

## Captions and credits

*Cover:* “Plano Geographico de las Ymmediaciones de la Ymperial Mexico,” Joseph Antonio de Alzate y Ramírez, 1776. Based on Carlos de Sigüenza y Góngora’s map of the seventeenth century.

Source: España, Ministerio de Defensa. Archivo Cartográfico y de Estudios Geográficos del Centro Geográfico del Ejército, Mapas y Planos, América, México, 54. Reprint and web by permission.

*Figure 1.1.* The first Chichimecs arrive in an already densely settled and exploited pre-Hispanic lacustrine landscape.

Source: Codex Xolotl, Bibliothèque nationale de France, Fonds mexicain, 1–10. Reprint and web by permission.

*Figure 1.2.* Magistrate of Cuautitlan maps information for a 1590 land-grant request: located west of the maize plots (*milpas*) belonging to the township of San Cristóbal Ecatepec, the plot is on “infertile lands” (*tierras eriazas*) but near water and three roads (in indigenous symbology).

Source: Archivo General de la Nación - México, Tireras, vol. 2777, exp. 7, f. 27. Reprint and web by permission.

*Figure 1.3.* Colonial-era Pila Real at San Juan Atlamica on east margin of the Cuautitlan River, as seen in 1926, with its five outlets (in Roman numerals) and intake (marked with arrow). Note mounds of silt cleaned out of it by beneficiaries.

Source: Archivo Histórico del Agua-AN-18-212-6/30. Reprint and web by permission.

*Figure 1.4.* East margin of the Cuatitlan River with water flowing into the two sluices of El Chiflón and into Teoloyuca’s inlet (*canoa*), 1926.

Source: Archivo Histórico del Agua-AN-18-212-5/30. Reprint and web by permission.

*Figure 1.5.* Plan of the gates of the Canal of “El Chiflón” and of the Pila Real of Atlamica, 1927.

The canal draws from the Cuautitlan River to the left (west). The pila feeds five canals or “rivers” that ramify further.

Source: Archivo Histórico del Agua-AS-caja 559, exp. 8249, leg. 1, f. 201. Reprint and web by permission.

*Figure 1.6.* Teoloyuca’s portion of water flowing from the outlet of the *canoa*, with the township mobilized for repairs. Note the solid stakes anchoring the borders.

Source: Archivo Histórico del Agua-AN-18-212-7/30. Reprint and web by permission.

*Figure 1.7.* Colonial-era pila in Teoloyuca, with arrows indicating inflow and outflows of water, and doubling as trough and pool.

Source: AHA-AN-18-212-13/30. Reprint and web by permission.

*Figure 1.8.* The Cuautitlan River's water distribution as seen by the City of Mexico, Repartimiento de Aguas del Río Cuautitlan, 1763, with detailed listing of water apportionment among Pila Real beneficiaries.

Source: Archivo General de la Nación - México, Tierras, vol. 2028, exp. 5, f. 118. Reprint and web by permission.

*Figure 1.9.* View of the Pila Real and the distribution of the Cuautitlan's water as seen by local users of two of pila's canals in 1756.

Source: Archivo General de la Nación - México, Tierras, vol. 1503, exp. 5, f. 32. Reprint and web by permission.

*Figure 2.1.* Enrico Martínez's 1608 "Description of the region of Mexico and the works of the drainage of the lake," showing sections of the Desagüe. The depiction of Lakes San Cristóbal, Xlatocan, and Zumpango appears unrealistically shrunken relative to Adrian Boot's shown in Figure 2.4 and subsequent representations, suggesting the desire to impress a sense of success in draining the northwest quadrant upon viewers, royal and city authorities, and urban elites.

Source: España, Ministerio de Educación, Cultura y Deporte. Archivo General de Indias, MP-México, 54. Reprint and web by permission.

*Figure 2.2.* Adrian Boot's vision of the enclosed basin of Mexico and its viceregal capital, before embarking.

Source: España, Ministerio de Educación, Cultura y Deporte. Archivo General de Indias, MP-México, 55. Reprint and web by permission.

*Figure 2.3.* *Regionis circa lacum Mexicanus*, a map of the basin and the Desagüe, attributed to Adrian Boot, 1614. Differences in calligraphy with Figure 2.2 and written documents by Boot, as well as otherwise inexplicable inaccuracies (such as the relative locations of Lakes Xaltocan and San Cristóbal), suggest this is a copy of a lost original. The inaccuracies that appear were replicated in the 1700 edition of Gemelli Careri's *Giro del Mondo* and only corrected in later editions of the work, as other cartographical renditions of the basin began to circulate in Europe. Source: Harvard Map Collection; Giovanni Francesco Gemelli Careri, *Giro del Mondo*, 9 vols. (Naples: Stamperia di Giuseppe Roselli, 1700), 6: 57. Reprint and web by permission.

*Figure 3.1.* Fray Andrés de San Miguel's translucent open trench.

Source: Archivo General de la Nación - México, Desagüe, vol. 3, exp. 6, f. 361. Reprint and web by permission.

*Figure 3.2.* Multiuse hoist, probably similar to those used under Enrico Martínez.

Source: España, Ministerio de Educación, Cultura y Deporte. Archivo General de Indias, MP-Ingenios, 196. Reprint and web by permission.

*Figure 4.1.* Sobreestante Pedro Porras's 1677 plan for the dam at the Coyotepec silting pool.

Source: Archivo General de la Nación - México, Desagüe, vol. 7, exp. 1, f. 5. Reprint and web by permission.

*Figure 4.2.* This screw or spindle gate (compuerta de husillo) used in the Desagüe in the 1850s probably differed little from those used during the colonial era.

Source: Archivo General de la Nación - México, Fomento Desagüe, vol. 3, f. 236. Reprint and web by permission.

*Figure 4.3.* Plants useful in earthworks: hilaria cenchroides, as depicted by Aimé de Bonpland.

Source: Aimé Bonpland et al., *Nova genera et species plantarum*, 7 vols. (Lutetiae Parisiorum: sumtibus Librariae Graeco-Latino-Germanico, 1815–25), I: 37, I: 96, and I: 117.

*Figure 5.1.* Commissioned by Superintendant Domingo de Trespalacios y Escandón, the hydrological and hydraulic detail in painter Joseph de Páez's 1753 depiction of the basin was probably based on Joseph Francisco de Cuevas Aguirre y Espinosa's 1748 report as well as firsthand familiarity.

Source: CONACULTA-Instituto Nacional de Antropología e Historia, Mexico. Reprint and web by permission.

*Figure 5.2.* Francisco de Zúñiga y Ontiveros's 1773 view of the Desagüe proper. The Cuautitlan River appears simply as the "Desagüe River," led by the albarradón del Rey to discharge into the drainage. Note spillways, sluiceways, and the Vertideros warden's house.

Source: Archivo General de la Nación - México, Fomento Desagüe, vol. 1bis, f. 214. Reprint and web by permission.

*Figure 5.3.* Sebastián Fernández de Medrano's diagram of how to arrange fascine in fortifications works. On the top right, the fascine bundles are arranged perpendicularly to the edge of the rampart; at the other end, transversal and perpendicular layers have finished the structure's core.

Source: Sebastián Fernández de Medrano, *Rudimentos Geométricos y Militares* (Brussels: Casa de la viuda Vleugart, 1677), 184.

*Figure 5.4.* Materials for building a fortification's earthworks, *tepes*, fascine, and carts.

Source: Sebastián Fernández de Medrano, *El arquitecto perfecto en el arte militar* (Brussels: Casa de Lamberto Marchant, 1700), 190.

*Figure 5.5.* Spades for sod cutting (top row), and a handheld rammer (center left) used to stamp earth, fascine, sods, and other materials placed in earthworks.

Source: Adam Freitag, *Architectvra militaris nova et aucta: oder Neue vermehrte Fortification, von regular Vestungen, von irregular Vestungen vnd aussen Wercken: von praxi Offensivâ und Defensivâ: auff die neweste niederländische Praxin gerichtet vnd beschrieben* (Leyden: n.p., 1631), 66.

*Figure 5.6.* Using ramps, carts, and human work in fortifications to extract debris and to deposit it in the area that will form the escarpment (center of top image; outer edges of bottom image).

source: Sebastián Fernández de Medrano, *El arquitecto perfecto en el arte militar* (Brussels: Casa de Lamberto Marchant, 1700), 207.

*Figure 5.7.* The “Indian-dangling” method of work in 1755. Unperturbed, Superintendent Trespalacios (facing viewer), guarda mayor José Antonio Palacios (to his right, pointing), a subordinate guarda, and a notary inspect the Bóveda Real, the mouth of the extant Desagüe tunnel. Note also remaining arches and stone-and-mortar revetment inside this vaulted section. Source: Archivo General de la Nación - México, Desagüe, vol. 15, exp. 7, f. 306. Reprint and web by permission.

*Figure 5.8.* Jaime Franck's depiction of the Bóveda Descubierta.

Source: Archivo General de la Nación - México, Desagüe, vol. 7, exp. 3, f. 112. Reprint and web by permission.

*Figure 5.9.* “What the tunnel lacks in width it has in excess height,” Franck explains, using an image inset.

Source: Archivo General de la Nación - México, Desagüe, vol. 7, exp. 3, f. 113. Reprint and web by permission.

*Figure 5.10.* “The effect of said collapse can be seen in the present figure, in which *abcde* is what fell from above.” A scale in varas is attached to the right margin to aid the viewer in seeing the magnitude of the problem in the Techo Bajo section of the tunnel.

Source: Archivo General de la Nación - México, Desagüe, vol. 7, exp. 3, f. 116. Reprint and web by permission.

*Figure 5.11.* The other afflictions of the Techo Bajo—debilitated tepetate side supports.  
Source: Archivo General de la Nación - México, Desagüe, vol. 7, exp. 3, f. 116v. Reprint and web by permission.

*Figure 5.12.* Adrian Boot instructs master architect Bartolomé Bernal how to read his plans for spillways on the causeways of Chapultepec and Sanctorum: “All that in this plan appears in color is what is to be done as new construction,” providing also a scale in varas (center and left of image).

Source: Archivo General de la Nación - México, Desagüe, vol. 3, exp. 4, f. 244. Reprint and web by permission.

*Figure 5.13.* Luis Bouchard de Becours’s 1705 *Plano de las fortificaciones de la Ciudad de San Francisco de Campeche con indicación (en color amarillo) de las obras que hay que hacer* and *Mapa de la Ciudad de Campeche (San Francisco de) y de sus contornos*. His Desagüe map likely used the same conventions.

Source: España, Ministerio de Educación, Cultura y Deporte. Archivo General de Indias, MP-México, 98 and 99. Reprint and web by permission.

*Figure 6.1.* Ricardo Aylmer, 1767, view of the Desagüe on its terrain.

Source: España, Ministerio de Educación, Cultura y Deporte. Archivo General de Indias, MP-México, 240. Reprint and web by permission.

*Figure 6.2.* Ricardo Aylmer’s longitudinal and cross-sections of the Desagüe formed the basis for the technical instructions in the consulado contract.

Source: España, Ministerio de Educación, Cultura y Deporte. Archivo General de Indias, MP-México, 241bis. Reprint and web by permission.

*Figure 6.3.* Joseph de Urrutia’s plan of the Desagüe in 1768, showing two sets of measurements for the longitudinal plan in the center. Left, traditional methods yielded distances in varas on the terrain; right, triangulation with instruments provided latitudes and longitudes. In the center, the engineer explains the usage to the two methods is the reason why the two sets of distances differ.  
Source: España, Ministerio de Defensa. Archivo Cartográfico y de Estudios Geográficos del Centro Geográfico del Ejército, Mapas y Planos, América, México, 52. Reprint and web by permission.

*Figure 6.4.* Hoists used in the Rayas mines of Guanajuato since 1704. Such machines allowed extraction of debris and water from depths far greater than the Desagüe's using minimal manpower (in shafts numbered 24–28, for instance).

Source: España, Ministerio de Educación, Cultura y Deporte. Archivo General de Indias, MP-México, 96. Reprint and web by permission.

*Figure 6.5.* The state of the consulado's open trench conversion in 1773, when it requested a contract extension to continue working with the water-sweeping method. The extant tunnel intake at Bóveda Real appears on the left, and the outlet at Boca de San Gregorio on the right; white segments show "finished" sections.

Source: España, Ministerio de Educación, Cultura y Deporte. Archivo General de Indias, MP-México, 689. Reprint and web by permission.

*Figure 6.6.* José Antonio de Alzate y Ramírez's 1767 proposal to abandon the Desagüe de Huehuetoca and instead drain Lake Texcoco into the "large concavities" found at under volcanoes in the peninsula of Ixtapalapa (A and C).

Source: Archivo General de la Nación - México, Desagüe, vol. 17, exp. 10, f. 224. Reprint and web by permission.

*Figure 6.7.* Three years before Alzate, maestro mayor Ildefonso Iniesta Vejarano used this image to explain why he believed that a "sump" drainage into cavities, this time into one north of Lake Texcoco, would not work.

Source: España, Ministerio de Defensa. Archivo Cartográfico y de Estudios Geográficos del Centro Geográfico del Ejército, Mapas y Planos, América, México, 51. Reprint and web by permission.

*Figure 6.8.* Joaquín Velázquez de León's projection of the level of Lake Texcoco on the open trench.

Source: Archivo General de la Nación - México, Fomento Desagüe, vol. 3, f. 19. Reprint and web by permission.

*Figure 6.9.* Joaquín Velázquez de León's 1774 *Perfil longitudinal del desagüe general de la laguna de México*.

Source: España, Ministerio de Defensa. Archivo Cartográfico y de Estudios Geográficos del Centro Geográfico del Ejército, Mapas y Planos, América, México, 53. Reprint and web by permission.

*Figure 6.10.* Maestros of the late eighteenth century tried to abide by cartographical and draftsmanship conventions diffused by engineers and the Real Academia de San Carlos. Here maestro mayor Ignacio Castera's 1789 "Plan of the ground and profiles of the works in the Real Desagüe de Huehuetoca" partakes of some of them.

Source: España, Ministerio de Educación, Cultura y Deporte. Archivo General de Indias, MP-México, 415. Reprint and web by permission.

*Figure 6.11.* Three of Miguel de Costanzó's 1788 five cross-sections of the Desagüe, using all conventions current in the corps of engineers at the time.

Source: Archivo General de la Nación - México, Desagüe, vol. 24, exp. 3, ff. 103–8. Reprint and web by permission.

*Figure 7.1.* The haciendas, ranchos, and townships surrounding the Desagüe in 1775. Teoloyuca's lands extend into Lake Zumpango.

Source: Archivo General de la Nación - México, Tierras, vol. 287, exp. 6, f. 30. Reprint and web by permission.

*Figure 7.2.* Mier's tunnel to drain Lake Zumpango, as imagined by Diego de Guadalajara in 1796. It was to tap the lake at Vertideros (on the left) and take its "excess" water to the Desagüe at the Bóveda Real.

Source: Archivo General de la Nación - México, Desagüe, vol. 29, exp. 10, f. 92. Reprint and web by permission.

*Figure 7.3.* Profile along the length of Diego de Guadalajara's 1796 tunnel project to drain Lake Zumpango, with scales in *pulgadas* for heights and *varas* for length.

Source: Archivo General de la Nación - México, Desagüe, vol. 29, exp. 10, f. 91. Reprint and web by permission.

*Figure 7.4.* Guadalajara's response to the collapse of the tunnel to drain Lake Zumpango—the Canal de Guadalupe, surveyed with precision and here pristinely drawn with conventional signs that belied the looseness of the terrain and the probable uselessness of the project.

Source: Archivo General de la Nación - México, Desagüe, vol. 30, exp. 2, f. 58. Reprint and web by permission.

*Figure 7.5.* Mier and Guadalajara's "New Canal of Guadalupe" on the ground. Neither the tunnel that collapsed nor the canal that replaced it extended to greater depths of Lake Zumpango. Note the two margins for the lake—lighter green for the rainy season; dark for the dry.

Source: Archivo General de la Nación - México, Desagüe, vol. 32, exp. 2, f. 241. Reprint and web by permission.

*Figure 7.6.* Master architect Ignacio Castera's 1795 "General map of the lakes that surround the city of Mexico," showing two potential routes for the extension of the Desagüe to Lake Texcoco are shown. The eastern one in red is Joaquín Velázquez de León's project; the western, in yellow, military engineer Pedro Ponce's. Note again the significant variation in the surface covered by the lakes in the wet and dry seasons in light and dark green. The "receptacle of the lakes" covered the light area, making the reservation of this surface onerous for its riparian users.

Source: Archivo General de la Nación - México, Fomento Desagüe, vol. 1bis, f. 213. Reprint and web by permission.

*Figure 7.7.* Guarda mayor Francisco Power collecting and transmitting data from his subordinates in tabular form, according to Mier's *Orden económico*.

Source: Archivo General de la Nación - México, Desagüe, vol. 30, exp. 4. Reprint and web by permission.

*Figure 8.1.* Four sectional cuts of the Canal de Guadalupe five years after completion, showing original slope inferior to angle of repose of the soil ( $45^\circ$ ) and accumulated silting: the canal was useless.

Source: Archivo General de la Nación - México, Desagüe, vol. 35, exp. 1, f. 18. Reprint and web by permission.