Water-Quality Effects of Stormwater Runoff into Sand Pits on Ground Water in Sedgwick County, Kansas:

Phase II
Kingston Cove and Pine Bay Pits and Comparison with Phase I Results

A report for
the Groundwater Quality Task Force, including
Equus Beds Groundwater Management District #2
Wichita Area Builders Association
Kansas Department of Agriculture, Division of Water Resources
Kansas Department of Health and Environment
and Sedgwick County

Don Whittemore

KU KANSAS GEOLOGICAL SURVEY
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PURPOSE OF STUDY

Senate Bill 364 passed in 2004

- Amended water-appropriation laws for sand and gravel pits
- Introduced new section including studies and recommendations related to pollution control and flood control impacts of diverting water runoff into sand and gravel pits
- Parts of bill were related to Groundwater Quality Task Force formed in December 2002 by Equus Beds Groundwater Management District No. 2 and representatives of Wichita Area Builders Association to address issues regarding use of sand pits for stormwater flow management

ACKNOWLEDGMENTS

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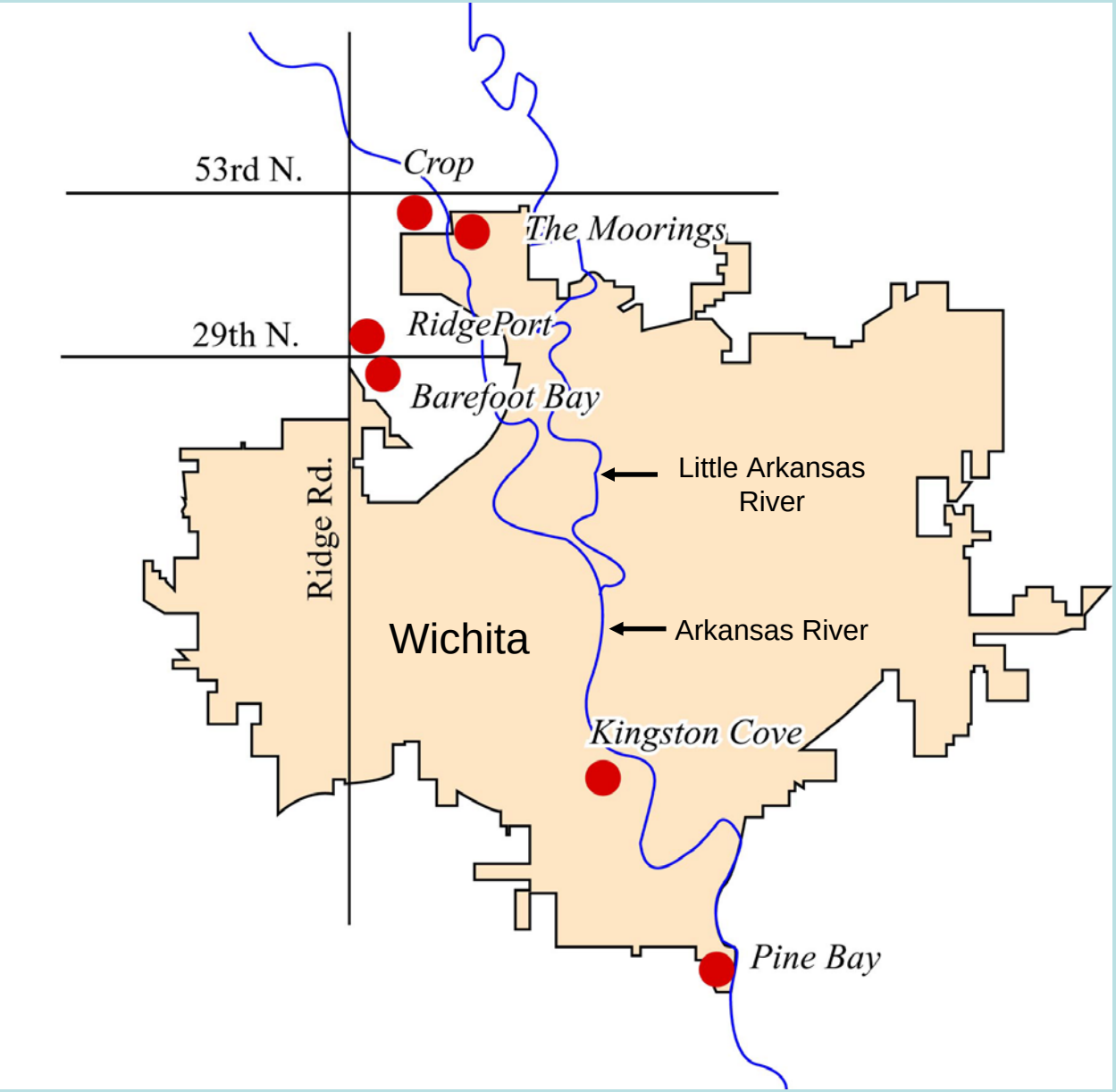
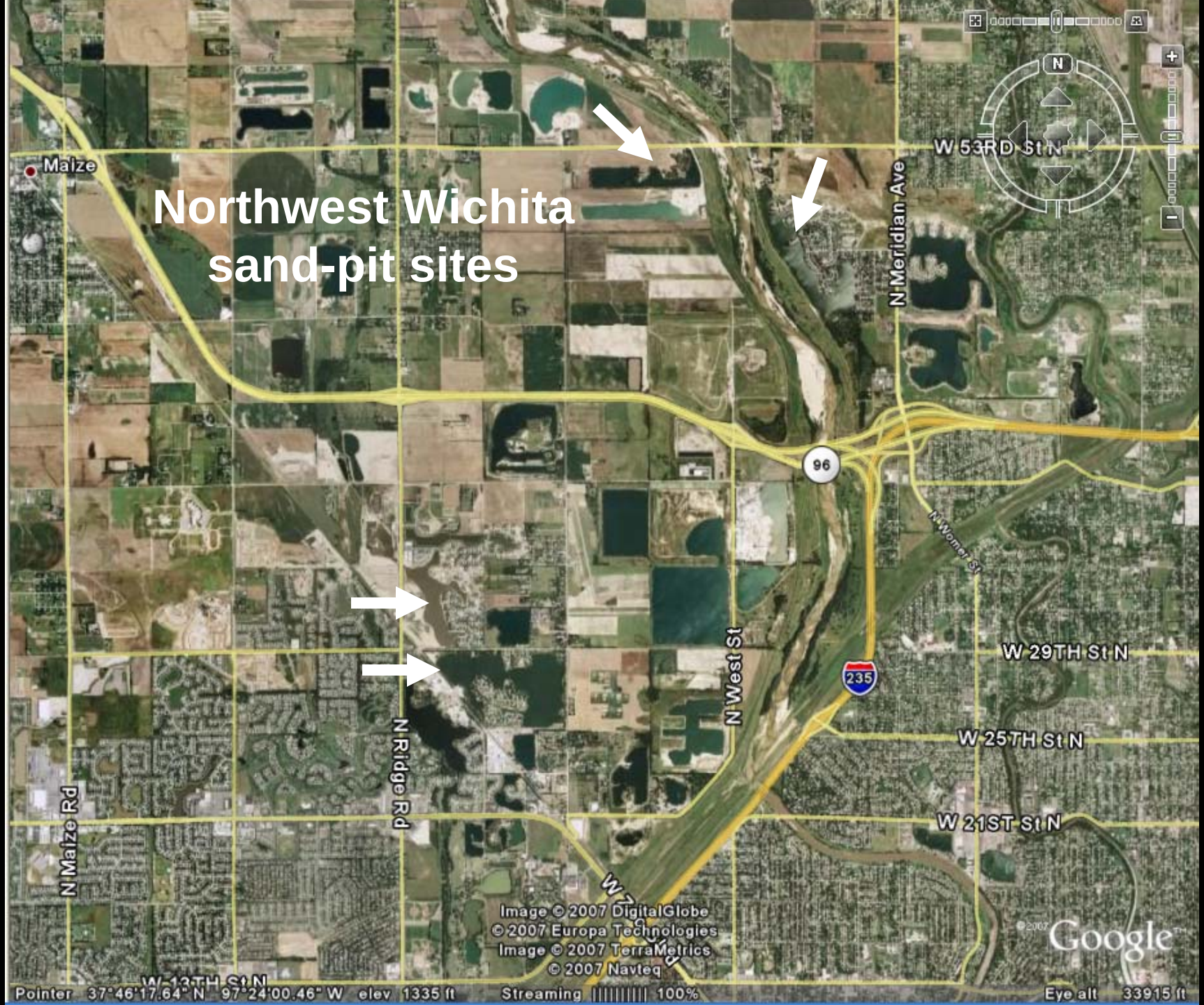
- Donald Carlson, Kansas Department of Health and Environment
- Michael Dealy, formerly Equus Beds GMD No. 2 (now KGS)
- David Warren and Brian Fisher, the City of Wichita
- Wess Gaylon, Wichita Area Builders Association
- John Gage and Mike McNamee, U.S. Bureau of Reclamation
- Andrew Ziegler and Larry M. Pope, U.S. Geological Survey
- Debra Baker, Kansas Water Office
- Rex Buchanan and Lawrence Skelton, Kansas Geological Survey
- Senator Carolyn McGinn, Chairperson, Natural Resources Committee

USBR provided drilling and well installation as a service. KDHE, KWO, Sedgwick County, KDA, GMD2, WABA, and the City of Wichita provided funds for phase I, KDHE for phase II, and the USGS included cost share, for sampling and analysis of waters and sediment at the sand-pit sites by the USGS.

Location of the Six Sand and Gravel Pit Study Sites




Northwest Wichita
sand-pit sites
Maize
W 53RD St N
N Meridian Ave
96
N Women's St
N West St
W 29TH St N
235
W 25TH St N
W 21ST St N
N Ridge Rd
N Maize Rd
W 13TH St N
Image © 2007 DigitalGlobe
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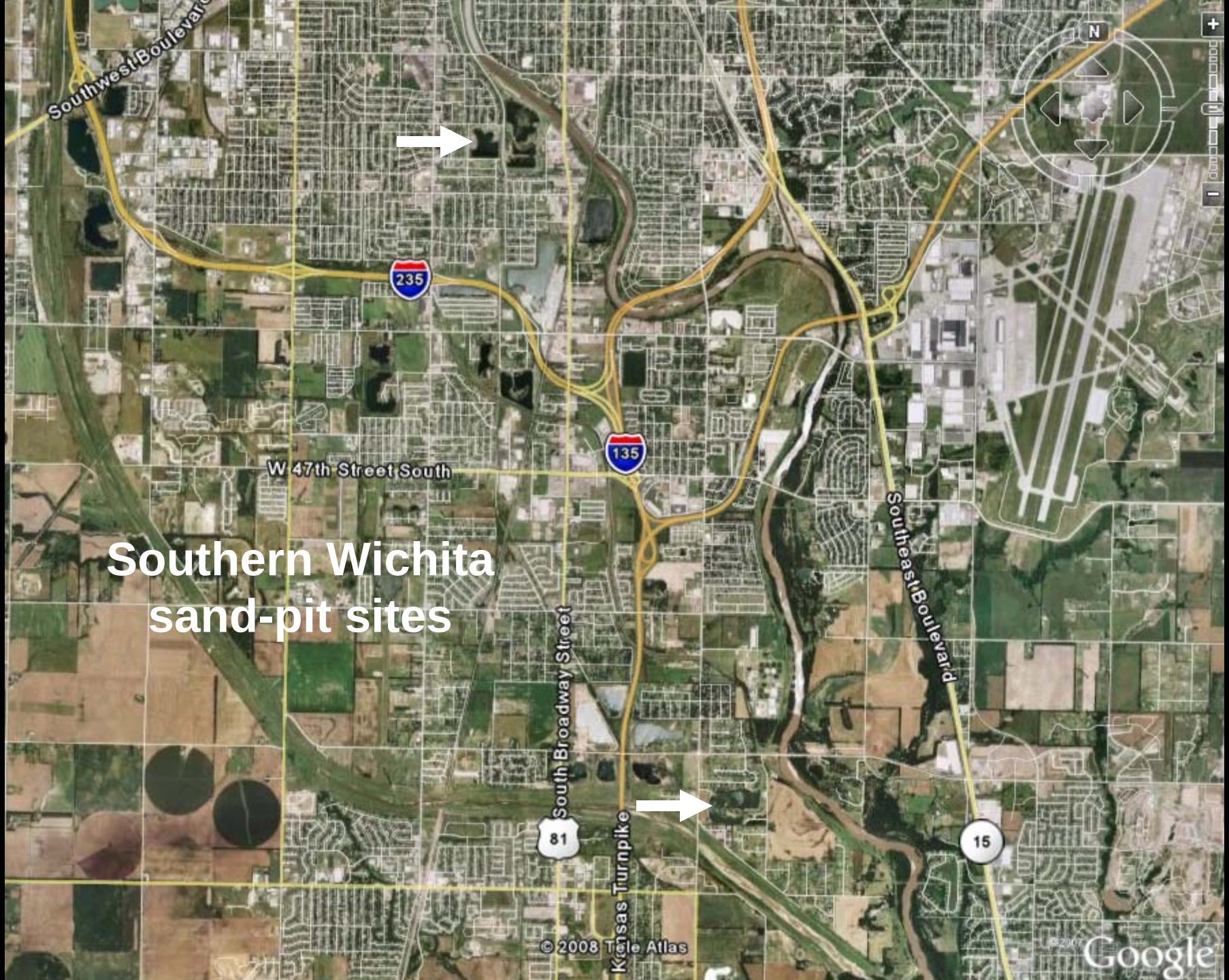
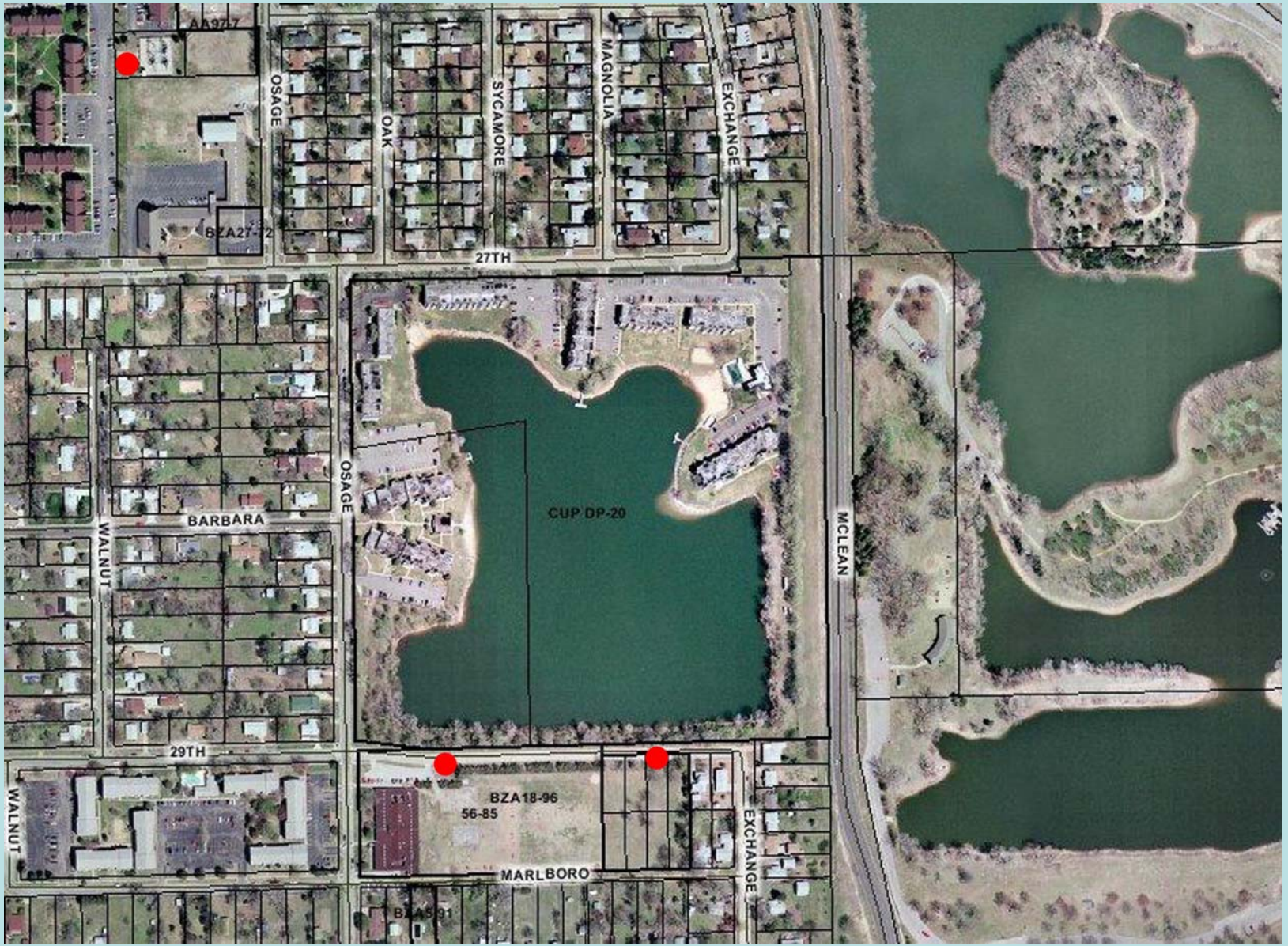
Google
Pointer 37°46'17.64" N 97°24'00.46" W elev 1335 ft
Streaming 100%
Eye alt 33915 ft



Southern Wichita sand-pit sites

CHARACTERISTICS OF STUDY SITES

Name of pit	Type of area	Age of pit	Age of develop-ment	Water area, acres	Greatest depth, ft
Barefoot Bay	New residential	Active in 1974	1991 to 2004	113	30
Ridge Port	New residential	Cropland in 1997	1991 to present	87	6.7
The Moorings	Old residential	Active in 1968	1978 to present	111	31
Cropland	Control site, in cropland	Active in 1968	-	42	32
Kingston Cove	Apartments, commercial	Active in 1960	1968 to 1974	18	19
Pine Bay Estates	New residential, septic systems, golf course	Active in 1968	1986 to 2002	32	14



Kingston Cove Sand Pit and Location of Three Monitoring wells

Pine Bay Sand Pit and Location of Three Monitoring wells

USGS SAMPLING AND ANALYSES

Types of Samples

Surface water from the sand pits
Ground water from the monitoring wells
Sediment from the bottom of the pits

Types of Water Analyses

18 physical and chemical properties
5 bacteriological values
40 inorganic constituents
118 pesticide and degradate compounds
134 organic compounds other than pesticides

Types of Sediment Analyses

5 physical and chemical properties
45 inorganic constituents
32 organic compounds

CHARACTERISTICS OF CHEMICAL RESULTS RELATIVE TO DRINKING-WATER STANDARDS - INORGANICS

Total dissolved solids and major constituents

- Total dissolved solids – exceeded secondary standard in all pit and well waters at all six sites – primarily natural salinity source
- Chloride – exceeded secondary standard in all pits and most well waters of northwest Wichita sites

Dissolved trace constituents

- Iron – exceeded secondary standard in a downgradient well water at Ridge Port and in upgradient wells at Kingston Cove and Pine Bay
- Manganese – exceeded secondary standard in a few pit waters and most ground waters at northwest Wichita sites, and in all well waters at southern Wichita sites
- Arsenic – same as primary standard in same downgradient well at Ridge Port with high iron; slightly exceeded standard in one downgradient well at Kingston Cove; well waters with higher iron and manganese generally contained greater arsenic

CHARACTERISTICS OF CHEMICAL RESULTS FOR PIT SITES - BACTERIA

- Surface waters in pits – levels less than maximum desired for contact recreation except for one sample from Ridge Port pit; Ridge Port and Barefoot Bay pits are part of classified stream segment because they receive drainage from Big Slough
- All monitoring well samples – detectable or measurable coliform bacteria
- In general, levels of bacterial parameters were lower in monitoring well waters than in pit waters at all sites.

CHARACTERISTICS OF CHEMICAL RESULTS RELATIVE TO DRINKING-WATER STANDARDS - PESTICIDES

- Concentrations of all pesticides observed were present at levels substantially below primary standards and health advisories. Detection of alachlor in Ridge Port and Barefoot Bay pit water was above MCLG of zero.
- Most commonly detected pesticides of interest relative to drinking water were herbicides: atrazine and two of its degradates, and metolachlor and simazine.
- A greater number and generally greater concentrations of pesticides were present in the waters at the northwest Wichita sites (20 compounds) than at the southern Wichita sites (nine compounds).
- Concentrations of pesticides and degradates were usually higher in pit surface waters than in monitoring well waters.
- Concentrations of pesticides and degradates were usually higher in downgradient well waters than in upgradient well waters, and were usually highest in the southeast well (general direction of ground-water flow).

CHARACTERISTICS OF CHEMICAL RESULTS RELATIVE TO DRINKING-WATER STANDARDS – OTHER ORGANICS

- Six different organic compounds other than pesticides were found in surface waters and 19 different compounds were detected in well waters at the six pit sites; concentrations for all except four were substantially below primary standards and health advisories. Pentachlorophenol detected in one sample at Moorings pit was below MCL but above MCLG of zero.
- Compounds detected in surface waters were generally different from those detected in ground waters.
- Ground waters at Kingston Cove in southern Wichita contained many volatile organic compounds (VOCs); concentrations of three (chlorinated ethenes) exceeded primary standards and the presence of five others (chlorinated hydrocarbons and benzene) exceeded MCLG of zero. None of these VOCs were detected at the other five sites. The source is probably surface infiltration to the ground water outside the immediate pit area.

CHARACTERISTICS OF CHEMICAL RESULTS FOR SEDIMENT

- General chemical character of sediment at the five residential pits was similar. Cropland pit sediment had lower carbon, nitrogen, and sulfur contents.
- Highest cadmium, copper, lead, mercury, and zinc concentrations occurred at Kingston Cove. Highest arsenic, chromium, and nickel concentrations occurred at Cropland pit; the difference may be related to dilution of natural sediment by particulates with higher organic content at the residential pits.
- Sediments at the six pits did not have metals contents that exceeded guidelines for *probable* toxic effects on freshwater ecosystems. However, maximum arsenic, cadmium, chromium, copper, lead, nickel, and zinc observed in some sediments exceeded screening levels for *threshold* or *possible* toxic effects for ecosystems.
- The pesticide chlordane was detected in sediment at Barefoot Bay. The pesticide DDT, its degradates (DDE and DDD), and polychlorinated biphenyls (PCBs) were found in sediment at Kingston Cove at levels exceeding guidelines for *threshold* toxic effects for ecosystems.

SUMMARY AND CONCLUSIONS

- No inorganic constituents in waters, except arsenic in one well water, were found at levels hazardous to human health.
- Many pesticides were found in surface and ground waters, but none at concentrations hazardous to human health.
- Many organic compounds other than pesticides were found in surface and ground waters, but none at concentrations hazardous to human health except VOCs that exceeded MCLs and MCLGs in Kingston Cove ground waters.
- Selected metals in sediments at all pits exceeded threshold toxic effects for ecosystems; DDT and PCBs exceeded threshold toxic effects for ecosystems at Kingston Cove.
- Concentration distributions of pesticides, other organics, and selected inorganics in the pit and well waters indicate that surface water in the pits enters the ground water in the ground-water flow direction. This would occur when surface runoff into the pits increases the water level above that of the ground water. Thus, stormwater runoff containing contaminants can enter ground water through the sand pits and impact ground-water quality.

FUTURE STUDY AND RECOMMENDATIONS

- Sedgwick County may collect and analyze additional samples from the sand-pit sites. Sampling recommendations include:

  Sample Big Slough stormflow entering Ridge Port pit and surface water at southern end of this pit to determine difference in runoff from watershed including agricultural use versus local residential runoff.

  Focus on analyses of pesticides and organic compounds other than pesticides that were detected at sand-pit study sites.

  Focus on collecting more frequent samples for atrazine, metolachlor, and simazine content during different seasons and runoff conditions.

- Discovery of VOCs in ground waters around Kingston Cove at levels exceeding primary drinking-water standards suggests that the locations of known or unknown contamination plumes may need additional investigation.

The Phase I and II reports are on the KGS web site

http://www.kgs.ku.edu

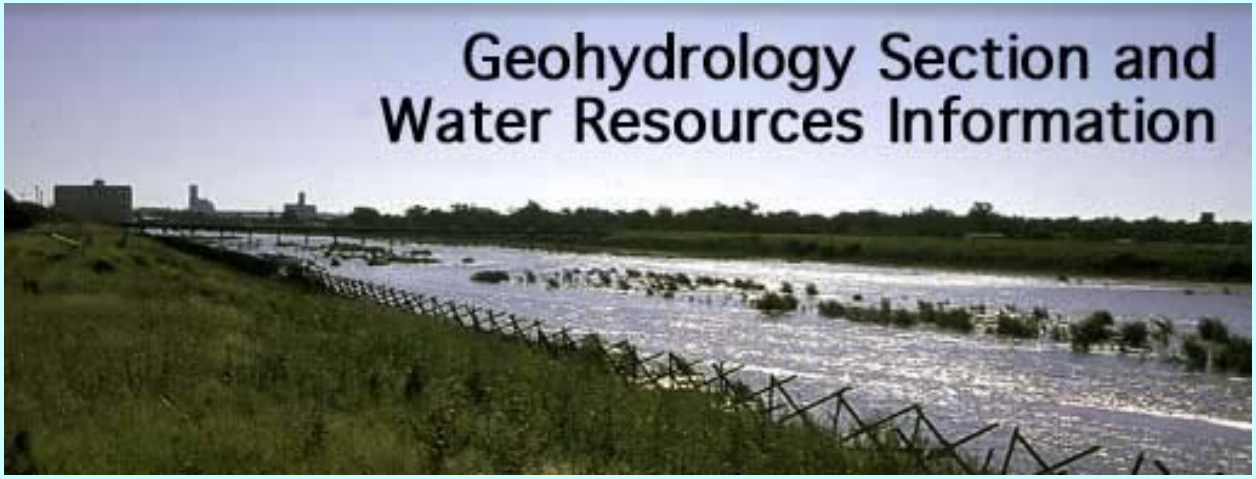
Click on Water, then click on

Other projects, aquifers

and then on

Water-quality Effects of Stormwater Runoff into Sand Pits

The full data set is also available as a spreadsheet on this web site.



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