calculate time-related capture zones in the presence of aquifer heterogeneity. Kinzelback (1986, pp. 227-230) presents the formalism for considering a heterogeneous velocity distribution. Shafer (1987) presents the formalism and gives examples of capture zones in heterogeneous aquifers.

The purpose of the present paper is to present a program for calculating time-related capture zones in simple aquifers. The program is short and efficient and adaptable to a range of computing environments from personal computers to mainframes. Because the program assumes simple
aquifer conditions (isotropic, homogeneous, uniform thickness, uniform regional flow, and steady state), it should be used with care in a real-world situation. However, the program should be a useful initial planning tool for aquifer protection or cleanup.

## Basic Equations

The basic equations that are used to describe the capture zone curves are taken from Bear and Jacobs (1965). As mentioned in the introduction, this formulation assumes an aquifer with a constant regional hydraulic conductivity ( K ). A regional flow direction and magnitude ( $\mathrm{q}_{\mathrm{o}}$ ) also is assumed constant and given by the Darcy equation.

$$
\begin{equation*}
\mathrm{q}_{\mathrm{o}}=-\mathrm{K} \frac{\partial \mathrm{~h}}{\partial \mathrm{~s}} \tag{1}
\end{equation*}
$$

$h$ is the regional hydraulic head (without the pumping well), and $s$ is the direction of the head gradient perpendicular to lines of constant head. In what follows, it will be assumed the x axis is parallel (or antiparallel) to the regional flow direction. The aquifer is assumed to be of constant thickness (B) and constant effective porosity (n). At this point, a well pumping at a rate Q is superimposed upon the regional system, and a new steady-state head configuration is established. The object is to calculate the area of the aquifer that will contribute water to the well during a specified time period; or alternatively, to calculate the area affected by injection for a given time interval, after the well is in steady state with the regional system. The curves surrounding these affected areas are loosely called capture curves for a given time period. It is convenient to define three dimensionless parameters:

$$
\begin{align*}
& \overline{\mathrm{x}}=\frac{2 \pi \mathrm{q}_{\mathrm{o}} B}{\mathrm{Q}} \mathrm{x}  \tag{2}\\
& \overline{\mathrm{y}}=\frac{2 \pi \mathrm{q}_{\mathrm{o}} B}{\mathrm{Q}} \mathrm{y}  \tag{3}\\
& \overline{\mathrm{t}}=\frac{2 \pi \mathrm{q}_{0}{ }^{2} B}{\mathrm{nQ}} \mathrm{t} \tag{4}
\end{align*}
$$

$\mathrm{q}_{\mathrm{o}}, \mathrm{B}, \mathrm{Q}$, and n are the previously defined Darcy velocity, aquifer thickness, pumpage rate, and effective porosity, respectively. $\mathrm{x}, \mathrm{y}$, and t are the space and time coordinates in the real world; whereas $\overline{\mathrm{x}}, \overline{\mathrm{y}}$, and $\overline{\mathrm{t}}$ are their dimensionless counterparts. Using these dimensionless variables, Bear and Jacobs (1965) show that the capture curves are given by the following equation.

$$
\begin{equation*}
\exp (\bar{x}-\bar{t})=\cos \bar{y}+\frac{\bar{x}}{\bar{y}} \sin \bar{y} \tag{5}
\end{equation*}
$$

Unfortunately, equation (5) is a transcendental equation which cannot be solved explicitly for either $\overline{\mathrm{x}}$ or $\overline{\mathrm{y}}$.

There are two cases where equation (5) can be simplified somewhat. When $\overline{\mathrm{t}} \rightarrow \infty$, equation (5) reduces to

$$
\begin{equation*}
\bar{x}=-\frac{\bar{y}}{\tan \bar{y}} \tag{6}
\end{equation*}
$$

which is the familiar form for the ground-water divide (Todd, 1980, pp. 121-123). From equation (6), it is seen that as $\bar{x} \rightarrow \infty$, the limiting value of $\overline{\mathrm{y}}$ is $\pm \pi$. The stagnation point occurs at $\overline{\mathrm{y}}=0$ and $\overline{\mathrm{x}}=-1$; this result can be obtained from equation (6) by taking the limit as $\bar{y} \rightarrow 0$ (see Figure 1). Another useful simplification of equation (5) results when $\overline{\mathrm{y}}$ $=0$; this corresponds to the two points where the capture curve crosses the $\overline{\mathrm{x}}$ axis. Taking the limit as $\overline{\mathrm{y}} \rightarrow 0$ of equation (5) gives the extreme values $\overline{\mathrm{x}}_{e}$,

$$
\begin{equation*}
\exp \left(\bar{x}_{e}-\bar{t}\right)=1+\bar{x}_{e} \tag{7}
\end{equation*}
$$

(See Figure 1 for examples of $\bar{x}_{\mathrm{e}}$.) A slight rearrangement of equation (7) gives the form

$$
\begin{equation*}
\overline{\mathrm{t}}=\overline{\mathrm{x}}_{\mathrm{e}}-\ln \left(1+\overline{\mathrm{x}}_{\mathrm{c}}\right) \tag{8}
\end{equation*}
$$

Equations (5) and (8) will form the basis for calculating capture curves at a given normalized time $\overline{\mathrm{t}}$. Unfortunately, both are transcendental equations, so iterative techniques will be used to obtain their solution. The resulting curves will enclose the area of the aquifer containing water either injected or discharged by the well up to time $\overline{\mathrm{t}}$. The curves represent sharp fronts (deterministic curves) because hydrodynamic dispersion has been neglected. Those who are not interested in the mathematical details of solution may wish to skip to the section describing the computer program availability.

## Iterative Solution

The capture curves given by equation (5) are symmetric about the $\overline{\mathrm{x}}$ axis; and the x axis is assumed to be parallel to the regional hydraulic gradient with its origin at the well. The requirement that the origin be at the well is relaxed in the computer program. From the discussion in the previous section, the limits on the coordinates are $-1 \leq \bar{x} \leq \infty$ and $-\pi \leq \overline{\mathrm{y}} \leq \pi$. The solution that we shall obtain is a numerical one at discrete values of $\overline{\mathrm{x}}$. The approach that we shall take involves solving equation (8) for the extreme values of $\bar{x}$ at a certain $\overline{\mathrm{t}}$. The region bounded by these two extremes will be discretized to give a certain number of discrete values of $\bar{x}$ (usually between 100 and 1000). Let $\bar{x}_{\mathrm{i}}$ represent one of these values. At that point with $\bar{\tau}$ and $\overline{\mathrm{x}}$ known, equation (5) will be solved to obtain $\bar{y}$. Unfortunately, no single form of equation (5) seems to work well for the full range of coordinates. (Three forms will be used later.)

The extreme values of $\bar{x}$ are found by solving equation (8). Rearranging equation (8) slightly allows an iterative solution scheme to be developed (one-point method, Atkinson, 1989, pp. 76-83).

$$
\begin{equation*}
\overline{\mathrm{x}}_{\mathrm{e}}^{(\mathrm{m}+1)}=\overline{\mathrm{t}}+\ln \left[1+\overline{\mathrm{x}}_{\mathrm{e}}^{(\mathrm{m})}\right] \tag{9}
\end{equation*}
$$

The $m$ in equation (9) is an iteration index. An initial guess for $\overline{\mathrm{x}}_{\mathrm{c}}$ must be known, but $\overline{\mathrm{x}}_{\mathrm{c}}=0$ always seems to work well. Iteration continues on equation (9) until convergence occurs. If the initial guess for $\overline{\mathrm{x}}_{\mathrm{e}}$ is zero and $\overline{\mathrm{t}}$ is positive, it is clear that equation (9) will converge on a positive value. If $\bar{t}$ is small, then $\overline{\mathrm{x}}_{\mathrm{c}}$ also will be small and the logarithmic term of equation (8) can be written as a series expansion to yield

$$
\begin{equation*}
\overline{\mathrm{t}}=\frac{\overline{\mathrm{x}}_{\mathrm{e}}^{2}}{2}-\frac{\overline{\mathrm{x}}_{\mathrm{e}}^{3}}{3}+\frac{\overline{\mathrm{x}}_{\mathrm{e}}^{4}}{4}-\ldots \tag{10}
\end{equation*}
$$

Solving for the lowest power of $\overline{\mathrm{x}}_{\mathrm{e}}$ gives

$$
\begin{equation*}
\overline{\mathrm{x}}_{\mathrm{e}}^{(\mathrm{m}+1)}=\sqrt{2}\left[\overline{\mathrm{t}}+\frac{\overline{\mathrm{x}}_{\mathrm{e}}^{(\mathrm{m}) 3}}{3}-\frac{\overline{\mathrm{x}}_{\mathrm{e}}^{(\mathrm{m}) 4}}{4}+\ldots\right]^{1 / 2} \tag{11}
\end{equation*}
$$

Iterating equation (11) works well for small values of $\bar{t}$ and $\overline{\mathrm{x}}_{\mathrm{e}}$.

Equations (9) and (11) work well for the positive value of the $\bar{x}$ extremes; however, a slightly different version is needed to find the negative extreme value. Rearranging equation (7) slightly gives the following iterative solution.

$$
\begin{equation*}
\bar{x}_{e}^{(m+1)}=\exp \left(\bar{x}_{e}^{(m)}-\bar{t}\right)-1 \tag{12}
\end{equation*}
$$

Clearly, if $\bar{t} \rightarrow \infty$, equation (12) gives an extreme value of -1 . If the initial guess for $\overline{\mathrm{x}}_{\mathrm{e}}$ is zero and $\overline{\mathrm{t}}$ is positive, the result for the first iteration will be negative. Experience has shown that equation (12) converges rapidly on the negative value of $\bar{x}_{e}$.

Now that the extreme values of $\bar{x}$ are known for a particular $\overline{\mathrm{t}}$, we can pick a discrete value $\overline{\mathrm{x}}_{i}$ located between these two extremes. The only unknown in equation (5) is now $\bar{y}$, and an iterative solution can be set up. The most obvious iterative form is obtained from equation (5) by multiplying by $\bar{y}$ and $\exp (\bar{t}-\bar{x})$ to obtain

$$
\begin{equation*}
\bar{y}_{i}^{(m+1)}=\exp \left(\bar{t}-\bar{x}_{i}\right) \cdot\left[\bar{y}_{i}^{(m)} \cos \bar{y}_{i}^{(m)}+\bar{x}_{i} \sin \bar{y}_{i}^{(m)}\right] \tag{13a}
\end{equation*}
$$

However, numerical experiments show that equation (13a) does not have as wide a region of convergence as we would like. The convergence properties of equation (13a) can be changed by adding $\bar{y}_{i}$ to each side of the equation (Atkinson, 1989, pp. 76-83). The resulting equation which we shall use is

$$
\begin{align*}
\bar{y}_{i}^{(m+1)}= & \frac{\bar{y}_{i}^{(m)}}{2}+\frac{1}{2} \exp \left(\bar{t}-\bar{x}_{i}\right) \\
& {\left[\bar{y}_{i}^{(m)} \cos \bar{y}_{i}^{(m)}+\bar{x}_{i} \sin \bar{y}_{i}^{(m)}\right] } \tag{13b}
\end{align*}
$$

As long as $\left|\bar{y}_{\mathrm{i}}\right| \leq \pi / 2$ and $\overline{\mathrm{x}} \geq 1$, equation (13b) works well.

An alternate form of equation (5) can be obtained by solving for $\cos \bar{y}$ and then taking the inverse cosine function.

$$
\begin{equation*}
\bar{y}_{i}^{(m+1)}=\cos ^{-1}\left[\exp \left(\bar{x}_{i}-\bar{t}\right)-\frac{\bar{x}_{i}}{\bar{y}_{i}^{(m)}} \sin \bar{y}_{i}^{(m)}\right] \tag{14}
\end{equation*}
$$

Numerical experiments show that this form works well for all values of $\bar{x}$ and $\bar{y}$ as long as $\bar{t} \leq 1$. For $\bar{t} \geq 1$, equation (14) can be used only for $\bar{x} \leq 1$.

The final form of equation (5) needed to fill in all remaining values of $\bar{x}, \bar{y}$, and $\bar{t}$ is given by rearranging and solving for the tangent of $\bar{y}_{i}$.

$$
\begin{equation*}
\tan \overline{\mathrm{y}}_{\mathrm{i}}=\left(\frac{\overline{\mathrm{y}}_{\mathrm{i}}}{\overline{\mathrm{x}}_{\mathrm{i}}}\right) \cdot\left(\frac{\exp \left(\overline{\mathrm{x}}_{\mathrm{i}}-\overline{\mathrm{t}}\right)}{\cos \overline{\mathrm{y}}_{\mathrm{i}}}-1\right) \tag{15}
\end{equation*}
$$

Using the trigonometric identity $\tan (-\theta)=\tan (\pi-\theta)$ allows us to rewrite equation (15) in iterative notation.

$$
\begin{equation*}
\bar{y}_{i}^{(m+1)}=\pi-\tan ^{-1}\left[\left(\frac{\bar{y}_{i}^{(m)}}{\bar{x}_{i}}\right) \cdot\left(1-\frac{\exp \left(\bar{x}_{i}-\bar{t}\right)}{\cos \bar{y}_{i}^{(m)}}\right)\right] \tag{16}
\end{equation*}
$$

Numerical experiments show that this equation works well for $\overline{\mathrm{t}}>1$ and $\overline{\mathrm{x}}>1$ if $\left|\overline{\mathrm{y}}_{\mathrm{i}}\right|>\pi / 2$. Clearly, equation (16) has a problem at $\overline{\mathrm{y}}=\pi / 2$ because the cosine function is zero. Therefore, special provision must be made to prevent equation (16) from being used too near the region where $\overline{\mathrm{y}}=\pi / 2$.

The iterative equations (13), (14), and (16) for $\bar{y}$ require an initial guess for the $\mathrm{m}=0$ iteration. That question was avoided in the above paragraphs where the equations were developed. However, in practice, this presents no problem. Using the extreme values of $\overline{\mathrm{x}}$, a discrete set of $\overline{\mathrm{x}}_{\mathrm{i}}$ 's are calculated by dividing the region between the extremes into an integral number of steps (usually between 100 and 1000). Solution then proceeds sequentially from the negative $\bar{x}$ extreme to the positive $\bar{x}$ extreme. At each of the extreme values of $\overline{\mathrm{x}}$, we know that $\overline{\mathrm{y}}=0$. Therefore, as we step through the solution we will always know the value of $\bar{y}$ at the previous $\bar{x}$ value, and we can use this as the initial guess for $\bar{y}$ at the current value of $\bar{x}$. If at least 100 steps in $\bar{x}$ are used, the value of $\bar{y}$ does not change dramatically in one step and the above procedure is very efficient. As the solution proceeds, the appropriate equation (13), (14), or (16) is selected depending on the values of $\bar{t}, \bar{x}$, and the current value of $\bar{y}$.

## Computer Program

A simple computer program to calculate capture curves based on the material presented here has been written in FORTRAN and is available at nominal cost from the Publication Sales Office of the Kansas Geological Survey. Computer Program Series \#90-5 is a publication containing the material of this paper as well as a more detailed description of the program workings, a FORTRAN listing, some sample data sets with output, and an IBM compatible disk containing the program. We commonly run the program on an IBM AT compatible computer; however, it can be adapted easily to a wide variety of computer environments. Usually only the input and output statements need modification.

## Results and Application

The results of using the algorithms discussed here are shown in Figure 1 for $\bar{t}$ values of $1,3,5$, and $\infty$. The $\bar{t}=\infty$ curve corresponds to the normal ground-water divide. Equations (13), (14), and (16) can be applied only in certain regions of $\bar{t}, \bar{x}$, and $\bar{y}$ as discussed earlier. These various regions are shown on Figure 1, each with a different background pattern. Figure 1 was produced with a commercially available graphics package directly from the output file of the program. No graphics capability is included in the program; it is assumed that the user has access to a similar package.

In a real-world application, one will not be dealing with the dimensionless quantities $\overline{\mathrm{t}}, \overline{\mathrm{x}}$, and $\overline{\mathrm{y}}$ but with actual time


Fig. 1. Capture zones and regions of equation application.
and distances. However, equations (2), (3), and (4) provide the necessary conversions, so the simple user interface in the main program provides the connection to a specific application. Parameters may be given in any consistent set of units. To begin, one must know the average value of hydraulic conductivity and the regional hydraulic gradient vector (direction and magnitude). These quantities are used in equation (1) to calculate the specific discharge or Darcy velocity ( $\mathrm{q}_{\mathrm{o}}$ ). Knowing the average regional thickness of the aquifer (B), the effective porosity (n), and the discharge (or injection) rate of the well $(Q)$, the program can calculate $\bar{t}$ from equation (4) for the actual time of interest. The program then calculates the $\bar{x}_{i}$ and $\bar{y}_{i}$ of the capture curve of interest. These values of $\bar{x}$ and $\bar{y}$ are used with equations (2) and (3) to solve for the real-world coordinates $x$ and $y$, which can then be plotted on an appropriate map base. Currently, the program assumes that the x axis is parallel to the regional hydraulic gradient; but, the well may be located at arbitrary coordinates. If the x axis assumption is not true, an appropriate rotation of coordinates will be needed before plotting on the desired map base.

## Discussion

Strictly speaking, the program presented here only deals with one well in a uniform, homogeneous, isotropic aquifer with uniform, steady, regional flow. In practice these conditions are rarely satisfied. However, the type of analysis presented here can be very useful as a first phase in developing wellhead protection or aquifer cleanup schemes (Javandel and Tsang, 1986). If conservative aquifer parameters are used, the analysis presented here should outline a maximum capture zone. The program presented here only deals with one well; however, the approximate result for several wells can be obtained by applying the program once for each well and superimposing the results. As long as the capture zones do not overlap, the approximate result should be very good. As the well spacing gets smaller and the capture zones overlap, the approximate results will deviate more from the correct solution; as long as the well spacing is greater than or equal to $\mathrm{Q} / \pi \mathrm{q}_{\mathrm{o}} \mathrm{B}$, the results are expected to be acceptable (see Javandel and Tsang for details of superimposing multiple wells). For the final analysis, if heterogeneity and nonuniform flow are very important, a more
complex program such as that presented by Shafer (1987) should be used.

The program presented here is useful for planning wellhead protection and aquifer cleanup schemes. However, the user must always be mindful of its limitations. The presented program is simple and can be embedded in many computing environments, including personal computers, work stations, and mainframes. We have used the program on a work station interfaced with a geographical information system (GIS) to plot capture zones for several wells in Kansas (Woods et al., 1987; Whittemore et al., 1987; and Merchant et al., 1988). The program is presented here in the hope that it will be useful to others.

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Carl D. McElwee graduated in 1965 from William Jewell College with a B.A. in Physics. He received the M.A. and Ph.D. degrees from the University of Kansas in 1967 and 1971, respectively. His research area was solid-state physics. From 1971 to 1974 he workedfor Texaco, Inc., in Houston, Texas, as a Research Geophysicist. Since 1974 he has workedfor the Kansas Geological Survey in the Geohydrology, Geophysics, and Advanced Projects Sections. His area of special interest is the quantitative description of aquifer systems by field measurements and modeling.

## Lawrence Douglas County Metropolitan Planning Office

6 East 6th Street,
P.O. Box 708, Lawrence, KS 66044

Planning Staff:
As interested property owners, we are writing this letter to object to the Conditional Use Permit (CUP) that Penny Sand Co. has applied for near 1500N and 1850E. This CUP asks permission for a pit mining operation for sand removal. This would completely change the agricultural setting of the area. If allowed, this CUP would subject the area to dramatically increased industrial activity, including noise, dust, and environment destruction. We ask that you deny the CUP for the following reasons:
(1)The affected area has some interesting Douglas County history associated with it and contains some historic houses.
(2) The river bank in the vicinity of this proposed pit mining operation is unstable and has moved considerably over recent times. If pit mining is allowed in this area, in times of flood the chances of a dramatic river channel change is magnified greatly.
(3) On this proposed 434 acre pit mining site, the majority of the area is covered by some of the highest quality soils as defined by the US Department of Agriculture. It seems very short sighted to produce sand for short term gain and lose the potential for significant food and fiber production indefinitely.
(4)There is a large amount of overburden (unusable soil, silt and clay) that must be removed (typically 23-24 feet). Removing this much overburden will create an environmental nightmare
(5) Opening this pit operation will expose one of the most prolific aquifers in this region to potential pollution. This aquifer is a magnificent resource that must be protected and preserved for the future.
(6)Several neighboring house wells could be affected by this pit. Just down the valley about $15 / 8$ miles lies the Eudora Public Water Supply Well Field; it could also be affected by the proposed pit mining operation.

Thank you for your consideration of our concerns.

Penny Sand Pit Petition


Penny Sand Pit Petition


Penny Sand Pit Petition


Penny Sand Pit Petition

| Name | Address | Phone Number | email |
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# Building Blocks Daycare Center 1411 E 1850 Road Lawrence, KS 66046 (785) 865-3999 

To: Lawrence Douglas County<br>Metropolitan Planning Office<br>6 East 6th Street,<br>P.O. Box 708,<br>Lawrence, KS 66044

We want to object to the greatly increased heavy truck traffic on 442 due to this application, which will interfere with our customers dripping off and picking up children. We are a licensed daycare center near the proposed Penny Sand Plant. We are licensed for 129 children that can attend our center. We have over 30 teachers that work at the center. Parents and teachers drive daily between 7 AM to 6 PM Monday through Friday. Few years back we requested the Burlington Rail Road and the State of Kansas to review the increased traffic going through 1850 Road. Within a few months of the study both the State and Burlington implemented a railroad crossing due to the increased traffic.

Please realize that we already have the following people using 442 (Old K 10).

- Up to 129 parents dropping children during the day.
- Over 30 teachers coming to our facility during the day.
- Public school buses coming to our facility to drop children at the center.
- Our current vans driving during the day to pick and bring back children from different schools in Lawrence and Eudora.
- Folks visiting Pendleton during the year to purchase vegetables and fruits.
- Folks that work in Eudora and travel to Lawrence for employment.
- Folks that live in KC and work in Lawrence use the back road (442) to get to work.

Currently everyone in the neighborhood have a well for water source to either their house or business. We can't afford to lose our only source of water. I just can't imagine digging that many acres won't affect our only water source to the facility. Without water we would lose our children and would be forced to close the facility as water is a requirement by KDHE and would eliminate over 30 jobs.

We request that you deny the permit for the safety of the children, teachers and everyone traveling on the highway.


Peter Shenouda

# MEMORANDUM 

TO: City of Eudora Planning Commission<br>CC: City of Eudora Staff<br>FROM: Scott Michie, City of Eudora Planning Advisory Consultant<br>SUBJECT: Staff Findings, Penny Sand Conditional Use Permit to Douglas County<br>DATE: September 10, 2012 County Agenda of 9-24-2012, Sand Pit CUP

The City of Eudora plans and code requirements are met in the subject sand pit application. These staff findings are submitted based on the three City zoning standards considered for a permit application most similar to the county's CUP:

## Eudora Standard 1: Whether the proposed use meets City regulations.

Staff Finding: The subject application does not conflict with City of Eudora regulatlons, because the sand dredging site is at or beyond the outer northwest edge of the City's Planning Area; and as such, does not impede the City's long-standing public policies for: a) utilization and conservation of the natural resources northwest of the City, b) protection of its planned long term industrial areas, and c) minimization of industrial traffic through town on Main Street heading south to K-10 Highway.

Eudora Standard 2: Whether the proposed use complies with the Comprehensive Plan. Staff Finding: The application does not conflict with the City of Eudora Comprehensive Plan. The City plan calls for preservation of the river floodplain natural resources in its planning area, recognizing them as "the most prominent natural features north and west of the City." As the current processing plant is outside of the City's planning area, and the expanded sand dredging would be partially beyond the City's planning area, the operation may be considered outside of the area of City concern for "preservation of the river floodplains in its planning area." In addition, the Penny Sand application complies with the industrlal land use recommendation of the City Map by directing industrial traffic west of the City:

Industrial areas should have reasonable and convenient access to major arterials and railroad facilities as required. The use of local streets and traffic that cuts through the community off of arterial streets is strongly discouraged as it increases road maintenance and traffic conflicts.

Eudora Standard 3: Whether the proposed use and site plan will be objectionable or detrimental to the public welfare of the community under the circumstances of the particular case regarding setback, height, density and similar aspects.
Staff Finding: No such objection or detriment is found in this case.
Review and analysis by Terrane Resources Company should be considered before the public can be assured against harm as to long-term potential impacts of the proposed sand pit operation on City of Eudora public water wells.

## End of Memorandum

# Friends . Kaw 

Septernber 21, 2012

Douglas County Commission
1100 Massachusetts Street
Lawrence. KS 66044-3040

Kansas Riverkerper(9)
Laura Caluell
2012 Board of Directors

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Chat Lamer, Pres.
R.J. Stephenson, Vice Pres.

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Lance Burr
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Friends of the Kaw
P.O. Box 1512 .

Lawrence, KS 65044
Kansas City:
913-963-3460,
Lawrence:
785-512-7200
Report River
Pollution:
1-866-RIV-KEEP
Email:
Rivorkceperaikikansas
Riketon5

## Website:

htip:/KansacRiver.ors

RE: CUP for proposed Penny's Concrete Inc. Pit Mine
Friends of the Kaw, Inc. is a 501 c 3, grassroots environmental organization whose mission is to protect and preserve the Kansas River for present and future generations. Towards that end, we have advocated - since our inception in the early 1990's - that inriver sand and gravel operations move out of the river and onto the land (pit mining) due to (a) irreparable hann done to the river's channel, banks and ecosystem; and (b) degradation of our drinking water quality; (c) degradation to public water intake supply systems; and bridge structures.

The Kansas River has been commercially mined (dredged) for sand and gravel since the early 1900's. Past dredging activities are documented to have caused significant damage to riverbed, habitat, and water quality.

The Army Corps is currently considering a proposal from five private dredging companies to increase dredging on the Kaw close to $50 \%$, from 2.2 million tons to 3.2 million tons of sand per year.

The following preliminary findings come from a study funded by the Kansas Department of Wildlife and Parks (KDWP) and carried out by Kansas State University researchers Melinda Daniels and Craig Paukert. The scientists have documented riverbed incision in dredged reaches, which is most likely also causing excessive bank erosion both upstream and downstream of dredge sites.

Private in-channel dredging operations on rivers like the Kansas River cause deepening and widening of the channel and accelerate erosion of the banks. As a result, dredging lowers the water level of the river and the adjacent water table in the floodplain. This creates the risk for harm to public river uses (such as water treatment facilities, municipal wells, bridge footings, etc.) as well as to fish communities throughout the watershed, including endangered species.

KANSAS RIVERKEEPER®


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Friends of the Kaw reccntly interviewed Daniels for its public comment to the U.S. Army Corps of Engineers. "If you take 3.2 million tons from the river bottom, then the river will take 3.2 million tons from the riverbanks, trying to balance the sediment load in the system," Daniels said. "That's the simple physics of how water works in river channels to transport sediment, Landowners along the river, particularly farmers with unforested river banks next to their fields should be worried. So should anyone with a water intake pipe or a creek in their backyard. The effects of in-channel dredging will propagate both upstream and downstream from the dredge site until a hard control point, like a dam or a bedrock outcrop, is reached. That means up tributary streams as well as the main river."

Daniels surveyed major dredge holes on the Kansas River with a sophisticated new measuring technology, an acoustic Doppler instrument that mapped river channel topography and measured water velocity. The researchers discovered that while the Kansas River averages four to five feet deep, active dredge holes can measure up to forty feet deep.

The researchers also discovered that these deep dredge holes can migrate up and down river sometimes very rapidly, depending on water conditions. Even during small flow increases, researchers documented the upslope lip of a dredge hole traveling upstream.
"People used to think the dredge holes just filled up, but now we know they don't. The holes first cause erosion upstream and downstream and then eventually do fill in, but not before causing a net loss of sediment from the bed and banks of the channel, meaning the channel does not simply go back to its original state," Daniels said. "If there's no bedrock, or physical structure like the Bowersock Dam to stop them, those dredge boles cause channel erosion that will keep on going through the entire river network. Their effects can even travel up the tributaries." Unless a bridge footing or other engineering infrastructure in the river is armored, the migrating hole could erode that physical structure as well.

The technical term for this river phenomenon is a "migrating head cut." Here's how it works: The Kansas River is a sand bed river. Sand is a light sediment, and water transports it easily. When dredgers excavate into the riverbed, that hole creates a steep wall (or head cut) where the river depth suddenly increases. Water rushes rapidly over that wall, gaining speed and picking up sand from the upstream edge. At the same time, some sand falls into the bole. The water passing over the hole then picks up new sediment downstream, causing erosion there as well. The hole starts to expand, both upstream and downstream.

Over time, repeated dredging deepens and widens the river by removing sediment from the system. The result is that the river bottom lowers, along with the water level. This can leave the intakes for water treatment plants stranded. Dredging on the Missouri River has been scaled back recently because of similar problems propagating into the lower Kansas River and other tributaries to the Missouri.

When the river deepens, the water table in the floodplain lowers. Daniels said that this creates the potential for less water storage, which could affect the many municipal wells along the river. A lower water table also affects river vegetation and forests. For example, the cottonwood - the state tree of Kansas - can't survive unless its roots can reach a good water supply.

The deep dredge holes may affect fish populations, too. "The river's physical babitat is significantly different between dredged and un-dredged areas," noted Daniels.

However, dredging's most major environmental impacts for fish are not limited to the Kaw. Since migrating head cuts can also affect river tributaries, Daniels said the K-State study raises questions about risks to the habitat of endangered species (like the Topeka Shiner) that live in these smaller streams.

Danicls said that knowledge of the environmental impacts of dredging is incomplete without studying dredging's impacts on the entire Kansas River system.
"We need a new environmental impact study that considers the impacts of dredging on fish that live in the tribularies as well," said Daniels. Right now, the U.S. Army Corps of Engineers is depending on an environmental impact statement (EIS) dating from 1991.

Before Daniels and Paukert carried out their study, the effect of sand and gravel dredging on the Kansas River bad not been seriously studied. This study was the first time such sophisticated measuring technology has been used.
"The Army Corps has studied similar conditions with sand dredging on the Missouri River," said Daniels. "They are aware of the problems, and if dredging is a problem for the Missouri River, then it's going to be a problem for the Kansas River. Simply shifting the problem from the Missouri to the Kansas is not a good strategy."

How fast will the dredge boles move? Water movement on the Kaw is greatly influenced by how much water the Army Corps releases from upstream reservoirs. Extreme rains plus reservoir releases can add a lot of extra velocity to the Kansas River system. In some circumstances, this may mean the dredge holes have the potential for very rapid movement.

Friends of the Kaw understands that sand is needed for a healthy construction economy and we believe enough geological studies provide evidence that sand can be reasonably and efficiently obtained from "off-river" pit mines in the Kansas River valley. Friends of the Kaw has reviewed the plans drafted by Land Plan Engineering for Penny's Concrete, Inc, proposed pit mine. We support this application for a pit mine by Penny's Concrete, Inc. However, we encourage the Douglas County Commission and Planning Commission to carefully consider and address the residential neighbors' concerns.

Sincerely,


Laura Calwell, Kansas Riverkeeper for Friends of the Kaw
Cc: Phil Struble, Land Plan Engineering

LEAGUE OF WOMEN VOTERS ${ }^{\circledR}$
OF LAWRENCEIDOUGLAS COUNTY

President Melinda Henderson

President-Elect David Burress

Vice President Milton Scott

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James Dunn

Sally Hayden

Tile King

## Ruth Lichtwardt

## Marlene Merrill

Lawrence-Douglas County Planning Commission
Eudora Planning Commission
City Hall
Lawrence, Kansas 66044
RE: ITEM NO. 1: CONDITIONAL USE PERMIT FOR PENNY SAND PIT; N 1500 RD \& E 1850 RD (KM)
Dear Chairman Liese and Planning Commissioners:
The League of Women Voters of Lawrence/Douglas County bases its letters and communications on its adopted Environmental Positions. Based on excerpts from these Positions which read, to "...preserve the social and physical environment...avoid pollution of air, water, and land...[support] the conservation of agricultural land...at the country level...," we are asking that you carefully consider the environmental impact of the Penny Sand Pit excavation operation.

We recognize that the utilization of our natural resources is a necessary feature of human activities, but that we must also do it wisely and with careful consideration for preserving a sustainable environment. Therefore, based on the material available in the Staff Report, we cannot support the pit mining for sand proposed in the current request for CUP-12-00099 and urge that the Planning Commissions deny the application.

Our reasons are as follows:

1. Contamination of the Eudora water supply is a distinct possibility based on the professional research of Professor Carl McElwee, a recognized authority on groundwater and water resources.
2. Contamination of nearby wells of neighboring properties would likely occur.
3. Chances for the permanent reorientation of the Kansas River course would be increased, especially in a flood, an environmental misfortune that many in Douglas County have attempted to avoid using containment measures.
4. Loss of irreplaceable Capability Class I and II agricultural soils would occur. This loss would be permanent, whereas the gain from the sand production would be relatively short-lived.
5. The effects of the mining operation would be counter to several statements and policies that Horizon 2020 encourages us to follow.
6. Reclaiming the land and providing a safe and stable environment during the 30 -year initial approval period of the CUP will be very expensive for the operator of the project. Maintaining the lake will also be someone's financial responsibility. There is no requirement for providing a bond or other financial guarantee to the County in the event that the owner of the project goes bankrupt or otherwise fails.
7. Because of the number of conditions required to be met, it can be predicted that these conditions will be costly to monitor and difficult to properly enforce. This will make it less of a positive revenue gain for the County.
For these reasons and others not mentioned here, we urge the Planning Commissions to recommend denial of this open pit mining CUP-12-00099. We appreciate the careful consideration that the Planning Commissions give to issues such as this. Thank you.

Best regards,


Melinda Henderson, President
LWV Lawrence/Douglas County


Alan Black, Chair
Land Use Committee

# PLANNI NG COMMISSI ON REPORT <br> Regular Agenda - Public Hearing Item 

PC Staff Report
9/24/12

## ITEM NO. 2: A TO R-T; 31 ACRES; 1674 N 1000 RD (MKM)

Z-12-00098: Consider a request to rezone approximately 31 acres from County A (Agriculture) to County R-T (Rural-Tourism Business), located at 1674 N 1000 Rd. Submitted by Mid-American Association for Autistic Training and Research (MAATR), for Marcus and Sandra Patton, property owners of record. MKM

STAFF RECOMMENDATION: Staff recommends approval of the rezoning request for approximately 31 acres from A (Agricultural) District to R-T (Rural Tourism), and forwarding it to the Board of County Commissioners with a recommendation for approval based on the findings of fact found in the body of the staff report.

Staff recommends approval of the buffer width reduction to 100 ft along the north and south property line subject to the following conditions:

- The reduction on the south property line would apply only to the area needed to accommodate the activity area parking area and drive. The buffer on the remainder of the south property line would remain at 200 ft .
- A note would be added to the site plan which limits the use of the driveway to the cabins to 4 cabins, to insure it remains a low-intensity use.

Applicant's reason for request:
"The subject property is in an ideal location to meet the growing demand for service for those with autism via proven successful horse and animal therapy, along with other therapeutic and educational services. Its proximity to Lawrence and the KC metro, yet the country feel, makes it appealing for the applicant and future guests. In addition, the current improvements and uses will tie in to the applicant's overall plans, minimizing the need for construction and alterations to the subject property.

MAATR's proposed plan includes classes (such as art, music and other educational services) and respite cabins for guests to stay in. We may also have a small country store to sell items grown/made by our autistic guests. The current zoning (agricultural) does not allow these as permitted uses. Rezoning to Rural Tourism, would allow all aspects of our plan to be considered permitted uses. It will also have very little impact/change in traffic and remain low use/low intensity-those with autism do better in smaller groups, so we plan on having very personal, low-key activities."

## ATTACHMENTS

Attachment A: Concept Plan
Attachment B: Letter regarding buffer area on north

## OTHER ACTI ON REQUI RED

- Approval of rezoning by Board of County Commissioners and publication of resolution.
- Property must be platted prior to development. This includes the submittal of preliminary plat for Planning Commission approval and submittal of final plat for Planning Director's administrative approval and County Commission acceptance of any
dedications. The subject property is part of a larger tract with a residence. The residence and surrounding property will be removed through the Homestead Exemption Survey prior to platting of the subject property.
- Submittal of site plan for County Commission approval.
- Building permit must be obtained from the Zoning and Codes Office prior to construction.


## PUBLIC COMMENT

- No public comment was received prior to the printing of this staff report.


## GENERAL I NFORMATI ON

Current Zoning and Land Use:

Surrounding Zoning and Land Use:

A (Agricultural) District; horse barn, mobile homes for farm employees, and various out-buildings Agricultural uses.

To the North, East and South: A (Agricultural) District,; agricultural and rural residential uses, and open space.

To the west: A (Agricultural), F-F (Floodway Fringe Overlay) and F-W (Floodway Overlay) Districts; Agricultural uses and wooded stream corridor.
(Figure 1)


Figure 1. Land use and zoning of the surrounding property. Subject property outlined in green

## Project Summary

Rezoning to the R-T District is requested for approximately 31 acres to facilitate the development of a facility that would provide therapy and educational services for children and adults with autism. The use would include a commercial riding stable, riding arena, walking trails, cabins, dwelling for on-site manager, open space, and an activity building for music, art, and other classes and activities.

The site currently contains a riding stable and arena, along with other agricultural out-buildings and mobile homes for the farm employees. The plan is to utilize the barn and riding stable as well as the other out-buildings and to maintain one mobile home for the caretaker's residence until they are able to construct a dwelling. The BZA has the authority to approve a temporary and conditional permit for a mobile home (Section 12-323-3.11 of the Zoning Regulations) so
this portion of the request will require BZA approval. The temporary and conditional permit would be required with the site planning of the property.

The applicant explained that the use is by nature low-intensity as people with autism do not do well in loud or crowded situations. They plan to construct several small cabins ( 3 on the west side of the property and one to the north.) Other cabins could be added during the site planning stage, as the plan provided with the rezoning is a concept plan; however it is unlikely that any additional cabins could be installed along the west side of the property as each cabin is required to have 3 acres available for a septic system. The total number of cabins will be determined at the site planning stage. Any additional cabins will require submittal of a revised site plan for consideration and action by the County Commission.

They may have a petting area in one of the out-buildings for small animal therapy and plan on constructing an activity center for music, art, and other therapy and educational programs. The size of the activity center has not been determined at this time, but the applicant estimates it will be about 2000 to 4000 sq ft. Eventually they will develop a gathering place in the activity center for their guests and their families. The proposed development is illustrated in the concept plan included as Attachment A.

As for the intensity of the use, the applicant provided the following information:
"When you are dealing with children and adults with autism, you have to keep it very simple and small. They typically do not do well in large groups. A good majority of our therapies will be one-on-one. If we do groups, it is best to keep them at 5 or less. With that being said, besides occasional 'special events', we do not perceive having more than 10 to 15 guests at a time (that is after we are operating long enough to run multiple groups at once.)

The uses that are being proposed are permitted in the A District with approval of a Conditional Use Permit; however the applicant elected to seek rezoning to the RT District in order to obtain a more permanent approval.

The applicant provided the following information regarding the proposed use:
"It will be a place of relaxation, learning and respite for children and adults with autism. Our main focus will be horse therapy. That will involve guided horseback riding in the indoor arena and outside areas alike. We will also have small animal therapy and maybe some education on growing and caring for plants.

We will eventually have small classes (such as art \& music therapy), upon approval of the Rural Tourism classification. Once we are operational for awhile, we will plan a Phase II, which would include an activity and gathering place for our guests and their families. It would include a small residential kitchen for preparing small group meals.

We will also need an "on-site" manager to watch over and care for the facility. For now, we would like to keep the allowed mobile home for that person-until we can build them a permanent residence. That residence will have a kitchen and regular "home" basics. The guest cabins, however, will not have any kitchens in them."

The applicant is requesting a reduced buffer area surrounding the activity area, which will be discussed later in this report.

## I. ZONI NG AND LAND USES OF SURROUNDI NG PROPERTI ES

The surrounding area is zoned A (Agricultural) with Floodway and Floodway Fringe Overlay Zoning located along the Coal Creek stream corridor to the west and northwest of the subject property. Land uses of surrounding property include agriculture, open space, and rural residences.

Staff Finding -The surrounding properties are zoned for and primarily used for agricultural uses. Rural residences and woodlands are also present. The R-T Zoning and rural tourism use would be compatible with the zoning and land uses of surrounding property.

## II. CHARACTER OF THE AREA

The subject property is located within the southern portion of the Lawrence Urban Growth Area. The area is rural in nature with a mix of agricultural and residential uses. In addition to scattered rural residences, there are 2 platted residential subdivisions about $1 / 2$ mile to the west of the subject property along E 1600 Road: Mears Addition with 5 undeveloped lots, and Cedarwood Hills Subdivision with 31 developed lots. Additional smaller land divisions were created through the 5 acre exemption for additional rural residences in this area. (Figure 2)


Figure 2. Land use in area. Residential properties line E 1600 Road. Scattered rural residences and agricultural uses in remainder of area. Coal Creek stream corridor located to the west of the subject property. Principal arterial road shown in red, minor collector road shown in yellow.

The area contains environmentally sensitive lands in the form of stream corridors, regulatory floodway and floodway fringe, and woodlands; however, these are not located on the subject property. (Figure 3)

Two principal arterials, N 1000 Road/County Route 458 and E 1600 Road/County Route 1055,
intersect in the area. The subject property has good access to the major transportation network, being located on and taking direct access to N 1000 Road/County Route 458. (Figure 4)

Staff Finding - This is a rural area with a mix of agricultural and residential uses and has good access to the major transportation network. The area contains the following environmentally sensitive lands: stream corridors, regulatory floodway and floodway fringe, and stands of mature trees. The R-T Zoning is compatible with the character of the area and should serve to maintain and enhance it.


Figure 3a. Subject property outlined in red.
Stream corridors in blue, floodway in dark green, floodway fringe in pale green, stream corridors in blue, and woodlands visible from the NAIP photo imagery.

## III. SUITABI LITY OF SUBJ ECT PROPERTY FOR THE USES TO WHICH IT HAS BEEN RESTRICTED

Applicant's Response:
"Allowed by current zoning, the current use of the property is a commercial stable and farm. With the acreage and current improvements, it is suitable for that use. With the open space and utilizing those improvements, the property would also be suitable for small classes, small respite cabins and possibly a country store, if allowed by the Rural Tourism zoning."

The subject property is developed with a barn, riding stable, mobile home, and various other out-buildings. (Photos in Figure 6) Per Section 12-306-2 of the Zoning Regulations, permitted


Figure 3b. Subject property outlined in red. High quality agricultural soils in hatched area.


Figure 4. Transportation network in the area.
uses in the A District include agricultural uses; animal hospital or clinic; commercial dog kennel; commercial greenhouse; commercial riding stable; detached dwelling; churches, parish halls, etc; schools; and country clubs. The property is suited for these uses.

Per Section 20-309B-2 of the Zoning Regulations, the following uses are permitted in the R-T District: outdoor recreation; open air theatre; places of social assembly; lodging; cultural centers, museums or similar uses; and agricultural uses. Accessory uses permitted include retail stores, commercial riding stable, and residential dwellings when associated with the tourism use as caretaker or manager. Based on the conceptual site plan, Attachment A, and the applicant's narrative of the use included earlier in this report, the proposed rural tourism use will include cabins, an activity center, a retail component to sell products made by the facility's guests, a dwelling unit for the caretaker, commercial riding stable, and trails for riding or walking. The property is suited to these rural tourism uses.

Staff Finding - The property is suited for uses permitted in the Agricultural Zoning District and is also suited for uses allowed within the Rural Tourism District as the purpose of the district is to permit uses that integrate with and maintain the rural character of the property.

## IV. LENGTH OF TI ME SUBJ ECT PROPERTY HAS REMAI NED VACANT AS ZONED

Staff Finding - The property is currently developed with agricultural buildings and a mobile home for a farm employee.

## V. EXTENT TO WHICH REMOVAL OF RESTRICTIONS WILL DETRIMENTALLY AFFECT NEARBY PROPERTY

## Applicant's response:

"Rezoning and removing restrictions will NOT detrimentally affect nearby property. The uses proposed will be very similar to the current uses. The additional uses that would be possible by the rezoning would be low-impact/intensity activities. Applicant does not foresee traffic increasing much more than what is currently seen with the commercial stables of Coal Creek Farm. In addition, the surrounding area is also agricultural; therefore, rezoning to Rural Tourism would fit in with the surrounding agricultural zoning/uses. There are also current slopes and tree lines that act as natural buffers to the site."

Possible impacts from development typically include lighting, noise, and traffic. Per the conceptual site plan, the activity center is proposed to be located within the interior of the site. Cabins, agricultural uses, and walking or riding areas are proposed along the perimeter. Any proposed exterior lighting will be reviewed at the site planning stage to minimize any negative impacts such as light trespass or glare onto the neighboring properties. The subject property is located on N 1000 Road/County Route 458 which is a paved 'principal arterial' that is designed to handle larger volumes of traffic than local or collector roads.

The proposed use will be of a higher intensity than the existing use, but will not be a high impact or intensity use as a limited number of guests are anticipated at any one time due to the nature of the facility. As the property has direct access to a paved arterial road there should be no negative impacts associated with dust or increased traffic.

A 200 ft natural buffer area or other appropriate distance as determined by the Board of County Commissioners is required for Rural Tourism uses to insure that the rural character of the area is maintained and to minimize any negative impacts. The Zoning Regulations note that this buffer area shall be limited to agriculture or other low-impact uses. (Section 12-309B-3.02)

The purpose of the buffer area is to provide separation and buffering between the tourism use and adjacent uses. The proposed facility will include several uses which are permitted by right in the Agricultural District and which


Figure 5. Nearby residences identified with green marker. currently occur on site; however, the cabins and activity center are uses which would require a CUP in the A District as they could have more impact on adjacent properties than agricultural uses.

The applicant requested a reduced buffer width of 100 ft on the west, south, and east side of the property and 0 buffer width on the north side. This request was based in part on the fact that the required 200 ft buffer would encumber approximately $2 / 3$ of the total site area and the fact that their rural tourism use will be primarily agricultural in nature with low intensity activities. The following is a review of the buffer width reduction request:

## BUFFER WIDTH REDUCTION REVIEW <br> SOUTH BUFFER

The activity center is planned for the southern side of the property. The drive and activity center parking area are shown within the 200 ft buffer area on the concept plan. The applicant requested that the buffer width along the south be reduced to 100 ft to allow the activity center parking area and drive to be located between the activity center and the road. Two concept plans are included in Attachment A; one with the 200 ft buffer width, the other with 100 ft . The 100 ft buffer area on the south would result in the drive and parking area being located outside of the buffer area. Landscaped screening for the parking area from N 1000 Road will be determined during the site planning process. The other uses proposed are located outside of the 200 ft buffer area, or are agricultural uses-such as the small horse stable identified as building $A$ and would be permitted to be located within the buffer.

- Staff's recommendation is to reduce the buffer area width to 100 ft as needed to accommodate the parking and drive area for the activity center and cabins while maintaining the 200 ft buffer area for the remainder of the southern portion of the property. The location of the drive and parking area, and associated 100 ft wide buffer area, would be determined at the site planning stage.


## EAST BUFFER

The subject property is adjacent to agricultural land to the east. The concept plan shows this area as pasture and riding areas. These would be considered low impact and agricultural uses which are permitted within the buffer area.

- Staff's recommendation is to maintain the 200 ft buffer area width on the east side of the property as there is no conflict with the proposed use and the required buffer area in this location.


## WEST BUFFER

A residence is located on the parcel adjacent to the west property line. Three cabins are shown along the west side of the property on the concept plan. The cabins are located outside of the buffer area; however, the access drive to these cabins is within the buffer area. The applicant requested a reduced buffer area of 100 ft along the west side to provide flexibility with locating the cabins. It is necessary to provide 3 acres for a septic system each for cabin.

They also requested that the drive be considered a low-impact use as it will only provide access to the 4 cabins on site. Many of the trips from the cabin to the activity center, barn, or other out-buildings will be on foot or horseback. If the drive is located in the required buffer area, staff recommends restricting its use to accessing the 4 cabins to insure limited traffic. Landscaping would help minimize the visual impact of the drive to the property to the west. Staff recommends that additional landscaping, including a majority of evergreen species, be planted between the drive and the west property line if the driveway is located within the required buffer area.

- Staff's recommendation is to maintain the 200 ft buffer width and allow the location of the access drive to the cabins within the required buffer with the condition that a note be added to the site plan that this driveway use is restricted to providing access to 4 cabins. Landscaping should be planted along the west property line to screen the drive from the residence to the west.

NORTH
Rick Andrews, owner of the property to the north, provided a letter of support for the removal of the buffer along the north property line as he felt the tree line provided adequate buffering. This letter is included as Attachment B. A 100 ft buffer width on the north side of the property would include the tree line. Uses shown on the concept plan include the north cabin and its access drive.

- Staff recommends a reduced buffer width of 100 ft on the north side of the property based on the adjacent property owner's comments and the existing tree row. The 100 ft buffer area will allow space for the tree row and for perhaps a wider tree row to be developed through time to buffer the uses from the property to the north. The drive could be located within the buffer area with the same condition as noted above.

Staff Finding - Due to the low intensity and agricultural nature of the proposed use there should be no negative impact to neighboring property. Attention will be provided to screening, lighting, and site design and configuration through the site planning stage to reduce or minimize any negative impacts. This setback should adequately buffer the adjacent properties from the use, even with the reduced width of 100 ft on the north and the portion that would be reduced to 100 ft on the south to accommodate the activity center parking area and connection to the access drive. The drive to the west providing access to the cabins would be considered a low-impact use if a note were added to the site plan that the drive was limited to providing access to 4 cabins located on the west and north side of the property. Trees, with a majority being evergreen species, could be planted along the west side of the drive to screen it from the property to the west.

## V. RELATIVE GAIN TO THE PUBLIC HEALTH, SAFETY AND WELFARE BY THE DESTRUCTION OF THE VALUE OF THE PETITI ONER'S PROPERTY AS COMPARED TO THE HARDSHI P IMPOSED UPON THE INDIVI DUAL LANDOWNERS

Applicant's response:
"Over the years there has been a significant rise in autism, and it continues to grow. Many of those diagnosed with autism years ago are now becoming adolescents and adults. The majority of the focus is on early intervention and the younger population, leaving limited options for those who are older. The applicant's approval and ability to do their project as planned will help fill those many needs and more that are not currently available. It will also be a place for volunteers and even students of KU to do internships and/or learn. Without the approval, applicant would be limited on the educational services, recreational therapy, and much needed respite they could provide."

Evaluation of these criteria includes weighing the benefits the denial of the rezoning request would provide for the public versus the hardship the denial would impose on the owner of the subject property. Benefits are measured based on the anticipated impacts of the rezoning request on the public health, safety and welfare.

If the rezoning were denied, the property would maintain its Agricultural zoning classification and could be used for agricultural purposes or developed with a use that is permitted within the A District. The proposed use could be achieved through approval as a Conditional Use; however, the applicant wanted a more permanent approval than is provided with the Conditional Use Permit so elected the R-T Zoning. The approval of the rezoning would provide a more permanent approval for the facility and would limit the permitted uses to those which are permitted in the R-T District with the intent to maintain and enhance the rural character of the area.

Staff Finding - There would be little, if any, gain to the public health, safety or welfare from the denial of the rezoning request. The proposed use would be possible under the A Zoning with a Conditional Use Permit; however, the R-T Zoning offers a more permanent approval for the use.

## VII. CONFORMANCE WI TH THE COMPREHENSI VE PLAN

Applicant's Response:
"The subject property lies within the Douglas County UGA (Urban Growth Area) and appears to fit much of the planned criteria/goals as specifically stated in the Horizon 2020 Plan. The proposed project will assist in the conservation of the rural character and natural features of the area, help preserve the environmental and ecological function of the area, it will allow a significant amount of 'green space', park and recreation for the public, the majority of the existing vegetation will be utilized (as well as additional vegetation planted), it will provide diverse educational opportunities to the special population with limited access to resources and it would help the progression of land uses to help achieve a transition in land uses and intensity levels."

Chapter 4 of Horizon 2020, ‘Growth Management’, describes the future growth area for Lawrence as the Urban Growth Area (UGA) and establishes criteria for urban development in each service area of the UGA based on its proximity to city limits and availability of City services and infrastructure. The subject property is located within Service Area 4 which is the last service area that is expected to be annexed into the City and provided with City services; therefore, urban development is not anticipated for this area in the near future. The annexation policy recommends that land within the UGA be annexed into the city prior to urban densities of development.

The comprehensive plan distinguishes between the future growth areas of incorporated cities in the county and the remainder of the unincorporated area by designating the future growth area as the UGA (Urban Growth Area) and the remainder of the unincorporated area as rural. The term 'rural' then has various meanings. When used to describe a geographical location in the comprehensive plan it refers to the unincorporated portion of the county that is not within an Urban Growth Area. When used in general discussion, the term 'rural' refers to being 'in the country' as opposed to being within an urbanized area. The Rural Tourism zoning district uses the term 'rural' to refer to the non-urbanized areas rather than to areas that are located outside of the Urban Growth Area. Development and uses within the Rural Tourism District are intended to integrate with and enhance the rural character of the area. The agriculturally based use being proposed in this Rural Tourism District is in conformance with recommendations in the Comprehensive Plan regarding development within the UGA.

Chapter 4 also contains parameters for development within the rural area and includes 'rural tourism uses'. As rural tourism uses may occur in as well as outside of the UGA, the subject location is being reviewed with the following criteria recommended in the Comprehensive Plan (Page 4-4. Horizon 2020): (Staff discussion follows the criteria and is italicized.)

1) Has direct access to an improved arterial roadway.

Subject property is located adjacent to, and has direct access to N 1000 Road, a principal arterial.
2) Public water supply available.

The property is serviced by RWD\#1. Capacity is available and the applicant is discussing the logistics of service provision with the Rural Water District.
3) Separated from existing conference, recreation, or tourism facilities by at least 3 miles or other appropriate distance as determined by the Board of County Commissioners.
The proposed R-T District is approximately 3.5 miles northeast of another Rural Tourism Zoning District, Sadies Lake.
4) Designed to preserve and/or integrate natural resources and the rural environment through appropriate land use, site design, buffering, or other methods.
The proposed uses will integrate with the rural environment. Site design, buffering, lighting review, and other measures will insure compatibility with the rural environment during the site planning process.

## STAFF REVI EW

The proposed rural tourism use consists of uses which are permitted in the Agricultural District such as agricultural uses and commercial stables. The proposed uses which would require approval of a Conditional Use Permit are the cabins, caretaker's dwelling, and the activity center. The proposed uses are permitted in the Rural Tourism Zoning District.

The property being rezoned is of adequate size to meet the standards of the R-T District, which are the same as those for the B-2 District. The proposed rezoning and subsequent land division would be in conformance with the frontage requirements in the access management standards. The proposed use and the proposed site layout are compatible with the rural character of the area.

The subject property meets the criteria for Rural-Tourism commercial zoning.


Figure 6a. View along N 1000 Rd to the east.


Figure 6b.View along N 1000 Rd to the west.


## MAATR On The Prairie

Conceptual Plan With Requested 100' Buffer (not exact scale)


## MAATR On The Prairie

Conceptual Plan w/200' Buffer (not exact sale)



1033 E 1700 Rd
Lawrence,KS
September 20, 2012

Mary Miller
City/County Planner
P.O. Box 708

Lawrence, KS 66044

Mary:
Please accept this letter as our approval for MAATR to forgo the 200' set back along proposed North and East property lines. As we would be the property owners adjacent to the North, and also the East. We feel the existing tree line would be a sufficient buffer on the North. Regarding proposed East line, we would welcome any activity , especially a structure as this would be an added protection for our Alpacas.

Sincerely,


Rick Andrews

## MAATR Buffer Reduction Request

We appreciate staff's recommendation for approval on the RT rezoning and willingness to work with us on the reduction of the buffer area; however, if our calculations are correct, the buffer area, as recommended by staff, is still approx $45 \%$ of our proposed area. The majority of our plan is agriculturally related and the other activities will involve a low number of users and it is anticipated it would not be much busier than the current allowed use of a commercial stable. It is also our understanding that no public comment had been received about any issues with our proposal of use for the property. With that being said, we would like to request the following:

## 1. NORTH BUFFER REMOVED

There is an existing tree line along the north property line that acts as a natural buffer that we will keep in place. In addition, there is a significant distance to the residential cabin to the north, owned by Rick and Vickie Andrews. We already have a letter from Mr. \& Mrs. Andrews, adjacent property owners to the north and east stating they are in favor of removing the north and east side buffers alike.

Having the septic south (down hill) of the cabins would help with the flow to the fields. That might require having the cabins just a bit more north.

## 2. EAST BUFFER REMOVED

The Andrews plan on having a vineyard to the east of our proposed property. As you will see in their letter, they feel having more activities on the east will also protect their alpacas better. We would like to have the option in the future to expand on our services toward the east, as requested by the Andrews, which would limit the need for expansion to the west and south.

## 3. WEST BUFFER 100’

Mr. McLear of MAATR spoke with Mr. Evans, property owner to the west to explain our plans there. He has no problems with what we are planning on doing. Though we do not plan on having any high-impact uses, we would like to have a little more room and options for the future.

## 4. SOUTH BUFFER 100’

Staff had already recommended a reduced buffer of $100^{\prime}$ for the parking and drive area. Any other use we would have just outside of that 100 ' foot buffer would not be any higher impact that a parking/drive area would be anyway.

We are concerned that our board of directors might have a problem with such a drastic reduction in the space we will have to work with. Coal Creek Farm is an ideal location for our project; however, if we are limited on almost half of the land, it makes it less appealing to the board of directors. We feel the general public would benefit greatly from MAATR's proposed uses. We appreciate your consideration of our requests.

## Memorandum <br> City of Lawrence <br> Planning \& Development Services

TO: Planning Commission<br>FROM: Sandra Day, Planning Staff<br>CC: Scott McCullough, Planning and Development Services Director Sheila Stogsdill, Assistant Planning Director<br>\section*{Date: For September 24, 2012 meeting}<br>RE: Misc Item 1: Variance associated with Minor Subdivision for Grand Addition, (MS-1200092);

1. From the 150 ft right-of-way requirement in Section 20-810(e) (5) for arterial streets to allow the right-of-way for Kasold Drive to remain at 100 ft .
2. From the sidewalk requirement in Section 20-811 (c) for a sidewalk on both sides of the street.

Attachment A: Minor Subdivision MS-12-00092, Grand Addition No. 2
Attachment B: Public Improvement Plan for relocated recreation path

The subject property is located at 3400 and 3401 Aldrich Street. The Grand Addition No. 2 Minor Subdivision/Replat [MS-12-00092] proposes to divide two corner lots into four lots on the north and south sides of Aldrich Street. Minor Subdivisions are processed administratively but Planning Commission approval is currently required for variances from the Subdivision Design Standards. A copy of the Minor Subdivision is included with this memo for context; however, no action is required on the Minor Subdivision.

The Subdivision Regulations state that an applicant may request a variance from the Design Standards in the Regulations in accordance with the variance procedures outlined in Section 20$813(\mathrm{~g})$. This section lists the criteria that must be met in order for a variance to be approved. The requested variance is evaluated with the approval criteria below:

1. From the 150 ft right-of-way requirement in Section 20-810(e) (5) for arterial streets to allow the right-of-way for Kasold Drive to remain at 100 ft .

Kasold Drive is classified as an arterial street in the Future Thoroughfares Map. Per Section 20-810(e) (5), 150 feet of right-of-way must be dedicated for arterial streets when platting property. The applicant is requesting a variance from this requirement to allow the right-of-way to remain at 100 ft .

The property on each side of the street is responsible for dedicating one-half of the required right-ofway; therefore, an additional 25 feet would be required along the length of the residential lots.
2. From the sidewalk requirement in Section 20-811 (c) for a sidewalk on both sides of the street.

The subdivision was originally developed in the early 2000's. At the time the subdivision was approved sidewalks were only required to be provided on one side of the street. This subdivision was developed with a public sidewalk along the north side of Aldrich Street that connects to the recreation path along Kasold Drive. The Minor Subdivision includes the division of two platted lots into four platted lots, two lots on each side of Aldrich Street. Only the south side lots are affected by the requirement to include sidewalks.

Criteria 1. Strict application of these regulations will create an unnecessary hardship upon the Subdivider.

Applicant Response:
The 50 foot was deemed acceptable when the property was originally platted in 2000 and the Subdivision was created. The right-of-way width was adequate for the reconstruction of Kasold. Increasing the Right-of-Way now would result in non-conforming lot and would negate the Minor Subdivision.

Only one side of the street required sidewalks when originally platted in 2000. If required to provide sidewalks for these lots it would be the only segment of sidewalk on the south side.

This property was platted in November 2000. The right of way requirement at that time for an arterial street was $100^{\prime}$. The subdivision regulations were changed to require 150 in 2006 . Kasold Drive was recently reconstructed in (2011). The life span of this improvement is expected to last 50 years. There are no plans to add a median along this segment of Kasold Drive. The dedication of an additional $25^{\prime}$ would result in a lot smaller than proposed. As a corner lot, additional area is recommended in the subdivision regulations to offset the additional building setbacks that are often applicable and to provide separation of the living area from the public right-of-way.

The recent reconstruction of Kasold Drive and the expected longevity of the improvements negate the need for the applicant to dedicate additional right-of-way that will not be used is a hardship to the applicant.

This project involves a substantial investment in relocating the recreation path from its current alignment to the revised alignment along Kasold Drive and reconfiguration the connection of the path along the north line of the subdivision to Green Meadows Park.


Staff Finding: Requiring the dedication of additional right-of-way for Kasold Drive would decrease the distance between the planned residences and the right-of-way line. The dedication would
constitute an unnecessary hardship on the property owner, as the additional right-of-way is not needed for future street improvements.

Aldrich Street is approximately $930^{\prime}$ long. Requiring the construction of the sidewalk for east $137^{\prime}$ along the south side of Aldrich would be an unnecessary hardship on the property owner. Pedestrian access terminates at the cul-de-sac with no cross access out of the subdivision to the south. There are no planned connections around this subdivision other than the existing recreation path along Kasold Drive. This sidewalk is not needed to fill in designated gaps in the City's sidewalk gap program.

Criteria 2. The proposed variance is in harmony with the intended purpose of these regulations.
Applicant Response:
The presently configured plat was acceptable under the existing Subdivision Regulations in 2000. No other part of Kasold Drive from $23^{\text {rd }}$ Street to $31^{\text {st }}$ Street has the additional Right-of-Way dedicated so dedicating additional for this property would be an anomaly more than the norm.

The subdivision design approved in 2000 did not require a sidewalk on both sides of the street. No other portion of Aldrich Street would have a sidewalk along the south side.

Right-of-way dedication is required when properties are platted to insure the required right-of-way is available for improvements to adjacent roadways. No additional improvements are anticipated for this segment of Kasold Drive that would require additional right-of-way. The City Engineer has no objection to the right-of-way remaining at 100 ft .

Sidewalks generally support alternative (non-motorized) means of transportation. Aldrich was constructed with a sidewalk on the north side of the street provided general pedestrian access to the recreation path to Kasold Drive. The remainder of the subdivision is unaffected by the proposed Minor Subdivision. The Minor Subdivision process is generally administrative and usually does not include public improvements. This project is unique in that the existing recreation path will be demolished and reconstructed within the Kasold Drive right-of-way to accommodate the two new lots. No additional improvements to the street and sidewalk facilities are anticipated for Aldrich Street. The City Engineer has no objection to the exclusion of sidewalk along this segment of Aldrich Street.

Staff Finding: Allowing the right-of-way to remain at 100 feet would continue the established development pattern of Kasold Drive. The additional right-of-way is not necessary for planned street improvements. The variance is in harmony with the intended purpose of these regulations.

This Minor Subdivision represents a very small change in the overall development of a street ending in a cul-de-sac. No plans exist to provide pedestrian connection to the south out of the subdivision. It is unlikely that sidewalk would be constructed the full length of the remaining street segment. This variance is in harmony with the intended purpose of these regulations.

Criteria 3: The public health, safety, and welfare will be protected.
Applicant Response:

The public health, safety, and welfare will be protected in as much as they are under the presently configured plat. The existing Right-of-Way and sidewalk facility is sufficient to provide safety and welfare of pedestrians and motor vehicles on Kasold Drive.

This property is the subject of a minor subdivision request to accommodate infill development. Sufficient right-of-way and easement exist to accommodate the necessary infrastructure to serve this property. The variance affects only the south two lots since sidewalk along the north side of Aldrich Street was constructed initially.

Staff Finding: Maintaining the current right-of-way width for Kasold Drive in this area will help maintain the development pattern.

Sidewalk is provided along the north side of Aldrich Street that dead-ends in a cul-de-sac. Only local traffic occurs on Aldrich Street.

The public health, safety, and welfare will not be negatively impacted with the granting of these variances.

## Staff Recommendation:

1. Approve the variance requested from Section 20-810(e)(5) to allow the Kasold Drive right-ofway in this location to remain at 100 feet, rather than the 150 feet required by Code.
2. Approve the variance requested from Section 20-811(c) to forego the construction of sidewalk along the south side of Aldrich Street.

## GRAND ADDITION NO. 2

RECREATION PATH RELOCATION IMPROVEMENTS CITY OF LAWRENCE PROJECT NUMBER $\qquad$







 NoRTHING: $229,571.45$
EASTING: $2,086,16.45$
HCP- 2 PROPERTT PN AT NORTHEAST CORNER OF LOT 1 , BLOCK ONE.
NORTHNG: 229,386.51

hcp. 3 Property pin at Southeast corner of Lot 1 , block two. NORTHNG: 229, 141.61
EASTING: $;, 086,178.22$
$\frac{\text { BENCH MARSS. }}{1 .}$




## DESIGNED BY

CHECKED BY
issue date
SEPTEMBER 6,2012
$\qquad$

SHEET


City of Lawrence Douglas County
PLANNING \& DEVELOPMENT SERVICES

## ADMINISTRATIVE DETERMINATION

MINOR SUBDIVISION
September 4, 2012

MS-12-00092: Grand Addition No. 2, a minor subdivision/replat of Lot 1 and Lot 30, Grand Addition. A four-lot division located at 3400 and 3401 Aldrich Street. Submitted by Dean Grob for Jerry Willis, Grand, LLC, property owners of record.

ADMINISTRATIVE DETERMINATION: The Planning Director approves the Minor Subdivision for Grand Addition No. 2, subject to the following conditions:

1. Provision of an executed Master Street Tree Plan per Section 20-810(g) per the City Horticulture Manager's approval.
2. Provision of a revised Minor Subdivision plat with the following changes:
a. Provide a note on the face of the drawing to indicate the date of approval and the specific variance granted.
b. Provide additional dimension along the east side of Lot 1, Block 1 tro dimension the new utility and pedestrian easement. Show distance form Lot corner to south end of easement.

## KEY POINTS

- This request is for the division of two lots into four lots located on the north and south sides of Aldrich Street. The property is being divided to accommodate two new duplex structures on the resulting new lots.
- Each lot is currently developed with a duplex structure.


## SUBDIVISION CITATIONS TO CONSIDER

- This application is being reviewed under the Subdivision Regulations for Lawrence and Unincorporated Douglas County.
- Section 20-810(e)(5)(i) requires 150 ft of right-of-way for arterial streets.
- Section 20-811 (C) requires sidewalks on both sides of a street.


## ASSOCIATED CASES/OTHER ACTION REQUIRED

- Submittal of signed mylar copy and recording fees for recording of Minor Subdivision at the Register of Deeds.
- The applicant shall provide certification that all taxes that are due and payable have been paid prior to the recording of the plat.


## GENERAL INFORMATION

Current Zoning and Land Use: RM12D (Multi-Dwelling Residential) District; existing duplex lots.

Surrounding Zoning and Land Use:
RS7 (Single-Dwelling Residential) District; residential development to the north, existing subdivision.

## SITE SUMMARY

## Area

Number of Existing Lots:
Lot 1, Block 1
Lot 30, Block 1
Number of Proposed Lots:
North Side of Aldrich Street Lot 1, Block 1 Lot 2, Block 1
South Side of Aldrich Street
Lot 1, Block 2
Lot 2, Block 2

RM12D (Multi-Dwelling Residential) District; to the west and south. Open area surrounding subdivision is platted as dedicated drainage easement and encumbered by regulatory floodplain.

PD - [Meadows Place PRD] to the east; Existing residential development and floodplain for Atchison Tributary.
1.234 acres

2
28,287 SF
25,484 SF
4

16,778 SF
11,509 SF
13,916 SF
11,566 SF

## STAFF REVIEW

This minor subdivision includes the division of two developed lots into four lots to facilitate additional development along Aldrich Street. Lot 1 and Lot 30, Block 1 of the original subdivision were platted as large lots with significant easement adjacent to Kasold Drive. This large easement provided dedicated space for the multi-use path, utilities, and a landscape berm along Kasold Drive. Per Section 20-801(e)(2) of the Subdivision Regulations, a Lot of Record or Parcel in the city that was created before the effective date of this article may be used for residential purposes for a detached dwelling or for another use that is allowed in the UR (Urban Reserve) District without further review under this article, until such lot of record or parcel is further subdivided. The subject property consists of two platted lots, which were created prior to the effective date of the Subdivision Regulations, but the division of these lots requires approval through a Minor Subdivision/replat. The lots being created through this Minor Subdivision conform to the minimum dimensional and area requirements of the RM12D zoning District.

RIGHT-OF-WAY
The Major Thoroughfares Map classifies Aldrich Street as a local street and. Kasold Drive as a principal arterial street. The Subdivision Regulations require 60 ft . of right-of-way for local streets and 60 ft . was dedicated with the Grand Addition. No additional right-of-way is required for Aldrich Street. A principal arterial street requires 150 in the current design standards. A total of 50 ' was dedicated for Kasold Drive as per the design standards at that time. A principal arterial street without a median required only 100' of right-of-way at the time this property was originally platted. This segment of Kasold Drive was reconstructed last year. The City Engineer indicated he would have no objection to a variance from the requirement to dedicate additional right-of-way. The Planning Commission will consider the variance at their meeting scheduled for September 24,

2012 from the requirement in Section 20-810(e)(5)(i) to provide 150 ft of right-of-way for a principal arterial to allow the Kasold Drive right-of-way to remain at 100 ft at this location. This variance should be noted on the plat prior to recording the drawing with the Register of Deeds Office.

In addition to public streets, sidewalks are also required on both sides of a street per Section 20811 (c). This project includes a variance from providing a sidewalk along the south side of Aldrich Street. The City Engineer indicated he would have no objection to a variance from the requirement to construct a sidewalk along this street segment. The Planning Commission will consider the variance at their meeting scheduled for September 24, 2012 from the requirement in Section 20-811(c) to provide a sidewalk on both sides of the street. This variance should be noted on the plat prior to recording the drawing with the Register of Deeds Office.

## UTILITIES/EASEMENTS

Adequate utilities are available to serve the lots. This project includes the vacation of several existing easements originally platted to accommodate the creation of the new lots and developable area within these new lots. The vacation request is being processed through the Public Works Department and scheduled to be considered by the City Commission on September 18, 2012.


The current $15^{\prime}$ perimeter easement along Kasold Drive would remain. The existing utility and pedestrian easement would be reduced from $50^{\prime}$ to a $10^{\prime}$ utility easement as shown on the
proposed minor subdivision drawing. A new utility and pedestrian easement will be dedicated across the northern portion of Lots $1 \& 2$, Block 1.

The existing recreation path, located in the existing easement will be relocated into the existing right-of-way at the developers expense with this project. Some additional dimension of the drawing is recommended to clearly identify the new utility and pedestrian easement.

ACCESS
Aldrich Street provides direct access to the lots. Direct access to Kasold Drive is not recommended or proposed with this project.

## MASTER STREET TREE PLAN

A Master Street Tree Plan is required with this plat. The street tree plan requires revision to the legal description and the City Horticulture Manager suggested other species than the proposed Maple. A Master Street Tree Plan, which is acceptable to the City Horticulture/Forestry Manager, must be executed prior to the recording of the minor subdivision plat.

Conclusion: The Minor Subdivision, as conditioned, and with the variances pending approval by the Planning Commission, conforms to the approval criteria in Section 20-808(d) conforms to the approval criteria in Section 20-808(d) of the Subdivision Regulations.

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## PLANNI NG COMMI SSI ON REPORT Regular Agenda - Public Hearing Item

## ITEM NO. 4A: I-4 and VC to UR-FP; 31.7 ACRES; NORTH OF K-10 BETWEEN GREENWAY CI RCLE \& E 1575 ROAD (SMS)

Z-12-00119: Consider a request to rezone approximately 31.7 acres (and adjacent railroad r -o-w) from I-4 (Heavy Industrial) and VC (Valley Channel) Districts to UR-FP (Urban Reserve Floodplain Overlay) District, located in the NE1/4 \& NW1/4 Sec 4-13-20 (Former Farmland Industries property, N of K-10 between Greenway Circle \& E 1575 Rd). Initiated by City Commission on 8/7/12.

STAFF RECOMMENDATION: Staff recommends approval of the rezoning request for 31.7 acres from I-4 (Heavy Industrial) and VC (Valley Channel) to UR-FP (Urban Reserve-Floodplain Overlay) District and forwarding it to the City Commission with a recommendation for approval based on the findings of fact found in the body of the staff report.

Applicant's reason for request: Facilitate development of new business park.

## KEY POI NTS

- Sector plan identifies property as suitable for industrial development.
- The property has access to a planned arterial street (E $15^{\text {th }}$ Street).
- Annexation of property requires designation of a suitable city zoning district.
- Chronology of planning efforts related to this property:
o 2001 -- Farmland Industries plant shut down due to bankruptcy
o 2005 -- Substantial field work completed under direction by KDHE
o 2006 -- Site Characterization Report completed by Shaw Environmental, Inc with conclusion that a significant portion of site suitable for reuse in present state
o 2007 -- City Commission initiated planning process for Farmland Industries Redevelopment Plan
o 2008 -- Governing Bodies adopted Farmland Industries Redevelopment Plan
o 2009 -- City annexed property
o 2009 - City acquired property
o 2009 -- Governing Bodies adopted updated Horizon 2020 - Chapter 7 with locational criteria evaluating the site
o 2010 -- City awarded demolition contract for clean-up of site
o 2011 -- City Commission hired Bartlett \& West/CDM Smith to develop Master Plan
o 2012 -- Informational meetings held in May with surrounding property owners
o 2012 -- Rezoning, Preliminary Plat \& SUP applications submitted in July


## ATTACHMENTS

- Area map.
- Proposed rezoning exhibit.


## GOLDEN FACTORS TO CONSI DER

CHARACTER OF THE AREA

- The property is encumbered by the floodplain and used for agricultural fields.


## CONFORMANCE WITH HORIZON 2020

- The proposed request is consistent with land use recommendations found in Horizon 2020 and the Farmland Industries Redevelopment Plan.


## ASSOCI ATED CASES/ OTHER ACTI ON REQUI RED

Items being considered at the September Planning Commission meeting:

- Rezoning request [Z-12-00120] approximately 170.4 acres (and adjacent railroad r-o-w) from I-4 (Heavy Industrial) District to UR (Urban Reserve) District, located in the NE1/4 \& NW1/4 Sec 4-13-20.
- Rezoning request [Z-12-00121] approximately 170.7 acres (and adjacent highway r-o-w) from I-4 (Heavy Industrial), I-1 (Limited Industrial), A (Agricultural) County Districts and CC200 (Community Commercial Center) City District to IG (General Industrial) District, located in the NW1/4 \& SW1/4 Sec 4-13-20.
- Rezoning request [Z-12-00122] approximately 59.0 acres (and adjacent highway r-o-w) from I-1 (Limited Industrial), B-1 (Neighborhood Business); A (Agricultural) [County Districts] and IG (General Industrial) District to IM (Medium Industrial) District, located in the SE1/4 Sec 5-13-20 \& SW1/4 Sec 4-13-20.
- Preliminary Plat of the former Farmland Industries property [PP-12-00101]
- Special Use Permit [SUP-12-00100] for relocation and construction of a Westar substation to provide electricity to the Former Farmland Industries property and surrounding properties.
Other action required:
- City Commission approval of rezoning requests and adoption of ordinances.
- City Commission approval of the Special Use Permit and adoption of ordinance.
- Publication of rezoning and Special Use Permit ordinances.
- Submittal of Final Plat for administrative approval and recordation.
- City Commission acceptance of dedication of easements and rights-of-way for the Final Plat.
- Release of Special Use Permit site plan to Development Services for Building Permits.
- Submission and approval of administrative site plans for individual lot development within the business park.


## PUBLIC COMMENT RECEI VED PRI OR TO PRINTI NG

No public comment was received prior to publication of this staff report.

## Project Summary:

This property includes approximately 32 acres. The property has approximately 2,600 feet of frontage along N 1500 Road. The southwesterly edge of the property abuts the BNSF railroad right-of-way for approximately 2,900 feet. The northwestern portion of this tract is encumbered by the regulatory floodplain and the northeastern portion includes high quality agricultural soils. The proposed request is for rezoning the property to the UR-FP (Urban Reserve-Floodplain Overlay) District.

## 1. CONFORMANCE WITH THE COMPREHENSI VE PLAN

The Comprehensive Plan recognizes the need to identify an adequate amount of available land in Douglas County to meet diverse industrial and business related development needs. Chapter 7 - Industrial \& Employment-Related Land Use (Policy 2.1), identifies general locational criteria for industrial developments which include:

- feasible access to Federal and State transportation networks;
- adequate parcel size, generally over forty acres;
- lie primarily outside of the regulatory floodplain; and
- have minimal average slopes.

The Plan identifies this site as meeting these general criteria.
The proposed zoning provides to Urban Reserve-Floodplain Overlay provides a 'holding zone' for property to avoid premature development. The property provides for the planned expansion of the business park as laid out in the Preliminary Plat.

The community's need to identify land for future business parks is again stated in Chapter 12 Economic Development, Policy 6: Business Infrastructure, Priority 6.1: Business Park Development. The chapter states "Douglas County must identify land for future business and corporate business parks that takes advantage of the airport, the interstate/highway system, and the westward growth of Johnson County. Within the next few years, the City and County Commissions shall identify and designate at least 1000 acres of land for industrial expansion over the next 25 years. The commissions shall also put in motion the capitalization and infrastructure development needed to bring those 1000 acres into productive use."

The Farmland Industries Redevelopment Plan brings together the community goals of creating additional employment and open space by providing a plan to redevelop a brownfield into a major community asset. The plan indicated this portion of the property would be suitable for general industrial uses and ultimately provides for potential access to E 19th Street and possibly to E 15th Street.

Staff Finding -- The proposed rezoning is in conformance with the recommendations in Horizon 2020 and the Farmland Industries Redevelopment Plan.

## 2. ZONI NG AND USE OF NEARBY PROPERTY, I NCLUDI NG OVERLAY ZONI NG

Current Zoning and Land Use: I-4 (Heavy Industrial) and VC (Valley Channel) Districts; agricultural fields.

Surrounding Zoning and Land Use: To the north:
I-3 (Heavy Industrial) and VC (Valley Channel) Districts; agricultural fields.

To the south and west:
I-4 (Heavy Industrial) District; majority vacant (northern portion of former Farmland Industries property) with bag house, bulk warehouses, above-ground storage tanks and remediation ponds.

To the east:
VC (Valley Channel) District; agricultural fields.

Staff Finding -- The surrounding property is predominantly county industrial zoned and used for agricultural fields. Much of the property to the north and east is encumbered by the floodplain. A portion of the parcel also includes Class I soils. The property is bounded on the southwest by the BNSF railroad tracks. The remediation ponds and remaining Farmland structures are located across the tracks.

## 3. CHARACTER OF THE NEI GHBORHOOD

Staff Finding -- This area has historically been used as agricultural fields due to the proximity of the floodplain. The property to the south was utilized as part of the fertilizer plant since 1954. The City developed around the former Farmland Industries property with the island annexation of East Hills in the mid-1980s. This area has been anticipated as a natural expansion of industrial park sites for many years.

## 4. PLANS FOR THE AREA OR NEIGHBORHOOD, AS REFLECTED IN ADOPTED AREA AND/ OR SECTOR PLANS INCLUDI NG THE PROPERTY OR ADJ OI NING PROPERTY

Staff Finding - This property was studied in detail through the development of the Farmland Industries Redevelopment Plan. The plan brings together the community goals of creating additional employment and open space by providing a plan to redevelop a brownfield into a major community asset. The plan indicated this portion of the property would be suitable for general industrial uses and ultimately provides for potential access to E 19th Street and possibly to E 15th Street.

## 5. SUITABILITY OF SUBJ ECT PROPERTY FOR THE USES TO WHICH IT HAS BEEN RESTRICTED UNDER THE EXISTI NG ZONI NG REGULATI ONS

The request is to rezone the property to the UR-FP District. Since the property has been annexed into the city, the county zoning designations are no longer appropriate. The property is adjacent to a boundary line road, E 1500 Road (future E $15^{\text {th }}$ Street) and continues to be used for agricultural fields. Crop Agriculture is a use that is permitted in most City zoning districts. It is anticipated for future uses, but is not intended for immediate development.

This property is encumbered by the regulatory floodplain. Section 20-1201(c) of the Development Code requires the additional zoning designation of FP Overlay District. The FP (Floodplain Management Regulations Overlay) District is an appropriate zoning district for property encumbered with the floodplain.

The property is within the boundary of the Farmland Industries Redevelopment Plan and within an area designated for future industrial development.

Staff Finding -- The current county zoning designations are no longer appropriate since the property has been annexed into the city. Rezoning to the Urban Reserve-Floodplain Overlay District provides an appropriate city zoning district while the property to the south continues to undergo clean-up and remediation.

## 6. LENGTH OF TI ME SUBJ ECT PROPERTY HAS REMAI NED VACANT AS ZONED

Staff Finding - The property is currently undeveloped and used as agricultural fields. The county industrial zoning designation has been in place since 1966 when the County adopted zoning regulations. The Valley Channel designation preceded the County's FEMA floodplain designations.

## 7. EXTENT TO WHICH APPROVING THE REZONING WILL DETRIMENTALLY AFFECT NEARBY PROPERTIES

Staff Finding - The property was annexed in July 2009 and the County District is no longer appropriate. A portion of the property is located in the regulatory floodplain and therefore, rezoning to the Floodplain Overlay District is required. The property is not proposed for immediate development. Rezoning to the UR District provides a 'holding zone' for property to avoid premature development.

The only principal uses allowed in the UR District are Crop Agriculture and any lawful use in existence immediately prior to annexation. The City's Floodplain Management Regulations control property in the FP Overlay District. The property must be rezoned to a City of Lawrence zoning district following annexation. This portion of the property will need to be rezoned to a different City District prior to any development. Rezoning to the UR-FP District will not detrimentally affect nearby properties.

## 8. THE GAIN, IF ANY, TO THE PUBLIC HEALTH, SAFETY AND WELFARE DUE TO THE DENIAL OF THE APPLICATION, AS COMPARED TO THE HARDSHIP IMPOSED UPON THE LANDOWNER, IF ANY, AS A RESULT OF DENI AL OF THE APPLICATION

Evaluation of this criterion includes weighing the benefits the denial of the rezoning request would provide for the public versus the hardship the denial would impose on the owner of the subject property. Benefits are measured based on the anticipated impacts of the rezoning request on the public health, safety and welfare.

Staff Finding - If the rezoning request were denied, the area would remain a mix of zoning districts and could not be developed for future expansion of the community's tax base. Approval of the request provides the opportunity to develop a coordinated business park supporting the general industrial uses planned for the majority of the park. The gain to the public is the potential addition of a substantial number of acres of industrial property following additional remediation efforts and future improvements to $\mathrm{E} 15^{\text {th }}$ Street.

## 9. PROFESSI ONAL STAFF RECOMMENDATION

Section 20-223(a) identifies the purpose of the UR District as follows:
The UR, Urban Reserve District, is a Special Purpose Base District primarily intended to provide a suitable classification for newly annexed land. The District is intended to avoid premature or inappropriate development that is not well served by infrastructure or community services. It is also intended for implementation in areas where an adopted neighborhood plan or area development plan is not in place. It permits only very low-intensity development until such time that a land use plan and infrastructure and community senvices are in place.

Section 20-303 states that
The FP, Floodplain Management Regulations are implemented as an Overlay District.
This property is not adjacent to an improved city street, is encumbered by the regulatory floodplain and contains high quality agricultural soils. It is not currently suitable for new development, but may continue to be used for agricultural uses in the interim. The UR District provides a 'holding zone' until such time this property is ready for development. The FP Overlay District is mandated when properties encumbered by the floodplain are annexed into the City.

Rezoning to another City district will be necessary before any new industrial uses may be developed in this part of the park. If this request is approved, additional development standards including final platting, site planning, and compliance with applicable design guidelines will be considered with future development applications.

This staff report reviews the proposed location for its compliance with the Comprehensive Plan, the Golden Factors, and compatibility with surrounding development. The development proposal meets the locational criteria required for approval. The rezoning request is compliant with recommendations in Horizon 2020 and Farmland Industries Redevelopment Plan. Staff recommends approval of the rezoning request for 31.7 acres from I-4 (Heavy Industrial) and VC (Valley Channel) to UR-FP (Urban Reserve-Floodplain Overlay) District and forwarding it to the City Commission with a recommendation for approval based on the findings of fact found in the body of the staff report.


## PLANNI NG COMMI SSI ON REPORT Regular Agenda - Public Hearing Item

## ITEM NO. 4B: I-4 to UR; 170.4 ACRES; NORTH OF K-10 BETWEEN GREENWAY CI RCLE \& E 1575 ROAD (SMS)

Z-12-00120: Consider a request to rezone approximately 170.4 acres (and adjacent railroad r -o-w) from I-4 (Heavy Industrial) District to UR (Urban Reserve) District, located in the NE1/4 \& NW1/4 Sec 4-13-20 (Former Farmland Industries property, N of K-10 between Greenway Circle \& E 1575 Rd). Initiated by City Commission on 8/7/12.

STAFF RECOMMENDATI ON: Staff recommends approval of the rezoning request for 170.4 acres from I-4 (Heavy Industrial) to UR (Urban Reserve) District and forwarding it to the City Commission with a recommendation for approval based on the findings of fact found in the body of the staff report.

Applicant's reason for request: Facilitate development of new business park.

## KEY POI NTS

- Sector plan identifies property as suitable for industrial development.
- The property has access to a planned arterial street (E $15^{\text {th }}$ Street) and close proximity to the planned intersection for the completed K-10 by-pass.
- Annexation of property requires designation of a suitable city zoning district.
- Chronology of planning efforts related to this property:
o 2001 -- Farmland Industries plant shut down due to bankruptcy
o 2005 -- Substantial field work completed under direction by KDHE
o 2006 -- Site Characterization Report completed by Shaw Environmental, Inc with conclusion that a significant portion of site suitable for reuse in present state
o 2007 -- City Commission initiated planning process for Farmland Industries Redevelopment Plan
o 2008 -- Governing Bodies adopted Farmland Industries Redevelopment Plan
o 2009 -- City annexed property
o 2009 - City acquired property
o 2009 -- Governing Bodies adopted updated Horizon 2020 - Chapter 7 with locational criteria evaluating the site
o 2010 -- City awarded demolition contract for clean-up of site
o 2011 -- City Commission hired Bartlett \& West/CDM Smith to develop Master Plan
o 2012 -- Informational meetings held in May with surrounding property owners
o 2012 -- Rezoning, Preliminary Plat \& SUP applications submitted in July


## ATTACHMENTS

- Area map.
- Proposed rezoning exhibit.


## GOLDEN FACTORS TO CONSI DER

## CHARACTER OF THE AREA

- The property includes existing structures (bag house, bulk warehouses and aboveground storage tanks) and the remediation ponds.
- A portion of the property to the north remains outside the city limits.


## CONFORMANCE WITH HORIZON 2020

- The proposed request is consistent with land use recommendations found in Horizon 2020 and the Farmland Industries Redevelopment Plan.


## ASSOCI ATED CASES/ OTHER ACTI ON REQUI RED

Items being considered at the September Planning Commission meeting:

- Rezoning request [Z-12-00119] approximately 31.7 acres (and adjacent railroad r-o-w) from I-4 (Heavy Industrial) and VC (Valley Channel) Districts to UR-FP (Urban Reserve Floodplain Overlay) District, located in the NE1/4 \& NW1/4 Sec 4-13-20.
- Rezoning request [Z-12-00121] approximately 170.7 acres (and adjacent highway r-o-w) from I-4 (Heavy Industrial), I-1 (Limited Industrial), A (Agricultural) County Districts and CC200 (Community Commercial Center) City District to IG (General Industrial) District, located in the NW1/4 \& SW1/4 Sec 4-13-20.
- Rezoning request [Z-12-00122] approximately 59.0 acres (and adjacent highway r-o-w) from I-1 (Limited Industrial), B-1 (Neighborhood Business); A (Agricultural) [County Districts] and IG (General Industrial) District to IM (Medium Industrial) District, located in the SE1/4 Sec 5-13-20 \& SW1/4 Sec 4-13-20.
- Preliminary Plat of the former Farmland Industries property [PP-12-00101]
- Special Use Permit [SUP-12-00100] for relocation and construction of a Westar substation to provide electricity to the Former Farmland Industries property and surrounding properties.
Other action required:
- City Commission approval of rezoning requests and adoption of ordinances.
- City Commission approval of the Special Use Permit and adoption of ordinance.
- Publication of rezoning and Special Use Permit ordinances.
- Submittal of Final Plat for administrative approval and recordation.
- City Commission acceptance of dedication of easements and rights-of-way for the Final Plat.
- Release of Special Use Permit site plan to Development Services for Building Permits.
- Submission and approval of administrative site plans for individual lot development within the business park.


## PUBLIC COMMENT RECEI VED PRI OR TO PRINTI NG

No public comment was received prior to publication of this staff report.

## Project Summary:

This property includes approximately 170 acres. The property has approximately 650 feet of frontage along N1500 Road. The northeasterly edge of the property abuts the BNSF railroad right-of-way for approximately 5,000 feet. The proposed proposes to rezone the property to the UR (Urban Reserve) District.

## 1. CONFORMANCE WITH THE COMPREHENSI VE PLAN

The Comprehensive Plan recognizes the need to identify an adequate amount of available land in Douglas County to meet diverse industrial and business related development needs. Chapter 7 - Industrial \& Employment-Related Land Use (Policy 2.1), identifies general locational criteria for industrial developments which include:

- feasible access to Federal and State transportation networks;
- adequate parcel size, generally over forty acres;
- lie primarily outside of the regulatory floodplain; and
- have minimal average slopes.

The Plan identifies this site as meeting these general criteria.
The proposed zoning provides to Urban Reserve provides a 'holding zone' for the future industrial property while remediation efforts continue. The property provides for the planned expansion of the business park as laid out in the Preliminary Plat.

The community's need to identify land for future business parks is again stated in Chapter 12 Economic Development, Policy 6: Business Infrastructure, Priority 6.1: Business Park Development. The chapter states "Douglas County must identify land for future business and corporate business parks that takes advantage of the airport, the interstate/highway system, and the westward growth of Johnson County. Within the next few years, the City and County Commissions shall identify and designate at least 1000 acres of land for industrial expansion over the next 25 years. The commissions shall also put in motion the capitalization and infrastructure development needed to bring those 1000 acres into productive use. "

The Farmland Industries Redevelopment Plan brings together the community goals of creating additional employment and open space by providing a plan to redevelop a brownfield into a major community asset. The plan indicated this portion of the property would be suitable for general industrial uses and ultimately provides for potential access to E 19th Street and possibly to E 15th Street.

Staff Finding -- The proposed rezoning is in conformance with the recommendations in Horizon 2020 and the Farmland Industries Redevelopment Plan.

## 2. ZONI NG AND USE OF NEARBY PROPERTY, I NCLUDI NG OVERLAY ZONI NG

Current Zoning and Land Use: I-4 (Heavy Industrial) District; majority vacant (northern portion of former Farmland Industries property) with bag house, bulk warehouses, above-ground storage tanks and remediation ponds.
Surrounding Zoning and Land Use: To the north:
I-3 (Heavy Industrial) District north of N 1500 Road and I4 (Heavy Industrial) District across railroad r/w; agricultural fields.

To the south:
I-4 (Heavy Industrial) District and IG (General Industrial) District; portion of former Farmland Industries property, undeveloped County owned property and portions of East Hills Business Park.

To the east:
RS7 and RS10 (Single-Dwelling Residential) Districts; existing mobile home park, single-family homes and undeveloped property.
To the west:
OS-FP (Open Space - Floodplain Overlay) District; Cityowned parcel containing Pump Station No. 25.

Staff Finding - The surrounding property is a mix of city and county zoned property. The majority of the area is county industrial property that is the former Farmland Industries property to the south. The property to the north is zoned county industrial and used as agricultural fields. Much of the property to the north is also encumbered by floodplain. Properties to the west include a residentially zoned mobile home park and single-family subdivision. The east side of the property is bounded by the BNSF railroad tracks and additional property that is part of this development package.

## 3. CHARACTER OF THE NEI GHBORHOOD

Staff Finding -- This area is located between the eastern city limits and the East Hills Business Park along K-10 highway. It had been used as a portion of the fertilizer plant for more than 50 years. The City developed around the former Farmland Industries property with the island annexation of East Hills in the mid-1980s. This area has been anticipated as a natural expansion of industrial park sites for many years.

## 4. PLANS FOR THE AREA OR NEIGHBORHOOD, AS REFLECTED IN ADOPTED AREA AND/ OR SECTOR PLANS INCLUDI NG THE PROPERTY OR ADJOINING PROPERTY

Staff Finding - This property was studied in detail through the development of the Farmland Industries Redevelopment Plan. The plan brings together the community goals of creating additional employment and open space by providing a plan to redevelop a brownfield into a major community asset. The plan indicated this portion of the property would be suitable for general industrial uses and ultimately provides for potential access to E 19th Street and possibly to E 15th Street.

## 5. SUITABILITY OF SUBJ ECT PROPERTY FOR THE USES TO WHICH IT HAS BEEN RESTRICTED UNDER THE EXISTI NG ZONI NG REGULATI ONS

The request is to rezone the property to the UR District. Since the property has been annexed into the city, the county zoning designations are no longer appropriate. Due to the continuing remediation efforts, the ponds will be in use for a number of years into the future and this portion of the site is anticipated for future, rather than immediate, development. Therefore, the UR District is appropriate.

The property is within the boundary of the Farmland Industries Redevelopment Plan and within an area designated for future industrial development.

Staff Finding - The current county zoning designations are no longer appropriate since the property has been annexed into the city. Rezoning to the Urban Reserve District provides an appropriate city zoning district while the property continues to undergo clean-up and remediation.

## 6. LENGTH OF TIME SUBJ ECT PROPERTY HAS REMAI NED VACANT AS ZONED

Staff Finding - The property was developed in the 1950s as a fertilizer plant and remained in operation until 2001. In 2011, the City made extensive progress in demolishing multiple structures; however some of the plant structures remain and will be removed with development of the future business park. The bag house, two above ground storage tanks and two bulk warehouses remain as well as the seven remediation ponds. The county zoning designations have been in place since 1966 when the County adopted zoning regulations.

## 7. EXTENT TO WHICH APPROVING THE REZONING WILL DETRIMENTALLY AFFECT NEARBY PROPERTIES

Staff Finding - The property was annexed in July 2009 and the County District is no longer appropriate. This parcel represents the majority of the northern part of the site. It is not proposed for immediate development and includes seven remediation ponds. Rezoning to the UR District provides a 'holding zone' for property to avoid premature development. The property must be rezoned to a City of Lawrence zoning district following annexation.

The only principal uses allowed in the UR District are Crop Agriculture and any lawful use in existence immediately prior to annexation. The part of the property is internal to the entire site and will likely continue to be used for storage activities while environmental remediation efforts progress. This portion of the property will need to be rezoned to a different City District prior to any development. Rezoning to the UR District will not detrimentally affect nearby properties.

## 8. THE GAIN, IF ANY, TO THE PUBLIC HEALTH, SAFETY AND WELFARE DUE TO THE DENIAL OF THE APPLICATION, AS COMPARED TO THE HARDSHIP IMPOSED UPON THE LANDOWNER, IF ANY, AS A RESULT OF DENI AL OF THE APPLICATION

Evaluation of this criterion includes weighing the benefits the denial of the rezoning request would provide for the public versus the hardship the denial would impose on the owner of the subject property. Benefits are measured based on the anticipated impacts of the rezoning request on the public health, safety and welfare.

Staff Finding - If the rezoning request were denied, the area would remain a mix of zoning districts and could not be developed for future expansion of the community's tax base. Approval of the request provides the opportunity to develop a coordinated business park supporting the general industrial uses planned for the majority of the park. The gain to the public is the potential addition of a substantial number of acres of industrial property following additional remediation efforts.

## 9. PROFESSI ONAL STAFF RECOMMENDATION

Section 20-223(a) identifies the purpose of the UR District as follows:
The UR, Urban Reserve District, is a Special Purpose Base District primarily intended to provide a suitable classification for newly annexed land. The District is intended to avoid premature or inappropriate development that is not well served by infrastructure or community services. It is also intended for implementation in areas where an adopted neighborhood plan or area development plan is not in place. It permits only very low-intensity development until such time that a land use plan and infrastructure and community services are in place.

This part of the former Farmland Industries property still contains structures such as the bag house, bulk warehouses and aboveground storage tanks as well as the seven ponds that are utilized in the on-going remediation efforts. This property is not currently suitable for new development, but may be used for storage purposes in the interim. The UR District provides a 'holding zone' until such time this property is ready for development. Rezoning to another City district will be necessary before any new industrial uses may be developed in this part of the park. If this request is approved, additional development standards including final platting, site planning, and compliance with applicable design guidelines will be considered with future development applications.

This staff report reviews the proposed location for its compliance with the Comprehensive Plan, the Golden Factors, and compatibility with surrounding development. The development proposal meets the locational criteria required for approval. The rezoning request is compliant with recommendations in Horizon 2020 and Farmland Industries Redevelopment Plan. Staff recommends approval of the rezoning request for 170.4 acres from I-4 (Heavy Industrial) to UR (Urban Reserve) District and forwarding it to the City Commission with a recommendation for approval based on the findings of fact found in the body of the staff report.

## PLANNI NG COMMI SSI ON REPORT Regular Agenda - Public Hearing Item

## ITEM NO. 4C: I-4, I-1, A and CC-200 to IG; 170.7 ACRES; NORTH OF K-10 BETWEEN GREENWAY CI RCLE \& E 1575 ROAD (SMS)

Z-12-00121: Consider a request to rezone approximately 170.7 acres (and adjacent highway r-o-w) from I-4 (Heavy Industrial), I-1 (Limited Industrial), A (Agricultural) [County] Districts and CC200 (Community Commercial Center) [City] District to IG (General Industrial) District, located in the NW1/4 \& SW1/4 Sec 4-13-20 (Former Farmland Industries property, N of K-10 between Greenway Circle \& E 1575 Rd). Initiated by City Commission on 8/7/12.

STAFF RECOMMENDATI ON: Staff recommends approval of the rezoning request for 170.7 acres from I-4 (Heavy Industrial), I-1 (Limited Industrial), A (Agricultural) and CC-200 (Community Commercial) to IG (General Industrial) District and forwarding it to the City Commission with a recommendation for approval based on the findings of fact found in the body of the staff report.

Applicant's reason for request: Facilitate development of new business park.

## KEY POI NTS

- Sector plan identifies property as suitable for industrial development.
- The property has immediate access to an improved arterial street and close proximity to the planned intersection for the completed K-10 by-pass.
- Annexation of property requires designation of a suitable city zoning district.
- Chronology of planning efforts related to this property:
o 2001 -- Farmland Industries plant shut down due to bankruptcy
o 2005 -- Substantial field work completed under direction by KDHE
o 2006 -- Site Characterization Report completed by Shaw Environmental, Inc with conclusion that a significant portion of site suitable for reuse in present state
o 2007 -- City Commission initiated planning process for Farmland Industries Redevelopment Plan
o 2008 -- Governing Bodies adopted Farmland Industries Redevelopment Plan
o 2009 -- City annexed property
o 2009 - City acquired property
o 2009 -- Governing Bodies adopted updated Horizon 2020 - Chapter 7 with locational criteria evaluating the site
o 2010 -- City awarded demolition contract for clean-up of site
o 2011 -- City Commission hired Bartlett \& West/CDM Smith to develop Master Plan
o 2012 -- Informational meetings held in May with surrounding property owners
o 2012 -- Rezoning, Preliminary Plat \& SUP applications submitted in July


## ATTACHMENTS

- Area map.
- Proposed rezoning exhibit.


## GOLDEN FACTORS TO CONSI DER

## CHARACTER OF THE AREA

- Property contains a portion of the Westar electrical substation and the majority of the former Farmland Industries industrial plant.
- Includes undeveloped County owned property located between the former plant and the developing East Hills Business Park.


## CONFORMANCE WITH HORIZON 2020

- The proposed request is consistent with land use recommendations found in Horizon 2020 and the Farmland Industries Redevelopment Plan.


## ASSOCI ATED CASES/ OTHER ACTI ON REQUI RED

Items being considered at the September Planning Commission meeting:

- Rezoning request [Z-12-00119] approximately 31.7 acres (and adjacent railroad r-o-w) from I-4 (Heavy Industrial) and VC (Valley Channel) Districts to UR-FP (Urban Reserve Floodplain Overlay) District, located in the NE1/4 \& NW1/4 Sec 4-13-20.
- Rezoning request [Z-12-00120] approximately 170.4 acres (and adjacent railroad r-o-w) from I-4 (Heavy Industrial) District to UR (Urban Reserve) District, located in the NE1/4 \& NW1/4 Sec 4-13-20.
- Rezoning request [Z-12-00122] approximately 59.0 acres (and adjacent highway r-o-w) from I-1 (Limited Industrial), B-1 (Neighborhood Business); A (Agricultural) [County Districts] and IG (General Industrial) District to IM (Medium Industrial) District, located in the SE1/4 Sec 5-13-20 \& SW1/4 Sec 4-13-20.
- Preliminary Plat of the former Farmland Industries property [PP-12-00101]
- Special Use Permit [SUP-12-00100] for relocation and construction of a Westar substation to provide electricity to the Former Farmland Industries property and surrounding properties.
Other action required:
- City Commission approval of rezoning requests and adoption of ordinances.
- City Commission approval of the Special Use Permit and adoption of ordinance.
- Publication of rezoning and Special Use Permit ordinances.
- Submittal of Final Plat for administrative approval and recordation.
- City Commission acceptance of dedication of easements and rights-of-way for the Final Plat.
- Release of Special Use Permit site plan to Development Services for Building Permits.
- Submission and approval of administrative site plans for individual lot development within the business park.


## PUBLIC COMMENT RECEI VED PRIOR TO PRI NTI NG

No public comment was received prior to publication of this staff report.

## Project Summary:

This property includes approximately 170 acres. The property has approximately 2693 feet of frontage along K-10/E $23^{\text {rd }}$ Street. The request proposes to rezone the property to the IG (General Industrial) District.

## 1. CONFORMANCE WITH THE COMPREHENSI VE PLAN

The Comprehensive Plan recognizes the need to identify an adequate amount of available land in Douglas County to meet diverse industrial and business related development needs. Chapter 7 - Industrial \& Employment-Related Land Use (Policy 2.1), identifies general locational criteria for industrial developments which include:

- feasible access to Federal and State transportation networks;
- adequate parcel size, generally over forty acres;
- lie primarily outside of the regulatory floodplain; and
- have minimal average slopes.

The Plan identifies this site as meeting these general criteria.
The proposed zoning provides for a range of uses in the proposed IG District to support new business and industrial development for the community.

The community's need to identify land for future business parks is again stated in Chapter 12 Economic Development, Policy 6: Business Infrastructure, Priority 6.1: Business Park Development. The chapter states "Douglas County must identify land for future business and corporate business parks that takes advantage of the airport, the interstate/highway system, and the westward growth of Johnson County. Within the next few years, the City and County Commissions shall identify and designate at least 1000 acres of land for industrial expansion over the next 25 years. The commissions shall also put in motion the capitalization and infrastructure development needed to bring those 1000 acres into productive use. "

The Farmland Industries Redevelopment Plan brings together the community goals of creating additional employment and open space by providing a plan to redevelop a brownfield into a major community asset. The plan indicated this portion of the property would be suitable for general industrial uses and provides for highway visibility and access.

Staff Finding -- The proposed rezoning is in conformance with the recommendations in Horizon 2020 and the Farmland Industries Redevelopment Plan.

## 2. ZONI NG AND USE OF NEARBY PROPERTY, I NCLUDI NG OVERLAY ZONI NG

Current Zoning and Land Use: I-4 (Heavy Industrial), I-1 (Limited Industrial), A (Agricultural) [County] Districts and CC200 (Community Commercial Center) [City] District; former Farmland Industries lab building, portion of Westar electrical substation (to be relocated to the north) and vacant (southern and central portions of former Farmland Industries property). [The CC-200 portion is K-10 right-of-way zoned with the Fairfield Farms development.]

Surrounding Zoning and Land Use: To the north:
I-4 (Heavy Industrial) District; majority vacant (northern portion of former Farmland Industries property) with bag house, bulk warehouses and above-ground storage tanks.

To the south:
CC200 (Community Commercial) and IL (Light Industrial) [City] Districts and I-1 (Limited Industrial) [County] District; majority undeveloped and existing Tractor Supply store.

To the east:
I-4 (Heavy Industrial) District proposed to be rezoned to IM (Medium Industrial) and UR (Urban Reserve) Districts; vacant (eastern portion of former Farmland Industries property) proposed for north-south street connection to $19^{\text {th }}$ Street and utility corridor.

To the west:
IG (General Industrial) District; majority undeveloped property between former Farmland Industries and East Hills Business Park and AT\&T cell tower (property included in the related Preliminary Plat).

Staff Finding -- The surrounding property is a mix of city and county zoned property. The majority of the area is county industrial property that is the former Farmland Industries property to the north and west. The properties to the east include the undeveloped County owned property (included in the Preliminary Plat) and the developing lots within the East Hills Business Park. The properties to the south are undeveloped multi-family and commercially zoned properties along the highway frontage road. Developed properties in the Mt. Blue PID are also located to the southeast.

## 3. CHARACTER OF THE NEI GHBORHOOD

Staff Finding -- This area is located between the eastern city limits and the East Hills Business Park along K-10 highway. It had been used as a portion of the fertilizer plant for more than 50 years. The City developed around the former Farmland Industries property with the island annexation of East Hills in the mid-1980s. This area has been anticipated as a natural expansion of industrial park sites for many years.

## 4. PLANS FOR THE AREA OR NEIGHBORHOOD, AS REFLECTED IN ADOPTED AREA AND/ OR SECTOR PLANS INCLUDI NG THE PROPERTY OR ADJOINING PROPERTY

Staff Finding - This property was studied in detail through the development of the Farm/and Industries Redevelopment Plan. The plan brings together the community goals of creating additional employment and open space by providing a plan to redevelop a brownfield into a major community asset. The plan indicated this portion of the property would be suitable for general industrial uses and provides for highway visibility and access.

## 5. SUITABI LITY OF SUBJ ECT PROPERTY FOR THE USES TO WHICH IT HAS BEEN RESTRICTED UNDER THE EXISTI NG ZONI NG REGULATI ONS

The request is to rezone the property to the IG District. Since the property has been annexed into the city, the county zoning designations are no longer appropriate. The property is within the boundary of the Farmland Industries Redevelopment Plan and within an area designated for future industrial development.

Staff Finding - The current county zoning designations are no longer appropriate since the property has been annexed into the city. Rezoning to the General Industrial District provides substantial acreage to be developed and marketed for job growth in the community.

## 6. LENGTH OF TI ME SUBJ ECT PROPERTY HAS REMAI NED VACANT AS ZONED

Staff Finding - The property was developed in the 1950s as a fertilizer plant and remained in operation until 2001. In 2011, the City made extensive progress in demolishing multiple structures; however some of the plant structures remain and will be removed with development of the future business park. The county zoning designations have been in place since 1966 when the County adopted zoning regulations.

## 7. EXTENT TO WHICH APPROVING THE REZONING WILL DETRIMENTALLY AFFECT NEARBY PROPERTIES

Staff Finding - The property was annexed in July 2009 and the County Districts are no longer appropriate. The property must be rezoned to a City of Lawrence zoning district prior to development. Rezoning to the IG District provides substantial acreage to be developed and
marketed for job growth in the community. Approval of the request is not anticipated to detrimentally affect nearby properties.

## 8. THE GAIN, IF ANY, TO THE PUBLIC HEALTH, SAFETY AND WELFARE DUE TO THE DENIAL OF THE APPLICATION, AS COMPARED TO THE HARDSHIP I MPOSED UPON THE LANDOWNER, IF ANY, AS A RESULT OF DENI AL OF THE APPLICATION

Evaluation of this criterion includes weighing the benefits the denial of the rezoning request would provide for the public versus the hardship the denial would impose on the owner of the subject property. Benefits are measured based on the anticipated impacts of the rezoning request on the public health, safety and welfare.

Staff Finding - If the rezoning request were denied, the area would remain a mix of zoning districts and could not be developed for future expansion of the community's tax base. Approval of the request provides the opportunity to develop a coordinated business park supporting the general industrial uses planned for the majority of the park. The gain to the public is the addition of a substantial number of acres of industrial property and the ability to offer new sites for potential job growth in the community.

## 9. PROFESSI ONAL STAFF RECOMMENDATI ON

Section 20-217(a) identifies the purpose of the IG District as follows:
The IG, General Industrial District, is primarily intended to accommodate moderate- and high-impact industrial uses, including large scale or specialized industrial operations requiring good transportation access and public facilities and services. The District is generally incompatible with residential areas and low-intensity commercial areas.

This portion of the former Farmland Industries property is well suited to these uses with its highway frontage and location abutting existing IG zoned property to the east. If this request is approved, additional development standards including final platting, site planning, and compliance with applicable design guidelines will be considered with future development applications.

This staff report reviews the proposed location for its compliance with the Comprehensive Plan, the Golden Factors, and compatibility with surrounding development. The development proposal meets the locational criteria required for approval. The rezoning request is compliant with recommendations in Horizon 2020 and Farmland Industries Redevelopment Plan. Staff recommends approval of the rezoning request for 170.7 acres from I-4 (Heavy Industrial), I-1 (Limited Industrial), A (Agricultural) and CC-200 (Community Commercial) to IG (General Industrial) District and forwarding it to the City Commission with a recommendation for approval based on the findings of fact found in the body of the staff report.

# PLANNI NG COMMI SSI ON REPORT Regular Agenda - Public Hearing Item 

## ITEM NO. 4D: I-1, B-1, A \& I G to IM; 59.0 ACRES; NORTH OF K-10 BETWEEN GREENWAY CIRCLE \& E 1575 ROAD (SMS)

Z-12-00122: Consider a request to rezone approximately 59.0 acres (and adjacent highway r -o-w) from I-1 (Limited Industrial), B-1 (Neighborhood Business); A (Agricultural) [County Districts] and IG (General Industrial) District to IM (Medium Industrial) District, located in the SE1/4 Sec 5-13-20 \& SW1/4 Sec 4-13-20 (Former Farmland Industries property, N of K-10 between Greenway Circle \& E 1575 Rd). Initiated by City Commission on 8/7/12.

STAFF RECOMMENDATI ON: Staff recommends approval of the rezoning request for 59.0 acres from I-1 (Limited Industrial), B-1 (Neighborhood Business), A (Agricultural) and IG (General Industrial) to IM (Medium Industrial) District and forwarding it to the City Commission with a recommendation for approval based on the findings of fact found in the body of the staff report.

Applicant's reason for request: Facilitate development of new business park.

## KEY POI NTS

- Sector plan identifies property as suitable for industrial development.
- The property has immediate access to an improved arterial street and close proximity to the planned intersection for the completed K-10 by-pass.
- Annexation of property requires designation of a suitable city zoning district.
- Chronology of planning efforts related to this property:
o 2001 -- Farmland Industries plant shut down due to bankruptcy
o 2005 -- Substantial field work completed under direction by KDHE
o 2006 -- Site Characterization Report completed by Shaw Environmental, Inc with conclusion that a significant portion of site suitable for reuse in present state
o 2007 -- City Commission initiated planning process for Farmland Industries Redevelopment Plan
o 2008 -- Governing Bodies adopted Farmland Industries Redevelopment Plan
o 2009 -- City annexed property
o 2009 - City acquired property
o 2009 -- Governing Bodies adopted updated Horizon 2020 - Chapter 7 with locational criteria evaluating the site
o 2010 -- City awarded demolition contract for clean-up of site
o 2011 -- City Commission hired Bartlett \& West/CDM Smith to develop Master Plan
o 2012 -- Informational meetings held in May with surrounding property owners
o 2012 -- Rezoning, Preliminary Plat \& SUP applications submitted in J uly


## ATTACHMENTS

- Area map.
- Proposed rezoning exhibit.


## GOLDEN FACTORS TO CONSI DER

CHARACTER OF THE AREA

- Former buffer area between Farmland Industries and Douglas County Fairgrounds property and mobile home park west of the fairgrounds access road.
- Majority of property does not have frontage on K-10 and sits behind the commercial properties along the frontage road.


## CONFORMANCE WITH HORIZON 2020

- The proposed request is consistent with land use recommendations found in Horizon 2020 and the Farmland Industries Redevelopment Plan.


## ASSOCI ATED CASES/ OTHER ACTION REQUIRED

Items being considered at the September Planning Commission meeting:

- Rezoning request [Z-12-00119] approximately 31.7 acres (and adjacent railroad r-o-w) from I-4 (Heavy Industrial) and VC (Valley Channel) Districts to UR-FP (Urban Reserve Floodplain Overlay) District, located in the NE1/4 \& NW1/4 Sec 4-13-20.
- Rezoning request [Z-12-00120] approximately 170.4 acres (and adjacent railroad r-o-w) from I-4 (Heavy Industrial) District to UR (Urban Reserve) District, located in the NE1/4 \& NW1/4 Sec 4-13-20.
- Rezoning request [Z-12-00121] approximately 170.7 acres (and adjacent highway r-o-w) from I-4 (Heavy Industrial), I-1 (Limited Industrial), A (Agricultural) County Districts and CC200 (Community Commercial Center) City District to IG (General Industrial) District, located in the NW1/4 \& SW1/4 Sec 4-13-20.
- Preliminary Plat of the former Farmland Industries property [PP-12-00101]
- Special Use Permit [SUP-12-00100] for relocation and construction of a Westar substation to provide electricity to the Former Farmland Industries property and surrounding properties.
Other action required:
- City Commission approval of rezoning requests and adoption of ordinances.
- City Commission approval of the Special Use Permit and adoption of ordinance.
- Publication of rezoning and Special Use Permit ordinances.
- Submittal of Final Plat for administrative approval and recordation.
- City Commission acceptance of dedication of easements and rights-of-way for the Final Plat.
- Release of Special Use Permit site plan to Development Services for Building Permits.
- Submission and approval of administrative site plans for individual lot development within the business park.


## PUBLI C COMMENT RECEI VED PRI OR TO PRI NTI NG

- Email from Kate Dinneen regarding rezoning of A zoned property


## Project Summary:

This property includes approximately 59 acres. The property has approximately 1227 feet of frontage along E 1575 Road which currently provides limited access to the fairgrounds property. The property also has approximately 350 feet of frontage along K-10/E $23^{\text {rd }}$ Street and includes the proposed signalized intersection with O'Connell Road to the south. The request proposes to rezone the property to the IM (Medium Industrial) District.

## 1. CONFORMANCE WITH THE COMPREHENSI VE PLAN

The Comprehensive Plan recognizes the need to identify an adequate amount of available land in Douglas County to meet diverse industrial and business related development needs. Chapter 7 - Industrial \& Employment-Related Land Use (Policy 2.1), identifies general locational criteria for industrial developments which include:

- feasible access to Federal and State transportation networks;
- adequate parcel size, generally over forty acres;
- lie primarily outside of the regulatory floodplain; and
- have minimal average slopes.

The Plan identifies this site as meeting these general criteria.
The proposed zoning provides transition from west to east with lesser intense uses anticipated in the proposed IM District which borders the fairgrounds property and existing residential uses to the west.

The community's need to identify land for future business parks is again stated in Chapter 12 Economic Development, Policy 6: Business Infrastructure, Priority 6.1: Business Park Development. The chapter states "Douglas County must identify land for future business and corporate business parks that takes advantage of the airport, the interstate/highway system, and the westward growth of Johnson County. Within the next few years, the City and County Commissions shall identify and designate at least 1000 acres of land for industrial expansion over the next 25 years. The commissions shall also put in motion the capitalization and infrastructure development needed to bring those 1000 acres into productive use."

The Farmland Industries Redevelopment Plan brings together the community goals of creating additional employment and open space by providing a plan to redevelop a brownfield into a major community asset. The plan indicated this portion of the property would be suitable for civic uses to potentially accommodate expansion of the fairgrounds. The most recent fairgrounds master plan does not anticipate expansion here. Civic uses are permitted in the IM District and moderate uses are a suitable use adjacent to the residential and civic properties to the west.

Staff Finding -- The proposed rezoning is in conformance with the recommendations in Horizon 2020 and the Farmland Industries Redevelopment Plan.

## 2. ZONI NG AND USE OF NEARBY PROPERTY, I NCLUDI NG OVERLAY ZONI NG

Current Zoning and Land Use: I-1 (Limited Industrial), B-1 (Neighborhood Business), A (Agricultural) [County Districts] and IG (General Industrial) District; vacant (southwestern portion of former Farmland Industries property) and portion of Westar electrical sub-station (to be relocated to the north).

Surrounding Zoning and Land Use: To the north:
IG (General Industrial) District; automotive salvage and recycling.

To the south:
CS (Commercial Strip), UR (Urban Reserve), RS10 (SingleDwelling Residential) and CO (Commercial Office) Districts; existing commercial businesses and Knights of Columbus along frontage road and undeveloped property along south side of K-10/E $23^{\text {rd }}$ Street.

To the east:
I-4 (Heavy Industrial) [County District]; former Farmland Industries office building, portion of Westar electrical substation (to be relocated to the north) and vacant (southern portion of former Farmland Industries property).

To the west:
GPI (General Public \& Institutional) District and RS7 (Single-Dwelling Residential) District; Douglas County Fairgrounds and existing mobile home park.

Staff Finding -- The surrounding property is a mix of city and county zoned property. The majority of the area is county industrial property that is the former Farmland Industries property to the east. The properties to the south are commercially zoned properties along the highway frontage road. Property to the west includes the residentially zoned mobile home park and the GPI zoned county fairgrounds. Immediately to the north are industrially zoned auto salvage/recycling businesses.

## 3. CHARACTER OF THE NEI GHBORHOOD

Staff Finding -- This area is located between the eastern city limits and the East Hills Business Park along K-10 highway. It had been used as a buffer area to the fertilizer plant for more than 50 years. The City developed around the former Farmland Industries property with the island annexation of East Hills in the mid-1980s. This area has been anticipated as a natural expansion of industrial park sites for many years.

## 4. PLANS FOR THE AREA OR NEIGHBORHOOD, AS REFLECTED IN ADOPTED AREA AND/ OR SECTOR PLANS INCLUDI NG THE PROPERTY OR ADJOINING PROPERTY

Staff Finding - This property was studied in detail through the development of the Farmland Industries Redevelopment Plan. The plan brings together the community goals of creating additional employment and open space by providing a plan to redevelop a brownfield into a major community asset. The plan indicated this portion of the property would be suitable for civic uses to potentially accommodate expansion of the fairgrounds. The most recent fairgrounds master plan does not anticipate expansion here. Civic uses are permitted in the IM District and moderate uses are a suitable use adjacent to the residential and civic properties to the west.

## 5. SUITABI LITY OF SUBJ ECT PROPERTY FOR THE USES TO WHICH IT HAS BEEN RESTRICTED UNDER THE EXISTI NG ZONI NG REGULATI ONS

The request is to rezone the property to the IM District. Since the property has been annexed into the city, the county zoning designations are no longer appropriate. The property is within the boundary of the Farmland Industries Redevelopment Plan and within an area designated for future industrial development.

Staff Finding - The current county zoning designations are no longer appropriate since the property has been annexed into the city. Rezoning to the Medium Industrial District provides a transition from the lesser intense uses to the west and the planned General Industrial uses to the east.

## 6. LENGTH OF TI ME SUBJ ECT PROPERTY HAS REMAI NED VACANT AS ZONED

Staff Finding - The property is currently undeveloped except for a portion of the Westar substation that was constructed more than 50 years ago. The county zoning designations have been in place since 1966 when the County adopted zoning regulations. The IG portion was zoned M-3 (Intensive Industrial) when the Pyle Subdivision was approved in 1976 and converted to the IG District in 2006. That portion of the property was never developed.

## 7. EXTENT TO WHICH APPROVING THE REZONING WILL DETRIMENTALLY AFFECT NEARBY PROPERTIES

Staff Finding - The property was annexed in July 2009 and the County Districts are no longer appropriate. The property must be rezoned to a City of Lawrence zoning district prior to development. Rezoning to the IM District provides a transition of moderate industrial uses on the western edge of the planned business park. Approval of the request is not anticipated to detrimentally affect nearby properties.

## 8. THE GAI N, IF ANY, TO THE PUBLIC HEALTH, SAFETY AND WELFARE DUE TO THE DENIAL OF THE APPLICATION, AS COMPARED TO THE HARDSHIP I MPOSED UPON THE LANDOWNER, IF ANY, AS A RESULT OF DENI AL OF THE APPLICATION

Evaluation of this criterion includes weighing the benefits the denial of the rezoning request would provide for the public versus the hardship the denial would impose on the owner of the subject property. Benefits are measured based on the anticipated impacts of the rezoning request on the public health, safety and welfare.

Staff Finding - If the rezoning request were denied, the area would remain a mix of zoning districts and could not be developed for future expansion of the community's tax base. Approval of the request provides the opportunity to develop a coordinated business park with a transition of uses between existing residential, civic and commercial uses to the general industrial uses planned for the majority of the park. The gain to the public is the addition of a substantial number of acres of industrial property and the ability to offer new sites for potential job growth in the community.

## 9. PROFESSI ONAL STAFF RECOMMENDATI ON

Section 20-216(a) the purpose of the IM District as follows:
The IM, Medium Industrial District, is intended to accommodate moderate-impact industrial facilities and wholesale, storage and distribution operations.

This majority of this portion of the former Farmland Industries property does not have highway frontage or visibility since it is located north of the commercial properties along the frontage road and adjacent to the fairgrounds access road. Most of this property will have internal access from the new business park streets and will provide a transition between the residential and fairground uses to the west and the anticipated general industrial uses to the east. If this request is approved, additional development standards including final platting, site planning, and compliance with applicable design guidelines will be considered with future development applications.

This staff report reviews the proposed location for its compliance with the Comprehensive Plan, the Golden Factors, and compatibility with surrounding development. The development proposal meets the locational criteria required for approval. The rezoning request is compliant with recommendations in Horizon 2020 and Farmland Industries Redevelopment Plan. Staff recommends approval of the rezoning request for 59.0 acres from I-1 (Limited Industrial), B-1 (Neighborhood Business), A (Agricultural) and IG (General Industrial) to IM (Medium Industrial) District and forwarding it to the City Commission with a recommendation for approval based on the findings of fact found in the body of the staff report.

| From: | Sheila Stogsdill |
| :--- | :--- |
| To: | Sheila Stogsdill |
| Subject: | FW: website comment - Z-12-00122 |
| Date: | Monday, September 10, 2012 10:21:28 AM |

From: Kate Dinneen [mailto:kld310@earthlink.net]
Sent: Thursday, September 06, 2012 11:43 AM
To: Sheila Stogsdill
Subject: Re: website comment - Z-12-00122
Thank you for your reply and your further explanation. I appreciate your work!
Kate
----- Original Message -----

## From: Sheila Stogsdill

To: 'kld310@earthlink.net'
Cc: Scott McCullough ; Megan Gilliland
Sent: Wednesday, September 05, 2012 5:12 PM
Subject: website comment - Z-12-00122
Ms Dinneen -
Thank you for your comments regarding the proposed rezoning of a portion of the former Farmland Industries property. Your comments will be forwarded to the Planning Commission as part of the September packet later this month. Crop Agricultural uses are permitted in the Industrial Districts. Ag uses may be an interim use on portions of the property prior to ultimate business park uses are developed.

If you have other questions about the proposed development, please feel free to contact me.
Sheila M. Stogsdill, Assistant Director - sstogsdill@lawrenceks.org
Planning \& Development Services Department |www.lawrenceks.org/pds
City Hall, 6 E. 6th Street P.O. Box 708, Lawrence, KS 66044-0708
office (785) 832-3157 | fax (785) 832-3160
"Your opinion counts! Customer feedback helps us serve you better. Please tell us how we're doing by completing this short online Customer Satisfaction Survey: http://lawrenceks.org/pds/survey/satisfaction. "

From: Megan Gilliland
Sent: Tuesday, September 04, 2012 7:00 AM
To: Scott McCullough
Subject: FW: Our goal: Better city service [\#349]
Correspondence for PC.
From: Wufoo [mailto:no-reply@wufoo.com]
Sent: Monday, September 03, 2012 12:51 PM
To: Megan Gilliland
Subject: Our goal: Better city service [\#349]
Subject: Sept 24 Planning Commission Meeting
Comments: I 'd like to suggest that the commission remove the piece of Agricultural Zoned acreage from the Z-12-00122 proposed change to IM. The piece of land could still be used for agricultural purposes and as we continue to lose space for food growing it would be good to save it where we can. Unless, of course, it is part of the contaminated space.

Name: Kate Dinneen


## PLANNI NG COMMISSI ON REPORT REGULAR AGENDA

PC Staff Report 9/24/12

## ITEM NO. 4E: PRELI MI NARY PLAT THE FORMER FARMLAND INDUSTRIES PROPERTY; N OF K-10 BETWEEN GREENWAY CI RCLE \& E 1575 ROAD (SMS)

PP-12-00101: Consider a Preliminary Plat for the Former Farmland Industries property, an industrial subdivision containing 20 lots, 4 tracts and 4 greenway tracts. The property is located N of K-10 between Greenway Circle \& E 1575 Rd. Submitted by Bartlett \& West, for City of Lawrence, property owner of record.

## STAFF RECOMMENDATI ON:

Staff recommends approval of the Preliminary Plat of the former Farmland Industries Property subject to the following conditions:

1. Provision of a revised plat including:
a. Dedication of full $50^{\prime}$ of right-of-way for E $15^{\text {th }}$ Street;
b. Dedication of a 15 ' utility easement along the south side of Lots $1 \& 2$, Block $B$ to accommodate the planned sanitary sewer separate from the proposed 30 ' landscape easement, if needed;
c. Provision of a utility easement crossing Lots $7 \& 8$, Block $C$ and Lot 1 , Block $D$ if the existing overhead power lines are not relocated;
d. Provision of actual minimum FFE on all lots adjacent to drainage easements once those elevations are determined; and
e. Provision of street names for all internal park streets and E 1575 Road.
2. Execution of revised access control agreements with KDOT prior to recording of a Final Plat.

Applicant's Reason for Request:

Subdivision requirement prior to construction of major utility and infrastructure for business park development.

## KEY POI NTS

- The property is identified in Horizon 2020 and the Farmland Redevelopment Plan for future industrial development.
- Chronology of planning efforts related to this property:
o 2001 -- Farmland Industries plant shut down due to bankruptcy
o 2005 -- Substantial field work completed under direction by KDHE
o 2006 -- Site Characterization Report completed by Shaw Environmental, Inc with conclusion that a significant portion of site suitable for reuse in present state
o 2007 -- City Commission initiated planning process for Farmland Industries Redevelopment Plan
o 2008 -- Governing Bodies adopted Farmland Industries Redevelopment Plan
o 2009 -- City annexed property
o 2009 - City acquired property
o 2009 -- Governing Bodies adopted updated Horizon 2020 - Chapter 7 with locational criteria evaluating the site
o 2010 -- City awarded demolition contract for clean-up of site
o 2011 -- City Commission hired Bartlett \& West/CDM Smith to develop Master Plan
o 2012 -- Informational meetings held in May with surrounding property owners
o 2012 -- Rezoning, Preliminary Plat \& SUP applications submitted in July


## ATTACHMENTS

- Preliminary Plat.
- Concept Plan.


## SUBDI VI SI ON CITATI ONS TO CONSI DER

- This application is being reviewed under the Subdivision Regulations for Lawrence and Unincorporated Douglas County, effective J an 1, 2007.
- Section 20-813 states that building permits will not be issued for unplatted property.


## ASSOCI ATED CASES/ OTHER ACTI ON REQUI RED

Items being considered at the September Planning Commission meeting:

- Rezoning request [Z-12-00119] approximately 31.7 acres (and adjacent railroad r-o-w) from I-4 (Heavy Industrial) and VC (Valley Channel) Districts to UR-FP (Urban Reserve Floodplain Overlay) District, located in the NE1/4 \& NW1/4 Sec 4-13-20.
- Rezoning request [Z-12-00120] approximately 170.4 acres (and adjacent railroad r-o-w) from I-4 (Heavy Industrial) District to UR (Urban Reserve) District, located in the NE1/4 \& NW1/4 Sec 4-13-20.
- Rezoning request [Z-12-00121] approximately 170.7 acres (and adjacent highway r-o-w) from I-4 (Heavy Industrial), I-1 (Limited Industrial), A (Agricultural) County Districts and CC200 (Community Commercial Center) City District to IG (General Industrial) District, located in the NW1/4 \& SW1/4 Sec 4-13-20.
- Rezoning request [Z-12-00122] approximately 59.0 acres (and adjacent highway r-o-w) from I-1 (Limited Industrial), B-1 (Neighborhood Business); A (Agricultural) [County Districts] and IG (General Industrial) District to IM (Medium Industrial) District, located in the SE1/4 Sec 5-13-20 \& SW1/4 Sec 4-13-20.
- Special Use Permit [SUP-12-00100] for relocation and construction of a Westar substation to provide electricity to the Former Farmland Industries property and surrounding properties.
Other action required:
- City Commission approval of rezoning requests and adoption of ordinances.
- City Commission approval of the Special Use Permit and adoption of ordinance.
- Publication of rezoning and Special Use Permit ordinances.
- Submittal of Final Plat for administrative approval and recordation.
- City Commission acceptance of dedication of easements and rights-of-way for the Final Plat.
- Release of Special Use Permit site plan to Development Services for Building Permits.


## PLANS AND STUDIES REQUIRED

- Traffic Study - The traffic study has been reviewed. City and KDOT staffs continue to discuss necessary improvements on K-10 to accommodate the business park use. The City has requested that the speed limit along this section of the highway be reduced to reflect arterial city street speeds. KDOT is reviewing access control agreements.
- Downstream Sanitary Sewer Analysis - The downstream sanitary sewer analysis has been reviewed and is accepted for this project.
- Drainage Study - A drainage study was prepared by CDM Smith (the City's consultant) and has been reviewed and accepted.
- Retail Market Study - Not applicable to project.


## PUBLIC COMMENT

No public comment was received prior to publication of this staff report.

## Site Summary

Gross Area:
Number of Existing Lots:
Number of Proposed Lots:
Right-of-Way Dedicated:
Public Use Area Dedicated:
Net Area included in proposed lots:
583.2 acres

11 unplatted parcels and 3 platted lots
20 lots, 4 tracts and 4 greenway tracts
25.4 acres
191.1 acres (portions of Tract A eventually may be developed with business park uses following clean-up) 342 acres +/- (includes 32 acres in floodplain)

## GENERAL INFORMATION

Current Zoning and Land Use:
County Zoning Districts:
I-4 (Heavy Industrial),
I-1 (Limited Industrial), B-1 (Neighborhood Business),
A (Agricultural) and
VC (Valley Channel)
and
City Zoning Districts:
IG (General Industrial) and CC200 (Community Commercial Center).


Portions of the plat include vacant land that was part of the former Farmland Industries property and the existing Westar electrical substation. Farmland Industries improvements that remain include: lab building, bag house, bulk warehouses, above-ground storage tanks and remediation ponds. The plat also includes the unplatted property located between existing East Hills Business Park and the former Farmland property and includes an existing AT\&T communications tower. The area located between E 15 ${ }^{\text {th }}$ Street and the BNSF railroad tracks contains agricultural fields and is encumbered with floodplain.

Surrounding Zoning and Land Use:
To the north:
IG (General Industrial), I-3 (Heavy Industrial) and VC (Valley Channel) Districts; auto recycler/salvage yard north of the western portion of site and agricultural fields north outside of the city.

To the west:
VC and IG Districts; agricultural fields and existing businesses in East Hills Business Park.

To the south:
PID - [LRM], PID - [Mt. Blue], I-1, IL (Limited Industrial), CC200, IG, RS10, UR and CS (Commercial Strip) Districts; concrete plant, storage company, church, retail and service uses.

To the east:
CS, RS7 (Single-Dwelling Residential) and GPI (General Public \& Institutional) Districts; retail and service uses, mobile home park and County fairgrounds.


Floodway Fringe Overlay is regulated by Article 12 of the Development Code. The 500-year floodplain is not regulated by the code. Subject property is outlined.

## STAFF REVI EW

The property included in this Preliminary Plat encompasses the former Farmland Industries property, an existing Westar electrical substation, an existing AT\&T communications tower, unplatted parcels west of East Hills Business Park owned by Douglas County, and platted \& unplatted portions of East Hills Business Park located west of Greenway Circle.

The former Farmland Nitrogen Manufacturing Plant operated east of Lawrence from 1954 to 2001. The City officially became the owner of the property in 2009. In 2011, extensive progress was made in demolishing over 35 structures and removal of over 1,600 tons of scrap metal for recycling. The City continues to work on the environmental clean-up of the property, which includes remediation efforts to pump ground water from portions of the site which has an overabundance of nitrogen from the fertilizer manufacturing operation. The City pumps the ground water to local farm fields as part of the remediation efforts.

The southern portions of the property are currently available for development and the northern portions are part of the active remediation efforts or are encumbered by floodplain. The plat therefore lays out the infrastructure network for the initial stages of development. The plat also shows the eventual extension of the main north-south street which will intersect with E $19^{\text {th }}$ Street and ultimately provide access to the northern portions of the property. The initial infrastructure will provide an east-west street that connect to the existing East Hills business park and provides access to the properties at the west end located north of the existing commercial businesses along $\mathrm{K}-10$. The main entrance to the park will be a signalized intersection at K-10/O'Connell Road. The extension of O'Connell Road will eventually tie into E 19 ${ }^{\text {th }}$ Street, but the initial phase will terminate approximately 1000 feet north of the east-west street. A second entrance providing right-in/rightout access will be constructed approximately midway between the new signalized intersection and the existing East Hills Drive intersection with K-10.

The Preliminary Plat also provides a development tract for the relocation of the existing Westar substation approximately a quarter of a mile into the property. The relocation is necessary because the existing substation is located in alignment with the planned intersection. This provides an opportunity to update the electrical equipment and remove it from its current visible location. The substation is a Minor Utility and requires approval of a Special Use Permit prior to construction. The related request, SUP-12-00100, is also on this month's agenda.

The Preliminary Plat provides 100' of right-of-way for all of the new streets in the business park. The additional right-of-way provides space for municipal utility extensions as well as construction of a Complete Streets profile including bike lanes and a multi-use path. Greenway Tracts are platted in natural drainage areas through the site to provide space for utility locations and stormwater conveyance or detention. The intent is that these Greenway Tracts will provide visual amenities throughout the park.

A large portion of Greenway Tract A includes the area that continues to be subject to remediation efforts and the series of lime \& effluent runoff ponds and overflow ponds. Portions of this area will likely be available for business park development in the future. This property is proposed to be rezoned to UR (Urban Reserve) until such time it is ready for development.

A triangular shaped part of the northern parcel located between E $15^{\text {th }}$ Street and the BNSF railroad tracks is partially encumbered by the floodplain. This property is proposed to be rezoned to UR FP (Urban Reserve-Floodplain Overlay) and may be developed in the future when utilities are extended and E $15^{\text {th }}$ Street is improved.

## Zoning and Land Use

The property included in this preliminary plat encompasses over 580 acres. The southwestern portion includes vacant land that was part of the former Farmland Industries property and a portion of the existing Westar electrical substation. This area is currently zoned I-1 (Limited Industrial), B1 (Neighborhood Business), A (Agricultural) and IG (General Industrial) District.

The majority of the highway frontage includes the former Farmland Industries lab building, a portion of the Westar electrical substation (to be relocated to the north), vacant parts of former Farmland Industries property and highway right-of-way. This part of the property is currently zoned I-4 (Heavy Industrial), I-1 (Limited Industrial), A (Agricultural) and CC200 (Community Commercial Center) District.

The central portion of the site is primarily vacant but also contains the existing bag house, bulk warehouses, above-ground storage tanks and remediation ponds. This area is zoned I-4 (Heavy Industrial) District. This part of the plat also includes the unplatted property between East Hills Business Park and the former Farmland property. An existing 205' AT\&T communications tower is located in this area. This area was annexed into the City in 1986 and is zoned IG (General Industrial) District.

The area located between E $15^{\text {th }}$ Street and the BNSF railroad tracks contains agricultural fields and is zoned I-4 (Heavy Industrial) and VC (Valley Channel) Districts. The western portion of this parcel is encumbered with floodplain and will be rezoned to the Floodplain Overlay District.

## Streets and Access

The property is located between K-10 and E $15^{\text {th }}$ Street. New north-south streets are planned at the intersection of K-10 \& O'Connell Road and at a mid-point between this new intersection and the existing K-10 \& East Hills Drive intersection. A new east-west street will tie into the existing East Hills Business Park properties at Greenway Circle and provide access to the new development lots planned in the southern portion of the property. Eventually the O'Connell Road extension will tie into E 19 ${ }^{\text {th }}$ Street providing additional options for traffic distribution and access.

A minor north-south street just west of the main entrance will be constructed to connect with the existing frontage road. This street will provide the commercial properties along the frontage road with access to the signalized intersection for improved safety.

Temporary cul-de-sacs are shown at the west end of the east-west street and on the O'Connell Road extension. The lots have been laid out to maximize flexibility in an effort to have large lots available for development. Lots along several of the cul-de-sacs can be combined if a potential tenant desires a large parcel. If individual lots are desired, the streets can easily be extended to accommodate smaller lots.

The plat also dedicates right-of-way along the western boundary where existing County right-ofway easement currently provides 'back door' access to the County fairgrounds. Eventually this street will be improved to city standards as adjacent lots are developed.

KDOT has access control along the majority of the highway frontage. The plat proposes to remove the access restrictions at the frontage road/north-south street intersection, the K-10/O'Connell Road intersection, and the right-in/right-out intersection. Three existing driveway access points at median breaks south of Lots $1,2 \& 3$, Block B and the existing AT\&T access point (at Lot 4, Block
B) are proposed to be closed and access restricted. Access to the AT\&T tower will eventually be provided from the north-south cul-de-sac adjacent to Lot 4, Block C.

Removal of access control is proposed between Tract A \& B, at the K-10/O'Connell Road extension intersection, and east of Greenway Tract C. KDOT is currently reviewing right-of-way agreements that will need to be revised in conjunction with the plat proposals.

City staff has not yet determined what the business park name will be or internal street names. Street names will need to be determined prior to recording of a Final Plat for any portion of the property.

## Utilities and Infrastructure

Utilities and infrastructure to accommodate the new business park will be extended in phases. Water and sanitary sewer are planned to be located in the 100' wide rights-of-ways or in the Greenway Tracts through the property. Additional utility easements are provided outside of the rights-of-ways to provide for private utility extensions. Significant Westar transmission easements also are provided along the north side of Block $A$ and the west side of Block C .

Tracts A, B \& C provide significant areas for Westar related improvements and the substation will be located on Tract D. The Subdivision Regulations define a Tract as follows: "When part of a Platted Subdivision, a Tract is a Parcel reserved for open space, storm drainage, Easement purposes or an otherwise specific and restricted use." Because of the unique nature of the utility improvements necessary to support the new substation and various ownership interests, it was determined through the platting process to create tracts for these uses. Access to Tract D is provided by Tract C. Building permits will be required prior to the installation of structures on these tracts. General Note 9 specifically identifies uses anticipated in these tracts.

## Easements and Rights-of-way

As noted above, a substantial number of new easements will be provided throughout the property. Specific landscape easements are provided along the K-10 frontage and along the northern boundary of Block A. Specific Westar transmission easements are located to support the relocated substation improvements. An additional 50' easement is reserved for the City's future Noreaster Waterline improvement. An additional utility easement is needed along a portion of the highway frontage so that a new sanitary sewer is not located within the planned landscape easement. (This easement is only necessary if the sanitary sewer is constructed along the highway frontage. Ongoing discussions with the consultant and Utilities Department may result in a different configuration.)

The Greenway Tracts are also designed to serve as utility and stormwater easements through the property. The majority of Greenway Tract A is proposed to be zoned UR (Urban Reserve) because it contains portions of the property that are not immediately ready for development. Once clean-up efforts are completed, portions of this tract potentially could be replatted to create development lots south of the BNSF railroad tracks.

Easements along side lot lines in Blocks A, B and C are not designated now in order to provide the most flexibility if lots should be combined for a large user. Similarly, front easements are not provided along the cul-de-sac streets in order to minimize the need to vacate multiple easements if lots are combined. Additional easements to serve a specific development can be provided at either the final plat or site plan stage in the review process.

Existing easements, including AT\&T's access and utility easements to the communications tower, will be vacated with this plat. When the existing tower was constructed in 1992, the Zoning Ordinance did not require the establishment of setbacks related to fall zones. The Development Code currently requires a setback of $1 / 2$ the tower height when adjacent to residential property or a setback established based upon the fall zone determined by engineering standards. The tower is located in the northeast corner of the one acre parcel owned by AT\&T and sits approximately 40' from the north and east lot lines. The property configuration creates a non-conforming condition for the cell tower, which will need to be cured through the site planning process in the future and may require variances and/or fall zone easements on the lot it is located on and adjacent lots.

As noted above, the street rights-of-ways throughout the park are 100' wide to accommodate Complete Street improvements. The main entry to the business park will be at the signalized intersection of K-10/O'Connell Road (extended). This access concept departs from the anticipated street concept in T2030 and the Farmland Redevelopment Plan. Those documents had anticipated the main entrance at Franklin Road with a minor arterial extension north intersecting with the minor arterial extension of E 19 ${ }^{\text {th }}$ Street into the park. Closer examination of the site terrain and highway profile determined that the entrance be moved west to O'Connell Road. The plat includes the east-west collector connection to East Hills Business Park and the minor arterial connection north to E 19 ${ }^{\text {th }}$ Street.

## Conformance

The Comprehensive Plan recognizes the need to identify an adequate amount of available land in Douglas County to meet diverse industrial and business related development needs. Chapter 7 Industrial \& Employment-Related Land Use (Policy 2.1), identifies general locational criteria for industrial developments which include:

- feasible access to Federal and State transportation networks;
- adequate parcel size, generally over forty acres;
- lie primarily outside of the regulatory floodplain; and
- have minimal average slopes.

The Plan identifies this site as meeting these general criteria.
Chapter 7 also includes specific criteria to be used in evaluating proposals at the development plan level. These include:

- preserve environmentally sensitive areas, including vegetative cover and wildlife habitat, to act as buffers and site amenities;
- encourage natural stormwater management, including locations that permit direct discharge to the floodplain;
- have available and adequate utilities, infrastructure and services (i.e. police and fire protection) for the proposed use;
- be compatible with existing and future zoning/land use patterns, including the use of appropriate buffers between land uses;
- be annexed before development if adjacent to municipal boundaries.

The Preliminary Plat, as designed, incorporates these criteria. The Greenway Tracts located throughout the property will contain stormwater conveyance and detention features and provide open space amenities to the business park. The plat provides for the relocation of the Westar electrical substation farther north into the property which offers an opportunity to upgrade facilities serving this part of the community. The substation requires numerous easements which are generally contained in Tracts A, B \& C which will also provide open green space opportunities in the southwestern part of the property.

The proposed zoning provides transition from west to east with lesser intense uses anticipated in the proposed IM District which borders the fairgrounds property and existing residential uses to the west. Due to long term remediation efforts that are underway, the northern portions of the property will not be immediately available for development. The proposed UR and UR-FP Districts recognize that these areas are not yet ready for industrial uses.

The community's need to identify land for future business parks is again stated in Chapter 12 Economic Development, Policy 6: Business Infrastructure, Priority 6.1: Business Park Development. The chapter states "Douglas County must identify land for future business and corporate business parks that takes advantage of the airport, the interstate/highway system, and the westward growth of Johnson County. Within the next few years, the City and County Commissions shall identify and designate at least 1000 acres of land for industrial expansion over the next 25 years. The commissions shall also put in motion the capitalization and infrastructure development needed to bring those 1000 acres into productive use."

In Chapter 16 - Environment, the Plan recommends using natural approaches to stormwater system design and management and utilizing Best Management Practices (BMPs) for stormwater structures and pollutant discharge, erosion and sediment control, and water quality. The Preliminary Plat has been designed to incorporate several large Greenway Tracts which will provide natural stormwater conveyance courses through the park. A substantial amount of open space will also be provided in the various Tracts adjacent to the entrances and surrounding the Westar substation. The attached Concept Plan illustrates various features designed into the business park layout including: regional detention, retention of mature trees, greenway tracts with stormwater amenities, recreational paths \& trails, and the potential development of a park \& ride/trailhead parking lot near the park entrance.

The Farmland Industries Redevelopment Plan brings together the community goals of creating additional employment and open space by providing a plan to redevelop a brownfield into a major community asset. The design of the proposed plat incorporates transportation and open space recommendations that will create linkages through the park and provide connectivity to East Hills and eventually to the neighborhoods to the northwest.

The preliminary plat, as conditioned, is in conformance with the recommendations in Horizon 2020 and the design standards of the Subdivision Regulations and the Development Code.











September 12, 2012
RE: Don's Steakhouse Property - 2176 E $23^{\text {rd }}$ Street
Mayor Schumm,
On behalf of my client, Gary Bartz, owner of the former Don's Steakhouse located at 2176 E. $23{ }^{\text {rd }}$ Street, we submitted a proposal last December for a 3 year option to buy the ground north of his property from the City of Lawrence at $\$ 2$ per square foot.

Since that time the concept completed by the City's consultants for the Farmland ground has been submitted to the City. Based off the information provided by the concept plan it makes sense to add this property to my clients ground. With that in mind we would like to move forward with his proposal to purchase the 1.46 acre piece of land north of his property. (See attachments)

We believe adding this ground to the site will give potential buyers of the property a better option for redevelopment and the potential of combing with the property to the east which is also for sale. Combining all three of these properties would provide 4.46 acres.

Access to the property is best served from the existing frontage road. Alternatively, if this ground is not sold to Don's Steak House the access to the lot would be from E. 1575 Road which would not be ideal.

We would appreciate your consideration of this proposal and look forward to discussing it with you.

Respectfully,

Paul Werner
Cc: Gary Bartz
Darron Ammann, Bartlett \& West



# PLANNI NG COMMI SSI ON REPORT <br> Regular Agenda - Public Hearing Item: 

PC Staff Report
09/24/12
ITEM NO. 4F: SPECI AL USE PERMIT FOR WESTAR SUBSTATION; N OF K-10 BETWEEN GREENWAY CIR \& E 1575 RD (SMS)

SUP-12-00100: Consider a Special Use Permit for a Westar substation to provide electricity to the Former Farmland Industries property and surrounding properties. The property is located N of K-10 between Greenway Circle \& E 1575 Rd. Submitted by Bartlett \& West for Westar Energy.

STAFF RECOMMENDATI ON: Staff recommends approval of SUP-12-00-100, a Special Use Permit for , a Minor Utility, based upon the findings presented in the body of the staff report and subject to the following condition:

1. Review and approval of a landscape screening plan to be provided prior to final inspection of the substation improvements.

## Applicant's Reason for Request: SUP required for use of property as a minor utility.

## KEY POI NTS

- An electrical substation is a Minor Utility which serves more than one specific development; therefore approval is required through a Special Use Permit per Section 20530 of the Development Code.
- The proposal will relocate the existing electrical substation to provide for the construction of a new signalized intersection with K-10 and the major entrance to the business park.


## FACTORS TO CONSI DER

- Procedural requirements of Section 20-1306; Special Use Permits.


## ASSOCI ATED CASES/ OTHER ACTI ON REQUI RED

Other items being considered at the September Planning Commission meeting:

- Rezoning request [Z-12-00122] approximately 59.0 acres (and adjacent highway r-ow) from I-1 (Limited Industrial), B-1 (Neighborhood Business); A (Agricultural) [County Districts] and IG (General Industrial) District to IM (Medium Industrial) District, located in the SE1/4 Sec 5-13-20 \& SW1/4 Sec 4-13-20.
- Preliminary Plat for former Farmland Industries [PP-12-00101].

Other action required:

- City Commission approval of rezoning request and adoption of ordinance.
- City Commission approval of the Special Use Permit and adoption of ordinance
- Publication of rezoning and Special Use Permit ordinances.
- Submittal of Final Plat for administrative approval and recordation.
- City Commission acceptance of dedication of easements and rights-of-way for the Final Plat.


## PLANS AND STUDI ES REQUI RED

- Traffic Study- Provided as part of Preliminary Plat submittal.
- Downstream Sanitary Sewer Analysis - The City Utility Engineer indicated that a DSSA is not required.
- Drainage Study - Provided as part of Preliminary Plat submittal.
- Retail Market Study - Not applicable to project.


## PUBLIC COMMENT

No public comment was received prior to the printing of this staff report.

## GENERAL I NFORMATI ON

Current Zoning and Land Use:
I-1 (Light Industrial) [County] District; [proposed rezoning to IM (Medium Industrial)
City District]; undeveloped, former 'west' stormwater ponds on Farmland Industries property $\qquad$


Surrounding Zoning and Land Use:
To the north: IG (General Industrial) City District; auto recycler/salvage yard.

To the south and west: I-1 (Light Industrial) [County] District; [proposed rezoning to IM (Medium Industrial) City District]; undeveloped, former undeveloped Farmland Industries property


To the east and southeast: I-4 (Heavy Industrial) County District; [proposed rezoning to IG (General Industrial) City District; recently demolished portions of Farmland Industries plant and the existing electrical substation to be replaced by this development proposal.

## Summary of Special Use

Westar currently has an electrical substation on the former Farmland Industries property which will be relocated to the northwest to accommodate the new K-10/O'Connell Road intersection. This request proposes to construct the new substation on Tract $D$ which will be located west of the O'Connell Road extension and north of the new east-west street in the business park. Tract C, which surrounds Tract D on three sides, accommodates the numerous easements required for the substation and provides access to Tract D. Additional Westar easements are placed in Tract $B$ to provide access to the highway right-of-way. The easement for the existing equipment (located in proposed Tract A) will be vacated with the plat for the new business park.

The proposed substation improvements include a compacted gravel pad enclosed by an 8 ' high black chain link fence with barbed wire on an approximately 3 acre tract. Perimeter lighting will be placed inside the fence with fixtures pointed down toward the equipment. The enclosure will contain new transmission equipment and cabinets. Additional transmission poles will be located within Tracts B \& C as needed. An access drive from the east-west park street to Tract $D$ will be located Tract C. The remainder of Tract C will be planted in turf with perimeter landscaping.

The relocation will occur in accordance with an agreement between Westar and the City. The agreement includes the design and planting of landscape screening by the City. The majority of this landscaping will occur on Tract C , but will also include landscaping on the east side of Lot 6 , Block A. The landscape plan must be submitted for review and approval prior to completion of the substation construction. This agreement will be recorded at the Register of Deeds and recording information will be noted on the face of both the SUP and the Preliminary Plat.

The substation is defined as a Minor Utility in Section 20-1765 of the Development Code:

## 20-1 765 UTILI TI ES, MINOR

Public utilities that have a local impact on surrounding properties. Typical uses include electrical and gas distribution substations, lift stations, telephone switching boxes, and water towers. Excludes "Wireless Telecommunication Facilities" use types.

## SI TE SUMMARY

|  | Existing | Proposed | Change |
| ---: | :---: | :---: | :---: |
| Property Area (sq ft): | $140,007.50 \mathrm{SF}$ | $140,007.50 \mathrm{SF}$ | - |
| Total Impervious Area (sq ft): | 0 | 0 | - |
| Total Pervious Area (sq ft): | $140,007.50 \mathrm{SF}$ | $140,007.50 \mathrm{SF}$ | - |

## Site Plan Review

This site is being platted as Tract D with the former Farmland Industries plat. The site plan shows the proposed location of the substation with the equipment pad, fence and a $3: 1$ slope around the perimeter to drain the pad to the south and east. A $350^{\prime}$ long gravel drive will be constructed through Tract $C$ from the main east-west business park street. Due to the infrequent usage and length of the drive through the mainly grassy Tract C, the Planning Director has waived the paving requirements of Section 20-913(e) for this access drive. The City Stormwater Engineer has indicated that the reduced impervious surface results in less drainage impact in the immediate area. The City Commission approval of the Special Use Permit will confirm this Development Code waiver.

## Review and Decision-Making Criteria (20-1306(i))

## 1. WHETHER THE PROPOSED USE COMPLIES WITH ALL APPLICABLE PROVI SI ONS OF THIS DEVELOPMENT CODE

The proposed use, a Minor Utility which provides service to a large portion of the community, is an allowed use in the proposed IM (Medium Industrial) District subject to Special Use Permit approval.

A minimum of one off-street parking space is required for Minor Utilities. The site will be accessed by utility trucks for routine maintenance and there will be no employees on site. The substation is also designed with $20^{\prime}$ wide double-swing gates which allow utility trucks to access the equipment pad, as needed. The length of the access drive provides plenty of space for vehicles in the event there is a need for multiple vehicles or equipment on-site at the same time.

A photometric plan has been submitted and approved for the perimeter lighting fixtures proposed.

The setbacks in the IM District are front - 25 ' and interior side and rear adjacent to nonresidential $-15^{\prime}$. All equipment is located at least 15 ' inside of the Tract D boundaries. The 'front' of the Tract is technically Tract C which extends more than 350' south to the east-west street frontage. The maximum height in the IM District is $45^{\prime}$. Site sections provided indicate that all of the equipment except for transmission poles will be less than $30^{\prime}$ tall. Power poles and similar utility structures are excluded from the maximum height limitations in Section 20-602 of the Development Code.

The location of the access drive does not meet the separation requirements from the intersection with the new north-south street located between Tracts A \& B. Section 20-915(e)(2)(iii) requires 250 ' between a driveway and a collector street intersection. The location is restricted due to the numerous Westar easements and transmission pole placement. The City Engineer has waived this separation requirement due to the low volume use of this driveway as provided by Section 20-915(e)(3).

Staff Finding - With the approved administrative waivers, and as conditioned, the site plan complies with the requirements set out in the Development Code.

## 2. WHETHER THE PROPOSED USE IS COMPATIBLE WITH ADJ ACENT USES IN TERMS OF SCALE, SITE DESIGN, AND OPERATING CHARACTERISTICS, I NCLUDI NG HOURS OF OPERATION, TRAFFIC GENERATION, LIGHTI NG, NOI SE, ODOR, DUST AND OTHER EXTERNAL I MPACTS

The proposed substation will have less of a visual impact from K -10 than the existing substation due to its relocation a quarter mile north of the highway frontage. The equipment will be updated and surrounded by substantial greenspace and landscape screening. Per the City/Westar agreement, the City will maintain the landscaping around the perimeter of Tract D. The ample greenspace provided by the easements in Tract C provide the opportunity to minimize the visual impact the equipment will have within the business park. Exterior lighting is intended only when maintenance work is necessary during evening or night hours. Security lighting is intended to be minimal.

The only traffic to the substation will be for maintenance on the facility. There will be no increase in traffic, and perhaps less traffic as a result of the mechanical improvements, from that with the existing substation.

Updated equipment installation provides an added amenity in marketing the business park.
Staff Finding - The proposed relocated substation will be compatible with adjacent uses.

## 3. WHETHER THE PROPOSED USE WILL CAUSE SUBSTANTIAL DIMINUTION IN VALUE OF OTHER PROPERTY IN THE NEI GHBORHOOD IN WHICH IT IS TO BE LOCATED

The existing substation has been in place for over 50 years. The proposal to update equipment and relocate the substation farther north into the business park provides an opportunity to create a landscaped entrance to the park with a new signalized intersection. This will enhance the value of the proposed business park and provide enhanced service to portions of the surrounding community.

Staff Finding - The relocation of the substation is anticipated to enhance the value of the proposed business park and will not result in any diminution of value of other property in the area.

## 4. WHETHER PUBLIC SAFETY, TRANSPORTATION AND UTLITY FACILITIES AND SERVICES WILL BE AVAILABLE TO SERVE THE SUBJECT PROPERTY WHILE MAINTAINING SUFFICIENT LEVELS OF SERVICE FOR EXISTING DEVELOPMENT

The electrical substation is a public utility intended to serve the surrounding area. The proposed improvements within the proposed plat for the former Farmland Industries property will provide adequate access to the property and additional easements necessary to serve the new improvements. The driveway located on Tract $C$ will provide adequate access for the limited traffic anticipated for the maintenance of the facility.

Staff Finding - The proposed use, a Minor Utility, is a public service which would serve the surrounding area. Sufficient safety, transportation and utility facilities will be available to serve the subject property.

## 5. WHETHER ADEQUATE ASSURANCES OF CONTINUING MAI NTENANCE HAVE BEEN PROVIDED

Staff Finding - The site plan will function as the enforcement document to assure that maintenance and use of the property is consistent with the approval. In addition, the recorded City/Westar agreement spells out responsibilities during construction and landscaping responsibilities for the perimeter areas.

## 6. WHETHER THE USE WILL CAUSE SIGNIFICANT ADVERSE IMPACTS ON THE NATURAL ENVI RONMENT

Adequate oversight will be provided for the protection of the natural environment through the state regulatory oversight Westar facilities require and the City's ownership control of the surrounding portions of the business park site.

Staff Finding - The proposed use, with the protection measures required by State and Local governments, should not cause significant adverse impacts on the natural environment.

## 7. WHETHER IT IS APPROPPRIATE TO PLACE A TIME LIMIT ON THE PERIOD OF TIME THE PROPOSED USE IS TO BE ALLOWED BY SPECI AL USE PERMIT AND, IF SO WHAT THAT TIME PERIOD SHOULD BE.

Time limits are established on Special Use Permits to permit a periodic review to determine if the use remains compliant with the area or if a rezoning would be appropriate. An electrical substation is part of necessary infrastructure whose life span will be determined by demand and operational characteristics. It would not be appropriate to place a time limit on this use.

Staff Finding - The project provides necessary infrastructure for surrounding developments; therefore, it would not be appropriate to place a time limit on this use.

## Conclusion

The proposed substation will have a positive impact on the area by improving electrical services in the area and to maintain a high level of service. The relocation permits the development of a safe, new signalized entrance to the proposed business park and the ability to create greenway amenities at the entrance. The use is compatible with, and appropriate for, this location and staff recommends approval of the Special Use Permit with the condition noted.
LEGAL DESCRIPTION FOR SUBSTATION AREA





general notes

2. Curber ver vacan lot Ano ditivion pono
topographic negramton provioe by bartlet \& west, nc.

5. Lohting shall be locateo approxmarely $3^{\prime}$ nside fence line. refer to westar flooo logr detall


 SITE PLAN NOTES:







GRADING \& EROSION CONTROL PLAN NOTES: (NOTE: FG INDICATES FINISH GRADE)

(6) Slopes Shall tie in to existing ground at $3: 1$ slopes maxmum where shown
(8) TEMOORARY EROSON ANO SEDMENT CONTROL MEASURES NSTALED AS PART OEFHIS PAN SHAL NOT BE


(c)

PROJECT CONTROL

: 2436650.12 .12





| SITE SUMMARY |  |
| :---: | :---: |
| ExIITTING SITE SUMMARY |  |
|  |  |
| Torah Meperucs |  |
| $\overline{\text { Total Ara: }}$ | 140.007 .50 S.F. (3.21 AC.) |
| new site summary |  |
|  |  |
|  |  |
| Total Properiv Area. | 140,007.50 S.F. (3.2 A A.) |
|  | 1 |
|  | - |
|  |  |
|  | SITE PLAN |
|  | $\stackrel{0}{\circ}$ |




# Memorandum City of Lawrence Planning \& Development Services 

TO: David L. Corliss, City Manager<br>FROM: Scott McCullough, Director<br>Date: August 13, 2012<br>RE: Code Review and Text Amendment I nitiation

This memo seeks initiation of city code amendments to ensure business-friendly, responsive, and efficient processes for development. Initiation does not adopt any code changes, but does begin the process for review by staff, the Planning Commission and the public for eventual consideration by the City Commission.

The code is constantly under review and revision. Most notably, PDS made significant changes to the Land Development Code in 2009 to reduce the amount of process for minor development projects and infill projects that were not intensifying use. These changes employed input from several stakeholders including the Chamber of Commerce, individual consultants, LAN, and professional staff.

More recently, utility standards were revised to streamline variance procedures, a reciprocal licensing agreement was reached between the city and Johnson County to the benefit of contractors, and streamlining the sidewalk dining hearing procedures are in process.

In order to continue to seek improvements to enable and encourage development while ensuring that such development continues to enhance neighborhoods, staff has reviewed the standards and processes of certain sections of the City Code and provides these recommendations for revisions with the goal of continually improving the development process.

| Code Standard or <br> Processing I ssue | Discussion of Standard or Process | Status |
| :--- | :--- | :--- |
| 1. Review | A photometric plan is a study of the light | Proposed - requires City <br> requirement for <br> Photometric Plan <br> for all but |
| Outdoor <br> Recreation <br> Lighting | properties from any outside light source on <br> projects that require site planning. The study <br> conveys evidence that the maximum light | revisions to the Land of <br> levelopment Code. <br> levels of the code are not exceeded. The study |
|  | can be time consuming and costly for an <br> applicant. The value of the study could be |  |


|  | maintained by prescribing a level of code <br> standards for outdoor lighting in lieu of the <br> study. For example, standards related to the <br> height of parking lot poles, bulb wattage, <br> setback from property line, etc. can ensure <br> low light impact to adjacent neighbors while <br> lessening the burden on applicants. |  |
| :--- | :--- | :--- |
| 2. Review the <br> requirement for a <br> Retail Market <br> Study to be <br> submitted with <br> zoning and site <br> plan applications | The code requires that a retail market study <br> be submitted for any proposal that includes <br> 50,000 square feet of retail uses. This is <br> intended to ensure a healthy retail market as <br> development occurs in the city. Planning Staff <br> maintains a bi-annual retail market study that <br> provides valuable information about the <br> overall health of the retail market. While <br> specific market studies can provide important <br> information about a project's potential impact <br> on the market as well, the requirement to <br> provide a study in addition to the one <br> completed by staff is viewed by some as costly <br> and time consuming when a prudent analysis <br> of any proposal can be made with the <br> information contained in staff's study. | Proposed - requires City <br> Commission initiation of <br> revisions to Horizon 2020 <br> and the Land <br> Development Code. |
| 3. Review the |  |  |
| requirement that |  |  |
| development |  |  |
| projects be |  |  |
| required to |  |  |
| comply with |  |  |
| Horizon 2020 |  |  |$\quad$| For rezoning applications, the Development |
| :--- |
| Code requires compliance with Horizon 2020, |
| yet the state statutes and case law views the |
| comprehensive plan as a guide document. |
| Removing the requirement for comprehensive |
| plan compliance for rezoning requests would |
| streamline the application process while |
| maintaining the integrity of the adopted plans |
| as one of the Golden Factors by which to |
| analyze a request. |$\quad$| Proposed - requires City |
| :--- |
| Commission initiation of |
| revisions to the Land |
| Development Code. |


|  | mechanism to grant the variance for minor <br> subdivisions - City Engineer approval, for <br> example. |  |
| :--- | :--- | :--- |
| 6. Review the Master |  |  |
| Street Tree Plan <br> process | The Master Street Tree Program ensures that <br> street trees are planted with any new <br> subdivision. Replatting through the minor <br> subdivision process can alter the number of <br> trees assigned to individual lots, thus requiring <br> revisions to the street tree plan. Staff believes <br> efficiencies in process can occur with a review <br> of the program. | Proposed - requires City <br> Commission initiation of <br> revisions to the <br> Subdivision Regulations. |
| 7. Review the notice <br> for easement and <br> right-of-way <br> dedication and <br> vacation on minor <br> subdivisions | Dedicating and/or vacating easements and <br> rights-of-way can be accomplished with the <br> minor subdivision process with a 20-day notice <br> period to surrounding property owners prior to <br> City Commission consideration. Staff believes <br> efficiencies can be made in the notice <br> requirement that would maintain notice to <br> surrounding property owners, but that could <br> reduce the overall time required to submit the <br> application to the City Commission. | Proposed - requires City <br> Commission initiation of <br> revisions to the <br> Subdivision Regulations. |

## Action Requested:

Initiate the recommended text amendments noted above to the various sections of the City Code.

SEP 242012
City County Planrsing office Lawrence, Kansas

President
Melinda Henderson

President-Elect David Burress

Vice President Milton Scott

Secretary
Caleb Morse

Treasurer Marjorie Cole

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Sally Hayden

Cille King

Ruth Lichtwardt

September 24, 2012

Lawrence/Douglas County Planning Commission
City Hall
Lawrence KS 66044

RE: MISC NO. 1 TEXT AMENDMENT INITIATION

Dear Chairman Liese and Commissioners:

Attached, for your review, is a copy of a letter we sent to the City Commission on August 19, 2012. This letter addressed the initiation of several text amendments which are on your agenda this month as Miscellaneous Item 1.

In our letter to the City Commission, we addressed concerns about two specific amendments (Revisions \#2 and \#3), which we discuss in detail in the attached letter. While our preference would be for you to not initiate these two particular amendments, should you go ahead and do so, we look forward to providing input about them as they move through the review process.

Thank you for your work serving the city and the county as Planning Commissioners.
Yours truly,

Melinda Henderson, President
League of Women Voters of Lawrence/Douglas County


Marlene Merrill

[^6]League of Women Voters of Lawrence-Douglas County
P.O. Box 1072, Lawrence, Kansas 66044

August 19, 2012
4 202012
Mr. Bob Schumm, Mayor
Lawrence City Commissioners
City Hall
Lawrence, KS 66044

## RE. CONSENT AGENDA NO. 9, CODE REVIEW AND TEXT AMENDMENT INITIATION

Dear Mayor Schumm and City Commissioners:
On behalf of public concern, the League asks that Item No. 9 be removed from the Consent Agenda and opened for discussion.

This Memorandum is asking the City to initiate seven Land Development Code and Horizon 2020 changes that would radically change our land use planning system in Lawrence. All of the proposals in the Memorandum need to be carefully scrutinized and we ask that you not initiate any of them. Below we have discussed the two proposals that are of most concern to us.
A. Text revision No. 3: "Review the requirement that development projects be required to comply with Horizon 2020."

The language further explains, "Removing the requirement for comprehensive plan compliance for rezoning requests would streamline the application process..." This proposal would remove the essential purpose of the comprehensive plan: to be able to plan ahead. It is the means by which through its goals, policies and specific area plans, plus the plans which are also a part of it such as the Transportation Plan, it creates the framework that allows everything in the city to connect appropriately and function properly. Our Land Development Code states as follows:

> "20-104 PURPOSE This Development Code is intended to implement the Lawrence/Douglas County Comprehensive Land Use Plan and other applicable plans adopted by the City Commission, hereinafter collectively referred to as the "Comprehensive Plan" - in a manner that protects, enhances and promotes the health, safety, and general welfare of the citizens of Lawrence."

Removing the mandatory compliance with Horizon 2020 of zoning applications would eliminate the policies that determine where and when rezoning is appropriate and valid and would create an arbitrary approach to zoning. It would allow zoning decisions to be determined on the basis of opinions rather than facts. It would eliminate the predictability essential for private and public economic and functional decisions.
B. Text Revision No. 2. "Review the requirement for a Retail Market Study to be submitted with zoning and site plan applications." [Note added: This specifically applies to the 50,000 square foot provision for retail uses.]

Removing this requirement would essentially remove the standard that would trigger a market analysis. These market analyses are important for new business investors as well as for existing business owners who rely on population demand to maintain viable businesses. These are essential tools for our community to maintain a healthy business environment. Predictability is critical in maintaining a well-functioning business environment,

There are other reasons for not changing any of the Comprehensive Plan and Land Development Code provisions as proposed in this Item No. 9, and we ask again that you not initiate any of these text amendments.


Vice President


Alan Black, Chairman
Land Use Committee


[^0]:    ${ }^{2}$ Minimum right-turn design hour volumes (vph) required to warrant right-turn treatments.

[^1]:    CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and $w$ completed on (mo/day/year) . . . . . . . 9/0.6/96. Water Well Contractor's License No. . . . . . . 18.2 . under the business name of STRADER DRIILING CO., INC. and this record is true to the best of my knowledge and belief. Kans
    

[^2]:    INSTRUCTIONS: Use typewriter or ball point pen. PLEASE PRESS FIRMLY and PRINT clearly. Please fill in blanks, underline or circle the correct answers. Send top three copies to Kansas Department of Health and

[^3]:    INSTRUCTIONS: Please fill in blanks and circle the correct answers. Send three copies to Kansas Department of Health and $\quad$ nvy forment, Burepu of Wated. 1000 S W Jackson St, Ste. 420, Topeka, Kansas 86812-1387. Telephone: 813-296-5545. Send one to WATER WELL OWNER and rellain ohe for your records.

[^4]:    "The concentration distributions of pesticides and organics other than pesticides at the four pit sites in northwest Wichita, as well as the general pattern in iron, manganese, and ammonium ion concentrations in the downgradient well waters relative to the upgradient well and pit waters, indicate that surface water in the sand pits flows into the ground water in the southeast to south-southeast

[^5]:    ${ }^{\text {a }}$ Senior Scientist, Kansas Geological Survey, 1930 Constant Avenue, Lawrence, Kansas 66047.

    Received February 1990, revised August 1990 and January 1991, accepted September 1990.

    Discussion open until January 1, 1992.

[^6]:    Leage of Women Voters of Lawrence/Douglas County

