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Chapter 1 : WEC/UW Effects of Canals and Levees on Everglades Ecosystems: Circular

DRAINAGE MODIFICATIONS IN SOUTHEASTERN OHIO AND ADJACENT PARTS OF WEST VIRGINIA AND KENTUCKY. By W. G. TIGHT. INTRODUCTION. The field work upon which this paper is based was carried on intermittently for.

This document was prepared by the staff of the California Coastal Commission to discuss techniques which may eliminate or reduce the adverse effects of grading along the California coast. This report has not been approved by the Commission. Unfortunately, grading often results in negative alteration of the environment. Visual degradation caused by grading is often dramatic in mountainous areas and along coastal bluffs where flat areas have been created by grading. Grading may also disturb the natural habitats of plants and animals in areas on or near a project where grading occurs. The large areas of exposed earth at sites where grading has occurred can lead to increased erosion and siltation, as well as shifts in depositional areas. Changes in sedimentation rates and patterns can result in contamination of surface and groundwater systems, which in turn may result in lower quality of public drinking water as well as pose a threat to the stability of an environmentally sensitive habitat. Although some grading is required for most construction projects, the California Coastal Commission is concerned about unnecessary or excessive grading and its effects on the coastal environment. Various designs and construction techniques exist to lessen the extent and effects of grading. Figure 1 illustrates the key steps in project planning and development where grading can be reduced. Even with carefully planned development, most sites will require some grading. Engineered structures used often in conjunction with drainage controls may be used to stabilize slopes and allow construction with minimal grading. The method of stabilization is chosen based upon evaluation of the type of hazard involved, magnitude of the problem, potential triggering mechanisms, threat to life and cost. The primary focus of this paper is on the various engineering techniques to stabilize a site with minimal landform alteration. This discussion is not intended to replace professional site inspections or designs by engineering geologists and civil engineers. The techniques discussed here should be considered only after all planning and design options have been exhausted. It also must be recognized the some hazards cannot be mitigated sufficiently to make a site safe for development because the environmental or engineering costs of the mitigation are too high, or, in some cases, because no solution currently exists. Furthermore, not every site can support the same scale and intensity of development, so even if a site is developable, it might not be suitable for a specific project. The issues of land use and site planning will not be discussed in this paper; however, these issues have a very direct and obvious impact on grading and the level of landform alteration required for project development. However, many locations have one or more development constraints and even with the most innovative site designs, some slope modifications will often be required and engineered structures may be needed to make a site suitable for development. There are many engineering techniques to solve stability problems, all of which require varying degrees of natural terrain alteration. The method of stabilization is chosen based upon evaluation of the type of hazard involved, magnitude of the problem, potential triggering mechanisms, threat to life and property, and cost. Effective stabilization methods should only be determined after an evaluation of geologic and hydrologic conditions is completed by a certified engineering geologist and a registered professional engineer. Slope alteration as a method of stabilization commonly involves variations of the cut and fill technique. The most common technique used to stabilize slopes is a buttress fill Figure 2. Buttress fills are used to stabilize poorly consolidated or incompetent bedrock, and have been used frequently for the relatively weak sedimentary formations in southern California. A typical compacted fill buttress is constructed by removing the outer face of a cut slope and replacing it with engineered, compacted fill. The buttress fill mass is designed specifically to retain the slope behind it, usually with a factor of safety of at least 1. Such a buttress is "keyed" into competent underlying materials to provide adequate support. Key widths along the toe of slope typically range between 15 and feet. Buttress fill slopes are generally constructed with a finished grade of 2: Rather, the fill is constructed along a slope face to mitigate surficial slope failures, such as ravelling, erosion and rockfalls. The base width of stabilization fills is commonly half the height of the slope. Buttress fills involve large amounts of grading and disturb large areas during construction. Earth removal and, the sharp, unnatural lines of a finished buttress slope are apparent when compared to the irregular contours of more natural landforms. Contour grading can be used to reduce the visual impacts of the graded areas by designing the finished slope face to more closely conform to natural contours. Contour grading does not reduce the quantity of grading, but can create rounded or undulating landforms designed to resemble the unaltered slopes on and adjacent to the construction site. The Department of Planning for the City of Los Angeles has prepared planning guidelines for contour or landform grading, which were adopted by the City Council City of Los Angeles, These guidelines are also used in some neighboring communities and in portions of Los Angeles County. Aside from aesthetic impacts, earth exposed during the construction of a buttress can cause accelerated erosion and siltation when drainage and soil retention methods are not utilized during grading. Sheetwash and gullying remove soil from exposed slopes as drainage patterns develop within the slope and along low-lying areas at the base of the slopes, resulting in extensive siltation at adjacent locations. However, utilization of proper erosion control methods e. Water control is generally maintained through installation of surface and subsurface drainage devices within and adjacent to potentially unstable slopes. Surface and subsurface drainage design must include consideration of the effects of surface runoff and groundwater migration on the stability and water quality of adjacent sites Powers, ; Gedney and Weber, In landslide areas drainage design is especially important because an influx of water from irrigation, disposal of sewage effluent or leaks from water storage devices can raise groundwater levels, increase pore-water pressure, and load slopes, thus causing an increase in failure potential Broms and Wong, Control of surface and groundwater flow is also important in minimizing erosion and siltation both on and off site. A properly designed drainage system should increase slope stability and decrease erosion and siltation. Drainage control is particularly important in bluff top stabilization along the coast. Bluff top stabilization is often best attained by designing final site contours that direct surface water away from the bluff to storm drains Kuhn, Designing a surface contour that directs water away from the bluff results in reduced infiltration and groundwater recharge in areas adjacent to the bluff, thus reducing the risk of bluff failure. Runoff and infiltration of water along a slope or over a bluff face can often be reduced by planting vegetation on top of the slope or bluff, as certain types of vegetation anchor soils, which in turn reduces erosion. A vegetative cover that does not require irrigation must be chosen because the infiltration of the water from irrigation can result in increased failure potential. However, vegetation is ineffective in stabilizing slopes where movement has already begun, so in many situations, vegetation cannot be used as the sole stabilization method. Surface drains are instrumental in controlling erosion of slopes and in drainage control adjacent to fill slopes. The most common surface drainage devices used in prevention of slope erosion and failure are terrace drains. Terrace drains are commonly 3 to 5 feet wide, 18 inch deep, V-shaped structures that are paved with 3 inches of reinforced concrete or gunite. A problem with terrace drains is that often they are left exposed, which degrades the aesthetics of a hillside. This can be minimized by concealing the structures with vegetation. Pipe drains buried at the surface can perform the same function as terrace drains, but are not advised because buried pipes often get plugged and drainage control is hindered. Terrace drains also get clogged by debris and drains are effective only if they are periodically cleaned and maintained. Surface water control on sites that are already developed may require construction of drains or repaving of areas such as parking lots or accessways to direct water away from slopes or a bluff. However, at many sites, construction or reconstruction of water control devices may not be possible without reducing the stability of the bluff face. In these situations, the only available drainage control may be to contain and redirect runoff over the face through channels or piping that extend to ocean at the toe of the slope. If conduits are used to divert runoff, they must be maintained regularly and replaced immediately should a leak develop. Subsurface Drainage Systems Stability of a slope generally increases with decreased seepage, pore-water pressure, and slope weight, all of which may be achieved with installation of subdrains Gedney and Weber, The main functions of subdrains are to remove subsurface water directly from an unstable slope, to redirect adjacent groundwater sources away from the subject property and to reduce hydrostatic pressures beneath and adjacent to engineered structures Scullin, Many slopes cannot be effectively dewatered and therefore, this technique cannot be applied everywhere. An important consideration in design of all drainage systems is short and long term maintenance. Over time drainage systems can clog; pipes can corrode or rupture, and other problems can arise which would prevent the system from functioning properly. Such problems can counter or diminish the beneficial effects of the drainage system, possibly leading to slope damage or failure, structural damage or the need for extensive remedial grading. The described drainage systems are generally installed along with other mitigation devices to increase slope stability. The methods outlined in this section require various amounts of grading, however, the included techniques generally result in less landform alteration than does cut and fill. The differences in grading and degree of landform alteration are generally reflected in the installation method and the size of a particular engineered mitigation device. This section includes descriptions of the effective applications, limitations, installation, and maintenance of various engineering devices. Ground Inclusions A ground inclusion is a metal bar that is driven or drilled into competent bedrock rock which is not highly fractured or broken up to a provide stable foundation for structures such as retaining walls and piles, or to hold together highly fractured or jointed rock. Ground inclusions can be used at times as alternatives to the foundation piles which are typically used to support structures within mountainous or steep areas. The size and thickness of a retention system can also be diminished by using a system stabilized with inclusions Juran and Elias, Elimination of deep foundations and a reduction in required size of a support structure make the use of inclusions an important method in reducing grading and minimizing visual impacts of a project. Three common types of ground inclusions are ground anchors, soil nails and rock bolts. Permanent ground anchors are tendons which are placed in competent rock or soil to control displacements and provide vertical and lateral support for engineered structures and natural slopes Juran and Elias, Anchors are frequently used in waterfront structures and to tie-back retaining walls to prevent failures due to rotational loading or failures due to buoyant forces of water. Soil nailing is a soil reinforcement technique that places closely spaced metal bars or rods into soil to increase the strength of the soil mass Broms and Wong, Figure 4. Soil nails are either installed in drilled bore holes and secured with grout, or they are driven into the ground. The soil nails are generally attached to concrete facing located at the surface of the structure. The function of the facing is to prevent erosion of the surface material surrounding the soil nails, rather than provide structural support Broms, This facing can be constructed to mimic the look of the surrounding landform and provide spaces for vegetation; however, the facing will not be the same as the existing top soil. Soil nailing is a method that can be used to control shallow landslides. In these situations, movement is controlled by inserting 15 to 30 mm bars in drilled holes, generally spaced 2 meters apart, which are then filled with grout. The bars must extend beyond the failure zone into stable rock, and are typically between 3 and 10 meters in length Broms and Wong, Rock bolting is a method of securing or strengthening closely jointed or highly fissured rocks in cut slopes by inserting and firmly anchoring a steel bar in predrilled holes that range in length from less than one meter to about 12 meters Bates and Jackson, Figure 5. Rock bolts generally have heads that expand following installation and are classified according to their method of anchorage: Like soil nails, these bolts generally are attached to some type of facing. Limitations and considerations for the use of ground inclusions are usually in the area of long term stability. Metal inclusions are generally protected from corrosion by a sealant or grout; however, in environments where there is frequent interaction with groundwater, breakdown of inclusions is accelerated. Also, the effects of creep on the structural integrity of a wall or other anchored systems must be considered in the design of a structure Juran and Elias, There are specific soil liquidity and plasticity limits that are not suitable for the use of anchors Cheney, Construction above the anchors may be limited, and excavation would undermine the stability of any anchors present Cheney, Piles Piles are long, relatively slender columns positioned vertically in the ground or at an angle battered used to transfer load to a more stable substratum.

Piles are often used to support or stabilize structures built in geologically unstable areas.

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Chapter 2 : Snake River - Wikipedia

-- Some observations on the preglacial drainage of Wayne and adjacent counties. By J.H. Todd. -- Preglacial drainage conditions in the vicinity of Cincinnati, Ohio.

Summary of Pleistocene Drainage Changes The present stream pattern of Kansas has evolved almost entirely as a result of events during Pleistocene time. However, in order to view in proper perspective this relatively short interval of rapid evolution of the present drainage, we should look farther back into the geologic record. The earliest drainage that has a bearing on present stream patterns is that which existed on the early Cretaceous erosion surface. This surface in central and eastern Kansas beveled Pennsylvanian and Permian rocks. It was a surface of moderate relief and in central Kansas it is preserved along a northeasterly trend by progressively overlapping Cheyenne sandstone, Kiowa shale, and Dakota formation. The contact of Cretaceous on Permian is exposed in a belt extending from Comanche County on the Oklahoma state line to Washington County on the Nebraska state line. At many localities the basal few feet of Cretaceous rocks contains pebbles and cobbles of a size and type unknown in the remainder of the Kansas Cretaceous section. These pebbles are genetically related to the erosion surface rather than to any stratigraphic position within the Cretaceous as indicated by the fact that they are found only adjacent to the unconformable surface. They occur in the Cheyenne, Kiowa, and Dakota where each of these units is in contact with pre-Cretaceous rocks, but are never found in the Dakota or Kiowa where these units are underlain respectively by Kiowa and Cheyenne. The pebbles and cobbles found above the pre-Cretaceous erosion surface are well rounded, smooth, and in size are as much as 4. They consist predominantly of chert, quartz, and quartzite, and siliceous cemented quartz sandstone. In two chert pebbles from Rice County in central Kansas fusulines have been identified by M. Thompson personal communication who states that the particular species are known to occur only in lower Permian limestones more than miles farther east in Kansas. The occurrence of eastern fusulines is association with metamorphic rocks strongly suggests a source to the northeast, thus establishing the direction of major drainage in early Cretaceous time as southwesterly across eastern and central Kansas. The alignment of lenticular sand bodies in the Dakota formation confirms this interpretation. Channel sands display a general southwest-northeast trend whereas beach and bar sands are commonly at right angles to this trend Norman Plummer, personal communication. Late Tertiary Drainage There is no direct evidence to indicate whether or not drainage lines extended themselves as consequents across the Cretaceous sediments and thus returned to a southwesterly trend as Cretaceous seas withdrew. Data bearing on this point have been removed by erosion. However, strong evidence indicates that, in any event, such a trend was not in existence in late Tertiary time. In central and western Kansas Pliocene sediments of the widespread Ogallala formation are composed of coarse clastic materials derived predominantly from a western source in the Rocky Mountain region and from local bedrock. In marked contrast to the lithology of the Ogallala formation, the late Tertiary sediments in the eastern one-fourth of Kansas are entirely attributable to the Permian and Pennsylvanian rocks eastward from and including the Herington limestone. The fact that the locally derived high level chert gravels in eastern Kansas are Tertiary in age is demonstrated by their physiographic position. A prominent terrace occurring about 40 feet above the present flood plain has been studied along much of the Cottonwood-Neosho River Valley by H. This terrace has been dated as Kansan by petrographically distinctive Pearlette volcanic ash Frye, Swineford, and Leonard, contained in the sediments at Emporia. Also, vertebrate fossils from the same level in Lyon County have been examined by R. Remnants of a distinct chert gravel veneered terrace that may be Nebraskan in age occur along the same valley system at a level 80 to feet above the present flood plain. Other chert gravels occur at several higher positions and in Coffey, Anderson, and Alien counties they cap divide areas at elevations as much as feet above the same reference flood plain level. Above the Emporia foot terrace all surficial deposits are severely weathered throughout their thickness. They consist only of chert of types characteristic of the Herington and stratigraphically lower limestones in a reddish clay matrix, and therefore their dating rests solely on their physiographic position. The high level gravels at positions as much as feet above flood plain level and judged to be pre-Pleistocene because as much as feet of bedrock incision occurred after their deposition and prior to the deposition of Nebraskan terrace gravels. The high level gravels are considered to be late Tertiary in age because Cretaceous sediments which approached or overlapped the western part of the Flint Hills region were removed and the resistant cherty Florence, Fort Riley, and adjacent limestones were etched into strong relief prior to the deposition of these high level gravels. No stream-rounded chert gravels occur on the crest of the Flint Hills even though broad gently sloping surfaces are common. These relationships show that some time during the Tertiary the Flint Hills became a major divide separating two strongly contrasting depositional provinces. The western of these two provinces discharged drainage southward from Kansas into Oklahoma, and the eastern province discharged its drainage eastward into Missouri. Although data on the pre-Pleistocene history north of Kansas River Valley are obscured by glacial deposits a similar erosional history is known to have obtained. Detailed studies of pebble lithologies by Davis show that even along the Kansas River Valley, now the only valley carrying western drainage through the Flint Hills, western materials were not deposited until after the Kansan glacial age and that the late Tertiary drainage pattern was similar to that farther south. Details of the pre-Pleistocene drainage are not known but the regional distribution of Pliocene sediments, Ogallala stratigraphy, and lithologies of clastic sediments show clearly that streams flowing toward the east or southeast from the Rocky Mountain region crossed western and central Kansas and left the State toward the south. The early Pliocene drainage was localized in valleys in an erosional topography of gentle slopes but with divides as much as to feet above the major valley floors. This is attested by the stratigraphic overlap of the several members of the Ogallala on the former bedrock surface. As alluviation proceeded through Pliocene time these erosional valleys were filled so that the resulting plains of alluviation generally coalesced over the former divides. Thin deposits of uppermost Ogallala are relatively common along the crest of the Greenhorn limestone Cretaceous cuesta showing that this present scarp-forming formation, as well as the Fort Hays limestone, exerted little influence on regional topography by the end of Ogallala deposition. However, late Tertiary drainage that flowed eastward from the Flint Hills crest was much less effective in obliterating the bedrock topography as the deposits of these streams were restricted to valley bottoms. Thin chert gravel deposits at several levels above the terrace presumed to be Nebraskan in age indicate that the late Pliocene topography of eastern Kansas was essentially erosional on the Paleozoic bedrock with a maximum local relief of less than feet and that the major valleys were flanked by two or perhaps more terraces thinly veneered with chert gravels. Nebraskan Drainage As the Nebraskan glacier started to accumulate, Kansas was a region of subdued topography and with much less relief than that existing at the present time. The western third of the State was an extensive alluvial plain with perhaps a few low gently rounded divides underlain immediately by Cretaceous rocks. This surface was not without character, however, as such a plain developed by laterally shifting depositing streams must have displayed features such as natural levees, abandoned channel segments, and intra-channel "backswamp" areas typical of surfaces built by stream deposition. The water table under this surface must have been quite shallow as it now is under parts of the Arkansas River alluvial plain and standing bodies of water must have occurred in disconnected low places. If this surface were warped along an east-west axis in northwestern Kansas, and tilted gently toward the east, as suggested by Smith , drainage of essentially a consequent origin may have developed and so given rise to a semi-radial stream pattern in northwestern Kansas. This conclusion is strengthened by the fact that northwestern Kansas was never crossed by a major through-flowing stream during Pleistocene time. In central Kansas, this western alluvial plain merged laterally with an erosional plain of almost equally subdued relief. In central Kansas broad alluviated valleys were joined by alluviated tributaries which were filled to shallow depths with locally derived materials. A major stream flowed south across central Kansas Fig. Figure Reconstructed major drainage lines in Kansas in late Nebraskan time. Dashed line is maximum extent of Nebraskan glacier. Names refer to abandoned valley segments. Deepening of all major stream channels occurred generally in Kansas at about the beginning of the Pleistocene. The depth of this incision ranged widely in different places. For example, in the filled Chase channel in central Rice County described by Fent , late Nebraskan sediments are the lowest part of the fill of a valley cut feet below thin Ogallala on adjacent uplands; in eastern Ellis County Nebraskan stream sediments occur about feet below Ogallala beds capping the adjacent Fort Hays limestone scarp A. Berry, in preparation ; in the northwestern corner of Ness County a remnant of a Nebraskan terrace is less than 75 feet below the Ogallala; while along Cimarron River Valley in southwestern Kansas and in north-central McPherson County Nebraskan stream sediments rest on eroded Ogallala formation. In the glaciated area Nebraskan deposits are obscured except along the Missouri River Valley in Doniphan and northern Atchison counties. In that area David City Nebraskan sand and gravel occur below Nebraska till and rest on Pennsylvanian bedrock about 35 feet above the flood plain of Missouri River Frye and A. Leonard, , whereas in the same area chert gravels overlain by glacial deposits and judged to be pre-Nebraskan in age occur 25 to 50 feet higher above the same datum. These data also indicate moderate bedrock incision during earliest Pleistocene time. The cause of this early Pleistocene stream incision is not known. It can hardly be attributed to lowering of sea level because most of the downcutting was accomplished by the time the Nebraskan ice had reached its maximum extent; furthermore the maximum depths of downcuttings in Kansas were in the central area. Neither is crustal warping alone an adequate explanation. The maximum unwarping of the late Pliocene surface was in the northwestern part of the State Smith, and that area contains the least evidence of marked early Pleistocene valley deepening. Although several factors probably contributed to the early Pleistocene downcutting, the principal causes are judged to be changes in stream regimen--that is, the relation of volume to load--and generally accentuated gradients produced by regional eastward tilting. The inferred reconstruction of the late Nebraskan drainage is shown on the map in Figure Other parts of the pattern are based on terrace remnants and on projections from known deposits e. Another arm of this late Nebraskan system is represented by alluvial deposits in east-central Ellis County and near Galacia in northwestern Barton County Latta, where a stream crossed the present divide separating Smoky Hill from Arkansas drainage. From the "Galatia channel" the stream flowed southeastward through Chase channel across Rice County and joined the north-south master stream in Sedgwick County. In southwestern Kansas another major north-south drainage line extended south through the Scott-Finney depression Waite, and seemingly spread laterally to alluviate an extensive basin lying west of the Crooked Creek and Fowler faults Frye, in central Meade County. In strong contrast to the present drainage pattern the general grain of the Nebraskan drainage of southern and central Kansas was north-northwest to south-southeast. As the Nebraskan glacier entered only the northeastern corner of the State, it was presumably served by an eastern spillway along its southern limit defined by test drilling Frye and Walters, , and now buried under Kansas till. Outwash of Nebraskan continental glaciers does not occur beyond the limits of Kansan glaciation Davis, Kansan Drainage Events directly and indirectly related to Kansan glaciation initiated the sequence of drainage adjustments, perhaps still in progress, that gave rise to the present stream systems of the State. Kansan ice entered Kansas from the northeast but advanced well beyond the limit of Nebraskan glaciation, overrode the Flint Hills upland into Washington County, and covered important parts of this earlier divide in Marshall and Pottawatomie counties. The western and southern extremities of the Kansan glacier produced the eventual integration of the Kansas River system. The stream pattern at the beginning of Kansan time is judged to have been similar to that of late Nebraskan time. During the advancing phase of Kansan glaciation Kansas streams generally deepened their channels; the prominent valley across southern Nemaha and northern Jackson counties was deepened and then alluviated with pro-Kansan Atchison formation sands, and eventually overridden by the ice. Locally the Kansan glacier extended across the position of the Kansas River Valley and forced meltwaters into a temporary spillway to the east along Wakarusa Valley Todd, This spillway, however, was not available to the meltwaters from the western edge of the lobe because it was effectively blocked by the ice mass itself. Available evidence indicates that the only avenue of escape for the meltwaters and outwash from the Washington and Marshall County area was toward the southwest and thence southward along the line of the formerly well-established drainageway across Saline, McPherson, Harvey, and Sedgwick counties. Such a spillway course reversed the direction of flow through the headwaters of an "ancestral Kaw Valley" in the Flint Hills area and spilled into the headwaters of a tributary to the major south-flowing stream through central Kansas. At least two other important spillways, later abandoned, carried meltwater and outwash westward from the western margin of the Kansan glacier in Kansas Fig. These temporary drainage lines originated along the ice margin where it extended west of the Flint Hills divide and as they were heavily alluviated and soon abandoned they had little influence on the future stream pattern. The spillway westward along the present course of the Smoky Hill Valley past Junction City, however, had a profound effect on later drainage as the temporarily large volume of water and sediment deeply notched the major divide and provided the mechanism for the integration of the present Kansas River system. Figure Reconstructed major drainage lines in Kansas in late Kansan time. Arrows and numbers refer to direction and position of stream flow during early stage of Kansan glacial retreat 1 , and during latest statge of Kansan retreat, or during early Yarmouthian time 2. Dashed line is maximum limit of Kansan glacier. Evidence for this western spillway is fragmentary but nevertheless quite strong. Regional examination of chert gravels and physiography in eastern Kansas, and particularly studies of pebble lithology by Davis along the Kansas River Valley, show that drainage from west of the Flint Hills did not come east across the divide until after retreat of the Kansan glacier. Outwash sand and gravel on bedrock occur high above the valley flat of the Smoky Hill River west of Junction City, and the former McPherson valley across McPherson County is filled to a depth of feet with sand, gravel, and silt dated as late Kansan in age by more than a half dozen localities of Pearlette volcanic ash. The late Kansan drainage through McPherson valley is known to have been southward because of the gradients of bedrock floors and its integration with the drainage pattern demonstrated by extensive terrace deposits along Smoky Hill Valley, abandoned Wilson valley, and widespread test drilling. Present elevations do not indicate a gradient from the Flint Hills area toward the McPherson channel as the bedrock floor under the Kansan stream sediments in that abandoned valley is as high, or higher, than the level of the outwash deposits west of Junction City. This is the expectable relationship if the drainage history is as shown in Figure The Smoky Hill Valley spillway toward the west was in use at the time of the Kansan glacial maximum and it is safe to infer that isostatic adjustments to this ice mass--the greatest to invade the midwest--were at least as great as those that have been determined to have been associated with late Wisconsinan glaciers Flint, , pp. The area where this spillway crossed the crest of the Flint Hills is within 25 miles of the glacial margin and should have had maximum effect of the marginal isostatic bulge, whereas the McPherson channel is more than miles from the nearest point along the ice front and may have been beyond the effects of superelevation.

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Chapter 3 : Teays River - Wikipedia

Get this from a library! Drainage modifications in southeastern Ohio and adjacent parts of West Virginia and Kentucky. [W G Tight; Geological Survey (U.S.),].

Creation[edit] Scattered erratics in northeastern Kentucky and southern Ohio [5] are pre- Kansan in age. Only the Nebraskan is recognized as earlier than Kansan; these have been designated as remnants of deposits left by the Nebraskan glacier. The back up of water diverted the upper basin over the surrounding divides into the preglacial Ohio River. The entire Silurian section below the Liston Creek limestone [7] and a few feet of the upper Ordovician probably would be visible in the vicinity of La Fontaine. These terraces probably correspond in age to an erosional surface in the unglaciated areas known as the Parker strath, which was the result an erosion cycle that ended before the Kansan phase of the pre-Illinoian glaciation. The Parker strath probably represents an erosional level existent at the beginning of the Pleistocene before the rejuvenation associated with, and following, the Nebraskan glaciation. The general appearance and width of the strath terrace along the Teays Valley in Indiana indicates that it represents only a slight rejuvenation following the Lexington cycle. The valley then disappears under glacial sediments but can be tracked using water well yields and other means Hansen, A total of seven tills have been identified within the Teays River Valley Andrews, In portions of Ohio, the buried valley is up to 2 miles 3. The Teays River was dissected and largely wiped away by advancing glaciers and their meltwater. These glaciers were the massive continental ice sheets that began to cover large parts of Ohio and other states downstream west of Ohio between 2. Their presence caused lakes Lake Tight , Lake Monongahela , etc. Overflow of these lakes into nearby, lower valleys caused large floods and new rivers to form. These new rivers â€" formed about 2 million years ago â€" included the present-day Ohio and Scioto Rivers, which are associated with the most direct evidence of the Teays. West Virginia [edit] The Teays River was the main stream of a preglacial river system. This area is northeast of Asheville. This continues to the northwest to Charleston. As New River, it was joined by the Greenbrier and Bluestone rivers. At Charleston, the Kanawah, is joined by the Elk River. The valley varies in width, from 0. No doubt, a large stream once occupied this abandoned valley. Approaching Huntington, the Guyandotte River joins the general path of the ancient river beginning at Barboursville and follows it north until the former river veers west over the south hills of Huntington and joins the Ohio River Valley heading west towards Kentucky. The Ohio River follows the Teays path until leaving the Ohio River in the north end of Catlettsburg where it veers away just south of Ashland to Wheelersburg. The Ohio River has a floor of the original valley as shown by the silted flats south of Ashland and the terraces between Franklin Furnace and Wheelersburg. It is buried beneath the glacial drift. The Teays continued northward to Chillicothe, where it disappears under a layering of Wisconsin drift. From there, it crosses the northeast corner of Fayette County near Waterloo, extending in a northwesterly direction past London in Madison County, to Vienna in Clark County. Here the Teays was joined by the Groveport River, which drained central Ohio. From Vienna, the Teays River continues in a westerly direction, to a point near Springfield, in Clark County, and thence northwestward past Boulusville and St. The Teays continued its course westward past the village of Mercer to Rockford. Continuing west to the Ohio-Indiana state line in Mercer County. It turns to the northwest 3 metres 0. In Illinois, the valley is called the Mahomet. The average gradient of the Mahomet Valley above Beardstown, Illinois, is about 7 inches per mile Well records do not indicate a broad depression, which widens northward and is of sufficient size to have accommodated so large a stream as the Cincinnati River. The diversion occurred during the Nebraskan or older pre-Illinoian glaciation. This is based on an analysis of the drift found in the valley from the Kansan or late pre-Illinoian age. Albans in West Virginia and the valley extending north from Wheelersburg in Ohio. These valleys can be seen on aerial and satellite images. However, short segments of some such valleys are still occupied by the Ohio and Scioto Rivers. The Scioto flows through the valley in the opposite direction south to that taken by the Teays north. Appalachian Plateau near Athens in southeast Ohio. The plateau was characterized by low, rolling hills and slow-moving rivers until glaciers disturbed regional streams. The distant ridge is actually a flat upland surface beneath Albany, OH. A shallow paleovalley, now filled with proglacial lake sediments, underlies the flat surface. The paleovalley once fed the Teays River and contains river and lake sediments. The valley was abandoned after the Ohio River was formed and surrounding streams cut downward to increase their valley depths. The present Ohio-Mississippi river system contains some distinctive relict fish populations descended from Jurassic Period fishes of the Teays, such as the primitive bowfin Amia calva and various gars Lepisosteus spp. He claimed that a large river would have had to exist to create the wide and deep valley. Conventional geologists did not support his claim. Tight, a professor at Denison University in Granville, Ohio , saw the same type of valley and small stream running from Charleston to the Ohio River. It had only a minor water course beyond St. Here, the Kanawha River turns north. Professor Tight sought in vain to persuade the geological community that this valley once carried a mighty river that continued across Ohio , Indiana and Illinois through a valley now deeply buried under glacial deposits. He called it the Teays pronounced taze River, for a village in West Virginia.

Chapter 4 : The preglacial drainage of Ohio; comprising the results of researches - CORE

December, "Some drainage modifications in Washington and adjacent counties. By W. G. TightHistory of the Little Miami River. By J. A. BownocherSome observations on the preglacial drainage of Wayne and adjacent counties.

A Calusa boy watches a canoe pass in a village canal. MacMahon and Marquardt [Click thumbnail to enlarge. Levees were built for the primary purpose of storing water during dry periods and restricting seepage into developed but low-lying areas located between the Everglades and the densely populated Atlantic coastal ridge. Canals were constructed to drain and reclaim the wetlands and to convey water to southeastern Florida where it recharges into the aquifer to supply well fields for the urban population. During times when water is plentiful and the threat of flooding exists, the same canals are used to discharge fresh water from the Everglades to the coasts. Tabb, University of Miami, pers. Depletion of natural water storage areas and flow losses by canal discharge to the coast are thought to be major factors underlying the persistence of overly dry conditions in the Everglades south of Tamiami Trail. The diversion of water from Shark River Slough and Taylor Slough in the southern Everglades has significantly reduced freshwater inflow to Florida Bay and led to hypersalinity in biologically vital coastal estuaries Fourqurean et al. In addition, fresh water is no longer delivered by gradual sheet flow but via canals in sudden, unnaturally timed pulses Light and Dineen ; Abtew et al. These sudden releases flood wildlife habitat, disperse fish concentrations, and dramatically alter salinities in estuaries, resulting in mortality of estuarine species McIvor et al. For instance, pulsed discharges and rapid salinity fluctuations in coastal Biscayne Bay caused important changes in fish assemblages, decreasing numbers and species richness Serafy et al. Levees and canals have other less obvious but potentially damaging hydrologic effects on Everglades ecosystems. Levees create deep, pooled conditions in southern areas of the enclosed basins, with minimal or no flow Figure 5. The average water depths tend to be too deep to support a diverse assemblage of plant communities Watts et al. Also, the excavation of canals through the less permeable peat into the more highly permeable aquifer, and the "stair-step" of abrupt water-level changes created by levees, enhance groundwater-surface water interactions in the Everglades Krupa and Diaz ; Harvey et al. Both levee and canal operations increase upward mixing and discharge of relatively salty water from deep in the sand and limestone aquifer beneath the Everglades, which is damaging to sensitive biological communities Harvey and McCormick Canals draw water from the surrounding wetlands. In combination with reduced water deliveries, this results in complete dry-down during the dry season, diminished aquatic habitat during the wet season, soil loss and flattening of the peat surface. Canals also alter surface water chemistry by directly exposing surface water to the bedrock. Levees create deep, pooled conditions in the southern half of the enclosed basins, with water depths that tend to be too deep to support a diverse assemblage of plant communities. Everglades canals have been found to contain concentrations of phosphorus up to 30 times those historically present in the marsh McCormick et al. Phosphorus concentrations are highest in the northern Everglades and decrease along a north-to-south gradient that extends up to 7 km into the surrounding marsh McCormick et al. Thus, enrichment and linked ecological processes vary through the marsh as a function of distance to canals Doren et al. However, in ENP they are still elevated compared with reference sites in the interior of the park McCormick et al. Cattails limit light penetration, further reducing periphyton growth Grimshaw et al. Chemical Contaminants Canals have been implicated in the introduction of excess chemicals from urban and agricultural areas into the Everglades Gunderson and Loftus Levels of some insecticides, including endosulfan which is very toxic to aquatic fauna, at times exceed state surface water quality standards Pfeuffer and Rand Pesticide residues have also been detected outside of canals in the surface waters of Florida Bay, with evidence of toxicity to estuarine organisms Scott et al. In the s, mercury was found at dangerous levels in Everglades fishes and their predators Stober et al. Methylated mercury is at least 10 times as toxic and bioaccumulative as is elemental mercury. While accumulation of methylmercury occurs mostly in the marsh rather than in canals , canal fish become contaminated when they consume marsh prey forced into canals by low water or when they forage in the marsh during the wet season. Mercury levels in fish and birds have declined markedly since the s Frederick et al. Canals dug into the surficial aquifer, and levees that created a "stair-step" of water levels, have increased the relative contributions of both groundwater and surface-water inflows both of which are higher in ionic strength than precipitation to Everglades hydrologic budgets Harvey and McCormick However, in LNWR, when stages in the perimeter canal rise above interior marsh stages as a result of stormwater discharges, canal water can intrude as much as 3. Effects of Canals and Levees on Landscape Features and Biota Wetland Fragmentation Degradation of Ridge and Slough Landscape Canals and levees fragment what were once continuous wetlands and interrupt historical sheet flow across the landscape Sklar et al. The existing system does not contain a functional landscape mosaic of adequate extent, heterogeneity, spatial configuration, connectivity, and natural hydrologic periodicity to provide the seasonal habitat requirements of historical populations of alligators, wading birds, snail kites, and their prey. Connectivity of contiguous marsh areas is particularly important during and following dry-down events, so that dispersal and recolonization of affected marsh areas by aquatic organisms can occur and aquatic productivity may be maintained Fleming et al. Compartmentalization of the Everglades has led to soil loss, flattening of the peat surface, and altered flow velocity, resulting in degradation of the distinct directional pattern of ridge and slough vegetation Sklar et al. Much of the post-drainage landscape is scattered, blurred, and unstructured with major changes in plant communities SCT ; Figure 6. The mosaic landscape has been replaced in many areas by large uniform stands of sawgrass SCT ; Figure 6 , which are much poorer in aquatic species than the sloughs and wet prairies that preceded them Loftus and Kushlan ; Gunderson and Loftus Thus, the compartmentalized landscape offers considerably less habitat, foraging areas, and refuges for wildlife. Wading birds, often considered indicators of the health of Everglades ecosystems, thrive in a mosaic of wetland habitats that includes wet prairies and sloughs, since they rarely use dense sawgrass stands Hoffman et al. The endangered Everglades snail kite Rostrhamus sociabilis plumbeus also depends on a diversity of wetland habitats. Relying almost exclusively on a single prey species the apple snail, Pomacea paludosa , snail kites forage mainly in sparse emergent vegetation in open-water areas Bennetts et al. Thus the vanishing of the ridge and slough matrix may further threaten this endangered species. Landscape has been almost completely converted to sawgrass, and sloughs have almost completely disappeared. Tree islands are biodiversity hotspots that provide food, cover, and critical nesting sites for numerous species; they also play an important ecological role in the sequestration of carbon and phosphorus Sklar and Van der Valk The once tear-shaped islands oriented approximately north-south according to water flow, are becoming irregularly shaped Brandt et al. Compartmentalization of the system may also appear to affect the genetic structure of certain aquatic taxa populations, despite the fact that only about 60 generations have passed since canal and levee construction Trexler and Loftus However, populations of at least one species, the spotted sunfish Lepomis punctatus , did not show genetic differentiation, possibly as a result of sub-populations mixing in the canal system during the dry season McElroy et al. Barriers to Disturbance Canals and levees also function as barriers to disturbance. Lightning-ignited wildfires were a certain and predictable landscape process in preth century Florida Abrahamson and Hartnett While the incidence of lightning may not have changed, the probability that lightning-ignited fire can propagate across a large area of the remnant Everglades landscape has decreased because of the increased number of firebreaks from canals, levees, and roads Abrahamson and Hartnett ; Sklar et al. In the most recent assessment, 34 nonnative freshwater fish species were found to be reproducing in Florida, 23 of which were considered established Shafland et al. Canals facilitate establishment of these species by offering permanent thermal and drought refugia habitats Trexler et al. A summary of eight quantitative fish surveys in southern Florida Trexler et al. However, the number of invasions continues to increase and, at least in ENP, appears associated with new water-management practices intended to restore hydrologic conditions and increase the hydroperiod of marl marshes Kline et al. To date, few studies have documented significant detrimental ecological effects from these introductions, leading to conflicting perspectives on the overall impact of nonnative aquatic taxa in the Everglades ecosystem Shafland ; Trexler et al. Yet, as the number of invasions continues to increase e. Evidence is increasing but still inconclusive for some species as to whether introduced fishes harm native aquatic communities in south Florida Shafland ; Trexler et al. Any lack of harm may be because native aquatic fauna tend to be habitat generalists that are resilient to both natural and anthropogenic disturbances Trexler et al. On the other hand, there may be impacts on native species that are as yet unseen Courtenay , beyond the detection ability of current monitoring programs Trexler et al. At the same time, there is no doubt that the presence of nonnative fishes has altered ecosystem structure. The question remains, however, whether these changes in structure result in detectable and significant changes in ecosystem function and the provisioning of services. More research, particularly empirical work, is needed to tackle this question. Water temperatures measured at bottom probes situated at the bottom of the water on top of the substrate at three hydrostations in Everglades National Park during the record cold spell in January All specimens found in BNP have been concentrated near canal mouths and in nearshore areas between canals, suggesting that the snails are dispersing through canals Wingard et al. The red-rimmed melania carries parasitic liver flukes and lung flukes that can cause illness in animals and humans who consume infected fish or crabs. In addition to potential health and economic effects, this species may cause major ecological damage by out-competing native snail species Wingard et al. Exotic apple snails Pomacea insularum, P. The island apple snail, P. Nonnative apple snails are also carriers of the rat lungworm, a parasite that infects humans exposed to the snails Hollingsworth and Cowie Nonnative Aquatic Plants Canals enhance growing conditions for establishment and expansion of three major invasive pest plants: Canals allow for the distribution and expansion of pest plants from urban areas to the east, and provide ample deep-water, nutrient-enriched habitats for them. Water lettuce, water hyacinth, and hydrilla have been shown to modify water chemistry, slow the already limited water flow in canals, and shade out native species Schmitz et al. Water hyacinth also increases detritus-deposition rates, which depletes oxygen levels and can lead to large-scale mortality of aquatic organisms Schmitz et al. In addition, the dense vegetation created by these aquatic invaders can impede navigation, flood control, and the recreational use of canals Cervone et al. Terrestrial Invaders Levees associated with canals provide disturbed upland habitat for the most noxious terrestrial pest plants in south Florida, most notably Australian pine Casuarina equisetifolia , Brazilian peppertree Schinus terebinthifolius , and several exotic grasses such as Burma reed Neyraudia reynaudiana and napier grass Pennisetum purpureum. Recent vegetation mapping by the University of Georgia demonstrates that levees are corridors for nonnative plant persistence and dispersal Forman and Alexander The persistence of pest plants on levees makes them available for dispersal into pristine habitat by "island hopping. Levees also act as artificial terrestrial corridors into the wetland landscape for insect species such as fire ants Ferriter et al. Habitats, Refuges, and Sinks The habitat value of canals is a complex topic that is receiving increasing attention of researchers J. Trexler, Florida International University, pers. Despite the fact that canals are a long-standing feature of the Everglades, our understanding of how they function as habitat for aquatic fauna and how this may be similar or different from natural habitats is still very limited. Pathway into Interior Wetlands Without canals, many new colonists and marine invaders would not successfully colonize interior wetlands. These deep-water habitats connect freshwater areas to the coast, allowing fishes tolerant of fresh and brackish waters to move far inland. Through connections to the northern Everglades, canals have also received colonists from that region, thereby boosting the numbers of native species in canals and allowing for range expansion among native fishes Loftus et al. In addition, there are higher numbers of nonnative species in canals than in the wetlands Trexler et al. The "Subsidized" Everglades Bass Fishery There is a strong seasonal effect on abundance of aquatic fauna in the vicinity of canals, suggesting that canals serve as important dry-down habitats for aquatic fauna Rehage and Trexler Canals and other artificial, deep-water habitats culvert pools, borrow pits provide refuge to large numbers of both native and nonnative aquatic predators in the dry season Loftus and Kushlan ; Trexler et al. Those large predatory fish populations are likely subsidized by the movement of small forage fish and shrimp into canals during the dry season Rehage and Trexler , where they fall prey to predatory fishes and alligators Howard et al. Thus, recreational fisheries in canals are likely enhanced by the combination of nutrient enrichment, movement of prey into canals during seasonal dry-downs, and the low habitat complexity of canals which may increase predator efficiency Savino et al. Unlike elsewhere in the system, WCA 3A marshes remain flooded and considerably deep even in the peak of the dry season, likely providing foraging opportunities for bass and other large-bodied taxa year-round. During the dry season, other canals become disconnected from marshes, and predators become dependent solely on prey that moved into the canals at the beginning of the dry season in addition to the in situ production, both of which may deplete over the dry season. In canals that bisect agricultural and urban areas, this prey subsidy is completely absent. Thus, canals may act as sinks for forage species produced in the wetlands, many of which become prey for the large numbers of resident and seasonal canal inhabitants Hunt ; Loftus and Kushlan ; Howard et al. The loss of forage species to canal inhabitants could affect predators that forage in the wetlands, such as wading birds; however, these effects have not yet been studied. Population Sink for Alligators Alligators, which prey on fishes but provide them with dry-season refugia in their ponds, have disappeared from former habitat in peripheral Everglades marshes because of both drainage and saltwater incursion Mazzotti and Brandt While canals adjacent to wetlands provide habitat for dense populations of alligators, these populations are dominated by adults and exhibit negligible production compared to interior habitats Chopp et al.

Chapter 5 : e-WV | Teays River

The study of this particular region was the natural result of earlier studies of drainage modifications in Ohio, in the region more nearly adjacent to the glaciated area. Until a few years ago but very little systematic study of the drainage features of Ohio had been made.

Hide This is a view of the west canyon wall, as seen from Silken Skein falls. Photo by Tyson Berndt. The Hyalite Canyon area is located in the northern section of the Gallatin Range which, on a much larger geologic scale, is part of the Wyoming Archean Province Mogk et al. The Wyoming Archean Province is composed of some of the oldest rocks on the continent, and rocks in the Gallatin Range have yielded ages as old as 3. These rocks contain some of the best "hard rock" climbing routes in the area! These basement Archean metamorphic rocks are covered by more than 4, feet of Paleozoic and Mesozoic layers of sandstone, shale, and limestone Weber, According to Todd , these sedimentary layers were approximately 10, feet thick in the southern part of the Gallatin Range and were subsequently removed by the erosive power of wind, water, and ice. Evidence for this lays in the fact that some of the Eocene Absaroka Volcanic rocks rest directly on top of the Archean metamorphics. The only way for this to occur is for the previous layers of sediment to be completely weathered away from the scene prior to deposition of the volcanic rocks. Just imagine the span of time it would take to carry away all of that material! Check out the stratigraphic column for Montana: These volcanics were the result of massive outpourings of epiclastic gravel, sand, and mud deposits consisting of older rocks; these are major debris flow deposits known as lahars , some volcanic ash fall deposits these are pyroclastic rocks and relatively rare andesitic lava flows Todd, ; Chadwick, This volcanic region stretches from Bozeman, Montana, miles southeastward into Wyoming Chadwick, The Eocene Absaroka Volcanics are part of a massive volcanic event that impacted most of the northwestern part of North America, including the Challis Volcanics of central Idaho, San Poil Volcanics of north central Washington, and the Montana Alkali Province that lies in the northern and eastern part of the state. The Absaroka Volcanics have an eastern belt that is more potassic in composition, and a western belt that is more sodic in composition. Here is a reference map that illustrates the extent of the Absaroka Volcanics produced by Dr. Todd Feeley, used with permission. The volcanics situated in the northern Gallatin Range are more than 6, feet thick, and are, for the most part, resting horizontally or dipping gently to the southeast Chadwick, The volcanic history of the area is discussed in greater detail in the following section. Volcanic units include extrusive rocks volcanic ash and lava flows , intrusive rocks dikes and sills , and massive debris flows lahars. It shows the general stratigraphic makeup of the Gallatin Mountains in the Hyalite region. The initial structure of the Gallatin Range was established during an episode of mountain building called the Laramide Orogeny which began roughly 65 million years ago. This type of mountain building was caused by immense compressional forces from tectonic plate interactions that created high angle reverse fault zones. The compressive forces basically split the Archean basement rocks into pieces, some of which moved up and some of which moved down Levin, As these large sections of basement rock were uplifted, overlying sedimentary layers were pushed up producing overturned and folded layers of rock, and these uplifts were subsequently eroded to their present levels of exposure. Resultant features included domes, basins, monoclines, and anticlines. The mountains we see today are also the result of repeated episodes of Cenozoic extensional "normal faulting" Levin, Examples of these two styles of faults are illustrated in the figure below. The landscape we see today is the result of erosion by glaciers, rivers, and surficial "mass wasting" processes that continue to sculpt the surface of the Earth. Hide The image on top is an example of a normal fault. One side of the strata drops down when compared to the other. The image on the bottom is an example of a reverse fault. This is the type of fault that occurred during the Laramide mountain building episode. Notice that one side of the strata is pushed up compared to the other. Photo taken from http: Erosive forces have sculpted this present-day landscape. Notice the layering of debris flows and how this material is deposited downslope when it breaks away.

Chapter 6 : ATTACHMENT 3: Overview of Engineering Techniques to Reduce Grading

Drainage modifications in southeastern Ohio and adjacent parts of West Virginia and Kentucky, by W. G. Tight. Ill pp., 17 pis. Underground waters of Salt.

Abstract The Teays River was a preglacial river which drained a large portion of the east-central United States. The river met its end when Pre-Illinoisan Early Pleistocene ice sheets dammed the region, causing the formation of a large glacial lake, resulting in breached drainage divides and the formation of new drainage channels. These changes would eventually result in the creation of the modern Ohio River drainage system. Geographic Setting The Teays River was a preglacial river, comparable in size to its eventual successor, the Ohio River. The Teays River drained a large portion of the east-central U. Teays River Valley From Teller, The largest tributary to the Teays River was the Old Kentucky River Teller , which extended from southern Kentucky through Frankfort where I currently reside , and subsequently flowed northeast, meeting other tributaries and eventually joining the Teays. The valley then disappears under glacial sediments but can be tracked using water well yields and other means Hansen, A total of seven tills have been identified within the Teays River Valley Andrews, In portions of Ohio, the buried valley is up to 2 miles wide and lies beneath FT of glacial sediments Hansen, Some believe that the Teays formed during the Tertiary Hansen, This scenario dates the formation of the Teays to approximately five million years ago, when water flowing from the Appalachian Mountain region carved channels while flowing to lower elevations Ohio Department of Natural Resources. Another possibility is that the westward flowing Teays was a result of even earlier Pleistocene glaciations Figure 3 , which rerouted an earlier drainage system flowing to the Great Lakes region Gray, ; Andrews ; Dutch Possible Pre-Teays Drainage From Dutch, Glaciation and the Teays River Pre-Illinoisan Early Pleistocene glaciations brought an end to the Teays River Hansen, , although specific dates were poorly constrained prior to recent cosmogenic isotope dating of fluvial deposits Andrews, Dating of sediments suggests that the glacial advance which blocked the Teays did so sometime between 1. The advance of ice sheets eventually dammed the Teays resulting in the formation of glacial Lake Tight, which is named after William George Tight, professor of geology and botany at Denison University. The article gave evidence for the existence of a preglacial river that had origins in the Appalachians Tight, Glacial Lake Tight From Hansen, Lake Tight rose to an elevation of nearly feet and created a number of lakes in tributary valleys Hansen, The lake extended into portions of Ohio, West Virginia, and Kentucky and covered approximately square miles. Dating of the seasonal changes in preserved lake bottom sediments known as the Minford Clay indicate the lake was present for greater than years Hansen These clays were analyzed by Bonnett et al and determined to have reversed polarity, indicating that if they were deposited in the Pleistocene, they were deposited during the Matuyama reversed polarity chron Bonnett, This data suggests a glaciation and Lake Tight formation date between 0. The waters of Lake tight created new drainage as it breached drainage divides and created new drainage channels which were lower in elevation than the Teays Hansen, This new drainage system named Deep stage would mark the beginning of the Ohio River system, although subsequent glaciations would be needed to carve the modern Ohio River Hansen, The Teays River gradually changed its course as glaciations dammed and filled trunk valleys several times, forcing rivers beyond the glacial margin to establish new channels Teller, This likely happened in a step process as continental ice sheets invaded the Teays River watershed Teller, Modern Remnants Although the Teays River no longer exists it has resulted in many lasting impacts. Many people live atop the ancient Teays River Valley which is filled with glacial sediments. These sand and gravel sediments create a productive aquifer for municipal water supplies Ohio Department of Natural Resources. In addition to providing a groundwater resource, the river also has an impact on the biology of the region. Shawnee State Forest contains isolated patches of several Appalachian plants far to the north of their native ranges. Their origins are believed to be from deposition as seeds were carried downstream from their original habitat prior to the glaciations Ohio Department of Natural Resources.

DOWNLOAD PDF SOME DRAINAGE MODIFICATIONS IN WASHINGTON AND ADJACENT COUNTIES. BY W. G. TIGHT.

The river is also credited for isolating endangered species of cave beetles in Ohio, where they are the only known specimens north of the Ohio River. The beetles were likely stranded as the Teays river changed course Ohio Department of Natural Resources. In addition, the Minford clay is mined in some areas as a raw material for making brick and ceramic products Hansen, References Andrews, William M. The view from midstream, in Melhorn, W. Ohio Department of Natural Resources: Geological Survey Professional Paper Page created to fulfill requirements of ES Quaternary Geology. See earth Webpage submitted on November 28,

Chapter 7 : KGS--Pleistocene Geology of Kansas--Pleistocene Drainage

Tight, W.G., , Drainage modifications in southeastern Ohio and adjacent parts of West Virginia and Kentucky: U.S. Geological Survey Professional Paper Page created to fulfill requirements of ES Quaternary Geology.

Refer to Appendix A for standards applicable to plumbing appurtenances and fixtures defined in this Section. To border, to touch, to terminate at point of contact, adjacent. Easily approached or entered with minor modifications, such as the removal of an access panel, door or similar obstruction e. Concrete, asphalt and ceramic tile are not considered accessible. The unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet supplying water to a tank or plumbing fixture and the flood-level rim of the receptacle. An air gap in a drainage system is a piping arrangement in which a drain from a fixture, appliance or device discharges indirectly into another fixture, receptacle or interceptor at a point above the flood level rim. Illustrations A and B. An approved support for securing pipe, fixtures and equipment to walls, ceilings, floors or any other structural members. An additive or surface coating that prohibits the growth of bacteria or staphylococci. A device consisting of a float valve with a flow-splitter to provide for tank and trap refill that has an integral vacuum breaker and that is used in conjunction with water closet flush tanks. Accepted or acceptable under an applicable specification stated or cited in this Part or accepted as suitable for the proposed use. A drain placed in the floor of a basement areaway, a depressed or basement entry way, a loading platform, or a paved driveway that cannot otherwise be drained. A device supplied with water under positive pressure that passes through an integral orifice, causing a partial vacuum and resulting in movement of fluid by siphonage. A device consisting of a soft disc, reaction cup, fully guided stem guide, air vent port, and air port shield or hood to prevent fouling of the vent port, used for protection against back siphonage. A condition caused when a force is exerted and reverses the flow of gas, water or air in a direction opposite the intended normal direction of flow. A condition caused when a negative force or vacuum is exerted and reverses the flow of gas, water or air to a direction opposite the intended normal direction of flow. A device designed to prevent reverse flow in a water system, specifically back siphonage. The device should be used only where no back pressure may occur. A device or valve that is installed in a sanitary sewer, storm drain or storm sewer to prevent sewage or drainage from backing up. The reversal of flow from that normally intended. Hydraulic conditions that cause backflow include back siphonage, back pressure and aspiration. A device or an assembly used to prevent contamination of the potable water supply through an actual or potential cross-connection. A plumbing appurtenance consisting of two internally force loaded, independently acting check valves that operate normally in the closed position; two tight-closing, resilient seated shut-off valves; and four test cocks. A plumbing appurtenance consisting of two internally force loaded, independently acting check valves, designed to operate normally in the closed position, separated by an intermediate chamber able to automatically vent to atmosphere. A plumbing appurtenance consisting of two internally force loaded, independently acting check valves, designed to operate normally in the closed position; two tight-closing, resilient seated shut-off valves; and four test cocks. The assembly must include a bypass line with a water meter and double check assembly. A plumbing appurtenance consisting of two internally force loaded, independently acting check valves, designed to operate normally in the closed position. A plumbing appurtenance used to prevent carbonated water or carbon dioxide from backflow into a potable water system. The assembly consists of two internally force loaded, independently acting check valves, designed to operate normally in the closed position, residing in a common body. A plumbing appurtenance consisting of two internally force loaded, independently acting check valves, designed to operate normally in the closed position, separated by an intermediate zone that includes an internally force loaded hydraulic operated relief for venting to atmosphere, designed to operate normally in the open position, two tight-closing, resilient seated shut-off valves, four test cocks, and a metered reduced pressure backflow prevention assembly bypass. A plumbing appurtenance consisting of two internally force loaded, independently acting check valves, designed to operate normally in the closed position, separated by an intermediate zone that includes an internally force loaded, hydraulically operated relief for venting to atmosphere, designed to operate normally in the open position, two tight-closing resilient shut-off valves, and four test cocks. A device consisting of a float valve equipped with a flow-splitter to provide a tank and trap refill; used in conjunction with a flush tank on a water closet. Any group of two or more identical adjacent fixtures that discharge into a common horizontal waste or soil branch. A controlled outlet on a boiler to permit emptying or discharging of sediment. Any part of the piping system other than a main, riser or stack. A length of soil or waste stack corresponding in general to a story height, but in no case less than 8 feet, within which the horizontal branches from one floor or story of a building are connected to the stack. A horizontal vent connecting one or more individual vents with a vent stack or stack vent. The part of the lowest horizontal piping of a drainage system that receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the building house sewer. The part of the horizontal piping of a drainage system that extends from the end of the building drain, receives the discharge of the building drain and conveys it to a public sanitary sewer or private sewage disposal system. The building sewer commences 5 feet outside the building foundation wall. The lowest horizontal portion of the storm drainage system used for conveying rain water, surface water, ground water, subsurface water, site drainage, condensate or cooling water inside the walls of a building to a point 5 feet beyond the outside of the building foundation wall. The portion of a sanitary drainage system see definition of "Drainage System" that cannot drain by gravity into the building drain. A device, fitting, or assembly of fittings installed in a building drain to prevent circulation of air between the drainage system of the building and the building sewer. Piping that conveys corrosive or toxic chemical waste to the drainage system. A branch vent that serves two or more traps and extends from the front of the last fixture connection of a horizontal waste branch to the vent stack. This type of venting applies only to floor drains and floor outlet fixtures. Cooling water and condensate waste from refrigeration or air conditioning equipment, cooled condensate from steam heating systems, and seepage water. A system that has a backflow device or assembly installed in the water supply system to contain backflow within the premises. Other plumbing appurtenances, such as a single check valve or a water pressure regulator installed in the water supply system, may also create a closed water system. State or local statutes, ordinances, or administrative rules, e. This Part will be referenced in this rule as "Part". A standard for plumbing contained in any local rule or ordinance that has not been officially adopted can be construed only as a recommended standard. Water below 85 degrees Fahrenheit. A fixture combining two or more compartments or receptors. A system of waste piping with the horizontal wet venting of one or more floor drains by means of a common waste and vent pipe adequately sized to provide free movement of air above the flow line of the drain. A sewer that receives storm water and sewage. A vent connecting at the junction of two fixture drains and serving as a vent for both fixtures. The joining of two pieces of pipe, or pipes and fittings, valves or other appurtenances. Any solid, liquid or gaseous matter that, when present in a potable water supply distribution system, may cause the water to degrade so that water quality standards are not met or physical illness, injury or death to persons consuming the water could result. Water not suitable for human use or that does not meet the water quality standards of rules of the Illinois Pollution Control Board titled Primary Drinking Water Standards. A vertical vent that is a continuation of the drain to which it connects. The drain may be either vertical or horizontal. A drain or waste line from two or more fixtures or sink compartments of a single fixture , such as a combined three-compartment sink, connected to a single common trap. The mark on an atmospheric vacuum breaker established by the manufacturer and stamped "-CL-". This determines the minimum elevation above the flood-level rim or top of the fixture, whichever shall apply, at which the device shall be installed. When an atmospheric vacuum breaker does not bear a critical level marking, the bottom of the vacuum breaker shall constitute the critical level. Any actual or potential connection or arrangement between two otherwise separate piping systems, one containing potable water and the other containing fluids or gases of any kind that do not meet potable water quality standards, in which the non-potable substances in one system may flow into the potable water system or enter it through a means such as back pressure, back siphonage or aspiration. A tested and approved plumbing appurtenance, complete with shut-off valves, installed in a potable water line to prevent potable water from being mixed with any substance from a piping system containing non-potable substances, connected in any manner to the potable water supply. The installation of a backflow prevention device or assembly on the service line to a premises to protect water quality. The installation of a backflow prevention device or assembly at each actual or potential cross-connection within a premises to protect water quality. The identification and elimination of all unprotected connections between a potable water system and any other substance. A plumbing appurtenance installed in a potable water line to prevent any substance of any kind from being mixed. An individual who holds an Illinois Plumbing License and who has been certified in accordance with 35 Ill. A submerged inlet installation where a potable water pipe is connected or extended below the overflow rim of a receptacle, or an environment that contains a non-potable substance at atmospheric pressure. An installation where a potable water pipe is connected to a closed vessel or piping system that contains a non-potable substance above atmospheric pressure. A pipe that is terminated at a developed distance of 2 feet or more by means of a plug or other closed fitting, except piping serving as a cleanout extension to an accessible area. The Illinois Department of Public Health. The length of a pipe measured along the center line of the pipe, including fittings. The length of a straight line passing through the center of an object, e. For the diameter of a pipe, see "Pipe Diameter". Any pipe that carries waste water in a building drainage system. The laying and connecting of piping from 5 feet outside the foundation wall of a building to the public sanitary sewer system in the street or alley. The mathematical factor used by the plumbing industry to estimate the probable load on the drainage system caused by discharge from various plumbing fixtures. All piping within public or private premises that conveys sewage, rain or other liquid wastes to a point of disposal, but does not include the mains of a public sewer system or a private or public sewage treatment or disposal plant. The drainage system does not include the venting system. Drainage and venting are separate systems, although both are part of the overall plumbing system. A soil or waste system where all piping is of threaded pipe, using recessed drainage fittings. The minimum cross-sectional area at the point of water supply discharge, measured or expressed in terms of the diameter of a circle or, if the opening is not circular, the diameter of a circle of equivalent cross-sectional area. This is applicable to sizing an air gap. A plumbing system or any part of a plumbing system that has been installed prior to January 1, A joint that is developed with a special drilling tool used to penetrate a copper pipe wall, after which two steel pins are extended from the drill. While rotating, the drill head is withdrawn from the pipe under power, raising an external collar from the hole in the pipe. The branch pipe is then brazed into the collared outlet. Stationary, immovable or immobile, as in a fixed air gap. A water supply pipe, soil pipe or waste pipe serving one or more fixtures. A device designed to support an off-the-floor plumbing fixture. The vertical or horizontal outlet pipe from the trap of the fixture to the junction of that pipe with any other drain pipe. A water supply pipe connecting the fixture to a branch or main water supply pipe. A valve used to control water supply to an individual plumbing fixture, appurtenance or appliance.