FLOOD PREVENTION 2018

AUGUST 2018

DECEMBER 2016

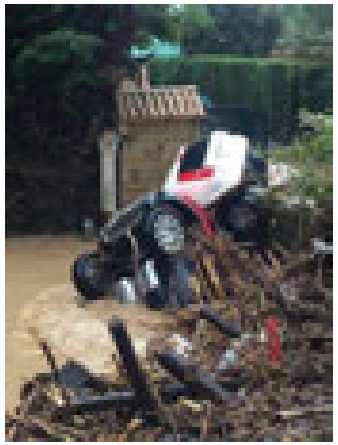
- THE MORNING OF THE 4TH OF DECEMBER 2016, MARBELLA AROSE WITH TORRENTIAL RAIN ALERTS FORCASTING PRECIPITATIONS UP TO 100 LITERS/M2/DAY.
- UNFORTUNATELY FORCAST WAS LARGELY EXCEEDED, WITH RAIN IN THE AREA HIGHER THAN 170 LITERS/M2 IN 12 HOURS, AND PEAKS OVER 90 LITERS/M2 IN ONE HOUR.
- THE DRAINAGE CAPACITY OF THE BENABOLA CREEK THAT CROSSES THE GOLF COURSE FROM HOLES 2 AND 18, TO HOLE 12, WAS NOT ENOUGH FOR SUCH AN AMMOUNT OF WATER.
- DAMAGES IN THE GOLF COURSE WERE EXTENSIVE, WORTH MORE THAN 1,5 MILLION EUROS. THE SIGHT WAS HORRIFYING.
- FROM THE VERY FIRST MOMENT, WE FOCUSED IN TWO
  - REPAIR DAMAGES AS SOON AS POSIBLE
  - **TAKE MEASURES** SO THAT **IN FUTURE FLOOD EVENTS** DAMAGES WERE NOT SO SEVERE

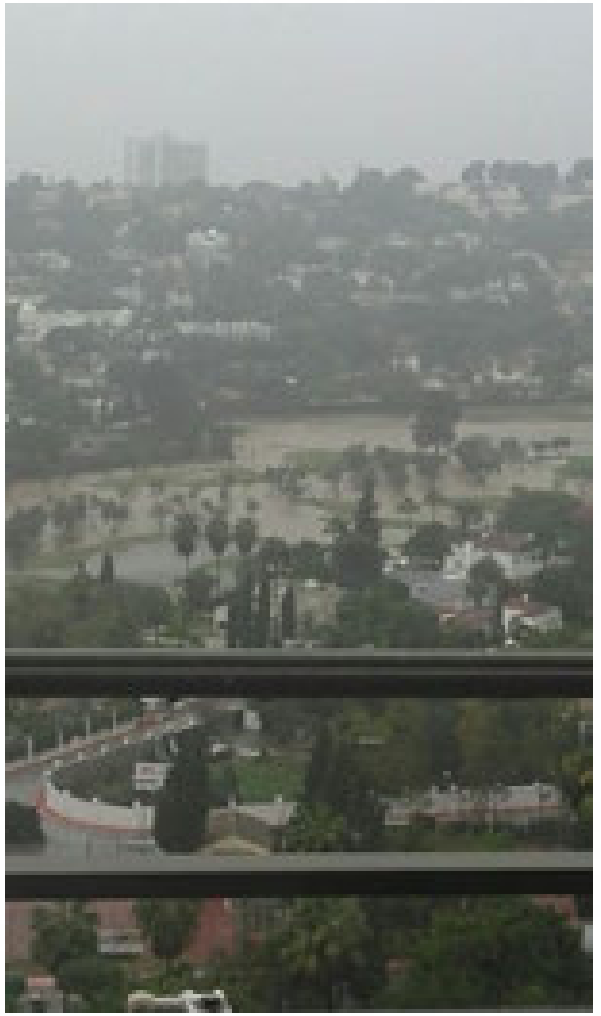
DAMAGE

- SINCE THE BEGINNING, WE HAVE BEEN AWARE OF THE SERIOUSNESS OF THE DAMAGE. THE HOLES CROSSED BY THE BENABOLA CREEK WERE THE MOST AFFECTED.
- THERE WAS DAMAGE IN EVERY AREA OF THE COURSE: FACILITIES, GREENS, TEES, BUNKERS, FAIRWAYS AND ROUGHS, FLOWERBEDS, CART PATHS AND OUR BOUNDARIES WITH NEIGHBOUR.
- IN ONE AREA THERE WAS EROSION DAMAGE CAUSED BY THE SEVERE, HIGH SPEED FLOW OF WATER: LANDSLIDES, EROSION, LIFTING OF THE CART PATHS AND DRAINAGES AREAS…
- IN OTHER AREAS, ONCE THE WATER FLOW HAD STOPPED, SILT, MUD, ROCKS AND A LARGE AMOUNT OF OTHER DEBRIS WAS DEPOSITED OVER THE SURFACE. THIS SLUDGE ON THE TURF CREATED LAYERS WHICH WERE VERY DIFFICULT TO CLEAN AND LEFT IRREPARABLE DAMAGE. SLUDGE DEPOSITS WERE MORE PREVALENT ON THE LOWER HOLES OF THE COURSE, THOSE LACKING A NATURAL EXIT POINT FOR THE WATER: HOLES 13 & 14.

DAMAGE

DAMAGE



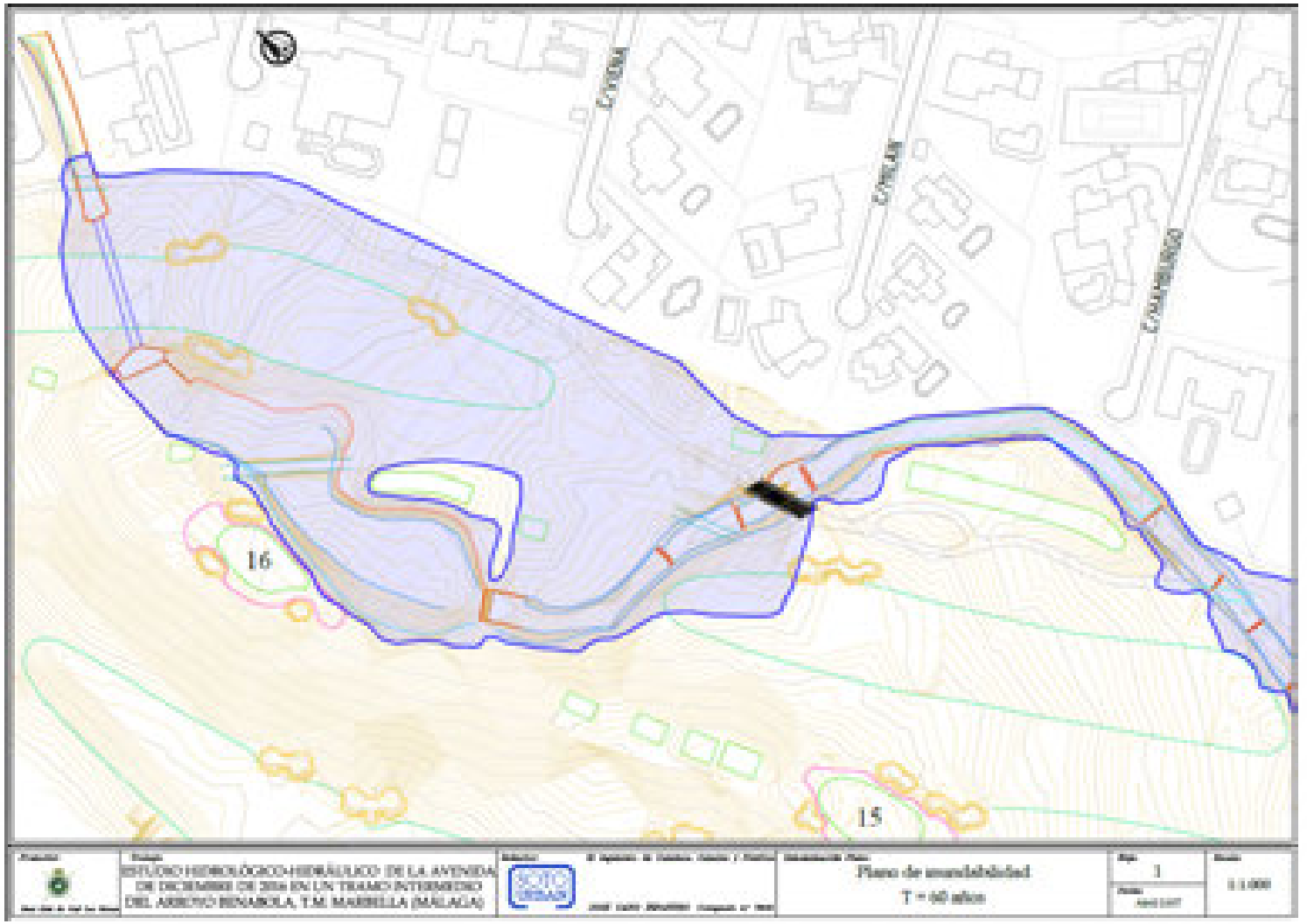


HYDROLOGICAL STUDY

- IN OTHER TO ANALYSE THE FLOOD RISK, SOTOURBAN ENGINEERING WAS HIRED TO CARRY OUT A HYDROLOGICAL STUDY OF THE RIVER BASIN.
- THE FIRST CONCLUSION OF THEIR STUDY WAS THAT THE EXPECTED FREQUENCY FOR SIMILAR RAINFALL WAS EVERY 60 YEARS, BUT THAT THE FREQUENCY FOR SIMILAR DAMAGE, EVEN WITH COPIOUS RAIN, WAS RELATIVELY SHORT: BETWEEN 10-20 YEARS.
- CONSIDERING THESE RESULTS, MEASURES TO PROTECT THE COURSE FROM FLOODS WERE ANALIZED, FOCUSING ON 3 ASPECTS:
- - PROTECT GREENS: HOLES 12 AND 17
- - AVOID OVERFLOWING OF LAKES AND CREEKS: MAINLY TOWARD HOLES 13-14 WITHOUT NATURAL EXIT FOR THE WATER.
- - PREVENT DAMAGE FROM EROSION: AT HOLES 2 AND 18
-

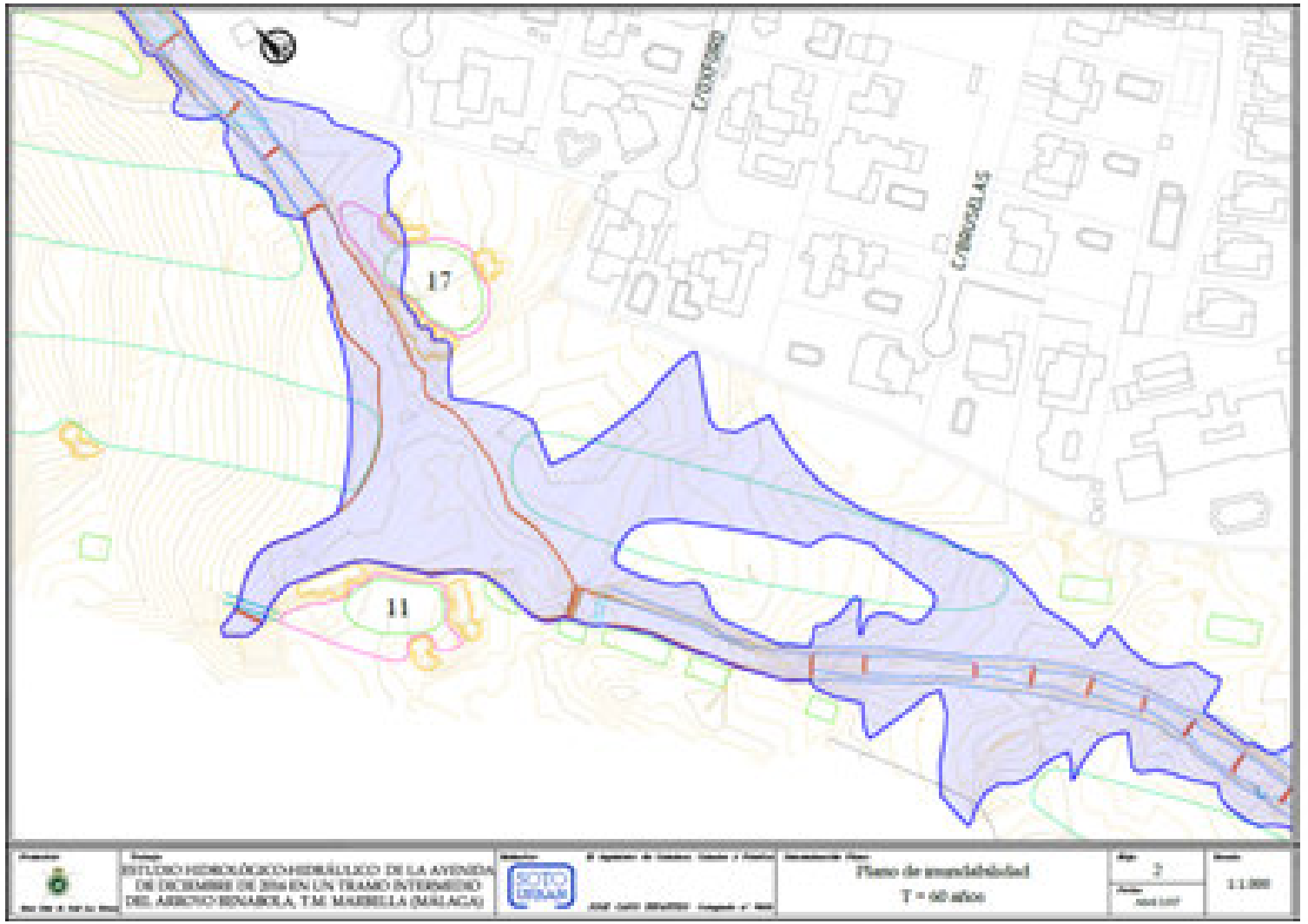
FLOODED AREAS HOLE 18

(EVERY 10-20 YEARS, BUT SIMILAR RAIN OCCURS EVERY 60 YEARS)



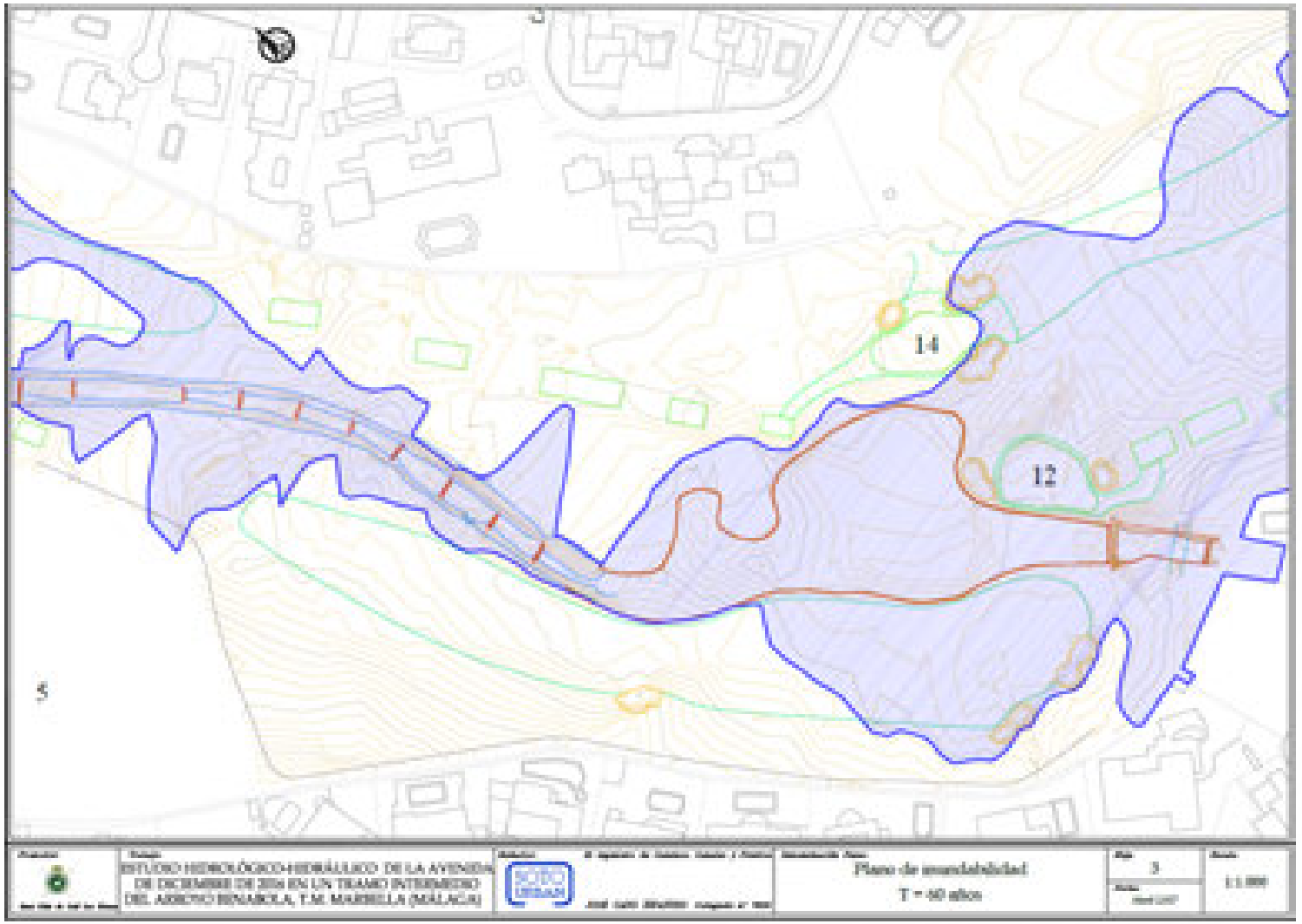
FLOODED AREAS HOLE 15-17

(EVERY 10-20 YEARS, BUT SIMILAR RAIN OCCURS EVERY 60 YEARS)



FLOODED AREAS HOLE 12-14

(EVERY 10-20 YEARS, BUT SIMILAR RAIN OCCURS EVERY 60 YEARS)



HISTORIC DATA

- DATA IS CONSISTENT WITH PAST OBSERVATIONS. SIMILAR FLOODING OCCURRED IN 1983

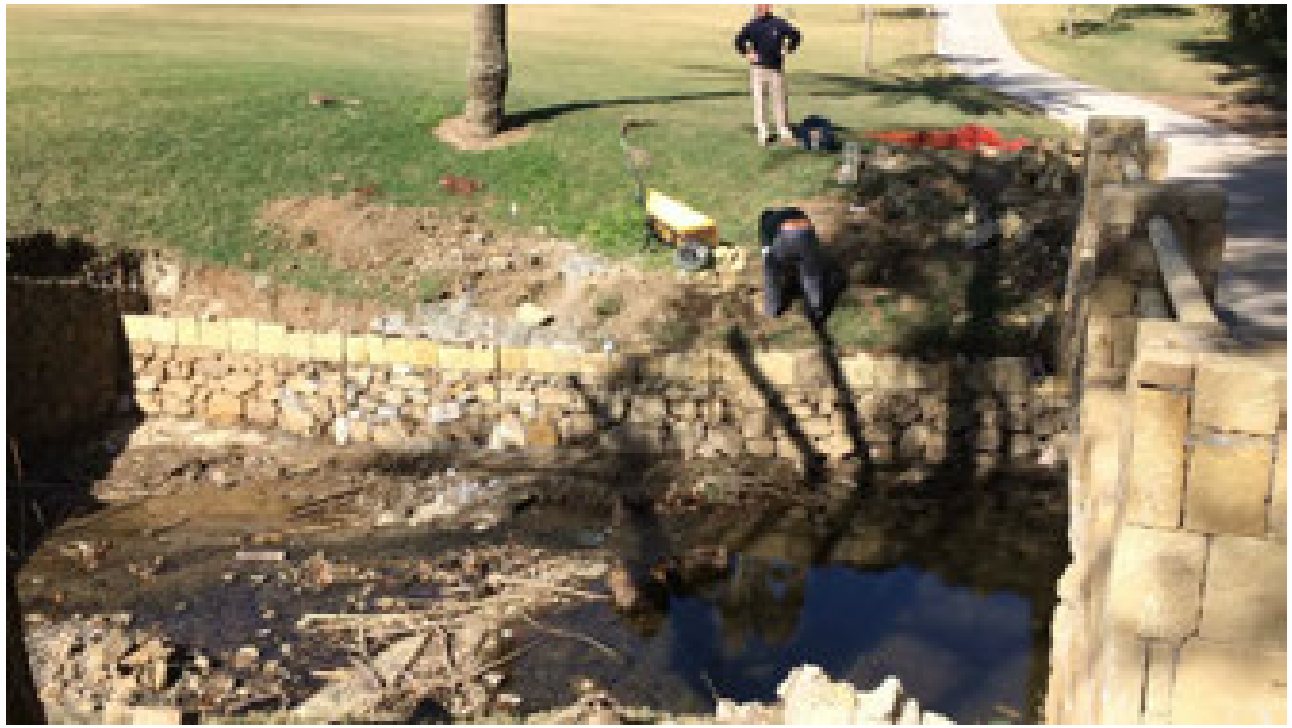
MEASURE 1: HOLE 18

- GOAL:
- HOLD THE WATER IN BENABOLA CREEK BEFORE THE PIPE THAT CROSSES HOLE 18.

- SOLUTION:
- RAISING STONE WALLS TO HOLD BACK THE FLOODS.

MEASURE 1: BEFORE

MEASURE 1: AFTER



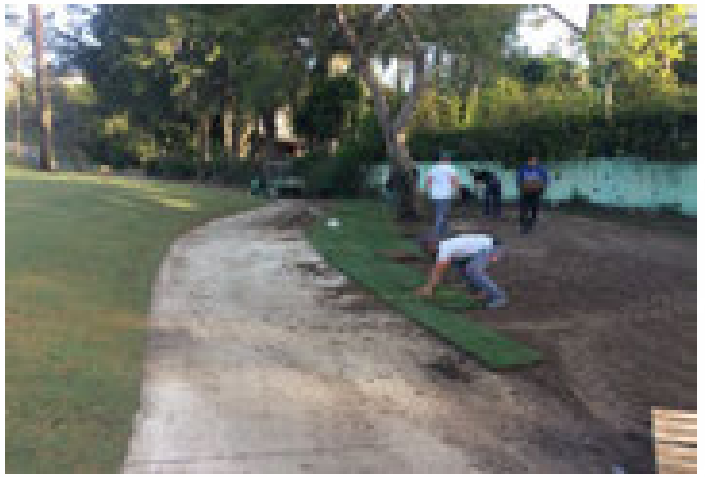
MEASURE 1: AFTER

MEASURE 2: HOLE 18

- GOAL:
- PREVENT EROSIONS AT THE ENTRANCE OF BENABOLA CREEK INTO THE COURSE, CAUSED BY THE FUNNEL CREATED IN THE PIPE THAT CROSSES HOLE 18
- SOLUTION:
- REMOVAL OF PIPE WOULD CHANGE THE DESIGN AND WOULD BE QUITE EXPENSIVE. DAMAGE IS REDUCED RESHAPING THE CART PATH TO HOLD WATER TOWARDS THE TEES, AND PLANTING THE SIDES OF THE HOLE WITH TURF TO AVOID EROSION.

MEASURE 2: BEFORE

MEASURE 2: AFTER



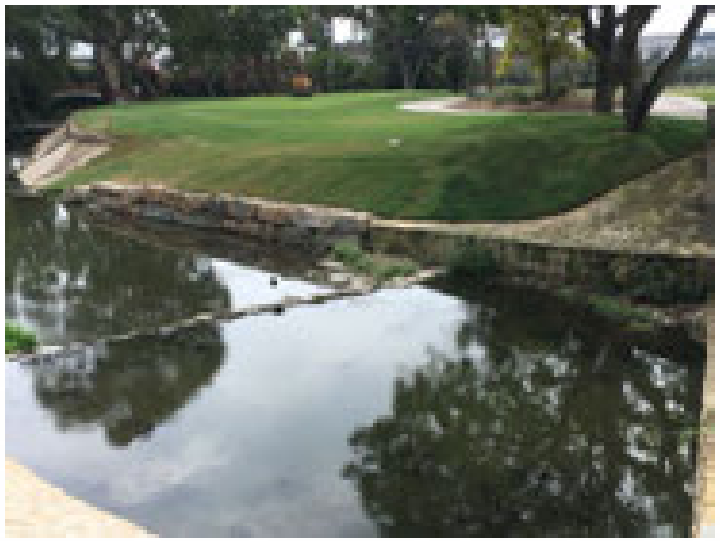
MEASURE 3: TEE 18

- GOAL:
- PREVENT FLOODS IN TEE 18

- SOLUTION:
- THE SECTION OF THE CREEK AFTER TEE 18 IS PROTECTED WITH STONE WALLS.

MEASURE 3: BEFORE

MEASURE 3: AFTER



MEASURE 3: BEFORE

MEASURE 3: AFTER

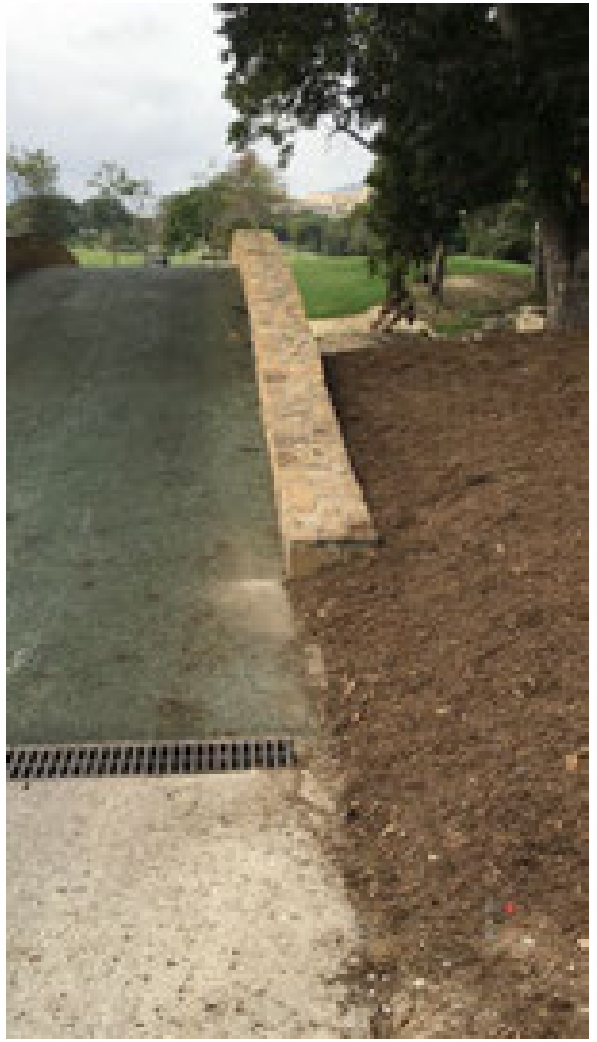
MEASURE 4: GREEN 17

- GOAL:
- PREVENT FLOODS IN GREEN 17

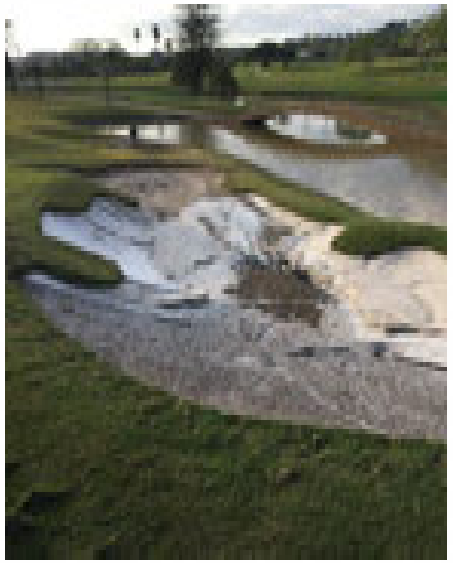
- SOLUTION:
- INSTALL A STONE WALL ON THE LEFT SIDE, BEFORE AND AFTER THE BRIDGE, TO RAISE THE OVERFLOW HEIGHT. THE DEBRIS FROM CLEANING THE LAKE AT HOLE 15 WILL BE USED AS INFILL.
- LAST DAMN WILL BE LOWERED.
- A CREAGER SHAPE IS USED IN THE NEW DAMN TO IMPROVE WATER EVACUATION.

MEASURE 4: BEFORE

MEASURE 4: AFTER



MEASURE 4: BEFORE



MEASURE 4: AFTER

MEASURE 5: DAMN AT 15

- GOAL:
- PREVENT FLOODS AT FAIRWAY 15

- SOLUTION:
- MAKE THE DAMN WIDER AT HOLE15/GREEN 11. EVACUATION FLOW WILL IMPROVE IN THIS LAKE.

MEASURE 5: BEFORE

MEASURE 5: AFTER

MEASURE 6: TEE 12

- GOAL:
- PREVENT FLOODS ON THE FAIRWAY

- SOLUTION:
- THE SECTION OF THE BENABOLA CREEK ON THE RIGHT SIDE IS PROTECTED WITH STONE WALLS.

MEASURE 6: BEFORE

MEASURE 6: AFTER

MEASURE 7: TEE 15

- GOAL:
- PREVENT FLOODS IN TEES 15

- SOLUTION:
- RAISING LEFT SIDE WITH SOIL

MEASURE 7: BEFORE

MEASURE 7: AFTER

MEASURE 8: GREEN 12

- GOAL:
- PREVENT FLOODS IN GREEN 12

- SOLUTION:
- MAKE THE DAMN WIDER IN THE LAKE AT HOLE 12. EVACUATION FLOW WILL IMPROVE IN THIS LAKE
- DAMN HEIGHT IS DROPPED 30 CM TO LOWER THE LEVEL OF WATER DURING FLOODS.
- A CREAGER SHAPE IS USED IN THE NEW DAMN TO IMPROVE WATER EVACUATION.
- YUCAS AND SHRUBS ARE REMOVED ON

MEASURE 8: BEFORE

MEASURE 8: AFTER

MEASURE 8: AFTER

MEASURE 8: BEFORE

MEASURE 8: AFTER

MEASURE 9: GREEN 12-14

- GOAL:
- PREVENT FLOODS IN HOLES 13-14

- SOLUTION:
- RAISE GROUND LEVEL BETWEEN GREENS 12 AND 14 TO HOLD WATER FROM LAKE WHEN WATER LEVEL INCREASES, PREVENTING FLOODS TOWARD LOWER HOLES IN THE COURSE.

MEASURE 9: BEFORE

MEASURE 9: AFTER

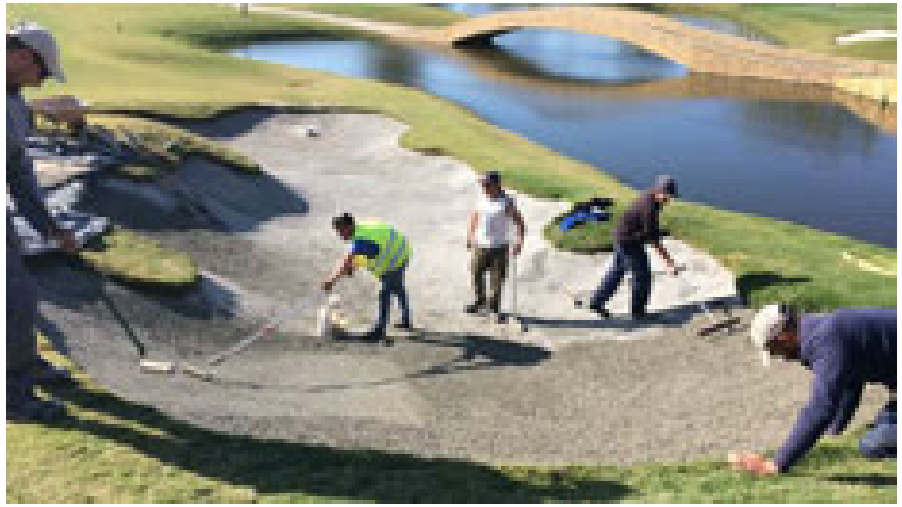
MEASURE 10: BUNKERS

- GOAL:
- PROTECT BASE OF BUNKERS AND MAKE CLEANING OF CONTAMINATED SAND EASIER IN CASE OF FLOODS.

- SOLUTION:
- INSTALATION OF A HARD BASE IN THE BUNKERS TO PROTECT DRAINAGE IN A FLOOD EVENT. INSTALATION OF CAPILARY CONCRETE IN EVERY BUNKER IN THE COURSE
- THE SYSTEM ALLOWS FOR AN EASY CLEANING OF CONTAMINATED SAND WITHOUT DISRUPTING THE BASE OF BUNKERS AND DRAINAGE.

MEASURE 10: BEFORE

MEASURE 10: AFTER



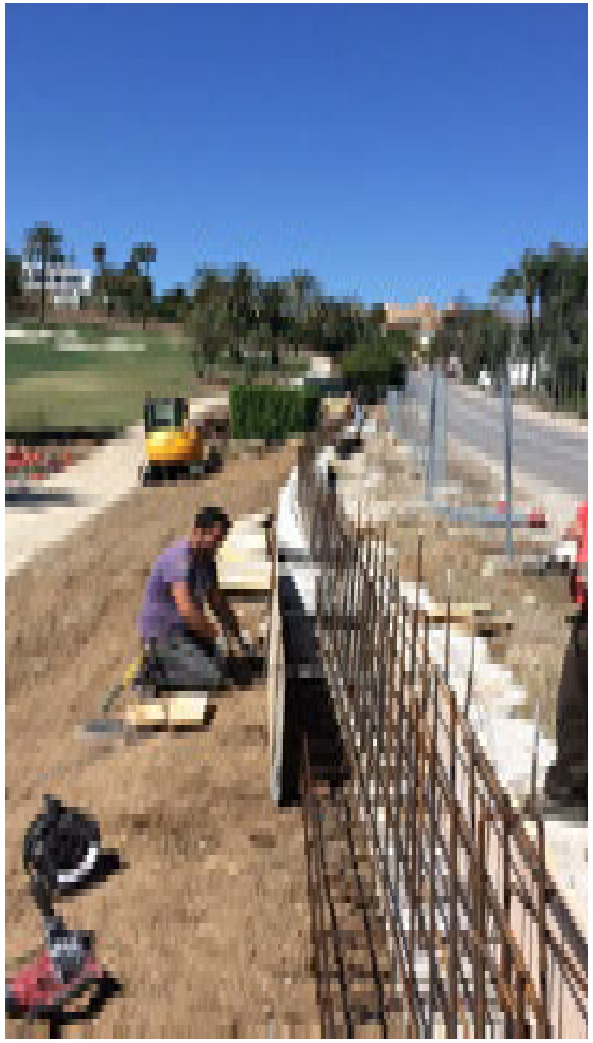
MEASURE 11: HOLE 2

- GOAL:
- PROTECT HOLE 2 FROM FLOODING COMING FROM LOS NARANJOS´ LAKE.

- SOLUTION:
- INSTALATION OF A CONCRETE WALL ALONG THE STREET.
- WATER ALONG AVENIDA DEL PRADO IS DIRECTED INTO THE CREEK.
- IMPROVEMENTS OF OVERFLOW AT LOS NARANJOS´ LAKE BY MUNICIPALITY
- SIDEWALK IS CONDITIONED TO HOLD WATER

MEASURE 11: BEFORE

MEASURE 11: AFTER



MEASURE 12: CREEK AT 2

- GOAL:
- AVOID EROSION IN THE BANKS AT HOLE 2

- SOLUTION:
- LANDSCAPING PROJECT TO STABILISE THE BANK.
- STONE COVER ALONG THE CREEK AND IMPROVEMENTS IN THE CART PATH.

MEASURE 12: BEFORE

MEASURE 12: BEFORE

MEASURE 12: AFTER

MEASURE 13: HOLES 3-4-5

- GOAL:
- AVOID EROSIONS FROM WATER COMING FROM NEIGHBOURS AT HOLES 3, 4 AND 5

- SOLUTION:
- IMPROVEMENTS IN THE SEWAGE AND RAINWATER COLLECTION SYSTEM CROSSING THE COURSE BY THE MUNICIPALITY.
- CATCHMENT OF WATER AT HOLE 3, CONDUCTING INTO THE RAINWATER COLLECTION SYSTEM.

MEASURE 13: BEFORE

MEASURE 13: AFTER

MEASURE 14: LAKE TEE 8

- GOAL:
- IMPROVE WATER FLOW IN THE LAKE

- SOLUTION:
- CLEAN UP OF LAKE BOTTOM, GETTING RID OF AENEAS THAT WERE REDUCING WATER FLOW.

MEASURE 14: BEFORE

MEASURE 14: AFTER

MEASURE 15: LAKE GREEN 6

- GOAL:
- PROTECTION OF OVERFLOW AND SIDE BANKS OF THE CREEK TOWARD 6 FAIRWAY
- SOLUTION:
- PROTECTION OF BOTH SIDES OF THE BRIDGE WITH A STONE WALL.
- REFURBISHMENT OF BOTH SIDES OF THE CREEK WITH STONE COVER.

MEASURE 15: BEFORE

MEASURE 15: AFTER

MEASURE 15: BEFORE

MEASURE 15: AFTER

MEASURE 16: GREEN 6

- GOAL:
- PROTECT THE BANK OF THE LAKE AT GREEN 6

- SOLUTION:
- BUILDING UP OF STONE WALL ALONG THE GREEN SIDE.
- NEW SHAPE OF THE BUNKER BEHIND THE GREEN.

MEASURE 16: BEFORE

MEASURE 16: AFTER

¿FUTURE?

- ALL THESE IMPROVEMENTS SHOULD MINIMIZE THE CONSEQUENCES OF FUTURE SURGING FLOOD WATERS AS THE CREEK CROSSES OUR COURSE.
- BUT THESE MEASURES WILL NOT BE ENOUGH TO CONTROL EXCEPTIONAL EVENTS. HOWEVER, WE HAVE EXTENDED THE TIME (PROBABILITY) OF SUCH SEVERE DAMAGE HAPPENING AGAIN, AND MOREOVER WE HAVE PROTECTED THE MOST SUSCEPTIBLE AREAS: GREENES AND TEES
- OUR WEAK SPOTS ARE STILL:
- - UNDERGROUND PIPE ALONG 18 HOLE
- - NARROWING IN THE BRIDGE AT 18 TEE
- - WAY OUT OF BENABOLA CREEK AT 12 HOLE
- HOWEVER, CORRECTING THESE WEAK SPOTS, EITHER REQUIRES A SIGNIFICANT DISBURSEMENT HIGHER THAN THE EXPECTED BENEFITS, OR THEY NEED TO BE CORRECTED OUTSIDE OF OUR PROPERTY.